



EUROPEAN COMMISSION
DG Competition

PUBLIC VERSION

***Case M.10806 - BROADCOM /
VMWARE***

(Only the English text is authentic)

**REGULATION (EC) No 139/2004
MERGER PROCEDURE**

Article 8(2) Regulation (EC) 139/2004
Date: 12/07/2023

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EUROPEAN
COMMISSION

Brussels, 12.7.2023
C(2023) 4654 final

COMMISSION DECISION

of 12.7.2023

**declaring a concentration to be compatible with the internal market and the EEA
agreement**

(Case M.10806 – BROADCOM / VMWARE)

(Text with EEA relevance)

(Only the English text is authentic)

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COMMISSION DECISION

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THE EUROPEAN COMMISSION,

Having regard to the Treaty on the Functioning of the European Union¹,

Having regard to the Agreement on the European Economic Area, and in particular Article 57 thereof,

Having regard to Council Regulation (EC) No 139/2004 of 20.1.2004 on the control of concentrations between undertakings², and in particular Article 8(2) thereof,

Having regard to the Commission's decision of 20 December 2022 to initiate proceedings in this case,

Having given the undertakings concerned the opportunity to make known their views on the objections raised by the Commission,

Having regard to the opinion of the Advisory Committee on Concentrations,

Having regard to the final report of the Hearing Officer in this case,

Whereas:

1. THE PARTIES

- (1) On 15 November 2022, the European Commission (“**Commission**”) received a notification of a proposed concentration pursuant to Article 4 of Council Regulation (EC) No 139/2004 (the “**Merger Regulation**”) by which Broadcom, Inc. (“**Broadcom**” or “**Notifying Party**”, USA) intends to acquire sole control of VMware, Inc. (“**VMware**”, USA) (the “**Transaction**”).³ Broadcom and VMware are designated hereinafter as the ‘**Parties**’.
- (2) **Broadcom** is headquartered in the U.S. It is a technology company that designs, manufactures, and provides a broad range of semiconductors and infrastructure software solutions.

¹ OJ C 115, 9.8.2008, p.47.

² OJ L 24, 29.1.2004, p. 1 (‘the Merger Regulation’). With effect from 1 December 2009, the Treaty on the Functioning of the European Union (‘TFEU’) has introduced certain changes, such as the replacement of ‘Community’ by ‘Union’ and ‘common market’ by ‘internal market’. The terminology of the TFEU will be used throughout this decision.

³ Publication in the Official Journal of the European Union No C 442, 22.11.2022, p. 21.

- (3) **VMware** is headquartered in the U.S. It is active in IT software including virtualization and related workload management technologies for datacentres and cloud computing environments, application development and end-point management. The company is listed on the New York Stock Exchange. VMware was spun off from Dell in 2021, with Michael Dell still owning approximately 40% of VMware's non-controlling shares.

2. THE OPERATION AND THE CONCENTRATION

- (4) The Transaction consists in the acquisition of sole control by Broadcom over VMware, pursuant to a merger agreement dated 26 May 2022, according to which Broadcom will acquire all of VMware's voting securities. Therefore, the Transaction constitutes a concentration within the meaning of Article 3(1)(b) of the Merger Regulation.

3. UNION DIMENSION

- (5) The undertakings concerned have a combined aggregate worldwide turnover of more than EUR 5 000 million (Broadcom: EUR 22 994.97 million; VMware: EUR 10 933.26 million). Each of them has an EU-wide turnover in excess of EUR 250 million (Broadcom: EUR [Revenue information] million; VMware: EUR [Revenue information] million), and neither of them achieves more than two-thirds of its aggregate EU-wide turnover within the same Member State. The Transaction therefore has an EU dimension within the meaning of Article 1(2) of the Merger Regulation.

4. THE PROCEDURE

- (6) The Transaction was notified to the Commission on 15 November 2022.
- (7) After a preliminary examination of the notification and based on the Phase I market investigation, the Commission raised serious doubts as to the compatibility of the Transaction with the internal market and adopted a decision to initiate proceedings pursuant to Article 6(1)(c) of the Merger Regulation on 20 December 2022 (the "**Article 6(1)(c) Decision**").
- (8) On 21 December 2022, the Commission provided a number of key documents cited in the Article 6(1)(c) Decision to the Notifying Party.
- (9) On 12 January 2023, the Commission adopted a decision pursuant to Article 11(3) of the Merger Regulation, addressed to Broadcom, following Broadcom's failure to provide complete information in response to a request for information ("**RFI**") from the Commission (the "**Broadcom Article 11(3) Decision**"). On the same day, the Commission adopted a second decision pursuant to Article 11(3) of the Merger Regulation, following VMware's failure to provide complete information in response to a RFI from the Commission (the "**VMware Article 11(3) Decision**"). Both the Broadcom Article 11(3) Decision and the VMware Article 11(3) Decision compelled their addressees to submit a complete response to the RFI originally sent by the Commission and had the effect of suspending the time limits referred to in the first subparagraph of Article 11(3) of the Merger Regulation. Broadcom complied with the Broadcom Article 11(3) Decision on 14 February 2023 and VMware complied with the VMware Article 11(3) Decision on 14 February 2023. Thus, the suspension of the time limits expired on 14 February 2023.

- (10) On 13 January 2023, the Notifying Party submitted its written comments to the Article 6(1)(c) Decision (the “**Article 6(1)(c) Response**”).
- (11) On 24 January 2023, a State of Play meeting between the Notifying Party and the Commission took place.
- (12) On 16 February 2023, the Commission held a technical meeting with the Parties.
- (13) On 13 March 2023, the Phase II investigation period was extended by 10 working days in agreement with the Notifying Party pursuant to the first sentence of the second subparagraph of Article 10(3) of the Merger Regulation.
- (14) On 11 April 2023, another State of Play meeting between the Notifying Party and the Commission took place, during which the Commission explained its preliminary findings based on its Phase II investigation.
- (15) After reviewing the available evidence collected during the Phase I and Phase II investigation, the Commission came to the preliminary view that it is likely, and there is even a strong probability, that the Transaction would, on the worldwide markets for Fibre Channel Host Bus Adapters (“**FC HBAs**”) and storage adapters, significantly impede effective competition in a substantial part of the internal market within the meaning of Article 2(3) of the Merger Regulation, and issued a Statement of Objections to the Notifying Party on 12 April 2023 (the “**SO**”).
- (16) On 26 April 2023, the Notifying Party submitted its written comments on the SO (the “**SO Response**”).
- (17) An Oral Hearing took place on 5 May 2023.
- (18) On 10 May 2023, another State of Play meeting took place between the Notifying Party and the Commission, during which the Commission provided an update of its Phase II investigation and limited its objections to the worldwide market for FC HBAs.
- (19) On 12 May 2023, the Phase II investigation period was extended by 3 working days at the request of and in agreement with the Notifying Party pursuant to the first sentence of the second subparagraph of Article 10(3) of the Merger Regulation.
- (20) On 16 May 2023, the Notifying Party submitted commitments pursuant to Article 8(2) second subparagraph of the Merger Regulation in order to address the competition concerns identified by the Commission. Accordingly, the legal deadline for the Commission decision was automatically extended by 15 working days, pursuant to Article 10(3) first subparagraph of the Merger Regulation.
- (21) On 23 May 2023, the Commission launched a market test of the commitments submitted by the Notifying Party.
- (22) The Commission gave the Notifying Party detailed feedback on the outcome of the market test on 8 June 2023.
- (23) On 14 June 2023, the Notifying Party submitted revised commitments pursuant to Article 8(2) of the Merger Regulation.
- (24) On 16 June 2023, the Commission sent a draft of the decision taken pursuant to Article 8(2) of the Merger Regulation (the “**Decision**”) to the Advisory Committee with the view of seeking the Committee’s opinion. The meeting of the Advisory Committee took place on 30 June 2023 and the Committee issued a positive opinion.

5. THE COMMISSION'S INVESTIGATION

- (25) This Decision contains the Commission's findings on the basis of the market investigation it carried out prior to the notification of the Transaction, in Phase I and Phase II of the investigation.
- (26) Prior to the notification of the Transaction, the Commission sent ten requests for information (“**RFI**”) to the Parties, responses to which were included in the notification. The Commission also conducted several interviews with the Parties' customers and competitors.
- (27) During the first phase investigation, the Commission sent four RFIs to the Parties pursuant to Article 11 of the Merger Regulation. The Commission also sent RFIs in the form of four different questionnaires to competitors and customers of the Parties.
- (28) Over the course of its Phase II investigation, the Commission sent 13 RFIs to the Parties pursuant to Article 11 of the Merger Regulation, including two detailed internal documents requests, resulting in the submission of over 3 million internal documents (approximately one million internal documents from Broadcom and approximately two million from VMware). Further, the Commission held several calls with market participants and sent requests for information in the form of targeted requests to competitors and customers of the Parties.

6. INDUSTRY OVERVIEW

- (29) In this Section, the Commission provides an overview of all sectors that are relevant for the purpose of assessing the Transaction in order to provide context for the assessment undertaken in Section 8.

6.1. IT software, including virtualization software and containerization

- (30) The Parties are both active in IT software for enterprise customers.
- (31) Although Broadcom was originally mainly a hardware company (most importantly for this case and further explained below in Section 6.3.2: Network Interface Cards, Fibre Channel Host-Bus Adapters and storage adapters), it has started expanding into software via the acquisitions of CA Technology⁴ and Symantec⁵.
- (32) VMware mainly offers virtualization software and related workload management technologies for datacentres and clouds, application development and endpoint management.
- (33) **Virtualization software** converts a physical IT asset into a virtual resource and creates logical representations of all the components that it functions on top of (*e.g.*, CPU, memory, Basic Input/Output System, and the Operating System) in order to deliver unique capabilities.⁶ Virtualization can occur in different forms:⁷
 - (a) **Server Virtualization:** Server virtualization emulates computer hardware to enable the hardware of a single server to be divided into multiple computers, known as “virtual machines”.

⁴ Commission decision of 12 October 2018 in case M.9054 – *Broadcom / CA*.

⁵ Commission decision of 30 October 2019 in case M.9538 – *Broadcom/Symantec Enterprise Security Business*.

⁶ Commission decision of 29 February 2016 in case M.7861 – *Dell / EMC*, paragraph 63.

⁷ Form CO, paragraph 421.

- (b) **Network virtualization.** Network virtualization allows connecting virtual machines that are on separate physical networks from other virtual or physical machines to appear as if they were located on the same physical network.
 - (c) **Storage virtualization.** Storage virtualization aggregates storage disks inside different physical servers to form a single, shared pool of storage upon which a virtual machine can be deployed.
 - (d) **Desktop virtualization.** Desktop virtualization leverages server virtualization to provide physical machines in datacentres or cloud environments that run desktop OS (as opposed to more traditional server-application software).
- (34) As mentioned above, server virtualization enables computer operators to partition hardware in such a way as to create multiple, isolated environments – “virtual machines” – on a single server.⁸ Virtual machines emulate an independent physical device: they run their own “guest” operating system (“OS”), such as Microsoft Windows, that communicates with the virtual resources presented to it by the hypervisor, and, from the perspective of the software running on the virtual machines, appear identical to a physical device.⁹ In reality, however, the functionalities of the device are abstracted from the underlying physical hardware by means of a hypervisor (see **Figure 1**¹⁰).
- (35) A **hypervisor** is a specialised OS that runs directly on server hardware (*i.e.*, on “bare metal”),¹¹ splits this hardware into isolated pods¹², and deploys virtual machines thereon. It pools the computing resources provided by the hardware (*e.g.*, processors, memory, and storage) and allocates them among the different virtual machines.¹³ It then presents these virtual resources to the guest OS running on the virtual machine. The hypervisor communicates with the guest OS but does not interact directly with the application software that is running within virtual machines.
- (36) The main advantage thereby created is one of efficiency: applications running, *e.g.*, on a single physical server rarely consume all the resources of that server. Virtualization serves to overcome this inefficient use of hardware by enabling multiple applications and OSs to make use of a single piece of hardware, thus exhausting its full capacity, whilst maintaining a clear separation between them.¹⁴
- (37) While virtualization is a way of partitioning hardware, **containerization** is a way of partitioning an OS to produce isolated workspaces within it.¹⁵ It describes the process by which a container engine generates containers, *i.e.*, small, isolated, lightweight workspaces which contain applications and all their dependencies (*i.e.*, other programs on which the application relies to run, including elements of an OS). Once generated, containers are deployed and managed across networks through a process known as container orchestration.¹⁶

⁸ Form CO, paragraph 377.

⁹ Form CO, paragraph 326.

¹⁰ Form CO, figure 12.

¹¹ Form CO, paragraph 329. Communication between the hypervisor and the underlying hardware takes place through drivers; see Form CO, paragraph 331.

¹² Form CO, paragraph 379.

¹³ Form CO, paragraph 330.

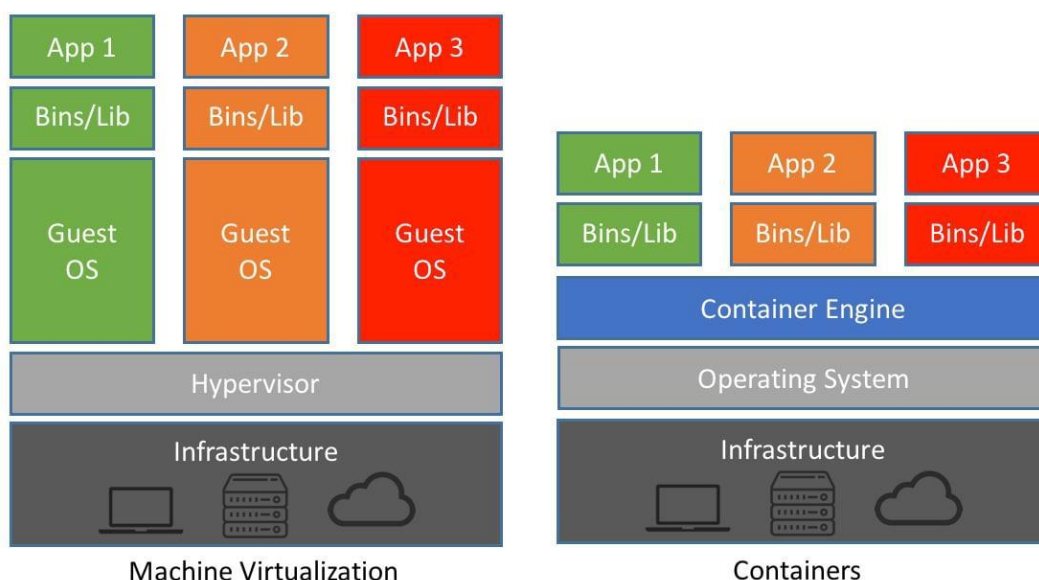
¹⁴ Form CO, paragraph 325.

¹⁵ Form CO, paragraph 377.

¹⁶ Form CO, paragraph 380.

- (38) Containerization enables applications to share the same OS while remaining isolated from one another in a way that appears as though they are running in separate OSs.¹⁷ Workloads running in containers can only use the resources they are assigned and are not aware of other containers running on the same underlying OS.¹⁸ Moreover, containers function according to a standard format and are, therefore, highly portable across different systems – they can be compared to shipping containers which can be transported seamlessly across different vehicles (e.g., ships, trains, and lorries).¹⁹
- (39) Unlike virtual machines, which each contain a full OS, containers only carry the binaries and libraries needed to run a specific application. As a result, containers use fewer computer resources than virtual machines.²⁰

Figure 1: Virtual Machines and Containers



Source: Notifying Party

6.2. The growth of cloud computing

- (40) In computing, **virtualization software** creates virtual versions of computer resources, like hardware, OS, storage devices, or network resources. Virtualization is, therefore, an intermediary layer between hardware and other software components, such as operating systems and applications. Virtualization software is one of the main software products marketed by VMware (see Section 7.4 7.4. below).²¹
- (41) Virtualization software has historically been used by enterprises to create virtual machines from physical infrastructure they own and operate themselves in datacentres on their premises (“on-premises”). This on-premises model is increasingly being displaced by **cloud computing**. Cloud computing is the on-demand delivery of computing resources over a network. Virtualization software is generally the mechanism by which the Cloud Service Providers (“CSPs”) implement

¹⁷ Form CO, paragraph 378.

¹⁸ Form CO, paragraph 378.

¹⁹ Form CO, paragraph 381.

²⁰ Form CO, paragraph 382.

²¹ Form CO, paragraph 46.

such on-demand delivery of computing resources.²² Amazon Web Services, Google Cloud, and Microsoft Azure are three of the major CSPs.

- (42) The two principal cloud deployment models are public cloud and private cloud. A **public cloud** is a service provided, managed and maintained off-premises via the internet in which computing resources are pooled virtually from hardware owned and managed by a third-party provider and allocated among multiple tenants. In a **private cloud**, services and infrastructure are maintained on a private network and the hardware (often “on-premises”) and software are dedicated solely to the relevant enterprise. Computing resources are shared by users of a single tenant (*i.e.*, an organization). Private clouds can be either hosted by an enterprise for the benefit of its own users (on-premises) or hosted by a third party who owns and operates a datacentre (off-premises). Off-premises private clouds are gated from other tenants using various isolation mechanisms, such as firewalls.²³
- (43) The key characteristics of cloud computing are that IT resources are provided on-demand in an “elastic” way (*i.e.*, they scale up or down dynamically to meet fluctuating demand), that the service is metered (you only pay for what you actually consume), and that services are requested through a “self-service” online control panel. Initially focused on IT resource provisioning (Infrastructure as a Service, “IaaS”), the cloud computing market has also quickly expanded to provide advanced IT services such as databases and analytics (Platform as a Service, “PaaS”), as well as business applications (Software as a Service, “SaaS”).²⁴
- (44) Cloud computing is growing rapidly as enterprises are migrating a proportion of workloads from on-premises servers and datacentres to the public cloud. Enterprises are also developing “cloud-native”²⁵ applications, *i.e.*, applications purposely designed to take advantage of cloud-computing environments. According to Gartner²⁶, “[t]he IaaS market continues to grow unabated as cloud-native becomes the primary architecture for modern workloads.”²⁷
- (45) Migration of workloads from on-premises datacentres and private clouds to the public cloud has been possible because CSPs offer comparable features to on-premises and private cloud deployment models. Instead of deploying virtual machines on-premises, organizations can provision and deploy virtual machines in the public cloud using these CSPs’ own virtualization technology.²⁸
- (46) Companies will customize their cloud migration strategies, methods, and timelines to address their specific needs. They may choose to move some workloads to the public

²² Form CO, paragraph 332.

²³ Form CO, paragraph 332.

²⁴ European Commission Cloud Strategy, 16 May 2019. Available at https://ec.europa.eu/info/sites/default/files/ec_cloud_strategy.pdf.

²⁵ Cloud-native is an approach to building and running applications that exploits the advantages of the cloud computing delivery model. It is based on access to flexible computing power, on-demand, along with modern data and application services for developers.

²⁶ Gartner is an IT research and consulting firm.

²⁷ Gartner, Gartner Says Worldwide IaaS Public Cloud Services Market Grew 41.4% in 2021 (June 2, 2022). Available at <https://www.gartner.com/en/newsroom/press-releases/2022-06-02-gartner-says-worldwide-iaas-public-cloud-services-market-grew-41-percent-in-2021>. Infrastructure-as-a-service (“IaaS”) is cloud-based software (or virtual hardware) that sits below an operating system and provides necessary compute resources, storage and networking capabilities for a given cloud model (can be thought of as virtual server space); can refer to either a public or private cloud infrastructure and is often provided as a service (on a pay-as-you-go model).

²⁸ Form CO, paragraph 334.

cloud over time, rather than all at once, whilst retaining other workloads in the private cloud. Customers may also choose from an array of migration methods: they can “lift and shift” legacy workloads to the public cloud “as is” (often refactoring them later), “refactor” or rewrite the code to be cloud native or disaggregate legacy code into microservices.²⁹

- (47) There are nevertheless certain workloads which customers have so far been more reluctant to migrate to or create in the cloud. Monolithic, legacy applications (*i.e.*, older applications written as a single, large block of code, which is harder to break down and deploy across containers and multiple clouds) are sometimes more costly to rewrite for the cloud. Customers may also be reluctant to migrate mission-critical applications that require zero risk of downtime or failure. Enterprises therefore distribute workloads across on-premises infrastructure, public, and private clouds, creating a “**hybrid cloud**”. This enables an enterprise to keep those workloads they prefer on-premises but reduce costs and increase efficiency by migrating other workloads to private or public clouds.³⁰ Furthermore, IT organizations and enterprises may also implement a “**multi-cloud**” strategy which is a cloud environment that includes more than one public cloud provider, regardless of whether it is hybrid or not.
- (48) VMware virtualization software has typically been used with on-premises infrastructure and to implement on-premises private clouds. VMware is now transforming from an on-premises infrastructure software provider to a multi-cloud company with a view to maintaining existing customer workloads as they move to the cloud and capturing new workloads in the cloud.³¹ VMware markets itself as the leading provider of multi-cloud services for all applications, enabling digital innovation with enterprise control.³²

6.3. Interoperability and certification

6.3.1. Interoperability

- (49) VMware’s hypervisor communicates with underlying physical hardware through device drivers. A driver is a program that tells software how to communicate with a device, providing an interface between the two. The purpose of the driver is to allow the OS’s/hypervisor’s own Application Programming Interface (“**API**”)³³ to be agnostic as to the specific vendor of the hardware.

²⁹ Form CO, paragraph 343.

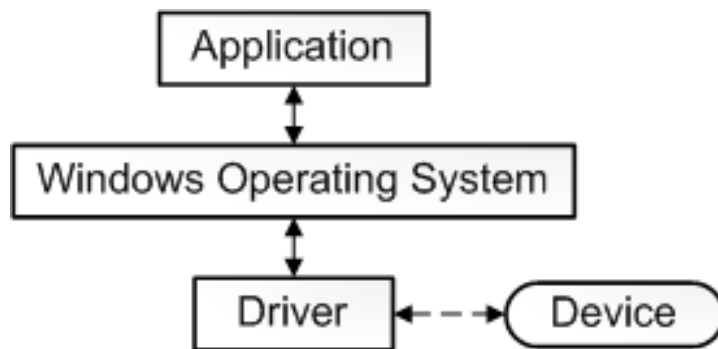
³⁰ Form CO, paragraph 187.

³¹ Form CO, paragraph 414.

³² See VMware, “About us”. Available at <https://www.vmware.com/company.html>.

³³ An API is an interface that enables one application to access another application without having to know complex details about how that other application works.

Figure 2: OS-Driver interaction



Source: Notifying Party

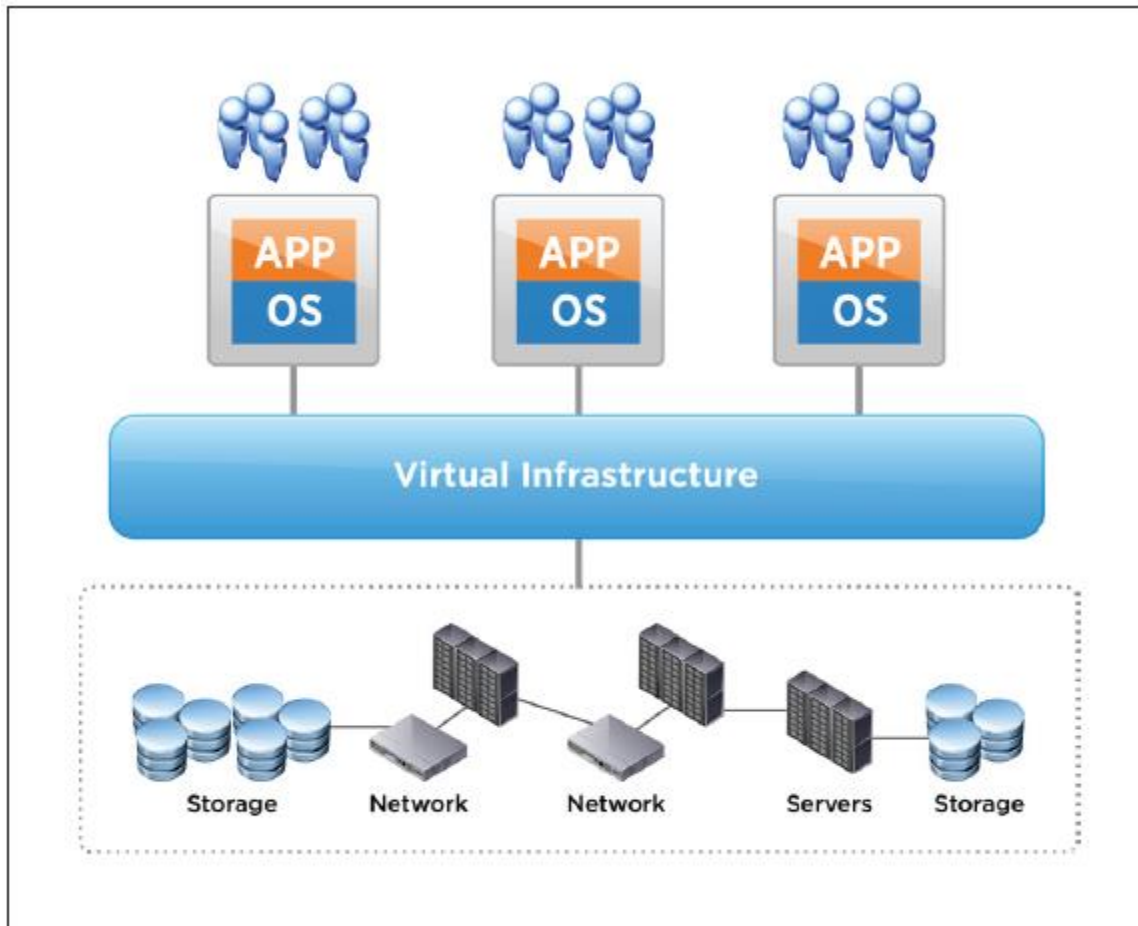
- (50) There are two sides to a driver: the side that communicates with the hardware and the side that communicates with the OS (see Figure 2 above). The communication between the driver and hardware is in a language proprietary to the original equipment manufacturer (“**OEM**”), as this relationship does not involve third-party hardware or software. The communication between the driver and the OS is based on standard, hardware-agnostic protocols unique to that OS.
- (51) Drivers are developed by device manufacturers. Since each OS communicates with drivers in different ways, OEMs must create OS-specific drivers for their hardware. VMware, like other OS vendors, publishes testing suites for hardware manufacturers to certify that their device drivers work with its hypervisor. VMware’s Native Driver Device Kit (“**NDDK**”) is used to create drivers for VMkernel, which is the proprietary OS kernel at the core of VMware’s ESXi hypervisor. The NDDK defines the API between the driver and VMware’s ESXi hypervisor. NDDK contains an environment for building drivers, sample drivers, debugging information, and documentation.
- (52) NDDK is made available to members of VMware’s I/O Vendor Partner (“**IOVP**”)³⁴ program. IOVP is a package within VMware’s Software-Defined Data Centre (“**SDDC**”) Integration program designed for OEMs that produce I/O (input/output) devices.³⁵ It is one of many certification programs designed to provide partners with the necessary tools and development resources to design, build, and integrate products with core VMware features and capabilities and facilitate interoperability with VMware software. The IOVP program is the relevant certification program for I/O devices, which includes among other things FC HBAs and storage adapters (see Figure 3 below).³⁶

³⁴ <https://techpartnerhub.vmware.com/programs/i-o-vendor-partner-package>.

³⁵ Input/output devices are devices that has the ability to accept inputted, outputted or other processed data.

³⁶ Parties’ reply to RFI 20, question 8.

Figure 3: I/O Vendor Partner program - architecture³⁷



Source: VMware

- (53) VMware's SDDC Integration program is a yearly subscription program that provides a set of resources and tools to help customers integrate their hardware products with VMware's software solutions and certify their hardware and software with all products within the VMware's SDDC product portfolio. Membership in the SDDC integration program also grants partners simultaneous access to updates and new releases of VMware's SDDC products for development and testing.
- (54) The SDDC and other specialised programs are generally available to any interested partner. VMware publishes an SDDC Integration program guide.³⁸ Compliance with the general participation requirements set out in this guide is relatively easy. The guide requires that partners (i) maintain their membership of VMware's Technology Alliance Partner ("TAP") program (membership of the TAP program is generally available to relevant hardware vendors); (ii) sign the program agreement; (iii) follow the instructions set out in the Guide; and (iv) submit a completed "Partner Onboarding Form" if they wish to be included in certain specialized programs, such as the IOVP program. While the IOVP is part of VMware's SDDC Integration program, admission is limited to input/output (I/O) hardware providers (e.g.,

³⁷ See VMware, "Technology Partner Hub". Available at: <https://techpartnerhub.vmware.com/programs/i-o-vendor-partner-package/documentation-and-reference>.

³⁸ See VMware, "Technology Partner Hub". Available at: <https://techpartnerhub.vmware.com/programs/sddc-integration/packages>.

suppliers of Network Interface Cards (“NICs”), FC HBAs or storage adapters, as well as server OEMs), as the program is designed for devices with I/O functionality.

- (55) NICs, FC HBAs and storage adapters are hardware devices that interact with VMware’s server virtualization software. In particular, NICs connect physical servers to a network (typically through the network protocol) in order to communicate with networked devices. FC HBAs connect servers to networked storage (often indirectly, via a switch). Storage adapters connect physical servers to storage devices directly.³⁹ NICs, FC HBAs and storage adapters will be discussed further in Section 7 below.
- (56) To be considered for participation, potential applicants must submit information about their company and products to VMware. The purpose of the admission criteria is to verify that applicants understand the program and have realistic expectations about what they can achieve. When joining one of VMware’s partner programs, vendors sign agreements covering the certification process.

6.3.2. *Certification*

- (57) Driver certification is the process of obtaining confirmation that a driver interoperates with an OS.
- (58) VMware publishes separate testing kits for each device type (*i.e.*, separate kits for NICs, FC HBAs, and storage adapters). These are only available to members of a corresponding partner program. Membership of the IOVP program provides suppliers of NICs, FC HBAs, and storage adapters with access to the IOVP Certification Kit.
- (59) VMware’s testing suites run a series of tests to determine whether a device and driver are interoperable with VMware’s products. The testing suites generate a log that the device manufacturer submits to VMware for review. VMware manually reviews the log to confirm that the device and driver work with VMware products. This process takes [Business secret – Production secrets and processes]. In some cases, a driver may pass testing smoothly with no need for troubleshooting. Hardware and software integration can nevertheless require some partners to work with VMware to troubleshoot issues that arise during testing. VMware provides technical guidance to resolve these problems; it is even obliged to do so under its contracts with partners.
- (60) Once VMware confirms that a driver has passed all tests, VMware certifies the driver and signs it with an encryption key to indicate that they are VMware tested and certified. The encryption key enables VMware’s virtualization software to verify that the driver is safe and is intended to prevent malware or malfunctioning drivers from being loaded into the server OS / hypervisor, making these environments more secure for customers.⁴⁰ Concretely, UEFI (Unified Extensible Firmware Interface) is an industry standard interface between the hardware’s firmware and the OS/hypervisor running on the hardware. UEFI Secure Boot provides security during a computer’s start-up process by checking for pre-authorized signatures in order to confirm the authenticity of critical bootloaders (*i.e.*, the initial set of applications being loaded by the firmware, such as the OS/hypervisor). Only software that is identified by its signature is loaded by the UEFI during the boot process. Microsoft,

³⁹ Form CO, paragraph 57.

⁴⁰ Parties’ reply to RFI 20, question 13.

Apple, and other OS vendors use a similar feature to UEFI Secure Boot to ensure the security of their systems.

- (61) Following the certification and signature processes, VMware lists the driver and device combination on the VMware Compatibility Guide on its website. It is market practice for OS and hypervisor vendors to only load certified and signed drivers.⁴¹
- (62) When hardware vendors bring to market new devices with a driver that was already certified by VMware as part of an existing device, they can claim equivalency over that device.⁴² This involves no testing with VMware and is only administrative, with VMware confirming that there is indeed an existing device with a driver that was already certified. Once confirmed, VMware certifies the new devices without engaging with the hardware vendor.
- (63) If the hardware OEM modifies the driver (*e.g.*, to introduce new features or to maintain compatibility with new versions of VMware), the driver must be submitted for re-certification. VMware charges approximately USD [Business secret – price structure] for each certification. For Broadcom, this amounts to approximately USD [Business secret – price structure] in certification charges in total each year. Since 2021, VMware has introduced a subscription model, which means that partners pay a fixed annual fee for certification. They still pay a fee per certification, but at a reduced rate depending on the membership Tier they enrol for. Each Tier includes a certain number of certifications.⁴³ By way of example, a VMware Certification Subscription Service – Tier 1 is sold on VMware’s website for USD 1,250 (for one year, up to 5 certification submissions at USD 250 per entitlement), while Tier 2 (up to 10 certification submissions at USD 245 per entitlement) is priced at USD 2,450.⁴⁴
- (64) VMware nevertheless tries to limit the need for partners to re-certify drivers by determining whether old drivers can be carried forward to new versions of VMware software. However, re-certification sometimes remains inevitable – Broadcom seeks certification with VMware when (i) releasing new generations of its hardware products, (ii) updating its firmware to fix bugs or patches, (iii) OEMs introduce updates to third-party hardware and (iv) in instances where OSs and hypervisors introduce new versions or updates with new functionality that is not covered by previous versions’ drivers.⁴⁵ VMware also provides device OEMs with information about forthcoming product changes. These changes can have an effect on the compatibility of drivers with VMware and often require drivers to be rewritten. VMware provides OEMs with information about these changes to give OEMs time to rewrite the driver before the new VMware product is released or the change is implemented. Similar to other OEMs and device vendors, Broadcom typically receives this information [Business secret - production process] ahead of any major VMware product release. Similar to other vendors, Broadcom likewise provides VMware with a [Business secret - production process] notice of major product changes that may impact VMware’s product.

⁴¹ ESXi does have an option for customers to choose to allow uncertified drivers to load if an OEM were able to develop a compatible driver outside of the IOVP program. In practice, a customer would be unlikely to load uncertified drivers, as only loading certified drivers is a means to ensure the security of the environment and guard against malware.

⁴² Article 6(1)(c) Response, paragraph 188

⁴³ Form CO, paragraph 692; Form RM, paragraph 15.

⁴⁴ <https://store-us.vmware.com/vmware-certification-subscription-service-tier-1-5514781400.html> and <https://store-us.vmware.com/vmware-certification-subscription-service-tier-2-5514781600.html>

⁴⁵ Parties’ reply to RFI 20, question 1.

- (65) Major VMware product releases and product changes are communicated to the companies enrolled in a particular partner program at the same time. All members of the SDDC Integration program, for example, would receive a communication about the launch of vSphere 8 at the same time. When VMware meets with OEMs or device vendors, any discussions around upcoming product changes will relate to changes that have already been announced to partners in that program. The discussions usually focus on technical issues and the impact of the product change (if any) on that partner's interoperability with VMware.
- (66) This arrangement benefits both VMware and OEMs. Without this head start, new VMware products would be released without any guarantee that those products would interoperate with users' hardware, thus deterring adoption. Likewise, without any guarantee of immediate interoperability with VMware products, potential VMware customers may be dissuaded from choosing OEMs' hardware.

7. RELEVANT MARKET DEFINITION

7.1. Introduction

7.1.1. *Approach to market definition in horizontally affected markets*

- (67) Broadcom and VMware are both active in IT software for enterprise customers. The Parties' activities overlap in a number of plausible markets or market segments.
- (68) In determining the relevant markets, where possible, the Notifying Party provided its views on the product and geographic market definitions on the basis of previous Commission decisions. The Notifying Party also relied on the segmentation adopted by the market intelligence companies International Data Corporation ("**IDC**")⁴⁶ and/or Gartner⁴⁷ in order to identify the narrowest possible product markets on which the Parties are active.
- (69) As set out in further detail in Sections 7.2.1.1, 7.3.1.1.1.1 and 7.3.1.2.1.1, the Commission has followed IDC and/or Gartner segmentation in past decisions.
- (70) For the purposes of the present Decision, the Commission carried out its competitive assessment on the basis of all the potential product market segments identified by the Notifying Party in accordance with IDC and/or Gartner segmentations for which market share data is available and which were affected on the basis of 2021⁴⁸ market shares data.
- (71) The Transaction only gives rise to limited horizontal overlaps (which amount to combined market shares of the Parties below 20%), with the exception of 4 IDC and/or Gartner market segments in which the Parties' combined market share exceed 20% at the worldwide or EEA level, namely: (i) **IT Asset Management & Software Asset Management** (Gartner terminology), (ii) **IT Automation and Configuration**

⁴⁶ IDC is a global market intelligence firm.

⁴⁷ IDC and Gartner classifications are not directly comparable with each other. This decision refers to the segments as indicated by the Notifying Party in the Form CO.

⁴⁸ The Notifying Party submits that on the basis of 2022 market share data, there are no additional affected markets in which the Parties' combined share is reported to exceed 20%. This is based on the following reports: Gartner Software data 2022 (Market Shares: All Software Markets, Worldwide), Gartner ITOM software data 2022 (Market Shares: IT Operations Management Software, Worldwide), IDC Software data 2022 (IDC Semiannual Software Tracker), 2022 and IDC Infrastructure software data (IDC Semiannual Software-Defined Infrastructure Tracker).

Management software and its sub-segment (iii) **Datacenter System and Application Control software**, and (iv) **Network software** (all IDC terminology).⁴⁹

7.1.1.1. Gartner terminology

- (72) Gartner categorizes the software industry into three levels: (i) macro markets, (ii) sub-segments, and for some sub-segments, (iii) categories.
- (73) Gartner identifies the macro markets for: (i) IT Operations Management (“ITOM”) software (Section 7.2.); (ii) Security⁵⁰; and (iii) Application Infrastructure and Middleware⁵¹.
- (74) Gartner divides the macro market ITOM Software into the following sub-segments: (i) Delivery Automation⁵², (ii) Health & Performance Analysis⁵³, (iii) Value Management (previously Experience Management), (iv) ITOM Mainframe tools⁵⁴ and (v) Other ITOM⁵⁵. Within the sub-segment Value Management, Gartner identifies the categories: (i) IT Financial Management tools (ITFM); (ii) IT Service Management tools, (iii) IT Asset Management & Software Asset Management (“**ITAM & SAM**”) (Section 7.2., and (iv) Other Value Management tools⁵⁶

7.1.1.2. IDC terminology

- (75) IDC categorizes the software industry into four levels: (i) primary markets; (iii) secondary markets; (iii) functional markets; and (iv) sub-markets.

⁴⁹ All other Gartner and/or IDC markets and sub-markets where there is a horizontal overlap do not give rise to affected markets.

⁵⁰ Gartner divides the macro-market Security in the following sub-segments: (i) Integrated Risk Management, (ii) Application Security, (iii) Consumer Security Software, (iv) Infrastructure Protection, (v) Identity Access Management, (vi) Data Security, (vii) Cloud Access Security Brokers, (viii) Other Security Software. See Form CO, Annexes (Horizontals) 2.

⁵¹ Gartner divides the macro-market Application Infrastructure and Middleware in the following sub-segments: (i) Transaction Processing Monitors, (ii) Application Platforms Software, (iii) Event Stream Processing (ESP) Platforms, (iv) High-Productivity Application Platform as a Service, (v) High-Control Application Platform as a Service, (vi) Application Integration Suites, (vii) Business-to-business Gateway Software (Stand-Alone), (viii) Integration Platform as a Service, (ix) Full Life Cycle API Management, (x) Event Brokers and Messaging Infrastructure, (xi) Managed File Transfer Suites, (xii) Business Process Management Suites, (xiii) Robotic Process Automation, (xiv) Digital Experience Platforms, (xv) Other Application Infrastructure and Middleware. See Form CO, Annexes (Horizontals) 2 and 4.

⁵² Gartner divides the sub-segment Delivery Automation in the following categories: (i) Cloud Management Tooling, (ii) Container Management Tools, (iii) DevOps Value Stream Delivery Platforms, (iv) DevOps Value Stream Management Platforms, (v) Infrastructure Automation, (vi) Service Orchestration and Automation Platforms, (vii) Network Automation and Orchestration and (viii) Other Automation Tools. See Form CO, Annex 3 (Horizontals).

⁵³ Gartner divides the sub-segment Health & Performance Analysis in the following categories: (i) Artificial Intelligence for Operations tools, (ii) Application Performance Monitoring tools, (iii) Digital Experience Monitoring tools, (iv) IT Infrastructure Monitoring tools, (v) Network Performance Monitoring tools, and (vi) Other Monitoring tools. See Form CO, Annex 3 (Horizontals).

⁵⁴ ITOM mainframe tools are used for managing and monitoring mainframe implementations. A roll-up of mainframe categories captured here include application performance monitoring, monitoring, DBMS management, automation, workload automation and ITPA. See Form CO, Annex 3 (Horizontals).

⁵⁵ Other ITOM includes any management tools and/or integrated functionality not specifically covered within the named categories detailed previously. Tools in this category include, but are not limited to, output management software used to manage hardware peripherals, such as printers. Emulators are windows/portals into mainframe, mini- and other platforms. Database administration automation and support tools that automate routine administration of databases, schema development and management, query analyzers, reorganization utilities, space tuners, and bulk data loading/unloading technologies. See Form CO, Annex 3 (Horizontals).

⁵⁶ See Form CO, Annex 3 (Horizontals).

- (76) IDC identifies the primary markets for (i) Application Development & Deployment⁵⁷; and (ii) System Infrastructure Software (Section 7.3.).
- (77) IDC sub-segments the primary market for System Infrastructure Software into the secondary markets for (i) Endpoint Management Software;⁵⁸ (ii) **Network software** (Section 7.3.1.2.), (iii) Security software⁵⁹, (iv) Storage software⁶⁰, (v) Physical and Virtual Computing Software⁶¹, and (vi) System and Service Management software (Section 7.3.1.1.).
- (78) IDC sub-segments the secondary market for Network software into the functional markets for: (i) Network Infrastructure software, and (ii) Network Management Software.
- (79) IDC sub-segments the secondary market for System and Service Management software into the functional markets for: (i) IT Automation and Configuration Management (“**ITACM**”) software, and (ii) ITOM software.
- (80) IDC further identifies 2 sub-markets of the functional market for ITACM Software: Datacenter System and Application Control (“**DSAC**”) and Workload Management.

7.1.2. *Conglomerate markets*

- (81) The main products relevant for the assessment of the Transaction in this Decision are VMware’s virtualization software on the one hand, and Broadcom’s FC HBAs and storage adapters, on the other hand.

7.2. **IT Operations Management (ITOM) software (Gartner terminology)**

- (82) ITOM software represents tools needed to manage the provisioning, capacity, performance and availability of computing, networking and application resources — as well as the overall quality, efficiency and experience of their delivery.⁶²
- (83) As mentioned in Section 7.1.1., Gartner divides the macro market ITOM software into the following sub-segments: (i) Delivery Automation, (ii) Health & Performance Analysis; (iii) Value Management; (iv) ITOM Mainframe Tools and (v) Other ITOM.
- (84) Value Management tools focus on improving the quality, efficiency and costs of the delivery and support of digital customer experiences.⁶³

⁵⁷ IDC sub-segments the primary market for Application Development & Deployment into the secondary markets for: (i) Analytics and Business Intelligence, (ii) Artificial Intelligence Platforms, (iii) Data Management, (iv) Integration and Orchestration, (v) Application Development, (vi) Software Quality and Life Cycle, (vii) Application Platforms. See Form CO, Annex 5 (Horizontal).

⁵⁸ IDC sub-segments the secondary market for Endpoint Management Software into Client Endpoint Management and Output management. See Form CO, Annex 5 (Horizontal).

⁵⁹ IDC sub-segments the secondary market for Security Software into the functional markets for: (i) Cybersecurity Analytic, Intelligence, Response and Orchestration Software, (ii) Endpoint Security Software, (iii) Identity and Digital Trust Software, (iv) Network Security Software, (v) Information and data security and (vi) Governance, risk and compliance. See Form CO, Annex 5 (Horizontal).

⁶⁰ IDC sub-segments the secondary market for Storage Software into the functional markets for: (i) Data replication and protection software, (ii) Archiving software, (iii) Storage infrastructure and device management software; (iv) Software-defined storage controller software. See Form CO, Annex 5 (Horizontal).

⁶¹ IDC sub-segments the secondary market for Physical and Virtual Computing Software into the functional markets for: (i) Operating Systems and Subsystems, (ii) Software-Defined Compute, (iii) Virtual Client Computing and (iv) Other Computing Software. See Form CO, Annex 5 (Horizontal).

⁶² Form CO, Annex 3 (Horizontal).

⁶³ Form CO, Annex 3 (Horizontal).

- (85) Within the sub-segment Value Management, Gartner identifies the category ITAM & SAM. ITAM & SAM tools provide inventory, management, and optimization of technology assets through the use of processes and tools throughout an asset's life cycle. This includes managing software licenses and SaaS consumption.⁶⁴
- (86) **Broadcom** offers the following Computer Associates ("CA") solutions⁶⁵ in ITAM & SAM: IT Asset Manager, Service Catalog, and Service Management. These solutions are used for license reporting, audit response, license optimization, etc.⁶⁶ A brief description of each product is included below⁶⁷:
- (a) IT Asset Manager can be used to allocate IT assets costs to specific business services and provide visibility to business owners of their cost and compliance. IT Asset Manager's capabilities include, for instance, vendor management through the compilation of information about vendors (including contact information and the vendor's relationships to other vendors), contract management by providing easy access to contract information, software cost analysis used to measure the financial impact of license portfolio and make informed decisions on cost allocation, and software compliance auditing and reporting with the display of results critical for decision support and the provision of key indicators for the highest audit risks, the most expensive licenses, significant publishers, and the largest contracts.
 - (b) Service Catalog communicates IT service offerings provided by the enterprise to the employees and provides financial insight into costs and consumption of these offerings. Service Catalog can be used to organize different IT assets to logical business services (*e.g.*, which assets participate in a mortgage underwriting service).
 - (c) Service Management is a self-service-based tool to access knowledge about the IT assets available in an organization. In particular, it is capable of discovering and cataloguing different IT assets, including servers, network equipment, and software applications.
- (87) **VMware** offers the following products in ITAM & SAM: vRealize Operations and CloudHealth.⁶⁸ A brief description of each product is included below⁶⁹:
- (a) vRealize Operations monitors costs for virtual machines that run on VMware assets (in addition to monitoring performance as described below) and includes True Visibility, which monitors performance and configuration status.
 - (b) CloudHealth is a cloud service management platform that monitors and allows for the optimization of usage of public cloud environments. It includes a function to monitor public cloud costs.

7.2.1. *Product market definition*

7.2.1.1. Commission's precedents

- (88) In previous decisions, the Commission considered a classification of software products based on functionality, the end-user (enterprise software vs. consumer software), and the specific sector in which the software is used (*e.g.*, healthcare

⁶⁴ Form CO, Annex 3 (Horizontal).

⁶⁵ Solutions of CA Technology.

⁶⁶ Form CO, paragraph 259.

⁶⁷ Form CO, paragraph 170.

⁶⁸ Form CO, paragraph 260.

⁶⁹ Form CO, paragraph 170.

software).⁷⁰ As regards functionality, the Commission considered a division based on: (i) infrastructure software; (ii) middleware; (iii) application software and office software; and (iv) operating/browser software.⁷¹ Within infrastructure software, the Commission considered the following additional sub-segmentation: (i) security software; (ii) ITOM software; (iii) application development software; and (iv) storage management software.⁷²

- (89) In *Broadcom/Symantec*⁷³, the Commission considered that within the ITOM software segment, Gartner included the following sub-segments: (i) Delivery Automation; (ii) Experience management (currently, Gartner refers to Experience Management as Value Management); (iii) Performance analysis; and (iv) other ITOM software not specifically covered within the above-named categories. Experience Management was further sub-divided into: (a) IT Services Management; and (b) Software Asset Management, IT Asset Management and IT Financial Management. Currently, Gartner separates IT Financial Management from ITAM & SAM.
- (90) In the previous decisions mentioned above, the Commission ultimately left the market definition open and carried out its assessment based on the narrowest possible market.⁷⁴

7.2.1.2. The Notifying Party's views

- (91) The Notifying Party submits that ITAM & SAM is the narrowest possible category where Gartner reports revenues for both Parties. Further, the Notifying Party considers that for the purposes of analysing the Transaction and in line with the Commission's practice to consider the most granular segmentations in its analyses, the Notifying Party has undertaken a competitive assessment at the level of this Gartner sub-category, despite the lack of actual competitive interaction. In any event, the Notifying Party considers that the exact product market definition can be left open.⁷⁵

7.2.1.3. The Commission's assessment

- (92) The Commission has not identified any reasons in this case to deviate from its precedents in which it defines the software industry market by reference to functionality and end-users, and identifies the narrowest possible product markets set out by existing market intelligence reports which have been provided by the Notifying Party, notably Gartner and/or IDC.

⁷⁰ Commission decision of 26 June 2011 in case M.6237 – *Computer Science Corporation / iSOFT Group*, paragraphs 22 and 25; Commission decision of 15 December 2014 in case M.7458 – *IBM / INF Deutsche Lufthansa*, paragraph 35; Commission decision of 30 October 2019 in case M.9538 – *Broadcom/Symantec Enterprise Security Business*, paragraph 14.

⁷¹ Commission decision of 26 June 2011 in case M.6237 – *Computer Science Corporation / iSOFT Group*, paragraph 22; Commission decision of 15 December 2014 in case M.7458 – *IBM / INF Deutsche Lufthansa*, paragraph 35; Commission decision of 30 October 2019 in case M.9538 – *Broadcom/Symantec Enterprise Security Business*, paragraph 15.

⁷² Commission decision of 30 October 2019 in case M.9538 – *Broadcom/Symantec Enterprise Security Business*, paragraph 16.

⁷³ Commission decision of 30 October 2019 in case M.9538 – *Broadcom/Symantec Enterprise Security Business*, paragraph 20.

⁷⁴ Commission decision of 26 June 2011 in case M.6237 – *Computer Science Corporation / iSOFT Group*, paragraph 32; Commission decision of 30 October 2019 in case M.9538 – *Broadcom/Symantec Enterprise Security Business*, paragraphs 24 and 25.

⁷⁵ Form CO, paragraphs 266 and 267.

(93) As mentioned above in Section 7.1.1., currently Gartner considers ITOM software, Security Software and Application Infrastructure and Middleware as macro-markets. Gartner segments the macro market for ITOM Software into the markets for (i) Delivery Automation; (ii) Health & Performance Analysis, (iii) Value Management, (iv) ITOM Mainframe Tools and (v) Other ITOM. Within Value Management, Gartner identifies the category for ITAM & SAM. The potential market for ITOM software may thus be further segmented on that basis.

(94) Finally, the market investigation did not suggest alternative product market definition.⁷⁶

7.2.1.4. Conclusion

(95) The Commission considers that, for the purposes of this Decision, the exact product market definition with regard to the supply of ITOM software can be left open, as the Transaction would not significantly impede effective competition under the narrowest possible product market definition, for which market share data is available, based on the Gartner segmentation.

(96) In Section 8.2.1.1., the Commission carries out an assessment on the basis of Gartner's ITAM & SAM category.

7.2.2. *Geographic market definition*

7.2.2.1. Commission's precedents

(97) In previous decisions, the Commission left the geographic market for infrastructure software (as well as any potential segmentations thereof) open, but considered that it was worldwide or at least EEA-wide in scope, since customers consider offers from vendors from all parts of the world, there are no technological barriers that restrict vendors from supplying customers globally, and infrastructure software are broadly identical across different countries.⁷⁷

7.2.2.2. The Notifying Party's views

(98) The Notifying Party submits the exact geographic market definition can be left open. For the purposes of assessing the Transaction, the Notifying Party provides worldwide and EEA shares.⁷⁸

7.2.2.3. The Commission's assessment

(99) In the market investigation, the Commission has not identified any reasons in this case to deviate from its precedents and considers that, in any event, for the purposes of this Decision, the exact geographic market definition with regard to the supply of ITOM software (as well as any potential segmentation of that market) can be left open.

7.2.2.4. Conclusion

(100) The Commission considers that, for the purposes of this Decision, the exact geographic market definition with regard to the supply of ITOM software, or any

⁷⁶ Replies to Q1, questions 4 and 5. The majority of respondents that expressed an opinion use IDC and Gartner reports and consider these are reliable sources for the software sector.

⁷⁷ Commission decision of 30 October 2019 in case M.9538 – *Broadcom/Symantec Enterprise Security Business*, paragraph 26-28.; Commission decision of 8 March 2017 in case M.8223 – *Micro Focus/HPE Software Business*, paragraph 36.

⁷⁸ Form CO, paragraph 267.

segment thereof, can be left open, as the Transaction would not significantly impede effective competition under any plausible geographic market definition.

7.3. System Infrastructure software (IDC terminology)

- (101) According to IDC, System Infrastructure software includes software solutions that provide the basic foundational layers of software that enable bare metal infrastructure hardware resources to host higher-level application development and deployment software and application software and provide the virtualization and management software used to configure, control, automate, and share the use of those resources across heterogeneous applications and user groups.⁷⁹
- (102) As mentioned in Section 7.1.1., IDC sub-segments the primary market for System Infrastructure software into the secondary markets for (i) Endpoint Management software; (ii) Network software, (iii) Security software, (iv) Storage software, (v) Physical and Virtual Computing software and (vi) System and Service Management software.

7.3.1.1. System and Service Management software

- (103) System and Service Management Software is used to manage, orchestrate, and optimize the use of server-side computing resources including bare metal virtual servers and container platforms as well as public cloud IaaS compute services to the extent that management services are priced separately from the core compute charges⁸⁰. According to IDC, System and Service Management software can be divided in the functional markets for: (i) ITACM software, and (ii) ITOM software. Within ITACM software, IDC identifies the sub-markets for DSAC software and Workload Management. ITACM and DSAC are affected markets.
- (104) ITACM software executes the configuration, provisioning, placement, migration, and workload management of on-premises and cloud-based physical and virtual systems in the ordinary course, *i.e.*, not during software development. ITACM allows IT professionals to (1) automate ordinary course IT processes and their configuration (systems and applications) that would otherwise be performed manually; and (2) balance computer workloads by ensuring that computer capacity is used most optimally and without causing bottlenecks.⁸¹
- (105) DSAC software includes software application configuration, deployment, patching, and automation for physical and virtual servers, container platforms, and public cloud. DSAC is a sub-segment of ITACM and focuses on the management of IT processes (systems and applications), and it only includes computer capacity management to the extent it concerns systems capacity management (not applications capacity management).⁸²
- (106) **Broadcom** offers the following products in the functional market of ITACM: Automic Automation, Autosys, Automic Continuous Delivery Automation, Configuration Automation, Server Automation, Client Management Suite, Dollar Universe Workload Automation, Server Management Suite, Symantec Service Desk. A brief description of each product is included below⁸³:

⁷⁹ Form CO, Annex 5 (Horizontals), page 68.

⁸⁰ Form CO, Annex 5 (Horizontals).

⁸¹ Form CO, paragraph 203.

⁸² Form CO, paragraph 203.

⁸³ Form CO, paragraph 204.

- (a) Automic Automation and Autosys are general-purpose tools for automating business processes and workload management. These tools provide hundreds of tasks in a library that IT operations professionals can use and combine to create automated workflows, such as monthly automated financial reporting workflows. Automated workflows are typically triggered by a schedule or event.
 - (b) Automic Continuous Delivery Automation is an orchestration tool that is used to deploy applications.
 - (c) Configuration Automation discovers network devices, servers, operating systems, applications, databases, and middleware running in enterprise infrastructure; inventories their configuration settings; and maps discovered components to run analysis on the change impact that takes place when configuration is changed.
 - (d) Server Automation is a datacentre management tool that automates provisioning, patching, and configuration of operating system, storage, network, and application components across physical, virtual, and public cloud systems.
 - (e) Client Management Suite is a systems management, patching, and remediation tool for applications and OS configurations on desktops and laptops.
 - (f) Dollar Universe Workload Automation is an IT workload automation tool.
 - (g) Server Management Suite is a provision, control, automation, and monitoring tool for servers from a central console.
 - (h) Symantec Service Desk is an automated incident response and problem resolution tool for remediation of end user incidents, systemic problems, and essential managed changes.
- (107) With the exception of Configuration Automation and Dollar Universe Workload Automation, all the other products also pertain to the sub-market for DSAC.
- (108) **VMware** offers the following products in the functional market of ITACM: Site Recovery Manager, vRealize Network Insight and vRealize Automation (including CodeStream, Cloud Assembly, and vRealize Orchestrator). A brief description of each product is included below⁸⁴:
- (a) Site Recovery Manager is a business continuity and disaster recovery solution that helps users to plan, test, and run the recovery of virtual machines in a vSphere environment.
 - (b) vRealize Network Insight is a network monitoring and application traffic flow visibility solution.
 - (c) vRealize Automation automates IT infrastructure and cloud provisioning, deployment, and configuration for applications, virtual machines, and other workloads, among others. It includes the following components:
 - (1) *vRealize Automation Code Stream* is a developer tool for moving software between Kubernetes containers from development to testing and production. It is a manual process (*i.e.*, it does not “orchestrate”)

⁸⁴ Form CO, paragraph 206.

triggered at each step by the individual software developer editing their source code manifest.

- (2) *Cloud Assembly* deploys machines, applications, and services to cloud vendor resources. It is used in conjunction with cloud-templates-as-code, which supports workflow from development to testing to production.
- (3) *vRealize Orchestrator* is a workflow automation platform that automates complex datacentre infrastructure tasks.

(109) Only vRealize Automation also pertains to the sub-market for DSAC.

7.3.1.1.1. Product Market definition

7.3.1.1.1.1. Commission precedents

- (110) In previous decisions, the Commission considered a classification of software products based on functionality, the end-user (enterprise software vs. consumer software), and the specific sector in which the software is used (*e.g.*, healthcare software).⁸⁵ As regards functionality, the Commission considered a division based on: (i) infrastructure software; (ii) middleware; (iii) application software and office software; and (iv) operating/browser software.⁸⁶ Within infrastructure software, the Commission considered the following additional sub-segmentation: (i) security software; (ii) ITOM software; (iii) application development software; and (iv) storage management software.⁸⁷
- (111) In *IBM/Red Hat*⁸⁸, the Commission considered that within System Infrastructure Software⁸⁹, IDC included the secondary markets for (i) Storage⁹⁰; (ii) Physical and Virtual Computing Software; (iii) Network and (iv) Operating Systems.
- (112) In the aforementioned cases, the Commission ultimately left the market definition open and carried out its assessment based on the narrowest market level that either Gartner or IDC provide.⁹¹

7.3.1.1.1.2. The Notifying Party's views

- (113) The Notifying Party submits that customers look for a functionality that fits their needs without adhering to strict categories that do not always reflect market reality.

⁸⁵ Commission decision of 26 June 2011 in case M.6237 – *Computer Science Corporation / iSOFT Group*, paragraphs 22 and 25; Commission decision of 15 December 2014 in case M.7458 – *IBM / INF Deutsche Lufthansa*, paragraph 35; Commission decision of 30 October 2019 in case M.9538 – *Broadcom/Symantec Enterprise Security Business*, paragraph 14.

⁸⁶ Commission decision of 26 June 2011 in case M.6237 – *Computer Science Corporation / iSOFT Group*, paragraph 22; Commission decision of 15 December 2014 in case M.7458 – *IBM / INF Deutsche Lufthansa*, paragraph 35; Commission decision of 30 October 2019 in case M.9538 – *Broadcom/Symantec Enterprise Security Business*, paragraph 15.

⁸⁷ Commission decision of 30 October 2019 in case M.9538 – *Broadcom/Symantec Enterprise Security Business*, paragraph 16.

⁸⁸ Commission decision of 27 June 2019 in case M.9205 – *IBM / Red Hat*, paragraph 12 and section 4.3.

⁸⁹ Although there is no clear correspondence between Gartner and IDC categories, the Notifying Party considers that Gartner's ITOM software corresponds to IDC's System Infrastructure software and its sub-segment System and Service Management software.

⁹⁰ Within the secondary market for Storage, IDC identified the functional market for Software-Defined Storage controller – Form CO, table 16.

⁹¹ Commission decision of 26 June 2011 in case M.6237 – *Computer Science Corporation / iSOFT Group*, paragraph 32; Commission decision of 15 December 2014 in case M.7458 – *IBM / INF Deutsche Lufthansa*, paragraph 42; Commission decision of 30 October 2019 in case M.9538 – *Broadcom/Symantec Enterprise Security Business*, paragraph 25; Commission decision of 27 June 2019 in case M.9205 – *IBM / Red Hat*, paragraphs 9, 117, 128, 135, 145, 153, 161, 169, 176, 185, 204.

Nevertheless, the Notifying Party follows the Commission's precedent that defines software markets by reference to the "sub segments" (Gartner) and "functional markets" (IDC) product classifications based on Gartner and/or IDC and by considering the most granular segmentations available. The Parties consider that the IDC and Gartner classifications, which identify overlaps in product categories based on their internal taxonomy even absent any competitive interaction between the products, conservatively allow the Commission to identify and analyse potentially reportable product markets for the purposes of this Transaction. Nonetheless, the Parties consider the product market definition may be left open.⁹²

7.3.1.1.1.3. The Commission's assessment

- (114) The Commission has not identified any reasons in this case to deviate from its precedents in which it defines the software industry market by reference to functionality and end-users as well as identifies the narrowest possible product markets set out by existing market intelligence reports which have been provided by the Notifying Party, notably Gartner and/or IDC.
- (115) As mentioned above in Section 7.1.1., currently IDC sub-segments the primary market for System Infrastructure Software into the secondary markets for (i) Endpoint Management Software; (ii) Network Software, (iii) Security Software, (iv) Storage Software, (v) Physical and Virtual Computing Software and (vi) System and Service Management Software. IDC segments the secondary market for System and Service Management software into functional markets for: ITACM and ITOM. Within ITACM, IDC identifies a submarket for DSAC. The potential market for System and Service Management software may thus be further segmented on that basis.
- (116) Finally, the market investigation did not suggest alternative product market definition.⁹³

7.3.1.1.1.4. Conclusion

- (117) The Commission considers that, for the purposes of this Decision, the exact product market definition with regard to the supply of System infrastructure software can be left open, as the Transaction would not significantly impede effective competition under the narrowest possible product market definition, for which market share data is available, based on the IDC segmentation.
- (118) In Sections 8.3.4. and 3.3.5., the Commission carries out an assessment on the basis of IDC's ITACM and DSAC market and submarket.

7.3.1.1.2. Geographic market definition

7.3.1.1.2.1. Commission precedents

- (119) In previous decisions, the Commission considered that the relevant geographic market for storage software was worldwide or at least EEA-wide but ultimately left the relevant geographic market open.⁹⁴

⁹² Form CO, paragraph 208.

⁹³ Replies to Q1, questions 4 and 5. The majority of respondents that expressed an opinion use IDC and Gartner reports and consider these are reliable sources for the software sector.

⁹⁴ Commission decision of 27 June 2019 in case M.9205 – *IBM / Red Hat*, paragraphs 110 and 118.

7.3.1.1.2.2. The Notifying Party's views

- (120) The Notifying Party submits that a global market definition may be appropriate, given that competition takes place worldwide, supply chains span the globe, customers purchase from suppliers irrespective of their location, and transport costs and other barriers to trade are low. For the purposes of this notification, the Notifying Party considers the exact geographic market definition can be left open.⁹⁵

7.3.1.1.2.3. The Commission's assessment

- (121) In the market investigation, the Commission has not identified any reasons in this case to deviate from its precedents and considers that, in any event, for the purposes of this Decision, the exact geographic market definition with regard to the supply of supply of System and Service Management software (as well as any potential segmentation of that market) can be left open.

7.3.1.1.2.4. Conclusion

- (122) The Commission considers that, for the purposes of this Decision, the exact geographic market definition with regard to the supply of System Infrastructure software, or any segment thereof, can be left open, as the Transaction would not significantly impede effective competition under the narrowest possible product market definition for which market share data is available, based on the IDC segmentation.

7.3.1.2. Network software

- (123) According to IDC, Network software includes a broad set of networking and communications technologies that are deployed across enterprise, cloud provider, and communication service provider domains. These encompass the software that are primarily deployed to build and support local area or wide area networks for established and emerging applications including voice and video, across enterprise/private and public and fixed and mobile networks.⁹⁶
- (124) IDC divides Network software in 2 functional markets: (i) Network Management software; and (ii) Network Infrastructure software. Network Management software covers products which manage the connectivity, and operating conditions of network infrastructures. They provide visibility and analysis into ongoing network operations and are used to manage and optimize network availability and performance, in addition to providing network configuration, connectivity, automation, deployment, and operational support for network infrastructures. Network Infrastructure software covers products which enable virtualized networking, optimization, orchestration and related network infrastructure functions across enterprise, datacentre, and communication service provider networks. This software can be an alternate deployment model running on commodity hardware while providing networking and/or communications functionality. Network infrastructure software includes software-defined networking software, and application delivery controllers.⁹⁷
- (125) **Broadcom** offers the following CA solutions in the functional market Network Management software: CA NetMaster® Network Automation, CA Spectrum, CA Network Flow Analysis, CA NetMaster® Network Management for TCP/IP, and CA

⁹⁵ Form CO, paragraph 210.

⁹⁶ Form CO, Annex 5 (Horizontals), page 72.

⁹⁷ Form CO, Annex 5 (Horizontals), page 72-73.

NetMaster® Network Management for SNA. A brief description of each product is included below⁹⁸:

- (a) CA NetMaster® Network Automation: NetMaster Network Automation is supplied as part of NetMaster Network Management for SNA. It handles the automation side of network management, by performing actions to keep networks available and distributing network resources. CA NetMaster Network Automation runs only on mainframe environments.
 - (b) CA Spectrum (now called DX Spectrum): this tool is used by organizations' network operations teams to solve network issues. It notices, locates, and solves these issues.
 - (c) CA Network Flow Analysis: this tool monitors network traffic. Monitoring data is then used to analyse how to make the network infrastructure more efficient, which improves the performance of those applications that operate in a network. The result is less network outages and cost efficiencies when the same network can be used for more traffic.
 - (d) CA NetMaster® Network Management for TCP/IP: this product manages networks that follow Transmission Control and Internet Protocols. In particular, the product monitors network resource usage, diagnoses network issues, analyses network performance, traces packets, and provides event history data. The product runs only on mainframe environments.
 - (e) CA NetMaster® Network Management for SNA: the product includes similar functionalities as CA NetMaster Network Management for TCP/IP, but it manages networks for Systems Network Architecture. SNA is IBM's data communication architecture. SNA is an alternative set of message formats for information exchange to those provided by TCP/IP. Similarly to CA NetMaster Network Management for TCP/IP, this product runs only on mainframe environments.
- (126) **VMware** offers the following products in the functional market Network Infrastructure software: NSX Cloud, NSX for Horizon, Software Load Balancer – ADC, VMware HCX, VMware NSX and VMware Software-Defined WAN (SD – WAN) which operate in cloud or virtualized environments. A brief description of each product is included below⁹⁹:
- (a) NSX Cloud enables a virtual cloud network to allow applications to securely network across on-premises datacentres and clouds, endpoints and things for both NSX and native public cloud across virtual networks. NSX Cloud is being discontinued.
 - (b) NSX for Horizon gives each virtual machine their own perimeter defence, thereby preventing malware and other attacks to spread from virtual desktops.
 - (c) Software Load Balancer – ADC, which is NSX Advanced Load Balancer, formerly known as Avi Networks, manages traffic for NSX. It provides multi-cloud load balancing, web application firewall and application analytics across on-premises datacentres and any cloud environment.
 - (d) VMware HCX works with NSX and is used to migrate applications to and between VMware environments. This includes migration of workloads

⁹⁸ Form CO, paragraph 291.

⁹⁹ Form CO, paragraph 293.

between on-premises environments and VMC on AWS and other hyperscaler solutions. HCX can also be used to migrate workloads from KVM and Hyper-V environments to vSphere.

- (e) VMware NSX – including NSX Cloud, NSX for Horizon, Software Load Balancer-ADC (which is NSX Advanced Load Balancer and manages traffic for NSX) – is VMware’s network virtualization and security software. NSX enables users to create and deploy virtual networks independent of the underlying hardware.
- (f) VMware Software-Defined WAN (SD – WAN) is offered together with VMware’s Edge, Orchestrator, and Gateway to deliver virtualized resources to Wide Area Network (“WAN”) connections over both ordinary broadband internet and private links.

7.3.1.2.1. Product market definition

7.3.1.2.1.1. Commissions precedents

- (127) In *IBM/Red Hat*¹⁰⁰, the Commission considered that within System Infrastructure Software, IDC included the secondary markets for (i) Storage;¹⁰¹ (ii) Physical and Virtual Computing software¹⁰²; (iii) Network and (iv) Operating Systems¹⁰³. The Commission considered a possible narrower IDC functional market for Network Management software can be identified but left open the exact product market definition.¹⁰⁴

7.3.1.2.1.2. The Notifying Party’s views

- (128) The Notifying Party submits that all Broadcom products reported under the IDC secondary market Network software are included in the functional market Network Management software and all VMware’s products reported under IDC secondary market Network software belong to the functional market Network Infrastructure software. Therefore, IDC only reports revenue for both Parties in the same market at secondary level (at the lower functional level, revenue for either VMware or Broadcom is reported in two different segments) and this is an artificial overlap.¹⁰⁵ For the purposes of analysing the present Transaction, the Notifying Party provides shares for IDC’s secondary market Network software, as well as for the functional markets Network Infrastructure software, and Network Management software.¹⁰⁶

7.3.1.2.1.3. The Commission’s assessment

- (129) The Commission has not identified any reasons in this case to deviate from its precedents in which it defines the software industry market by reference to functionality and end-users as well as identifies the narrowest possible product

¹⁰⁰ Commission decision of 27 June 2019 in case M.9205 – *IBM / Red Hat*, paragraph 12.

¹⁰¹ Within the secondary market for Storage, the Commission considered that IDC identified the functional market for Software-Defined Storage Controller.

¹⁰² Within the secondary market for Physical and Virtual Computing software, the Commission considered that IDC identified the functional market for Software-Defined Storage Compute and the sub-market for Container Infrastructure Software.

¹⁰³ Within the secondary market for Operating Systems, the Commission considered that IDC identified the functional markets for (i) Server Operating System (paid and unpaid), (ii) and (ii) Server Operating System (paid only).

¹⁰⁴ Commission decision of 27 June 2019 in case M.9205 – *IBM / Red Hat*, paragraph 135.

¹⁰⁵ Form CO, paragraphs 300, 306, 307, 313.

¹⁰⁶ Form CO, paragraph 299.

markets set out by existing market intelligence reports which have been provided by the Notifying Party, notably Gartner and/or IDC.

- (130) As mentioned above in Section 7.1.1., currently IDC sub-segments the primary market for System Infrastructure software into the secondary markets for (i) Endpoint Management software; (ii) Network software, (iii) Security software, (iv) Storage software, (v) Physical and Virtual Computing and (vi) System and Service Management software. IDC segments the secondary market for Network software into functional markets for: Network Management software and Network Infrastructure software. The potential market for Network software may thus be segmented on that basis.
- (131) Finally, the market investigation did not suggest alternative product market definition.¹⁰⁷

7.3.1.2.1.4. Conclusion

- (132) The Commission considers that, for the purposes of this Decision, the exact product market definition with regard to the supply of Network software can be left open, as the Transaction would not significantly impede effective competition under any potential product market definition, for which market share data is available, based on the IDC segmentation.
- (133) Given that there is no overlap between the Parties' activities in Network Management software and Network Infrastructure software, in Section 8.2.2.2., the Commission carries out an assessment on the basis of IDC's Network software market.

7.3.1.2.2. Geographic market definition

7.3.1.2.2.1. Commissions precedents

- (134) In *IBM/RedHat*¹⁰⁸, the Commission considered that the market for Network Management software is at least EEA-wide, if not global, but ultimately left open the exact geographic market definition.

7.3.1.2.2.2. The Notifying Party's views

- (135) For the purposes of analysing the present Transaction, the Notifying Party provides shares at both worldwide and EEA levels for IDC's secondary market Network software, as well as for the functional markets Network Infrastructure software, and Network Management software.¹⁰⁹

7.3.1.2.2.3. The Commission's assessment

- (136) In the market investigation, the Commission has not identified any reasons in this case to deviate from its precedents and considers that, in any event, for the purposes of this Decision, the exact geographic market definition with regard to the supply of Network software (as well as any potential segmentation of that market) can be left open.

7.3.1.2.2.4. Conclusion

- (137) The Commission considers that, for the purposes of this Decision, the exact geographic market definition with regard to the supply of Network software, or any

¹⁰⁷ Replies to Q1, questions 4 and 5. The majority of respondents that expressed an opinion use IDC and Gartner reports and consider these are reliable sources for the software sector.

¹⁰⁸ Commission decision of 27 June 2019 in case M.9205 – *IBM/RedHat*, paragraph 136.

¹⁰⁹ Form CO, paragraph 299.

segment thereof, can be left open, as the Transaction would not significantly impede effective competition under any potential product market definition, for which market share data is available, based on the IDC segmentation.

7.4. Virtualization software

(138) **Broadcom** does not offer any virtualization software.

(139) **VMware** offers several products that virtualize computer hardware (compute, networking and storage). VMware's server virtualization software, vSphere, consists of two components: ESXi and vCenter Server. ESXi is VMware's hypervisor, *i.e.*, the specialized OS which deploys virtual machines and runs directly on server hardware. vCenter Server allows the deployment and management of virtual machines across clusters of ESXi servers. VMware currently provides server virtualization for x86 systems only. VMware's network virtualization and security software is NSX, which enables users to create and deploy virtual networks independent of the underlying hardware. Finally, vSAN is VMware's storage virtualization technology.

(140) VMware also provides containerization software technology, called Tanzu. This is a suite of products that helps customers develop, deploy and manage containers. Tanzu Kubernetes Grid (container runtime that can be deployed across multiple environments such as on-premises, physical, virtual and cloud) is included in vSphere.

7.4.1. Product market definition

7.4.1.1. Commission precedents

(141) In previous decisions, the Commission considered a segmentation of software based on (i) the different functionalities of the software and the sector concerned, and (ii) the end uses offered by that particular software.¹¹⁰ As regards functionality, the Commission found that distinctions in the software industry are generally made between (i) infrastructure software (*i.e.*, servers and databases); (ii) middleware (*i.e.*, integration platforms); (iii) application software and office software; and (iv) operating/browser software.¹¹¹ In its decision in *Oracle / Sun Microsystems*, the Commission considered a further segmentation of middleware into, among other things, virtualization software.¹¹² However, the precise market definition was ultimately left open.

(142) In *Dell / EMC*¹¹³, the majority of market respondents confirmed that virtualization software should be considered as a separate market within middleware. Virtualization software has different functions and characteristics to traditional middleware.¹¹⁴ Middleware focuses on application stacks, such as application servers, enterprise service bus and other service-oriented architecture, and has a greater functionality and features.¹¹⁵

¹¹⁰ Commission decision of 26 June 2011 in case M.6237 – *Computer Science Corporation / iSOFT Group*, paragraph 22; Commission decision of 15 December 2014 in case M.7458 – *IBM / INF Deutsche Lufthansa*, paragraph 42.

¹¹¹ Commission decision of 29 February 2016 in case M.7861 – *Dell / EMC*, paragraph 54.

¹¹² Commission decision of 21 January 2010 in case M.5529 – *Oracle / Sun Microsystems*, paragraph 769.

¹¹³ Commission decision of 29 February 2016 in case M.7861 – *Dell / EMC*, paragraph 62.

¹¹⁴ Commission decision of 29 February 2016 in case M.7861 – *Dell / EMC*, paragraph 63.

¹¹⁵ Commission decision of 29 February 2016 in case M.7861 – *Dell / EMC*, paragraph 63.

- (143) The Commission considered a further segmentation based on the hardware or other components with which the virtualization software is paired (*e.g.*, servers, storage systems, networking and desktop).¹¹⁶ On the one hand, such segments of the market for virtualization software have a strong hardware affinity and typically follow the market dynamics of each of those components.¹¹⁷ On the other hand, virtualization software products, which are functional across servers, storage, networking, and desktop products all share common concepts, and may at times have overlapping capabilities.¹¹⁸ The precise market definition was ultimately left open.¹¹⁹
- (144) Furthermore, the Commission considered whether containerization technologies belong to a separate product market.¹²⁰ The respondents to the market investigation indicated that containers deliver a different type of virtualization compared to traditional virtual machine-based software. The two technologies are not functionally interchangeable as they have different fundamental features and functionalities. Therefore, containers should not be considered as part of the same product market.¹²¹ The Commission ultimately left the precise market definition open.¹²²
- (145) The market investigation in *Dell / EMC* did not specifically test the question whether the market for virtualization software could be further segmented based on deployment environments (*i.e.*, on-premises, private cloud and public cloud).
- (146) In *IBM / Red Hat*,¹²³ the Commission again considered the existence of a separate market segment for containerization technologies. Notably, the Commission contemplated the applicability of an International Data Corporation (“IDC”) report which defined three submarkets within the functional market for Software Defined Compute Software: (i) Container Infrastructure Software; (ii) Virtual Machine Software; and (iii) Cloud System Software. While the Commission considered that a market for Container Infrastructure Software in line with *Dell / EMC* and IDC’s segmentation could be identified, it ultimately left the exact product market definition open.

7.4.1.2. The Notifying Party’s views

- (147) The Notifying Party considers that the market for virtualization software is a separate software market comprising all virtualization software independent of its underlying components or hardware, its deployment environment, and its open source or proprietary nature. The market excludes containerization software.
- (148) The Notifying Party sets out that virtualization software can be understood to form part of two broader markets: (i) the Middleware market, and (ii) the market for Operating Systems (“OS”).¹²⁴ However, the Middleware market is too broad to constitute a product market in its own right, and, while a hypervisor can be seen as a specialised OS, it does not function as a substitute for general server OS.¹²⁵

¹¹⁶ Commission decision of 29 February 2016 in case M.7861 – *Dell / EMC*, paragraphs 64 and 65.

¹¹⁷ Commission decision of 29 February 2016 in case M.7861 – *Dell / EMC*, paragraph 64.

¹¹⁸ Commission decision of 29 February 2016 in case M.7861 – *Dell / EMC*, paragraph 65.

¹¹⁹ Commission decision of 29 February 2016 in case M.7861 – *Dell / EMC*, paragraph 71.

¹²⁰ Commission decision of 29 February 2016 in case M.7861 – *Dell / EMC*, paragraph 66.

¹²¹ Commission decision of 29 February 2016 in case M.7861 – *Dell / EMC*, paragraph 67.

¹²² Commission decision of 29 February 2016 in case M.7861 – *Dell / EMC*, paragraph 71.

¹²³ Commission decision of 27 June 2019 in case M.9205 – *IBM / Red Hat*, paragraphs 126 and 128.

¹²⁴ Form CO, paragraph 473.

¹²⁵ Form CO, paragraph 473.

- (149) The Notifying Party submits that there is no segmentation based on underlying component or hardware (*e.g.*, server, storage, network, desktop) because vendors often sell virtualization software for installation on generally available servers offered by multiple vendors rather than associated with any particular underlying hardware device or component inside the servers.¹²⁶ VMware's vSphere, for example, must virtualize or manage all hardware devices that interact with the guest OS.
- (150) The Notifying Party further submits that no distinction should be made between proprietary and open-source software.¹²⁷ This is because there is no meaningful distinction between proprietary and open-source software, as some vendors license proprietary tools with virtualization software but continue to make the virtualization software's source code freely available.¹²⁸ Furthermore, many customers switch away from VMware's proprietary virtualization software to open-source software.¹²⁹
- (151) In the view of the Notifying Party, the market should not be segmented on the basis of deployment environment.¹³⁰ Accordingly, the market for virtualization software includes CSPs' virtualization layers.
- (a) When transferring workloads to a cloud, customers can generally choose between (i) running the workloads on top of VMware's virtualization software on that cloud, and (ii) running the workloads on top of the CSP's own virtualization software. Conversely, CSPs are increasingly offering customers the ability to run CSPs' virtualization software on servers residing on customers' own datacentres.¹³¹ According to the Notifying Party, there is no material difference between virtualization of workloads on servers that are located on-premises and those on servers that are located off-premises.¹³²
 - (b) In its Article 6(1)(c) Response, the Notifying Party considers that there is no separate market for server virtualization software limited to (i) on-premises or (ii) on-premises and private cloud deployment. In the view of the Notifying Party, there are no changes in competitive dynamics since *Dell / EMC* justifying a segmentation based on deployment environments.¹³³ On the contrary, since *Dell / EMC*, the cost of migrating workloads to another deployment environment has declined, and the scope of (public) cloud-based workloads has only increased.¹³⁴
 - (c) The Notifying Party further considers that the alleged difficulties in switching workloads to public cloud are not supported by the market investigation or business reality. Customers across industries can (and do) deploy workloads on-premises, in the private and the public cloud as part of their hybrid multi-home strategy. According to the Notifying Party, any putative reluctance of a subset of customers to move certain workloads to public clouds will continue to be eroded by technological developments.¹³⁵

¹²⁶ Form CO, paragraph 474.

¹²⁷ Form CO, paragraph 476.

¹²⁸ Form CO, paragraph 476.

¹²⁹ Form CO, paragraph 477.

¹³⁰ Form CO, paragraph 478.

¹³¹ Form CO, paragraph 478.

¹³² Form CO, paragraph 479.

¹³³ Article 6(1)(c) Response, paragraph 31.

¹³⁴ Article 6(1)(c) Response, paragraph 37.

¹³⁵ Article 6(1)(c) Response, paragraph 38

- (d) The Notifying Party also submits in its Article 6(1)(c) Response that virtualization software providers are active in the cloud (with own cloud offerings or with solutions used in public cloud) and, importantly, cloud providers directly compete with on-premises solutions.¹³⁶
 - (e) In the SO Response, the Notifying Party further argues that the Commission's preliminary market definition excluding public cloud is based on an incorrect interpretation of the small but significant non-transitory increase in price ('SSNIP') test, as it is premised on customers needing to switch *all* workloads away for the market to include public cloud. According to the Notifying Party, the relevant economic and legal question should be whether customers would switch away *enough* workloads to counter a hypothetical price increase or quality degradation in the candidate market.
 - (f) In addition, the Notifying Party argues in its SO Response that considerations such as security are no longer barriers to switching workloads to the public cloud.
 - (g) Furthermore, the Notifying Party argued in the SO Response that the Commission's preliminary assessment ignores the impact of hybrid-cloud and multi-homing and overstates difficulties of switching workloads away from VMware.
- (152) Finally, the Notifying Party submits that containerization should be excluded from the market definition, given the lack of relevant third party data.¹³⁷ This does not imply the lack of substitutability between containers and virtual machines.¹³⁸ According to the Notifying Party, the availability of containers is an important and growing constraint on virtualization software and ought to be taken into account in assessing competition.¹³⁹ In any event, for the purposes of the present Decision, the Notifying Party does not consider that it is necessary for the Commission to conclude whether containerization technologies form a stand-alone market.¹⁴⁰

7.4.1.3. The Commission's assessment

1.1.1.1.1. Virtualization and containerization software

- (153) The market investigation aimed to verify whether container technology can be considered as belonging to a separate product market than virtualization software, taking into account demand and supply-side substitutability and main features.
- (154) The responses to the market investigation indicated that containers, while they can constitute an alternative for specific use cases, deliver a different type of virtualization than traditional virtualization software. The two technologies are not considered functionally interchangeable, as they have different features and functionalities. For certain use cases, they can be considered complementary, and they are often used in combination with virtualization software.
- (155) From a demand-side perspective, the majority of respondents expressing an opinion submitted that containers constitute an alternative for some of their workloads and

¹³⁶ Article 6(1)(c) Response, paragraph 41.

¹³⁷ Form CO, paragraph 480.

¹³⁸ Form CO, paragraph 481.

¹³⁹ Form CO, paragraph 482.

¹⁴⁰ Form CO, paragraph 484.

applications, but not for all.¹⁴¹ Several respondents indicated that virtualization software was better-suited for “*complete, monolithic*”¹⁴², “*mission critical*”¹⁴³, and “*legacy*”¹⁴⁴ applications, whereas containerization is mainly used for “*micro services-based applications*”¹⁴⁵ and “*workloads requiring elasticity and scale, rapid development and delivery, and multi-cloud portability*”.¹⁴⁶ One respondent explained that “[t]he security guarantees provided by container virtualization are still considered inferior to the guarantees provided by full OS virtualization, so in some cases customers may not view container virtualization as a technical replacement for OS virtualization.”¹⁴⁷ Notably, one respondent remarked that “*those two technologies are targeted on different scenarios with different technology stack. So, the products’ characteristics, price and end-customers’ demand are quite different.*”¹⁴⁸

- (156) Several respondents also considered that containerization is complementary to virtualization software.¹⁴⁹ For example, according to one respondent, “[c]ontainerization is often implemented on top of virtualization to take advantage of sophisticated compute, network and storage management capabilities provided by virtualization [containerization on bare-metal servers is also possible].”¹⁵⁰
- (157) Further, several respondents explained that the costs of migrating virtualized workloads to containers would be significant. As explained by one respondent, “[n]ot all applications can be containerized without rewriting them and hence not every application that is virtualized today can be easily containerized”.¹⁵¹ Another respondent stated that “*there is no business case for [migrating existing applications from virtual machines on to containers] as it is high cost to slice existing monolithic software codes currently developed on VM so that they can fit into containers.*”¹⁵²
- (158) From a supply-side perspective, the majority of respondents expressing a substantiated opinion indicated that, while a virtualization software provider could easily switch to develop containerization software, a switch from containerization software to virtualization software was not easily done, as it would require a significant investment.¹⁵³ One respondent highlighted that “*all of this tooling is*

¹⁴¹ Replies to Q2 – questionnaire to virtualization software competitors of VMware, question 4; replies to Q4 – questionnaire to customers of VMware and Broadcom, question 5.

¹⁴² Replies to Q2 – questionnaire to virtualization software competitors of VMware, questions 4.1 [ID 1418].

¹⁴³ Replies to Q2 – questionnaire to virtualization software competitors of VMware, questions 4.1; replies to Q4 – questionnaire to customers of VMware and Broadcom, question 5.1.

¹⁴⁴ Replies to Q2 – questionnaire to virtualization software competitors of VMware, questions 4.1; replies to Q4 – questionnaire to customers of VMware and Broadcom, question 5.1.

¹⁴⁵ Replies to Q2 – questionnaire to virtualization software competitors of VMware, question 4.1 [ID 1418].

¹⁴⁶ Replies to Q2 – questionnaire to virtualization software competitors of VMware, questions 4.1 [ID 1906]; replies to Q4 – questionnaire to customers of VMware and Broadcom, question 5.1 [ID 1909].

¹⁴⁷ Replies to Q2 – questionnaire to virtualization software competitors of VMware, question 4.1 [ID 1841].

¹⁴⁸ Replies to Q2 – questionnaire to virtualization software competitors of VMware, question 4.1 [ID 1415].

¹⁴⁹ Replies to Q2 – questionnaire to virtualization software competitors of VMware, question 4.1; replies to Q4 – questionnaire to customers of VMware and Broadcom, question 5.1.

¹⁵⁰ Replies to Q2 – questionnaire to virtualization software competitors of VMware, questions 4.1 [ID 1906].

¹⁵¹ Replies to Q2 – questionnaire to virtualization software competitors of VMware, questions 4.1 [ID 1761].

¹⁵² Replies to Q4 – questionnaire to customers of VMware and Broadcom, question 5.1 [ID 1517].

¹⁵³ Replies to Q2 – questionnaire to virtualization software competitors of VMware, question 5.

*significantly different than the tooling you need to run and manage virtual machines; it's a different way of thinking about the problem. [...] there would be very little overlap in the expertise".*¹⁵⁴

- (159) In light of the above, for the purposes of this Decision, the Commission concludes that containerization software does not belong to the market for virtualization software. The Commission will not assess the potential separate market for containerization software, as it considers that the Transaction will likely not significantly impede effective competition on this potential market.¹⁵⁵

7.4.1.3.2. Segmentation based on hardware or underlying component

- (160) The Commission's market investigation tested whether the market for virtualization software should be further segmented according to the underlying hardware or other components it is paired with (e.g., servers, networking, storage systems and desktop).
- (161) From a demand-side perspective, the majority of respondents expressing an opinion considered that server, storage, network, and desktop virtualization software are not comparable in terms of product characteristics, price, and intended use.¹⁵⁶ Customers indicated that *"storage and network virtualization do not and cannot replace server virtualization"*, *"[t]hey are different element"*¹⁵⁷ and *"[t]hese are complete different technologies responding to very different needs"*.¹⁵⁸
- (162) From a supply-side perspective, the majority of respondents expressing an opinion considered that a virtualization software provider could not switch easily between developing server, storage, network or desktop virtualization software.¹⁵⁹ As explained by one respondent, *"the actual technology behind server virtualization is completely different and is *significantly* more complex. The only feasible way for a network or storage virtualization company to create a server virtualization product, without hiring a completely new team and spending years of development, would be to take an open-source server virtualization software, like KVM or Xen, and incorporating it into their product. Even then, they would still need to gain enough expertise to adapt the open-source solutions, and track down performance and functional issues."*¹⁶⁰ Another respondent explained that *"[e]ach of server, storage, network and desktop is a different layer of the compute stack that supports a given application. [...] Each layer of this stack is a distinct kind of software; they are not interchangeable with each other and need to be present and working together for the application to get what it needs to operate."*¹⁶¹
- (163) In light of the above, for the purposes of this Decision, the Commission concludes that within a broader market for virtualization software, there is a narrower relevant product market for server virtualization software.

¹⁵⁴ Replies to Q2 - questionnaire to virtualization software competitors of VMware, question 5.1 [ID 1550].

¹⁵⁵ VMware's container technology runs on top of VMware's hypervisor. When VMware's container software is taken into consideration separately (not including VMware's hypervisor and virtualization software), there is no conglomerate link between containers and Broadcom's hardware.

¹⁵⁶ Replies to Q2 – questionnaire to virtualization software competitors of VMware, question 6; replies to Q4 – questionnaire to virtualization software competitors of VMware, question 6.

¹⁵⁷ Replies to Q4 – questionnaire to customers of VMware and Broadcom, question 6.1 [ID 4265].

¹⁵⁸ Replies to Q4 – questionnaire to customers of VMware and Broadcom, question 6.1 [ID 1517].

¹⁵⁹ Replies to Q2 – questionnaire to virtualization software competitors of VMware, question 7.

¹⁶⁰ Replies to Q2 – questionnaire to virtualization software competitors of VMware, question 7.1 [ID 1550].

¹⁶¹ Replies to Q2 – questionnaire to virtualization software competitors of VMware, question 6.1 [ID 1832].

7.4.1.3.3. Segmentation based on deployment environment

- (164) The market investigation aimed to verify whether the market for virtualization software could be segmented according to the environment in which the software is deployed (*i.e.*, on-premises, private cloud, or public cloud). The market investigation in *Dell / EMC* did not specifically address this possible segmentation.
- (165) The Commission's market investigation showed that server virtualization software for the public cloud should not be included in the same market as the market for server virtualization software for on-premises and private cloud deployments.
- (166) First, with respect to the distinction between on-premises and private cloud, several respondents to the market investigation indicated that they do not draw a clear distinction between on-premises and private cloud deployments, as opposed to the public cloud.¹⁶² Customers explained that the only difference between on-premises and private cloud was the way in which the workloads were accessed, *i.e.*, as a service over the internet from a centrally managed datacentre (private cloud), as opposed to managing its own IT infrastructure (on-premises). However, this distinction between on-premises and private cloud is relatively blurry especially in situations where private clouds are hosted by the customer itself (rather than by another service provider which manages and hosts the private cloud). For instance, KPN indicated: "*KPN's private cloud is managed by KPN itself and therefore constitutes on-premises deployment*".¹⁶³ Another customer explained that it "*never really distinguishes between private cloud and on-premises. For the most part, private cloud refers to systems that are hosted by another service provider. If Siemens directly manages the private clouds, private cloud and on-premises differ mainly in the way in which they are accessed.*"¹⁶⁴ The distinction drawn by respondents to the Commission's market investigation is rather between, on the one hand, on-premises and private cloud environments where services are completely controlled by a single organisation and not shared with others, and, on the other hand, public cloud services where enterprise data and applications reside in an environment shared with other organisations.
- (167) Second, despite the industry's trend (as set out above in Section 6) that end-customers currently tend to mix-and-match the environments in which they run their workloads and applications, thus creating a type of "hybrid cloud", the Commission's market investigation indicated that market respondents still distinguish between on-premises and private cloud on the one hand, and public cloud on the other hand. The majority of respondents expressing an opinion emphasise that such mix-and-matching is only possible for certain types of their applications or workloads.¹⁶⁵ In particular, the market investigation shows that most customers of virtualization software **do not consider public cloud as a suitable alternative for on-premises or private cloud workloads in the short run, or only for some workloads, or not at all**. For instance, one government entity indicated that 80-90% of its applications were not fit for the public cloud and would therefore remain on-

¹⁶² Agreed minutes of call with Airbus dated 9 February 2023 [ID 4074]; Agreed minutes of call with E.ON dated 13 February 2023 [ID 4050]; Agreed minutes of call with Nokia dated 22 February 2023 [ID 4157], Agreed minutes of call with KPN dated 16 February 2023 [ID 4047]; Agreed minutes of call with Siemens dated 27 February 2023 [ID 4079].

¹⁶³ Agreed minutes of call with KPN dated 16 February 2023 [ID 4047].

¹⁶⁴ Agreed minutes of call with Siemens dated 27 February 2023 [ID 4079].

¹⁶⁵ Replies to Q2 – questionnaire to virtualization software competitors of VMware, question 8; replies to Q4 – questionnaire to customers of Broadcom and VMware, question 7.

premises.¹⁶⁶ Customers indicated that they consider that certain workloads, including mission-critical and legacy workloads, cannot be migrated to public cloud. They also pointed to security, data privacy and data sovereignty considerations and contractual obligations as a reason to keep workloads on-premises or in the private cloud.

- (168) With regard to mission-critical applications, one customer stated: “We will continue to use on-premises or private cloud for mission critical information/application and some development environment”.¹⁶⁷ Another customer submitted that for some workloads, the nature of certain needs was such that these workloads would not be migrated to the public cloud: “Mission critical applications and time critical applications remain on-premise. We also tend to keep legacy applications as well as R&D related and lab workloads on premise due to cheaper price and capabilities.”¹⁶⁸
- (169) With regard to legacy applications, customers indicated that old legacy applications require dedicated infrastructure, which is often uneconomical in a public cloud model.
- (170) One customer further stated that many applications “are highly personalised [...] and therefore difficult to migrate from on-premises deployment into a standardized public cloud environment. Some of them may eventually be reprogrammed to run on the public cloud but not all.”¹⁶⁹ In addition, some workloads require lower latency and higher performance (i.e., a quick and efficient access to network elements) that is not available in the public cloud. For instance, Vodafone indicated: “While Vodafone monitors benchmarks for public cloud vendors, some workloads for the core networking functions are not suitable for the public cloud at this stage. To date, there is no public cloud offering that could fulfil Vodafone’s needs in terms of performance, low latencies, and geographical placement.”¹⁷⁰
- (171) For customers that would consider moving some of their workloads to the public cloud, the majority indicate that barriers to switching to the public cloud are high. These barriers to switching include the **need to redesign older applications, increased costs, business risk and time to transition**. One customer noted that “Existing applications would need to be refactored to be migrated from on-premises to the public cloud – Deutsche Telekom refers to this as “application modernization”. [Confidential]. To be susceptible to migration, older, e.g., Java-based, applications would be refactored into a Tanzu environment.”¹⁷¹ The same customer further explained: “[Many legacy applications] are highly personalised [confidential] and therefore difficult to migrate from on-premises deployment into a standardized public cloud environment. Some of them may eventually be reprogrammed to run on the public cloud but not all.”¹⁷² This is [...] by VMware’s internal documents that [Details of internal document describing migration of workloads to the public cloud]. VMware also notes that the public cloud “[Details of internal document comparing the public and private cloud].”¹⁷³

¹⁶⁶ Agreed minutes of call with ITZBund dated 15 February 2023 [ID 4057] (working translation from German).

¹⁶⁷ Replies to Q4 – questionnaire to customers of VMware and Broadcom, question 7.1 [ID 1713].

¹⁶⁸ Replies to Q4 – questionnaire to customers of VMware and Broadcom, question 7.1 [ID 1563].

¹⁶⁹ Agreed minutes of call with Deutsche Telekom dated 14 February 2023 [ID 4096].

¹⁷⁰ Agreed minutes of call with Vodafone dated 10 February 2023 [ID 3988].

¹⁷¹ Agreed minutes of call with Deutsche Telekom dated 14 February 2023 [ID 4096].

¹⁷² Agreed minutes of call with Deutsche Telekom dated 14 February 2023 [ID 4096].

¹⁷³ CMA document, [Confidential –VMware’s internal documents], page [...].

- (172) Several customers also pointed to **security, data privacy and data sovereignty considerations, including under national laws and regulations** requiring some workloads to be maintained on-premises or on private cloud, as opposed to the public cloud.¹⁷⁴ One customer noted that the decision to use on-premises or private cloud infrastructure is “*often based on security considerations.*”¹⁷⁵ Airbus indicated that “*Airbus does not have an authorization from public authorities to move highly confidential information (e.g. where data is classified under export control or as military restricted) to the public cloud. [...] As a consequence, Airbus continues to rely on private cloud and on-premises infrastructure for this type of data.*”¹⁷⁶ Similarly, E.ON noted that “*not all workloads currently deployed in its own datacentres on-premises will be migrated to the public cloud: E.ON will retain one supplier-managed private cloud environment where it will keep some workloads (e.g. business critical applications which are not supported in public cloud, regulated data and certain physical assets where E.ON entity ownership is required by state law) in the short to medium term. This data notably includes ‘Black Data’, i.e., data that, by virtue of local regulations, must be hosted in the territory of the state in question.*”¹⁷⁷ In relation to security risks, one customer indicated that some security risks linked to the public cloud could be avoided on-premises or in the private cloud.¹⁷⁸
- (173) Some customers also explained that some of their workloads cannot be migrated to the public cloud as a result of **contractual obligations** to keep their customers’ data in their own datacentres.¹⁷⁹
- (174) Third, with regard to the public cloud environment, all major CSPs offer cloud-based infrastructure, which uses the CSP’s own underlying “native” virtualization software to provide virtual-machines to customers on-demand. CSPs’ cloud-based infrastructure customers typically cannot access or manage the CSPs’ virtualization software, including its hypervisor, and can only request access to on-demand virtual machines that are created by the CSPs’ virtualization software.¹⁸⁰ This is very different from an on-premises or private cloud environment for which organisations require IT teams with technical expertise on the virtualization software. This is one of the distinguishing features between the on-premises and private cloud environments as opposed to the public cloud environments of several CSPs.
- (175) However, the large majority of respondents expressing an opinion considered it important to use and manage the virtualization software they purchase directly (themselves or via a third party, either for all or at least for some types of applications or workloads), as opposed to not having direct access to or being able to manage the native virtualization software that is part of the core public cloud-based infrastructure.¹⁸¹ As explained by one respondent, “*most customers expect [a] certain*

¹⁷⁴ Replies to Q4 – questionnaire to customers of Broadcom and VMware, question 7.1.

¹⁷⁵ Replies to Q4 – questionnaire to customers of VMware and Broadcom, question 7.1 [ID 1800].

¹⁷⁶ Agreed minutes of call with Airbus dated 9 February 2023 [ID 4074].

¹⁷⁷ Agreed minutes of call with E.ON dated 13 February 2023 [ID 4050].

¹⁷⁸ Agreed minutes of call with Deutsche Telekom dated 14 February 2023 [ID 4096].

¹⁷⁹ Agreed minutes of call with Siemens dated 27 February 2023 [ID 4079].

¹⁸⁰ Form CO, paragraph 444. Note that some CSPs do also offer virtualization software directly to customers as a business, separate from their core cloud-based infrastructure offering.

¹⁸¹ Replies to Q2 – questionnaire to virtualization software competitors of VMware, question 9; replies to Q4 – questionnaire to customers of Broadcom and VMware, question 8.

level of operational control and access to support their unique needs”¹⁸² and, without access, “they would have to rely on either default configurations or maybe one or two templates which would very likely not meet the requirements of diversity of applications that they have.”¹⁸³

- (176) Fourth, the majority of customers that expressed an opinion to the Commission’s market investigation indicated that, if the price of (proprietary) virtualization software were to go up 5-10% or the quality of the software decreased, they would not be able to switch away from their on-premises solution for all their workloads and applications.¹⁸⁴ One respondent indicated that “[g]iven many other factors that go into this decision, an increase of 5 to 10% – all else being equal – may not be material enough for some customers to justify the moving costs, the modification of or a departure from an established multi-year plan, and the re-training and re-skilling to move several workloads to the public cloud”.¹⁸⁵ Among the respondents that did indicate that customers would switch, the majority indicated that they would switch to a hybrid cloud environment (i.e., a mix of on-premises, private and public cloud environments).¹⁸⁶
- (177) Fifth, contrary to the Notifying Party’s claims, VMware’s Workloads Study in fact shows [Details on VMware’s study on workload migration to the public cloud].¹⁸⁷ The Workloads Study also shows that [Details on VMware’s study assessing types of workloads].¹⁸⁸ As set out below in Section 8.4.3.2.1.2.3., [Other confidential information – Concerns VMware’s internal documents] the substitutability between on-premises and private cloud on the one hand, and the public cloud on the other hand is limited.
- (178) Sixth, while the Commission has not carried out a quantitative SSNIP test in the SO and is not obliged to carry out such an assessment¹⁸⁹, the Notifying Party’s argument that the Commission’s market definition excluding public cloud is based on an incorrect interpretation of the SSNIP test is unconvincing and does not disprove the finding on the relevant market, for the reasons mentioned in the following paragraphs.¹⁹⁰

¹⁸² Citrix’s non-confidential reply to Q2 – questionnaire to virtualization software competitors of VMware, question 9.1 [ID 1761].

¹⁸³ Replies to Q2 – questionnaire to virtualization software competitors of VMware, question 9.1 [ID 1832].

¹⁸⁴ Replies to Q4 – questionnaire to customers of Broadcom and VMware, question 9.

¹⁸⁵ Replies to Q2 – questionnaire to virtualization software competitors of VMware, question 10.1 [ID 1832].

¹⁸⁶ Replies to Q2 – questionnaire to virtualization software competitors of VMware, question 10.2; replies to Q4 – questionnaire to customers of Broadcom and VMware, question 9.2.

¹⁸⁷ Annex 69 (Conglomerate) to the Form CO, slide 19.

¹⁸⁸ Annex 69 (Conglomerate) to the Form CO, slide 9.

¹⁸⁹ In its judgment of 11 January 2017, *Topps Europe v Commission*, T-699/14, EU:T:2017:2, paragraph 82, the General Court stated: “*The Commission did not [...] commit a manifest error of assessment in basing its conclusions on the relevant market on its assessment of the evidence gathered without having recourse to an SSNIP test*”. Similarly, with respect to geographic market definition, in its judgment of 5 October 2020, *HeidelbergCement and Schwenk Zement v Commission*, T-380/17, EU:T:2020:471, paragraph 331, the General Court noted that: “*As the Commission rightly notes in paragraph 143 of the defence, the ‘SSNIP test’ is not the only method available to it when defining the relevant geographic markets.*” See also the judgment of the General Court of 22 June 2022, *thyssenkrupp v Commission*, T-584/19, EU:T:2022:386, paragraphs 76 and 155, as well as the EFTA Court judgment of 5 May 2022 in Case E-12/20, *Telenor and Telenor Norge v EFTA Surveillance Authority*, paragraph 95.

¹⁹⁰ Parties’ Post-Oral Hearing submission of 9 May 2023, page 2; SO Response, paragraphs 85, 86, 88, 96, 97.

- (179) In the first place, while the Notifying Party correctly points out that the hypothetical monopolist need not lose all of its customers (or workloads) to virtualization solutions deployed on public cloud for a SSNIP to be unprofitable, this hypothetical monopolist can be thought of as the result of a hypothetical merger between all virtualization software solutions for deployments on-premises and on private cloud. In other words, when applied relative to current market conditions the SSNIP test is equivalent to asking whether a hypothetical merger to monopoly in the candidate market, *i.e.*, a merger that would eliminate all horizontal competition between suppliers of virtualisation software providers for deployments on-premises or on private cloud, would lead to (at least) a SSNIP. A finding that such a merger to monopoly would lead to a SSNIP does not imply or require that public cloud solutions exert no competitive constraint on the resulting hypothetical monopolist. It simply requires that even taking into account the competitive constraints from public cloud solutions (*i.e.*, taking account of switching, in full or in part, by customers to public cloud solutions) a price increase of as little as 5-10% would be profitable for the resulting hypothetical monopolist. The Notifying Party’s argument that “*the majority of respondents would switch or consider switching away some or all of their workloads*”¹⁹¹ does hence not imply that a SSNIP by a hypothetical monopolist would be unprofitable also for this point.
- (180) In the second place, where the observed percentage margins are already high, a SSNIP-test tends to lead to narrow relevant markets. While a high observed percentage margin implies that losing an individual customer or workload is relatively costly, it also implies that only relatively few customers would change virtualization solution in case of a price increase. In other words, high observed margins imply that own price elasticities of firms in the market are low, because otherwise firms would find it profitable to lower their price to attract more customers. The net effect is that the higher the observed margins, the fewer customers would switch away from each firm in the market following a price increase and hence the lower the proportion of such switching customers that would need to be recaptured by the hypothetical monopolist via other products in the candidate market for a SSNIP to be profitable. As discussed in Section 8.4.3.2., VMware’s margin [Business secret – margin calculation]%. This implies that a SSNIP would be profitable unless a very high proportion of switching customers would switch to products outside of the market instead of switching from one product within the candidate market to other products within the candidate market. The Notifying Party’s argument that “*the majority of workloads that customers would switch away from VMware in response to a foreclosure strategy would actually switch to the public cloud (and this share is actually greater than the share that would switch to on-premises providers)*”¹⁹² does hence not imply that a SSNIP would be unprofitable.¹⁹³

¹⁹¹ Parties’ Post-Oral Hearing submission of 9 May 2023, page 2.

¹⁹² Parties’ Post-Oral Hearing submission of 9 May 2023, page 2.

¹⁹³ The Notifying Party’s argument that the Commission has advanced a “novel suggestion” at the Oral Hearing that “high margins [can] replace the SSNIP test as a tool to delineate markets” (see Parties’ Post-Oral Hearing submission of 9 May 2023, page 2) misses the Commission’s point. An assessment of margins does not replace the SSNIP test. But margins are an integral part of evaluating the profitability of a price increase (relative to the appropriate benchmark price) for the hypothetical monopolist and hence of the SSNIP test. High margins also imply that a SSNIP would still be profitable even when recapture rates are relatively low, that is, even when a relatively large proportions of switching customers would switch to solutions outside the candidate market.

- (181) In the third place, applying a SSNIP-test starting from observed prices in the context of a conglomerate merger may bias the conclusions towards a finding of wide, not narrow, relevant markets. This is simply because the prevailing market price may already reflect the exercise of market power to a point where further price increases by the hypothetical monopolist are less profitable or unprofitable.¹⁹⁴ This likely bias in the SSNIP-test towards the finding of a wider market casts further doubt on the Notifying Party's argument that the candidate market cannot form a relevant anti-trust market.
- (182) Therefore, the Commission disagrees with the Notifying Party's argument that the Commission's assessment is based on an incorrect interpretation of the SSNIP test¹⁹⁵.
- (183) Finally, from a supply-side perspective, on the one hand, a majority of respondents expressing an opinion in the market investigation indicated that a virtualization software provider could easily switch between developing virtualization software for the on-premises environment and the private cloud environment, but to offer virtualization software for the public cloud environment is more difficult.¹⁹⁶ Some respondents indicated that this would not be possible.¹⁹⁷ As explained by one respondent, “[a]dapting on-premises virtualization software to public cloud requires addressing business and technical constraints imposed by the public cloud provider as well as integrating with cloud provider services. Additionally, changes may be required for licensing models, consumption-based as-a-service pricing, support, and security. These aspects bring increased effort in switching between on-premises and public cloud. Switching to private cloud could require lesser effort.”¹⁹⁸ On the other hand, public cloud suppliers cannot easily switch to offering private cloud solutions. While it is true that CSPs are starting to offer services in on-premises and private cloud deployments, their solutions are not yet viewed by customers as alternatives to the existing on-premises and private cloud solutions (see Section 8.4.3.2.1.2.3. below). In this regard, one customer noted: “On the telco side, the migration to public cloud is not as far advanced like on the IT-side because public cloud does not yet offer the same functionality as private cloud. Telefónica is still testing the capabilities of public cloud for the same features required in telco (e.g. performance or synchronisation).”¹⁹⁹ This is [Details of internal document describing the on-

¹⁹⁴ This bias can lead to the well-known “cellophane fallacy”, i.e. the wrong conclusion, on the basis of a SSNIP test applied at the prevailing price, that the relevant market must be wider than the product(s) of a dominant undertaking (see the explanations of this concept in paragraphs 158 to 171 of the Commission's decision in case AT.39523 Slovak Telekom). The “cellophane fallacy” is named after the US Supreme Court's market definition involving cellophane and other wrapping products in *United States v. E. I. du Pont de Nemours & Co.*, 351 U.S. 377 (1956)). The statement in the Commission's 1997 Market Definition Notice (paragraph 19) that “for the analysis of merger cases, the price to be taken into account [in the hypothetical monopolist test] will be the prevailing market price” hence needs to be read as applying to horizontal mergers only where the focus of market definition and the competitive assessment is on the merger induced change in market power through the elimination of competition between the merging parties.

¹⁹⁵ SO Response, paragraphs 85, 86, 88, 96, 97; Parties' Post-Oral Hearing submission of 9 May 2023, page 2.

¹⁹⁶ Replies to Q2 – questionnaire to virtualization software competitors of VMware, question 11.

¹⁹⁷ Replies to Q2 – questionnaire to virtualization software competitors of VMware, question 11.

¹⁹⁸ Replies to Q2 – questionnaire to virtualization software competitors of VMware, question 11.1 [ID 1906].

¹⁹⁹ Agreed minutes of call with Telefonica dated 14 February 2023 [ID 4043].

premises and private cloud market] in a VMware document noting that [Details of internal document describing the on-premises and private cloud market]”²⁰⁰

- (184) In light of the above, for the purposes of this Decision, the Commission concludes that within the market for server virtualization software, there are grounds to segment the market based on deployment model, *i.e.*, into market segments for virtualization software deployed (i) on-premises and in the private cloud, and (ii) in the public cloud.

7.4.1.3.4. Segmentation based on pricing model

- (185) The market investigation tested whether open-source virtualization software constitutes an alternative to proprietary virtualization software, and to what extent these types of software are substitutable. In the market investigation, the majority of respondents expressing an opinion indicated that open-source virtualization software constitutes an alternative for proprietary virtualization software.²⁰¹
- (186) One respondent, for example, indicated that “open-source virtualization software applications come along often and generally speaking nine out of ten will work well. So, in that sense, OSS virtualization software constitutes an alternative. It’s another matter whether somebody will make the effort to create open-source virtualization for a given workload, and our experience is customers probably will for a portion of their workloads. For the other portion, it may not be attractive to make that transition because they have taken a dependency on a lot of the features in proprietary virtualization software that may not exist here or may not exist in the degree of completion on the open-source side. Moreover, some customers, even if they could, might not transition because they don’t get feature or performance parity when they move.”²⁰² Another respondent stated: “Open source software plus value-added development create an alternative to proprietary virtualization software. This is accomplished by providing functionally equal feature sets in open source plus custom feature development, that a customer needs from proprietary virtualization software; making switching hypervisors easy to do from a workload perspective.”²⁰³
- (187) Respondents did note that once they were a customer of proprietary virtualization software, a switch towards open-source virtualization software would be technically complex.²⁰⁴ For instance, one respondent noted: “*The primary switching costs stem from performing migrations and also re-skilling the teams. Additional considerations involve certification of the application against the virtualization software.*”²⁰⁵ However, another respondent clarified that: “*The same issues apply when moving from any hypervisor to another: the virtual hardware is different, and so the software running inside the existing VMs may not be "happy" about the move. As above, a highly-automated "infrastructure as code" environment will have fewer issues here than an environment where servers have been set up and maintained by hand for a number of years. In addition to this, it takes an extra level of expertise to take open-*

²⁰⁰ VMware internal document, “[Confidential –VMware’s internal documents]”.

²⁰¹ Replies to Q4 – questionnaire to customers of Broadcom and VMware, question 10; replies to Q2 - questionnaire to virtualization software competitors of VMware, question 12.

²⁰² Replies to Q2 – questionnaire to virtualization software competitors of VMware, question 12.1 [ID 1832].

²⁰³ Replies to Q2 – questionnaire to virtualization software competitors of VMware, question 12.1 [ID 1418].

²⁰⁴ Replies to Q2 – questionnaire to virtualization software competitors of VMware, question 12.2.

²⁰⁵ Replies to Q2 – questionnaire to virtualization software competitors of VMware, question 12.3 [ID 1418].

*source components and assemble them into a functioning system, without support from experts in that field. It can be done, naturally, but requires developing a different kind of expertise in-house. The extra cost of the salaries of the IT people may balance out the cost savings and flexibility of building your own solution from the open-source components.*²⁰⁶

- (188) In light of the above, for the purposes of this Decision, the Commission concludes that the market for server virtualization software should not be segmented based on pricing model (proprietary versus open-source virtualization software).

7.4.1.4. Conclusion

- (189) In light of the above, for the purposes of this Decision, the Commission concludes that there is a market for server virtualization software (excluding containerization software), which includes both open-source and proprietary virtualization software, and which should be further segmented based on deployment model, *i.e.*, depending on whether the software is deployed (i) on-premises and in the private cloud, or (ii) in the public cloud. The Commission will carry out its competitive assessment on that basis.

7.4.2. Geographic market definition

7.4.2.1. Commission precedents

- (190) In *Dell / EMC*, the Commission concluded that the relevant geographic market for middleware and its market sub-segments (including virtualization software) is worldwide in scope.²⁰⁷

7.4.2.2. The Notifying Party's views

- (191) The Notifying Party submits that competition takes place worldwide and that supply chains and customers are distributed around the globe, while transport costs and other barriers to trade are low. Consequently, the relevant geographical market is global.²⁰⁸ The Article 6(1)(c) Response and the Response to the SO do not discuss the geographic market definition.

7.4.2.3. The Commission's assessment

- (192) Based on the results of the market investigation, the Commission considers that the market for virtualization software is global.
- (193) Respondents to the market investigation who supply virtualization software indicated that they supply on a global level.²⁰⁹ Respondents further consider that quality and price do not significantly differ depending on the location.²¹⁰
- (194) Similarly, the vast majority of respondents purchasing virtualization software indicated that they typically procure virtualization software on a global level.²¹¹

²⁰⁶ Replies to Q2 – questionnaire to virtualization software competitors of VMware, question 12.3 [ID 1550].

²⁰⁷ Commission decision of 29 February 2016 in case M.7861 – *Dell / EMC*, paragraph 70.

²⁰⁸ Form CO, paragraph 485.

²⁰⁹ Replies to Q2 – questionnaire to virtualization software competitors of VMware, question 13.

²¹⁰ Replies to Q2 – questionnaire to virtualization software competitors of VMware, question 14.

²¹¹ Replies to Q4 – questionnaire to customers of Broadcom and VMware, question 11.

7.4.2.4. Conclusion

- (195) In light of the above and in line with its previous decisional practice, for the purposes of this Decision, the Commission considers that the geographic scope of the market for virtualization software, or any segmentation thereof, is worldwide.

7.5. FC HBAs

- (196) Host-bus adapters (“HBAs”) connect servers to storage. They are mounted inside servers (or, less commonly, within external storage devices) and provide an interface between the server and the storage device. HBAs connect servers to networked storage located outside the server on a storage-area network (“SAN”), typically through a switch. SANs are based on the Fibre Channel or Ethernet networking protocols. FC HBAs use the Fibre Channel (“FC”) protocol to transfer data in a FC-based storage-area network, using fibre-optic cables to connect nodes.²¹²
- (197) FC HBAs typically slot into a PCI Express (“PCIe”) expansion slot on the host system’s motherboard. They are then connected via compatible cables to a switch.²¹³
- (198) **Broadcom** produces a range of FC HBAs. These vary by FC generation, PCIe²¹⁴ generation and the number of ports they include.
- (199) **VMware** does not produce FC HBAs.

7.5.1. Product market definition

7.5.1.1. Commission precedents

- (200) In *Broadcom / Brocade*²¹⁵, the Commission identified a separate market for FC HBAs, without further segmenting the market and conducted its assessment on the basis of the narrowest possible market, *i.e.*, the market for FC HBAs.²¹⁶

7.5.1.2. The Notifying Party’s views

- (201) The Notifying Party submitted in the Form CO that FC HBAs form a separate product market, without any further segmentation, including by speed, interconnection or generation.²¹⁷ In its Article 6(1)(c) Response, the Notifying Party did not address the Commission’s preliminary conclusion in the Article 6(1)(c) Decision that, for the purposes of this Decision, the relevant product market is the market for FC HBAs.²¹⁸
- (202) In its SO Response, the Notifying Party submitted that there are HBAs based on other technologies or protocols, and in particular Ethernet, which exert significant competitive constraints on FC HBAs at a system-level, as customers consider both FC and other technologies/protocols such as Ethernet when deciding on the architecture for new server infrastructure.²¹⁹

7.5.1.3. The Commission’s assessment

- (203) The Commission’s market investigation aimed to verify whether FC HBAs form a distinct product market or whether all HBAs belong to a broader product market. In

²¹² Form CO, paragraphs 606-608.

²¹³ Form CO, paragraph 611.

²¹⁴ Peripheral Component Interconnect Express.

²¹⁵ Commission decision of 12 May 2017 in case M.8314 – *Broadcom / Brocade*, paragraph 45.

²¹⁶ Commission decision of 12 May 2017 in case M.8314 – *Broadcom / Brocade*, paragraph 59.

²¹⁷ Form CO, paragraphs 640 and following.

²¹⁸ Article 6(1)(c) Response, footnote 34.

²¹⁹ SO Response, paragraphs 132-136.

particular, the market investigation aimed to verify whether HBAs that support another technology or protocol (such as IP or Ethernet HBAs) constitute an alternative for FC HBAs and whether switching to non-FC HBAs would constitute an option if the price of FC HBAs were to rise by 5-10%. The majority of respondents indicated that HBAs that support another technology or protocol are not a valid alternative for FC HBAs, as switching would be technically complex, disruptive to the business, and would require a significant amount of time.²²⁰ One customer explained that *“switching from infrastructure using FC HBA to infrastructure that does not use FC HBA requires an entire change of the infrastructure to utilize other technology. That is not easy to do and would not be done unless the price or quality change was sufficient enough to justify the cost and difficulty of changing infrastructure. Even then, the change would probably only occur as you switch out infrastructure generationally.”*²²¹ Another respondent explained that *“[w]hile the switch to non-FC HBA is economically advantageous, the technical complexity associated with migrating applications away from FC would be a long and cumbersome project. This is essentially dictated by the fact that Enterprise applications have come to rely on the reliability of FC technology, something the Ethernet NICs do not readily provide.”*²²² Finally, a server OEM explained: *“As Commission found in its Broadcom/Brocade decision [...], there is a market for Fibre Channel (FC) that is distinct from Ethernet or Infiniband [...]. Users of FC SANs purchase hardware that is specific to FC SANs, for example HBAs, SAN switches, and storage arrays, and those products are not substitutable for hardware products that support other technologies or protocols such as IP/Ethernet or Infiniband.”*²²³

- (204) The market investigation also shows that suppliers of FC HBAs could likely not easily switch production to non-FC HBAs within a short period of time and at minimal costs. One respondent submitted that a switch was not possible, explaining that *“alternate technologies like Ethernet require a separate skill-set to develop ASIC controllers. In addition, the related software development is fairly complex given some of the complexities around Ethernet deployment”*.²²⁴
- (205) The Commission therefore considers that, while in particular Ethernet SAN is continuously increasing performance, the results of the market investigation are inconclusive as to whether there should be a broader market for HBAs, including other protocols in addition to Fibre Channel, such as Ethernet.
- (206) Based on the above, the Commission confirms its preliminary finding that, for the purposes of this Decision, the relevant product market is the market for FC HBAs. In its competitive assessment, the Commission nevertheless analyses if and to what extent non-FC HBAs (such as Ethernet SANs) exert an out-of-market competitive constraint on FC HBAs.²²⁵

7.5.1.4. Conclusion

- (207) In light of the above, for the purposes of this Decision, the Commission concludes that there is a separate market for FC HBAs, without further segmentation.

²²⁰ Replies to Q4 – questionnaire to customers of Broadcom and VMware, questions 17 and 18.

²²¹ Replies to Q4 – questionnaire to customers of Broadcom and VMware, question 18.1 [ID 1731].

²²² Replies to Q3 – questionnaire to competitors of Broadcom, question 12.1 [ID 1962].

²²³ Replies to Q4 – questionnaire to customers of VMware and Broadcom, question 17 [ID1930].

²²⁴ Replies to Q3 – questionnaire to competitors of Broadcom, questions 14 and 14.1 [ID 1962].

²²⁵ Section 8.4.3.2.3.1.2.

7.5.2. Geographic market definition

7.5.2.1. Commission precedents

- (208) In *Broadcom / Brocade*²²⁶, the Commission noted that the results of its market investigation indicated that the market for FC HBAs is likely to be worldwide. In particular, respondents consider that suppliers operate on a worldwide basis, transport costs are not significant, location is not a factor for supplier selection and price levels are similar across regions. However, the Commission left the exact geographic market definition open, as this did not materially change the outcome of the Commission's decision.²²⁷

7.5.2.2. The Notifying Party's views

- (209) The Notifying Party agrees with the Commission's definition of a global geographic market.²²⁸

7.5.2.3. The Commission's assessment

- (210) Based on the results of the market investigation, the Commission considers that the market for FC HBAs is worldwide.
- (211) First, the results of the market investigation indicate that customers typically purchase FC HBAs from suppliers with a global presence.²²⁹ Second, FC HBA competitors indicated that they supply FC HBAs on a worldwide level.²³⁰

7.5.2.4. Conclusion

- (212) For the reasons set out above, the Commission concludes that, for the purposes of the assessment of the Transaction, the geographic scope of the market for FC HBAs is global.

7.6. Storage adapters

- (213) Storage adapters also connect servers to storage. Like FC HBAs, they are mounted inside servers (or, less commonly, within external storage devices) and provide an interface between the server and the storage device. Different to FC HBAs, storage adapters connect server CPUs to storage directly. This storage may be internal (*i.e.*, located within the server) or external (*i.e.*, located in a storage enclosure). Communication between the CPU and storage takes place over one of several industry-standard storage protocols, including the SAS²³¹, SATA²³² and NVMe²³³ protocols.²³⁴ Storage adapters typically slot into a PCIe expansion slot on the host system's motherboard. They are then connected via compatible cables to a switch.²³⁵
- (214) Storage adapters contain storage controllers, which are chips that provide the processing functionality for the I/O (input/output) card in storage adapters. Each storage adapter has one storage controller.²³⁶ See **Figure 4** below.

²²⁶ Commission decision of 12 May 2017 in case M.8314 – *Broadcom / Brocade*, paragraph 45.

²²⁷ Commission decision of 12 May 2017 in case M.8314 – *Broadcom / Brocade*, paragraph 46.

²²⁸ Form CO, paragraph 649.

²²⁹ Replies to Q4 – questionnaire to customers of Broadcom and VMware, question 20.

²³⁰ Replies to Q4 – questionnaire to customers of Broadcom and VMware, question 19.

²³¹ Serial Attached Small Computer System Interface.

²³² Serial Advanced Technology Attachment.

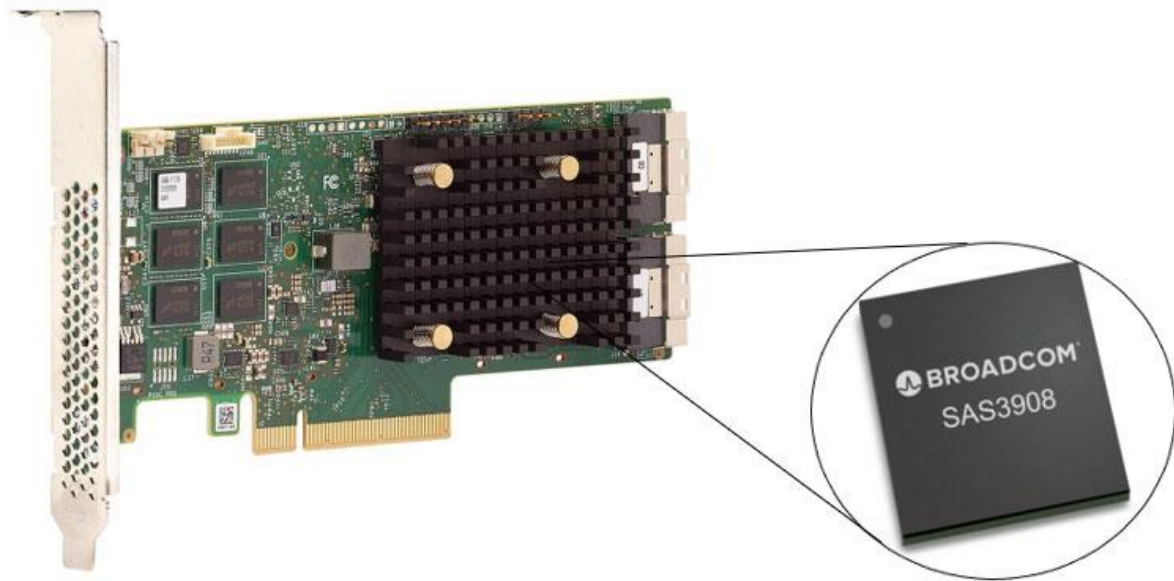
²³³ Non-Volatile Memory Express.

²³⁴ Form CO, paragraphs 606 and 610.

²³⁵ Form CO, paragraph 611.

²³⁶ Parties' reply to RFI 27.

Figure 4: Storage controller on a storage adapter



Source: Broadcom (the controller chip is underneath the black heat sink in the image)

- (215) Controllers and adapters can have RAID or non-RAID capabilities.²³⁷ RAID (Redundant Array of Independent Disks) is an enabling technology that leverages multiple disks as part of a set, which provides data protection in case of failure of the hard disk. Non-RAID does not have this type of data protection capabilities and is sometimes still referred to as JBOD.
- (216) **Broadcom** produces a range of storage adapters. These adapters are tri-mode – the same adapters can connect to storage through the SAS, SATA and NVMe protocols – and vary in bandwidth and the number of ports they contain. Broadcom supplies ready-built storage adapters (*i.e.*, Broadcom boards) based on its own storage controllers. In addition, Broadcom supplies storage controllers to third parties (mainly OEMs), who build their own storage adapters using Broadcom's storage controllers (*i.e.* Broadcom-based boards).
- (217) **VMware** does not produce storage adapters.
- 7.6.1. *Product market definition*
- 7.6.1.1. Commission precedents
- (218) The Commission has not previously considered the relevant product market for storage adapters.
- 7.6.1.2. The Notifying Party's views
- (219) The Notifying Party submitted in the Form CO that there is a separate market for storage adapters, which is not susceptible to any further sub-segmentation. The market for storage adapters should not be segmented by storage protocol, such as SAS, SATA and NVMe. Consumers do not need to switch storage adapters to switch to a drive based on a different protocol, as single storage adapters can support multiple protocols.²³⁸ SAS is a superset of SATA, and SAS storage adapters can

²³⁷ Parties' reply to RFI 27.

²³⁸ Form CO, paragraph 639.

connect to both SAS and SATA storage devices.²³⁹ Other storage adapters are “tri-mode” – they can support SAS, SATA, and NVMe storage devices.²⁴⁰ Suppliers likewise do not need to switch to produce storage adapters capable of supporting these standards, because a single adapter can support them all.²⁴¹ In the course of the investigation, the Notifying Party submitted that storage adapters and controllers must be considered separately when assessing any putative foreclosure.²⁴² From the demand-side, storage controllers have different customers, intended use and pricing, as they are an input for storage adapters and cannot be used interchangeably with a storage adapter on a stand-alone basis. From the supply-side, the production of storage controllers requires semiconductor expertise, whereas storage adapters can be built by companies with components sourced from third-parties.²⁴³

- (220) In its SO Response, the Notifying Party submitted that other storage technologies, such as direct-attach storage, exert significant competitive constraints on storage adapters at a system-level, as end-customers consider both storage adapters and other storage technologies such as direct-attach storage when deciding on the architecture for new infrastructure.²⁴⁴

7.6.1.3. The Commission’s assessment

- (221) First, the Commission’s market investigation aimed to verify whether storage adapters could be replaced by HBAs that support another protocol (such as IP or Ethernet HBAs).²⁴⁵ Similarly, the Commission tested whether storage adapters could be replaced by FC HBAs.
- (222) Although the results on whether storage adapters could be replaced by HBAs were mixed, overall the Commission considers that storage adapters cannot be replaced by HBAs as it is explained by a customer that “*storage adapters provide direct connection to SAS and/or SATA disk interfaces and an IP/Ethernet HBA would not have that capability as a direct alternative*”.²⁴⁶ The majority of respondents expressing an opinion considered that storage adapters could not be replaced by FC HBAs.²⁴⁷ As one customer indicated, “*HBAs and storage adapters are different technologies that serve different functions. HBAs connect to external storage as part of a fabric while storage adapters support connectivity between CPU and internal storage with RAID fault tolerance.*”²⁴⁸
- (223) Second, the Commission aimed to verify whether a market for storage adapters should be segmented based on the protocol that this device supports (e.g., from SAS to SATA or NVME). Essentially, the Commission tested whether a customer looking to switch to a drive based on a different protocol, would also require a different storage adapter that is compatible with that different protocol.

²³⁹ Form CO, paragraph 639.

²⁴⁰ Form CO, paragraph 639.

²⁴¹ Form CO, paragraph 639.

²⁴² Parties’ reply to RFI 27.

²⁴³ Parties’ reply to RFI 27.

²⁴⁴ SO Response, paragraphs 141-143.

²⁴⁵ Replies to Q3 – questionnaire to competitors of Broadcom, question 15; replies to Q4 – questionnaire to customers of Broadcom and VMware, question 21.

²⁴⁶ Replies to Q4 – questionnaire to customers of Broadcom and VMware, question 21.1 [ID 1912].

²⁴⁷ Replies to Q3 – questionnaire to competitors of Broadcom, questions 15 and 16; replies to Q4 – questionnaire to customers of Broadcom and VMware, questions 21 and 22.

²⁴⁸ Replies to Q4 – questionnaire to customers of Broadcom and VMware, question 21.1 [ID 1731].

- (224) The majority of respondents expressing an opinion considered that this was not the case.²⁴⁹ Several respondents explained that they were using: “*tri-mode storage adapters. All three protocols are supported.*”²⁵⁰ However, a few respondents were still using single-protocol storage adapters, as a consequence of which they would need to switch if they wanted to use another protocol.²⁵¹
- (225) Third, the Commission assessed whether storage adapters could be replaced by alternative storage technologies such as direct-attach storage. The Commission found that while customers have choice between technologies, these technologies are differentiated. The results of the market investigation did not bring forward any conclusive evidence as to whether there should be a broader market including alternative storage technologies. Based on the above, the Commission confirms its preliminary finding that, for the purposes of this Decision, the relevant product market is the market for storage adapters.
- (226) Fourth, the Commission assessed the relationship between the storage adapter and the storage controller. From a demand-side perspective, an end-customer requiring a storage adapter would not consider a storage controller to be a suitable alternative. A storage controller serves as the input for the storage adapter and cannot – on a stand-alone basis – be deployed in a server. In addition, storage controllers represent about [...] % [Business secret – price structure] of storage adapter’s price.²⁵²
- (227) From a supply-side perspective, providers of storage adapters could not easily enter the market for storage controllers, which are the most critical input for storage adapters. Producers of storage controllers are semiconductor companies with vast expertise and know-how in building silicon chips. Storage adapters do not require semiconductor expertise and customers of storage controllers can build their own storage adapters using components purchased from third parties.
- (228) In terms of interoperability with VMware’s virtualization software, it is the storage adapter including the storage controller that is certified rather than the storage controller in itself. On this basis, the Commission does not consider that storage controllers should be considered to be part of the same market as storage adapters, but rather as an input to the storage adapter market. Therefore, the Commission considers that for the case at hand, the relevant market to assess the conglomerate relationship between the Parties’ respective products and the impact of the Transaction is the downstream market for storage adapters. The Commission further considers that it is not necessary, for the purposes of this Decision, to conclude on the scope of an upstream market including storage controllers, as the device requiring certification of interoperability with VMware’s software is the storage adapter.

7.6.1.4. Conclusion

- (229) In light of the above, for the purposes of this Decision, the Commission concludes that there is a market for storage adapters, without further segmentation.

²⁴⁹ Replies to Q3 – questionnaire to competitors of Broadcom, question 23; and replies to Q4 – questionnaire to customers of VMware and Broadcom, question 23.

²⁵⁰ Replies to Q4 – questionnaire to customers of VMware and Broadcom, question 23.1 [ID 1731].

²⁵¹ Replies to Q4 – questionnaire to customers of VMware and Broadcom, question 23.1.

²⁵² Parties’ reply to RFI 27.

7.6.2. Geographic market definition

7.6.2.1. Commission precedents

- (230) The Commission has not assessed the boundaries of the market for storage adapters in past decisions.

7.6.2.2. The Notifying Party's views

- (231) The Notifying Party submits that the geographic market for storage adapters is global in scope.²⁵³

7.6.2.3. The Commission's assessment

- (232) Based on the results of the market investigation, the Commission considers that the market for storage adapters is worldwide.

- (233) First, customers typically purchase storage adapters from suppliers with a global presence. In the market investigation, the vast majority of respondents expressing an opinion indicated that this is the case.²⁵⁴ Second, suppliers of storage adapters indicated that they typically supply storage adapters on a global level and that the conditions of competition do not differ depending on the location of the datacentre of the customer.²⁵⁵ In the words of one respondent, competitors on the market “*operate worldwide, and prices and competition generally do not vary by location.*”²⁵⁶

7.6.2.4. Conclusion

- (234) For the reasons set out above, the Commission concludes that, for the purposes of the assessment of the Transaction, the geographic scope of the market for storage adapters is worldwide.

7.7. NICs / SmartNICs

- (235) A NIC is server components that provide an interface between the server and other computers and equipment on a network.

- (236) A SmartNIC is a NIC with an integrated CPU. SmartNICs are designed to process network, storage, and security functions. This offloads the burden on the server CPU onto a separate dedicated CPU on the SmartNIC card, thereby freeing up the server's CPU for other tasks.

- (237) **Broadcom** provides Ethernet NICs with bandwidths at, above, and below 25 Gb/s. Broadcom also sells Ethernet controllers—a NIC's on-board processor—as discrete integrated circuits.

- (238) Broadcom terminated its SmartNIC business in 2021, including [Business secret – strategic decisions and sales policy].

- (239) **VMware** does not offer NICs or SmartNICs.

7.7.1. Product market definition

7.7.1.1. Commission precedents

- (240) In *Nvidia / Mellanox*²⁵⁷, the Commission considered a potential segmentation of the market for datacentre network interconnects on the basis of the various protocols and

²⁵³ Form CO, paragraph 650.

²⁵⁴ Replies to Q4 – questionnaire to customers of VMware and Broadcom, question 24.

²⁵⁵ Replies to Q3 – questionnaire to competitors of Broadcom, questions 20 and 21.

²⁵⁶ Replies to Q3 – questionnaire to competitors of Broadcom, question 21.1 [ID 1785].

²⁵⁷ Commission decision of 19 December 2019 in case M.9424 – *Nvidia / Mellanox*, paragraph 53.

network technologies that they support. In particular, the Commission considered a distinction between high performance fabrics and Ethernet-based network interconnects. The Commission also considered further potential sub-segmentations within high performance fabrics and Ethernet-based network interconnects.

- (241) Firstly, the Commission identified two distinct product markets for (i) high performance fabrics, and (ii) Ethernet-based network interconnects.²⁵⁸ This conclusion is based on the limited substitutability between high performance fabrics and Ethernet-based network interconnects. From a demand-side perspective, the Commission found that there is a significant discrepancy in the performance of the two products, in particular as regards latency.²⁵⁹ Ethernet-based solutions do not constitute a suitable alternative to high performance fabrics because of significantly lower performance in terms of latency. From a supply-side perspective, the Commission likewise considered that there is limited substitutability between the two solutions.²⁶⁰ The market investigation had not shown any credible prospect that a competitor with Ethernet-based network interconnects would develop and start offering a high-performance fabric that would be able to compete successfully within less than a year.²⁶¹
- (242) Within high performance fabrics, the Commission considered potential segmentations (i) between different protocols, (ii) between the various components composing high performance fabrics and (iii) based on bandwidth. As regards (i), the Commission noted that the market investigation included indications that customers wanting to procure InfiniBand fabric would not consider any other alternative high performance fabrics.²⁶² However, the Commission eventually left this question open, as it did not materially change the Commission's assessment.²⁶³ As regards (ii), the Commission found that there is no need to further distinguish high performance fabrics based on the individual components composing the fabrics, as there is only very limited or no interoperability between individual components across the different custom software and the various components composing high performance fabrics are almost always sold together to final customers.²⁶⁴ As regards (iii), the Commission noted that bandwidth is an important parameter for the choice of network interconnect systems.²⁶⁵ However, for the purposes of the decision, the question whether high performance fabrics should be further distinguished based on bandwidth was left open.²⁶⁶
- (243) Within the market for Ethernet-based network interconnects, the Commission assessed a potential segmentation between the various components composing Ethernet-based network interconnects. For each individual component, the Commission also assessed a potential sub-segmentation based on bandwidth/speed.
- (244) Firstly, the Commission found that each of the main individual components composing Ethernet-based network interconnects – *i.e.*, NICs, switches, cables –

²⁵⁸ Commission decision of 19 December 2019 in case M.9424 – *Nvidia / Mellanox*, paragraph 57.

²⁵⁹ Commission decision of 19 December 2019 in case M.9424 – *Nvidia / Mellanox*, paragraphs 58-66.

²⁶⁰ Commission decision of 19 December 2019 in case M.9424 – *Nvidia / Mellanox*, paragraph 68.

²⁶¹ Commission decision of 19 December 2019 in case M.9424 – *Nvidia / Mellanox*, paragraph 69.

²⁶² Commission decision of 19 December 2019 in case M.9424 – *Nvidia / Mellanox*, paragraph 73.

²⁶³ Commission decision of 19 December 2019 in case M.9424 – *Nvidia / Mellanox*, paragraph 74.

²⁶⁴ Commission decision of 19 December 2019 in case M.9424 – *Nvidia / Mellanox*, paragraph 75.

²⁶⁵ Commission decision of 19 December 2019 in case M.9424 – *Nvidia / Mellanox*, paragraph 78.

²⁶⁶ Commission decision of 19 December 2019 in case M.9424 – *Nvidia / Mellanox*, paragraph 79.

constitute a separate product market.²⁶⁷ It based this decision on the limited supply- and demand-side substitutability between the different components. On the one hand, as regards demand-side substitutability, the Commission found that the components fulfil different functions (*i.e.*, NICs are not a substitute for switches).²⁶⁸ Furthermore, customers generally do not express a preference as to whether they procure all elements from the same supplier and noted that Ethernet network interconnect components are usually sold both on a stand-alone basis and as an integrated system.²⁶⁹ On the other hand, from a supply-side perspective, the Commission found that there are clear limits to the transferability of know-how and technology between Ethernet switches and NICs.²⁷⁰

- (245) Secondly, as regards NICs, the Commission considered the distinction between (i) Ethernet NICs of 25Gb/s and higher and (ii) Ethernet NICs below 25 Gb/s. It concluded that there is a separate product market for Ethernet NICs with a bandwidth speed of 25 Gb/s or higher which is distinct from the market for Ethernet NICs with a bandwidth speed of less than 25 Gb/s. It based this conclusion on the fact that there are certain applications, performance needs, or mixes of workloads for which customers would only consider Ethernet NICs with a bandwidth speed of 25 Gb/s or higher.²⁷¹ The only other speed that would be substitutable with the latter were higher speeds.²⁷² Finally, from a supply-side perspective, the Commission found that there are significant barriers in terms of time and costs for a supplier of Ethernet NICs with a bandwidth speed lower than 25 Gb/s to compete successfully with the faster NICs.²⁷³
- (246) Finally, the Commission considered whether Ethernet switches and Ethernet cables could potentially be further segmented based on bandwidth between switches and cables of 25 Gb/s and higher on the one hand and switches and cables below 25 Gb/s. However, the Commission decided to leave the precise market definition open, as the Transaction would not significantly impede effective competition in this respect.²⁷⁴

7.7.1.2. The Notifying Party's views

- (247) The Notifying Party agrees with the Commission's segmentation of the market for network-interconnect products into NICs, switches, and cables, as well as SmartNICs.²⁷⁵
- (248) The Notifying Party submits that there exists a market for SmartNICs that is separate from the market for NICs. In the view of the Notifying Party, NICs are incapable of providing SmartNIC functionality because their processors (*i.e.*, Microcontroller Units, "MCU") are too small, too slow, and too simple.²⁷⁶ SmartNICs, by contrast, include more complex micro-processing units ("MPU") – closer in capability and performance to a full CPU – capable of handling more complex tasks. This difference in capabilities is also reflected in the pricing of SmartNICs: while NICs cost approximately USD 60-350, SmartNICs come at a price of approximately USD

²⁶⁷ Commission decision of 19 December 2019 in case M.9424 – *Nvidia / Mellanox*, paragraph 82.

²⁶⁸ Commission decision of 19 December 2019 in case M.9424 – *Nvidia / Mellanox*, paragraph 84.

²⁶⁹ Commission decision of 19 December 2019 in case M.9424 – *Nvidia / Mellanox*, paragraphs 85 and 86.

²⁷⁰ Commission decision of 19 December 2019 in case M.9424 – *Nvidia / Mellanox*, paragraph 87.

²⁷¹ Commission decision of 19 December 2019 in case M.9424 – *Nvidia / Mellanox*, paragraph 87.

²⁷² Commission decision of 19 December 2019 in case M.9424 – *Nvidia / Mellanox*, paragraph 92.

²⁷³ Commission decision of 19 December 2019 in case M.9424 – *Nvidia / Mellanox*, paragraph 94.

²⁷⁴ Commission decision of 19 December 2019 in case M.9424 – *Nvidia / Mellanox*, paragraph 98.

²⁷⁵ Form CO, paragraph 588.

²⁷⁶ Form CO, paragraph 591.

500-1000 or more. Therefore, although SmartNICs could technically replace the function of a NIC (either as a NIC or as a part of an Ethernet SAN), customers would not use SmartNICs in this way, as they would be paying for a complex processing device for connectivity that could be achieved through a much cheaper product.²⁷⁷

- (249) Furthermore, the Notifying Party submits that the segmentation by communication protocols is no longer applicable, as Ethernet-based interconnects offer comparable performance to high-performance fabrics.²⁷⁸ However, in view of Broadcom's small market share in Ethernet NICs, Broadcom's exit from SmartNICs, and the limited uptake of non-Ethernet NICs, whether the distinct markets for NICs and SmartNICs also include non-Ethernet NICs has no bearing on the Commission's assessment of the Transaction.²⁷⁹
- (250) Furthermore, the Notifying Party disagrees with the Commission's previous segmentation of the NICs market by bandwidth speed. In the Notifying Party's view, there is no single use case that is served by a particular bandwidth.²⁸⁰ Customers mix-and-match NICs of different bandwidths to achieve similar results (*e.g.*, combining several NICs of lower bandwidths to achieve the bandwidth of a single NIC with higher bandwidth). Suppliers likewise use the same hardware to produce NICs capable of supporting multiple bandwidths. The Notifying Party therefore contends that the relevant markets for NICs and SmartNICs, respectively, encompass products of varying bandwidths, all of which constrain each other in a chain-of-substitution scenario (even if areas at the extreme end of the spectrum are not directly substitutable).²⁸¹

7.7.1.3. The Commission's assessment

7.7.1.3.1. Distinction based on protocol (Ethernet vs non-Ethernet)

- (251) In the market investigation, the Commission tested whether the NICs market should be segmented on the basis of protocol (*i.e.*, Ethernet NICs as opposed to NICs using other protocols, such as InfiniBand).
- (252) The majority of respondents expressing an opinion considered that, to a large extent, non-Ethernet NICs (*e.g.*, InfiniBand NICs) do not constitute an alternative for Ethernet NICs.²⁸² One respondent highlighted that such a change would be highly cost- and time-intensive and would entail not only the purchase of new equipment, but also the acquisition of required know-how and expertise to operate more specialised systems like InfiniBand.²⁸³
- (253) Even when assessing competition at the point of planning a new network, the market investigation indicates that it is often unlikely that an operator will view Ethernet networks as alternatives to non-Ethernet networks and *vice versa*.²⁸⁴ As expressed by one respondent, "*network hardware operates along a continuum of price and performance. It is clear that for some applications where customers do not need the*

²⁷⁷ Form CO, paragraph 593.

²⁷⁸ Form CO, paragraph 595.

²⁷⁹ Form CO, paragraph 596.

²⁸⁰ Form CO, paragraph 597.

²⁸¹ Form CO, paragraph 597.

²⁸² Replies to Q3 – questionnaire to Broadcom competitors (NICs, FC HBAs and storage adapters), question 4; replies to Q4 – questionnaire to customers of Broadcom and VMware, question 12.

²⁸³ Replies to Q3 – questionnaire to competitors of Broadcom, question 4.1; replies to Q4 – questionnaire to customers of Broadcom and VMware, question 12.

²⁸⁴ Replies to Q3 – questionnaire to competitors of Broadcom, question 4.1.

exceptionally high performance offered by non-Ethernet networking hardware that customers look only to Ethernet products, which are generally less expensive. By the same token, for high performance computing applications where high speed and low latency is more important than cost, Ethernet is unlikely to be viewed as an alternative despite the cost savings. Some customers, however, likely choose between Ethernet and non-Ethernet solutions, including choosing between Ethernet and Fibre Channel for storage networks, or between Ethernet and high performance fabrics like Infiniband. It is unlikely that non-Ethernet networking hardware would be considered an alternative to Ethernet hardware for general data center usage, or for Cloud Service Providers, as they lack key features and robust support for Ethernet, TCP/IP and other protocols which are native to the Internet.”²⁸⁵ InfiniBand offers high-speed performance and low latency, and thus serves, in particular, the needs of customers processing high-performance workloads.²⁸⁶

- (254) At the same time, InfiniBand is significantly more expensive. Accordingly, multiple respondents indicated that, for general datacentre usage, they do not view InfiniBand as an economically viable alternative.²⁸⁷ Even if customers were to be indifferent to prices, InfiniBand is unlikely to constitute an alternative as it is highly complex and thus more prone to errors as it lacks key features, in particular robust support for protocols that are native to the internet (e.g., Ethernet, TCP/IP). In the words of one customer: *“Using different network technologies for general purpose networking (which is what Ethernet and related technologies are positioned for) is not sensible, as the technologies like InfiniBand have a specific purpose which doesn’t match the general networking requirements. Enforcing such technologies would be counter-productive: the hardware would be more expensive and more specialized (thus also requiring different knowledge/expertise profiles, which again results in a more expensive workforce), the setups more complex and thus more failure-sensitive and would significantly reduce the options a company has (as you lock-in into a specific technology with a narrow market/vendor field).”*²⁸⁸
- (255) From a supply-side perspective, respondents considered that, while it was possible for a manufacture developing non-Ethernet NICs to switch production to Ethernet NICs, this would generally require some investment,²⁸⁹ which, in light of established market players providing Ethernet NICs would likely not be worthwhile.²⁹⁰
- (256) In light of the above, for the purposes of this Decision, the Commission concludes that within a broader market for the supply of NICs, there is a narrower relevant product market for the supply of Ethernet NICs.

7.7.1.3.2. Distinction based on bandwidth

- (257) The Commission further tested whether the NICs market should be segmented by bandwidth speed.
- (258) The market investigation showed that NICs of different bandwidths can serve as substitutes, however, the larger the difference in bandwidth speed, the smaller the

²⁸⁵ Replies to Q3 – questionnaire to competitors of Broadcom, question 4.1.

²⁸⁶ Replies to Q3 – questionnaire to competitors of Broadcom, question 4.1.

²⁸⁷ Replies to Q3 – questionnaire to competitors of Broadcom, question 4.1.

²⁸⁸ Replies to Q4 – questionnaire to customers of Broadcom and VMware, question 12.1.

²⁸⁹ Replies to Q3 – questionnaire to competitors of Broadcom, question 5.1.

²⁹⁰ Replies to Q3 – questionnaire to competitors of Broadcom, question 5.1.

degree of substitutability.²⁹¹ To a certain extent, there also exists a possibility to replace a higher bandwidth-speed NIC with two NICs of a lower bandwidth speed (e.g., one respondent indicated that operators “*may choose to use 4 ports of 100GE vs. 2 ports of 200GE if required*”).²⁹² As one customer elaborates, “*if certain performance metrics are needed, the choice boils down to three possible setups: i) You use lower-bandwidth[;] ii) You use new infrastructure that can deal with the specific bandwidth[;] iii) You use new infrastructure that can deal with higher bandwidths[.] This is an architectural balance. Combining existing infrastructure is possible to a certain extent, although eventually limits are taken on other infrastructure points anyway.*”²⁹³

- (259) From a supply-side perspective, the results were similar: while respondents believed that it was relatively simple to switch production from, e.g., 10 Gb/s NICs to 25Gb/s or other NICs in the lower speed ranges, switching to high-speed Ethernet NICs would require significant expertise, time, and a substantial investment, as well as access to expensive IP.²⁹⁴
- (260) In light of the above, for the purposes of this Decision, the Commission concludes that within the market for the supply of Ethernet NICs, the question whether the market should be segmented based on bandwidth (i) below 25 Gb/s, and (ii) above 25 GB/s can be left open.

7.7.1.3.3. Separate market for NICs/SmartNICs

- (261) While half of the respondents replied that SmartNICs and NICs are not substitutable, the other half indicated that, at least for certain bandwidths, SmartNICs do constitute an alternative to NICs.²⁹⁵ One respondent indicated that “[i]n certain cases, for high feature set NICs, SmartNICs can be used as a replacement but application is limited given considerable cost and power differences.”²⁹⁶ However, the functioning of SmartNICs is inherently different to that of a normal NIC. One respondent explained that “[SmartNICs] operate independent from the CPU or “host” processing and operating system, and maintain a completely independent security posture. Additionally, [SmartNICs] are generally required to have dedicated processing and memory complexes, along with special purpose processing complexes for storage, data movement, cryptography, compression and security. NICs, on the other hand, cannot operate independently or maintain an isolated security posture, and lack the required features. A customer facing a price increase on [SmartNICs] that wished to replace [SmartNICs] with Foundational NICs would need to add not just NICs to perform the networking functionality, but also other computing capability (in the form of servers with CPUs and perhaps specialized processors) to provide the required functionality. Given the expense of adding this functionality, Intel does not believe that customers would substitute Foundational NICs in response to a small but significant increase in the price of [SmartNICs].”

²⁹¹ Replies to Q3 – questionnaire to competitors of Broadcom, question 6.1; Replies to Q4 – questionnaire to customers of Broadcom and VMware, question 13.

²⁹² Replies to Q3 – questionnaire to competitors of Broadcom, question 6.1.

²⁹³ Replies to Q4 – questionnaire to customers of Broadcom and VMware, question 13.1.

²⁹⁴ Replies to Q3 – questionnaire to competitors of Broadcom, question Q8.1.

²⁹⁵ Replies to Q3 – questionnaire to competitors of Broadcom, question 9; replies to Q4 – questionnaire to customers of Broadcom and VMware, question 15.

²⁹⁶ Replies to Q3 – questionnaire to competitors of Broadcom, question 9.1.

- (262) Furthermore, SmartNICs generally come at a much higher price than NICs.²⁹⁷ It is therefore unlikely that a SmartNIC would be installed to fulfil the function that a normal NIC could achieve.
- (263) From a supply-side perspective, while it is ‘typical’ for a NICs supplier to move towards the development of SmartNICs, a switch in the opposite direction would not be simple.²⁹⁸ One respondent explained that “[m]uch of the IP design can be re-used but requires a new chip tapeout, integration and some re-design. Chip design and verification times can be greater than one year and will require significant personnel, resources and funds. The larger issue is the software required for a standard NIC to be commercially viable is significant. A new standard NIC supplier would have to provide drivers for a wide range of operating systems and demonstrate interoperability across a wide range of workloads and deployment scenarios.”²⁹⁹
- (264) In light of the above, for the purposes of this Decision, the Commission concludes that the market for the supply of Ethernet NICs does not include SmartNICs.

7.7.1.4. Conclusion

- (265) In light of the above, for the purposes of this Decision, the Commission reaches the conclusion that there is a separate market for the supply of NICs which does not include SmartNICs. Within a broader market for the supply of NICs, there is a narrower relevant product market for the supply of Ethernet NICs. The question whether the market for the supply of NICs should be segmented based on bandwidth speed between speeds above and below 25 Gb/s can be left open in this Decision as the Transaction would not significantly impede effective competition on the market for the supply of NICs irrespective of the precise market definition.

7.7.2. Geographic market definition

7.7.2.1. Commission precedents

- (266) In *Nvidia / Mellanox*, the Commission considered that the geographic scope for the various markets for network interconnects products, including Ethernet NICs, was worldwide.³⁰⁰

7.7.2.2. The Notifying Party’s views

- (267) The Notifying Party concurs with the geographic market defined by the Commission. In the Notifying Party’s view, competition takes place worldwide, manufacturing and supply chains span across the globe, customers purchase from suppliers irrespective of their location, and transport costs and other barriers to trade are low.³⁰¹

7.7.2.3. The Commission’s assessment

- (268) In the market investigation, the Commission investigated the geographic scope of the market for NICs. The results of the market investigation indicated that the scope of the market was worldwide. The majority of NIC suppliers expressing an opinion replied that they typically supply NICs at the worldwide level.³⁰² The majority of

²⁹⁷ Replies to Q3 – questionnaire to competitors of Broadcom, question 9.1.; replies to Q4 – questionnaire to customers of Broadcom and VMware, question 15.1.

²⁹⁸ Replies to Q3 – questionnaire to competitors of Broadcom, question 10 and 10.1.

²⁹⁹ Replies to Q3 – questionnaire to competitors of Broadcom, question 10.1.

³⁰⁰ Commission decision of 19 December 2019 in case M.9424 – *Nvidia / Mellanox*, paragraph 107.

³⁰¹ Form CO, paragraph 598.

³⁰² Replies to Q3 – questionnaire to competitors of Broadcom, question 18.

customers expressing an opinion likewise indicated that they purchase NICs from global suppliers.³⁰³

7.7.2.4. Conclusion

- (269) In light of the above and in line with its previous decisional practice, for the purposes of this Decision, the Commission reaches the conclusion that the geographic scope of the market for the supply of NICs, or any segmentation thereof, is worldwide.

8. COMPETITIVE ASSESSMENT

8.1. Introduction

8.1.1. *Rationale for the Transaction*

- (270) The Notifying Party submits that, by acquiring VMware, Broadcom expects to be able to fully realize VMware's potential to help enterprise customers flexibly move workloads between their own datacentres and the cloud as well as among cloud providers, to preserve the competitiveness of the datacentre and help those customers avoid being locked into a particular CSP. This acquisition will enable Broadcom to realize its vision of creating an infrastructure software platform able to compete more vigorously with giant software and cloud computing competitors, such as Amazon, Microsoft, Google, IBM, Oracle, and Alibaba.³⁰⁴

8.1.2. *Horizontally Affected Markets*

- (271) Section 8.3. assesses horizontal relationships between the Parties' activities in four affected markets or market segments in which the Parties' combined market share exceed 20% at the worldwide or EEA level: (i) ITAM & SAM, (ii) ITACM software and its sub-segment (iii) DSAC software, and (iv) Network software.³⁰⁵

8.1.3. *Conglomerate Markets*

- (272) The Transaction gives rise to a number of conglomerate relationships between VMware's and Broadcom's activities, each resulting from the close relationship between Broadcom's activities on the one hand, and VMware's activities on the market for server virtualization software in the on-premises and private cloud environment on the other hand. Section 8.4. assesses whether the Transaction could lead to foreclosure of Broadcom's rivals in a number of hardware markets through the leveraging of VMware's strong position in the market for server virtualization software in the on-premises and private cloud environment. The assessment is conducted separately for each hardware market.
- (273) Sections 8.4.3. to 8.4.5. assess the impact on rival providers of FC HBAs (Section 8.4.3.), storage adapters (Section 8.4.4.) and NIC (Section 8.4.5.) of a possible foreclosure strategy whereby the merged entity would restrict or degrade the certification of interoperability of these providers' hardware products with VMware's server virtualization software, by leveraging VMware's strong position in the market for server virtualization software in the on-premises and private cloud environment.

³⁰³ Commission decision of 12 May 2017 in case M.8314 – Broadcom / Brocade, paragraph 59.

³⁰⁴ Form CO, paragraph 9.

³⁰⁵ See Section 7.1.1. above: based on 2021 market share data included in Section 8.2., the Notifying Party has identified these 4 IDC and/or Gartner markets or market segments with market shares exceeding 20%.

- (274) Section 8.4.6. assesses whether the Transaction could lead to a hampering of innovation resulting from the merged entity delaying or hindering the development of SmartNICs (Section 8.4.6.) by no longer supporting Project Monterey, intended to build a version of its server virtualization software that runs on SmartNICs.
- (275) Finally, this Decision assesses whether the merged entity could, as a result of the Transaction, start bundling VMware's server virtualization software with Broadcom's software (Section 8.4.7.).

8.2. Market shares

- (276) According to the Horizontal Merger Guidelines and the Non-Horizontal Merger Guidelines,³⁰⁶ in the assessment of the effects of a merger, market shares constitute a useful first indication of the structure of the markets at stake and of the competitive importance of the relevant market players.
- (277) In the following tables, the Commission presents the market shares of the Parties in all of the markets listed in Section 7 above to the extent such data is available.

8.2.1. ITOM software (Gartner terminology)

- (278) As mentioned above in Section 7.1.1.1., Gartner segments the macro market for ITOM software into the markets for (i) Delivery Automation; (ii) Health & Performance Analysis, (iii) Value Management; (iv) ITOM Mainframe Tools; and (v) Other ITOM. Within Value Management, Gartner identifies the categories for (i) IT Financial Management tools (ITFM), (ii) IT Service Management tools, (iii) ITAM & SAM, and (iv) Other Value Management tools.

8.2.1.1. ITAM & SAM

- (279) **Tables 1 and 2** below set out the Parties' and their main competitors' market shares for the years 2019, 2020 and 2021 extracted from *Gartner Market Share: IT Operations Management Software, Worldwide, 2021* ("Gartner ITOM Report")³⁰⁷ and *Gartner Market Share All Software Markets, Worldwide, 2019*.³⁰⁸

³⁰⁶ Horizontal Merger Guidelines, paragraph 14; Non-Horizontal Merger Guidelines, paragraph 24.

³⁰⁷ Form CO, Annex 3 (Horizontal).

³⁰⁸ 2019 data is from Form CO, Annex 16 (Horizontal).

Table 1: IT Asset Management & Software Asset Management, worldwide

	2019 ³⁰⁹		2020		2021	
	USD M	Share (%)	USD M	Share (%)	USD M	Share (%)
Broadcom	[...]	[0-5]	[...]	[0-5]	[...]	[0-5]
VMware	[...]	[30-40]	[...]	[20-30]	[...]	[20-30]
<i>Combined</i>	[...]	[30-40]	[...]	[20-30]	[...]	[20-30]
Flexera	[...]	[10-20]	[...]	[10-20]	[...]	[10-20]
Tanium	[...]	[0-5]	[...]	[5-10]	[...]	[10-20]
ServiceNow	[...]	[0-5]	[...]	[5-10]	[...]	[5-10]
Snow Software	[...]	[5-10]	[...]	[5-10]	[...]	[5-10]
IBM	[...]	[0-5]	[...]	[0-5]	[...]	[0-5]
Others	[...]	[30-40]	[...]	[20-30]	[...]	[20-30]
Total	[...]	100.0	[...]	100.0	[...]	100.0

Source: Form CO, Table 35

Table 2: IT Asset Management & Software Asset Management, EEA³¹⁰

	2019 ³¹¹		2020		2021	
	USD M	Share (%)	USD M	Share (%)	USD M	Share (%)
Broadcom	[...]	[0-5]	[...]	[0-5]	[...]	[0-5]
VMware	[...]	[20-30]	[...]	[20-30]	[...]	[20-30]
<i>Combined</i>	[...]	[20-30]	[...]	[20-30]	[...]	[20-30]
Snow Software	[...]	[10-20]	[...]	[10-20]	[...]	[10-20]
Flexera	[...]	[10-20]	[...]	[10-20]	[...]	[10-20]
ServiceNow	[...]	[0-5]	[...]	[5-10]	[...]	[5-10]
Ivanti	[...]	[0-5]	[...]	[5-10]	[...]	[5-10]
Tanium	[...]	[0-5]	[...]	[0-5]	[...]	[0-5]
Others	[...]	[30-40]	[...]	[20-30]	[...]	[20-30]
Total	[...]	100.0	[...]	100.0	[...]	100.0

Source: Form CO, Table 36

- (280) Based on Gartner's 2021 data, the Parties' combined market share exceeds 20% at the worldwide and EEA level in the Gartner segment for ITAM & SAM, giving rise to an affected market.³¹²

³⁰⁹ 2019 figures also include market data for IT Financial Management ("ITFM"). Gartner does not provide 2019 data for ITAM & SAM only (without ITFM).

³¹⁰ Gartner ITOM Report provides shares only at regional level. Therefore, EEA in this particular dataset refers to regions Western and Eastern Europe. 2019 data follows the general definition of the EEA as explained in context of Gartner Annex 3 (Horizontal) to the Form CO.

³¹¹ 2019 figures also include market data for ITFM. Gartner does not provide 2019 data for ITAM & SAM only (without ITFM).

³¹² The Parties' combined market share for 2022 is [20-30]% Worldwide and [20-30]% in the EEA. This is based on the following report: Gartner Software data 2022 (Market Shares: All Software Markets,

8.2.2. System Infrastructure software (IDC terminology)

8.2.2.1. System and Service Management software

8.2.2.1.1. ITACM software

(281) **Tables 3 and 4** below set out the Parties' and their main competitors' market shares for the years 2019, 2020 and 2021 extracted from the *IDC Worldwide Semianual Software Tracker, 2022* ("IDC 2022").³¹³

Table 3: IT Automation and Configuration Management, worldwide

	2019		2020		2021	
	USD M	Share (%)	USD M	Share (%)	USD M	Share (%)
Broadcom	[...]	[0-5]	[...]	[0-5]	[...]	[0-5]
VMware	[...]	[10-20]	[...]	[10-20]	[...]	[10-20]
Combined	[...]	[20-30]	[...]	[20-30]	[...]	[20-30]
ServiceNow	[...]	[5-10]	[...]	[5-10]	[...]	[5-10]
Microsoft	[...]	[5-10]	[...]	[5-10]	[...]	[5-10]
BMC	[...]	[5-10]	[...]	[5-10]	[...]	[5-10]
IBM	[...]	[5-10]	[...]	[5-10]	[...]	[5-10]
Hitachi	[...]	[5-10]	[...]	[5-10]	[...]	[5-10]
Others	[...]	[30-40]	[...]	[30-40]	[...]	[30-40]
Total	[...]	100	[...]	100	[...]	100

Source: Form CO, Table 25

Table 4: IT Automation and Configuration Management, EMEA

	2019		2020		2021	
	USD M	Share (%)	USD M	Share (%)	USD M	Share (%)
Broadcom	[...]	[5-10]	[...]	[5-10]	[...]	[5-10]
VMware	[...]	[20-30]	[...]	[20-30]	[...]	[20-30]
Combined	[...]	[20-30]	[...]	[20-30]	[...]	[20-30]
BMC	[...]	[10-20]	[...]	[10-20]	[...]	[10-20]
Microsoft	[...]	[5-10]	[...]	[5-10]	[...]	[10-20]
IBM	[...]	[10-20]	[...]	[5-10]	[...]	[5-10]
Hewlett Packard Enterprise	[...]	[5-10]	[...]	[5-10]	[...]	[5-10]
ServiceNow	[...]	[0-5]	[...]	[0-5]	[...]	[0-5]
Others	[...]	[30-40]	[...]	[30-40]	[...]	[30-40]
Total	[...]	100	[...]	100	[...]	100

Source: Form CO, Table 26

³¹³ Worldwide) and Gartner ITOM software data 2022 (Market Shares: IT Operations Management Software, Worldwide).
Form CO, Annex 7 (Horizontals).

(282) IDC 2022 only includes EMEA and not EEA market shares. Notwithstanding, the Notifying Party considers that the EEA shares for 2019, 2020 and 2021 would not be substantially different from the EMEA shares.³¹⁴

(283) Based on IDC's 2021 data, the Parties' combined market share exceeds 20% at the worldwide and EMEA/EEA level in the IDC segment for ITACM, giving rise to an affected market.³¹⁵

8.2.2.1.1.1. DSAC software

(284) **Table 5** below sets out the Parties' and their main competitors' market shares for the years 2019, 2020 and 2021 extracted from IDC 2022 and *IDC Worldwide Datacenter System and Application Control Software Market Shares, 2021: Strong Growth on Economic Rebound*, published in July 2022 ("IDC DSAC").

Table 5: Datacentre System and Application Control, worldwide

	2019		2020		2021	
	USD M	Share (%)	USD M	Share (%)	USD M	Share (%)
Broadcom	[...]	[0-5]	[...]	[0-5]	[...]	[0-5]
VMware	[...]	[20-30]	[...]	[20-30]	[...]	[20-30]
Combined	[...]	[20-30]	[...]	[20-30]	[...]	[20-30]
ServiceNow	[...]	[5-10]	[...]	[10-20]	[...]	[10-20]
Microsoft	[...]	[10-20]	[...]	[10-20]	[...]	[10-20]
IBM	[...]	[5-10]	[...]	[5-10]	[...]	[5-10]
HashiCorp	[...]	[0-5]	[...]	[0-5]	[...]	[0-5]
BMC	[...]	[5-10]	[...]	[0-5]	[...]	[0-5]
Others	[...]	[40-50]	[...]	[40-50]	[...]	[30-40]
Total	[...]	100	[...]	100	[...]	100

Source: Form CO, Table 24

(285) IDC 2022 and IDC DSAC do not provide EMEA (or EEA) shares for the DSAC segment. DSAC accounts for 76% of worldwide and EMEA market size of DSAC's umbrella functional market ITACM in 2021. As such, the Notifying Party submits that a comparison of the Parties' shares for ITACM across different geographies give the best possible indication on the differences between the Parties' shares for DSAC at the EEA level and worldwide. The Parties' combined market share for ITACM software is c. [5-10]% points higher in EMEA than worldwide. Broadcom's share is c. [0-5]%-points higher in EMEA than worldwide, and VMware's share is c. [5-10]% points higher in EMEA than worldwide. The combined worldwide shares are similar for DSAC and ITACM (c. [0-5]%-point difference), though Broadcom's share is

³¹⁴ Form CO, footnote 83. The data provided by Gartner allows a calculation of EEA and EMEA shares which indicate that for both Broadcom and VMware, overall, there are only limited differences in shares for EEA versus EMEA (below 3% difference in share). For the Delivery Automation sub-segment, VMware EEA share is c. [0-5]% smaller than EMEA share for each year of 2019 – 2021, and otherwise differences between EEA and EMEA shares for either party are around or materially below 1%. Additionally, when comparing the relative proportions of Broadcom's own revenues for each segment, these proportions are broadly similar for EMEA as for EEA.

³¹⁵ The Parties' combined market share for 2022 is [20-30]% Worldwide and [20-30]% in the EEA. This is based on the following reports: IDC Software data 2022 (IDC Semiannual Software Tracker) and 2022H1 IDC Infrastructure software data (IDC Semiannual Software-Defined Infrastructure Tracker).

lower in DSAC than in ITACM, while VMware's share in DSAC is higher than in ITACM. Further, when comparing the relative proportions of Broadcom's own revenues for each of ITACM and DSAC, these proportions are [Information on EEA market shares] for EMEA as for EEA. Overall, this suggests that the Parties' market shares in DSAC at the EEA level are [Information on EEA market shares] from the Parties' DSAC market shares worldwide.³¹⁶ Based on IDC's 2021 data, the Parties' combined market share exceeds 20% at the worldwide and (likely) at the EMEA/EEA level in the IDC segment for DSAC, giving rise to an affected market.³¹⁷

8.2.2.2. Network software

(286) **Tables 6 and 7** below set out the Parties' and their main competitors' market shares for the years 2019, 2020 and 2021 extracted from IDC 2022.

Table 6: Network Software, worldwide

	2019		2020		2021	
	USD M	Share (%)	USD M	Share (%)	USD M	Share (%)
Broadcom	[...]	[0-5]	[...]	[0-5]	[...]	[0-5]
VMware	[...]	[20-30]	[...]	[20-30]	[...]	[20-30]
<i>Combined</i>	[...]	[20-30]	[...]	[20-30]	[...]	[20-30]
IBM	[...]	[5-10]	[...]	[5-10]	[...]	[5-10]
SolarWinds	[...]	[5-10]	[...]	[5-10]	[...]	[5-10]
F5	[...]	[5-10]	[...]	[5-10]	[...]	[5-10]
Citrix	[...]	[0-5]	[...]	[0-5]	[...]	[0-5]
Gigamon	[...]	[0-5]	[...]	[0-5]	[...]	[0-5]
Others	[...]	[40-50]	[...]	[40-50]	[...]	[40-50]
Total	[...]	100.0	[...]	100.0	[...]	100.0

Source: Form CO, table 41

³¹⁶ Form CO, Annex 22 (Horizontals).

³¹⁷ Reply to RFI 32, question 1. The Notifying Party submits that IDC has not yet published the 2023 "Worldwide Datacenter System and Application Control Software Market Shares" report. Accordingly, 2022 market share data for the DSAC sub-segment is not available. As this is a narrower sub-segment under the ITACM segment, Broadcom does not expect material differences between 2021 and 2022 data (as is the case for ITACM).

Table 7: Network Software, EMEA

	2019		2020		2021	
	USD M	Share (%)	USD M	Share (%)	USD M	Share (%)
Broadcom	[...]	[0-5]	[...]	[0-5]	[...]	[0-5]
VMware	[...]	[20-30]	[...]	[20-30]	[...]	[30-40]
<i>Combined</i>	[...]	[20-30]	[...]	[30-40]	[...]	[30-40]
IBM	[...]	[10-20]	[...]	[10-20]	[...]	[10-20]
SolarWinds	[...]	[10-20]	[...]	[10-20]	[...]	[5-10]
F5	[...]	[0-5]	[...]	[5-10]	[...]	[5-10]
HPE	[...]	[0-5]	[...]	[0-5]	[...]	[0-5]
Citrix	[...]	[0-5]	[...]	[0-5]	[...]	[0-5]
Others	[...]	[30-40]	[...]	[30-40]	[...]	[30-40]
Total	[...]	100.0	[...]	100.0	[...]	100.0

Source: Form CO, table 42

- (287) IDC 2022 only includes EMEA and not EEA market shares. The Notifying Party does not consider that the EEA shares for 2019, 2020 and 2021 would be substantially different from the EMEA shares. When comparing the relative proportions of Broadcom's own revenues for Network Software, the proportions [Business secret – market shares] for EMEA [Business secret – market shares] for EEA.³¹⁸
- (288) Based on IDC's 2021 data, the Parties' combined market share exceeds 20% at the worldwide and EMEA/EEA level in the IDC segment for Network software, giving rise to an affected market.³¹⁹
- (289) The Notifying Party submits that all Broadcom products reported under the IDC secondary market Network software are included in the functional market Network Management software and all VMware's products reported under IDC secondary market Network software belong to the functional market Network Infrastructure software. Therefore, IDC only reports revenue for both Parties in the secondary level. Given that at the functional level, revenue is reported to either VMware or Broadcom, there is no horizontal overlap.

8.2.3. Virtualization software

- (290) **Tables 8 to 14** set out VMware's and its main competitors' market shares for the years 2019, 2020 and 2021. **Tables 8 to 10** present shares by revenues (Gartner and IDC), while **Tables 11 to 14** present volume shares. There are some methodological limitations to each of the different approaches.
- (291) First, with regard to the **revenue shares**, Gartner's and IDC's data is based on estimates of vendors' revenues from server virtualization software. This means that

³¹⁸ Form CO, footnote 83 and Reply to RFI 32, question 2.

³¹⁹ The Parties' combined market share for 2022 is [20-30]% Worldwide and [20-30]% in the EEA. This is based on the following reports: Gartner Software data 2022 (Market Shares: IDC Software data 2022 (IDC Semiannual Software Tracker) and 2022H1 IDC Infrastructure software data (IDC Semiannual Software-Defined Infrastructure Tracker).

some vendors (such as Microsoft and several other CSPs) who do not separately charge for their software because they either bundle it with other products (such as their cloud platform) or because they offer open source-based software while monetizing their business by charging for (support) services, are not captured by the data in **Tables 8 to 10**.³²⁰ Furthermore, neither Gartner nor IDC provide data that reflect the separate deployment models.

Table 8: Server Virtualization Infrastructure for x86 servers (worldwide, by revenues – Gartner)³²¹

	2019		2020		2021	
	Revenue (USD M)	Share (%)	Revenue (USD M)	Share (%)	Revenue (USD M)	Share (%)
VMware	[...]	[90-100]	[...]	[90-100]	[...]	[90-100]
IBM	[...]	[0-5]	[...]	[0-5]	[...]	[0-5]
Huawei	[...]	[0-5]	[...]	[0-5]	[...]	[0-5]
Citrix	[...]	[0-5]	[...]	[0-5]	[...]	[0-5]
Inspur	[...]	[0-5]	[...]	[0-5]	[...]	[0-5]
Oracle	[...]	[0-5]	[...]	[0-5]	[...]	[0-5]
Virtuozzo	[...]	[0-5]	[...]	[0-5]	[...]	[0-5]
Sugon	[...]	[0-5]	[...]	[0-5]	[...]	[0-5]
Others	[...]	[0-5]	[...]	[0-5]	[...]	[0-5]
Total	[...]	100	[...]	100	[...]	100

Source: Form CO, Annex 11 (Conglomerate)

- (292) With regard to the IDC-based revenue shares set out below in **Table 9**, the Parties presented IDC’s functional market for “Software-Defined Compute Software” in the Form CO.³²² However, these shares are not limited to server virtualization software in the on-premises and private cloud environment, but these also contain containerization software and cloud system software. Furthermore, these shares encompass server virtualization used in traditional datacentres, private and public clouds.
- (293) Therefore, the Commission has also added **Table 10** which sets out IDC’s submarket of the functional market presented in **Table 9**. This is the market for “Virtual Machine Software” (also known as hypervisor software) which refers to server virtualization and partitioning. These shares do not include containerization or cloud system software. However, similarly to above, these shares are not limited to a particular deployment environment but apply across all deployment environments.

³²⁰ Commission decision of 29 February 2016 in case M.7861 – Dell / EMC, paragraph 157.

³²¹ These market shares are based on Gartner. Gartner defines the sub-segment “x86 Server Virtualization Infrastructure” as “includ[ing] the hypervisor, VM and virtual machine monitors (VMMs) for the x86 processor family”. Gartner’s share estimates therefore only include virtualization software that runs on x86 CPUs. These shares are not limited to a particular deployment environment, x86-based servers are used across all environments.

³²² Form CO, Annex 11 (Conglomerate).

Table 9: Software-Defined Compute Software (worldwide, by revenues – IDC)³²³

	2019		2020		2021	
	Revenue (USD M)	Share (%)	Revenue (USD M)	Share (%)	Revenue (USD M)	Share (%)
VMware	[...]	[60-70]	[...]	[60-70]	[...]	[60-70]
IBM	[...]	[5-10]	[...]	[5-10]	[...]	[5-10]
Huawei	[...]	[0-5]	[...]	[5-10]	[...]	[5-10]
H3C	[...]	[0-5]	[...]	[0-5]	[...]	[0-5]
Inspur	[...]	[0-5]	[...]	[0-5]	[...]	[0-5]
Alibaba Group	[...]	[0-5]	[...]	[0-5]	[...]	[0-5]
Amazon	[...]	[0-5]	[...]	[0-5]	[...]	[0-5]
Microsoft	[...]	[0-5]	[...]	[0-5]	[...]	[0-5]
Oracle	[...]	[0-5]	[...]	[0-5]	[...]	[0-5]
Google	[...]	[0-5]	[...]	[0-5]	[...]	[0-5]
SUSE	[...]	[0-5]	[...]	[0-5]	[...]	[0-5]
Tencent	[...]	[0-5]	[...]	[0-5]	[...]	[0-5]
Mirantis	[...]	[0-5]	[...]	[0-5]	[...]	[0-5]
Canonical	[...]	[0-5]	[...]	[0-5]	[...]	[0-5]
Digital Ocean	[...]	[0-5]	[...]	[0-5]	[...]	[0-5]
Hashicorp	[...]	[0-5]	[...]	[0-5]	[...]	[0-5]
Others	[...]	[5-10]	[...]	[5-10]	[...]	[10-20]
Total	[...]	100.0	[...]	100.0	[...]	100.0

Source: Form CO, Annex 11 (Conglomerate)

³²³

IDC's functional market "Software-Defined Compute Software" also includes container infrastructure software (which relates to container software) and cloud system software (which is a combination of server abstraction, orchestration software, and controller software, often sold as part of a larger cloud infrastructure platform solution). These shares are not limited to a particular deployment environment but apply across all deployment environments.

Table 10: Virtual Machine Software (worldwide, by revenues - IDC)³²⁴

	2019		2020		2021	
	Revenue (USD M)	Share (%)	Revenue (USD M)	Share (%)	Revenue (USD M)	Share (%)
VMware	[...]	[80-90]	[...]	[80-90]	[...]	[70-80]
IBM	[...]	[5-10]	[...]	[5-10]	[...]	[5-10]
Huawei	[...]	[0-5]	[...]	[0-5]	[...]	[5-10]
H3C	[...]	[0-5]	[...]	[0-5]	[...]	[0-5]
Microsoft	[...]	[0-5]	[...]	[0-5]	[...]	[0-5]
Others	[...]	[5-10]	[...]	[5-10]	[...]	[5-10]
Total	[...]	100.0	[...]	100.0	[...]	100.0

Source: Form CO, Annex 73 (Conglomerate)

- (294) Second, with regard to the **volume shares**, IDC previously produced volume shares of server virtualization hosts, which the Commission relied on in *Dell / EMC*.³²⁵ The Notifying Party has indicated that IDC discontinued production of that particular data set.³²⁶
- (295) Instead, the Notifying Party initially provided shares of the number of virtualized server CPUs installed globally, which the Parties calculated themselves based on VMware's internal data for VMware volumes and IDC data for third-party volumes.³²⁷ These shares are now set out in **Table 11**.
- (296) Thereafter, the Parties commissioned IDC to prepare a market model to estimate revised volume shares which rely solely on IDC data and do not use VMware internal data. **Tables 12** and **13** below provide IDC's estimates of VMware's and competitors' market shares in server virtualization software, both in terms of virtualized server CPUs installed and new virtualization licenses shipped. These shares include CSPs' on-premises versions of their public-cloud virtualization solutions. On the one hand, the installed base data measures sales in previous years instead of sales in each year, *i.e.*, 'stock' data, and as such reflects past competitive dynamics (**Table 12**). On the other hand, the new virtualization licenses shipped-based data tracks new installations (excluding new installations that rely on previously existing licenses) (**Table 13**).³²⁸

³²⁴ As explained in Annex 5 (Horizontals) to the Form CO, , within IDC's functional software market "Software-Defined Compute Software" (as presented in the Article 6(1)(c) Response and set out in Annex 11 (Conglomerate) to the Form CO, and Form CO, paragraphs 500-502), IDC defines a submarket for "Virtual Machine Software" (also known as hypervisor software) which refers to server virtualization and partitioning. These shares are not limited to a particular deployment environment but apply across all deployment environments.

³²⁵ Commission decision of 29 February 2016 in case M.7861 – *Dell / EMC*, tables 12-13.

³²⁶ The final iteration of IDC's server virtualization tracker was published in Q4 2015.

³²⁷ Form CO, Table 62.

³²⁸ The data set out in Table 12 and Table 13 do not correspond exactly to the IDC data that was used in *Dell / EMC*, given that the methodology does not entirely mirror the methodology that was used in IDC's former data set.

Table 11: Share of VMware's hypervisor in Worldwide Installed Base of Virtualized CPUs (Traditional Datacentre and Private Cloud)

	2019	2020	2021
VMware's active licenses	[...]	[...]	[...]
Total Virtualized CPUs installed	[...]	[...]	[...]
Share (%)	[40-50]	[40-50]	[40-50]

Source: Form CO, Table 62

Table 12: Shares of virtualized server CPUs installed worldwide (traditional datacentre and private cloud deployment)³²⁹

	2019		2020		2021	
	CPUs Installed	Share (%)	CPUs Installed	Share (%)	CPUs Installed	Share (%)
VMware	[...]	[40-50]	[...]	[30-40]	[...]	[30-40]
Microsoft	[...]	[20-30]	[...]	[20-30]	[...]	[20-30]
IBM (incl. RedHat)	[...]	[5-10]	[...]	[10-20]	[...]	[10-20]
Oracle	[...]	[0-5]	[...]	[0-5]	[...]	[0-5]
SUSE	[...]	[0-5]	[...]	[0-5]	[...]	[0-5]
AWS	[...]	[0-5]	[...]	[0-5]	[...]	[0-5]
Google	[...]	[0-5]	[...]	[0-5]	[...]	[0-5]
Alibaba	[...]	[0-5]	[...]	[0-5]	[...]	[0-5]
Other Hypervisors	[...]	[20-30]	[...]	[20-30]	[...]	[20-30]
Total	[...]	100.0	[...]	100.0	[...]	100.0

Source: Annex 4 to Annex RFI 13 Q 1

³²⁹

These shares are based solely on IDC's own data. The number of installed virtualized CPUs is the sum of all licenses shipped by each competitor in previous years that are still active.

Table 13: Shares of new virtualization licenses shipped worldwide (traditional datacentre and private cloud deployment)³³⁰

	2019		2020		2021	
	Number of licenses	Share (%)	Number of licenses	Share (%)	Number of licenses	Share (%)
VMware	[...]	[20-30]	[...]	[20-30]	[...]	[20-30]
Microsoft	[...]	[20-30]	[...]	[20-30]	[...]	[20-30]
IBM (incl. RedHat)	[...]	[10-20]	[...]	[10-20]	[...]	[10-20]
Oracle	[...]	[0-5]	[...]	[0-5]	[...]	[5-10]
SUSE	[...]	[0-5]	[...]	[0-5]	[...]	[0-5]
AWS	[...]	[0-5]	[...]	[0-5]	[...]	[0-5]
Google	[...]	[0-5]	[...]	[0-5]	[...]	[0-5]
Alibaba	[...]	[0-5]	[...]	[0-5]	[...]	[0-5]
Other Hypervisors	[...]	[20-30]	[...]	[20-30]	[...]	[20-30]
Total	[...]	100.0%	[...]	100.0%	[...]	100.0%

Source: Annex 1 to Annex RFI 13 Q 1

- (297) The number of VMware's active licenses estimated by IDC (**Table 12**) does not correspond to the figures from VMware's own data (**Table 11**). To compute shares of virtualized server CPUs installed worldwide in traditional datacentre and private cloud deployments that are based on the most accurate data available, the Commission has combined VMware's actual number of active licences (from **Table 11**) with the IDC estimates for the total market size and for the estimated number of licences by identified competitors (from **Table 12**). These shares are presented in **Table 14** below.

³³⁰

These shares are based solely on IDC's own data. New virtualization licenses shipped refers to all new hypervisor (or container host (bare-metal only) licenses obtained by customers). All new licenses are assumed to be priced per CPU. Reasons for new licenses being obtained include: 1. New server purchased/deployed with a hypervisor for new workloads (not replacing old servers). 2. New servers purchased/deployed with a hypervisor to replace retired servers – license required upgrade, migrated to a different platform, or retired servers were not virtualized. 3. Existing servers in the installed base required a hypervisor license – license required upgrade (new version), migrated to a different platform, or installed servers were not virtualized originally.

Table 14: Adjusted shares of virtualized server CPUs installed worldwide (traditional datacentre and private cloud deployment)³³¹

	2019		2020		2021	
	CPUs Installed	Share (%)	CPUs Installed	Share (%)	CPUs Installed	Share (%)
VMware	[...]	[40-50]	[...]	[40-50]	[...]	[40-50]
Microsoft	[...]	[20-30]	[...]	[20-30]	[...]	[20-30]
IBM (incl. RedHat)	[...]	[5-10]	[...]	[10-20]	[...]	[10-20]
Oracle	[...]	[0-5]	[...]	[0-5]	[...]	[0-5]
SUSE	[...]	[0-5]	[...]	[0-5]	[...]	[0-5]
AWS	[...]	[0-5]	[...]	[0-5]	[...]	[0-5]
Google	[...]	[0-5]	[...]	[0-5]	[...]	[0-5]
Alibaba	[...]	[0-5]	[...]	[0-5]	[...]	[0-5]
Other Hypervisors	[...]	[20-30]	[...]	[10-20]	[...]	[10-20]
Total	[...]	100.0	[...]	100.0	[...]	100.0

Source: Form CO, Table 62 and Annex 4 to Annex RFI 13 Q 1

(298) Similarly, according to the Parties, the number of VMware’s new virtualization licenses estimated by IDC (**Table 13**) does not correspond to the figures from VMware’s own data. To compute shares of new virtualization licenses worldwide in traditional datacentre and private cloud deployments that are based on the most accurate data available, the Parties adjusted VMware’s estimated number of new virtualized licenses provided by IDC (**Table 13**) to instead include VMware’s actual number of new virtualized licenses. As a result, VMware would have a market share of [30-40]% in 2019, [30-40]% in 2020 and [20-30]% in 2021.³³² The Parties did not put forward adjusted shares for competitors (but it can be assumed that this would not significantly change the market shares of competitors).

(299) These market shares and VMware’s position in the server virtualization software market will be discussed further below in Section 8.4.3.2.1.2.

8.2.4. FC HBAs

(300) **Tables 15** to **16** set out Broadcom’s and its main competitors’ market shares for the years 2017-2022. **Table 15** presents shares by revenues (Crehan Research) and **Table 16** presents volume shares. Once again, there are some methodological differences between the various methods.

(301) First, with regard to the **revenue shares**, the market shares are based on Crehan Research’s estimates of vendors’ revenues and market size and includes sales to

³³¹ These shares are based on VMware’s internal data for VMware volumes and IDC data for third-party volumes. The number of installed virtualized CPUs is the sum of all licenses shipped by each competitor in previous years that are still active.

³³² SO Response, Table 3, page. 101.

storage array customers. The Notifying Party adjusted the data to reflect Broadcom's actual revenues.

Table 15: FC HBAs (stand-up and mezzanine type)³³³ (worldwide, by revenue)³³⁴

		Broadcom	Marvell	Others	Total
2017	Revenue (USD M)	[...]	[...]	[...]	[...]
	Share (%)	[40-50]	[50-60]	[0-5]	100
2018	Revenue (USD M)	[...]	[...]	[...]	[...]
	Share (%)	[50-60]	[40-50]	[0-5]	100
2019	Revenue (USD M)	[...]	[...]	[...]	[...]
	Share (%)	[60-70]	[30-40]	[0-5]	100
2020	Revenue (USD M)	[...]	[...]	[...]	[...]
	Share (%)	[60-70]	[30-40]	[0-5]	100
2021	Revenue (USD M)	[...]	[...]	[...]	[...]
	Share (%)	[60-70]	[30-40]	[0-5]	100
2022 (Q1-Q3)	Revenue (USD M)	[...]	[...]	[...]	[...]
	Share (%)	[60-70]	[30-40]	[0-5]	100

Source: Form CO, Table 71 and Response to RFI 21, Annex Q1.

- (302) Second, with regard to the **volume shares**, the Notifying Party submitted that it does not have information regarding its market shares in terms of the volume of cards sold, which they submit is the most appropriate metric. Instead, the Notifying Party provided estimated shares of the number of ports sold globally, which it calculated based on Crehan Research's data on FC HBA sales reported. These shares are now set out in **Table 16** and include sales to storage array customers. While FC HBAs can have from one to four ports, FC HBAs used in storage arrays typically have a higher number of ports (e.g., four ports).

³³³ Stand-up and mezzanine are form factors for PCI expansion cards. The difference between both cards is only related to the physical form factor of the underlying card, not the functionality.

³³⁴ These market shares are based on Crehan Research's estimates of vendors' revenues and market size. Crehan's data has been adjusted to reflect Broadcom's actual revenues. The latest Crehan data reports only cover until 2022 Q3 and the Notifying Party therefore considers it is not possible to provide actual shares for the whole of year 2022.

Table 16: FC HBAs (worldwide, by volume)

		Broadcom	Marvell	Others	Total
2017	Ports ('000s)	[...]	[...]	[...]	[...]
	Share (%)	[50-60]	[40-50]	[0-5]	100
2018	Ports ('000s)	[...]	[...]	[...]	[...]
	Share (%)	[50-60]	[40-50]	[0-5]	100
2019	Ports ('000s)	[...]	[...]	[...]	[...]
	Share (%)	[60-70]	[30-40]	[0-5]	100
2020	Ports ('000s)	[...]	[...]	[...]	[...]
	Share (%)	[60-70]	[30-40]	[0-5]	100
2021	Ports ('000s)	[...]	[...]	[...]	[...]
	Share (%)	[60-70]	[30-40]	[0-5]	100
2022 (Q1-Q3)	Ports ('000s)	[...]	[...]	[...]	[...]
	Share (%)	[60-70]	[30-40]	[0-5]	100

Source: Response to RFI 21, Annex Q1 and Response to RFI 26.

8.2.5. Storage adapters

- (303) **Tables 17 and 18** set out Broadcom's and its main competitors' market shares for the years 2017 to 2022. **Table 17** presents shares by revenues and **Table 18** presents volume shares.
- (304) With regard to both the revenue and the volume shares, the Notifying Party submits that there is no third-party source available. It has provided estimated market shares on the assumption that the market for storage adapters is composed of: (i) ready-built storage adapters supplied by Broadcom, Microchip and Marvell (*i.e.*, "boards"); and (ii) storage adapters built by third parties using Broadcom's or Microchip's storage controllers (*i.e.*, "Broadcom and Microchip-based boards"). The Notifying Party believes that Broadcom-based storage adapters sold by third parties and can be viewed as competing with Broadcom's own storage adapters.
- (305) Broadcom's sales were estimated based on its own sales data, whereas competitors' sales were estimated based on Broadcom's business intelligence.³³⁵

³³⁵

For Broadcom's shares, the Notifying Party used, as a first step, the amount of Broadcom's storage controllers (value and volume). As a second step, it estimated sales of Broadcom-based storage adapters: (i) volume sales of storage adapters were considered equal to volume sales of storage controllers; value sales of storage adapters were estimated by multiplying by [Business secret – price structure] the average selling prices of Broadcom's storage controllers.

For Microchip's share, as a first step, the Notifying Party provided its best estimate of volume sales of Microchip boards and Microchip-based boards by customer. As a second step, provided its best estimate for the average selling price of Microchip Boards and Microchip-based Boards, depending on the customer and year. Estimated value sales were obtained by multiplying estimated volume sales by the average selling price. Marvell's shares were provided based on the Notifying Party's best estimates. See Annex 21 (Conglomerate) to Form CO.

Table 17: Storage adapters (worldwide, by revenue)³³⁶

		Broadcom boards	Broadcom-based boards	Broadcom total	Microchip boards and Microchip-based boards	Marvell storage adapters	Total
2017	Revenue (USD M)	[...]	[...]	[...]	[...]	[...]	[...]
	Share (%)	[20-30]	[40-50]	[60-70]	[20-30]	[5-10]	[...]
2018	Revenue (USD M)	[...]	[...]	[...]	[...]	[...]	[...]
	Share (%)	[20-30]	[40-50]	[60-70]	[20-30]	[5-10]	[...]
2019	Revenue (USD M)	[...]	[...]	[...]	[...]	[...]	[...]
	Share (%)	[20-30]	[40-50]	[60-70]	[20-30]	[5-10]	[...]
2020	Revenue (USD M)	[...]	[...]	[...]	[...]	[...]	[...]
	Share (%)	[20-30]	[40-50]	[70-80]	[20-30]	[5-10]	[...]
2021	Revenue (USD M)	[...]	[...]	[...]	[...]	[...]	[...]
	Share (%)	[30-40]	[40-50]	[70-80]	[20-30]	[5-10]	[...]
2022	Revenue (USD M)	[...]	[...]	[...]	[...]	[...]	[...]
	Share (%)	[30-40]	[40-50]	[80-90]	[10-20]	[0-5]	[...]

Source: Form CO, Table 73 and Response to RFI 21, Annex Q6.

³³⁶

These shares are based on the Parties' best estimates. See Annex 20-21 (Conglomerate) to the Form CO for a methodology note. No third-party data is available.

Table 18: Storage adapters (worldwide, by volume)

		Broadcom boards	Broadcom-based boards	Broadcom total	Microchip boards and Microchip-based boards	Marvell storage adapters	Total
2017	Volume (Number of devices)	[...]	[...]	[...]	[...]	[...]	[...]
	Share (%)	[10-20]	[50-60]	[60-70]	[20-30]	[10-20]	[...]
2018	Volume (Number of devices)	[...]	[...]	[...]	[...]	[...]	[...]
	Share (%)	[10-20]	[50-60]	[60-70]	[20-30]	[10-20]	[...]
2019	Volume (Number of devices)	[...]	[...]	[...]	[...]	[...]	[...]
	Share (%)	[10-20]	[40-50]	[60-70]	[20-30]	[10-20]	[...]
2020	Volume (Number of devices)	[...]	[...]	[...]	[...]	[...]	[...]
	Share (%)	[10-20]	[50-60]	[60-70]	[10-20]	[10-20]	[...]
2021	Volume (Number of devices)	[...]	[...]	[...]	[...]	[...]	[...]
	Share (%)	[20-30]	[40-50]	[60-70]	[20-30]	[10-20]	[...]
2022	Volume (Number of devices)	[...]	[...]	[...]	[...]	[...]	[...]
	Share (%)	[20-30]	[40-50]	[70-80]	[10-20]	[10-20]	[...]

Source: Form CO, Table 74 and Response to RFI 21, Annex Q6.

8.2.6. NICs

- (306) **Tables 19 and 20** set out Broadcom's and its main competitors' market shares for the years 2020-2022. **Table 19** presents shares by revenues and **Table 20** presents volume shares.

Table 19: Ethernet NICs (worldwide, by revenue)³³⁷

	2020		2021		2022	
	Revenue (USD M)	Share (%)	Revenue (USD M)	Share (%)	Revenue (USD M)	Share (%)
Broadcom	[...]	[5-10]	[...]	[10-20]	[...]	[10-20]
Intel	[...]	[40-50]	[...]	[30-40]	[...]	[20-30]
NVIDIA	[...]	[30-40]	[...]	[40-50]	[...]	[50-60]
Cisco	[...]	[0-5]	[...]	[0-5]	[...]	[0-5]
Marvell	[...]	[0-5]	[...]	[0-5]	[...]	[0-5]
AMD	[...]	[0-5]	[...]	[0-5]	[...]	[0-5]
Chelsio	[...]	[0-5]	[...]	[0-5]	[...]	[0-5]
Myricom	[...]	[0-5]	[...]	[0-5]	[...]	[0-5]
Other	[...]	[0-5]	[...]	[0-5]	[...]	[0-5]
Total	[...]	100	[...]	100	[...]	100

Source: Form CO, Table 66; Parties' Response to RFI 31

Table 20: Ethernet NICs (worldwide, by volume)

	2020		2021		2022	
	Ports ('000s)	Share (%)	Ports ('000s)	Share (%)	Ports ('000s)	Share (%)
Broadcom	[...]	[10-20]	[...]	[10-20]	[...]	[10-20]
Intel	[...]	[60-70]	[...]	[60-70]	[...]	[60-70]
NVIDIA	[...]	[10-20]	[...]	[10-20]	[...]	[20-30]
Cisco	[...]	[0-5]	[...]	[0-5]	[...]	[0-5]
Marvell	[...]	[0-5]	[...]	[0-5]	[...]	[0-5]
AMD	[...]	[0-5]	[...]	[0-5]	[...]	[0-5]
Chelsio	[...]	[0-5]	[...]	[0-5]	[...]	[0-5]
Myricom	[...]	[0-5]	[...]	[0-5]	[...]	[0-5]
Other	[...]	[0-5]	[...]	[0-5]	[...]	[0-5]
Total	[...]	100	[...]	100	[...]	100

Source: Parties' Response to RFI 31

³³⁷

These market shares are based on Crehan Research's estimates of vendors' revenues and market size. Crehan's data has been adjusted to reflect Broadcom's actual revenues.

8.3. Assessment of horizontal effects

8.3.1. Introduction

- (307) The Transaction gives rise to the following horizontally affected markets: (i) ITAM & SAM, (ii) ITACM software and its sub-segment (iii) DSAC software, and (iv) Network software, which will be covered in the following sections.

8.3.2. Legal Framework

- (308) The Guidelines on the assessment of horizontal mergers (“Horizontal Merger Guidelines”)³³⁸ describe two main ways in which horizontal mergers may significantly impede effective competition. In particular, the proposed concentration might be creating or strengthening a dominant position: (i) by eliminating important competitive constraints on one or more firms, which consequently would have increased market power, without resorting to coordinated behaviour (non-coordinated effects); and (ii) by changing the nature of competition in such a way that firms that previously were not coordinating their behaviour, are significantly more likely to coordinate and raise prices or otherwise harm effective competition (coordinated effects).
- (309) A merger giving rise to horizontal non-coordinated effects might significantly impede effective competition by creating or strengthening the dominant position of a single firm, one which, typically, would have an appreciably larger market share than the next competitor post-merger. Moreover, also mergers that do not lead to the creation of or the strengthening of a single firm’s dominant position may create competition concerns under the substantive test set out in Article 2(2) and Article 2(3) of the Merger Regulation. Regarding mergers in oligopolistic markets, the Merger Regulation clarifies that “*under certain circumstances, concentrations involving the elimination of important competitive constraints that the merging parties exerted upon each other, as well as a reduction of competitive pressure on the remaining competitors, may, even in the absence of a likelihood of coordination between the members of the oligopoly, result in a significant impediment to effective competition*”.³³⁹
- (310) The Horizontal Merger Guidelines list a number of factors which may influence whether or not significant horizontal non-coordinated effects are likely to result from a merger, such as the large market shares of the merging firms, the fact that the merging firms are close competitors, the limited possibilities for customers to switch suppliers, or the fact that the merger would eliminate an important competitive force. Not all those factors need to be present to make significant non-coordinated effects likely and it is not an exhaustive list.³⁴⁰

³³⁸ Guidelines on the assessment of horizontal mergers under the Council Regulation on the control of concentrations between undertakings (“Horizontal Merger Guidelines”), OJ C 31, 05.02.2004, paragraph 22.

³³⁹ Merger Regulation, recital 25. Similar wording is also found in paragraph 25 of the Horizontal Merger Guidelines.

³⁴⁰ Horizontal Merger Guidelines, paragraph 26.

8.3.3. ITAM & SAM

8.3.3.1. The Notifying Party's view

- (311) The Notifying Party considers that the Transaction will not significantly impede competition for the supply of ITAM & SAM for the following reasons.
- (312) The Notifying Party submits that the Parties' products do not compete against each other, as they may contain similar functionality but focus on different purposes and customers' needs. VMware's products provide visibility into and optimization of virtual machines that run on VMware's virtualization software ("vRealize Operations") or monitor and optimize resource usage (*e.g.*, virtual machine instances and associated CPU, memory and storage consumption, *etc.*) in the public cloud ("CloudHealth"). In contrast, Broadcom offers a stand-alone program [Business secret – quantities sold] that focuses on auditing and budgeting the cost of hardware assets and software licenses across platforms but does not assess a customer's usage or make recommendations to improve how a customer can make an efficiency use or purchase resources in cloud environments. While Broadcom's product reports cost for a variety of assets including hardware and software, for the purposes of providing visibility and cost allocation across different departments within a large IT organization, unlike "CloudHealth" it does not provide such reporting for a customer's usage of resources purchased, for example, from content security policies.³⁴¹ While the Notifying Party agrees with the use of Gartner's current segmentation that entails a single category for ITAM & SAM for the purposes of the Commission's assessment in the present Decision, it notes that, were ITAM and SAM to be considered separately, the Parties' products would not overlap as Broadcom's products belong to ITAM and VMware's products fall under the category of SAM.³⁴²
- (313) The Notifying Party also argues that the Parties face competition from a number of different credible and well-established competitors. Broadcom considers that "IT Asset Manager", "Service Catalog" and "Service Management" primarily compete with [Competitors' list]. VMware's "vRealize Operations" and "CloudHealth" directly compete with [Competitors' list].³⁴³
- (314) In addition, the Notifying Party considers that Parties' shares are low and [Business secret – financial situation of the company], and the increment resulting from the Transaction is negligible. The Parties' worldwide combined share in 2021 was [20-30%]% worldwide and [20-30%]% in EEA. Broadcom's share—and thus the increment resulting from the Transaction—is very low (only [0-5%]% in 2021 on a worldwide basis and [0-5%]% on an EEA basis), and its share is [Business secret – financial situation of the company].³⁴⁴
- (315) Further, the Notifying Party submits that the Herfindahl-Hirschman Index ("HHI") and Deltas resulting from the Transaction are negligible: the HHI [Business secret – financial situation of the company] exceeds the 1,000 threshold, and the delta does not exceed the 250 threshold included in the Commission's Horizontal Guidelines.³⁴⁵

³⁴¹ Form CO, paragraph 271.

³⁴² Form CO, paragraph 279.

³⁴³ Form CO, paragraph 272.

³⁴⁴ Form CO, paragraph 276.

³⁴⁵ Form CO, paragraph 277.

- (316) Finally, the Notifying Party submits that customers have countervailing buyer power in their commercial negotiations with the Parties, due to their size, their commercial importance to the Parties and their ability to switch to alternative suppliers. Broadcom's top customers in ITAM & SAM are companies with a significant level of technical understanding and expertise, such as [Business secret – customer list]. VMware's top customers in ITAM & SAM are sophisticated companies such as [Business secret – customer list]. A number of Broadcom's customers have switched away from Broadcom's ITAM product to an alternative solution, such as [Business secret – customer list]. VMware's customers have also switched away from a VMware SAM product to an alternative solution: *e.g.*, [Business secret – customer list] switched away from VMware's "vRealize Operations" to [Business secret – customer list]).³⁴⁶

8.3.3.2. The Commission's assessment

- (317) The Commission considers that the Transaction is unlikely to raise horizontal concerns in the market for the supply of ITAM & SAM, at a worldwide or EEA level.
- (318) First, the Parties' combined 2021 market shares in a narrowly defined ITAM & SAM market will remain moderate: [20-30]% worldwide and [20-30]% in the EEA.
- (319) Second, VMware's offering in ITAM & SAM will only increase modestly VMware's position in these markets. The increment contributed by Broadcom in the market for ITAM & SAM amounts to [0-5]% worldwide and [0-5]% in the EEA. The Parties will continue to face competition at the EEA level from a number of established players such as Snow Software ([10-20]% market share), Flexera ([10-20]%) or ServiceNow ([5-10]%), which have market shares that are larger than the increment resulting from the Transaction.
- (320) Third, the merged entity will continue to compete with a large number of other suppliers.
- (321) In the market investigation, the majority of respondents expressing an opinion considered that several companies supply product(s) that compete with Broadcom's products "IT Asset Manager", "Service Catalog", "Service Desk Manager" and/or "Service Management at a worldwide level. Such suppliers include ServiceNow, BMC, Flexera, IBM, Micro Focus and Ivanti³⁴⁷, which are also active at the EEA level.³⁴⁸
- (322) The majority of respondents expressing an opinion also considered that several companies supply product(s) that compete with VMware's products "vRealize Operations" and/or "Cloud Health" at a worldwide level. Such suppliers include BMC, IBM, ServiceNow and Flexera³⁴⁹, which are also active at the EEA level.³⁵⁰
- (323) One respondent noted that "generally speaking, the number of players in this market is broad and the barriers to entry low". There are options beyond those names listed here that would also increase potential competition; in particular, it has become

³⁴⁶ Form CO, paragraph 279 - 285.

³⁴⁷ Replies to Q1 – questionnaire for competitors and customers – Horizontal overlaps, question 6.

³⁴⁸ Form CO, Annex 48 (Section 8), "Broadcom and VMware's top 20 competitors in ITAM & SAM - EEA".

³⁴⁹ Replies to Q1 – questionnaire for competitors and customers – Horizontal overlaps, question 7.

³⁵⁰ Form CO, Annex 48 (Section 8), "Broadcom and VMware's top 20 competitors in ITAM & SAM - EEA"

increasingly more realistic for customers to be able to consider options for ITAM and SAM solutions to be created “DIY”, to have consulting firms come in and create bespoke solutions, or for Managed Service Providers to tailor solutions to a customer’s specific requirements. In addition, there are a number of other known competitors, such as Apptio, Corestack, Netapp, Densify, etc. who would be recognized by the likes of IDC, Gartner and Forrester and whose products could be leveraged to solve similar problems as these products/solutions are designed to resolve.³⁵¹

- (324) Fourth, the Commission considers that the Parties do not appear to compete closely. The vast majority of respondents that expressed an opinion considered that Broadcom’s and VMware’s products (identified above, in the present Section) focus on different customer needs.³⁵² Respondents explained that “*the market solutions are complementary*”³⁵³, “*the Broadcom portfolio solves challenges in customer main frame environments which is different than the software offering in VMware’s titles*”³⁵⁴ and “*VMWare’s main products focus on server virtualization around CPU/Memory, storage and network virtualization and surrounding operations management for the same, none of which are offered by Broadcom*”.³⁵⁵
- (325) For all the above reasons, the Commission concludes that the Transaction would not significantly impede effective competition on the market for the supply of ITAM & SAM, at a worldwide or EEA level.

8.3.4. ITACM software

8.3.4.1. The Notifying Party’s view

- (326) The Notifying Party considers that the Transaction will not significantly impede competition for the supply of ITACM software for the following reasons.
- (327) The Notifying Party submits that the Parties’ products do not compete against each other as the products generally do not overlap in functionality and are used for different purposes. Where functionality does overlap, the Parties’ products do not compete because VMware’s products are generally best used with VMware and cloud environments such as AWS, Azure, and Google Cloud, whereas Broadcom’s software is broader in nature and competes most effectively in on-premises environments. Products are also used for different purposes: VMware does not have any product designed to automate end-to-end business processes, while Broadcom offers end-to-end business process automation. In fact, Broadcom revenues are primarily derived from [Business secret – information about the financial situation of the company]. By contrast, none of the VMware solutions provide capabilities for this purpose.³⁵⁶
- (328) The Notifying Party also argues that the Parties face competition from a number of players. Broadcom considers that “Automic Automation” competes with

³⁵¹ Replies to Q1 – questionnaire for competitors and customers – Horizontal overlaps, questions 6.1. and 7.1 [ID 1409].

³⁵² Replies to Q1 – questionnaire for competitors and customers – Horizontal overlaps, question 8.

³⁵³ Replies to Q1 – questionnaire for competitors and customers – Horizontal overlaps, question 8.1 [ID 1533].

³⁵⁴ Replies to Q1 – questionnaire for competitors and customers – Horizontal overlaps, question 8.1 [ID 1939].

³⁵⁵ Replies to Q1 – questionnaire for competitors and customers – Horizontal overlaps, question 8.1. [ID 1587].

³⁵⁶ Form CO, paragraph 236.

[Competitors' list] whereas VMware's "vRealize Automation" competes with more niche players such as [Competitors' list].³⁵⁷

- (329) The Notifying Party considers that the Parties' shares are low and [Business secret – financial situation of the company]. The Parties' combined worldwide share was [20-30]% in 2021 and [Business secret – financial situation of the company] (a [0-5]% point [Business secret – financial situation of the company] since 2019).³⁵⁸
- (330) Further, the Notifying Party also argues that the HHI and Deltas resulting from the Transaction are negligible as the HHI [Business secret – financial situation of the company] exceeds the 1,000 threshold, and the delta does not exceed the 250 threshold included in the Commission's Horizontal Guidelines.³⁵⁹
- (331) Finally, the Notifying Party submits that strong customers have significant countervailing buying power in their commercial negotiations with the Parties, due to their size, their commercial importance to the Parties and their ability to switch to alternative suppliers. Broadcom's top customers are companies such as [Business secret – customer list] which are sophisticated players with a significant level of technical understanding and expertise. VMware's top customers are companies such as [Business secret – customer list] which have considerable internal experience and select their suppliers based on rigorous and sophisticated processes which allow them to compare suppliers across technical, business, operational and legal vectors. Broadcom's large enterprise customers (such as [Business secret – customer list]) are increasingly leveraging Red Hat's Ansible Automation Platform as a framework to deliver a variety of automation functions. Recently, VMware's customers (such as [Business secret – customer list]) have switched away from a VMware Delivery Automation product to an alternative solution.³⁶⁰

8.3.4.2. The Commission's assessment

- (332) The Commission considers the Transaction is unlikely to raise horizontal concerns in the market for the supply of ITACM software, at a worldwide or EEA level.
- (333) First, the Parties' combined 2021 market shares in a narrowly defined ITACM software market will remain moderate: [20-30]% worldwide and [20-30]% in EMEA.³⁶¹
- (334) Second, VMware's offering in ITACM software will only increase modestly VMware's position in these markets. The increment contributed by Broadcom in the market for ITACM amounts to [0-5]% worldwide and [5-10]% in EMEA. The Parties will continue to face competition at the EMEA level from a number of established players such as BMC ([10-20]% market share), Microsoft ([10-20]%) or IBM ([5-10]%), which have market shares that are larger than the increment resulting from the Transaction. These companies are also active at the EEA level.
- (335) Third, the merged entity will continue to compete with a large number of other suppliers.

³⁵⁷ Form CO, paragraph 244.

³⁵⁸ Form CO, paragraph 234.

³⁵⁹ Form CO, paragraph 235.

³⁶⁰ Form CO, paragraphs 246-253.

³⁶¹ As mentioned above, IDC only includes EMEA shares. The Notifying Party does not consider that the EEA shares for 2019, 2020 and 2021 would be substantially different from the EMEA shares. See Form CO, footnote 83.

- (336) In the market investigation, the majority of respondents expressing an opinion considered that several companies supply product(s) that compete with Broadcom's products "Asset Management Suite", "CA Agile Central/Rally", "CA Automic Dollar Universe", "CA JCL Check Workload Automation", "CA Plan Analyzer for DB2 for z/OS", "CA Workload Automation CA 7 Edition", "CA Workload Automation DE (dSeries)", "CA Workload Automation ESP Edition", "CA Workload Automation iDash", "CA Workload Automation Restart Option for z/OS Schedulers" at a worldwide level. Such suppliers include BMC, IBM, Micro Focus and Microsoft³⁶², which are also active at the EEA level.³⁶³
- (337) The majority of respondents expressing an opinion also considered that several companies supply product(s) that compete with VMware's products "Site Recovery Manager", "vCenterServer", "vRealizeAutomation", "vRealize Network Insight" and/or "vRealize Suite" at a worldwide level. Such suppliers include BMC, IBM, Microsoft, Nutanix, ServiceNow and Google³⁶⁴, which are also active at the EEA level.³⁶⁵
- (338) Fourth, the Commission considers that the Parties do not appear to compete closely. The majority of respondents that expressed an opinion considered that Broadcom's and VMware's products (identified above, in the present Section) focus on different customer needs.³⁶⁶ Respondents explained that "*the market solutions are complementary*"³⁶⁷ and "*the products have different combinations of functionalities that correspond to the different customer needs*".³⁶⁸ Respondents that expressed an opinion unanimously considered that VMware's ITACM software products are best used on VMware's virtualization software and/or in public cloud environments.³⁶⁹
- (339) For all the above reasons, the Commission concludes that the Transaction would not significantly impede effective competition on the market for the supply of ITACM software, at a worldwide or EEA level.

8.3.5. DSAC software

8.3.5.1. The Notifying Party's view

- (340) The Notifying Party considers that the Transaction will not significantly impede competition for the supply of DSAC software for the following reasons.
- (341) The Notifying Party submits that the Parties' products do not compete against each other as the products generally do not overlap in functionality and are used for different purposes. Where functionality does overlap, the Parties' products do not compete because VMware's products are generally best used with VMware and cloud environments such as AWS, Azure, and Google Cloud, whereas Broadcom's software is broader in nature and competes most effectively in on-premises

³⁶² Replies to Q1 – questionnaire for competitors and customers – Horizontal overlaps, question 15.

³⁶³ Form CO, Annex 45 (Section 8), "*Broadcom and VMware's top 20 competitors in IT Automation and Configuration Management Software (ITACM) - EEA*"

³⁶⁴ Replies to Q1 – questionnaire for competitors and customers – Horizontal overlaps, question 16.

³⁶⁵ Form CO, Annex 45 (Section 8), "*Broadcom and VMware's top 20 competitors in IT Automation and Configuration Management Software (ITACM) - EEA*".

³⁶⁶ Replies to Q1 – questionnaire for competitors and customers – Horizontal overlaps, question 17.

³⁶⁷ Replies to Q1 – questionnaire for competitors and customers – Horizontal overlaps, question 17.1 [ID 1533].

³⁶⁸ Replies to Q1 – questionnaire for competitors and customers – Horizontal overlaps, question 17.1. [ID 1829].

³⁶⁹ Replies to Q1 – questionnaire for competitors and customers – Horizontal overlaps, question 18.

environments. Products are also used for different purposes: VMware does not have any product designed to automate end-to-end business processes, while Broadcom offers end-to-end business process automation. In fact, Broadcom revenues are primarily derived from [Business secret – information about sales strategy]. By contrast, none of the VMware solutions provide capabilities for this purpose.³⁷⁰

- (342) The Notifying Party also argues that the Parties face competition from a number of players. Broadcom considers that “Automic Automation” competes with [Competitors’ list] whereas VMware’s “vRealize Automation” competes with more niche players such as [Competitors’ list].³⁷¹
- (343) The Notifying Party considers that the Parties’ combined shares are low and [Business secret – financial situation of the company]. The Parties’ combined worldwide share was [20-30]% in 2021 and [Business secret – financial situation of the company] (a [0-5]% point [Business secret – financial situation of the company] since 2019).³⁷²
- (344) Further, the Notifying Party also argues that the HHI and Deltas resulting from the Transaction are negligible as the HHI [Business secret – financial situation of the company] exceeds the 1,000 threshold, and the delta does not exceed the 250 threshold included in the Commission’s Horizontal Guidelines.³⁷³
- (345) Finally, the Notifying Party submits that strong customers have significant countervailing buying power in their commercial negotiations with the Parties, due to their size, their commercial importance to the Parties and their ability to switch to alternative suppliers. Broadcom’s top customers are companies such as [Business secret - customer list] which are sophisticated players with a significant level of technical understanding and expertise. VMware’s top customers are companies such as [Business secret - customer list] which have considerable internal experience and select their suppliers based on rigorous and sophisticated processes which allow them to compare suppliers across technical, business, operational and legal vectors. Broadcom’s large enterprise customers (such as [Business secret - customer list]) are increasingly leveraging Red Hat’s Ansible Automation Platform as a framework to deliver a variety of automation functions. Recently, VMware’s customers (such as [Business secret - customer list]) have switched away from a VMware Delivery Automation product to an alternative solution.³⁷⁴

8.3.5.2. The Commission’s assessment

- (346) The Commission considers that the Transaction is unlikely to raise horizontal concerns in the market for DSAC software, at a worldwide or EEA level.
- (347) First, the Parties’ combined 2021 market shares in a narrowly defined DSAC software market will remain moderate: [20-30]% worldwide and likely not materially different in EMEA or the EEA.³⁷⁵
- (348) Second, VMware’s offering in DSAC software will only increase modestly VMware’s position in these markets. The increment contributed by Broadcom in the market for DSAC amounts to [0-5]% worldwide and this is likely not materially

³⁷⁰ Form CO, paragraph 236.

³⁷¹ Form CO, paragraphs 241-243.

³⁷² Form CO, paragraph 234.

³⁷³ Form CO, paragraph 235.

³⁷⁴ Form CO, paragraphs 246-253.

³⁷⁵ See explanation in Section 8.2.2.1.1.1.

different in EMEA or the EEA.³⁷⁶ The Parties will continue to face competition at the EMEA level from a number of established players such as ServiceNow ([10-20]% market share), Microsoft ([10-20]%) or IBM ([5-10]%), which have market shares that are larger than the increment resulting from the Transaction. These companies are also active at the EEA level.

- (349) Third, the merged entity will continue to compete with a large number of other suppliers.
- (350) In the market investigation, the majority of respondents expressing an opinion considered that several companies supply product(s) that compete with Broadcom's products "Automic Automation", "Autosys", "CA Server Automation", "Client Management Suite", "Server Management Suite" and/or "Symantec ServiceDesk" at a worldwide level. Such suppliers include BMC, IBM, Microsoft, Micro Focus and Service Now³⁷⁷, which are active at the EEA level.³⁷⁸
- (351) The majority of respondents expressing an opinion also considered that several companies supply product(s) that compete with VMware's product "vRealize Automation" at a worldwide level. Such suppliers include IBM, Microsoft and HashiCorp³⁷⁹, which are active at the EEA level.³⁸⁰
- (352) Fourth, the Commission considers that the Parties do not appear to compete closely. The majority of respondents that expressed an opinion considered that Broadcom's and VMware's products (identified above, in the present Section) focus on different customer needs.³⁸¹ Respondents explained that "*VMware is focused on their virtualization while Broadcom's portfolio is broader*"³⁸² and "*those [Broadcom's] products focus on agile infrastructure atomization. VMware products used more in the classic infrastructure but developing to agile infrastructure*".³⁸³ The vast majority of respondents that expressed an opinion considered that VMware's DSAC software product is best used on VMware's virtualization software and/or in public cloud environments.³⁸⁴
- (353) For all the above reasons, the Commission concludes that the Transaction would not significantly impede effective competition on the market for the supply of DSAC software, at a worldwide or EEA level.

8.3.6. Network software

8.3.6.1. The Notifying Party's view

- (354) The Notifying Party considers that the Transaction will not significantly impede competition for the supply of Network software for the following reasons.

³⁷⁶ *Idem*.

³⁷⁷ Replies to Q1 – questionnaire for competitors and customers – Horizontal overlaps, question 23.

³⁷⁸ Form CO, paragraph 1023: "there is no IDC EMEA data available for DSAC and therefore the Parties do not provide contact details for the Parties' top 20 competitors in DSAC at EEA level. However, similarly to ITACM, the Parties expect that [Information on EEA competitors]."

³⁷⁹ Replies to Q1 – questionnaire for competitors and customers – Horizontal overlaps, question 24.

³⁸⁰ Form CO, paragraph 1023: "there is no IDC EMEA data available for DSAC and therefore the Parties do not provide contact details for the Parties' top 20 competitors in DSAC at EEA level. However, similarly to ITACM, the Parties expect that [Information on EEA competitors]."

³⁸¹ Replies to Q1 – questionnaire for competitors and customers – Horizontal overlaps, question 25.

³⁸² Replies to Q1 – questionnaire for competitors and customers – Horizontal overlaps, question 25.1 [ID 1776].

³⁸³ Replies to Q1 – questionnaire for competitors and customers – Horizontal overlaps, question 25.1[ID 1508].

³⁸⁴ Replies to Q1 – questionnaire for competitors and customers – Horizontal overlaps, question 26.

- (355) The Notifying Party submits that the Parties' products do not compete against each other as the products belong to different functional markets. VMware's products included in Network software are: (i) VMware NSX (including NSX Cloud, NSX for Horizon, Software Load Balancer-ADC), which is VMware's network virtualization and security software that enables users to create and deploy virtual networks independent of the underlying hardware; (ii) VMware SD-WAN, which is offered together with VMware's Edge, Orchestrator, and Gateway to deliver virtualized resources to Wide Area Network ("WAN") connections over both ordinary broadband internet and private links; and (iii) HCX which works with NSX and is used to migrate applications from on-premises environments to the private and public cloud. No Broadcom products include such functionalities. Broadcom's CA solutions reported under Network software – CA NetMaster® Network Automation, CA Spectrum, CA Network Flow Analysis, CA NetMaster® Network Management for TCP/IP, and CA NetMaster® Network Management for SNA – are different. Unlike VMware's products dealing with cloud and network virtualization, they either monitor network resource usage, diagnose network issues, analyse network performance, trace packets, and provide event history data, automate these management tasks, or monitor network traffic or solve network issues.³⁸⁵
- (356) The Notifying Party also argues that the Parties face competition from a number of players. Broadcom competes with [Competitors' list] – i.e., the players that are active in Network Management software. In contrast, VMware competes with [Competitors' list] – i.e., the players that are active in Network Infrastructure software.³⁸⁶
- (357) The Notifying Party considers that even when looking at the artificial overlap that IDC reports at secondary level, the Parties' shares are low and the increment resulting from the Transaction is negligible. The Parties' worldwide combined share in Network software in 2021 was [20-30]%. Broadcom's share – and thus the increment resulting from the Transaction – is low ([0-5]% in 2021 on a worldwide basis), and its share is [Business secret – financial situation of the company].³⁸⁷
- (358) Further, the Notifying Party submits that the Parties' HHI and increments are well below the Commission standard thresholds to identify competition concerns as the HHI [Business secret – financial situation of the company] exceeds the 1,000 threshold and the delta does not exceed the 250 threshold included in the Commission's Horizontal Guidelines.³⁸⁸
- (359) Finally, the Notifying Party submits that customers enjoy significant bargaining strength *vis-à-vis* Broadcom and VMware in their commercial negotiations, due to their size, their commercial significance to the Parties, the ability of these customers to switch to alternative suppliers, as well as the range of flexible perpetual/subscription fee-based monetization options. Broadcom's top customers in Network software are companies with a significant level of technical understanding and expertise, such as [Business secret - customer list]. VMware's top customers in Network software are companies of a similar profile and sophistication, such as [Business secret – customer list]. Customers have switched away from the Parties'

³⁸⁵ Form CO, paragraphs 306-309.

³⁸⁶ Form CO, paragraph. 310-312.

³⁸⁷ Form CO, paragraph 313.

³⁸⁸ Form CO, paragraph 313.

Network software product to an alternative solution (e.g., [Business secret – know-how]).³⁸⁹

8.3.6.2. The Commission's assessment

- (360) The Commission considers the Transaction is unlikely to raise horizontal concerns in the market for the supply of Network software, at a worldwide or EEA level.
- (361) First, the Parties' combined 2021 market shares in the Network software market will remain moderate: [20-30]% worldwide and [30-40]% in EMEA.³⁹⁰
- (362) Second, Broadcom's offering in Network software will only increase modestly VMware's position in these markets. The increment contributed by Broadcom in the market for Network software amounts to [0-5]% worldwide and [0-5]% in EMEA. The Parties will continue to face competition at the worldwide and EMEA level from a number of established players such as IBM ([5-10]% market share worldwide and [10-20]% EMEA) and SolarWinds ([5-10]% worldwide and [5-10]% EMEA), all of which have market shares which are larger than the increment resulting from the Transaction. These companies are also active at the EEA level.
- (363) Third, the merged entity will continue to compete with a large number of other suppliers.
- (364) In the market investigation, the majority of respondents expressing an opinion considered that several companies supply product(s) that compete with Broadcom's products "CA NetMaster Network Automation", "CA Spectrum", "CA Network Flow Analysis", "CA NetMaster Network Management for TCP/IP" and/or "CA NetMaster Network Management for SNA" at a worldwide level. Such suppliers include Cisco, IBM and SolarWinds³⁹¹, which are also active in the EEA.³⁹²
- (365) The majority of respondents expressing an opinion also considered that several companies supply product(s) that compete with VMware's products "NSX Cloud", "NSX for Horizon", "Software Load Balancer - ADC", "VMware HCX", "VMware NSX" and/or "VMware Software-Defined WAN (SD-WAN)" at a worldwide level. Such suppliers include Cisco, Citrix, F5 and Juniper³⁹³, which are also active in the EEA.³⁹⁴
- (366) Fourth, the Commission considers that the Parties do not appear to compete closely. The majority of respondents that expressed an opinion considered that Broadcom's and VMware's products (identified above, in the present Section) focus on different customer needs.³⁹⁵ Respondents explained that "*they are focused on different networking technologies*"³⁹⁶ and "*Broadcom's presence in the network automation*

³⁸⁹ Form CO, paragraph 313-321.

³⁹⁰ As mentioned above, IDC only includes EMEA shares. The Notifying Party considers that the EEA shares for 2019, 2020 and 2021 would be [Business secret – market shares] shares. See Form CO, footnote 83.

³⁹¹ Replies to Q1 – questionnaire for competitors and customers – Horizontal overlaps, question 31.

³⁹² Annex 68 (Section 8) to the Form CO "Broadcom and VMware's top 20 competitors in Network Software – Worldwide and EEA".

³⁹³ Replies to Q1 – questionnaire for competitors and customers – Horizontal overlaps, question 32.

³⁹⁴ Annex 68 (Section 8) to the Form CO "Broadcom and VMware's top 20 competitors in Network Software – Worldwide and EEA".

³⁹⁵ Replies to Q1 – questionnaire for competitors and customers – Horizontal overlaps, question 39.

³⁹⁶ Replies to Q1 – questionnaire for competitors and customers – Horizontal overlaps, question 33.1 [ID 1393].

*space is limited to network automation for mainframes and SAN. Broadcom is not directly competing with VMware's NSX products".*³⁹⁷ The vast majority of respondents that expressed an opinion considered that VMware's Network software products is best used on VMware's virtualization software and/or in public cloud environments.³⁹⁸

- (367) For all the above reasons, the Commission concludes that the Transaction would not significantly impede effective competition on the market for the supply of Network software, at a worldwide or EEA level.

8.3.7. Conclusion

- (368) In light of the above, the Commission concludes that the Transaction does not result in a significant impediment of effective competition on the markets for the supply of (i) ITAM & SAM, (ii) ITACM software and its sub-segment (iii) DSAC software, and (iv) Network software, as a result of a horizontal overlap between the Parties' activities.

8.4. Assessment of conglomerate effects

8.4.1. Introduction

- (369) The Transaction gives rise to a number of conglomerate relationships between VMware's and Broadcom's activities.
- (370) Following an overview of the legal framework (Section 8.4.2.), this Decision assesses whether the Transaction could lead to foreclosure of Broadcom's rivals in a number of hardware markets through the leveraging of VMware's position in the market for server virtualization software in the on-premises and private cloud environment. The assessment is conducted separately for the market for FC HBAs (Section 8.4.3.), the market for storage adapters (Section 8.4.4.), and the market for NICs (Section 8.4.5.).
- (371) Furthermore, this Decision assesses whether the Transaction could lead to a hampering of innovation resulting from the merged entity delaying or hindering the development of SmartNICs (Section 8.4.6.).
- (372) Finally, this Decision assesses whether the merged entity could, as a result of the Transaction, start bundling VMware's server virtualization software with Broadcom's software (Section 8.4.7.).

8.4.2. Legal framework

- (373) According to the Non-Horizontal Guidelines, in the majority of circumstances, conglomerate mergers will not lead to any competition problems.³⁹⁹
- (374) However, foreclosure effects may arise when the combination of products in related markets may confer on the merged entity the ability and incentive to leverage a strong market position from one market to another closely related market by means of tying or bundling or other exclusionary practices. While tying and bundling have often no anticompetitive consequences, in certain circumstances such practices may lead to a reduction in actual or potential competitors' ability or incentive to compete.

³⁹⁷ Replies to Q1 – questionnaire for competitors and customers – Horizontal overlaps, question 33.1.[ID 1569].

³⁹⁸ Replies to Q1 – questionnaire for competitors and customers – Horizontal overlaps, question 26.

³⁹⁹ Non-Horizontal Guidelines, paragraph 92.

This may reduce the competitive pressure on the merged entity allowing it to increase prices.⁴⁰⁰

- (375) In assessing the likelihood of such a scenario, the Commission examines, first, whether the merged firm would have the ability to foreclose its rivals⁴⁰¹, second, whether it would have the economic incentive to do so⁴⁰² and, third, whether a foreclosure strategy would have a significant detrimental effect on competition, thus causing harm to consumers.⁴⁰³ In practice, these factors are often examined together as they are closely intertwined.
- (376) In order to be able to foreclose competitors, the merged entity must have a significant degree of market power, which does not necessarily amount to dominance, in one of the markets concerned. The effects of bundling or tying can only be expected to be substantial when at least one of the merging parties' products is viewed by many customers as particularly important and there are few relevant alternatives for that product.⁴⁰⁴ Further, for foreclosure to be a potential concern, it must be the case that there is a large common pool of customers, which is more likely to be the case when the products are complementary.⁴⁰⁵ Finally, bundling is less likely to lead to foreclosure if rival firms are able to deploy effective and timely counter-strategies, such as single-product companies combining their offers.⁴⁰⁶
- (377) The incentive to foreclose rivals through bundling or tying depends on the degree to which this strategy is profitable.⁴⁰⁷ Bundling and tying may entail losses or foregone revenues for the merged entity.⁴⁰⁸ However, they may also allow the merged entity to increase profits by gaining market power in the tied goods market, protecting market power in the tying good market, or a combination of the two.⁴⁰⁹
- (378) It is only when a sufficiently large fraction of market output is affected by foreclosure resulting from the concentration that the concentration may significantly impede effective competition. If there remain effective single-product players in either market, competition is unlikely to deteriorate following a conglomerate concentration.⁴¹⁰ The effect on competition needs to be assessed in light of countervailing factors such as the presence of countervailing buyer power or the likelihood that entry would maintain effective competition in the upstream or downstream markets.⁴¹¹
- 8.4.3. *Foreclosure of suppliers of FC HBAs by restricting or degrading interoperability between rival FC HBAs and VMware's server virtualization software*
- (379) The Transaction gives rise to a conglomerate relationship between VMware's activities in the market for server virtualization software in the on-premises and private cloud environment and Broadcom's activities in the market for FC HBAs. While Broadcom does not sell or manufacture any hardware on which VMware's

⁴⁰⁰ Non-Horizontal Guidelines, paragraphs 91 and 93.

⁴⁰¹ Non-Horizontal Merger Guidelines, paragraphs 95 to 104.

⁴⁰² Non-Horizontal Merger Guidelines, paragraphs 105 to 110.

⁴⁰³ Non-Horizontal Merger Guidelines, paragraphs 111 to 118.

⁴⁰⁴ Non-Horizontal Merger Guidelines, paragraph 99.

⁴⁰⁵ Non-Horizontal Merger Guidelines, paragraph 100.

⁴⁰⁶ Non-Horizontal Merger Guidelines, paragraph 103.

⁴⁰⁷ Non-Horizontal Merger Guidelines, paragraph 105.

⁴⁰⁸ Non-Horizontal Merger Guidelines, paragraph 106.

⁴⁰⁹ Non-Horizontal Merger Guidelines, paragraph 108.

⁴¹⁰ Non-Horizontal Merger Guidelines, paragraph 113.

⁴¹¹ Non-Horizontal Merger Guidelines, paragraph 114.

virtualization software runs directly (such as CPUs, graphics-processing units (“GPUs”), or SmartNICs), Broadcom’s FC HBAs are server components which communicate with virtualization software indirectly, through drivers (see Section 6.3. above).

- (380) The Commission has examined whether the merged entity would have the ability, post-Transaction, to foreclose rival providers of FC HBAs by leveraging VMware’s strong position in the market for server virtualization software in the on-premises and private cloud environment.
- (381) In this regard, in its market investigation, the Commission has sought to verify whether the merged entity would likely have the **ability** and **incentive** to foreclose rival suppliers of FC HBAs by hampering the certified interoperability between their FC HBAs and VMware’s server virtualization software.
- (382) The Commission likewise sought to establish whether such a foreclosure strategy may have a negative **impact** on competition in the market for FC HBAs.

8.4.3.1. The Notifying Party’s view

- (383) The Notifying Party submits that the merged entity will not have the ability or the incentive to foreclose rival providers of FC HBAs through restricting or degrading the certified interoperability between these rival FC HBAs and VMware’s server virtualization software. Moreover, the Notifying Party submits that such foreclosure strategy would have no impact on effective competition in the worldwide market for FC HBAs.

8.4.3.1.1. Ability to foreclose

- (384) The Notifying Party submits that the merged entity will lack the ability to foreclose competing hardware providers by degrading the interoperability of their hardware with VMware’s virtualization software. This is based on the following arguments.

8.4.3.1.1.1. VMware has no significant degree of market power

- (385) The Notifying Party submits that the merged entity will not have the market power in the market for server virtualization software in general, nor in the on-premises and private cloud environment, to pursue such a foreclosure strategy. Concluding otherwise would disregard (i) VMware’s [Details on VMware’s market share] shares, (ii) the significant increase in competition in virtualization software since *Dell / EMC* both with on-premises (Microsoft, IBM/Red Hat, Oracle, SUSE, Nutanix and Citrix) and private cloud (Microsoft, AWS, Google, Oracle, IBM and Nutanix) suppliers, as well as with CSPs who are equally, if not better placed, than VMware to support customers’ hybrid/multi-cloud strategies, (iii) [Details on VMware’s internal documents] customers increasingly multi-home their workloads across different deployment environments, and (iv) many recent examples of customers [Details on VMware’s customers behavior].⁴¹² The Notifying Party further submits that high margins are not an indicator of a significant degree of market power.⁴¹³
- (386) First, the Notifying Party estimates that VMware holds **a market share close to [20-30]%** on the overall market for server virtualization software.⁴¹⁴ However, the Notifying Party submits that VMware’s market share is not significant and that the

⁴¹² Article 6(1)(c) Response, paragraph 50.

⁴¹³ Article 6(1)(c) Response, paragraph 87.

⁴¹⁴ Form CO, paragraph 723.

appropriate measure for present and future competitive dynamics is the market share based on new virtualized licenses shipped.

- (387) The Notifying Party submits that in 2021, VMware's share of supply in virtualization for all deployment types was [10-20]% and in the narrow traditional datacentre and private cloud segment, it corresponded to [20-30]%, or [20-30]% based on IDC data adjusted by VMware's actual data.⁴¹⁵ Microsoft is the market leader in both segments (with [20-30]% and [20-30]% market share respectively)⁴¹⁶ and VMware [Business secret – financial situation of the company], VMware's worldwide shares across all deployments [Business secret – financial situation of the company] from [10-20]% to [10-20]% and in the narrow traditional datacentre and private cloud segment, from [20-30]% to [20-30]%.⁴¹⁷
- (388) Second, VMware is subject to **significant competitive constraints** emanating from on-premises rivals including private cloud suppliers, including Microsoft Azure Stack, AWS Outposts and Google Anthos,⁴¹⁸ as well as constraints emanating from other virtualization software providers, CSPs and containerization providers. The Notifying Party refers to the Commission's decision in *Dell/EMC*⁴¹⁹, where these competitive constraints on VMware's virtualization software were referred to, and submits that, since this decision in 2016, said constraints have only increased.⁴²⁰
- (389) The Notifying Party refers, first, to proprietary server virtualization software as a source of competition, namely Microsoft's Hyper-V, a proprietary hypervisor bundled with Microsoft's popular Windows Server OS.⁴²¹ Hyper-V is part of a broad Microsoft offering that includes server Oss (Windows Server OS), on-premises virtualization (Hyper-V), cloud-based virtualization (Azure), on-premises stacks with virtualization (Azure Stack HCI), on-premises containerization (Windows Server Containers) and containerization (Azure Kubernetes Service). Consequently, Microsoft can offer users everything they need for a hybrid cloud environment that deploys workloads on bare metal and in virtual machines, containers, and the cloud.
- (390) A further source of competitive constraints is paid and unpaid open-source hypervisors. The Notifying Party notes, in this regard, that open-source hypervisors are an established alternative to proprietary virtualization software and popular among customers with mission-critical workloads, such as governments, banks, and utilities.⁴²²
- (391) Next, the Notifying Party submits that major public cloud providers, who have developed hypervisors for use in their own public clouds, exert considerable competitive constraints on VMware. Instead of using virtualization software to create virtual machines on-premises, customers can move workloads to the cloud and provision virtual machines there. Furthermore, these public cloud providers also increasingly displace VMware from on-premises environments by extending their public cloud infrastructure into private clouds.⁴²³ The Notifying Party bases these

⁴¹⁵ Article 6(1)(c) Response, paragraph 52 and SO Response, paragraph 188.

⁴¹⁶ Article 6(1)(c) Response, paragraph 53.

⁴¹⁷ Article 6(1)(c) Response, paragraph 54.

⁴¹⁸ SO Response, paragraph 303 and following.

⁴¹⁹ Commission decision of 29 February 2016 in case M.7861 – *Dell / EMC*.

⁴²⁰ Form CO, paragraph 724.

⁴²¹ Form CO, paragraph 726.

⁴²² Form CO, paragraph 726.

⁴²³ Form CO, paragraph 726.

arguments on a study by IDC indicating that the percentage of virtualized servers has increased from [30-40]% in 2016 to [50-60]% in 2021.⁴²⁴

- (392) The Notifying Party considers that internal documents confirm that VMware [Information on competitors]. Further, migrating workloads between hypervisor vendors requires no change to the workload and many customers use multiple hypervisors within their organizations.⁴²⁵ Multiple market research reports (and [Business secret – Know-how]) also confirm that private cloud solutions (such as Microsoft Azure, AWS Outposts and Google Anthos) are compelling alternatives to traditional on-premises solutions for customers who want to customize their cloud environments to meet their specific needs and may choose to keep some workloads on-premises to achieve the reliability and scalability methods of the cloud experience for those workloads.⁴²⁶ In addition, public cloud deployment has dramatically expanded in the past five years and it is expected to continue to grow at a faster pace than datacentre deployment.⁴²⁷
- (393) The Notifying Party also considers the competitive constraints from containerization software. Containers offer a runtime mechanism with a higher level of abstraction than virtual machines (namely abstraction of the OS rather than of the hardware), which makes it possible to match application with resources at a more granular level, as opposed to using virtual machines.⁴²⁸ The smaller and more lightweight nature of containers makes them ideally suited for developing applications as microservices. According to the Notifying Party, developers prefer working with containers because they offer flexibility and portability. Containers can encapsulate all the requirements for an application independently of the underlying host OS, and consequently make it easier to port applications across on-premises, hybrid, and multiple-cloud infrastructure.⁴²⁹
- (394) Third, the Notifying Party considers that VMware is **not uniquely positioned for the purposes of hybrid and/or multi-cloud strategies**. There exist numerous stronger competitors who supply on-premises, private cloud and public cloud solutions and spread workloads across different environments (*e.g.*, AWS, Microsoft Azure, Google Anthos, IBM Cloud, Oracle Cloud Infrastructure, Alibaba Cloud and Huawei Cloud). On the one hand, VMware is not the only infrastructure platform provider whose solutions can be used across public clouds, and on the other hand, the Workloads Study shows that [Details on vSphere customer's preferences].⁴³⁰ Furthermore, the Notifying Party considers that VMware customers [Details on VMware's customers' behavior].⁴³¹
- (395) Fourth, the Notifying Party submits that the assessment of market power should also take into account **switching of workloads** between two suppliers of server virtualization software which an end-customer already uses, rather than only switching from a current to a new server virtualization software provider, as well as switching of certain workloads rather than all workloads.⁴³²

⁴²⁴ Form CO, paragraph 726.

⁴²⁵ Article 6(1)(c) Response, paragraph 61.

⁴²⁶ Article 6(1)(c) Response, paragraph 63.

⁴²⁷ Article 6(1)(c) Response, paragraph 70.

⁴²⁸ Form CO, paragraph 729.

⁴²⁹ Form CO, paragraph 730.

⁴³⁰ Article 6(1)(c) Response, paragraphs 82-84.

⁴³¹ SO Response, paragraph 273.

⁴³² SO Response, paragraphs 218 and 220.

- (396) Fifth, the Notifying Party also submits that VMware's **high margins are not an indicator of a significant degree of market power** as such margins are not unusual for software products, given that most costs are fixed.⁴³³

8.4.3.1.1.2. The merged entity has no technical ability to engage in foreclosure

- (397) First, the Notifying Party submits that the ability to foreclose would require Broadcom to be able to **selectively target rivals**. This would entail that they are able to distinguish between (i) customers with a strong preference for rival hardware that would be prepared to switch to alternative hypervisors or migrate workloads to the cloud or containers, and (ii) customers using rival hardware who are less likely to migrate workloads, as they may be indifferent about the choice of hardware or have a strong preference for Broadcom's hardware.⁴³⁴ Where they are not able to do so, any putative foreclosure could only be achieved in a blanket manner and, given VMware's lack of significant degree of market power, this would not be successful.⁴³⁵
- (398) The Notifying Party provides a number of reasons why Broadcom will not be able to selectively target their customers in the described way.⁴³⁶ Firstly, VMware's software and Broadcom's hardware are not generally sold to a common pool of customers, and, even if the products were purchased by the same customer, VMware's software and Broadcom's hardware products are likely to be purchased through different procurement teams, and at different times. Secondly, VMware relies significantly on [Business secret – sales policy and strategy]. Thirdly, VMware cannot refuse or degrade interoperability for specific customers. The relevant hardware products interact with VMware's virtualization software through device drivers, *i.e.*, software written by the device manufacturer to allow VMware's hypervisor to interact with the hardware. VMware publishes standardized test suites that device manufacturers use to test and certify their drivers. Once VMware confirms that a driver has passed all tests, VMware certifies the driver, and the hardware can be used with VMware's virtualization software. This certification is specific to a hardware product, not a customer. Consequently, if VMware was to refuse or degrade interoperability with rival hardware, this would affect all customers of rival hardware, with no way of targeting specific customers.
- (399) As a result, Broadcom could not selectively target customers unless the customer tells VMware about various configurations and components of the potentially hundreds to thousands of servers it owns, Broadcom would be unable to identify them.
- (400) Second, the Notifying Party submits that VMware's **reputation for neutrality is critical** and acts as an absolute constraint on (i) total foreclosure and (ii) partial foreclosure, and that such foreclosure would either have to be so discreet that it could not plausibly have any impact on rivals or it would actually be detectable and harm VMware's reputation and overall business value.⁴³⁷ The Notifying Party argues that its rivals would promptly realize any delay as they would be alert for any sign of delay in comparison to past practice.⁴³⁸

⁴³³ Article 6(1)(c) Response, paragraph 87.

⁴³⁴ Form CO, paragraph 736.

⁴³⁵ Form CO, paragraph 739.

⁴³⁶ Form CO, paragraph 737.

⁴³⁷ SO Response, paragraphs 383-384.

⁴³⁸ SO Response, paragraphs 426-431.

- (401) The Notifying Party submits that there is no realistic ability for VMware to foreclose hardware rivals given that the value proposition of virtualization software and its commercial viability is inherently linked with virtualization software being compatible with as much hardware as possible. VMware's certification process is non-discriminatory and mostly automated as it is aimed at supporting a broad hardware ecosystem.⁴³⁹ The Notifying Party submits that (i) foreclosure would undermine its business model which is built on [Business secret – sales policy and strategy]; (ii) customers have various ways to circumvent the foreclosure strategy by, for example, simply not upgrading a newer version of vSphere or moving additional workloads to existing multi-home environments on rival hypervisors, or in the private cloud and public cloud; and (iii) foreclosure would put vSphere at a competitive disadvantage compared to other virtualization software.⁴⁴⁰
- (402) Third, the Notifying Party submits that technical support or interaction with VMware's engineers [Business secret – details on VMware's certification process] in the certification process, as [Business secret – details on VMware's certification process].⁴⁴¹
- (403) Fourth, in the SO Response, the Notifying Party submitted that the Commission misrepresented the importance of the server release date, because (i) there is a buffer to avoid missing the release date,⁴⁴² (ii) for full certification, OEMs can rely on rivals' existing products, include new products in the next quarterly update, therefore no lasting effects in terms of opportunity for new products beyond this initial period,⁴⁴³ and (iii) new generation FC HBAs have a slow adoption rate.⁴⁴⁴ For these reasons, the Notifying Party argues that the effects of foreclosure would be limited.

8.4.3.1.2. Incentive to foreclose

- (404) The Notifying Party submits that, even if the merged entity were able to foreclose, it would have no incentive to do so because (i) foreclosure would undermine VMware's neutrality, (ii) foreclosure would not be profitable, (iii) VMware's past ownership supports the lack of foreclosure strategy, (iv) customers have countervailing buyer power, and (v) Broadcom's rivals would retaliate.
- (405) First, as regards **VMware's neutrality**, the Notifying Party submits that the purpose of hypervisors, and VMware in particular, is to be OS-, hardware-, and software-agnostic. One of the key benefits of virtualization is to abstract from hardware diversity and present the underlying hardware, no matter how diverse, as homogenous to the OS, virtualization vendors must ensure that their products are compatible and work smoothly with as many hardware products as possible. For this reason, any effort to bias in any direction and any step away from VMware's neutrality would open vast opportunities for rivals.⁴⁴⁵ Furthermore, such a foreclosure strategy would harm VMware's reputation for openness.⁴⁴⁶ The Notifying Party recalls *Dell/EMC*⁴⁴⁷ and *IBM/Red Hat*⁴⁴⁸ in which the Commission

⁴³⁹ Article 6(1)(c) Response, paragraph 149.

⁴⁴⁰ Article 6(1)(c) Response, paragraph 150.

⁴⁴¹ SO Response, paragraphs 411-425.

⁴⁴² SO Response, paragraphs 401-407.

⁴⁴³ SO Response, paragraphs 394-401.

⁴⁴⁴ SO Response, paragraph 685.

⁴⁴⁵ Form CO, paragraph 740.

⁴⁴⁶ Form CO, paragraph 741.

⁴⁴⁷ Commission decision of 29 February 2016 in case M.7861 – *Dell / EMC*, paragraphs 178 and 180-181.

⁴⁴⁸ Commission decision of 27 June 2019 in case M.9205 – *IBM / Red Hat*, paragraphs 401 and 432.

considered the importance of neutrality and the reputational risk which would follow a departure from such a policy.⁴⁴⁹ According to the Notifying Party, VMware [Business secret – sales policy].⁴⁵⁰

- (406) Second, the Notifying Party further submits that **any foreclosure would not be profitable**. It first recalls the Commission’s assessment in *Dell/EMC*, in which it was assessed whether reduced vSphere sales would be compensated by increased Dell hardware sales.⁴⁵¹ At the time, the Commission found that foreclosure would not be profitable because Dell would lose more in vSphere sales (given vSphere’s [Business secret – margin calculation] gross margins) than it would gain from additional hardware sales.⁴⁵² According to the Notifying Party, if Dell had no incentive to degrade the interoperability of VMware’s virtualization software with rival hardware, then it follows that Broadcom must have no incentive either. The servers sold by Dell cost significantly more than Broadcom’s hardware, and servers’ absolute gross margins are likely to be higher than Broadcom’s gross margins on the hardware products involved.⁴⁵³
- (407) To support this argument, the Notifying Party replicated the Commission’s assessment in *Dell/EMC* and applied it to the present case to identify the number of customers that would need to switch from a foreclosed rival hardware vendor to the merged entity for foreclosure to be profitable.⁴⁵⁴ According to the Notifying Party’s analysis, a foreclosure strategy, in a conservative scenario, would only be profitable if more than [Business secret – estimates of quantities sold] of VMware server virtualization software customers that do not currently use Broadcom FC HBAs switched to Broadcom FC HBAs. In a more plausible scenario, more than [Business secret – estimates of quantities sold]% of VMware’s customers would need to switch for the strategy to be profitable.⁴⁵⁵ When accounting for the cumulative effect of all of the Commission’s feedback, the critical switching rate would still be at [Business secret – estimates of quantities sold]% for FC HBAs.⁴⁵⁶ In relation the hardware, the Notifying Party contends that differences in FC HBA features such as performance and reliability drive end-consumer preferences and that many end-consumers indeed have a preferred hardware supplier, which is why server OEMs multisource and offer choice to their customers. These customers would not likely switch to Broadcom hardware in response to any (temporary) partial foreclosure.⁴⁵⁷
- (408) *In relation to the software*, the Notifying Party contends that the (i) high virtualization costs are a reason for switching rather than against it, and multi-homing facilitates and accelerates switching.
- (409) The Notifying Party commissioned Management Insight Technologies (“MIT”) to carry out a comprehensive study to test VMware customer reactions to putative foreclosure scenarios (“the 2023 MIT Switching Survey”), which it submitted with its SO Response as evidence of switching by end-customers if the merged entity

⁴⁴⁹ Form CO, paragraphs 741-744.

⁴⁵⁰ Form CO, paragraphs 746-749.

⁴⁵¹ Form CO, paragraph 752.

⁴⁵² Form CO, paragraph 752.

⁴⁵³ Form CO, paragraph 753.

⁴⁵⁴ See Annex 55 (Conglomerate) and Annex 56 (Conglomerate) to the Form CO.

⁴⁵⁵ SO Response, paragraph 459.

⁴⁵⁶ SO Response, paragraph 494.

⁴⁵⁷ SO Response, paragraph 498 and following.

were to remove interoperability between VMware virtualization software and non-Broadcom FC HBAs and storage adapters.⁴⁵⁸

- (410) Third, the Notifying Party contends that VMware's previous behaviour under similar circumstances of ownership (first by EMC and later by Dell), should be taken as evidence that there is no incentive to engage in exclusionary conduct. In the view of the Notifying Party, Dell and EMC had a greater ability to use VMware virtualization software to increase their hardware sales than would Broadcom. Firstly, Dell servers, EMC storage arrays, and VMware software [Business secret – sales policy and strategy]. Secondly, storage arrays and servers are [Business secret – sales policy and strategy], thus increasing Dell and EMC's incentives to degrade interoperability.⁴⁵⁹ However, despite having plausibly had a greater incentive and ability to use vSphere to favour their hardware products, neither EMC nor Dell ever attempted to take advantage of VMware's offerings by foreclosing hardware rivals even during the era that predated the existential threats posed by CSPs.⁴⁶⁰
- (411) Fourth, the Notifying Party submits that Broadcom's customers have countervailing buyer power which curtails the Parties' ability to impede effective competition. Both VMware's and Broadcom's customers include sophisticated server OEMs, system integrators, and IT organizations who would retaliate if Broadcom attempted to degrade the interoperability of VMware's virtualization software with hardware of their choice.⁴⁶¹ Broadcom's top ten FC HBA customers account for [Business secret – quantities sold]% of Broadcom's total sales of FC HBAs.⁴⁶² Most of Broadcom's sales of the relevant hardware products correspond to sales to [Business secret – sales policy and strategy] to the extent that, in the past three years, OEMs constituted between [Business secret – quantities sold]% of Broadcom's global revenues in the relevant hardware products and [Business secret - quantities sold]% of Broadcom's EEA revenues in the relevant hardware products.⁴⁶³ Furthermore, the ability to counter any effort by Broadcom to foreclose is also a result of how these sophisticated technology enterprises procure the relevant hardware products through global requests for quotations and product-by-product competitive bidding procedures.⁴⁶⁴ Generally, these OEMs benefit from offering consumers a broad range of hardware and would [Business secret – strategic decisions].⁴⁶⁵ If Broadcom were to foreclose, these OEMs would [Business secret – strategic decisions]. Moreover, the Notifying Party argues that server OEMs will not be forced to rely exclusively on Broadcom since even assuming the foreclosure would be successful, OEMs can still purchase rival devices which have already been certified or devices certified by equivalency, which represent [Business secret – quantities sold]% of sales of FC HBAs every year. Furthermore, the Notifying Party considers that server OEMs can easily retaliate by [Business secret – strategic decisions].⁴⁶⁶
- (412) Furthermore, the Notifying Party submits that any such degradation would equally aggravate end-users of VMware's and Broadcom's products. Customers mix and

⁴⁵⁸ SO Response, paragraph 541 and Annexes -SO Response- Incentive- 4 and 6. See Section 8.4.3.2.2.3. below for more detail.

⁴⁵⁹ Form CO, paragraph 769.

⁴⁶⁰ Form CO, paragraph 770.

⁴⁶¹ Form CO, paragraph 774.

⁴⁶² Form CO, paragraph 775.

⁴⁶³ Form CO, paragraph 777.

⁴⁶⁴ Form CO, paragraph 778.

⁴⁶⁵ Form CO, paragraph 779.

⁴⁶⁶ SO Response, paragraphs 566 and following.

match their preferred hardware components and would reject any attempt to influence their choice of products by degrading interoperability.⁴⁶⁷ Customers would switch to alternative virtualization software providers or migrate workloads away from on-premises virtualization towards containers and the public cloud. Many of these customers already deploy some workloads in these environments and could shift additional workloads if on/off-premises environments became less attractive.⁴⁶⁸

- (413) Finally, the Notifying Party submits that server OEMs and large hyperscalers would retaliate against any foreclosure strategy. OS vendors predetermine the hardware devices supported by their OS and dictate the hardware supported by VMware. Server OEMs would not accommodate VMware because [Business secret – strategic decisions].⁴⁶⁹ Since the majority of servers worldwide do not use VMware’s virtualization software, OEMs would continue having the incentive to offer Broadcom’s rivals’ hardware products in their servers to meet demand from customers that have a preference for non-Broadcom hardware or would be indifferent.⁴⁷⁰ Server OEMs can easily retaliate against a hypothetical foreclosure strategy by [Business secret – strategic decisions].⁴⁷¹ Large hyperscalers dictate their own hardware requirements to server OEMs, and could [Business secret – strategic decisions].⁴⁷² Moreover, according to the Notifying Party, [Business secret – strategic decisions].⁴⁷³

8.4.3.1.3. Impact on effective competition

- (414) The Notifying Party submits that, even if the merged entity had both the ability and incentive to foreclose rival FC HBA vendors by degrading the interoperability of their products with VMware, there would be no significant impediment to effective competition.
- (415) First, the Notifying Party submits that Broadcom **does not have a significant degree of market power** in the market for FC HBAs. According to the Notifying Party, market shares in FC HBAs have – and will continue to – fluctuate significantly, which makes them an unreliable proxy for the assessment of market power. In fact, in the Notifying Party’s view, it is likely that such share fluctuations would occur in the near future in view of [Business secret – sales policy and strategy].⁴⁷⁴
- (416) Furthermore, Notifying Party also argues that the SO erroneously dismisses competitive constraints on Broadcom, namely the system-level competition between FC HBAs and other technologies or protocols (*e.g.*, Ethernet).⁴⁷⁵
- (417) The Notifying Party also submits that **any foreclosure behaviour would not significantly impede competition**. Even assuming that rivals would miss server OEMs delivery deadlines, the effects would remain short-lived and limited to the period of delay. Furthermore, the Notifying Party submits that the effects would in any case be insignificant, given that (i) missing the release deadline will only mean that the device will be added in the next quarterly refresh,⁴⁷⁶ (ii) rival’s already

⁴⁶⁷ Form CO, paragraph 781.

⁴⁶⁸ Form CO, paragraph 782.

⁴⁶⁹ Article 6(1)(c) Response, paragraph 267.

⁴⁷⁰ Article 6(1)(c) Response, paragraph 268.

⁴⁷¹ Article 6(1)(c) Response, paragraph 271 and 272.

⁴⁷² Article 6(1)(c) Response, paragraph 275.

⁴⁷³ SO Response, paragraph 600 and following.

⁴⁷⁴ SO Response, paragraph 635 and following.

⁴⁷⁵ SO Response, paragraphs 643, 646.

⁴⁷⁶ SO Response, paragraph 676.

certified generations of hardware (which constitute the majority of sales each year – [Business secret– quantities sold]% for FC HBAs) will not be impacted,⁴⁷⁷ (iii) sales losses would be limited due to the slow adoption rate for FC HBAs,⁴⁷⁸ (iv) rival hardware vendors would have ample opportunities to sell their products given that only [Business secret – quantities sold]% of servers worldwide are virtualized by VMware.⁴⁷⁹ Furthermore, the Notifying Party submits that partial foreclosure cannot affect several categories of devices, namely (i) FC HBAs sold into storage arrays (because they are not certified with VMware’s server virtualization software), (ii) already-certified FC HBA models, (iii) FC HBAs that would be certified by equivalency or (iv) FC HBAs that require full certification for which VMware’s support is not required. Therefore, the Notifying Party submits that the partial foreclosure theory can only affect [Business secret – quantities sold]% of FC HBA sales. The Notifying Party considers that any putative degradation of interoperability would not deprive rival hardware vendors that compete with Broadcom of “*minimum viable scale*”.⁴⁸⁰

- (418) For FC HBAs, assuming that Marvell incurred a 1-year delay and that all the sales would be diverted to Broadcom, the Notifying Party contends that Marvell revenues from VMware virtualized servers would decrease by USD [Business secret – market shares] million (*i.e.*, a loss of [Business secret – market shares] percentage points in market shares) and Marvell revenues from all servers would decrease by USD [Business secret – market shares] million (*i.e.*, a loss of [Business secret – market shares] percentage points in market shares). The putative losses as calculated by the Notifying Party are so small that they cannot justify the conclusion that rivals would invest less.
- (419) Finally, [Business secret - strategic decision].⁴⁸¹ In the Notifying Party’s view, [Business secret - strategic decision] eliminates all concerns, if any, about Broadcom’s ability to refuse or degrade the interoperability between rival FC HBAs and VMware’s server virtualization software, especially since Broadcom, [Business secret - strategic decision].⁴⁸²

8.4.3.2. The Commission’s assessment

- (420) For the reasons set out below and based on the results of the market investigation, the Commission has reached the conclusion that the merged entity would have the ability and incentive to engage in a market-wide partial foreclosure strategy *vis-à-vis* its only rival in the market for FC HBAs by degrading the certified interoperability between these rival hardware products and VMware’s server virtualization software in the on-premises and private cloud environment.⁴⁸³ The Commission agrees with the Notifying Party that it would not be possible to target the certified interoperability of specific FC HBA customers but considers that the merged entity would have the ability and incentive to engage in a market-wide foreclosure strategy

⁴⁷⁷ SO Response, paragraph 678.

⁴⁷⁸ SO Response, paragraph 685.

⁴⁷⁹ SO Response, paragraph 688; Form CO, paragraph 787.

⁴⁸⁰ Article 6(1)(c) Response, paragraph 278; SO Response, paragraphs 692-697.

⁴⁸¹ SO Response, paragraphs 703-707.

⁴⁸² SO Response, paragraphs 708-710.

⁴⁸³ Form CO, paragraph 736 and following. The Notifying Party submits that there is no possibility to target specific hardware customers given that Broadcom would need to distinguish between customers with a strong preference for rival hardware and customers using rival hardware but less likely to migrate workloads between hypervisors.

vis-à-vis its only rival in the market for FC HBAs that would impact the certified interoperability of all hardware customers (*i.e.*, a market-wide strategy). Moreover, if the merged entity engaged in such a market-wide foreclosure strategy, the anticompetitive effects on the market for FC HBAs would be significant.

8.4.3.2.1. Ability to foreclose

- (421) For the reasons set out below, the Commission has reached the conclusion that the merged entity would have the ability to engage in a market-wide foreclosure strategy of its rivals in the market for FC HBAs by degrading the certified interoperability between these rival hardware products and VMware's server virtualization software.
- (422) First, certified interoperability with VMware's hypervisor is important and necessary for FC HBAs. Second, VMware has a significant degree of market power on the market for server virtualization software in the on-premises and private cloud environment. Third, the merged entity has the technical ability to degrade (certified) interoperability with its hypervisor. Fourth, Broadcom's only rival in the market for FC HBAs, Marvell, is not able to deploy effective and timely counterstrategies.

8.4.3.2.1.1. Interoperability with hypervisor is important for FC HBAs

- (423) As set out in Section 6.3. above, like any other OS, hypervisors interact with some of the hardware within and connected to a server – such as processor, memory, and storage – to pool these physical computing resources and allocate them among the virtual machines. Such communication between these hardware products and the virtualization software happens indirectly, through drivers. This process similarly applies to FC HBAs. These hardware products interoperate with VMware's hypervisor ESXi.
- (424) Based on the results of the market investigation, interoperability with VMware's hypervisor ESXi is considered a **critical feature of competition** between hardware suppliers of these server components. A majority of market respondents expressing an opinion consider that it would not be possible to sell hardware products to end-customers (*i.e.*, enterprises) otherwise. Indeed, as will be set out in detail in Section 8.4.3.2.3.2., customers indicated they would not purchase non-certified interoperable hardware. Furthermore, all hardware suppliers⁴⁸⁴ submitted that they obtain certification of the interoperability of their products with VMware's server virtualization software (as well as with Windows and Linux).⁴⁸⁵ FC HBA's main customers, *i.e.*, server OEMs, require FC HBAs with the broadest OS support (*i.e.*, certified interoperability with the main OS versions of Windows, Linux and VMware) since it is too burdensome and complex to manage separate servers depending on which software the end-customer is running and whether this end-customer's servers are virtualized or not.
- (425) One market respondent explained: "With regards to interoperability, [name] indicates that to use VMware's virtualization software, hardware needs to be interoperable with it."⁴⁸⁶
- (426) One hardware supplier explained that "VMware is one of three major operating systems used in servers (along with Linux and Microsoft Windows), and support in

⁴⁸⁴ "Hardware suppliers" consist of FC HBA, storage adapter, and NIC vendors. See above Section 6.3 where it is explained that the VMware IOVP program is the relevant certification program for I/O devices which includes NICs, FC HBAs and storage adapters.

⁴⁸⁵ Replies to Q3 – questionnaire to competitors of Broadcom, question 28.

⁴⁸⁶ Agreed minutes of call with a market participant dated 25 August 2022 [ID 3008].

VMware is essential for Intel to be able to sell its products. Timely certification is essential as customers will not use Intel hardware that is not certified to work with VMware in mission critical applications. API disclosure and technical support from VMware are essential for Intel to make new hardware and/or features in hardware available to its customers running on VMware.⁴⁸⁷ Another hardware supplier indicated that: “Timely certification, API disclosures, and technical support are all “go-to-market” requirements. Without them, a company cannot compete effectively in the enterprise market. Timely certification is vital for enterprise customers. Enterprise customers place a high value on documentation certifying that a solution has been tested and will work as expected. VMware certifications are important enough that a business will not succeed with enterprise customers without them.”⁴⁸⁸ Finally, another hardware supplier stated that: “The VMWare certification process is a required step for Microchip products because VMWare will not support customers running uncertified configurations.”⁴⁸⁹

- (427) During a technical meeting, the Parties further confirmed that “certification ensures that compatible hardware devices are secure, safe, and as performant as required.”⁴⁹⁰ Furthermore, “Certification programs are routine for hypervisors.”⁴⁹¹
- (428) Microchip explained that “[s]erver OEMs expect that your hardware supports everything (or most) OS, because it is not feasible for server OEMs to manage their customer base by saying that a single server works with one OS, but not with another. The broadest type of OS certified interoperability is expected. In practice, this means that before the device is released on the market, an established hardware vendor will ensure certified interoperability with an estimated 70 types of OS versions. Most of these versions are Linux, the rest is Windows and VMware (with a few other smaller varieties such as Solaris, which has a smaller customer base). Server OEMs expect that your device is certified interoperable with the leading edge of all the versions of Linux, Windows and VMware. Server OEMs also expect that you will have all that OS support in hand.”⁴⁹²
- (429) On the basis of all these elements, and for the purposes of this Decision, the Commission has reached the conclusion that certified interoperability with **VMware’s hypervisor is important** for FC HBAs.

8.4.3.2.1.2. VMware holds a significant degree of market power on the market for server virtualization software in the on-premises and private cloud environment

- (430) According to the Non-Horizontal Merger Guidelines, in order to be able to foreclose competitors, the merged entity must have a significant degree of market power, which does not necessarily amount to dominance, in one of the markets concerned. The effects of bundling or tying can only be expected to be substantial when at least one of the merging parties' products is viewed by many customers as particularly

⁴⁸⁷ Replies to Q3 – questionnaire to competitors of Broadcom, question 23.4 [ID 1785].

⁴⁸⁸ Replies to Q3 – questionnaire to competitors of Broadcom, question 23.4 [ID 4246].

⁴⁸⁹ Replies to Q3 – questionnaire to competitors of Broadcom, question 23.4 [ID 4306].

⁴⁹⁰ VMware, *Interoperability & Certification*, Presentation to the European Commission, 16 February 2023, slide 19.

⁴⁹¹ VMware, *Interoperability & Certification*, Presentation to the European Commission, 16 February 2023, slide 19.

⁴⁹² Agreed minutes of call with Microchip dated 10 March 2023 [ID 4302].

important and there are few relevant alternatives for that product, *e.g.*, because of product differentiation or capacity constraints on the part of rivals.⁴⁹³

- (431) The Commission considers that VMware has a significant degree of market power in market for server virtualization software in the on-premises and private cloud environment. This is based on the following reasons.
- (432) First, VMware holds a significant market share on the market for server virtualization software in the on-premises and private cloud environment. Second, customers of virtualization software view VMware's product as particularly important. Third, there appear to be no relevant alternatives to VMware's product, given that no other virtualization software providers offer (i) a full stack of software products in addition to the hypervisor, (ii) maintain a cloud-agnostic ecosystem across deployment environments, (iii) offer an equally mature product that is (iv) of equal or greater interest to customers. Fourth, it is difficult and complex to switch away from VMware to a different hypervisor. Finally, the on-premises environment will remain important to customers. Each of these elements is discussed in further detail in the Sections 8.4.3.2.1.2.1. to 8.4.3.2.1.2.5. below.

8.4.3.2.1.2.1. VMware's market share is significant

- (433) The Notifying Party provided worldwide market shares by revenue (Gartner, IDC) for an overall virtualization software market (or wider subject to data availability) and volume (own estimates, IDC-model) for the market for server virtualization software in the on-premises and private cloud environment (see Section 8.2.3. above for the exact delineations).
- (1) **Revenue.** VMware's 2021 market share on an overall market for server virtualization software: [90-100]% (Gartner, limited to x86 servers for all deployments), [60-70]% (IDC, Software-Defined Compute Software for all deployments) and [70-80]% (IDC, Virtual Machine Software for all deployments)⁴⁹⁴; and
- (2) **Volume.** VMware's market share on a market for server virtualization software in the on-premises and private cloud environment: [40-50]% (Parties, virtualized server CPUs installed), [30-40]% (IDC, virtualized server CPUs installed) and [20-30]% (Parties and IDC, new virtualization licenses shipped including container hosts).
- (434) **Revenue-based.** The Commission agrees with the Parties' submissions that the revenue-based data may lack credibility given that it does not consider open-source alternatives or software that is bundled with other offerings. The Commission has therefore focused on volume shares in the remainder of this Section. Nevertheless, there appear to be numerous VMware internal documents, which will be referenced throughout Section 8, that [Other confidential information – VMware's internal documents].
- (435) **Volume-based.** As regards volume-based market shares, the Parties have provided the Commission with four sets of volume estimates as set out above. In the market for server virtualization software in the on-premises and private cloud environment, VMware's 2021 volume-based market share is [40-50]% (own estimate) for installed base and [20-30]% (own estimate) for new licenses, or [30-40]% (IDC-

⁴⁹³ Non-Horizontal Merger Guidelines, paragraph 99.

⁴⁹⁴ Revenue data for a narrower market or market segment for server virtualization software is not available.

commissioned) for installed base and [20-30]% (IDC-commissioned) for new licenses. Microsoft and IBM/Red Hat are the other big players in this market. Microsoft has 2021 shares of [20-30]% for installed base and [20-30]% for new licenses (both IDC-commissioned). IBM has 2021 shares of [10-20]% for installed base and [10-20]% for new licenses (both IDC commissioned).

- (436) First, regarding the Notifying Party's claim that VMware has no significant degree of market power, with only [20-30]% of new virtualization licenses shipped, the Commission notes that shares based on the installed base more accurately reflect VMware's entire customer base and the alternatives available to this customer base. Both existing and new customers could potentially be affected by the partial foreclosure strategy, given that these customers' FC HBAs will require replacement at a certain point in time. In addition, the Notifying Party's argument that shares of new licenses more accurately reflect the current and future choices of new and existing customers should also be seen in the context of VMware moving from a perpetual licensing model to a subscription-based licensing model. This may lead customers on perpetual VMware licenses that do not wish to migrate to a subscription-based model to hold on to their existent licenses for longer than usual (to the extent possible) so that VMware customers are underrepresented in the share of new licenses.
- (437) Nevertheless, all VMware customers, (including customers in the installed base) are likely to be subject to a significant degree of lock in as changing virtualization software is costly and disruptive (Section 8.4.3.2.2.), and a potential FC HBA market-wide partial foreclosure strategy could eventually affect the entire base of VMware customers, *i.e.*, both existing servers and/or new servers using existing VMware licenses (including perpetual licenses). Therefore, the Commission considers that market shares based on the installed base of customers on the market for virtualization software in the on-premises and private cloud environment are a more appropriate metric than shares based on the number of new licenses shipped. VMware has a market share of [40-50]% over the installed base of licences for deployments on-premises and on private cloud according to the Parties' own estimate.
- (438) Second, while the Commission acknowledges the Notifying Party's claim that revenue shares are likely less reliable and may overrepresent VMware's market share (see above in the present Section), the Commission considers that the volume estimates may underrepresent VMware's actual share.
- (439) [Details on VMware's internal documents] and third-party views consistently indicate that VMware's share is [Details on internal document describing VMware's market share].

(1) [Details on internal document describing VMware's market share] .⁴⁹⁵

(2) In a February 2022 presentation [Details on internal document describing VMware's market position].⁴⁹⁶⁴⁹⁷ This is presented below as **Figure 5**Figure 5.

⁴⁹⁵ CMA document, [Other confidential information – Concerns Broadcom's internal documents].

⁴⁹⁶ Broadcom internal document, [Other confidential information – Concerns Broadcom's internal documents].

⁴⁹⁷ Broadcom internal document, [Other confidential information – Concerns Broadcom's internal documents].

Figure 5: [Chart in internal document describing VMware's position]

[...]

Source: Broadcom

- (3) In a VMware document from [Details on internal document describing VMware's strategy] VMware mentions its [Details on internal document describing VMware's market position].⁴⁹⁸
- (4) Another VMware internal document [Details on internal document describing VMware's market position].⁴⁹⁹
- (5) In a strategic memo regarding [Details on internal document describing VMware's position and market share].⁵⁰⁰ The Commission understands that these shares are revenue-based estimates using IDC reports. VMware acknowledges: [Details on internal document describing quantities sold by VMware]. This is also evidenced by [Details of figure contained in internal document] (see **Figure 6**).

Figure 6: [Graph and chart in internal document describing VMware sales volumes]

[...]

Source: VMware

- (6) In a document [Details on internal document describing VMware's market share].⁵⁰¹
- (440) With regard to third-party views, an end-customer estimated that "80%-90% of companies in Europe use VMware (and the same percentage of companies in Germany use VMware)."⁵⁰² An association of end-customers indicated that: "VMware server virtualization solution named vSphere has around 90% market share for on prem deployment for both private and public sector users (legacy DC and on prem private cloud) It also has been adopted by many French CSP (OVHcloud, Orange, Capgemini, Thales, and other) and all large public cloud provider services (AWS, Azure, Google Cloud, Oracle, IBM, and AliCloud) which offer to the users either their own hypervisor solution, or VMware hypervisor running in their DC."⁵⁰³
- (441) An annual company assessment of [Details of internal document describing VMware's market share].⁵⁰⁴
- (442) Finally, further internal documents and third-party views that discuss the importance of VMware's server virtualization software more broadly, will be set out below (see Section 8.4.3.2.1.2.2.).
- (443) As explained in the Non-Horizontal Guidelines, market shares are the standard starting point to assess market power as part of the Commission's competitive assessment. Market shares (and related concentration levels) "*provide useful first indications*" of the structure of the markets at stake and of the competitive

⁴⁹⁸ VMware internal document, [Other confidential information –VMware's internal documents].

⁴⁹⁹ VMware internal document, [Other confidential information –VMware's internal documents].

⁵⁰⁰ VMware internal document, [Other confidential information –VMware's internal documents].

⁵⁰¹ CMA document, [Other confidential information –VMware's internal documents].

⁵⁰² Agreed minutes of call with Münchener Rück dated 9 February 2023 [ID 4153].

⁵⁰³ Replies to Q4 – questionnaire to customers of VMware and Broadcom, question 9.10 [ID 1517].

⁵⁰⁴ VMware internal document, [Other confidential information –VMware's internal documents].

importance of the relevant market players.⁵⁰⁵ In addition, the Commission is less likely to find competition concerns where the market share post-merger of the new entity is below 30%.⁵⁰⁶

- (444) As explained below, the market shares indicated above provide only a limited first indication of the merged entity's position on the market and are likely to underestimate it. Based on its assessment, while the Commission takes note of the shortcomings of both the revenue-based and volume-based market share data available, it considers that VMware's share in the worldwide market for server virtualization software in the on-premises and private cloud environment is likely to be higher than the volume-based [40-50]%, but lower than revenue-based IDC's [70-80]% and Gartner's [90-100]%. In addition to market shares, a number of other elements may indicate the existence of a significant degree of market power. The Commission has considered such elements below.

8.4.3.2.1.2.2. VMware is viewed by many customers as particularly important

VMware's strong position is confirmed by the market investigation

- (445) With respect to on-premises and private cloud infrastructure, a large number of respondents to the Phase I and Phase II market investigation indicated that VMware's server virtualization software is particularly important and widely used for end-customers with deployments in the on-premises and private cloud environment. In fact, during the Phase I and Phase II market investigation, several respondents stated that most **end-customers rely on VMware's ESXi** as the hypervisor in on-premises and private cloud environments.
- (446) In particular, associations of end-customers refer to the "*widespread use of VMware*"⁵⁰⁷ and clearly state that "*VMware is the industry leader for on-prem virtualization*."⁵⁰⁸ In an online press release, Cigref indicated that "*VMware is the world leader in virtualisation products and its solutions are used by 90% of large public and private organisations. For example, all 155 large French companies and public administrations that are members of Cigref are, without exception, VMware customers*" and "*VMware's virtualisation products are absolutely essential to support the large public and private organisations that use them in their digital transformation strategies and in controlling their infrastructure costs*."⁵⁰⁹
- (447) This was confirmed by Broadcom's hardware rivals. Marvell indicated that VMware's technology is particularly relied on by FC HBA customers (who value security, reliability, protection): "*VMware is a partner to Marvell on server operating systems, as VMware is the market leader in SAN deployment*."⁵¹⁰ Another hardware rival states that "*VMware is a premier hypervisor for VMs [Virtual Machines] and most Enterprise customers rely on it*".⁵¹¹ Another hardware rival stated that "*VMware, by virtue of its critical position in providing the de facto standard for Enterprise and Cloud virtualization, both at the hypervisor and the*

⁵⁰⁵ Non-Horizontal Merger Guidelines, paragraph 24.

⁵⁰⁶ Non-Horizontal Merger Guidelines, paragraph 25.

⁵⁰⁷ CIO Platform's non-confidential reply to RFI 1, question 4 [ID 3951].

⁵⁰⁸ Cigref's non-confidential reply to RFI 1, question 3 [ID 3952].

⁵⁰⁹ <https://www.cigref.fr/broadcoms-takeover-of-vmware-customers-are-alarmed-about-a-drift-in-practices>.

⁵¹⁰ Agreed minutes of call with Marvell dated 22 September 2022 [ID 4298].

⁵¹¹ Replies to Q3 – questionnaire to competitors of Broadcom, question 35 [ID 1894].

*orchestration/management level, has a unique position as a gatekeeper for all technology providers and products addressing the Enterprise market”.*⁵¹²

- (448) Furthermore, a server OEM stated that: “Lenovo does not choose the virtualization platform for our customers, they choose the required software based on the needs of their business. VMware is the market leader followed by the competitors listed above.”⁵¹³ Similarly, a distributor stated: “For on premise server virtualization, VMware vSphere is the gold standards – used by at least 2/3 of our customers. Other hypervisors have only relevance in test/dev teams.”⁵¹⁴
- (449) Moreover, end-customers consistently indicated that VMware has not only pioneered virtualization software, but that it is considered the clear market leader having built out an extensive ecosystem. For instance, one end-customer explained that “VMWare has been the market leader in virtualization technologies for some time and there is an enormous ecosystem based upon VMWare’s product”.⁵¹⁵ Another end-customer stated that “The maturity and functionality of VMware’s software makes it preferred choice”.⁵¹⁶ Moreover, an association of end-customers makes the analogy between VMware and Microsoft Office with regard to VMware’s pervasive presence for virtualization software and the fact that they, as the pioneer in virtualization technology, remain the market leader. They state that: “Building an office environment is not exceedingly complicated, yet Microsoft Office controls the market and remains the standard. Since customers tend to stay with Microsoft Office, smaller companies do not manage to enter the market, as they are unable to market products that have a maturity and attractiveness level comparable to Microsoft Office. The situation is the same for VMware, which is controlling the standard for virtualization today.”⁵¹⁷
- (450) Another market respondent indicated: “[Name] is a customer of VMware. [Name] considers VMware’s products ubiquitous in the technology business. The core product is vSphere virtualization software, which is critical to [name]’s business, as well as many other companies that use distributed or cloud-based computing power.”⁵¹⁸
- (451) End-customers contacted as part of the Phase II market investigation also submitted that VMware should really be seen as the standard for and leader in virtualization software. These end-customers also stated that they relied heavily and for most of their workloads in their on-premises and private cloud environment on one hypervisor, namely VMware, as opposed to multi-sourcing hypervisors within one deployment environment. Such multi-sourcing is not considered logical or practical since it increases complexity and a lift-and-shift between those hypervisors of workloads would in any event not be possible (see below Section 8.4.3.2.2.2.). These end-customers consist of large enterprises in highly regulated sectors or sectors dealing with sensitive or mission-critical data such as financial services, telecommunications, aerospace, pharmaceuticals, insurance, energy, and government.

⁵¹² Replies to Q3 – questionnaire to competitors of Broadcom, question 43 [ID 1962].

⁵¹³ Replies to Q4 – questionnaire to customers of VMware and Broadcom, question 25.1 [ID 1912].

⁵¹⁴ Replies to Q4 – questionnaire to customers of VMware and Broadcom, question 25.1 [ID 1794].

⁵¹⁵ Replies to Q4 – questionnaire to customers of VMware and Broadcom, question 25.1 [ID 1918].

⁵¹⁶ Replies to Q4 – questionnaire to customers of VMware and Broadcom, question 25.1 [ID 1700].

⁵¹⁷ Agreed minutes of call with Business IT users’ association dated 6 July 2022 [ID 43].

⁵¹⁸ Agreed minutes of call with market respondent dated 25 August 2022 [ID 3008].

- (452) All end-customers explained that all or the vast majority of their on-premises and private cloud servers are virtualized using VMware. These end-customers are therefore not multi-sourcing at all, or only for very specific workloads.
- (453) For instance, one respondent stated that “All of [respondent’s] regular servers are virtualized using VMware”.⁵¹⁹ Another respondent said that “For their on-premises infrastructure, however, [Respondent] sources entirely from VMware.”⁵²⁰. One end-customer explained that “Deutsche Telekom’s on-premises and private cloud solutions are based on VMware.”⁵²¹, and another one that “ITZBund’s entire ‘Stack’ is therefore predominantly based on VMware.”⁵²² Siemens noted that it “has a lot of datacentres and not one single strategy across all the datacentres. The way in which the datacentres are managed is not centralized. As a global conglomerate, Siemens grants as much autonomy in decision-making as possible to the different businesses in operating their own datacentres. (...) Looking at the total scheme of things, Siemens has [the large majority] of workloads running on VMware.”⁵²³
- (454) Further supporting statements came from end-customers confirming that they view VMware as the standard: “Thales views VMware as the standard”;⁵²⁴ “Previously, E.ON used Hyper-V (in addition to vSphere) but it has now consolidated to using only vSphere, because it is the dominant hypervisor”⁵²⁵ [E.ON]; and “Bayer uses mostly VMware for its own virtualization environment. Some specific applications run on Hyper-V but it is not used in any strategic areas.”⁵²⁶ Furthermore, “In Bayer’s view, VMware is the most stable and the safest virtualization environment, as well as the hypervisor with which Bayer has the most experience. Given that Bayer runs [confidential] virtualized servers, these are important factors to Bayer.”⁵²⁷ Vodafone explains that “On the IT side, VMware is a key partner to Vodafone. Vodafone develops its own private cloud capability on the basis of VMware’s software and is therefore strongly dependent on VMware”.⁵²⁸
- (455) One end-customer also explained that “70% of Munich Re’s estate is running on VMware, independent of the environment in which it is deployed (on-premises, private cloud or public cloud)” and estimates that “80%-90% of companies in Europe use VMware (and the same percentage of companies in Germany use VMware).”⁵²⁹
- (456) Another end-customer adds that it would not even decide to multi-source given VMware’s superior quality: “Airbus purchases what it considers to be the best hypervisor on the market, i.e., VMware’s vSphere, and would not deliberately, save for the aforementioned circumstances in which a hypervisor is integrated into a service or product (i.e., a closed environment), decide to multi source from different virtualization software provider”⁵³⁰

⁵¹⁹ Agreed minutes of call with market participant dated 8 February 2023 [ID 4120].

⁵²⁰ Agreed minutes of call with a market participant dated 9 February 2023 [ID 3982].

⁵²¹ Agreed minutes of call with Deutsche Telekom dated 14 February 2023 [ID 4096].

⁵²² Agreed minutes of call with ITZBund dated 15 February 2023 [ID 4057] (working translation from German).

⁵²³ Agreed minutes of call with Siemens dated 27 February 2023 [ID 4079].

⁵²⁴ Agreed minutes of call with Thales dated 16 February 2023 [ID 4060].

⁵²⁵ Agreed minutes of call with E.ON dated 13 February 2023 [ID 4050].

⁵²⁶ Agreed minutes of call with Bayer dated 22 February 2023 [ID 3958].

⁵²⁷ Agreed minutes of call with Bayer dated 22 February 2023 [ID 3958].

⁵²⁸ Agreed minutes of call with Vodafone dated 10 February 2023 [ID 3988].

⁵²⁹ Agreed minutes of call with Münchener Rück dated 9 February 2023 [ID 4153].

⁵³⁰ Agreed minutes of call with Airbus dated 9 February 2023 [ID 4074].

VMware's strong position is confirmed by Broadcom and VMware's internal documents

- (457) The importance of VMware is also confirmed by [Details of internal documents of the parties] VMware consistently refers to and views itself as [Details of internal documents describing VMware's market position]. As set out above in Section 8.4.3.2.1.2.1., the Parties' internal documents and third-party views consistently indicate that VMware's share is significantly higher than [40-50%]. These internal documents also show that [Other confidential information – VMware's internal documents].⁵³¹
- (458) With regard to VMware's market leadership regarding **existing virtualized workloads**, internal documents show that [Other confidential information – VMware's internal documents].⁵³² In this environment, [Details on internal document describing VMware's growth projections].
- (459) Various **Broadcom documents** refer to [Details on internal document describing VMware's market position].
- (460) In a Broadcom presentation [Details on internal document describing VMware's market position].⁵³³ [Details on internal document describing VMware's market position].⁵³⁴
- (461) In another report [Details on internal document describing VMware's financial position and customers].⁵³⁵
- (462) [Other confidential information – VMware's internal documents] VMware's leading position in server virtualization software in the on-premises and private cloud environment.
- (463) A [Details on internal document where Broadcom describes VMware's market position].⁵³⁶
- (464) Similarly, a VMware internal document [Details on internal document describing VMware's market position].⁵³⁷ [Details on internal document describing VMware's market position].⁵³⁸
- (465) In a memo regarding VMware's [Details on internal document describing VMware's strategy], VMware stated: [Details on internal document describing VMware's market position].⁵³⁹ This same internal document emphasizes [Details on internal document describing VMware's business].⁵⁴⁰
- (466) [Details on the date of internal document describing VMware's market position], a VMware presentation related to [Details on internal document describing VMware's

⁵³¹ For instance, and as will be set out below, VMware internal document, [Other confidential information – VMware's internal documents].

⁵³² For instance, and as will be set out below, VMware internal document, [Other confidential information – VMware's internal documents].

⁵³³ Parties' reply to RFI 15- Part 12 - [Other confidential information – Broadcom's internal documents].

⁵³⁴ Parties' reply to RFI 15- Part 12 - [Other confidential information – Broadcom's internal documents].

⁵³⁵ Broadcom internal document, [Other confidential information – Broadcom's internal documents].

⁵³⁶ CMA document, [Other confidential information – VMware's internal documents], page [Other confidential information – VMware's internal documents].

⁵³⁷ VMware internal document, [Other confidential information – VMware's internal documents].

⁵³⁸ VMware internal document [Other confidential information – VMware's internal documents].

⁵³⁹ VMware internal document [Other confidential information – VMware's internal documents].

⁵⁴⁰ VMware internal document, [Other confidential information – VMware's internal documents].

market position].⁵⁴¹ These VMware documents [Details on the sources of internal document describing VMware's market position].⁵⁴²

- (467) In a [Details of internal document describing VMware's market position], VMware reported on [Details of internal document describing VMware's market position]. VMware [Details of internal document describing VMware's market position].⁵⁴³
- (468) With regard to VMware's market [Details on VMware's market position], VMware considers that it is [Details on VMware's views on its market position]. This will be further explained in the following paragraphs.
- (469) First, [Details of internal documents] VMware's strategy for the future is to continue [Business secret – business plan and company strategy].
- (470) In order to continue to capture the continued growth of traditional and modern workloads in the on-premises and private cloud environment, VMware [Business secret - strategic decisions] (which will be set out further below in Section 8.4.3.2.1.2.3.). VMware promises to deliver [Business secret – VMware internal document].⁵⁴⁴
- (471) This is particularly relevant as on the one hand, [Business secret – know how concerning customer demand]. However, on the other hand, as set out above in Section 7.4.1.3.3. and below in Section 8.4.3.2.1.2.5., [Business secret – know how concerning customer demand].⁵⁴⁵
- (472) Accordingly, VMware indicates that it is [Business secret – know-how concerning VMware's market position]. By building a cloud connected multi-cloud infrastructure, VMware can [Business secret – know-how concerning VMware's customer demand].⁵⁴⁶ According to VMware, [Business secret – sales policy and strategy, in particular concerning VMware's customer demand]. Furthermore, VMware [Business secret – sales policy and strategy]. This will be set in detail below in Section 8.4.3.2.1.2.3.
- (473) Multiple VMware internal documents [Details on internal document describing VMware's strategy and market]. For instance, [Details on internal document describing VMware's business plan].⁵⁴⁷ [Details on internal document describing VMware's business plan].⁵⁴⁸ In a presentation containing a competitive analysis from [Details on internal document describing VMware's market position].⁵⁴⁹
- (474) Similarly, a [Date of internal document describing VMware's strategy and market] Broadcom presentation⁵⁵⁰ [Details on internal document describing VMware's strategy and market position].⁵⁵¹
- (475) The Notifying Party claims that VMware's cloud solutions are [Business secret – margin calculation].⁵⁵² However, the Commission does not consider this [Business

⁵⁴¹ VMware internal document, [Other confidential information –VMware's internal documents].

⁵⁴² VMware internal document, [Other confidential information –VMware's internal documents].

⁵⁴³ VMware internal document, [Other confidential information –VMware's internal documents].

⁵⁴⁴ VMware internal document, [Other confidential information –VMware's internal documents].

⁵⁴⁵ VMware internal document, [Other confidential information –VMware's internal documents].

⁵⁴⁶ VMware internal document, [Other confidential information –VMware's internal documents].

⁵⁴⁷ VMware internal document, [Other confidential information –VMware's internal documents].

⁵⁴⁸ VMware internal document, [Other confidential information –VMware's internal documents].

⁵⁴⁹ VMware internal document, [Other confidential information –VMware's internal documents].

⁵⁵⁰ Broadcom internal document, [Other confidential information –Broadcom's internal documents].

⁵⁵¹ Broadcom internal document, [Other confidential information –Broadcom's internal documents].

⁵⁵² Parties' reply to RFI 23.

secret – margin calculation] to be relevant for the assessment of VMware’s market power in the on-premises and private cloud environment as the public cloud solutions are not in the same market as VMware’s offers in the on-premises and private cloud environment. The extent to which public cloud exerts a constraint on VMware’s position in the on-premises and private cloud environment is assessed below in Section 8.4.3.2.1.2.5.

- (476) VMware’s internal documents also show that VMware’s multi-cloud strategy is still growing (*e.g.*, project Arctic⁵⁵³), [Business secret – know-how: details of status of VMware’s multi-cloud strategy].
- (477) Regarding VMware Cloud on AWS, VMware states that: [Business secret – financial and demand evolution of VMware Cloud]⁵⁵⁴ [Business secret – financial and demand evolution of VMware Cloud].⁵⁵⁵
- (478) VMware acknowledged [Business secret – description of customer demand] VMware states: [Business secret – description of VMware’s customer demand].⁵⁵⁶
- (479) Second, VMware internal documents also show [Business secret – Details of internal document describing VMware’s strategy with regard to a market segment].
- (480) For instance, on VMware internal document [Business secret – Details of internal document describing VMware’s strategy and customer demand]⁵⁵⁷ [Business secret – Details of internal document describing VMware’s strategy and customer demand].⁵⁵⁸
- (481) VMware also plans to [Business secret – business plans] its customers’ infrastructure and applications [Details on internal document describing VMware’s plans with regards to its customer’s infrastructure and applications].⁵⁵⁹
- (482) Third, VMware’s strategy in relation to existing and future virtualized workloads [Business secret – business plans]. In a [Other confidential information –Broadcom’s internal documents] presentation, Broadcom [Business secret – financial situation of company].⁵⁶⁰ As part of the Transaction, Broadcom has also publicly referred to its “*track record of significant R&D investment – as a company, we’ve grown total R&D spending 24x since 2009 – and this will remain a top priority after the deal closes with VMware as part of Broadcom*”.⁵⁶¹

VMware’s strong position is confirmed by third-party reports

- (483) A September 2022 IDC Market Analysis Perspective mentions that “the traditional virtualization software market is highly saturated and dominated by VMware”.⁵⁶²

⁵⁵³ <https://blogs.vmware.com/vsphere/2022/10/vmware-to-offer-a-broad-multi-cloud-portfolio-of-infrastructure-products-in-a-subscription-model-with-the-vmware-plus-options.html>.

⁵⁵⁴ VMware internal document, [Other confidential information –VMware’s internal documents].

⁵⁵⁵ VMware internal document, [Other confidential information –VMware’s internal documents].

⁵⁵⁶ VMware internal document, [Other confidential information –VMware’s internal documents].

⁵⁵⁷ VMware internal document, [Other confidential information –VMware’s internal documents].

⁵⁵⁸ Project Arctic was introduced at VMware World in 2021. See <https://blogs.vmware.com/vsphere/2021/10/how-innovations-in-vsphere-are-redefining-infrastructure-to-run-future-apps.html>.

⁵⁵⁹ VMware internal document, [Other confidential information –VMware’s internal documents].

⁵⁶⁰ Broadcom internal document, [Other confidential information –Broadcom’s internal documents].

⁵⁶¹ <https://www.broadcom.com/blog/broadcom-vmware>.

⁵⁶² IDC Market Analysis Perspective: Worldwide Software-Defined Compute, 2022, page/slide 8 [Parties’ reply to RFI 22, Annex 22.3].

- (484) An annual company assessment of VMware from August 2022 noted: [Details on internal document describing VMware’s market position].⁵⁶³ [Details on internal document describing VMware’s market position].⁵⁶⁴ The document further states: [Details on internal document describing VMware’s market position].⁵⁶⁵
- (485) A July 2022 IDC Report concluded that: “2021 saw VMware continue to hold a dominant position in the software-defined compute (SDC) software market, primarily through compute revenue from virtualization and cloud platforms”.⁵⁶⁶ IDC reported that VMware “has a huge impact on this market,” “[t]he majority of the revenue in the SDC market is generated by virtual machine software and primarily by VMware,” and that, with respect to distinct sub-markets, “VMware is the only vendor that generates significant revenue from standalone virtualization sales.”⁵⁶⁷
- (486) Similarly, a November 2021 report from Deutsche Bank Research notes [Other confidential information].⁵⁶⁸ Further: [Other confidential information].⁵⁶⁹
- (487) Based on these elements, as explained above in Section 8.4.3.2.1.2.1., the Commission therefore considers that the market shares provided by the Parties fail to provide an accurate and complete picture of the competitive situation with regard to the market for server virtualization software in the on-premises and private cloud environment. In addition to the elements presented in the current section, the Commission considers that the assessment of the merged entity’s market power should account for a number of additional and alternative factors, which are assessed below.

8.4.3.2.1.2.3. There are few relevant alternatives for VMware

- (488) Based on the Phase I and Phase II investigation as well as various VMware internal documents, the Commission considers that there are few relevant alternatives to VMware in the on-premises and private cloud environment, given vSphere’s **unique and differentiated features** including (1) VMware’s ability to provide a full stack or suite of products with vSphere, (2) the cloud agnostic nature of VMware’s products, and (3) the maturity and scale of its products which includes significant expertise on virtualization software. The Commission has also considered (4) the strength and viability of VMware’s main alternative suppliers (Microsoft and IBM (incl. Red Hat)), as well as the tail of smaller competitors such as Nutanix and Oracle.
- (489) On this basis, the Commission notes that several of the main potential alternatives identified by the Parties in the on-premises and private cloud environment cannot be considered as credible alternatives. This will be set out further in the below.

VMware supplies a full stack of products

- (490) Several of the respondents in the market investigation [Other confidential information] refer to VMware’s unique ability to supply a **full stack** of products. Customers emphasized the importance of simplicity and efficiency of their infrastructure, in particular with respect to managing the enterprise’s various workloads across the enterprise (see below) and the various deployment

⁵⁶³ VMware internal document, [Other confidential information –VMware’s internal documents].

⁵⁶⁴ VMware internal document, [Other confidential information –VMware’s internal documents].

⁵⁶⁵ VMware internal document, [Other confidential information –VMware’s internal documents].

⁵⁶⁶ IDC Report #US47973722, page 2.

⁵⁶⁷ IDC Report #US47973722, pages 6-7.

⁵⁶⁸ Deutsche Bank Research, November 2021, page 1.

⁵⁶⁹ Deutsche Bank Research, November 2021, page 1.

environments (for which VMware provides a single point of management, which will be set out in the next Section). They also emphasized the importance of VMware's ability to offer complementary technology and features (all types of virtualization software on top of server virtualization).

- (491) First, based on the Phase I market investigation, respondents submitted that VMware's server virtualization software competitors can provide an alternative for some of VMware's products in certain deployment models, but in none of these deployment models are they able to offer the full stack of products that VMware offers.⁵⁷⁰ An end-customer clarified that: *"The VMware stack is a fully integrated layer of different technologies like IaaS/CaaS/SDN with a single point of management which is a key point [of] differentiation."*⁵⁷¹
- (492) Further, an association of end-customers, when asked to list alternatives to VMware, explained that most other virtualization software suppliers only provide parts of the server virtualization software product suite that VMware is able to offer: *"They are all together capable to replace VMware but none of them can individually replace it."*⁵⁷²
- (493) Based on the market investigation, the majority of VMware's virtualization software rivals expressing an opinion submitted that there are specific types of end-customers for which VMware's server virtualization software is **one of only a limited number of choices** which these end-customers would, in practice, rely on, given VMware products' maturity, breadth and depth of features.⁵⁷³ For instance, one respondent noted: *"VMware provides specific capabilities (e.g. vMotion) to meet enterprise requirements for availability, resilience and other qualities of service. ISV software / Applications/Workloads and operational processes that have dependencies on these capabilities will have limited choice on moving to other providers which do not offer similar capabilities"*.⁵⁷⁴ Another respondent clarified: *"For server virtualization software, VMware is one of the preferred choices for enterprise customers running mission critical workloads."*⁵⁷⁵ Another respondent also commented on : *"Given the breadth and depth of VMWare virtualization solution, there are probably many customers who are locked into their software."*⁵⁷⁶
- (494) During the Phase II market investigation, several customers continued to emphasize VMware's unique ability to provide a full stack of products. For instance, an end-customer stated that they relied heavily on VMware because it *"leverages a lot of VMware capabilities and features."*⁵⁷⁷ Moreover, another end-customer also commented on the breadth of features and complementary products that VMware is able to offer: *"It is difficult to find alternatives to VMware that offer the same scope of features. Compared to other hypervisor providers, VMware offers a whole stack of products in addition to its hypervisor that work together seamlessly (network virtualization, desktop virtualization, etc.). For example, Nutanix only offers a hypervisor and storage virtualization, but does not offer network virtualization; Cisco offers network virtualization, but no other features. Even if Orange were to*

⁵⁷⁰ Replies to Q2 – questionnaire to virtualization software competitors of VMware, question 22.1.

⁵⁷¹ Replies to Q4 – questionnaire to customers of VMware and Broadcom, question 25.1 [ID 1737].

⁵⁷² Replies to Q4 – questionnaire to customers of VMware and Broadcom, question 25.1 [ID 1691].

⁵⁷³ Replies to Q2 – questionnaire to virtualization software competitors of VMware, question 22.

⁵⁷⁴ Replies to Q2 – questionnaire to virtualization software competitors of VMware, question 22 [ID 1906].

⁵⁷⁵ Replies to Q2 – questionnaire to virtualization software competitors of VMware, question 22 [ID 1418].

⁵⁷⁶ Replies to Q2 – questionnaire to virtualization software competitors of VMware, question 22 [ID 1761].

⁵⁷⁷ Agreed minutes of call with market participant dated 8 February 2023 [ID 4120].

switch away from VMware for one of the functions, there is no alternative offering the same footprint as VMware, and Orange would continue to use VMware for other functions. This would potentially lead to decreased efficiency, because of using two different virtualization solutions that might not function well together.”⁵⁷⁸ The same end-customer also confirmed that it relies on VMware for the entire stack: “The applications that run on Orange’s IaaS are virtualized using VMware, not just for server virtualization, but also for the entire stack (e.g., compute, network, and desktop virtualization)”.⁵⁷⁹ Another end-customer commented on both the absence of credible alternatives as well as on VMware’s wide ecosystem: “The reason why [mainly] VMware is used relates mostly to the absence of credible alternatives. VMware was the first company to offer virtualization. VMware has the widest ecosystem, with a range of integrated solutions. VMware’s technology is so much more advanced that other players [give the impression to] have more or less given up on competing with VMware.”⁵⁸⁰ Another end-customer also commented on VMware’s ecosystem and complementary services: “VMware offers a coherent ecosystem with many add-on services (e.g., security). [...] This makes VMware’s offering very attractive.”⁵⁸¹ Finally, another end-customer also confirmed it relies of VMware’s broad ecosystem: “VMware offers many additional services on which Thales currently relies and intends to use for the future.”⁵⁸²

- (495) Second, in its internal documents, VMware [Details on internal document describing VMware’s product portfolio and product demand]. This sets VMware apart from its virtualization software rivals given that several of its rivals are only able to provide specific virtualization software (such as desktop or network), but VMware is able to provide the full portfolio of virtualization software as well as management of that virtualization software. Indeed, VMware has a significant portfolio of virtualization software: [Details on internal document describing VMware’s product portfolio and product demand].⁵⁸³
- (496) VMware states that [Details of internal documents describing VMware Cloud Foundation’s main features].⁵⁸⁴
- (497) Further, one VMware internal document states: [Details on internal document describing VMware’s product strategy].⁵⁸⁵
- (498) Another VMware internal document states: [Details on internal document describing VMware’s approach to hyperconverged infrastructure].⁵⁸⁶
- (499) VMware internal documents confirm [Details on internal document describing VMware’s customers purchasing patterns].⁵⁸⁷
- (500) A VMware presentation from [Details of internal document describing VMware’s competitive positioning]. This document highlights that [Details of internal document describing VMware’s competitive positioning]. In particular, it is stated

⁵⁷⁸ Agreed minutes of call with Orange dated 17 February 2023 [ID 4163].

⁵⁷⁹ Agreed minutes of call with Orange dated 17 February 2023 [ID 4163].

⁵⁸⁰ Agreed minutes of call with Siemens dated 27 February 2023 [ID 4079].

⁵⁸¹ Agreed minutes of call with market participant dated 9 February 2023 [ID 3982].

⁵⁸² Agreed minutes of call with Thales dated 16 February 2023 [ID 4060].

⁵⁸³ VMware internal document, [Other confidential information –VMware’s internal documents].

⁵⁸⁴ VMware internal document, [Other confidential information –VMware’s internal documents].

⁵⁸⁵ VMware internal document, [Other confidential information –VMware’s internal documents].

⁵⁸⁶ VMware internal document, [Other confidential information –VMware’s internal documents].

⁵⁸⁷ VMware internal document, [Other confidential information –VMware’s internal documents].

that [Details of internal document describing VMware’s competitive positioning].⁵⁸⁸
See **Figure 7** below.

Figure 7: VMware’s virtualization portfolio

[...]

Source: VMware

- (501) Another VMware document notes: [Details on internal document describing VMware’s virtualization platform].⁵⁸⁹
- (502) A Broadcom internal document [Details on internal document describing VMware product features].⁵⁹⁰

VMware is cloud-agnostic

- (503) Several of the respondents in the market investigation as well as VMware internal documents refer to VMware’s **cloud agnostic position**. Respondents, of which several are engaging in a hybrid cloud strategy, consider this cloud agnostic position as a selling point which allows VMware to maintain its strong position on the on-premises and private cloud market.
- (504) As set out above in Section 6, customers are increasingly looking to engage in a hybrid and/or multi-cloud strategy. Based on the market investigation, several customers have commented on VMware’s cloud-agnostic solutions (*i.e.*, its partnerships with the various CSPs in the public cloud) as it being an important feature that allows on-premises and private cloud VMware customers to maintain the VMware ecosystem, even for those workloads (such as for instance modern applications, which are designed to suit the public cloud environment in contrast to the traditional IT environment) that would be run in the public cloud.
- (505) VMware is ubiquitous in the on-premises environment, with a significant installed base of “sticky, high-value” workloads, and by positioning itself as a multi-cloud provider that actively supports its customers if they choose to migrate certain on-premises workloads to the public cloud, or more frequently, with running new workloads on the customers’ chosen public cloud platforms, VMware maintains its ubiquity and the differentiated nature of its solutions in the on-premises and private cloud environment. In comparison, the majority of VMware’s rivals try to push their on-premises and private cloud customers onto their native public cloud (for instance, as will be set out below in the present Section, “*All roads lead to Azure*”). VMware continuously lists the fact that it is cloud-agnostic while its rivals try to push their customers onto their native public cloud, as the major selling point and point of differentiation. Accordingly, the Notifying Party’s argument that public cloud solutions are not part of the Commission’s market definition, and therefore, VMware’s cloud-agnostic position is not of material relevance, is inaccurate.⁵⁹¹ Respondents consider VMware’s cloud-agnostic position as a selling point which allows VMware to maintain its strong position in the on-premises and private cloud environment.
- (506) First, in the Phase I market investigation, one end-customer mentioned that “VMware products have a capability to manage virtual machines consistently across

⁵⁸⁸ VMware internal document, [Other confidential information –VMware’s internal documents].

⁵⁸⁹ VMware internal document, [Other confidential information –VMware’s internal documents].

⁵⁹⁰ Broadcom internal document, [Other confidential information –Broadcom’s internal documents].

⁵⁹¹ Response to the SO, paragraph 286.

on-premise and multiple public cloud environments”.⁵⁹² Another respondent submitted that “VMware’s unique offering in the on-premise/public cloud server virtualisation marketplace is HCX, the ability to link on-premise to cloud-based VMware hypervisor offering layer2 network extension and live migration (vMotion) between multiple locations on-premise and in the cloud (public cloud VMware). Its bundling within the cloud VMware product platforms is a compelling capability. The scale and breadth of the VMware infrastructure offering on-premise and in the cloud is a USP in its own right, with the advantages of procurement from a single supplier from server, network and storage virtualisation, virtual desktops and applications, automation, cloud management portals, systems management, cloud financials, security (ransomware, IPS, end point protection etc). All available with multiple routes to market, and with improving integration between the components of the portfolio.”⁵⁹³

- (507) Several end-customers that were contacted as part of the Phase II market investigation indicated that they relied on VMware cloud solutions in the public cloud in addition to using vSphere in their on-premises and private-cloud environments. End-customers explained that not having to use the cloud-native solutions, but instead being able to remain in VMware’s ecosystem across deployment environments, allows end-customers to continue running their legacy applications (which would otherwise require a re-platforming or re-architecting or would not work at all in the public cloud). Accordingly, VMware’s cloud-agnostic position was considered a real differentiating factor and selling point, allowing VMware to maintain its strong position in the on-premises and private cloud environment.
- (508) For instance, one end-customer stated: “As regards deployment on the public cloud, Thales makes use of IaaS, PaaS and SaaS. [...] When using IaaS offerings, Thales continues to deploy VMware as they continue to manage the virtualization software used.”⁵⁹⁴ Another end-customer emphasized how it was a deliberate choice to use VMware’s Cloud Foundation solution: “Munich Re chose deliberately not to ‘go native’ on Azure or other CSPs, i.e., using the CSP’s cloud-native solution, because to use VMware’s Cloud Foundation, allows Munich Re to continue running their legacy applications on VMware whilst eliminating many of their local datacenters that used to be located in Munich Re’s local offices across the globe.”⁵⁹⁵ This same end-customer further explained: “Effectively, from the perspective of Munich Re, there seemingly is no difference in using an application that is deployed on-premises, private cloud or the public cloud, because all applications run in the same VMware environment. Munich Re makes use of VMware’s cloud offerings. This means that, regardless of whether they use Microsoft, Amazon or Google’s public cloud platform, the environment will remain the same, i.e., VMware. This has the advantage that applications can be shifted more easily across systems.”⁵⁹⁶
- (509) Another end-customer clarified that VMware’s Cloud Foundation brings a major advantage as it ensure a seamless functioning of all features across all environments, although this end-customer nuanced that the features are not exactly the same

⁵⁹² Replies to Q4 – questionnaire to customers of VMware and Broadcom, question 27.1 [ID 1797 and ID 1812].

⁵⁹³ Replies to Q4 – questionnaire to customers of VMware and Broadcom, question 27.1 [ID 1537].

⁵⁹⁴ Agreed minutes of call with Thales dated 16 February 2023 [ID 4060].

⁵⁹⁵ Agreed minutes of call with Münchener Rück dated 9 February 2023 [ID 4153].

⁵⁹⁶ Agreed minutes of call with Münchener Rück dated 9 February 2023 [ID 4153].

depending on the cloud environment (e.g., AWS, Google or Microsoft): “one other major advantage of VMware over its hypervisor competitors is that all of VMware’s different functions work seamlessly together. VMware’s Cloud Foundation offer allows to deploy and manage all features across environments.”⁵⁹⁷ Another end-customer clarified that VMware also allows for a seamless migration from workloads between environments (within the VMware ecosystem): “Moreover, VMware allows for seamless migration between clusters, from on-premises to off-premises. This makes VMware’s offering very attractive.”⁵⁹⁸

- (510) One respondent further clarifies that VMware is particularly flexible in relation to licensing flexibility, i.e., licenses can be moved across environments (within the VMware ecosystem), compared to other providers: “When purchasing virtualization software, [Respondent] tries to obtain flexibility with licenses. In particular, it tries to ensure that any licenses that are bought initially to be deployed in an on-premises environment can remain in use when the workload is moved to the public cloud. VMware is particularly flexible in this regard: they have a virtualization solution available with a number of CSPs, so that [Respondent] can easily take its on-premises workloads to the cloud and continue using the VMware licenses there. This portability exists in relation to Google Cloud (Google Cloud VMware Engine, GCVE), but also in relation to Azure, etc. At least pre-Broadcom, VMware has always been very flexible in terms of portability compared to other providers.”⁵⁹⁹
- (511) Another end-customer also explains that it is for some applications necessary to continue using VMware, even when these would be migrated to the public cloud, in view of compatibility issues: “In particular, Nokia’s legacy applications are likely to remain on VMware, even when migrated to the public cloud. This is because cloud-native solutions are often not compatible with native applications or older application versions. VMware allows the application to be migrated to a hyperscaler environment within its virtualized environment, thereby avoiding the need to refactor the application in question to a new environment.”⁶⁰⁰
- (512) Second, VMware’s unique position as a true multi-cloud platform and one-stop-shop across environments, [Other confidential information – Broadcom and VMware internal documents].
- (513) In a Broadcom internal document [Details of internal document describing VMware’s position on the market and the migration of workloads].^{601 602}
- (514) In a VMware presentation containing a Cloud Infrastructure Business Group’s presentation to Broadcom from [Details of internal document describing customer preferences and VMware’s product strategy].^{603 604} (see **Figure 8** below).

Figure 8: Evolution of VMware solutions

[...]

Source: VMware

⁵⁹⁷ Agreed minutes of call with Thales dated 16 February 2023 [ID 4060].

⁵⁹⁸ Agreed minutes of call with a market participant dated 9 February 2023 [ID 3982].

⁵⁹⁹ Agreed minutes of call with a market participant dated 9 February 2023 [ID 3982].

⁶⁰⁰ Agreed minutes of call with Nokia dated 22 February 2023 [ID 4157].

⁶⁰¹ Broadcom internal document, [Other confidential information –Broadcom’s internal documents].

⁶⁰² Broadcom internal document, [Other confidential information –Broadcom’s internal documents].

⁶⁰³ VMware internal document, [Other confidential information –VMware’s internal documents].

⁶⁰⁴ VMware internal document, [Other confidential information –VMware’s internal documents].

- (515) In an internal document containing [Details of internal document analyzing the competitive positioning of VMware products].^{605 606}
- (516) In a VMware document considering [Details of internal document describing VMware's product strategy].^{607 608}
- (517) Based on past [Details of internal document describing VMware's customer demand].⁶⁰⁹ See **Figure 9** below.

Figure 9: VMware workload forecast [Business secret – know-how]

[...]

Source: VMware

- (518) Another internal memo regarding VMware' [Details of internal document describing VMware's product strategy].⁶¹⁰ This internal memo also shows [Details of internal document describing VMware's product strategy].⁶¹¹
- (519) For instance, VMware considers [Business secret – Details of VMware's position in the market]⁶¹² (see **Figure 10** below) [Business secret – Details of VMware's position in the market]. Importantly, while competitors like Microsoft offer similar infrastructure and platform solutions, their products are tailored to their proprietary cloud and cannot be used in relation to other clouds (*e.g.*, AWS). VMware, however, can be used across all major public clouds via its VMware Cloud platform. These public clouds include AWS, Microsoft Azure, Google Cloud, IBM Cloud, Oracle Cloud and 170 other cloud providers that are VMware Cloud Verified.⁶¹³
- (520) As indicated in another VMware internal document: [Details of internal document describing VMware's position in the market and product characteristics] (see **Figure 11** below).⁶¹⁴ This is also particularly relevant, given that VMware considers [Business secret – Details of VMware's views on the competitive landscape].⁶¹⁵ (see **Figure 12** below).

Figure 10: VMware's position in the industry⁶¹⁶

[...]

Source: VMware

Figure 11: [Figure that describes VMware's views of its competitive position]⁶¹⁷

[...]

Source: VMware

⁶⁰⁵ VMware internal document, [Other confidential information –VMware's internal documents].

⁶⁰⁶ VMware internal document, [Other confidential information –VMware's internal documents].

⁶⁰⁷ VMware internal document, [Other confidential information –VMware's internal documents].

⁶⁰⁸ VMware internal document, [Other confidential information –VMware's internal documents].

⁶⁰⁹ VMware internal document, [Other confidential information –VMware's internal documents].

⁶¹⁰ VMware internal document, [Other confidential information –VMware's internal documents].

⁶¹¹ VMware internal document, [Other confidential information –VMware's internal documents].

⁶¹² VMware internal document, [Other confidential information –VMware's internal documents].

⁶¹³ See NetApp BlueXP, "Vmware Cloud: Vmware at Your Service on AWS, Azure and GCP". Available at: <https://bluexp.netapp.com/blog/cvo-blg-vmware-cloud-vmware-at-your-service-on-aws-azure-and-gcp>.

⁶¹⁴ Parties' reply to RFI 8, question 10.8.

⁶¹⁵ See Annex 60 (Conglomerate) to the Form CO.

⁶¹⁶ VMware internal document, [Other confidential information –VMware's internal documents].

⁶¹⁷ Parties' reply to RFI 8, question 10.6, page 20.

Figure 12: VCF vs. Microsoft Azure⁶¹⁸

[...]

Source: VMware

- (521) Another VMware internal document states that [Details on internal document describing a competing product].⁶¹⁹
- (522) Another VMware internal document notes: [Details of internal document describing features of VMware product offering].⁶²⁰ Another VMware internal document states: [Details of internal document describing features of VMware's product offering and its position in the market].⁶²¹ [Details of internal document describing features of VMware's product offering and its position in the market].⁶²²
- (523) Finally, as stated above (see Section 8.4.3.2.1.2.2.), Deutsche Bank Research highlights VMware's key position in this hybrid / multi-cloud environment, given its multiple partnerships with cloud providers, the maturity of its cloud product and the ubiquity of its vSphere product, as "[Other confidential information]".⁶²³

VMware's virtualization software is mature, stable and battle-tested

- (524) First, the results of the market investigation show that respondents view VMware's product as **mature** with VMware having pioneered server virtualization technology and VMware being considered as true virtualization **experts**. Respondents to the market investigation as well as VMware itself consider that this sets VMware apart from its rivals.
- (525) During the Phase I and II market investigation, end-customers often commented on the expertise that exists around the VMware ecosystem, the expertise of VMware regarding virtualization software, and the stability and safety of the VMware ecosystem.
- (526) For instance, a market respondent indicated: [Name] does not believe there are any full stack competitors to VMware. Historically, there was one application per server. VMware was the innovator in the technological space that treated individual servers as "mini-mainframes that could be divided in pieces" and divided server computing capacity and storage capabilities in real time to process and complete tasks more efficiently."⁶²⁴
- (527) For instance, one end-customer stated that "the fact that VMware was the first to develop hypervisor technology means that there is a lot of competencies around their systems. [Confidential]. Regarding VMware alternatives, there often is not enough competency, at least not at enterprise grade. Because enterprise grade is so critical [confidential] (e.g., for the purpose of assuring availability and preventing data loss), due to high quality, certain alternatives to VMware are not an option or would require a skill shift."⁶²⁵ Further, another end-customer stated: "Additional hypervisors would require additional skillsets. Thales' teams have a lot of VMware

⁶¹⁸ Parties' reply to RFI 8, question 10.8, page 11.

⁶¹⁹ VMware internal document, [Other confidential information – VMware's internal documents].

⁶²⁰ VMware internal document, [Other confidential information – VMware's internal documents].

⁶²¹ VMware internal document, [Other confidential information – VMware's internal documents].

⁶²² VMware internal document, [Other confidential information – VMware's internal documents].

⁶²³ Deutsche Bank Research, November 2021, page 1.

⁶²⁴ Agreed minutes of call with market participant dated 25 August 2022 [ID 3008].

⁶²⁵ Agreed minutes of call with Deutsche Telekom dated 14 February 2023 [ID 4096].

expertise, but this expertise is not transferrable to, e.g., [confidential].”⁶²⁶ This same end-customer also clarified specifically how this set VMware apart from its competitors Microsoft and Citrix: “[Companies] do not view Hyper-V as an alternative to VMware: contrary to VMware, which is a specialized virtualization company, Microsoft only entered the market with Hyper-V after VMware established the technology and is not a virtualization company at its core. This becomes evident, e.g., in the level of technical support offered by VMware. VMware has a real expertise on their product. Microsoft can only credibly provide support to the extent that Hyper-V is deployed in Microsoft infrastructure. VMware offers support regardless of the infrastructure in which it is deployed. [Companies do not consider that]Citrix offer[s] a viable alternative as it is less advanced than VMware.”⁶²⁷

- (528) Another end-customer stated: “The reason why [mainly] VMware is used relates mostly to the absence of credible alternatives. [...] [Siemens IT personnel is highly trained in VMware, and the same knowledge [is not relevant for] or apply to competitors’ software.”⁶²⁸ Another end-customer stated: “In Bayer’s view, VMware is the most stable and the safest virtualization environment, as well as the hypervisor with which Bayer has the most experience. Given that Bayer runs [confidential] virtualized servers, these are important factors to Bayer.”⁶²⁹ Finally, another end-customer explained that they relied on VMware as it allows this end-customer to run legacy applications: “VMware [...] supports older versions of operating systems (“OS”) that cannot be supported natively or on bare metal as the type of bare metal required by these OS is no longer in use.”⁶³⁰
- (529) Second, [Details of VMware’s internal documents describing product features]. For instance, one VMware internal document states that [Details of VMware’s internal documents describing product features].⁶³¹ Another VMware’s internal document states that [Details of VMware’s internal documents describing product features].⁶³²
- (530) One Broadcom document of [Details of Broadcom internal document describing feature of VMware's and its position in the market].⁶³³
- (531) Accordingly, the Notifying Party’s argument in the SO Response⁶³⁴ that VMware recognizes competitive threats posed by more recent rivals, does not contradict the Commission’s assessment that market respondents and VMware internal documents acknowledge VMware’s mature position and corresponding strong reputation on the server virtualization market, having pioneered this type of software, and consider this as a selling point and differentiating factor.

VMware’s rivals supply less preferred alternatives compared to VMware

- (532) In its SO Response, the Notifying Party indicates that the Commission wrongly considered that VMware has limited credible competitors.⁶³⁵ Accordingly, in addition to the elements set out above that show the unique and differentiated features of VMware’s server virtualization software, the Commission has also

⁶²⁶ Agreed minutes of call with Thales dated 16 February 2023 [ID 4060].

⁶²⁷ Agreed minutes of call with Thales dated 16 February 2023 [ID 4060].

⁶²⁸ Agreed minutes of call with Siemens dated 27 February 2023 [ID 4079].

⁶²⁹ Agreed minutes of call with Bayer dated 22 February 2023 [ID 3958].

⁶³⁰ Agreed minutes of call with Nokia dated 22 February 2023 [ID 4157].

⁶³¹ VMware internal document, [Other confidential information – VMware’s internal documents].

⁶³² VMware internal document, [Other confidential information – VMware’s internal documents].

⁶³³ Parties’ reply to RFI 15- Part 12 – [Other confidential information – Broadcom’s internal documents]. .

⁶³⁴ SO Response, paragraphs 297-302.

⁶³⁵ SO Response, paragraphs 303-368.

closely analysed VMware internal documents and customers' and competitors' input regarding VMware's closest rivals.

- (533) **Microsoft.** Microsoft has proprietary virtualization software through its Hyper-V product (hypervisor), which is integrated into its Windows Server product. As set out above (see **Table 12**), IDC estimates that Microsoft has a share of [20-30]% in the market for server virtualization in the on-premises and private cloud environment. This is a little over half the size of VMware's market share. The majority of market respondents expressing an opinion also indicated Hyper-V as VMware's closest competitor in relation to existing workloads and applications.⁶³⁶ VMware internal documents also indicate that [Details of internal document describing VMware's views on competing products].
- (534) However, [Business secret – know-how] market respondents [Business secret – know-how] indicate that there are some limitations to Microsoft's Hyper-V which lead to conclude that it is not a comparable product to VMware's vSphere. A recurring key limitation mentioned is the lock-in with Microsoft's Azure platform.
- (535) First, a number of end-customers made statements pointing out that Hyper-V is viewed as a less-preferred or no alternative to VMware. One end-customer stated that they *"do not view Hyper-V as an alternative to VMware: contrary to VMware, which is a specialized virtualization company, Microsoft only entered the market with Hyper-V after VMware established the technology and is not a virtualization company at its core. This becomes evident, e.g., in the level of technical support offered by VMware. VMware has a real expertise on their product. Microsoft can only credibly provide support to the extent that Hyper-V is deployed in Microsoft infrastructure. VMware offers support regardless of the infrastructure in which it is deployed."*⁶³⁷ Another end-customer stated that *"Hyper-V [...] is not standard and Microsoft is currently not investing in it. Hyper-V lacks the broad required functionality and by external customers this is not seen as the common market standard Hypervisor."*⁶³⁸ Furthermore, NTT stated that *"VMware supports more Operating Systems than Microsoft Hyper-V"*.⁶³⁹ Finally, an association of end-customers indicated that *"Hyper V is not developed anymore by MSFT - Azure Stack remains very unstable and cannot be put in production"*.⁶⁴⁰
- (536) Second, in an internal document containing a competitive analysis from April 2022, [Details on internal document describing how VMware compares itself to rivals].⁶⁴¹
- (537) Third, in a VMware email exchange from [Details on internal document describing a competing product]. However, VMware also indicated that [Details on internal document describing a competing product].⁶⁴²
- (538) Fourth, in a VMware presentation from [Details on internal document describing and comparing with a competing product].⁶⁴³

⁶³⁶ Replies to Q4 – questionnaire to customers of VMware and Broadcom, question 25.

⁶³⁷ Agreed minutes of call with Thales dated 16 February 2023 [ID 4060].

⁶³⁸ Agreed minutes of call with KPN dated 16 February 2023 [ID 4047].

⁶³⁹ Replies to Q4 – questionnaire to customers of VMware and Broadcom, question 25.1 [ID 1526].

⁶⁴⁰ Replies to Q4 – questionnaire to customers of VMware and Broadcom, question 25.1 [ID 1517].

⁶⁴¹ VMware internal document, [Other confidential information – VMware's internal documents].

⁶⁴² VMware internal document, [Other confidential information – VMware's internal documents].

⁶⁴³ VMware internal document, [Other confidential information – VMware's internal documents].

Figure 13: [Figure comparing VMware and a competing product]

[...]

Source: VMware

(539) Fifth, in a VMware presentation [Details on internal document discussing a competing product] (see **Figure 14**).⁶⁴⁴

Figure 14: [Figure comparing a competing product]

[...]

Source: VMware

(540) Another slide of the same presentation provides more detail on [Details on internal document comparing a competing product] (see **Figure 15**).⁶⁴⁵

Figure 15: [Figure comparing features of a competing product]

[...]

Source: VMware

(541) Further, another slide refers to [Details on internal document describing a competing product] (see **Figure 16**).⁶⁴⁶

Figure 16: Reasons leading customers to return to vSphere

[...]

Source: VMware

(542) The remaining slides [Details on internal document describing a competing product].⁶⁴⁷ Moreover, the slide depicted as **Figure 17** below [Details on internal document describing a competing product].⁶⁴⁸

Figure 17: [Figure describing a competing product]

[...]

Source: VMware

(543) **IBM.** IBM offers virtualization software through its Red Hat virtualization product. Red Hat provides a paid open-source solution where the hypervisor is available for free and IBM charges for technical support. As set out above (see **Table 12**), IDC estimates that IBM has a share of [10-20]% in the market for server virtualization software in the on-premises and private cloud environment. The majority of customers expressing an opinion indicated Red Hat as the second alternative to VMware.⁶⁴⁹

(544) However, both market respondents and VMware internal documents indicate that also Red Hat does not compare to some of vSphere's functionalities.

(545) First, an end-customer stated that "Most of the network function providers work around VMware and Red Hat today, of which VMware is by far the preferred option."⁶⁵⁰ An association of end-customers indicated: "Cigref members consider

⁶⁴⁴ VMware internal document, [Other confidential information –VMware's internal documents].

⁶⁴⁵ VMware internal document, [Other confidential information –VMware's internal documents].

⁶⁴⁶ VMware internal document, [Other confidential information –VMware's internal documents].

⁶⁴⁷ VMware internal document, [Other confidential information –VMware's internal documents].

⁶⁴⁸ VMware internal document, [Other confidential information –VMware's internal documents].

⁶⁴⁹ Replies to Q4 – questionnaire to customers of VMware and Broadcom, question 25.

⁶⁵⁰ Agreed minutes of call with Telefonica dated 14 February 2023 [ID 4043].

they are very few competitors on virtualization solutions. [...] RedHat OpenStack is complex to integrate and stabilize”.⁶⁵¹

- (546) Second, a server OEM indicted that: “Red Hat OpenStack Platform provides basic virtualization and management but does not provide the same level of software quality and performance as VMware’s virtualization software.”⁶⁵²
- (547) Third, a VMware [Details on internal document describing a competing product].⁶⁵³
- (548) Fourth, a VMware document [Details on internal document comparing a competing product]. The same document also describes [Details on internal document comparing a competing product].⁶⁵⁴
- (549) Fifth, in a VMware email exchange from [Details on internal document describing a competing product].⁶⁵⁵
- (550) **Nutanix.** Nutanix offers virtualization software through its open-source Nutanix AHV hypervisor. The majority of market respondents expressing an opinion also indicated Nutanix as VMware’s third alternative to VMware.⁶⁵⁶ There is no individual volume share data available for Nutanix (see above **Tables 12 to 14**).
- (551) However, both market respondents and VMware internal documents indicate that Nutanix is not comparable to vSphere.
- (552) First, an end-customer stated: “Compared to other hypervisor providers, VMware offers a whole stack of products in addition to its hypervisor that work together seamlessly (network virtualization, desktop virtualization, etc.). For example, Nutanix only offers a hypervisor and storage virtualization, but does not offer network virtualization.”⁶⁵⁷
- (553) Second, a server OEM stated: “we understand that Nutanix’s AHV hypervisor, though based on KVM, is probably the closest replacement for VMware’s virtualization software today. It has some of the core features of vSphere, even though it is not a complete replacement.”⁶⁵⁸
- (554) Third, a VMware internal document states that [Details on internal document describing a competing product].⁶⁵⁹
- (555) Fourth, in a VMware presentation from [Details on internal document comparing a competing product]⁶⁶⁰, VMware [Details on internal document comparing a competing product].
- (556) **Citrix.** Citrix offers virtualization software through its paid open-source XenServer product. There is no individual volume share data available for Citrix (see above **Tables 12 to 14**). The majority of market respondents expressing an opinion also indicated Citrix as VMware’s fourth alternative to VMware.⁶⁶¹

⁶⁵¹ Replies to Q4 – questionnaire to customers of VMware and Broadcom, question 25.1 [ID 1517].

⁶⁵² Cisco’s non-confidential response to RFI 1, question 4 a) [ID 4288].

⁶⁵³ VMware internal document, [Other confidential information – VMware’s internal documents].

⁶⁵⁴ CMA document, VMware’s response to s109 Notice 2, pages 31 and 34, [ID RSLV_00045456].

⁶⁵⁵ VMware internal document, [Other confidential information – VMware’s internal documents].

⁶⁵⁶ Replies to Q4 – questionnaire to customers of VMware and Broadcom, question 25.

⁶⁵⁷ Agreed minutes of call with Orange dated 17 February 2023 [ID 4163].

⁶⁵⁸ Cisco’s non-confidential reply to –RFI 1, question 4 a) [ID 4288].

⁶⁵⁹ VMware internal document, [Other confidential information – VMware’s internal documents].

⁶⁶⁰ VMware internal document, [Other confidential information – VMware’s internal documents].

⁶⁶¹ Replies to Q4 – questionnaire to customers of VMware and Broadcom, question 25.

- (557) However, both market respondents and VMware internal documents indicate that Citrix is not comparable to vSphere.
- (558) First, an end-customer stated that “[Companies do not consider that] Citrix offer[s] a viable alternative as it is less advanced than VMware.”⁶⁶² Another end-customer stated: “Citrix only offers desktop and application virtualisation solutions, and is not able to replace the entire VMware range, in particular server virtualisation.”⁶⁶³
- (559) Second, in a VMware presentation from [Details on internal document describing a competing product]⁶⁶⁴, VMware stated [Details on internal document describing a competing product]. Furthermore, VMware notes that [Details on internal document describing a competing product].
- (560) Third, a market respondent indicated: “Other competitors, such as Citrix's opensource Xen product, are not even comparable to VMware. [Name] considers comparing other competitors such as Citrix to VMware like “buying an Ikea couch for you to assemble yourself, compared to buying completed furniture delivered to your home.”⁶⁶⁵
- (561) **Oracle.** Oracle offers virtualization software through its paid open-source product VM Server for x86 and also offers private cloud through Oracle Cloud@Customer. As set out above (see **Table 12**), IDC estimates that Oracle has a market share of [0-5]% in the market for server virtualization software in the on-premises and private cloud environment. The majority of market respondents expressing an opinion also indicated Oracle as VMware’s fifth alternative to VMware.⁶⁶⁶
- (562) A customer explained that Oracle’s hypervisor is used for Oracle workloads, noting that “customers use VMware as a general hypervisor, but they use OVM specifically for/with their Oracle products”.⁶⁶⁷ This customer also explained for instance that: “[Name] considers VMware to have largely perfected the administrative side of virtualization. It is easy for the customers to keep its tools healthy and move workloads around, as well as to provide security patches. For example, if the power supply breaks in a given server that uses the VMware tools, a customer can easily move all the running workloads to another server with the click of a mouse, whereas with OVM the customer would have approx. 3 hours of work.”⁶⁶⁸
- (563) In addition, Oracle is typically [Business secret – VMware’s internal documents] in VMware’s internal documents [Business secret – VMware’s internal documents].
- (564) **Other.** The Notifying Party also indicated players such as SUSE, Google, and AWS as rivals. However, these players, as set out above in **Table 12** have a marginal share compared to VMware.
- (565) Furthermore, generally, several end-customers explained that they did not consider VMware’s rivals to offer comparable products to vSphere. VMware is the market leader in the market for virtualization software in the on-premises and private cloud environment with no close alternative.

⁶⁶² Agreed minutes of call with Thales dated 16 February 2023 [ID 4060].

⁶⁶³ Agreed minutes of call with ITZBund dated 15 February 2023 [ID 4057] (working translation from German).

⁶⁶⁴ VMware internal document, [Other confidential information – VMware’s internal documents].

⁶⁶⁵ Agreed minutes of call with market participant dated 25 August 2022 [ID 3008].

⁶⁶⁶ Replies to Q4 – questionnaire to customers of VMware and Broadcom, question 25.

⁶⁶⁷ Minutes of call with a market participant dated 25 August 2022 [ID 3008].

⁶⁶⁸ Minutes of call with a market participant dated 25 August 2022 [ID 3008].

- (566) For instance, one end-customer stated it “does not believe that there is another vendor that is as good as VMware”.⁶⁶⁹ Another end-customer stated that “VMware is the leader in virtualization technology. It is difficult to find alternatives to VMware that offer the same scope of features. Compared to other hypervisor providers, VMware offers a whole stack of products in addition to its hypervisor that work together seamlessly (network virtualization, desktop virtualization, etc.). For example, [...] Cisco offers network virtualization, but no other features.”⁶⁷⁰ Another end-customer explained that “[Companies consider that other providers] are used on top of VMware as a complement to vSphere, rather than a replacement.”⁶⁷¹ Another market respondent indicated: [Name] does not believe there are any full stack competitors to VMware.”⁶⁷²
- (567) In its internal documents, VMware states [Details of internal document comparing VMware’s products against those of rivals].⁶⁷³
- (568) In relation to **Amazon (AWS)**, VMware internal documents [Details on internal document describing a competing product offering], VMware states [Details on internal document describing a competing product offering]. Another document notes that [Details on internal document describing a competing product offering].⁶⁷⁴ An end-customer also indicated that: “We have also listed AWS as a public cloud provider as this is a valid alternative for workload migration, although it’s only cost effective for micro-services workload. See previous comments about moving workloads and applications to public cloud (not an option for all workloads and applications).”⁶⁷⁵
- (569) In relation to **Google** specifically, [Details on internal documents describing competing products] VMware document notes that [Details on internal documents describing competing products].⁶⁷⁶ An end-customer states: “VMWare is unique in the range of deployment models it supports. Technologies like Outpost are not viable alternatives for on prem as the security models are quite different and therefore only offer proximity benefits.”⁶⁷⁷
- (570) **SUSE’s** Linux Enterprise Server includes the latest open-source virtualization technologies, Xen and KVM. With these hypervisors, SUSE’s Linux Enterprise Server can be used to install and manage multiple virtual machines. However, as set out in **Table 12** above, SUSE’s market share is only marginal. In addition, SUSE is [Business secret - VMware’s internal documents] as a competitor for server virtualization software in traditional datacentre and private cloud deployments.

8.4.3.2.1.2.4. It is difficult and complex to switch away from VMware

- (571) Market respondents indicate that it is **difficult to switch away** from VMware, particularly within a short-time horizon, and it would involve significant costs. Market respondents further clarified that even in a scenario where end-customers are already multi-sourcing hypervisors from different providers within the same

⁶⁶⁹ Agreed minutes of call with Siemens dated 27 February 2023 [ID 4079].

⁶⁷⁰ Agreed minutes of call with Orange dated 17 February 2023 [ID 4163].

⁶⁷¹ Agreed minutes of call with Nokia dated 22 February 2023 [ID 4157].

⁶⁷² Agreed minutes of call with a market participant dated 25 August 2022 [ID 3008].

⁶⁷³ VMware internal document, [Other confidential information – VMware’s internal documents].

⁶⁷⁴ CMA document, VMware’s response to s109 Notice 2, page 34, [ID RSLV_00019480].

⁶⁷⁵ Reply to Q4 – questionnaire to customers of VMware and Broadcom, question 27.1 [ID 1835].

⁶⁷⁶ CMA document, VMware’s s response to s109 Notice 1, pages 7, 22 and 23, [ID RSLV_00015886].

⁶⁷⁷ Reply to Q4 – questionnaire to customers of VMware and Broadcom, question 27.1 [ID 1819].

deployment environment, it would still not be logical or easy to migrate some or all workloads from one hypervisor to another.

- (572) First, during the Phase I market investigation, the majority of customers expressing an opinion indicated that once they or their end-customers have chosen a server virtualization software supplier within the on-premises environment, in practice, they do not tend to switch between different server virtualization software suppliers within the same environment.⁶⁷⁸ This is related to multiple factors, such as for instance the **type of applications** (e.g., legacy, monolithic or mission-critical applications) or the **type of data** (e.g., sensitive data).
- (573) For instance, one market respondent commented on the **expense and risk** when explaining why CSPs choose to offer VMware virtualization software as a virtualization solution with their native cloud offering (while they also offer their own native-virtualization software solutions): *“However, [company] is still compatible with VMware: [company] wrote a connector so that VMware works with their cloud because it knows how pervasive VMware’s technology is and how hard it is to switch away from it (it is massively expensive and risky, like “changing your plumbing when you need to continue to serve the water”), similar to Broadcom in mainframe.”*⁶⁷⁹
- (574) Indeed, the majority of end-customers currently using VMware’s server virtualization software for their **on-premises datacentre** submit that **switching away** from VMware to another supplier is technically **complex, disruptive** to the business, and **time-consuming**.⁶⁸⁰ Customers note that, depending on the scope, migration entails *“compute investment to support the migration, licence overlaps, reskilling, new tools, the rebuild of automation. The use of VMware’s snapshot makes it possible to carry out migrations from a VMware cluster to another VMware cluster but to change virtualization software, [...] you must rebuild the application. Another challenge is to change the hypervisor”*.⁶⁸¹
- (575) Similarly, the majority of customers that are currently using VMware’s server virtualization software for their applications and workloads in the **private cloud**, consider that switching away from VMware to another supplier is **technically complex, disruptive** to the business and **needs a lot of time**.⁶⁸² One customer states: *“We are not sure this would be feasible unless it was carried out at the point of a major compelling event. Many customers will remain with an incumbent supplier rather than accept a risk of transition/transformation to a new service from a new supplier. The move to a new private cloud infrastructure is a significant undertaking with new hardware needing to be deployed prior to migration, then a complex migration exercise especially where network functionality and automation on the private cloud are exploited by the customer. [...] This leads to a significant period of dual running with the potential for significant business impact to each customer, and significant costs.”*⁶⁸³
- (576) During the Phase II market investigation, end-customers re-affirmed that moving any given workload from one hypervisor to another is typically not just an easy “lift-and-

⁶⁷⁸ Replies to Q4 – questionnaire to customers of VMware and Broadcom, question 29.

⁶⁷⁹ Agreed minutes of call with market participant dated 25 August 2022 [ID 3008].

⁶⁸⁰ Replies to Q4 – questionnaire to customers of VMware and Broadcom, question 32.

⁶⁸¹ Replies to Q4 – questionnaire to customers of VMware and Broadcom, question 32 [ID 1517].

⁶⁸² Replies to Q4 – questionnaire to customers of VMware and Broadcom, question 33.

⁶⁸³ Replies to Q4 – questionnaire to customers of VMware and Broadcom, question 33 [ID 1537].

shift” exercise. Although it can be for certain plain workloads, it certainly does not apply to all types of data and workloads.

- (577) End-customers made numerous statements regarding the feasibility of switching “any given” workload away from VMware to another hypervisor. In the responses listed below, respondents refer either to “all workloads” or “certain workloads” that would be difficult to switch away from VMware. Accordingly, the Notifying Party’s claim that the SO overstates the difficulty of switching away from VMware, based on perceived inability of all workloads to switch away from VMware, is inaccurate.⁶⁸⁴
- (578) For instance, multiple end-customers commented on the fact that VMware’s software includes management surrounding the applications. Therefore, these applications rely on VMware and could not just be shifted with these management features to another hypervisor. In other words, end-customers’ IT infrastructure is tailored to VMware: *“To switch away [from VMware] would therefore be a sizeable endeavor”* and the *“significant difficulty lies in migrating the management surrounding the applications (e.g., automation, simplification). The entire environment would have to be rebuilt.”*⁶⁸⁵
- (579) Similarly, another end-customer pointed to the significant investment that customers make in the infrastructure that runs on VMware, and that the customer’s dependence increases year-on-year as additional infrastructure relying on VMware is added: *“Orange has made a significant investment with VMWare. Its legacy infrastructure uses VMware and Orange’s dependence on VMware increases year by year, as additional infrastructure is added to VMware. This makes both migration from on-premises to a cloud environment, as well as migration to a different hypervisor extremely difficult.”*⁶⁸⁶ End-customers also pointed to the investment in the training of personnel: *“A customer that has been a VMware shop for a while will have an IT team that is used to VMware, whatever the hardware is. Switching to another provider will be a learning curve and will take time, so most customers do not usually switch.”*⁶⁸⁷
- (580) Contrary to the Notifying Party’s claim⁶⁸⁸ that multiple customers multi-source hypervisors from different providers within the same deployment environment and generally multi-home and could therefore readily redeploy (or accelerate redeployment of) workloads to other solutions that they already use, the majority of end-customers expressing an opinion indicated that they did not consider it logical to multi-source hypervisors within the on-premises or private cloud environment, as this would reduce efficiency and increase complexity in the infrastructure. Furthermore, even if end-customers were to multi-source hypervisors on-premises, it would still not be easy to migrate workloads from one hypervisor to another, for example due to company policy reasons or the need for specific hardware that comes with integrated software.⁶⁸⁹
- (581) Multiple end-customers confirmed that they would not, on purpose, multi-source from different virtualization software providers. For instance: *“Airbus [....] would not deliberately, save for the aforementioned circumstances in which a hypervisor is*

⁶⁸⁴ SO Response, paragraph 217 and following.

⁶⁸⁵ Agreed minutes of call with Siemens dated 27 February 2023 [ID 4079].

⁶⁸⁶ Agreed minutes of call with Orange dated 17 February 2023 [ID 4163].

⁶⁸⁷ agreed minutes of call with HPE dated 22 September 2022 [ID 2035].

⁶⁸⁸ Article 6(1)(c) Response, paragraph 107.

⁶⁸⁹ Agreed minutes of calls with end-customers, as cited in the paragraphs below.

integrated into a service or product (i.e., a closed environment), decide to multi-source from different virtualization software providers”.⁶⁹⁰ On the contrary, end-customers stated that there would be no good reason to multi-source in relation to hypervisors. “[In general, there is] no good reason for [an enterprise customer] to pursue a multi-vendor strategy in relation to hypervisors. [Confidential] Additional hypervisors would require additional skillsets. Thales’ teams have a lot of VMware expertise, but this expertise is not transferrable to, e.g., [confidential].”⁶⁹¹ End-customers commented for instance on the added complexity of managing multiple hypervisors and corresponding technologies. “[confidential] managing multiple hypervisors and different technologies for each of them in an on-premises environment is a complex and difficult task, and the fact of needing to invest resources in the maintenance of multiple parallel infrastructures prevents [confidential] using the same resources in innovation.” This same end-customer also commented on the need for consolidation of hypervisors against the background of a hybrid cloud environment: “In addition, consolidating the compute infrastructure to one virtualization system facilitates the task of migrating the workloads to the public cloud. An important factor in this regard is resiliency, which is significantly easier to implement when the entire infrastructure relies on one consolidated architecture rather than on a fragmented set of different hypervisors. Another reason for maintaining a coherent software set-up is ensuring hardware compatibility.”⁶⁹²

- (582) As set out above, for multiple reasons such as avoiding vendor lock-in, several end-customers said multi-sourcing seemed attractive, however, in practice it would just add complexity and reduce the value of the hypervisor and its corresponding ecosystem. One respondent said that “Ideally, [Respondent] would certainly consider using another hypervisor in addition to VMware, but in reality, it is simply more convenient to stay within one ecosystem. If [Respondent] were to consider using a different hypervisor, they would switch away from VMware completely rather than having another hypervisor in addition to VMware’s hypervisor. This is essentially to simplify the stack and, while there are benefits to multi-sourcing, this comes at a cost.”⁶⁹³ Another market respondent indicated: “However, it is difficult to maintain 2 stacks of technical procedure and training so this type of multi-homing is rare and usually customers use VMware’s virtualization software exclusively.”⁶⁹⁴
- (583) If an end-customer were to decide to multi-source, it would reduce the number of features that it could use as well as the options for standardisation. For instance, one market participant stated that “When you start using multiple hypervisors, the scope of features you can standardize becomes more limited, as you can only standardize those capabilities and features that these different hypervisors have in common. From a business perspective, there are thus disadvantages to using multiple hypervisors in parallel. In the [confidential] industry, most companies therefore pursue a single-vendor strategy, rather than a multi-sourcing strategy.”⁶⁹⁵ Another end-customer stated: “In relation to whether multi-sourcing of hypervisors would be considered, in Munich Re’s view, it is unlikely that companies would use another hypervisor in parallel with VMware. [...] Of course, it would be possible for Munich Re to make use of another hypervisor in addition to VMware but this would not fit its

⁶⁹⁰ Agreed minutes of call with Airbus dated 9 February 2023 [ID 4074].

⁶⁹¹ Agreed minutes of call with Thales dated 16 February 2023 [ID 4060].

⁶⁹² Agreed minutes of call with E.ON dated 13 February 2023 [ID 4050].

⁶⁹³ Agreed minutes of call with a market participant dated 9 February 2023 [ID 3982].

⁶⁹⁴ Agreed minutes of call with a market participant dated 25 August 2022 [ID 3008].

⁶⁹⁵ Agreed minutes of call with market participant dated 8 February 2023 [ID 4120].

strategy for standardization. While the option exists in theory, this is just not practical from an operational perspective. It would be difficult to standardize processes effectively.”⁶⁹⁶

- (584) Multi-sourcing also does not automatically bring with it the possibility to easily lift and shift workloads between both hypervisors. A migration between hypervisors would always be part of a long-term strategy. One end-customer explained that *“Switching workloads from one hypervisor to another cannot be done overnight given the technical complexities. For example, if one hypervisor were to fail, it would not be straightforward to lift and shift the workload to a different vendor’s hypervisor [...] In any event, shifting a workload to a different hypervisor would be for the longer term, given the time it takes to port workloads”*⁶⁹⁷ Another end-customer confirmed that *“Even if multiple hypervisors were in place, it would not be possible to simply lift and shift a given workload from one hypervisor to another. In general, transferring a workload from one hypervisor to another would be hugely traumatic from an operator’s engineering and operational functions.”*⁶⁹⁸ Finally, another end-customer confirmed that moving any given workload from one hypervisor to another would only be considered along with all other workloads as part of a major rebuild of the entire IT architecture, but it would not be considered for individual workloads: *“Changing the hypervisor would only be possible as part of a major transformation or re-design of the entire IT architecture, but not for individual applications or workloads. [...]. A hypervisor change would only take place at the time of such re-design”*⁶⁹⁹
- (585) Second, these difficulties to switch between hypervisors, including from VMware to another player within environments, [Other confidential information – VMware’s internal documents].
- (586) In a [Details on internal document discussing customer purchasing patterns].⁷⁰⁰
- (587) In a VMware presentation [Details on internal document comparing VMware and rival products].⁷⁰¹
- (588) Finally, based on the above, while the Commission acknowledges the existence of third-party migration tools, containerization technology, the existence of multi-homing or multi-sourcing, which may reduce the cost and complexity for some workloads and for some end-customers to a certain extent, the Commission’s investigation shows that it is typically difficult and complex to switch away from VMware.
- 8.4.3.2.1.2.5. Customers will continue to maintain on-premises footprint regardless of the out-of-market constraint of public cloud
- (589) As set out above in Section 6.2., and in line with the Notifying Party’s claim in the Article 6(1)(c) Response, the Commission’s market investigation confirms that there is indeed an ongoing **industry trend** for companies to move away from owning and managing a stand-alone on-premises data infrastructure towards employing a hybrid and/or multi-cloud strategy. Essentially, these companies are mixing-and-matching

⁶⁹⁶ Agreed minutes of call with Münchener Rück dated 9 February 2023 [ID 4153].

⁶⁹⁷ Agreed minutes of call with Telefonica dated 14 February 2023 [ID 4043].

⁶⁹⁸ Agreed minutes of call with Vodafone dated 10 February 2023 [ID 3988].

⁶⁹⁹ Agreed minutes of call with ITZBund, dated 15 February 2023 [ID 4057] (working translation from German).

⁷⁰⁰ VMware internal document, [Other confidential information – VMware’s internal documents].

⁷⁰¹ VMware internal document, [Other confidential information – VMware’s internal documents].

on-premises infrastructure, private and public cloud environments as well as multiple virtualization software vendors depending on the specific deployment model. This trend is in line with the Notifying Party's conclusions from its various industry studies, *i.e.*, its Workload Study⁷⁰², the MIT and Bain studies⁷⁰³ in which it is concluded that customers use various deployment types across workloads, and a relevant share of customers use a hybrid-cloud strategy.

- (590) However, the Commission's market investigation, including various VMware internal documents, also shows that the on-premises and private cloud environment will remain relevant despite this ongoing trend to move towards a hybrid cloud strategy.
- (591) First, during the Phase I market investigation, the vast majority of customers expressing an opinion submitted that they mix-and-match the environments in which they run their workloads and applications, however the majority of these customers note that they are only able to do so for some types of workloads or some types of applications.⁷⁰⁴ One customer notes: "*All companies [sic] are engaged in a move to cloud strategy*".⁷⁰⁵ Another customers states: "*Most vendors have recognized hybrid as the de facto enterprise operating model inclusive of public, private, on-premises and edge deployments*".⁷⁰⁶
- (592) However, both customers and competitors who responded to the market investigation confirmed that, despite this ongoing industry trend to move away from stand-alone on-premises infrastructure towards a more hybrid strategy, the on-premises and private cloud environment will remain relevant. There are workloads and applications for which the public cloud is not a suitable alternative and which, therefore, will remain on-premises or in the private cloud.⁷⁰⁷
- (593) For instance, one customer notes that the decision to use on-premises or private cloud infrastructure is "*often based on security considerations*".⁷⁰⁸ Another customer states: "*We will continue to use on-premises or private cloud for mission critical information/application and some development environment*".⁷⁰⁹ Another customer submitted: "*Mission critical applications and time critical applications remain on-premise. We also tend to keep legacy applications as well as R&D related and lab workloads on premise due to cheaper price and capabilities. Non-critical applications like network management functions or non critical data processing applications may reside in the private / global cloud*".⁷¹⁰
- (594) The majority of customers expressing an opinion also submitted that in the current market, even in the event of a 5-10% price increase of virtualization software in the on-premises environment, or in the event of a quality decrease, they would not be able to switch away all their workloads and applications from the on-premises environment.⁷¹¹ Factors to consider when deciding in which environment workloads and applications will be run include: "*cost, efficiency, end-user response time,*

⁷⁰² Annex 4 (Conglomerate) to the Form CO.

⁷⁰³ Article 6(1)(c) Response, paragraph 23.

⁷⁰⁴ Replies to Q4 – questionnaire to customers of VMware and Broadcom, question 7.

⁷⁰⁵ Replies to Q4 – questionnaire to customers of VMware and Broadcom, question 7.3 [ID 1517].

⁷⁰⁶ Replies to Q4 – questionnaire to customers of VMware and Broadcom, question 7.3 [ID 1909].

⁷⁰⁷ Replies to Q4 – questionnaire to customers of VMware and Broadcom, question 9.

⁷⁰⁸ Replies to Q4 – questionnaire to customers of VMware and Broadcom, question 7.1 [ID 1800].

⁷⁰⁹ Replies to Q4 – questionnaire to customers of VMware and Broadcom, question 7.1 [ID 1713].

⁷¹⁰ Replies to Q4 – questionnaire to customers of VMware and Broadcom, question 7.1 [ID 1563].

⁷¹¹ Replies to Q4 – questionnaire to customers of VMware and Broadcom, question 9.

security, architectural dependencies, cost and complexity of transformation to different environments etc. [...] Other requirements such as security and data sovereignty may limit where workloads are permitted to run.”⁷¹² Other customers noted: “Due to sovereignty obligations, some companies cannot run all workloads in public clouds and specifically U.S or China public clouds. EU public clouds (OVH like) can be an option, but they can only offer IaaS services while many applications requires PaaS services. [...]”⁷¹³ Another customer clarifies: “On-premises is the most expensive deployment today and workloads are typically deployed on premises because they cannot be deployed in a private or public cloud for reasons other than cost or quality of virtualization SW.”⁷¹⁴

- (595) During the Phase II market investigation, multiple end-customers also indicated there will always be types of workloads, applications or customers that will need to remain, at least partially, on-premises, providing similar reasons as set out above.
- (596) A number of end-customers considered that some workloads would remain on-premises in view of **security considerations**. For instance, “Bayer acknowledges that it will not be possible to move 100% of its workloads to the public cloud – some workloads will need to remain on-premises for reasons of, e.g., security. Furthermore, manufacturing workloads will need to remain on-premises.”⁷¹⁵ Another end-customer stated that “there are certain categories of data, such as health data, which [name] refuses to migrate to the cloud not because this is be prohibited, but to comply with its own data security standards.”⁷¹⁶ Another end-customer stated that “The public cloud is mainly used for data and AI, but not for application hosting. In addition, some data cannot be stored in the public cloud for security reasons. As a result, some applications will remain on-premises for at least five to ten years”.⁷¹⁷
- (597) Some of these security considerations are also tied to **government regulations**, which prevent these end-customers from migrating to the public cloud. For instance, “[C]ertain workloads are tied in by local government regulations. For example, Sweden’s national regulations require certain data to be stored in Sweden. Since Microsoft’s public cloud servers are located in Amsterdam, these workloads would need to remain on-premises.”⁷¹⁸ Another end-customer referred to military restricted data: “Airbus considers that there are some workloads that can only be deployed on VMware on-premises, but could not be moved to the public cloud. These are the workloads that need to be isolated (e.g., where data is classified under export control or as military restricted)”⁷¹⁹. This same market participant also indicated that there are certain limitations resulting from the lack of authorization by the public authorities to “move highly confidential information (e.g. where data is classified under export control or as military restricted) to the public cloud. For this type of data, Airbus is awaiting the development of the sovereign cloud which, to date, has not been properly established and exists only “on paper” (e.g.). As a consequence, Airbus continues to rely on private cloud and on-premises infrastructure for this type of data. In light of this, Airbus predicts that moving away from on-premises to the

⁷¹² Replies to Q4 – questionnaire to customers of VMware and Broadcom, question 7 [ID 1909].

⁷¹³ Replies to Q4 – questionnaire to customers of VMware and Broadcom, question 7 [ID 1517].

⁷¹⁴ Replies to Q4 – questionnaire to customers of VMware and Broadcom, question 9 [ID 1731].

⁷¹⁵ Agreed minutes of call with Bayer dated 22 February 2023 [ID 3958].

⁷¹⁶ Agreed minutes of call with a market participant dated 8 February 2023 [ID 4120].

⁷¹⁷ Agreed minutes of call with Orange dated 17 February 2023 [ID 4163].

⁷¹⁸ Agreed minutes of call with E.ON dated 13 February 2023 [ID 4050].

⁷¹⁹ Agreed minutes of call with Airbus dated 9 February 2023 [ID 4074].

public cloud would take the next 5-10 years.”⁷²⁰ Another end-customer stated that “While there is no rule directly prohibiting deployment of certain workloads on the public cloud, regulation imposes stringent conditions to do so and, to remain prudent, [name] prefers to deploy workloads on-premises where the CSP does not clearly demonstrate that its infrastructure complies with these criteria.”⁷²¹ Another end-customer stated that “Some customers have confidential information that cannot be held on the public cloud. Export or government data, for example, would not be moved to the public cloud. Whether a specific application can be moved to the public cloud would need to be assessed on a case-by-case basis”.⁷²²

- (598) Several other end-customers stated that **mission-critical workloads or applications** would need to remain on-premises and could not be migrated to the public cloud. For instance, an end-customer stated that it “considers that certain workloads cannot be migrated to the public cloud. For internal workloads, there are certain applications that fulfil critical functions and therefore need to be kept on-premises. For external workloads, KPN’s offering includes Cloud VL which assures end-customers that their data will be kept on KPN’s datacenters.”⁷²³ Another end-customer stated that “Hosting zones for each workload are determined on the basis of the criticality of the workload in question – critical data will remain on-premises and will not be affected by Thales’ migration strategy.” The same respondent added that “critical workloads will not be moved from on-premises to the public cloud. An application may be deemed critical for a variety of reasons, e.g., where it is defined as such under applicable regulations, or where it is of a sensitive nature. As an example, confidential business information [confidential] (e.g., sensitive M&A data) would not be [confidential] on the public cloud given that [confidential].”⁷²⁴
- (599) Some end-customers pointed to the **lesser performance** of public cloud compared to on-premises as a reason to remain on-premises, e.g., when there is a requirement for quick and efficient (i.e., low latency) access to network elements. For instance, “While Vodafone monitors benchmarks for public cloud vendors, some workloads for the core networking functions are not suitable for the public cloud at this stage. To date, there is no public cloud offering that could fulfil Vodafone’s needs in terms of performance, low latencies, and geographical placement. In Europe, 60% of Vodafone’s on-premises workloads run on VMware, the remaining 40% are non-virtualized.”⁷²⁵
- (600) Another end-customer indicated **strategic reasons**: “Not all applications can be moved to the public cloud. In some cases, [confidential] Siemens cannot keep the data on the public cloud [for contractual reasons]. [confidential] Siemens [confidential] prefers to maintain control over these matters and retain their data on-premises for strategic reasons. [Confidential].”⁷²⁶
- (601) Further arguments pointed to the fact that public cloud would require a **rewrite of some older applications**, and that some **legacy applications require dedicated infrastructure**. “[Many legacy applications] are highly personalised [confidential] and therefore difficult to migrate from on-premises deployment into a standardized

⁷²⁰ Agreed minutes of call with Airbus dated 9 February 2023 [ID 4074].

⁷²¹ Agreed minutes of call with a market participant dated 8 February 2023 [ID 4120].

⁷²² Agreed minutes of call with Nokia dated 22 February 2023 [ID 4157].

⁷²³ Agreed minutes of call with KPN dated 16 February 2023 [ID 4047].

⁷²⁴ Agreed minutes of call with Thales dated 16 February 2023 [ID 4060].

⁷²⁵ Agreed minutes of call with Vodafone dated 10 February 2023 [ID 3988].

⁷²⁶ Agreed minutes of call with Siemens dated 27 February 2023 [ID 4079].

public cloud environment. Some of them may eventually be reprogrammed to run on the public cloud but not all, For example, [applications] with sensitive data like HR or finance systems would never be migrated from on-premises to the public cloud, as this would be incompatible with the GDPR”⁷²⁷

- (602) Other end-customers pointed to **rewriting applications** or **incompatibilities between services or hardware with the public cloud**. For instance, one end-customer pointed to the fact that a significant number of its core processing applications still run-on mainframe, which would make migration to the public cloud more difficult as it wanted to avoid running some applications on mainframe on-premises and other applications (which don’t require the mainframe) on the public cloud. “Mainframe continue to play a crucial role in [name]’s infrastructure, as a significant number of core processing applications still run on mainframe. This renders migration to the cloud more difficult, as it is undesirable to run some applications on the mainframe on-premises and other applications (which do not require to be run on the mainframe) on the public cloud. Therefore, this entrenches the dependence on on-premises infrastructure.”⁷²⁸ The same market participant added “for its existing on-premises workloads, [name] uses server management services that cannot be used as-is in the cloud. To clarify this further, this non-compliance for using cloud could be licensing (which is the easiest to resolve), but also software that is not allowed in the cloud by the vendor, or which requires specific hardware (which you cannot run in the cloud), or which requires architectural designs that are not feasible in the cloud (such as specific network constructs). Vendors will often have a “cloud offering”, but that’s a different product (even when it uses the same name) with different behaviour or even different functionality. This renders a migration of these workloads to the cloud extremely difficult given that this would also entail a switch of these server management services. [...] [Name] therefore sees no benefit in moving these workloads to the cloud”.⁷²⁹
- (603) Similarly, another end-customer used server management services that were either not licensed to be used in the public cloud, or not allowed in the public cloud, or required hardware which you can’t run in the public cloud. This end-customer stated:
- (604) Second, [Other confidential information – VMware’s internal documents] the on-premises environment remains highly relevant and that multiple workloads will continue to be run in the on-premises environment. Furthermore, the switch to the public cloud is a complex multi-year strategy.
- (605) A VMware internal document states that: [Details on internal document discussing customer demand].⁷³⁰
- (606) In a VMware presentation containing [Details on internal document with forecast of customer demand].⁷³¹ This presentation also shows [Details on internal document discussing customer demand](see **Figure 18** below).⁷³²

⁷²⁷ Agreed minutes of call with Deutsche Telekom dated 14 February 2023 [ID 4096].

⁷²⁸ Agreed minutes of call with a market participant dated 8 February 2023 [ID 4120].

⁷²⁹ Agreed minutes of call with a market participant dated 8 February 2023 [ID 4120].

⁷³⁰ Form CO, CMA documents, [Other confidential information – Broadcom internal documents].

⁷³¹ VMware internal document, [Other confidential information – VMware’s internal documents].

⁷³² VMware internal document, [Other confidential information – VMware’s internal documents].

Figure 18: [Title of figure describing customer demand]

[...]

Source: VMware

- (607) For instance, in a VMware document from [Details on internal documents discussing customer demand] VMware states: [Details on internal documents discussing customer demand].⁷³³
- (608) VMware indicates [Details on internal documents discussing customer demand].⁷³⁴ The graphic referred to is pictured below as **Figure 19** and illustrates that [Details on internal documents discussing customer demand]. See Section 8.4.3.2.1.2.5. below.

Figure 19: Market dynamics VMware

[...]

Source: VMware

- (609) In a VMware internal document of [...],⁷³⁵ [Details on internal document describing factors influencing customers' decision to migrate workloads].⁷³⁶
- (610) [Details on internal document describing factors influencing customers' decision to migrate workloads].
- (611) [Details on internal document describing factors influencing customers' decision to migrate workloads].
- (612) [Details on internal document describing factors influencing customers' decision to migrate workloads].
- (613) VMware also [Details on internal document describing trends in cloud migration].⁷³⁷ Similarly, in a VMware memo regarding [Details on internal document describing trends in cloud migration].^{738 739}
- (614) In a VMware internal document from [Details on internal document describing factors influencing cloud migration].⁷⁴⁰

8.4.3.2.1.2.6. Conclusion

- (615) On the basis of all these elements, and for the purposes of this Decision, the Commission has reached the conclusion that VMware enjoys **a significant degree of market power** in the market for server virtualization software for the on-premises and private cloud environment.

⁷³³ VMware internal document, [Other confidential information – VMware's internal documents].

⁷³⁴ VMware internal document, [Other confidential information – VMware's internal documents] and VMware internal document, [Other confidential information – VMware's internal documents].

⁷³⁵ VMware internal document, "[Other confidential information – VMware's internal documents] and VMware internal document, [Other confidential information – VMware's internal documents].

⁷³⁶ <https://www.mckinsey.com/industries/technology-media-and-telecommunications/our-insights/cloud-migration-opportunity-business-value-grows-but-missteps-abound>.

⁷³⁷ VMware internal document, [Other confidential information – VMware's internal documents] and VMware internal document, [Other confidential information – VMware's internal documents].

⁷³⁸ VMware internal document, [Other confidential information – VMware's internal documents].

⁷³⁹ VMware internal document, [Other confidential information – VMware's internal documents].

⁷⁴⁰ CMA document, VMware's response to s109 Notice 1, page 11, [ID RSLV_00015886]–.

8.4.3.2.1.3. Ability to foreclose rival FC HBA providers through degradation of certified interoperability with VMware's server virtualization software

- (616) The Commission considers that the merged entity has the ability to foreclose rival FC HBA providers (*i.e.*, Marvell) by delaying the development and certification process of rival FC HBAs that are interoperable with VMware's server virtualization software for the following reasons.
- (617) **VMware controls the interoperability and certification process.** As set out above (see Sections 6.3. and 8.4.3.2.1.1.), FC HBAs interoperate with VMware's hypervisor ESXi through the installation of a certified driver. Such interoperability is made possible through extensive information exchange between VMware and FC HBA suppliers, including API exchange, exchanges about future hardware versions as well as new versions of ESXi, vSphere and vCenter, technical support (incl. debugging), as well as certification of hardware's interoperability with VMware. VMware's software is proprietary, and VMware is in charge of the interoperability and certification process. There are two main elements to this process.
- (618) First, in the months before submitting a driver for certification, FC HBA providers rely on VMware's cooperation in terms of information exchange as well as technical support. This cooperation pre-empts many technical issues which would otherwise come up at the stage of certification of their hardware's interoperability with VMware's hypervisor ESXi. FC HBA manufacturers are thus subject to VMware's goodwill throughout the process.
- (619) Second, at the end of this cooperation to develop a driver that ensures interoperability, as set out above in Section 6.3., FC HBA manufacturers submit their driver to VMware for certification, essentially obtaining confirmation that a driver works with VMware's OS/hypervisor. Once confirmed, VMware signs the hardware's manufacturers drivers as being VMware-certified. Without this signature, the security interface (UEFI) would not be able to verify the authenticity of the driver and would prevent the hardware's driver from loading. There are no specific industry standards or protocols to which the merged entity will be subject.
- (620) **Foreclosure would have a market-wide scope.** Contrary to the Notifying Party's claim, the Commission does not consider that an inability to target specific end-customers (*i.e.*, targeting those end-customers that would switch from rival to Broadcom hardware) would prevent the merged entity from pursuing a broader, market-wide foreclosure strategy. Instead, the Commission considers that the foreclosure mechanisms as described below in Section 8.4.3.2.1.3.2. would still have market-wide scope.
- (621) **Pool of common customers.** The Non-Horizontal Merger Guidelines set out that for foreclosure to be a potential concern, it must be the case that there is a large common pool of customers. This is the case here in the sense that the end-customers (*e.g.*, banks, insurance companies, telecom operators) purchase servers that include FC HBAs as well as server virtualization software that runs on the servers. For the identified mechanisms of technical tying (as will be further described in the Sections 8.4.3.2.1.3.1.-8.4.3.2.1.3.2. below), it is irrelevant whether the products are purchased by the same customers or rather via distributors or resellers; what matters is that the products interoperate, and that end-customers value the interoperability.

8.4.3.2.1.3.1. No ability to engage in total foreclosure

- (622) The Commission considers that the merged entity **would not have the ability to engage in total foreclosure** of FC HBA rivals.

- (623) In relation to the cooperation on interoperability, the Notifying Party submitted that VMware has full discretion to deny admission to partner programs. Therefore, if a hardware supplier that is not developing I/O devices applies to join VMware's I/O Vendor Partner Program,⁷⁴¹ this applicant would be considered incompatible⁷⁴² and VMware could deny that hardware supplier access to the I/O Vendor Partner Program and the Software-Defined Data Center integration program, which contains the tools and resources required to develop, certify, and release I/O device drivers for FC HBAs.⁷⁴³
- (624) In relation to the certification process, the Notifying Party submitted that this process is completed automatically using VMware's automated validation program without VMware's intervention, and technical troubleshooting is required in [...] % of certification requests submitted via this program.⁷⁴⁴ The Notifying Party further submits that the length of the interactions around troubleshooting depends on the nature of the issue encountered, and that the total duration of the certification process is case-specific.
- (625) However, the Notifying Party's internal documents and results of the market investigation indicate that VMware has a reputation of openness. The Notifying Party further explained that hardware neutrality is imperative for VMware's business model.
- (626) The Commission acknowledges the Notifying Party's submission that to deny a hardware vendor access to partner programs would be a rare scenario. Similarly, it acknowledges that an outright refusal to certify an interoperable driver is unlikely to occur.
- (627) Therefore, the Commission considers that any attempt by VMware to engage in total foreclosure by declining or rejecting the certified interoperability with rival FC HBA providers would likely affect VMware's reputation of neutrality.

8.4.3.2.1.3.2. Ability to engage in partial foreclosure by delaying certification of interoperability of rival FC HBAs with VMware's server virtualization software

- (628) The Commission considers that the merged entity **would have the ability to engage in partial foreclosure** of FC HBA rivals. VMware has the technical ability to tamper with the information exchange, technical support or certification of interoperability with its software. The results of the market investigation revealed that the merged entity could delay certified interoperability between rival FC HBAs and VMware's server virtualization software in a number of ways, during the interoperability and certification process and/or in response to *ad hoc* requests, for instance by delaying the validation of the certification process of hardware rivals, by delaying the technical support required from VMware during the certification process, or by prioritizing the exchange of information regarding VMware's newest software releases and features with Broadcom. As a result of such delays in the certification of their FC HBAs, Broadcom's rivals would suffer reputational harm to an extent that it could influence their decision to continue investing in the market for FC HBAs.

⁷⁴¹ See VMware, "I/O Vendor Partner". Available at: <https://techpartnerhub.vmware.com/programs/i-o-vendor-partner-package>.

⁷⁴² Form CO, paragraph 684.

⁷⁴³ See VMware, "I/O Vendor Partner". Available at: <https://techpartnerhub.vmware.com/programs/i-o-vendor-partner-package>.

⁷⁴⁴ Parties' reply to RFI 20, question 12.

Partial foreclosure by hampering the interoperability and certification process

- (629) A long and continuous process of close cooperation takes place between hardware vendors, server OEMs and the server OS/hypervisor (*i.e.*, Windows, Linux and VMware) before a device and server platform is released onto the market which includes all features of that OS. Market respondents have indicated that the production timeline of a server as well as the FC HBA components for that server are as follows.
- (630) The production timeline could be described as “train tracks” running in parallel but converging at certain points.⁷⁴⁵ Essentially, the release of FC HBAs is often tied to the server OEM’s releases of their new servers, which in turn are aligned with VMware for the release of their major new vSphere updates.⁷⁴⁶
- (631) Typically, every two years there is a new generation of server CPUs that are released (by Intel and AMD). Intel refers to this production model as the “tick-tock model”, where one side of the binary system is refreshed each release cycle.⁷⁴⁷ Server OEMs tend to orient their product cycles around that, because each server will require updates to their designs based on these major CPUs releases. In parallel, every 12-18 months, there will also be minor updates to these server CPUs. These releases can also drive opportunities in the markets for FC HBAs.
- (632) Associated with the release of these new server generations, there will also be updates to the major server OS/hypervisors.⁷⁴⁸ Server OEMs plan server releases (based on the release of the new or updated CPUs) and construct a roadmap with VMware that provides the right cadence between the OS release and the release dates for the server (hardware) and the OS (every 18 to 26 months for VMware)⁷⁴⁹. This is important because customers usually time upgrades of virtualization software together with upgrades of pre-defined hardware, *i.e.*, server refresh cycles.⁷⁵⁰ To that end, VMware [Business secret – production secret and processes].⁷⁵¹
- (633) VMware will typically inform FC HBA vendors approximately 12 months in advance of their planned OS release.⁷⁵² This allows these vendors to start planning the necessary adjustments to drivers, or functionality of the hardware components to ensure they work with VMware and pick up vSphere’s new (planned) features. As part of a new vSphere release or minor updates, VMware will also communicate with hardware vendors on whether out-of-box drivers that hardware vendors released outside of the vSphere release/update cycle should be included in-box.⁷⁵³ Similarly, these hardware vendors will inform VMware approximately two to three years in advance of their planned hardware updates, to ensure that the OS will work with this new hardware.⁷⁵⁴ Hardware vendors also inform VMware of technical aspects and

⁷⁴⁵ Agreed minutes of call with Marvell dated 08 March 2023 [ID 4322].

⁷⁴⁶ Agreed minutes of call with Microchip dated 10 March 2023 [ID 4302].

⁷⁴⁷ See for instance: <https://www.intel.com/content/www/us/en/newsroom/news/intel-embraces-internal-foundry-model.html?wapkw=tick%20tock>.

⁷⁴⁸ Parties’ reply to RFI 20, question 2.

⁷⁴⁹ Form CO, footnote 1034.

⁷⁵⁰ Form CO, footnote 1034.

⁷⁵¹ Parties’ reply to RFI 20, question 1.

⁷⁵² Parties’ reply to RFI 20, question 1.

⁷⁵³ Parties’ reply to RFI 20, question 1.

⁷⁵⁴ Agreed minutes of call with Marvell dated 8 March 2023 [ID 4322]; Parties’ reply to RFI 20, question 1.

minor feature updates and meet with VMware engineers on a semi-regular basis to discuss.⁷⁵⁵

- (634) The convergence between server OEMs and hardware vendors occurs 12 to 18 months in advance of a major server release.⁷⁵⁶ When there is a new server release, hardware vendors' goal is to bring to the market a new FC HBA that is compatible with the new server generation released by the OEMs and that provides the widest OS support (*i.e.*, the component is certified interoperable with a very wide selection of the most recent OS versions of Windows, Linux and VMware).⁷⁵⁷ Server OEMs typically expect hardware vendors to seek certification of their devices with VMware. Broadcom itself submits that it could not sell FC HBAs that have not been certified for interoperability with VMware.⁷⁵⁸
- (635) To reach this aim, the hardware vendors need to have started engaging with VMware and other server OS vendors (as set out above, approximately 12 months in advance) to ensure their products will be qualify for use by the server OEM. During this process, there will be regular meetings in which the FC HBA vendors discuss with VMware the planned roadmap and where engineers exchange technical updates that need to occur in the hardware components and/or server OS, so that they function well together. This includes the exchange of design information, modifications to support new features, tests with pre-release versions of hardware and software, as well as undergoing the certification process with VMware.⁷⁵⁹ A similar process is happening in parallel in relation to other OS vendors.
- (636) With respect to the certification process, server OEMs need certified compatibility with all OS, including VMware. That is because server OEMs do not want to be in a situation in which their servers work with only some OS, but not all.⁷⁶⁰ As a result, server OEMs will only put devices on the approved vendor list as soon as they have received certification of interoperability. The certification process with VMware generally builds on the engineering work that has been done in the preceding 18-24 months.⁷⁶¹
- (637) The qualification with the server OEM (*i.e.*, the testing of the functioning of the server including hardware components) takes about 6 to 9 months for each server cycle. Once a FC HBA model has qualified, the server OEM will put this device on the approved vendor list.⁷⁶²
- (638) Internal documents also show the importance of this close cooperation between the hardware vendor, server OEM and the server OS/hypervisor vendor in the context of the VMware certification process. These internal documents show that server OEMs and hardware vendors mutually agree on deliverables for hardware devices for the purposes of the server OEM's new product launch.
- (639) For instance, in an email exchange⁷⁶³ between Broadcom and [Details of internal document describing discussions with customers].

⁷⁵⁵ Parties' reply to RFI 20, question 1.

⁷⁵⁶ Agreed minutes of call with Marvell dated 8 March 2023 [ID 4322].

⁷⁵⁷ Agreed minutes of call with Microchip dated 10 March 2023 [ID 4302].

⁷⁵⁸ Parties' reply to RFI 20, question 21.

⁷⁵⁹ Agreed minutes of call with Microchip dated 10 March 2023 [ID 4302].

⁷⁶⁰ Agreed minutes of call with Microchip dated 10 March 2023 [ID 4302].

⁷⁶¹ Agreed minutes of call with Marvell dated 8 March 2023 [ID 4322].

⁷⁶² Agreed minutes of call with Marvell dated 8 March 2023 [ID 4322].

⁷⁶³ Broadcom internal document, [Other confidential information – Broadcom's internal documents].

- (640) In a Broadcom presentation from [Details on internal document describing timelines regarding relationships with third parties].⁷⁶⁴

**Figure 20: [Title of figure describing timeline of cooperation between Broadcom and a customer]
[Business secret – customers]**

[...]

Source: Broadcom

- (641) One respondent to the market investigation⁷⁶⁵ explained: “All certification work is done under NDA between component supplier, VMware and OEM. AMD currently invests heavily in dedicated internal resources, supplies reference server systems and peripherals, and makes direct payments to VMware to help drive OS/Hypervisor compatibility and to support certification testing. Despite this investment, VMware appears to do significantly more internal testing earlier in the process with our primary CPU competitor. This may be because AMD’s current CPU market share is less than our competitor, but we believe this is a disadvantage to AMD since it likely gives our competitor greater visibility and influence into VMware targets and criteria. VMware certification is currently a somewhat opaque process: VMware does not disclose targets or metrics to be met by AMD to achieve certification. Instead, the process involves AMD presenting data (testing results, etc. as requested by VMware) and VMware confirms by response whether those results are sufficient for certification.”⁷⁶⁶ That respondent also noted that: “There is a possibility that the hardware of the merged entity will have certain features implemented earlier than the rest of the market. Furthermore, the support for inhouse certifications vs. external certifications could be biased in favor of the merged entity.”⁷⁶⁷
- (642) Another respondent stated: “The merged entity has the ability to refuse to certify Intel devices for use with VMware because it is not contractually obligated to certify Intel devices and has the ability to delay or simply refuse to certify such devices.”⁷⁶⁸ That same respondent also submitted that: “The merged entity has the ability to refuse to enable new functionality of Intel devices in VMware, thereby making them less compatible with VMware”⁷⁶⁹
- (643) Essentially, in the context of this close cooperation between VMware and the hardware vendor, VMware would have the ability to delay the technical support that is provided to hardware vendors as part of this process or delay the provision of specific information regarding VMware’s updates. Post-Transaction, the merged entity could thus delay Broadcom rivals’ technical roadmap. Such a foreclosure strategy would be hard to detect by Broadcom’s rivals or server OEMs, given that the multi-year roadmap provides for an overall framework, but the large amount of contact points between VMware and the hardware vendors as part of what is a very intense collaboration, provide it with many opportunities to cause intentional delays in providing information or technical support in a discreet manner, or engage in discreet preferencing of Broadcom compared to Broadcom rivals. The discreet nature of the preferencing is a result of a multitude of smaller delays together causing a delay that has the effects as described below in Section 8.4.3.2.1.3.3., rather than

⁷⁶⁴ Broadcom internal document, [Other confidential information – Broadcom’s internal documents].

⁷⁶⁵ Replies to Q3 – questionnaire to competitors of Broadcom, questions 29, 30, 31, 32, and 33 [ID 1894].

⁷⁶⁶ Replies to Q3 – questionnaire to competitors of Broadcom, question 26 [ID 1894].

⁷⁶⁷ Replies to Q3 – questionnaire to competitors of Broadcom, question 33.1 [ID 1894].

⁷⁶⁸ Replies to Q3 – questionnaire to competitors of Broadcom, question 30 [ID 1785].

⁷⁶⁹ Replies to Q3 – questionnaire to competitors of Broadcom, question 32.1 [ID 1785].

only causing a delay in final step of the certification itself. Such discreet preferencing would in any event only be detected much later.

- (644) The Notifying Party's argument that technical support or interaction with VMware's engineers is currently not frequently needed in the certification process, disregards the importance of the lengthy and intense cooperation process preceding certification. Indeed, Marvell explained that 90-98% of the issues are already taken care of before getting to the qualification/certification cycle, due to clear communication and technical support throughout the cooperation process, rather than during the submission of test results and waiting for the approval of VMware.⁷⁷⁰ This means that there is a significant scope for causing delays and thereby hampering Broadcom's rivals, in manners that would be difficult to attribute to the merged entity's behaviour. Marvell submitted that: *"If Marvell and VMware did not go through that exchange of information and continuous communication, the certification process would be a lot more burdensome and difficult, and it would be impossible for Marvell to successfully go through the certification process in a timely and easy manner"*⁷⁷¹
- (645) Furthermore, VMware's and hardware vendors' incentives today are aligned, which will be different post-Transaction. Accordingly, any current infrequent need for technical support in the certification process is not indicative for the situation post-Transaction. The Notifying Party's argument that withholding updates on upcoming vSphere updates from hardware vendors would come at VMware's own detriment as customers' workload may fail on the hardware device, should therefore be interpreted differently in a post-Transaction setting.⁷⁷² Similarly, if there are any agreements in place today, those were negotiated in a setting where VMware had no incentives to treat one hardware vendor different than another.
- (646) Finally, the Notifying Party's argument that hardware vendors could start the certification process sooner or shift resources to expedite the VMware process⁷⁷³ is not convincing, given that the certification of hardware products' interoperability with VMware is just one of many aligned development tracks.

Partial foreclosure by delaying or degrading support in response to *ad hoc* requests

- (647) In the context of VMware's certification process, internal documents show that [Business secret – production process]. These internal documents also show that [Business secret – production process].
- (648) In a Broadcom email from [...],⁷⁷⁴ [Details on internal document describing a Broadcom exchange about a product].
- (649) These documents show that there is currently an active, transparent dialogue between VMware and hardware vendors, however, post-Transaction, it will be very difficult to detect for hardware vendors whether the merged entity delayed troubleshooting or certification or created other issues on purpose in favour of Broadcom's certification.

⁷⁷⁰ Agreed minutes of call with Marvell dated 8 March 2023 [ID 4322].

⁷⁷¹ Agreed minutes of call with Marvell dated 8 March 2023 [ID 4322].

⁷⁷² Parties' reply to RFI 20, question 1.

⁷⁷³ SO Response, paragraph 374.

⁷⁷⁴ Broadcom internal document, [Other confidential information – Broadcom's internal documents] and Broadcom internal document, [Other confidential information – Broadcom's internal documents].

8.4.3.2.1.3.3. Conclusion

- (650) Overall, several of these strategies listed above would result in an unfair time-to-market advantage for Broadcom, compared to its FC HBA rival. If a hardware vendor incurs delays, its products will not be qualified by the server OEM at the stage of the initial release of the new server. Whereas the hardware may qualify at a later stage, the hardware vendors will miss the initial server release as well as the corresponding PR cycle.⁷⁷⁵ A further concern if VMware does not complete and accept certification within a set timeframe would be that Marvell's drivers may also not be incorporated into VMware's new OS release (in-box). In this case, their driver will have to be released at a later stage, out-of-box (on Marvell's website and on VMware's website for download and installation).⁷⁷⁶
- (651) Marvell indicated that, by missing these key deadlines, there may be significant financial and reputational losses which could ultimately impact Marvell's decision to invest in the market for FC HBAs or, at some point, drive Marvell to stop investing in that market altogether.⁷⁷⁷
- (652) The Notifying Party's argument that rival FC HBAs would be included in the server OEMs' offering with the next quarterly update of the server⁷⁷⁸ does not alleviate concerns, as the reputational damage will have already taken place.
- (653) For the same reason, the Notifying Party's argument⁷⁷⁹ that many FC HBAs are certified by claiming equivalence, or that Marvell would in any event be able to continue to compete for at least the next 8 to 9 years with its already-certified FC HBAs (2020-2021), is unconvincing. Marvell would encounter reputational damage and miss important marketing deadlines which is part of the PR cycle around each major server and server OS release. Marvell would not be able to convince end-customers of the newest features of their hardware devices as well as the fact that these devices also support the new features of any major update of vSphere. Marvell indicates that: *"For timing, when designing a new server, end customers are often impatient. Any delay in ensuring certification and compatibility could potentially lead to revenue and business loss."*⁷⁸⁰ Marvell may feel that its FC HBAs are at risk of always obtaining certification of interoperability with VMware's server virtualization software after Broadcom's FC HBAs, which would ultimately result in Marvell's questioning its future investment in the market for FC HBAs.⁷⁸¹ This will also be set out further in detail in Section 8.4.3.2.3. below.
- (654) Based on the above, the Commission has reached the conclusion that the merged entity will have the ability to engage in a partial foreclosure strategy, by delaying certification of rival FC HBAs for interoperability with VMware's server virtualization software therefore degrading their ability to compete.

⁷⁷⁵ Agreed minutes of call with Marvell dated 8 March 2023 [ID 4322].

⁷⁷⁶ Marvell's non-confidential reply to RFI 1, question 6 d) [ID 4437].

⁷⁷⁷ Agreed minutes of call with Marvell dated 8 March 2023 [ID 4322].

⁷⁷⁸ SO Response, paragraphs 394-401.

⁷⁷⁹ Parties' reply to RFI 21, questions 2 a), 2 f), 2 g), 3 c), 7 a), 7 f), 7 g); SO Response, paragraph 426-431.

⁷⁸⁰ Marvell's non-confidential reply to RFI 1, question 6 c) [ID 4437].

⁷⁸¹ Agreed minutes of call with Marvell dated 8 March 2023 [ID 4322].

8.4.3.2.1.4. Marvell is not able to deploy effective and timely counterstrategies

- (655) The Non-Horizontal Merger Guidelines set out that bundling is less likely to lead to foreclosure if rival firms are able to deploy effective and timely counterstrategies, such as single-product companies combining their offers.
- (656) First, Broadcom’s FC HBA rival, *i.e.*, Marvell is a hardware company, which does not own any (server) virtualization software solutions.
- (657) Second, even in a scenario whereby Marvell would combine its hardware solutions with a server virtualization software provider, Marvell and Microchip would still be heavily reliant on VMware’s software. As set out above in Section 8.4.3.2.1.1., server OEMs expect that server components provide the broadest OS support, *i.e.*, certified compatibility with several versions of Windows, Linux and VMware. Furthermore, VMware is viewed by many customers as important in light of its unique and differentiated features. Accordingly, Marvell and Microchip would still be heavily reliant on VMware’s virtualization software.
- (658) Third, Marvell is not able to sponsor the entry of new suppliers in the market for server virtualization software.
- (659) As set out above in Section 8.2., the market for server virtualization software in the on-premises and private cloud environment is a relatively stable market, with VMware having a very strong position. IBM indicated that: *“In our expectation, the overall compute virtualization market will not see new entries due to several reasons – 1) Existing mature open-source and proprietary offerings; 2) Progressive adoption of containerization and cloud provided virtualization; 3) Emerging processor architectures that provide more flexible and dynamic composition of resources. However, containerization and network/storage virtualization continue to see new innovations and we expect new entrants and solutions in these spaces”*.⁷⁸²
- (660) In a memo regarding VMware’s [Details on internal document describing VMware’s position in the market] from [Details on internal document describing VMware’s position in the market], [Details on internal document describing VMware’s position in the market].⁷⁸³

8.4.3.2.1.5. Conclusion

- (661) On the basis of all these elements, and for the purposes of this Decision, the Commission has reached the conclusion that the merged entity has the **ability** to foreclose its rival in the market for FC HBAs by delaying the certification of interoperability between rival hardware products and VMware’s server virtualization software.

8.4.3.2.2. Incentive to foreclose

- (662) For the reasons set out below, the Commission has reached the conclusion that the merged entity would have the incentive to engage in a market-wide foreclosure strategy of its rival in the market for FC HBAs by degrading the certified interoperability between these rival hardware products and VMware’s server virtualization software in the on-premises and private cloud environment.

⁷⁸² Replies to Q2 – questionnaire to virtualization software competitors of VMware, question 17.1 [ID 1906].

⁷⁸³ VMware internal document, [Other confidential information – VMware’s internal documents].

- (663) According to the Non-Horizontal Merger Guidelines, the incentive to foreclose rivals depends on the degree to which the strategy is profitable. The merged entity faces a trade-off between the possible costs associated with foreclosure and the possible gains from expanding market shares in the markets concerned.⁷⁸⁴
- (664) In order to assess whether the merged entity would have the incentive to employ the partial foreclosure strategies set out above in Section 8.3.2.3.1.3., the Commission has assessed, first, the critical switching rate implied by a standard static “vertical arithmetic” as proposed by the Notifying Party. The critical switching rate is defined as the fraction of VMware virtualization software customers that would need to switch from using Broadcom’s rival FC HBAs to Broadcom components, rather than switching away from VMware’s virtualization software, for the gains from additional Broadcom sales to outweigh the losses in profits from the loss of VMware virtualization software licensees. While the Commission acknowledges that the critical switching rates implied by such standard analysis are high, they do not imply that foreclosure would be unprofitable.
- (665) Second, the market investigation indicates that virtually all end-customers are likely to switch from rival to Broadcom FC HBAs. This is because end-customers are generally indifferent to the supplier of such components which in any event is selected by OEMs with generally no significant difference between brands of such components. At the same time end-customers choose their virtualization software and would find a change in hypervisor very difficult and disruptive. Moreover, no customer would buy non-certified interoperable hardware.
- (666) Third, the Commission considered the likelihood of countervailing factors such as buyer power, the likelihood of retaliation by rivals, or – as submitted by the Notifying Party – any risk of reputational harm as a result of a change to VMware’s model of neutrality. The Commission considers that no countervailing factors are present.
- (667) Fourth, the Commission considers that VMware’s past ownership by Dell and EMC provides no guarantee as to Broadcom’s conduct in relation to VMware post-Transaction.

8.4.3.2.2.1. High critical switching rates from standard vertical arithmetic analyses do not in themselves imply absence of incentives to foreclose

- (668) As set out in Section 8.4.3.1.2., the Notifying Party submitted a standard “vertical arithmetic” analysis that calculates the percentage of customers that would need to switch from a foreclosed rival hardware vendor to the merged entity for foreclosure to be profitable. This analysis is based on a comparison of VMware’s average unit margins on software products and associated services per server to Broadcom’s unit margin on FC HBAs that are included in an average server that carries Broadcom hardware.
- (669) While such an analysis is standard, the Commission considers that the question whether actual switching is likely to exceed the critical threshold derived in this way cannot be assessed independently of other implications of, and the reasons for, substantially different unit margins earned by VMware and Broadcom. In particular, a high critical switching rate cannot, in itself, be taken as an indication that the likely actual switching rate would fall below this threshold so that foreclosure would not be profitable.

⁷⁸⁴ Non-Horizontal Merger Guidelines, paragraph 105.

- (670) This is because differences in margins not only imply the critical switching rate for foreclosure to be profitable, but also reflect (i) differences in market power by the entities involved and (ii) differences in the value of upstream and downstream products from the perspective of purchasers, and hence how likely it is that switching will occur. In essence, a high margin usually indicates that an entity has substantial market power and hence that its customers have strong preferences for the product over available substitute products. As laid out in Section 8.4.3.2.1.2., VMware holds a significant degree of market power on the market for server virtualization software in the on-premises and private cloud environment. Accordingly, VMware is able to charge high percentage margins (in the order of [Business secret – margin calculation]%) on its software products and support services to customers in that market. According to the Notifying Party, VMware’s unit margins per server on average exceeds USD [Business secret – price structure] once associated products are accounted. While [Business secret – margins calculation] [Business secret – price structure]. Pre-merger, these figures indicate that VMware is able to extract substantially higher rents (in absolute terms) from customers in the market for virtualization software for on-premises deployments than Broadcom earns on hardware sales for servers on which these customers run this software. This indicates that customers depend substantially more on VMware than on Broadcom or have a substantially stronger preference for VMware products than for Broadcom products. Therefore, faced with a choice of either giving up VMware software or giving up Broadcom hardware, customers should be expected to be far more willing to abandon the lower value components (Broadcom’s hardware) than the higher value component (VMware’s software). These substantial difference between absolute margins earned on VMware’s software products and Broadcom’s margins on FC HBA hence not only imply a high critical switching rate for foreclosure to be profitable. They also indicate that the actual switching rate is likely to be high. Therefore, a high critical switching rate is not, in itself, an indication that there will be no incentive to foreclose.⁷⁸⁵
- (671) In the SO, the Commission further identified several issues in the vertical arithmetic submitted by the Notifying Party, which may lead to an overstatement of the critical switching rates. First, the Notifying Party based its estimates on the price of the most expensive vSphere licenses instead of actual revenues from licenses and services. Second, the Notifying Party’s vertical arithmetic did not fully consider the importance of volume discounts. [Business secret – know-how]. Third, the static

⁷⁸⁵ This has been observed in recent contributions to the economic literature. See for example, O’Brien, Daniel P (2022), “Tethering Vertical Merger Analysis” available at <https://ssrn.com/abstract=4061410>. See also Inderst, R and T. Valletti (2011), “Incentives for Input Foreclosure”, 55 Eur. Econ. Rev. 820. The Commission agrees with the observations by Professor P. Rey submitted as Annex 2 (Incentives) of the Notifying Party’s SO Response that the profitability of foreclosure cannot rely solely on the analysis of pre-merger margins and that a high critical switching rate does not imply an incentive to foreclose. The Commission also agrees that a high margin does not necessarily indicate that customers are not willing to switch away from VMware in response to price increases. However, the combination of VMware software with Broadcom components through the merger can create a previously non-existing incentives to implement a foreclosure strategy. Moreover, the foreclosure strategy at issue would not involve a price increase on VMware products, but rather a reduction in interoperability that simply requires customers to switch between two homogeneous hardware products. In any event, the Commission’s point is that high critical switching rates in themselves do not imply that actual switching rates do not exceed this threshold. Therefore, the Commission has carried out an assessment of likely actual switching behaviour (Section 8.4.3.2.2.2) and bases its conclusions on incentives to foreclose on a comparison between the likely critical switching rate and the likely actual switching rate, in agreement with the approach proposed by Professor Rey.

vertical arithmetic assumes that prices and margins would remain constant following the foreclosure strategy, while foreclosure of non-Broadcom hardware might allow Broadcom to raise prices of its hardware components. If after foreclosure Broadcom would raise prices or margins, then the critical switching rates would be lower than those estimated based on current prices or margins. Fourth, the vertical arithmetic submitted by the Notifying Party did not take into account that some workloads migrating away from vSphere solutions for on-premises and/or private cloud deployments might be recaptured by VMware's public cloud solutions [other confidential information].⁷⁸⁶

- (672) In its SO Response, the Notifying Party provided updated calculations using average revenues and margins across VMware's products to account for all VMware's virtualization software and associated products. First, according to the Notifying Party, both VMware and Broadcom earn percentage margins in the order of [Business secret – margin calculations] on their respective products. The value of the Broadcom FC HBAs per server is estimated to be USD [Business secret – price structure] with a lifetime of such products of [Business secret – know-how]. The costs for customers of VMware software licenses and support services over the same time horizon is estimated at USD [Business secret – know-how] for vSphere, and USD [Business secret – know-how] when associated products and services are taken into account. This substantial difference in average value across and unit margins between VMware products and Broadcom products per server results in the high critical switching rates for profitable foreclosure. This results in critical switching rates of [...] % considering only vSphere sales only, or [...] % considering vSphere plus associated products. Second, the Notifying Party argues that [Business secret – know-how]. Third, the Notifying Party also argues that the recapture rate from the VMware internal document cited in the SO does not reflect actual recapture assessed in more recent documents. In any event, even using recapture rate of [Business secret – know-how] % from the original document would only have a limited impact on the critical switching rate. Finally, the Notifying Party argues that the foreclosure strategy would not adversely affect competition in the relevant markets. As such, the competitive constraints from Broadcom's rivals would continue, leaving no room for a price increase. An additional constraint would come from OEMs who would have incentives to actively counter the partial foreclosure strategy in order to maintain competition in their supply.
- (673) In light of the Notifying Party's modifications and further analysis in the response to the SO, the Commission acknowledges that volume discounts and recapture through VMware public cloud solutions are unlikely to have a material impact on the critical switching rate. The Notifying Party's argument that foreclosure would have no material impact on Broadcom's ability to raise price is related to the assessment of the impact of the foreclosure strategy which is assessed in Section 8.4.3.2.3. The conclusion of that Section is that foreclosure would have a significant detrimental effect on competition in the worldwide market for FC HBAs. The Notifying Party's argument that Broadcom would not be able to raise the price of its components therefore has to be rejected, which implies that the critical switching rates as calculated above remain somewhat overstated.
- (674) For the purposes of this decision, the Commission nevertheless accepts the Notifying Party's revised calculations of the critical switching rates which indicate that a

⁷⁸⁶

VMware internal document, [Other confidential information – VMware's internal documents].

foreclosure strategy would be profitable if [80-90]% of VMware customers using FC HBAs by Broadcom's rivals would switch to corresponding Broadcom products. A critical switching rate of [80-90]% implies that foreclosure would be profitable if [Business secret – price structure] VMware customers (or workloads) is lost as a result of the foreclosure strategy.

8.4.3.2.2.2. The market investigation indicates that virtually all end-customers are likely to switch from rival to Broadcom FC HBAs

- (675) The Commission has investigated the role of server OEMs and end-customers to assess the likely reaction to a possible degradation of certified interoperability between VMware's virtualization software and Broadcom's rival FC HBAs. Based on the Phase I and II market investigation, the Commission has come to the conclusion that a very significant number, if not all, customers of VMware would switch to Broadcom FC HBAs. Therefore, even if the critical switching rate was as high as the Notifying Party suggests, the actual switching rate would likely be higher than the critical switching rate.
- (676) First, any partial foreclosure behaviour would be mainly and primarily felt by server OEMs, while end-customers are indifferent to the exact FC HBA supplier. At the very least, the end-customers' choice of virtualization software is not influenced by their FC HBAs. Second, there is generally no significant feature difference between a Broadcom and rival FC HBA. End-customers can typically use both, and easily switch between these components at the time of a server refresh. Third, end-customers determine which virtualization software they run and invest significantly in their software infrastructure, including IT personnel that is trained in their server OS / hypervisor. Fourth, server virtualization software represents a significant cost relative to the price of FC HBAs. Finally, no customer would buy a hardware component which is non-certified interoperable with the software on which they are running their workloads.
- (677) Considering these elements, the Commission considers that the Notifying Party's claim that any hypothetical partial foreclosure behaviour by the merged entity would drive VMware customers to rival virtualization software providers for at least some of their workloads (within the same environment or towards the public cloud), or that VMware customers who are already migrating some of their workloads to the public cloud, away from VMware, would accelerate that move, is implausible. As set out, these server components, which are commodity products, do not determine or influence customers' choice of virtualization software. Each of these elements will be set out in more detail below.

8.4.3.2.2.2.1. Server OEMs typically select the FC HBA, while end-customers are generally indifferent to the FC HBA supplier

- (678) First, end-customers typically do not choose the exact FC HBAs for their servers. Instead, these individual hardware components are selected by the customers' **server OEM**, who then incorporates these into the servers and sells this integrated server solution to the end-customer. Therefore, this feature of the supply chain means that any switching of hardware is done at the server OEM level rather than by the end-customers themselves.
- (679) The Notifying Party confirmed that Broadcom's main customers were not end-customers. Instead, Broadcom's customers for FC HBAs are mainly OEMs

(including [Business secret – customers lists]). These players typically procure FC HBAs through global requests for quotation.⁷⁸⁷ In 2021, based on revenues, [90-100]% of Broadcom’s FC HBAs was sold to OEMs and Original Design Manufacturers (“ODMs”) and [0-5]% to hyperscalers.⁷⁸⁸

- (680) The Notifying Party stated: “FC HBAs are almost never purchased directly by end-customers, regardless of industry or sector. End-customers of all industries and sectors select FC HBAs in the server systems that they purchase from server OEMs” and “Broadcom sells the vast majority of its FC HBAs through server and storage OEMs that typically purchase FC HBAs on an individual order basis.”⁷⁸⁹
- (681) Second, the Notifying Party indicated that it estimates that approximately [40-50]% of end-customers do not have any preference for their FC HBA supplier, while the remaining [60-70]% would have a preference for Marvell or Broadcom.⁷⁹⁰ However, based on the Commission’s market investigation, all end-customers that expressed an opinion during the Phase II market investigation confirmed they rely on **server OEMs** (or their managed services provider) to determine the FC HBA brand contained in their server packages.⁷⁹¹ While the large majority of these end-customers indicated that they leave the decision entirely in the hands of the server OEM, as long as there is software compatibility, two end-customers⁷⁹² also indicated that they rely on the server OEM’s catalogue. This catalogue includes only those choices that the server OEM decides to purchase. For instance, Siemens “*purchases hardware from OEMs like Dell or HPE. It usually receives list of components from the OEM and then checks whether the components on this list are compatible with VMware. [...] As long as the hardware works with VMware, Siemens usually does not further specify which components are to be used.*”⁷⁹³ Another end-customer stated: “*For its network hardware, Telefónica relies on server OEMs.*”⁷⁹⁴
- (682) Furthermore, end-customers repeatedly stated that they were largely indifferent to the various options of hardware brands in the server OEM’s proposed package as long as the hardware was compatible with the customers’ software needs. One end-customer indicated that they may have some preference, but this related to Ethernet NICs and not FC HBAs.⁷⁹⁵
- (683) For instance, one end-customer stated: “Thales purchases servers from server OEMs. The OEM defines a list of servers without providing much detail on the brands of the server components. Thales indicates that they are largely indifferent to the choice of hardware brand. Thales does not have any specific requirements in terms of security, as they provide their own security products, which they implement on their servers.”⁷⁹⁶ Another end-customer submitted: “The managed services provider is responsible for the hardware costs (ordering and installing the hardware). Usually, E.ON has little involvement in the hardware purchasing decision. Only where E.ON finds that there are shortcomings in the approach taken by the managed services

⁷⁸⁷ Form CO, paragraphs 874 and 886-887.

⁷⁸⁸ See Annex 40 (Section 8) to the Form CO.

⁷⁸⁹ Parties’ reply to RFI 21.

⁷⁹⁰ Parties’ reply to RFI 21.

⁷⁹¹ Agreed minutes of calls with end-customers, as cited in the paragraphs below.

⁷⁹² Agreed minutes of call with Orange dated 17 February 2023 [ID 4163]; Agreed minutes of call with Siemens dated 27 February 2023 [ID 4079].

⁷⁹³ Agreed minutes of call with Siemens dated 27 February 2023 [ID 4079].

⁷⁹⁴ Agreed minutes of call with Telefonica dated 14 February 2023 [ID 4043].

⁷⁹⁵ Agreed minutes of call with Vodafone dated 10 February 2023 [ID 3988].

⁷⁹⁶ Agreed minutes of call with Thales dated 16 February 2023 [ID 4060].

provider (such as, for example, the costs involved in migrating legacy applications) would E.ON intervene. As a result, the hardware compatibility layer is almost entirely outsourced.”⁷⁹⁷ Another end-customer stated: “In the past, Bayer would issue a Request for Proposal (“RFP”) in regular periods to procure hardware. The RFP set out certain “t-shirt sizes” (e.g., a requirement for compatibility with VMware software, other requirements) confirmed and Bayer normally purchased a server that fit within those “t-shirt sizes” regardless of the hardware components. Currently, the hardware procurement is largely outsourced to Bayer’s service provider.”⁷⁹⁸

- (684) Several end-customers also explicitly confirmed that, if server OEMs were to ask or suggest end-customers to switch between brands of a specific server component in order to maintain VMware compatibility, these end-customers would accept that suggestion. For instance, one end-customer stated *“Munich Re is not a hardware company, so it does not have the knowledge to manipulate any hardware components itself. Munich Re depends on the server OEM to provide it with a ready-to-use server. If Munich Re’s server OEM was to ask or advise Munich Re to change the brand of a specific server component such as an FC HBA (which Munich Re does not use) or a storage adapter (which Munich Re does use) in order to maintain VMware compatibility, Munich Re would just accept this as long as this would not affect its currently automated processes.”*⁷⁹⁹ Similarly, an end-customer stated: *“Airbus orders hardware based on its framework contract with HPE, which, in turn, relies on subcontractors to install the systems in Airbus’ datacenters. Airbus is relatively indifferent to the choice of hardware component built into its servers. If, hypothetically, HPE were to tell Airbus that a given Microchip or Marvell component would need to be replaced by a Broadcom component, Airbus would likely just accept this. What matters for Airbus is that its hardware infrastructure is compatible with its software stack, whereas the identity of the chip vendor is of little importance to Airbus.”*⁸⁰⁰
- (685) Third, for those limited instances where end-customers would have a preference for specific FC HBA or storage adapter components, end-customers will still rely on the server OEM’s catalogue, which includes only those choices that the server OEM decides to purchase.⁸⁰¹ While various server OEMs indicate that they multi-source FC HBAs or storage adapters, server OEMs also appear to have a vested interest or agreement with the hardware vendor to push a certain choice as the default (in view of agreed volume discounts, or other negotiations, see below in the current Section).
- (686) During the Phase II market investigation, the majority of server OEMs that purchase FC HBAs and expressed an opinion indicated that they multi-source from Broadcom and Marvell.⁸⁰² None of the server OEMs indicated that they purchased only from Marvell.
- (687) In relation to those server OEMs that list more than one vendor as an option for FC HBAs, [Other confidential information] hardware vendors indicate that server OEMs will still offer a default configuration or try to push a default configuration onto end-customers for the future (in view of volume discounts and other types of agreements with Broadcom).

⁷⁹⁷ Agreed minutes of call with E.ON dated 13 February 2023 [ID 4050].

⁷⁹⁸ Agreed minutes of call with Bayer dated 22 February 2023 [ID 3958].

⁷⁹⁹ Agreed minutes of call with Münchener Rück dated 9 February 2023 [ID 4153].

⁸⁰⁰ Agreed minutes of call with Airbus dated 9 February 2023 [ID 4074].

⁸⁰¹ Agreed minutes of call with HPE dated 22 September 2022 [ID 2035].

⁸⁰² Server OEMs replies to RFIs 1, question 2 a).

- (688) For instance, in an email from [Other confidential information – Broadcom’s internal documents], Broadcom states: [Details of internal document describing agreement between Broadcom and a third party].⁸⁰³ In an email from [Business secret – business plans].⁸⁰⁴
- (689) This was also confirmed by hardware vendors. For instance, Microchip indicated that “End-customers do not play a role in server OEMs’ choice of the default option of supplier. From the perspective of end-customers, it does not really matter which storage adapter is running on the server, as long as it is working. End-customers choose the OS environment first, and the server vendor afterwards. The price of the storage adapter would only come third in terms of customer preference. In addition, the storage adapters offered by Broadcom and Microchip are roughly equivalent, mature products with similar features. As a result, what really matters is the server OEMs’ choice of default option.”⁸⁰⁵

8.4.3.2.2.2. There is generally no significant difference between FC HBA brands

- (690) Nearly all respondents to the Phase I and II market investigation indicated that there is generally no significant difference in terms of specifications and features between a Marvell or Broadcom FC HBA. Typically, end-customers can use either brand. This was confirmed by the main customers (*i.e.*, server OEMs), the end-customers as well as FC HBA suppliers themselves.
- (691) One **server OEM** stated: “No – both providers’ products are generally commoditized and extremely competitive in terms of function, features, and price”.⁸⁰⁶ Another server OEM indicated: “Generally, Dell sees no major differences between Marvell FC HBA and Broadcom FC HBA, in both specifications and features. Customers may prefer one vendor over another in order to harmonize a product with their existing infrastructure, but they can use either.”⁸⁰⁷ Another server OEM indicated that, while it didn’t consider there were significant feature differences between both, it sourced exclusively from Broadcom to optimize discounts and negotiations: “[Respondent] does not consider that there is a significant specification or feature difference between the different FC HBA providers”⁸⁰⁸ Finally, another server OEM indicated that there are indeed no significant differences, but some of the secondary differences may be relevant for some of their high-end customers. Accordingly, this customer sources the vast majority of its FC HBAs from Broadcom: “There are not significant differences. There are secondary differences in the supported numbers of logins and exchanges (Fibre Channel protocol elements) between the two. Marvell supports fewer. Those differences matter to some of our high-end IBM Power customers.”⁸⁰⁹ Furthermore, with regard to this customer, [Details on internal document regarding Broadcom’s business plans].⁸¹⁰
- (692) Similarly, **end-customers** indicated they did not consider there were significant differences in terms of specifications and features between rival FC HBAs. During the Phase II investigation, end-customers consistently indicated that the identity of the hardware vendor was not relevant, as long as it was compatible with the end-

⁸⁰³ Broadcom internal document, [Other confidential information – Broadcom’s internal documents].

⁸⁰⁴ Broadcom internal document, [Other confidential information – Broadcom’s internal documents].

⁸⁰⁵ Agreed minutes of call with Microchip dated 10 March 2023 [ID 4302].

⁸⁰⁶ HPE’s non-confidential reply to RFI 1, question 5 b) in relation to FC HBAs [ID 3507].

⁸⁰⁷ Dell’s non-confidential reply to RFI 1, question 5 b) in relation to FC HBAs [ID 3556].

⁸⁰⁸ Market participant’s non-confidential reply to RFI 1, question 5 b) [ID 3716].

⁸⁰⁹ IBM’s non-confidential reply to RFI 1, question 5 b) [ID 3519].

⁸¹⁰ Broadcom internal document, [Other confidential information – Broadcom’s internal documents].

customers' software stack. This has been set out in detail above in the current Section.

- (693) Finally, this was also confirmed by the vendors of FC HBAs themselves, *i.e.*, Broadcom and Marvell⁸¹¹.
- (694) **Broadcom** submitted a comparison between Broadcom's and Marvell's FC HBAs specifications (such as device generation, PCIe generation, Speed (Gbps), number of ports and IOPS (millions). This comparison shows that [Business secret – production process].⁸¹² The Notifying Party also indicates: "*Both Broadcom and Marvell's FC HBAs have similar features (e.g., a maximum speed of 64 Gbps and the same number of ports) and can cater for all end-user use cases.*"⁸¹³
- (695) **Marvell** noted that: "For FC HBAs, the features and speeds must adhere to certain standards, *i.e.*, T-11. Thus, the main mode of competition is for one company to implement a feature or functionality before a competitor does. [...] However, as you move to higher block sizes, there is reduced overhead and Marvell and Broadcom are similar".⁸¹⁴

8.4.3.2.2.3. End-customers determine which virtualization software they run

- (696) In contrast to the hardware choice, end-customers generally always choose the virtualization software which their enterprise will be running.
- (697) As set out by the Notifying Party in the Form CO, VMware's server virtualization software is supplied through VMware's indirect sales channels to the end-customers. VMware's partners enter negotiations directly with the end-customers in relation to the sale of the server virtualization software.⁸¹⁵ This sales model supports respondents' indications that the choice of virtualization software provider is "*not dependent on hardware but on customer preference*".⁸¹⁶
- (698) Based on the Phase II market investigation, the majority of **server OEMs** expressing an opinion confirmed that the end-customer will determine which virtualization software they run.⁸¹⁷ To the contrary, none of the end-customers that replied to the Phase I and/or Phase II market investigation indicated that their server OEM would determine the server virtualization software provider.
- (699) One server OEM explained that they sell server virtualization software as part of the server package in most cases, and in some instances just the software, however the selection of this software is always done by the end-customer: "*The selection of virtualization software is done by each end-customer. We sell server virtualization software with server in most cases, but there are also cases where we sell virtualization software alone in response to the end-customers' request.*"⁸¹⁸
- (700) Similarly, another server OEM stated: "Dell sells servers with and without virtualization software. For any downstream sale, customer choice leads how Dell fulfills the order. For example, if the customer wants a VMware integrated

⁸¹¹ Marvell's non-confidential reply to RFI 1, question 4 [ID 4437].

⁸¹² Parties' reply to RFI 21, question 3.b, Annex Q3 in relation to FC HBAs and question 8.b.

⁸¹³ Parties' reply to RFI 21.

⁸¹⁴ Marvell's non-confidential reply to RFI 1, question 4 [ID 4437].

⁸¹⁵ Form CO, tables 105-106.

⁸¹⁶ Agreed minutes of call with HPE dated 22 September 2022 [ID 2035].

⁸¹⁷ Parties' reply to RFI 1, question 7.

⁸¹⁸ Hitachi's non-confidential reply to RFI 1, question 7 [ID 3634].

experience, Dell will sell a VMware integrated solution. Similarly, if the customer wants to build themselves, we will sell the software and hardware separately.”⁸¹⁹

- (701) A few other server OEMs confirmed that the virtualization software selection was determined by the end-customer, and that this choice in the majority of instances was VMware. For instance, one server OEM stated: “Customers will determine which server virtualization software they require. As indicated in response to Question 6 above, we estimate that a large majority of our server customers use ESXi on the Cisco UCS servers they purchase. Cisco’s customers will typically also determine whether they want to purchase the server virtualization software directly from Cisco, or through other channels.”⁸²⁰ Another server OEM stated: “Lenovo does not choose the virtualization platform for our customers, they choose the required software based on the needs of their business. VMware is the market leader followed by the competitors listed above.”⁸²¹

8.4.3.2.2.2.4. Server virtualization software represents a significant cost factor relative to the price of FC HBAs

- (702) End-customers make large investments in their virtualization software infrastructure, which dwarf their investment in FC HBAs.
- (703) First, there is a significant pricing difference between these products. As part of the Parties’ vertical arithmetic analysis,⁸²² they estimated the average per server price of one FC HBA⁸²³, compared to the average per server price of a vSphere license and associated support and services. These figures are set out in the Table below.

Table 21: Average price of VMware license, and FC HBA

	Average price (USD)	Proportion of VMware license
VMware license	[...] ⁸²⁴	N/A
FC HBA	[...]	[0-5]%

Source: Form CO, table 82; footnote 1098.

- (704) This is confirmed by server OEMs which indicated that, while FC HBAs perform key functions as part of the server package, their proportion in the total cost of the server is relatively small. For instance, one server OEM indicated: “FC HBAs and/or storage adapters are important parts of the server and perform key functions, but they are not a substantial proportion of the server sales cost.”⁸²⁵ Another server

⁸¹⁹ Dell’s non-confidential reply to RFI 1, question 7 [ID 3556].

⁸²⁰ Cisco’s non-confidential reply to RFI 1, question 7 [ID 4288].

⁸²¹ Replies to Q4 – questionnaire to customers of VMware and Broadcom, question 25.1 [ID 1912].

⁸²² Annex 55 (Conglomerate) to the Form CO.

⁸²³ One storage adapter or one FC HBA per CPU.

⁸²⁴ VMware indicates that the price of a licence for vSphere plus associated products (NSX, vSAN, SDDC Manager and vRealize) is about USD [Business secret – price structure] per CPU. The average license is used for [Business secret – production process] years, so we conservatively estimate the price of a licence for five years (lifetime of the server) to be USD [Business secret – price structure] per CPU. The Parties’ conclusions are robust to alternative values. VMware estimates that the price of associated support and services is about USD [Business secret – price structure] per CPU. This estimate reflects the penetration rates of these VMware products for customers that purchase vSphere, which VMware estimates to be [Business secret – price structure] for NSX, [Business secret – price structure] for vSAN, [Business secret – price structure] for SDDC and [Business secret – price structure] for vRealize. See Annex 56 (Conglomerate) to the Form CO for more details.

⁸²⁵ HPE’s non-confidential reply to RFI 1, question 5 j) [ID 3507].

OEM submitted: “Both FC HBAs and storage adapters typically do not represent a significant portion of the value of the overall server sale. For example, we estimate that the FC HBA and the storage adapter each account for about 5% (roughly) of the overall price for the server.”⁸²⁶

- (705) Similarly, a distributor stated: “Hardware is usually considered commodity”.⁸²⁷
- (706) At the same time, on top of the cost of a VMware license, end-customers make an enormous investment in their entire virtualization software infrastructure, which includes significant investments in the VMware ecosystem, as well as training of IT personnel in the VMware software.
- (707) For instance, one hardware vendor explained: “Customers make an enormous investment in their virtualization software infrastructure, an investment that dwarfs their investment in NICs. Customers that seek to use the latest features available in Intel and Broadcom NICs would choose Broadcom NICs if new Intel NICs were not certified at the time that the customer was making their decision.”⁸²⁸
- (708) An end-customer stated: “Unlike with server virtualization software, where choosing a single vendor and using all the capabilities that that vendor offers to maximize investment results, FC HBA vendors often do not have functionality differentiation – quality and price are the stronger drivers here.”⁸²⁹ Another end-customer stated: “Airbus invested heavily in automation on VMware which is a proprietary API and the underlying code of Airbus’ applications is therefore not automatically compatible with other virtualization software. None of the technology offered within one software family (e.g., VMware) will function on competing products.”⁸³⁰
- (709) Second, as set out in detail above in Section 8.4.3.2.2.2., to purchase server virtualization software from VMware is about more than just the naked vSphere license, it’s about a whole suite of products and complementary technologies on which an entire VMware software ecosystem is built, including apps that are being built on VMware. For instance, an end-customer explained: “Technically, all hypervisor developers advertise having a tool that allows for workloads previously deployed on another hypervisor to be converted to their hypervisor. In reality, however, something will always break along the way. Furthermore, companies using VMware usually standardize their systems accordingly, making it cumbersome to switch away.”⁸³¹.
- (710) In a VMware memo [Details on internal document discussing VMware product investments], VMware [Details on internal document discussing VMware product investments].⁸³²

⁸²⁶ Cisco’s non-confidential reply to RFI 1, question 5 j) [ID 4288]

⁸²⁷ Replies to Q4 – questionnaire to customers of VMware and Broadcom, question 42.3.1 [ID 1794].

⁸²⁸ Replies to Q3 – questionnaire to competitors of Broadcom, questions 35 and 36.1 [ID 1785].

⁸²⁹ Replies to Q4 – questionnaire to customers of VMware and Broadcom, question 19 [ID 1547].

⁸³⁰ Agreed minutes of call with Airbus dated 09 February 2023 [ID 4074].

⁸³¹ Agreed minutes of call with Münchener Rück dated 9 February 2023 [ID 4153].

⁸³² VMware internal document, [Other confidential information – VMware’s internal documents].

8.4.3.2.2.2.5. End-customers consider it very difficult and disruptive to switch to an alternative hypervisor while hardware is in any event replaced as part of server refresh

- (711) The results of the Phase I and Phase II market investigation show that end-customers find it difficult, technically complex and disruptive to the business to migrate workloads between hypervisors. This is set out above in detail in Section 8.4.3.2.2.2.
- (712) In contrast, FC HBAs are in any event replaced as part of the server refresh. Such a server refresh happens on average every four to six years. The Notifying Party considered in its vertical arithmetic analysis an ‘average’ server with a lifetime of five years.⁸³³
- (713) As set out above (see Section 8.4.3.2.2.2.), end-customers indicated that they purchased new FC HBA components as part of the server from their server OEMs. Similarly, the Notifying Party indicated that “*FC HBA adapters are typically replaced upon the expiry of a server’s lifespan, i.e., after five years.*”⁸³⁴
- (714) The Notifying Party also clarified that it is rare for these hardware components to be changed outside the context of a server refresh: “*It is rare for customers to replace these hardware devices on an existing server or to repurpose them upon the expiry of the server in which they were originally installed. Broadcom [Business secret – concerning Broadcom product releases].*”⁸³⁵ As set out in the Notifying Party’s Article 6(1)(c) Response, enterprise customers often have tens of thousands of servers. To replace FC HBA components (outside the context of a server refresh), each of these servers would have to be taken offline and opened up to replace the hardware, then tested to ensure that the replacement hardware works, and finally be brought back online to run a virtual machine. The Notifying Party estimates that such a process would take an estimated 3-4 hours per server, thus ca. 30-40,000 hours to replace hardware (FC HBAs and storage adapters) in 10,000 servers (while many of VMware customers have thousands of servers (there are datacentres with 50-60,000 servers)).⁸³⁶

8.4.3.2.2.2.6. No player would buy non-certified interoperable hardware

- (715) As already set out above in Section 8.4.3.2.1.1., certified interoperability with the three major server OS / hypervisors (Windows, Linux, VMware) is a critical feature of competition. As will be set out further below, no player would buy non-certified interoperable hardware.
- (716) Based on the Phase I and Phase II market investigation, the vast majority of customers expressing an opinion, including VMware end-customers⁸³⁷ and server

⁸³³ Annex 55 conglomerate Form CO. Amazon considers the useful life of a server to be five years (https://www.theregister.com/2022/02/04/amazon_q4_2021/). Google considers the useful life of a server to be four years (https://www.theregister.com/2022/02/02/alphabet_q4_2021/). Microsoft considers the useful life of a server to be six years (<https://www.fool.com/earnings/calltranscripts/2022/07/27/microsoft-msft-q4-2022-earnings-call-transcript/>). Surveys of datacentre owners from 2020 appear to indicate a range of 3-5 years for a typical replacement cycle (<https://www.statista.com/statistics/1109492/frequency-of-data-center-system-refresh-replacementworldwide/#:~:text=As%20per%20data%20from%20a,they%20did%20so%20every%20year>).

⁸³⁴ Form CO, paragraph 613.

⁸³⁵ Parties’ reply to RFI 21.

⁸³⁶ Article 6(1)(c) Response, paragraph 217, page 93.

⁸³⁷ Replies to Q4 – questionnaire to customers of VMware and Broadcom, question 38.

OEMs,⁸³⁸ indicated that they would not purchase hardware (NICs, FC HBAs or storage adapters) which are not certified interoperable with VMware.

- (717) **Server OEMs** in particular, which are the main customers on the markets for FC HBAs, confirmed that customers require hardware components that are certified interoperable and compatible with their software needs. Without this certified interoperability, server OEMs cannot offer these components as part of their server package to these end-customers.
- (718) As part of the Commission's Phase I market investigation, customers were asked how important it was for customers to purchase NICs, FC HBAs or storage adapters for which its compatibility with VMware's server OS/hypervisor has been certified by VMware.⁸³⁹ Out of all customers that expressed an opinion (*i.e.*, very important, important, or not important), the large majority indicated this was very important, with a few indicating important, or not important.
- (719) As part of the Commission's phase II market investigation, server OEMs were presented with a hypothetical scenario where the merged entity would, post-Transaction, degrade the relative interoperability or refuse certification of Marvell FC HBAs, and whether this would affect the server OEM's decision to offer/install the FC HBA in the server. The majority of server OEMs considered such degraded certified interoperability would indeed affect their purchasing decisions, while a few server OEMs also indicated they would try to work around the lack of certified interoperability.⁸⁴⁰
- (720) For instance, one server OEM stated: "When relying on VMware's hypervisor, it is important to be able to purchase NICs and other devices that support and are compatible with VMware's virtualization software. If our suppliers' products were no longer certified as compatible with VMware's hypervisors, this would have a significant impact on Cisco in particular as the large majority of our customers adopt VMware's server virtualization software."⁸⁴¹ Another server OEM stated: "The importance of VMware compatibility is dependent on customer needs. For example, if the end customer intends on utilizing VMware software, they may likely view certification as necessary."⁸⁴²
- (721) One server OEM also emphasized the particular importance of certified interoperability with VMware, as it is the leading hypervisor for virtualized workloads: "*In a VMware-based virtual environment, users must choose hardware with VMware certification. VMware has the top share of Hyper-visor in virtual environments, and VMware's certification is important.*"⁸⁴³
- (722) Server OEMs also explicitly stated that certification is an important purchasing criterion, given that server OEMs don't want to have some servers which are certified interoperable with one OS, and another set of servers which are certified interoperable with another OS. Having different server configurations for different OSs would have server OEMs incur additional costs since they would need to test and certify different products.

⁸³⁸ Replies to Q4 – questionnaire to customers of VMware and Broadcom, question 38, focusing on the responses of server OEMs.

⁸³⁹ Replies to Q4 – questionnaire to customers of VMware and Broadcom, question 38.

⁸⁴⁰ Server OEMs replies to RFI 1, question 8.

⁸⁴¹ Replies to Q4 – questionnaire to customers of VMware and Broadcom, question 38.1 [ID 1517].

⁸⁴² Replies to Q4 – questionnaire to customers of VMware and Broadcom, question 38.1 [ID 1936].

⁸⁴³ Replies to Q4 – questionnaire to customers of VMware and Broadcom, question 38.1 [ID 1713].

- (723) For instance, one server OEM stated: “Hardware certification by the virtualization software is important purchasing criteria.”⁸⁴⁴ Another server OEM stated: “From a technical standpoint this is important because Oracle designs single systems that are capable of supporting multiple OSes and virtualization environments. Oracle does not want to (and would not) develop systems that are unique for VMware or any other single operating system. Moreover, certifications mean fewer field repairs and returns and better support.”⁸⁴⁵ Another server OEM also confirmed that without this certified interoperability, they would not be able to supply his hardware to their end-customers: “In order to reduce business risk or interruption, we follow the recommended hardware and firmware versions to ensure interoperability. It is important that the adapters that are used with our products, are compatible with solutions that our clients are expected to use. Without this compatibility, it will limit the ability to serve our clients which would affect business outcomes. Since this is client driven, these requirements change with the clients we support and offer our products to.”⁸⁴⁶
- (724) Server OEMs also pointed to the importance of certification to obtain technical support on the virtualization software. One server OEM stated: “*Certification is required to get support.*”⁸⁴⁷
- (725) The Commission acknowledges that certain server OEMs indicated they would try to work around the VMware certification.⁸⁴⁸ Indeed, those few customers that expressed an opinion, and had indicated that they considered certification “important” instead of “required” clarified that they would try to obtain such certification as part of the development and release of their servers (instead of separately via the hardware vendor). For instance, “*Fujitsu certifies compatibility with its chosen connectivity technologies as it develops and releases its servers and storage devices.*”⁸⁴⁹ Another server OEM stated: “*It's important but not critical for a part to be certified by VMWare (e.g. HPE could still certify and warrant that a part works with VMWare), but it is very helpful from a brand reliance perspective to have VMWare also stand by the product.*”⁸⁵⁰
- (726) As part of the Phase II market investigation, these server OEMs reaffirmed the necessity of buying (and/or selling as part of the server package) only certified interoperable FC HBAs, primarily via the hardware vendor, or in an alternative and less mentioned scenario, as part of the server certification process.⁸⁵¹
- (727) In relation to FC HBAs, the majority of server OEMs expressing an opinion indicated that if the merged entity were to degrade the relative interoperability or refuse certification, that would affect their purchasing decisions and that they would see themselves obliged to switch to a supplier that interoperates with their customers’ software.⁸⁵² A delay in certification would result in, or be perceived as a degradation for the reasons set out in Section 8.4.3.2.1.3.

⁸⁴⁴ Replies to Q4 – questionnaire to customers of VMware and Broadcom, question 38.1 [ID 1797 and 1812].

⁸⁴⁵ Replies to Q4 – questionnaire to customers of VMware and Broadcom, question 38.1 [ID 1554].

⁸⁴⁶ Replies to Q4 – questionnaire to customers of VMware and Broadcom, question 38.1 [ID 1909].

⁸⁴⁷ Replies to Q4 – questionnaire to customers of VMware and Broadcom, question 38.1 [ID 4265].

⁸⁴⁸ SO Response, paragraphs 533-539.

⁸⁴⁹ Replies to Q4 – questionnaire to customers of VMware and Broadcom, question 38.1 [ID 1537].

⁸⁵⁰ Replies to Q4 – questionnaire to customers of VMware and Broadcom, question 38.1 [ID 1731].

⁸⁵¹ Server OEMs replies to RFI 1, question 8.

⁸⁵² Server OEMs replies to RFI 1, question 8.

- (728) One server OEM explained that “if Marvell’s FC HBAs would no longer be certified as compatible with VMware’s virtualization software, given that the large majority of Cisco’s server customers use ESXi on the Cisco UCS servers they purchase (and we do not have any indications that this will change any time soon), Cisco would have no other option than to look for an alternative supplier that can provide FC HBAs that are certified to work with ESXi. At this time, the only alternate supplier of FC HBAs that Cisco is aware of is Broadcom.”⁸⁵³
- (729) Another server OEM confirmed that such scenario would affect its decision “to offer/install the [Marvell FC HBA] in the server, because end users won’t be able to get support for resolving the problem unless VMware OS passes the authentication test on a per-IO card basis, using the device driver authentication test program provided by VMware.”⁸⁵⁴
- (730) Some respondents indicated that they would try to work around the lack of interoperability to the extent that this would remain economically viable. In particular, one server OEM indicated that “*perhaps, HPE’s decision to offer/install would depend on whether the interoperability deficiencies were so great that the deficiencies could not be overcome economically with design changes to the server by HPE. If financially viable, HPE may try to design around and improve interoperability. No component is perfect, and the platform designers must optimize their platforms around the components available. VMware’s refusal to certify the HBA would be immaterial to HPE if HPE could still certify its platforms on VMware. If HPE could not economically design the system to sufficiently perform, it might decide not to qualify or purchase the component if customers would prefer or accept other components.*”⁸⁵⁵
- (731) **Other customers**, such as a storage OEM⁸⁵⁶ indicated the following: “From an enterprise IT perspective, NetApp needs compatible and certified NICs, FC HBAs and storage adapters for security requirements for our critical data.”⁸⁵⁷ A distributor submitted: “Support is only guaranteed as long as we deploy the software on certified hardware components. Since the entire IT-Infrastructure would be at risk, we would buy certified components only.”⁸⁵⁸
- (732) Similarly, **end-customers** also consider purchasing certified interoperable hardware as critical. As set out above in Section 8.4.3.2.1.1., certified interoperability with VMware’s software is important. VMware end-customers indicated that they would **not** purchase FC HBAs that were **not certified** by VMware as **interoperable** with VMware’s hypervisor.⁸⁵⁹
- (733) Several end-customers stated certified interoperability is important, necessary, or critical. For instance, BT stated that: “*It is very important to BT that NICs are on the VMware certified hardware list (HCL).*”⁸⁶⁰ JP Morgan said: “It is critical that the components in our environment are certified to work together.”⁸⁶¹ Another end-

⁸⁵³ Cisco’s non-confidential reply to RFI 1, question 8. [ID 4288]

⁸⁵⁴ Hitachi’s non-confidential reply to RFI 1, questions 8 and 10 [ID 3634].

⁸⁵⁵ HPE’s non-confidential reply to RFI 1, question 8 and 10 [ID 3507].

⁸⁵⁶ As listed by the Parties as top 10 customers of Broadcom of FC HBAs or storage adapters respectively in Annexes (Section 8) 20-21 and 62-63 to the Form CO.

⁸⁵⁷ Replies to Q4 – questionnaire to customers of VMware and Broadcom, question 38.1 [ID 1942].

⁸⁵⁸ Replies to Q4 – questionnaire to customers of VMware and Broadcom, question 38.1 [ID 1794].

⁸⁵⁹ Replies to Q4 – questionnaire to customers of VMware and Broadcom, question 38.1.

⁸⁶⁰ Replies to Q4 – questionnaire to customers of VMware and Broadcom, question 38.1 [ID 1835].

⁸⁶¹ Replies to Q4 – questionnaire to customers of VMware and Broadcom, question 38.1 [ID 1819].

customer confirmed this certified interoperability is an important purchasing criteria: *“Any HW bought from any vendor will be verified to be OS/hypervisor certified compatible.”*⁸⁶² Siemens stated: *“Compatibility to the server virtualization software is important for us.”*⁸⁶³ Thales submitted: *“Thales would not purchase NICs, FC HBAs or storage adapters for which compatibility with VMware’s server OS/hypervisor has not been certified by VMware”*⁸⁶⁴ Vodafone indicated: *“Compatibility is critical for full-stack certification of the network functions.”*⁸⁶⁵

- (734) A number of end-customers also explain that certification means support by the vendors. CVS Health stated: *“All our solutions are certified and must be supported by the vendors.”*⁸⁶⁶ Deutsche Telekom noted: *“The certification is required, because without it we would have supportability issues in case of incidents.”*⁸⁶⁷ Telecom Italia noted: *“Without the certification of the network interface VMware support is no longer guaranteed.”*⁸⁶⁸
- (735) Rockwell explained that without certified interoperability of adapters, various virtualization capabilities cannot be used, and reliability cannot be guaranteed: *“NICs and HBAs must be certified on VMWare to take advantage of advanced network and storage virtualization capabilities and ensure high reliability”*.⁸⁶⁹
- (736) **Hardware vendors** also confirmed that customers would not purchase FC HBAs that were not certified interoperable with VMware. Broadcom and Marvell indicated, in relation to their FC HBA development and release process, that they by default sought to “qualify” (i.e., to certify interoperability) with (various versions of) the three major server OS, which constitute Windows, Linux and VMware.
- (737) As set out above in Section 8.4.3.2.1.1., Broadcom indicated that it by default certifies the interoperability of its hardware devices with Windows, Linux and VMware before these devices are released on the market.⁸⁷⁰ Furthermore, Broadcom acknowledges that *“Customers will typically purchase servers that are already certified with vSphere.”*⁸⁷¹ In particular, *“If an OEM wants its server platform to be certified on VMware, it will typically require the devices included in the server, including FC HBAs, to be certified with VMware. For that particular use case, Broadcom could not sell FC HBAs that have not been certified with VMware.”*⁸⁷²
- (738) Marvell indicated that “for us to be able to sell our hardware, we need to ensure that we are compatible with VMware. If our products are not, the customer will not want our hardware and the server OEM will not consider our hardware.”⁸⁷³ Marvell also explained that the requirement to get the broadest OS support in order to be able to sell the device falls on the hardware manufacturer: “generally speaking, the burden

⁸⁶² Replies to Q4 – questionnaire to customers of VMware and Broadcom, question 38.1 [ID 1547].

⁸⁶³ Replies to Q4 – questionnaire to customers of VMware and Broadcom, question 38.1 [ID 1779].

⁸⁶⁴ Replies to Q4 – questionnaire to customers of VMware and Broadcom, question 38.1 [ID 1770].

⁸⁶⁵ Replies to Q4 – questionnaire to customers of VMware and Broadcom, question 38.1 [ID 1728].

⁸⁶⁶ Replies to Q4 – questionnaire to customers of VMware and Broadcom, question 38.1 [ID 1844].

⁸⁶⁷ Replies to Q4 – questionnaire to customers of VMware and Broadcom, question 38.1 [ID 1826].

⁸⁶⁸ Replies to Q4 – questionnaire to customers of VMware and Broadcom, question 38.1 [ID 1737].

⁸⁶⁹ Replies to Q4 – questionnaire to customers of VMware and Broadcom, question 38.1 [ID 1918].

⁸⁷⁰ VMware, Interoperability & Certification, Presentation to the European Commission, 16 February 2023, slide 19.

⁸⁷¹ Parties’ reply to RFI 20, question 11 b).

⁸⁷² Parties’ reply to RFI 20, question 21 b).

⁸⁷³ Marvell’s non-confidential reply to RFI 1, question 6 c) [ID 4437].

of having HBAs certified for any given OS falls on the HBA manufacturer”.⁸⁷⁴ [Details on internal document discussing certification of a third party product].⁸⁷⁵

- (739) Similarly and for additional context, Microchip explained that server OEMs and end-customers expect the broadest OS support because most server OEMs design their servers in such a way that they work with all major server OS / hypervisors (i.e., Window, Linux and VMware): *“With respect to the certification process, server OEMs need compatibility certificates with all OS, including VMware. That is because server OEMs do not want to be in a situation in which their servers work with only a part of the OS, not all.”*⁸⁷⁶ Furthermore, server OEMs expect that the hardware components offer the broadest OS support because it is just not feasible to manage their business in such a way that some of their server models work with one OS, but not with the other. Therefore, as a default, Microchip ensures certified interoperability with numerous OS versions of the main server OS / hypervisors: *“[s]erver OEMs expect that your hardware supports everything (or most) OS, because it is not feasible for server OEMs to manage their customer base by saying that a single server works with one OS, but not with another. The broadest type of OS certified interoperability is expected. In practice, this means that before the device is released on the market, an established hardware vendor will ensure certified interoperability with an estimated 70 types of OS versions. Most of these versions are Linux, the rest is Windows and VMware (with a few other smaller varieties such as Solaris, which has a smaller customer base). Server OEMs expect that your device is certified interoperable with the leading edge of all the versions of Linux, Windows and VMware. Server OEMs also expect that you will have all that OS support in hand.”*⁸⁷⁷ Finally, Microchip also explained that the VMware certification process is a necessary step since *“VMWare will not support customers running uncertified configurations”*.⁸⁷⁸
- (740) Some hardware vendors also explained that, if a hardware product is not (certified) interoperable with certain OS providers, these OEMs may choose not to even list or offer these products, or they would relegate these products as a customer-selected option instead of as the default-configuration.⁸⁷⁹
- (741) For instance, a NIC supplier explained: *“Many OEMs may not list/offer NIC products on their servers if they are not certified by the OS provider.”*⁸⁸⁰ Although this specific statement relates to NICs, the Commission considers that it applies more broadly to all products in the VMware IOVP program.⁸⁸¹ In a similar vein, Microchip explained that an adapter may no longer be part of the options presented to any end-customer if it is not compatible, given how expensive it is to integrate and maintain the storage adapter in the server platform, and given how server OEMs want to be able to release the newest server model with all new hardware features ensuring compatibility with all server OS. Server OEMs want *“one [server] model that can run anything”*⁸⁸² and

⁸⁷⁴ Marvell's non-confidential reply to RFI 1, question 6 c) [ID 4437].

⁸⁷⁵ Broadcom internal document, [Other confidential information – Broadcom's internal documents].

⁸⁷⁶ Agreed minutes of call with Microchip dated 10 March 2023 [ID 4302].

⁸⁷⁷ Agreed minutes of call with Microchip dated 10 March 2023 [ID 4302].

⁸⁷⁸ Replies to Q3 – questionnaire to competitors of Broadcom, question 23.4 [ID 4306].

⁸⁷⁹ Replies to Q3 – questionnaire to competitors of Broadcom, question 23.4.

⁸⁸⁰ Replies to Q3 – questionnaire to competitors of Broadcom, question 23.4 [ID 1894].

⁸⁸¹ As explained in Section 6.3 above, the VMware IOVP program is the relevant certification program for I/O devices which includes NICs, FC HBAs and storage adapters. The development and certification process is similar for products that are part of this program.

⁸⁸² Replies to Q3 – questionnaire to competitors of Broadcom, question 35.1 [ID 4306].

“Alternatively, Microchip’s products might still be supported, but would be relegated to being a customer-selected option rather than the default storage adapter.”⁸⁸³.

- (742) Hence, in response to a partial foreclosure strategy by the merged entity, server OEMs may not take up affected, non-certified rival hardware products in their portfolio at all until they are certified, not just for customers that wish to run VMware if server OEMs were to prefer a one-server model that can run any server OS. Alternatively, Broadcom rival FC HBAs would be relegated to being a customer-selected option rather than the by default configuration.
- (743) As part of the Phase I market investigation, respondents were also asked whether they would switch away from Broadcom’s rival hardware products in case of delayed or denied certification.⁸⁸⁴ However, these questions did not distinguish between a scenario of a server refresh (which the Commission envisages when describing potential mechanisms of foreclosure, see Section 8.4.3.2.1.3.2. above) or a scenario whereby customers, mid-server lifecycle, would need to open up their existing servers to manually replace FC HBAs or storage adapters in order to maintain compatibility with VMware. The latter scenario is not considered relevant or plausible, because VMware ensures backwards compatibility of its new vSphere releases with older hardware.
- (744) Regardless, the majority of customers expressing an opinion still believed that they would be forced to **switch** to Broadcom hardware if the merged entity’s rival hardware products were **no longer (certified as) interoperable** with VMware software.⁸⁸⁵ In particular, customers point out that *“if a product is incompatible with VMWare, we cannot use it with VMWare and we would be forced to use something else if we or a customer wishes to have a product used with [VMware].”⁸⁸⁶* Furthermore, *“We would be forced to switch to Broadcom products due to technical incompatibility with alternate products. The cost of moving away from VMware would be very high and they’re an integral part of a data center solution, so we’d be forced to buy the compatible Broadcom products.”⁸⁸⁷* This illustrates further the importance of certified interoperability of FC HBAs with server virtualization software.

8.4.3.2.2.3. MIT Study

- (745) With its SO Response, the Notifying Party submitted the results of a survey of end-customers of virtualization software (IT specialists) across multiple jurisdictions to test VMware customer reactions to putative foreclosure scenarios, which it has commissioned for the purposes of the merger proceedings (“The MIT Switching Survey”).⁸⁸⁸ The MIT Switching Survey was commissioned by the Notifying Party in early February 2023 and the preliminary results were delivered to Broadcom and VMware on 24 March 2023. The sample of respondents in the MIT Switching Survey consists of 1,204 end-customers that currently rely on VMware as a virtualization solution, targeting respondents according to job-title, company size, industry and geography to enhance the representation of vSphere deployments.

⁸⁸³ Replies to Q3 – questionnaire to competitors of Broadcom, question 35.1 [ID 4306].

⁸⁸⁴ Replies to Q3 – questionnaire to competitors of Broadcom, questions 35, 36; replies to Q4 – questionnaire to customers of VMware and Broadcom, question 40.

⁸⁸⁵ Replies to Q4 – questionnaire to customers of VMware and Broadcom, questions 39 and 40.

⁸⁸⁶ Replies to Q4 – questionnaire to customers of VMware and Broadcom, question 39.1 [ID 1731].

⁸⁸⁷ Replies to Q4 – questionnaire to customers of VMware and Broadcom, question 39.1 [ID 1526].

⁸⁸⁸ SO Response, paragraph 541 and Annexes – SO Response – Incentive 4 and 6.

- (746) The Notifying Party submitted the MIT Switching Survey as evidence of switching by end-customers if the merged entity were to remove interoperability between VMware virtualization software and non-Broadcom FC HBAs and storage adapters. According to the Notifying Party, the results of the MIT Switching Survey provide evidence that [Business secret – know-how: discussion of customer demand] of end-customers would switch virtualization software in response to hardware incompatibility: [Business secret – know-how: discussion of customer demand].⁸⁸⁹
- (747) To examine the impact of the foreclosure strategy, the MIT Switching Survey asked end-customers to consider a scenario where the next version of vSphere (vSphere 9.0) which would be launched within the next two years is only compatible with Broadcom FC HBAs but not with future generations of non-Broadcom FC HBAs. End-customers were asked whether and how this scenario would lead them to change 1) their plans to migrate existing vSphere workloads and 2) their plans to deploy net new workloads on vSphere.
- (748) The Commission considers that the results from this survey cannot be considered reliable and rejects the Notifying Party's arguments on that basis for the following reasons.
- (749) First, as set out in Section 8.4.3.2.2.2., the Commissions' market investigation indicated that, while end-customers determine which virtualization software they run and make large investments in their entire virtualization software infrastructure, they typically do not choose the exact FC HBAs for their servers. Instead, end-customers typically rely on server OEMs to determine the FC HBA brand in their server package ensuring software compatibility. Therefore, the choice of switching from non-Broadcom to Broadcom hardware to maintain compatibility with VMware's software is done at the server OEM level, rather than by end-customers themselves. Accordingly, to examine the impact of a putative foreclosure strategy as set out in Section 8.4.3.2.3., server OEMs should have been the target of the MIT Switching Survey, or at least included as a crucial player.
- (750) Second, the scenario examined in the MIT Switching Survey, does not correctly depict the foreclosure strategy set out by the Commission, which consists in the delay of the validation of the development and certification process of rival FC HBAs that are interoperable with VMware's virtualization software, by declining or delaying the technical support required from VMware during the certification process, or by prioritizing the exchange of information regarding VMware's newest software releases and features with Broadcom. This foreclosure mechanism would be discreet and difficult to detect by end-costumers. Unlike the scenario presented, end-customers would not learn 2 years in advance about the incompatibility between vSphere and Broadcom hardware. In addition, the new vSphere version would still ensure backwards compatibility and therefore the hardware components included in end-customers' servers remain compatible with VMware's virtualization software. As a result, end-costumers would only learn about the incompatibility of vSphere 9.0 with non-Broadcom hardware components at the moment of a server refresh, at which point they would need to decide on new hardware components and would notice that certain hardware components may not be certified as interoperable with vSphere 9.0.
- (751) Third, respondents to the MIT Switching Survey are likely to have overstated their willingness to switch away from VMware in case of foreclosure of non-Broadcom

⁸⁸⁹ SOR, paragraph 551.

FC HBAs and storage adapter. Potential bias with respect to the intensity of switching are often a concern with surveys asking about switching intentions following in response to hypothetical changes in market conditions. In the present case, the responses to the MIT Switching Survey provide concrete indications of such biases. In particular, respondents used the final open-ended question in the survey to warn Broadcom of the possible consequences of a foreclosure strategy. This is exemplified by the following comments: “[Business secret – know-how: discussion of customer demand patterns].”⁸⁹⁰

- (752) For the reasons set out above, and for the purposes of this Decision, the Commission considers the evidence gathered in the 2023 MIT Switching Survey to be unreliable for the estimation of actual switching rates in response to a delay of the validation of the certification process of hardware rivals. Further, the Commission notes that by not discussing the MIT Survey with the Commission prior to submitting it with its response to the SO, the Notifying Party did not follow the recommendations set out in the Commission’s Best Practices for the submission of economic evidence.⁸⁹¹

8.4.3.2.2.4. There are no countervailing factors such as the presence of buyer power or the likelihood of retaliation by rivals

- (753) As part of the Notifying Party’s Article 6(1)(c) Response, the Notifying Party submits that Broadcom’s rivals such as [Business secret – know-how] on which VMware’s business depends, would retaliate⁸⁹² and that the same can be expected from server OEMs and large hyperscalers in relation to any foreclosure strategy.⁸⁹³ However, based on the market investigation, it appears unlikely that such retaliation would occur in relation to the market for FC HBAs.

8.4.3.2.2.4.1. Foreclosure mechanisms are discreet and difficult to detect or prove

- (754) As set out above (see Section 8.4.3.2.1.3.2.), the envisaged foreclosure mechanisms are relatively **discreet** and **difficult to detect** or **prove**. Given the close cooperation required over a significant amount of time between hardware vendor and server OS, it would be easy and discreet for VMware to put a competitor on the slow track or engage in subtle preferencing of Broadcom. This is particularly the case, given that a significant amount of the cooperation takes the form of physical meetings and engineering discussions. The impact of such conduct would in any event only be detected much later, at which stage it would be difficult for a competitor to tie back any delay to the merged entity’s behaviour.⁸⁹⁴ Marvell indicated that, by missing these key deadlines, there may be significant financial and reputational losses which could ultimately impact Marvell’s decision to invest in the market for FC HBAs or, at some point, drive Marvell to stop investing in that market altogether
- (755) One hardware vendor explained that 90-98% of issues are already taken care of before getting to the qualification/certification cycle, due to clear communication and technical support throughout the cooperation (rather than during the submission of

⁸⁹⁰ MIT Switching Survey

⁸⁹¹ DG Competition Staff Working Paper on “Best practices for the submission of economic evidence and data collection in cases concerning the application of Articles 101 and 102 TFEU and in merger cases”, (https://competition-policy.ec.europa.eu/mergers/legislation/best-practices_en).

⁸⁹² Article 6(1)(c) Response, paragraphs 257-264.

⁸⁹³ Article 6(1)(c) Response, paragraphs 265-275.

⁸⁹⁴ However, these delays could ultimately impact Marvell’s decision to invest in the market for FC HBAs or, at some point, drive Marvell to stop investing in that market altogether, as described in more detail in Section 8.4.3.2.1.3.3.

test results and approval of VMware), so there is a significant scope for delays and hampering, which are difficult to attribute to the merged entity's behaviour. Marvell indicated that: *"When Marvell develops a driver for its FC HBAs and submits for certification with VMware, usually the process is clean due to clear communications in advance. [Confidential] there is a lot of build up (in terms of communication, beta-level drops for testing, etc.) along the way, which ensures that approx. 90-98% of the issues are already taken care of before getting to the qualification / certification cycle. If Marvell and VMware did not go through that exchange of information and continuous communication, the certification process would be a lot more burdensome and difficult, and it would be impossible for Marvell to successfully go through the certification process in a timely and easy manner."*⁸⁹⁵

- (756) Similarly, for additional context, Microchip explains that "many of these behaviors would likely be very difficult to detect or prove [...]. Putting a competitor on the slow track could easily be done with verbal conversations and general employee behavior without leaving any email trails, etc. Additionally, all engineering teams have a limit to their resources and the number of things that can be worked on at any given time. It would seem to be very easy for Microchip products to always be at the bottom of the engineering priority list vs. competing Broadcom products when it comes to support for bug fixes or new features, and it would even look justifiable in some senses."⁸⁹⁶ Microchip also explains more generally that: "For any company in control of its own somewhat opaque certification process, it would be possible for it to limit information exchanges and cooperation that could impact the positive results for any company seeking certification and be difficult to detect or prove".⁸⁹⁷
- (757) As set out above, while today, VMware's and hardware vendors are aligned, this will be different post-Transaction. Accordingly, any honest and transparent cooperation during the interoperability and certification process today is not per se indicative for the situation post-Transaction. Similarly, if there are any agreements in place pre-Transaction, those were negotiated in a setting where VMware had no incentives to treat one hardware vendor different than another. As part of the Transaction process, [Business secrets - sales policy and strategy]. This will be set out in further detail in Section 9 below.

8.4.3.2.2.4.2. Broadcom's FC HBA rivals do not have countervailing buyer power or the ability to retaliate

- (758) In relation to **Broadcom's rivals**, the partial foreclosure strategy that is set out above (see Section 8.4.3.2.1.3.2.), consists of discreet and difficult to detect, or at least difficult to prove, behaviour targeted at Broadcom's rival on the market for FC HBAs, i.e., Marvell in practice.
- (759) The Commission considers it unlikely that Marvell would have countervailing buyer power or would be able to retaliate against such foreclosure behaviour by the merged entity. As set out above in Section 8.4.3.2.2.2., VMware's software is typically always chosen by the end-customer, while the server OEMs select or propose the FC HBA components. As already set out above, end-customers demand that the server and its components are certified compatible with the software that these customers are running. Therefore, if Marvell is not able to provide their main customers, i.e., the server OEMs, with a certified interoperable device, or with the relevant driver

⁸⁹⁵ Agreed minutes of call with Marvell dated 08 March 2023 [ID 4322].

⁸⁹⁶ Replies to Q3 – questionnaire to competitors of Broadcom, question 29 [ID 4306].

⁸⁹⁷ Replies to Q3 – questionnaire to competitors of Broadcom, question 29 [ID 4306].

source code in a timely fashion, the server OEMs will not accept these devices, and the end-customer will be switched to an alternative FC HBA provider. This is also due to this supply model, where the FC HBA supplier does not or is less likely to directly “reach” the end-customer, while VMware does “reach” the end-customer, as it is directly (or via distributors/resellers) marketed and sold to the end-customer.

- (760) Moreover, Marvell is a partner to and dependent on VMware. A large number of virtualized end-customers run on VMware. For instance, Marvell indicated that: “VMware, by virtue of being the first company to create an Enterprise grade operating system (OS) that catered to virtualization, became the market leader in OS deployments in SAN.”⁸⁹⁸ In any event, as already set out above in Section 8.4.3.2.1.1., if a FC HBA supplier wishes to sell its products to server OEMs, they need to have the widest OS support available. For instance, in a Broadcom press release from April 2017, Broadcom marketed its MegaRAID controllers announcing that these devices were being shipped to server and external storage OEMs. As part of this press release, Broadcom explicitly listed: “*Certified Broadcom OS Support for Microsoft Windows, VMware, Linux (SuSE, Red Hat), and FreeBSD*”.⁸⁹⁹
- (761) According to the Notifying Party⁹⁰⁰, key x86 players on which VMware relies, [Business secret – know-how] would likely retaliate against any threat to the x86 ecosystem (such as a degradation of certified interoperability between VMware’s software (which only runs on x86) and Marvell’s FC HBA devices), protecting the smaller players.⁹⁰¹ However, this argument is not credible in this setting, given the nature of the partial foreclosure mechanisms, *i.e.*, subtle preferencing of Broadcom regarding updates of new features, discreet delays in providing technical support, *etc.* (as set out above in Section 8.4.3.2.1.3.2.). **Marvell** also submitted that it would not have the ability to discipline certain hypothetical foreclosure behaviour or incentivize the merged entity to ensure continued certified interoperability.⁹⁰²

8.4.3.2.2.4.3. Server OEMs do not have countervailing buyer power or the ability to retaliate

- (762) In relation to potential retaliation or buyer power from **server OEMs**, the Commission considers it unlikely that Broadcom’s main customers would be able to retaliate in reply to hypothetical partial foreclosure behaviour by the merged entity.
- (763) First, contrary to the Notifying Party’s claims in its Article 6(1)(c) Response, **all server OEMs that expressed an opinion submitted that they would not be able to retaliate**. Indeed, when asked whether they considered that they would be able to discipline certain hypothetical foreclosure behaviour or incentivize the merged entity to ensure continued certified interoperability, all server OEMs that expressed an opinion submitted that it would not have such ability.⁹⁰³
- (764) Second, server OEMs currently **multi-source**, but in practice already appear to **rely heavily on Broadcom**. The Notifying Party submits that server OEMs have a multi-sourcing business model, which they would not readily give up and be left at the mercy of Broadcom.⁹⁰⁴ However, in reality, given Broadcom’s dominant, or at least

⁸⁹⁸ Agreed minutes of call with Marvell dated 22 September 2022 [ID 4298].

⁸⁹⁹ <https://www.broadcom.com/company/news/product-releases/12061>.

⁹⁰⁰ Form CO, paragraph 5 and Article 6(1)(c) Response, paragraph 224 onwards.

⁹⁰¹ Article 6(1)(c) Response, paragraph 263 onwards.

⁹⁰² Marvell's non-confidential reply to RFI 1, question 7 a) [ID 4437]; Microchip's non-confidential reply to RFI 1, question 7 a) [ID 4313].

⁹⁰³ Server OEMs replies to RFIs 1, questions 9 a) and 11 a).

⁹⁰⁴ Article 6(1)(c) Response, paragraphs 269 and 170 onwards.

very strong position on the highly concentrated market for FC HBAs (as will be set out further in Section 8.4.3.2.3.), server OEMs appear to already rely very heavily on Broadcom.

- (765) As set out above, the majority of server OEMs that purchase FC HBAs and expressed an opinion, currently multi-source from Broadcom and Marvell (see paragraph (686) above).⁹⁰⁵ However, several of these server OEMs also indicated that they source the majority of their FC HBA volumes from Broadcom. One server OEM indicated it sources exclusively from Broadcom. No server OEM indicated that it sourced exclusively from Marvell.⁹⁰⁶ In addition, no end-customers indicated having a specific preference for a particular FC HBA vendor (see Section 8.4.3.2.2.2. above).
- (766) For additional context this heavy reliance on [Details on internal documents describing customer demand].⁹⁰⁷
- (767) Third, as set out above in Section 8.4.3.2.1.1., server OEMs require the **broadest OS support for any FC HBA** (i.e., VMware, Windows, Linux). This is also standard in the industry, as already set out above, Broadcom and Marvell indicated that they obtain certification for their FC HBAs before selling to server OEMs.⁹⁰⁸ As set out above, hardware suppliers market the new features on their devices including this wide OS support via press releases as a selling point by Broadcom and other hardware vendors.⁹⁰⁹ The majority of server OEMs expressing an opinion also confirm that their decision to offer Broadcom's rivals' FC HBAs would be affected in case of reduced certified interoperability. Several OEMs explained that they would be obliged to switch to a supplier that interoperates with their end-customers software.⁹¹⁰
- (768) Accordingly, if, because of the merged entity's putative foreclosure behaviour, Marvell is degraded in terms of certified interoperability (by delays in the development and certification process and delayed support in response to *ad hoc* requests, see Section 8.4.3.2.1.3.2.), server OEMs will be forced to rely exclusively on Broadcom for its FC HBAs
- (769) This is for instance also indicated by HPE: "If Broadcom supplies a certain product that is not available anywhere else, HPE will have no power."⁹¹¹
- (770) Fourth, contrary to the Notifying Party's claims that server OEMs want to multi-source to maintain flexibility, server OEMs also appear to have an interest to obtain volume discounts or similar advantages by purchasing larger volumes with one supplier and with various of its products. For instance, HPE stated: "*HPE typically tries to scale efficiencies and buy more from a particular vendor in order to obtain better price offerings for its customers. Following the Transaction, Broadcom could have an incentive to sell its products in combination with VMware's software products. This could be an opportunity for HPE to have more leverage in negotiations and drive efficiencies.*"⁹¹² As stated above, this is also evident from

⁹⁰⁵ Server OEMs replies to RFIs 1, question 2 a).

⁹⁰⁶ Server OEMs replies to RFIs 1, question 2 b).

⁹⁰⁷ Broadcom internal document, [Other confidential information – Broadcom's internal documents].

⁹⁰⁸ Marvell's non-confidential reply to RFI 1, question 6 c) [ID 4437].

⁹⁰⁹ <https://www.broadcom.com/company/news/product-releases/12061>.

⁹¹⁰ Server OEMs replies to RFI 1, question 8.

⁹¹¹ Agreed minutes of call with HPE dated 22 September 2022 [ID 2035].

⁹¹² Agreed Minutes of call with HPE 22 September 2022 [ID 2035].

some server OEM's server configuration options, whereby for instance, HPE has the Broadcom storage adapter as the default configuration on its website for its Gen11 servers⁹¹³ (see Section 8.4.3.2.2.1.).

- (771) Finally, contrary to the Notifying Party's argument that server OEMs could in retaliation switch Broadcom devices to rival devices in other markets than the markets for FC HBAs, as described in more detail in Section 8.4.3.2.2.5., market participants indicate that Broadcom is an aggressive player. Considering that it is active in several markets containing sticky products (*i.e.*, situational monopolies, where customers have difficulties to switch), market respondents indicated that Broadcom tends to offer products as a bundle, threatening increased prices for part of the bundle, if customers switch for the other part of the bundle. Hence, server OEMs could be deprived of significant price advantages or even the ability to source essential server components in case they start switching FC HBAs.⁹¹⁴
- (772) Based on the above, the Commission considers it implausible that post-Transaction, when server OEMs' options for timely certified interoperable FC HBAs would be reduced to Broadcom devices only, they would be able to retaliate or exercise buyer power. On the contrary, it appears that server OEMs already heavily rely on Broadcom for their FC HBAs needs. In addition, pre-transaction, server OEMs could still threaten to switch given the general indifference of the end-customers and their multi-sourcing strategies, however, when, post-transaction server OEMs options are reduced to Broadcom devices, this latent switching possibility also disappears.

8.4.3.2.2.4.4. Hyperscalers do not have countervailing buyer power or the ability to retaliate

- (773) In relation to potential retaliation by large **hyperscalers**, the Notifying Party itself indicates that hyperscalers are not big customers of FC HBAs. According to the Notifying Party, public cloud environments do not use FC HBAs. Rather, public cloud environments typically use Ethernet SANs and/or CPU direct-attached storage.⁹¹⁵
- (774) Hyperscalers [Business secret – quantities sold] account for [Business secret – quantities sold] of Broadcom's FC HBA sales. The Notifying Party states that the major CSPs - AWS, Google, and Microsoft - do not use FC HBAs to the same degree as on-premises deployments. AWS, for example, typically uses CPU-direct-attached storage in its public cloud.⁹¹⁶
- (775) CSPs themselves also indicate that FC HBAs are not strategic to their cloud business. For instance, Oracle indicates: "*FC-HBA is more of a legacy connectivity solution and would not be primarily used in the Cloud datacenter space.*"⁹¹⁷
- (776) Accordingly, the Notifying Party's argument appears again more geared towards Ethernet NICs given that, in contrast to FC HBAs, 38% of Broadcom's Ethernet NICs are sold to hyperscalers.

⁹¹³ https://www.hpe.com/psnow/doc/a50004308enw.pdf?jumpid=in_pdp-psnow-gs at 9, 26-27.

⁹¹⁴ See quotes mentioned in Section 8.3.2.3.2.4 below, in particular the Agreed Minutes of call with Business IT users' associations dated 6 July 2022 [ID 43].

⁹¹⁵ Parties' reply to RFI 23.

⁹¹⁶ Form CO, paragraph 623.

⁹¹⁷ Oracle's non-confidential reply to RFI 1, question 8 d) [ID 4303].

8.4.3.2.2.5. VMware's past ownership by EMC and Dell provides no guarantee about Broadcom's conduct

- (777) In its Article 6(1)(c) Response, the Notifying Party submits that the Decision disregards VMware's past behaviour while it was owned by EMC, and then Dell.⁹¹⁸
- (778) However, while VMware's past behaviour under ownership of EMC and Dell is one of the relevant factors to be considered as part of the Commission's competitive assessment, the Commission should not solely rely on these elements. In particular, based on the Phase I and Phase II investigation, various respondents have indicated that VMware's behaviour is likely to be impacted significantly because of Broadcom.
- (779) First, Microchip indicated concerns regarding a past experience at the time when Dell owned VMware. Microchip indicated that: "*When Dell owned VMware, Microchip experienced certain difficulties working with VMware (...) and at times struggled to achieve timely certification for interoperability.*"⁹¹⁹ Such a bias in favour of Broadcom by Dell seems supported by the fact that Dell remains as one of the only server OEMs which continues to be a "Broadcom-only" shop in relation to their storage adapter products.
- (780) Another hardware vendor indicated: "[...] Despite this investment, VMware appears to do significantly more internal testing earlier in the process with our primary CPU competitor. This may be because AMD's current CPU market share is less than our competitor, but we believe this is a disadvantage to AMD since it likely gives our competitor greater visibility and influence into VMware targets and criteria. [...]"⁹²⁰
- (781) In an internal presentation from [Details on internal document discussing customer views], VMware noted [Details on internal document discussing customer views].⁹²¹
⁹²²
- (782) Further, VMware publicly stated in relation to the spin-off from Dell, that the spin-off would give VMware more freedom to pursue its strategy '*to create a ubiquitous software and SaaS platform across all clouds and hardware infrastructure*'.⁹²³ VMware's strategy post spin-off was therefore based on neutrality amongst others, and the inference is that under Dell's ownership, VMware had less freedom to pursue this strategy.
- (783) Second, various respondents to the market investigation indicated that Broadcom is an aggressive player.
- (784) For instance, NVIDIA indicated that: "Broadcom is aggressive and gaining sales."⁹²⁴ One respondent mentioned that "Broadcom knows it's hard to move away from [company] and therefore pushes the limits in its contractual relationships, including by bundling products" and that "when software is acquired by Broadcom, there is a drastic decline in innovation or improvement, if any at all (...). Whereas VMware is

⁹¹⁸ Broadcom internal document, [Other confidential information – Broadcom's internal documents].

⁹¹⁹ Agreed minutes of call with Microchip dated 10 March 2023 [ID 4302].

⁹²⁰ Replies to Q3 – questionnaire to competitors of Broadcom, question 26 [ID 1894].

⁹²¹ CMA document, VMware's response to s109 Notice 1, page 6, [ID RSLV_00012714].

⁹²² CMA document, VMware's response to s109 Notice 1, page 11, [ID RSLV_00012714].

⁹²³ <https://news.vmware.com/releases/vmware-and-dell-technologies-reach-agreement-regarding-spin-off>.

⁹²⁴ NVIDIA's non-confidential reply to RFI 1, question 7 [ID 4006].

interested in growing the overall industry, Broadcom is a “landlord trying to extort rent”.⁹²⁵

- (785) An association of customers explained that “although VMware is dominant in virtualization, the associations consider that it is a reasonable provider. The same cannot be said of Broadcom. (...) Broadcom is not interested in VMware’s future strategy and will try to make as much money as possible out of the company, as quickly as possible (a “milking strategy”). The associations are concerned that the acquisition of VMware by Broadcom will lead to (i) price increased, as Broadcom has demonstrated an aggressive approach to pricing in the past, (ii) a decrease in quality and (iii) cuts in R&D”. Further, “members of the associations previously complained about Broadcom’s practices, including unfair practices in relation to contract renewals (leaving customers no room for negotiation), changes in the location of the competent courts (i.e. French customers could no longer rely on the jurisdiction of French courts), drastic price increases and lack of transparency on pricing (Broadcom would only provide prices for bundles and refuse to provide prices per product)”⁹²⁶
- (786) A customer mentioned that its concerns related to the transaction are based on its past experience: “following the merger, Bayer experienced “service drops” in terms of capability and technical support) with [confidential]. Bayer does not deem this to be unusual: mergers often cause an initial decline in service quality due to the fact that the entities need to consolidate their systems (there are certain procedures in the relationship with that service provider that need to be recalibrated). Nonetheless, Bayer has some particular reservations regarding [confidential], as its experience [confidential] has been rather frustrating.”⁹²⁷
- (787) Another respondent indicated that “negotiations with Broadcom have been very difficult. In the beginning, and during several time periods, Broadcom refused to negotiate altogether. [Confidential]. Even where Broadcom would be willing to negotiate, proposals would always involve a significant price increase. (...) Broadcom, in its own words, refers to a ‘sticky business’. It knows that customers have no other choice. This allows Broadcom to enforce significant price increases”. In relation to the Transaction, the same respondent mentioned that “in light of [confidential] and Broadcom’s track record of aggressive commercial behaviour, [name] expects to see increased costs and bundling. Furthermore, [confidential], Broadcom often uses refusals to negotiate when it knows that a customer is dependent on its products. In many cases, it refuses to open negotiations until very shortly before the termination of the previous contract. At this time, it will issue a ‘take it or leave it’ offer to the customer. (...) While Broadcom is known for making drastic cost-reductions, these will not suffice to achieve that aim [of increasing VMware profitability]. This is why Broadcom will likely resort to aggressive commercial practices.”⁹²⁸

8.4.3.2.2.6. Conclusion

- (788) On the basis of these elements, and for the purposes of this Decision, the Commission concludes that the merged entity has the incentive to foreclose rivals in the market for FC HBAs by degrading the certified interoperability between these

⁹²⁵ Agreed minutes of call with a market participant dated 25 August 2022 [ID 3008].

⁹²⁶ Agreed minutes of call with Business IT users’ association dated 6 July 2022 [ID 43].

⁹²⁷ Agreed minutes of call with Bayer dated 22 February 2023 [ID 3958].

⁹²⁸ Agreed minutes of call with a market participant dated 14 October 2022 [ID 3171].

rival FC HBA products and VMware's server virtualization software in the on-premises and private cloud environment.

8.4.3.2.3. Impact on effective competition

- (789) For the reasons set out below, the Commission has reached the conclusion that a partial foreclosure of its rival in the market for FC HBAs by degrading the certified interoperability between rival FC HBA products and VMware's server virtualization software in the on-premises and private cloud environment is likely to have significant effects on competition in the market for FC HBAs, by reducing the ability of Broadcom's FC HBA rival to compete.
- (790) The Non-Horizontal Merger Guidelines set out that bundling or tying may result in a significant reduction of sales prospects faced by single-component rivals in the market. The reduction in sales by competitors is not in and of itself a problem. Yet, in particular industries, if this reduction is significant enough, it may lead to a reduction in rivals' ability or incentive to compete. This may allow the merged entity to subsequently acquire market power (in the market for the tied or bundled good) and/or to maintain market power (in the market for the tying or leveraging good). Furthermore, according to the Guidelines, it is only when a sufficiently large fraction of market output is affected by foreclosure resulting from the merger that the merger may significantly impede effective competition.
- (791) The Commission has found that, first, Broadcom is dominant, or at least holds a very strong position, in the highly concentrated market for FC HBAs where it faces only one challenger, Marvell (see Section 8.4.3.2.3.1.). Second, Broadcom's FC HBA rival would be hampered in its ability to compete effectively in part of the market (see Section 8.4.3.2.3.2.). Third, Broadcom's FC HBA rival would invest less (see Section 8.4.3.2.3.3.). This will allow Broadcom to maintain and/or strengthen its dominant, or at least very strong position, in the market for FC HBAs.

8.4.3.2.3.1. The market for FC HBAs is highly concentrated and Broadcom is dominant, or at least holds a very strong position in this market

- (792) In assessing Broadcom's market power in the worldwide market for FC HBAs, the Commission considered Broadcom's market position based on market shares, internal documents as well as out-of-market constraints.

8.4.3.2.3.1.1. Broadcom's position in the market for FC HBAs

- (793) First, the worldwide market for FC HBAs is a **highly concentrated** market.
- (794) As illustrated in Table 22, Broadcom held [60-70]% [Business secret – market share], while its only material competitor, Marvell, held [30-40]% market share. These market shares suggest that Broadcom has a **dominant, or at least very strong position**. Marvell's market shares have been decreasing from [50-60]% in 2017 to below [30-40]% in 2019 and since stayed relatively stable.

Table 22: FC HBA market shares (revenue, worldwide)

	2017 (%)	2018 (%)	2019 (%)	2020 (%)	2021 (%)	2022 (Q1-Q3) (%)
Broadcom	[40-50]	[50-60]	[60-70]	[60-70]	[60-70]	[60-70]
Marvell	[50-60]	[40-50]	[30-40]	[30-40]	[30-40]	[30-40]
Others	[0-5]	[0-5]	[0-5]	[0-5]	[0-5]	[0-5]
Total	100	100	100	100	100	100

Source: Form CO, Table 71 and Response to RFI 21, Annex Q1.

- (795) Broadcom's dominant, or at least very strong position, is also confirmed by Broadcom's internal documents, which will be discussed below.
- (796) The Commission does not consider the Notifying Party's argument credible that the Commission should not take into account at least [Business secret – quantities sold]% of Broadcom's FC HBA sales for its assessment of Broadcom's position on the market for FC HBAs, because these FC HBAs are not mounted inside servers but instead will be mounted into storage arrays, which do not run VMware.⁹²⁹ As set out above (see Section 7.5.7.5.2.3.), there is a worldwide market for FC HBAs, which is not segmented based on type of customer or end-use. On the contrary, the Notifying Party also submitted in the Form CO that it considers there is a worldwide market for FC HBAs which requires no further segmentation.⁹³⁰ The results of the market investigation did not bring forth any evidence to contradict this conclusion. Furthermore, in *Broadcom/Brocade*, it was indicated that only a minority of FC HBAs (15%) are used in storage devices (*i.e.*, storage arrays), while the large majority of FC HBAs are mounted in servers.
- (797) Further, the Notifying Party indicated that, during the Covid-19 pandemic and [Business secret – details of Broadcom supply agreements],⁹³¹ ⁹³² ⁹³³ The Commission has looked at these [Business secret – number of customers] Broadcom customers' purchasing behaviour between 2017 and 2022, and notes that these purchases seem [Business secret – know-how: evolution of purchasing behavior of certain Broadcom customers]. Therefore, the Commission does not expect that [Business secret – know-how: discussion of Broadcom supply agreements] would materially affect Broadcom's growing FC HBA market share trend. See Table 23, Figure 21, Table 23 and Figure 22 below.

⁹²⁹ Parties' reply to RFI 21.

⁹³⁰ Form CO, paragraphs 640-650.

⁹³¹ [Business secret - customers].

⁹³² Broadcom is a fabless company that outsources semiconductor manufacture to contract manufacturers including [Business secret – know-how].

⁹³³ Parties' reply to RFI 21.

Table 23: Share of Broadcom FC HBA customers' purchases with Broadcom

Broadcom customer	2017	2018	2019	2020	2021	2022
[Business secret – customer]	[0-5]	[0-5]	[0-5]	[0-5]	[0-5]	[0-5]
[Business secret – customer]	[20-30]	[20-30]	[20-30]	[10-20]	[20-30]	[20-30]
[Business secret – customer]	[20-30]	[20-30]	[20-30]	[20-30]	[20-30]	[20-30]
[Business secret – customer]	[0-5]	[0-5]	[0-5]	[5-10]	[5-10]	[0-5]
[Business secret – customer]	[0-5]	[0-5]	[0-5]	[0-5]	[0-5]	[0-5]
[Business secret – customer]	-	-	-	-	-	[10-20]
Total	[50-60]	[50-60]	[50-60]	[50-60]	[50-60]	[60-70]

Source: Commission's analysis of Broadcom's Transaction Data

Figure 21: Volume shares of Broadcom FC HBA customers' purchases with Broadcom

[...]

Source: Commission's analysis of Broadcom's Transaction Data

Figure 22: Volumes of Broadcom FC HBA customers' purchases with Broadcom

[...]

Source: Commission's analysis of Broadcom's Transaction Data

(798) Second, new entry is unlikely. The Notifying Party indicated that there has not been any significant entry in the markets for FC HBAs in the last five years.⁹³⁴ This is later contradicted by the Notifying Party's reply to RFI 21 which states: "[Business secret – know-how concerning competitive conditions]."⁹³⁵ ⁹³⁶ However, none of Broadcom's hardware rivals, including Marvell, identified this player as a new entrant.

(799) Third, Broadcom internal documents confirm Broadcom's dominant, or at least very strong, position in these markets.

(800) For instance, a Broadcom presentation from [Details of internal document describing Broadcom's FC HBA sales].⁹³⁷

Figure 23: Broadcom's sales of 32G FC HBAs

[...]

Source: Broadcom

⁹³⁴ Form CO, paragraph 943.

⁹³⁵ Parties' reply to RFI 21.

⁹³⁶ Parties' reply to RFI 21.

⁹³⁷ Broadcom internal document, [Other confidential information – Broadcom's internal documents].

(801) A presentation containing a [Details on internal document describing evolution of Broadcom's FC HBAs sales] from [Details on internal document describing evolution of Broadcom's FC HBAs sales] (See **Figure 24** below).⁹³⁸

Figure 24: Broadcom's sales of FC HBAs in the period 2016-2021 and target for 2022

[...]

Source: Broadcom

(802) This same presentation shows [Details on internal document describing Broadcom's market share].⁹³⁹ See **Figure 25** below.

Figure 25: [Details on internal document describing Broadcom's market share]

[...]

Source: Broadcom

(803) A Broadcom presentation which [Details on internal document describing Broadcom's market share] (See **Figure 26** below).⁹⁴⁰

Figure 26: [Details on internal document describing Broadcom's market position]

[...]

Source: Broadcom

(804) For instance, in a Broadcom ECD presentation [Details on internal document describing adoption ratio of Broadcom's FC HBAs]⁹⁴¹. See **Figure 27** below.

Figure 27: [Title of a figure describing customer demand for Broadcom products] [Business secret – know-how]

[...]

Source: Broadcom

(805) Furthermore, in the same presentation, Broadcom commented on the [Details on internal document describing Broadcom's forecast of customer demand]. See **Figure 28** below.

Figure 28: [Title of figure describing Broadcom's forecast of customer demand] [Business secret – business plans]

[...]

Source: Broadcom

(806) In addition, in a Broadcom presentation dated [Details on internal document describing Broadcom's market position].⁹⁴² See **Figure 29** below.

Figure 29: [Title of figure describing Broadcom's market position]

[...]

Source: Broadcom

8.4.3.2.3.1.2. Out-of-market constraints

(807) The Notifying Party has also indicated that certain alternative technologies constrain Broadcom's market power in the market for FC HBAs. This relates in particular to

⁹³⁸ Broadcom internal document, [Other confidential information – Broadcom's internal documents].

⁹³⁹ Broadcom internal document, [Other confidential information – Broadcom's internal documents].

⁹⁴⁰ Parties' reply to RFI 15 - Part 01 [Other confidential information – Broadcom's internal documents].

⁹⁴¹ Parties' reply to RFI 15 - Part 08 [Other confidential information – Broadcom's internal documents].

⁹⁴² Broadcom's internal document, [Other confidential information – Broadcom's internal documents].

Ethernet SANs (which use Ethernet NICs).⁹⁴³ In addition, the Notifying Party indicated that FC HBAs are constrained by the migration of workloads to the public cloud.⁹⁴⁴

- (808) **Ethernet SANs versus FC HBAs.** As set out in Section 7.57.5.1.3. above, in the Phase I investigation, the majority of customers expressing an opinion indicated that alternative technologies or protocols do not constitute an alternative for FC HBAs.⁹⁴⁵ Furthermore, this was confirmed by the majority of server OEMs that expressed a view.⁹⁴⁶
- (809) Furthermore, the market investigation also indicates that the FC remains the preferred solution for workloads by customers that value the latency, reliability, and security resulting from a separate FC protocol.⁹⁴⁷ This was also confirmed by the Notifying Party.⁹⁴⁸ A minority of customers to the market investigation indicated that Ethernet could constitute a valid alternative protocol to FC, or that they would at least investigate alternative technologies.⁹⁴⁹
- (810) For instance, one server OEM indicated: “Although both FC and Ethernet can carry storage traffic, using different protocols, their characteristics are very different. Again, it is a case of the use of appropriate technology to solve the problem, and you cannot use one to solve the problems best suited to the other. Their capabilities do not completely overlap.”⁹⁵⁰ Another server OEM submitted “If customers have existing FC infrastructure, they must use FC HBAs to connect into it. Switching to another technology would require an extremely expensive rip out and replace of customer’s infrastructure. FC has unique features that satisfy some customer requirements.”⁹⁵¹ Finally, Marvell stated: “[...] in the enterprise space, there is about 7-8% Ethernet high-speed penetration. But maintaining the protocol is a heavy lift for OEMs. There is no growth in that segment; it is just there because of legacy support. Fiber channel brings a robustness and reliability for mission-critical applications that Ethernet cannot match.”⁹⁵²
- (811) [Details on internal documents comparing Broadcom product sales]⁹⁵³ and [Details on internal documents comparing Broadcom product sales]⁹⁵⁴
- (812) **Public cloud.** As explained in Section 8.4.3.2.1.2.5., the Commission considers that public cloud constitutes a limited out-of-market constraint on enterprise deployments. While there is an ongoing industry trend for companies to move away to public cloud, the on-premises and private cloud environment will remain relevant will remain relevant for certain workloads and applications. Moreover, at least part of these workloads and applications are of special importance to the customers because they are mission-critical (see Section 7.4.1.3.). This in turn implies that any constraint from public cloud on Broadcom’s supply of FC HBAs is also limited.

⁹⁴³ Parties’ reply to RFI 21.

⁹⁴⁴ Form CO, paragraph 623.

⁹⁴⁵ Replies to Q4 – questionnaire to customers of VMware and Broadcom, question 17.

⁹⁴⁶ Replies to Q4 – questionnaire to customers of VMware and Broadcom, question 17.

⁹⁴⁷ Replies to Q4 – questionnaire to customers of VMware and Broadcom, question 21.

⁹⁴⁸ Parties’ reply to RFI 21.

⁹⁴⁹ Replies to Q4 – questionnaire to customers of VMware and Broadcom, questions 17.1, 18.1 and 19.1.

⁹⁵⁰ Replies to Q4 – questionnaire to customers of VMware and Broadcom, question 17.1 [ID 1537].

⁹⁵¹ Replies to Q4 – questionnaire to customers of VMware and Broadcom, question 17.1 [ID 1909].

⁹⁵² Replies to Q3 – questionnaire to competitors of Broadcom, question 11 [ID 1962].

⁹⁵³ Broadcom internal document, [Other confidential information – Broadcom’s internal documents].

⁹⁵⁴ Broadcom internal document, [Other confidential information – Broadcom’s internal documents].

- (813) Marvell indicated that “The typical enterprise customers would still need to operate in on-premises data centers because of mission critical applications and security concerns. The cloud, which runs on an ethernet-based protocol, cannot offer the same reliability and security that an on-premises data site running fibre channel protocols can, and thus large enterprise customers that run mission-critical applications are unable to make the switch to cloud”.⁹⁵⁵
- 8.4.3.2.3.2. Marvell’s ability to effectively compete in the FC HBA market would be hampered
- (814) The degradation of the certified interoperability between rival FC HBAs and VMware’s server virtualization software in the on-premises and private cloud environment will hamper the ability of Broadcom’s rival in the market for FC HBAs to compete in light of the importance of interoperability with VMware (see Section 8.4.3.2.1.1. above). Such a degradation of certified interoperability will allow Broadcom to maintain and/or strengthen its dominant, or at least very strong position, in the market for FC HBAs.
- (815) First, Broadcom’s FC HBA rival, Marvell, is likely to incur reputational damages based on missing server OEM delivery deadlines. Marvell would suffer from the perceived risk by customers that its FC HBA components would be certified interoperable in a less timely manner with VMware, compared with Broadcom’s hardware. Such reputational damage would also lead to financial losses, and given the high investment required to compete in the market for FC HBAs, it may lead to Marvell reconsidering its decision to invest and continue to compete in this market.⁹⁵⁶ This reduction in competition may, in turn, result in higher prices, lower quality and less innovation which will be passed on to end-customers. Given that the market for FC HBAs is already highly concentrated with only one credible and significant competitor remaining, any lessening of competition would be highly problematic. Marvell indicated that: “*For timing, when designing a new server, end customers are often impatient. Any delay in ensuring certification and compatibility could potentially lead to revenue and business loss*”.⁹⁵⁷
- (816) In the SO Response, the Notifying Party submitted that the Commission misrepresented the importance of the server release date, because (i) [Business secret – production process],⁹⁵⁸ (ii) for full certification, OEMs can rely on rivals’ existing products, include new products in the next quarterly update, therefore no lasting effects in terms of opportunity for new products beyond this initial period,⁹⁵⁹ and (iii) [Business secret – production process].⁹⁶⁰ For these reasons, the Notifying Party argues that the effects of foreclosure would be limited. The Commission considers that the Notifying Party’s arguments do not alleviate concerns, as any hampering of the certification of new FC HBAs, in a market where Broadcom already has a dominant, or at least a very strong, position, could create the perception for Marvell that it can no longer compete on a level playing field and thereby affect its incentive to invest and participate in this market.⁹⁶¹

⁹⁵⁵ Marvell’s non-confidential reply to RFI 1, question 1 d) [ID 4437].

⁹⁵⁶ Agreed minutes of call with Marvell dated 8 March 2023 [ID 4322].

⁹⁵⁷ Marvell’s non-confidential reply to RFI 1 question 6 c) [ID 4437].

⁹⁵⁸ SO Response, paragraphs 401-407.

⁹⁵⁹ SO Response, paragraphs 394-401.

⁹⁶⁰ SO Response, paragraph 685.

⁹⁶¹ Agreed minutes of call with Marvell dated 8 March 2023 [ID 4322].

- (817) Second, the worldwide market for FC HBAs is a very **narrow competitive landscape**. This market consists of [Details on the number of customers] customers, [Details on customers]. If any of these [Details on customers] were to shift orders to Broadcom for the reasons explained above, this would have a significant impact on Marvell's position in the market, which has steadily declined over time, as well as on its decision to continue investing and competing in the FC HBA market. It is not to be excluded that such a possibility would in the first-place impact Marvell's consideration of remaining active in this market.
- (818) Broadcom indicates that on the market for FC HBAs, the [Business secret-customers] account for [...] % of Broadcom's sales, and [Business secret-customers] accounted for [...] % of Broadcom's FC HBA sales.⁹⁶² Accordingly, given the limited number of customers on these markets, reputational harm is likely to have far-reaching consequences.
- (819) Third, virtual servers constitute a significant part of the overall server market. Based on Tables 49 and 50 of the Form CO, in 2021, virtualized servers (both public and private cloud) represent [50-60] % of worldwide server CPUs and units installed. Marvell indicated that: "*Virtualization has become a mainstream technology in server deployments since it ensures optimal usage of deployed infrastructure.*"⁹⁶³ Any partial foreclosure strategy of the merged entity in relation to virtualized servers would have a significant effect.
- (820) Fourth, as set out in Section 8.4.3.1.3., contrary to the Notifying Party's claim that Broadcom's FC HBA rival would still have access to a large part of the demand for FC HBAs (*i.e.*, for that part of the market which is not virtualized, or not virtualized by VMware), the market investigation indicates that any such strategy would likely also impact non-virtualized servers and servers not virtualized by VMware.
- (821) Hardware vendors need to develop their products with the broadest OS support. One hardware supplier explained that "VMware is one of three major operating systems used in servers (along with Linux and Microsoft Windows), and support in VMware is essential for Intel to be able to sell its products. [...]"⁹⁶⁴ Another respondent indicated that "Many OEMs may not list/offer NIC products on their servers if they are not certified by the OS provider."⁹⁶⁵ Whereas these statements were made in relation to NIC products, these are equally applicable to FC HBAs.
- (822) The fact that Marvell would not obtain certification of interoperability of its FC HBAs with VMware's server virtualization software at the time of the server release, would lead to server OEMs not including its products in their portfolio at all at the time of the server release and until they obtain certification, and not just for customers that wish to run VMware. As set out above in Section 8.4.3.2.2.2., end-customers are in any event indifferent and rely on the server OEM. An end-customer indicated that: "*In most of the hardware we buy (server, storage) from OEM we have no choice to choose between the brands of components like HBA.*"⁹⁶⁶
- (823) As already set out above in Section 8.4.3.2.1.1., server OEMs expect the broadest OS support and do not wish to be burdened with the cost and complexity of certification. Marvell stated: "*[g]enerally speaking, the burden of having HBAs certified for any*

⁹⁶² Parties' reply to RFI 21.

⁹⁶³ Agreed minutes of call with Marvell dated 22 September 2022 [ID 4298].

⁹⁶⁴ Replies to Q3 – questionnaire to competitors of Broadcom, question 23.4 [ID 1785].

⁹⁶⁵ Replies to Q3 – questionnaire to competitors of Broadcom, question 23.4 [ID 1894].

⁹⁶⁶ Replies to Q4 – questionnaire to customers of VMware and Broadcom, question 39 [ID 1734].

*given OS falls on the HBA manufacturer as OEMs typically do not want the burden and cost of this exercise, but there are exceptions.”*⁹⁶⁷ Consequently, if Broadcom rivals are not delivering a fully certified interoperable product by the agreed server OEMs deadlines, server OEMs will not include the affected products in their catalogue offered to both virtualized and non-virtualized end-customers at that point in time. Contrary to the Notifying Party’s claims in the Article 6(1)(c) Response, the contestable available demand for servers shipped with FC HBAs accordingly becomes extremely limited for Broadcom’s rivals. Accordingly, this would allow Broadcom to maintain and/or strengthen its dominant, or at least very strong position, in the market for FC HBAs.

8.4.3.2.3.3. Marvell would invest less

- (824) In a situation where Marvell considers that it is not competing on a level playing field with Broadcom, Marvell would have less incentives to invest in its FC HBA products.
- (825) Marvell indicated that, post-Transaction, based on the financial and reputational losses, they would start investing less in these markets or leave the market in its entirety: *“In the long term, if Marvell keeps missing deadlines, it will suffer significant financial and reputational losses. Customers will no longer perceive Marvell as a quality FC HBAs vendor and it is difficult to estimate the magnitude of the consequent financial and reputational losses. Ultimately, the financial losses would impact Marvell’s investment decisions in the sense that Marvell would invest less in FC HBAs or, at some point, Marvell would stop investing in FC HBAs.”*⁹⁶⁸
- (826) In addition, contrary to the Notifying Party’s claims in the Article 6(1)(c) Response, the Commission understands that the FC HBA products still require regular updates and investment, for instance to update their speeds.
- (827) The Notifying Party submitted that Marvell and Broadcom are currently competing with [Business secret – know-how].⁹⁶⁹ Based on Figure 3 included in the Notifying Party’s response to RFI 21, Broadcom [Business secret – business plans].⁹⁷⁰ Marvell also indicated that for FC HBAs: *“Broadcom and Marvell also have different strengths at different speeds.”*⁹⁷¹
- (828) In view of the above, the Notifying Party’s argument that the effects of foreclosure would be limited as they would impact only new devices that require full certification, and not any devices for which Marvell could claim equivalence or its older devices with which it could continue to compete, is of relative importance. Any hampering of the certification of new FC HBAs could create the perception for Marvell that it can no longer compete on a level playing field and thereby affect its incentive to invest and participate in this market.
- (829) Accordingly, the fact that Broadcom’s FC HBA rival would invest less, would allow Broadcom to maintain and/or strengthen its dominant, or at least very strong position, in the market for FC HBAs.

⁹⁶⁷ Marvell's non-confidential reply to RFI 1, question 6 c) [ID 4437].

⁹⁶⁸ Agreed minutes of call with Marvell dated 8 March 2023 [ID 4322].

⁹⁶⁹ Parties’ reply to RFI 21.

⁹⁷⁰ Parties’ reply to RFI 21, Figure 3.

⁹⁷¹ Marvell's non-confidential reply to RFI 1, question 4 [ID 4437].

8.4.3.2.3.4. Conclusion

(830) On the basis of these elements, and for the purposes of this Decision, the Commission concludes that foreclosing Marvell in the market for FC HBAs by delaying the development and certification process of rival FC HBAs that are interoperable with VMware's server virtualization software in the on-premises and private cloud environment would have a significant detrimental effect on competition in the worldwide market for FC HBAs.

8.4.4. *Foreclosure of suppliers of storage adapters by restricting or degrading interoperability between rival storage adapters and VMware's server virtualization software*

(831) The Transaction gives rise to a conglomerate relationship between VMware's activities in the market for cloud server virtualization software in the on-premises and private cloud environment and Broadcom's activities in the market for storage adapters. Broadcom's storage adapters are server components which interact with server virtualization software indirectly, through drivers (see Section 6.3. above).

(832) The Commission has examined whether the merged entity would have the ability, post-Transaction, to foreclose rival providers of storage adapters by leveraging VMware's strong position in the market for on-premises and private cloud server virtualization. In this regard, in its Phase I and Phase II market investigation, the Commission has sought to verify whether the merged entity would likely have the **ability** and the **incentive** to degrade the certified interoperability between these rival storage adapters and VMware's server virtualization software.

(833) This could be achieved in several ways by impacting the certification procedure, as set out above in Section 8.4.3.2.1.3.2.

(834) The Commission has likewise sought to establish whether such a foreclose strategy may have a negative **impact** on competition in the market for storage adapters.

8.4.4.1. The Notifying Party's view

(835) The Notifying Party submits that the merged entity will not have the ability or the incentive to foreclose rival providers of storage adapters through restricting or degrading the certified interoperability between these rival storage adapters and VMware's server virtualization software. Moreover, the Notifying Party submits that such foreclosure strategy would have no impact on effective competition in the worldwide market for storage adapters.

8.4.4.1.1. Ability to foreclose

(836) As explained in more detail in Section 8.4.3.1.1., the Notifying Party submits that the merged entity will lack the ability to foreclose competing hardware providers by degrading the interoperability of their hardware with VMware's virtualization software. This is based on the following arguments.

(837) First, the Notifying Party submits that the merged entity will not have the market power to pursue such a foreclosure strategy, pointing at VMware's market share on the overall market for server virtualization software and competitive constraints emanating from other virtualization software providers, CSPs, and containerization providers.⁹⁷²

⁹⁷² Form CO, paragraphs 724-730.

(838) Second, the Notifying Party submits that the merged entity will not be able to technically engage in foreclosure. The merged entity would not be able to selectively target those customers who would be less likely to migrate workloads to alternative server virtualization software providers, thereby rendering any putative foreclosure unsuccessful.⁹⁷³ Furthermore, the Notifying Party submits that the value proposition of virtualization software and its commercial viability is inherently linked to the software's compatibility with as much hardware as possible.⁹⁷⁴

8.4.4.1.2. Incentive to foreclose

(839) As explained in more detail in Section 8.4.3.1.2., the Notifying Party submits that the merged entity will also lack the incentive to foreclose competing hardware providers by degrading the interoperability of their hardware with VMware's virtualization software. In brief, this is based on the following arguments.

(840) First, the Notifying Party submits that foreclosure would undermine VMware's neutrality and stepping away from this policy would risk reputational damage.⁹⁷⁵

(841) Second, according to the Notifying Party's analysis, a foreclosure strategy would only be profitable if more than [Business secret – margin calculations]% of VMware server virtualization software customers that do not currently use Broadcom storage adapters switched to Broadcom storage adapters. The Notifying Party submits that such significant switching is highly unlikely and that any foreclosure strategy would therefore not be profitable.⁹⁷⁶ Specifically for storage adapters, the Notifying Party submits that rival storage adapters which have already been certified or storage adapters which have been certified by equivalency represent [Business secret – margin calculations]% of sales of storage adapters every year.⁹⁷⁷

(842) Third, according to the Notifying Party, VMware's past ownership supports the lack of foreclosure strategy.⁹⁷⁸

(843) Fourth, the Notifying Party submits that customers have countervailing buyer power.⁹⁷⁹ Broadcom's top ten storage adapter customers account for [Business secret – Customers and distribution lists]% of Broadcom's total sales. In short, if Broadcom were to foreclose, the Notifying Party submits that OEMs would switch to alternative suppliers or produce more in-house, and end-customers would switch to alternative server virtualization software or migrate away from on-premises or private cloud workloads altogether.⁹⁸⁰

(844) Finally, the Notifying Party believes that Broadcom's rivals would retaliate when faced with foreclosure.⁹⁸¹

8.4.4.1.3. Impact on effective competition

(845) The Notifying Party submits that, even if the merged entity had both the ability and incentive to foreclose rival storage adapter vendors by degrading the interoperability

⁹⁷³ Form CO, paragraphs 736-739.

⁹⁷⁴ Article 6(1)(c) Response, paragraph 149.

⁹⁷⁵ Form CO, paragraphs 740-749.

⁹⁷⁶ Form CO, paragraphs 752-762; Article 6(1)(c) Response, paragraphs 234-241.

⁹⁷⁷ SO Response, paragraphs 440, 583.

⁹⁷⁸ Form CO, paragraphs 769-770.

⁹⁷⁹ Form CO, paragraphs: 774-777; Article 6(1)(c), paragraphs 265-269.

⁹⁸⁰ Form CO, paragraphs: 780-782; Article 6(1)(c), paragraphs 271-274.

⁹⁸¹ Form CO, paragraphs 783-786.

of their products with VMware, there would be no significant impediment to effective competition.

- (846) First, the Notifying Party submits that Broadcom **does not have a significant degree of market power** in the market for storage adapters. According to the Notifying Party, OEMs are not distributors of Broadcom's storage adapters, but rivals competing with Broadcom for the sale of storage adapters. In particular, approximately [80-90]% of the value of the storage adapter comes from the board surrounding the controller, end-customers view these storage adapters as fully substitutable with Broadcom's own storage adapters, and server OEMs handle their own certification of the storage adapters. The merged entity would therefore endure significant competitive pressure from rivals' storage adapters offering.
- (847) The Notifying Party also submits that **any foreclosure behaviour would not significantly impede competition**. Even assuming that rivals would miss server OEMs delivery deadlines, the effects would remain short-lived and limited to the period of delay. Furthermore, the Notifying Party submits that the effects would in any case be insignificant.⁹⁸² Specifically for storage adapters, storage adaptor rivals already have certified generations of hardware which constitute [90-100]% of storage adapter sales each year. Furthermore, the Notifying Party submits that partial foreclosure cannot affect several categories of devices.⁹⁸³ Therefore, the Notifying Party submits that the partial foreclosure theory can only affect [0-5]% of storage adapter sales.⁹⁸⁴
- (848) The Notifying Party considers that any putative degradation of interoperability would not deprive rival hardware vendors that compete with Broadcom of "*minimum viable scale*".⁹⁸⁵
- (849) For storage adapters, assuming that Microchip incurred a 1-year delay and that all the sales would be diverted to Broadcom, the Notifying Party contends that Microchip revenues from VMware virtualized servers would decrease by [Business secret – market shares] and Microchip revenues from all servers would decrease by [Business secret – market shares].⁹⁸⁶ The putative losses as calculated by the Notifying Party are so small that they cannot justify the conclusion that rivals would invest less.
- (850) Finally, Broadcom [Business secret – sales policy and strategy].⁹⁸⁷ [Business secret – sales policy and strategy].⁹⁸⁸

8.4.4.2. The Commission's assessment

8.4.4.2.1. Ability to foreclose

- (851) The Commission considers that, post-Transaction, the merged entity would **have the ability** to foreclose rival providers of storage adapters by restricting or degrading interoperability of rival storage adapters with VMware's server virtualization software.
- (852) The Commission's assessment of the merged entity's ability to foreclose rival providers of storage adapters as a result of the conglomerate relationship between

⁹⁸² SO Response, paragraphs 692-697.

⁹⁸³ SO response, paragraph 678.

⁹⁸⁴ SO Response, paragraph 679.

⁹⁸⁵ Article 6(1)(c) Response, paragraph 278.

⁹⁸⁶ SO Response, paragraphs 692-697.

⁹⁸⁷ SO Response, paragraphs 703-707.

⁹⁸⁸ SO Response, paragraphs 708-710.

VMware's activities in the worldwide market for server virtualization software in the on-premises and private cloud environment and Broadcom's activities in the storage adapter market runs parallel to its assessment of the relationship with Broadcom's activities in the worldwide market for FC HBAs in a number of ways.

- (853) First, certified interoperability with VMware's hypervisor is equally important and necessary for storage adapters as it is for FC HBAs (see Sections 6.3. and 8.4.3.2.1.1. above).
- (854) Second, VMware has a significant degree of market power on the worldwide market for server virtualization software in an on-premises and private cloud environment (see Section 8.4.3.2.1.2. above).
- (855) Third, the merged entity has the ability to engage in partial foreclosure by delaying or degrading certified interoperability between Broadcom's rivals in storage adapters and VMware's server virtualization software (see Section 8.4.3.2.1.3. above).
- (856) Fourth, Broadcom's storage adapter rivals are not able to deploy effective and timely counterstrategies, as they do not own any server virtualization software solutions, would not be able to sponsor the entry of new suppliers in the market for server virtualization software, and would continue to be heavily reliant on VMware's software even if they were to combine their storage adapters with other server virtualization software providers' products (see Section 8.4.3.2.1.4. above).
- (857) In light of the foregoing, the Commission finds that the merged entity would have the ability to foreclose competing suppliers of storage adapters by degrading the certified interoperability between these rival hardware products and VMware's server virtualization software in the on-premises and private cloud environment.

8.4.4.2.2. Incentive to foreclose

- (858) The Commission considers that, post-Transaction, the merged entity would **not have the incentive** to foreclose rival providers of storage adapters by restricting or degrading interoperability of rival storage adapters with VMware's server virtualization software.
- (859) The Commission's assessment of the merged entity's incentive to foreclose rival providers of storage adapters as a result of the conglomerate relationship between VMware's activities in the worldwide market for server virtualization software in the on-premises and private cloud environment and Broadcom's activities in the storage adapter market runs parallel to its assessment of the relationship with Broadcom's activities in the worldwide market for FC HBAs in a number of ways.
- (860) First, in order to assess whether the merged entity would have the incentive to engage in the partial foreclosure strategies set out above in Sections 8.4.3.2.1.3. and 8.4.4.2.1, the Commission has assessed the critical switching rate implied by a standard static "vertical arithmetic" as proposed by the Notifying Party. As discussed in Section 8.4.3.2.2. above), the Commission concluded that the shortcomings of the vertical arithmetic analysis submitted by the Notifying Party are likely to bias the magnitude of the critical switching rate. In its SO Response, the Notifying Party submitted an updated vertical arithmetic with revised VMware's prices and margins and taking into account the recapture of workloads in VMware public cloud solutions. In line with the SO, the Notifying Party also revised the estimates for Broadcom's prices and margins to account for the difference in the margins of storage adapters and storage controllers. The resulting critical switching rate implies that the foreclosure strategy would be profitable if [Business secret – Margins calculations]% of customers using vSphere plus associated products switched to

Broadcom products, which is significantly higher than that in relation to FC HBAs.⁹⁸⁹

- (861) Second, the 2023 MIT Switching Survey submitted by the Notifying Party, covering storage adapters in addition to FC HBAs, cannot be relied on for the estimation of the actual switching rates in response to a delay of the validation of the certification process of hardware rivals, due to a number of methodological flaws (see Section 8.4.3.2.2.3. above).
- (862) Third, VMware's past ownership by EMC and Dell provides no guarantee about Broadcom's conduct 8.4.3.2.2.3.5. above).
- (863) However, **certain market dynamics specific to storage adapters lead to different conclusions** as to the merged entity's incentive to engage in foreclosure by delaying or degrading the certified interoperability between rival storage adapters and VMware's server virtualization software.
- (864) First, the Commission has found that customers may be less inclined to switch from rival storage adapters to Broadcom storage adapters as they would be to switch from rival FC HBAs (see Section 8.4.3.2.2.2.). While it holds true for storage adapters that end-customers determine which virtualization software they run⁹⁹⁰, that server virtualization software represents a significant cost factor relative to the price of the hardware⁹⁹¹, and that end-customers consider it more difficult and disruptive to switch to an alternative hypervisor than to switch to a different storage adapter⁹⁹², there is more differentiation on the market for storage adapters due to presence on the market of OEMs with competing custom-made storage adapters. This is discussed in more detail in Section 8.4.4.2.2.1., below.
- (865) Second, and consequently, the Commission considers that the server OEMs have buyer power as they may, when faced with the foreclosure behaviour, postpone the release of their new servers until they have obtained certification for their custom-made storage adapters. This is discussed in more detail in Section 8.4.4.2.2.2., below.

8.4.4.2.2.1. Storage adapter products are differentiated

- (866) In the market for storage adapters, Broadcom faces competition from Microchip as well as from server OEMs who build custom-made storage adapters based on storage controllers purchased from Broadcom, Microchip and Marvell and subsequently sell them to end-customers.⁹⁹³
- (867) As described above in Section 7.6., the storage controller amounts to approximately [20-30]% of the value of the complete storage adapter. A significant portion of the

⁹⁸⁹ This arithmetic is based on the assumption that VMware customers using storage adapters of Broadcom's rivals would switch to corresponding Broadcom or Broadcom-based products. When it is assumed that some OEMs that produce their own storage adapters based on Broadcom controllers will have to switch to Broadcom's own storage adapters instead, the critical switching rate falls short of [Business secret – Margins calculations].

⁹⁹⁰ See Section 8.4.3.2.2.2.3.

⁹⁹¹ See Section 8.4.3.2.2.2.4. As part of the vertical arithmetic analysis, the estimated average price per server of one storage adapter amounts to [Business secret – cost structure] USD, whereas the estimated average price per server of a vSphere license and associated support and services amounts to [Business secret – cost structure] USD. This results in the average price of the storage adapter per server representing [Business secret – cost structure]% of the average price of the vSphere license and associated support and services.

⁹⁹² See Section 8.4.3.2.2.2.5.

⁹⁹³ See also Section 8.2.5.

value of the storage adapter is therefore created by the rest of the adapter surrounding the controller. When OEMs build a storage adapter based on a Broadcom, Microchip or Marvell controller, they offer different storage adapter configurations with proprietary customized software and features, including (among other things) the form factor, the underlying controller, the number of port connectors, the drive interface, the RAID levels. These specifications reflect feedback and preferences of end-customers' and are designed to fit into their respective server architectures. Furthermore, OEMs' storage adapters are differentiated in terms of configuration, management software, customer support services and pricing.⁹⁹⁴

- (868) The market for storage adapters is characterised by product differentiation and the possibility of customization of storage adapters offered by server OEMs is a factor towards the end-customer's choice of storage adapter. The importance of OEMs' storage adapters is also reflected in the market shares: they collectively constituted [60-70]% and hence the majority of the storage adapter sales in 2021.

8.4.4.2.2.2. There are countervailing factors present

- (869) As explained above in Section 7.6., it is the storage adapter including the storage controller that is certified for interoperability with VMware's server virtualization software rather than the storage controller in itself. When server OEMs develop their custom-made storage adapters, it is in the process of seeking certification that they could be faced with the foreclosure behaviour as described in Section 8.4.3.2.1.3., *i.e.*, a delay in the certification.
- (870) As described above, there are two key differences with the market for FC HBAs: first, whereas server OEMs only acquire FC HBAs from third parties for resale to the end-customers, they actively compete in the market for storage adapters. Second, given the level of product differentiation, there is still an added value for OEMs in pursuing the strategy of offering more than one product to end-customers, *i.e.*, offering their own storage adapters in addition to Broadcom's storage adapters, even if they were to incur a delay in certification.
- (871) The foreclosure mechanism as described in Section 8.4.3.2.1.3. results in hardware vendors missing the initial release of a new server as well as the corresponding PR cycle, leading to financial and reputational losses. However, unlike competitors of Broadcom in the market for FC HBAs, the server OEMs would not suffer in the same way from the reputational damage as a result of the delayed certification of their storage adapters, given that they control the timing and PR surrounding new server releases.
- (872) As a result, the Commission considers that OEMs would be able to mitigate the impact of a delayed certification of their storage adapters. This would have reduced the potential gains of a foreclosure strategy and, in turn, decrease the merged entity's incentive to engage in such behaviour.

8.4.4.2.3. Impact on effective competition

- (873) For the reasons set out below, the Commission considers that a foreclosure strategy against Broadcom's rival providers of storage adapters is not likely to have a significant impact on competition in the worldwide market for storage adapters by reducing the ability of storage adapter rivals to compete.

⁹⁹⁴ SO Response, paragraph 507.

- (874) As set out above in Section 8.4.3.2.3., the Non-Horizontal Merger Guidelines set out that bundling or tying may result in a significant reduction of sales prospects faced by single-component rivals in the market. The reduction in sales by competitors is not in and of itself a problem. Yet, in particular industries, if this reduction is significant enough, it may lead to a reduction in rivals' ability or incentive to compete. This may allow the merged entity to subsequently acquire market power (in the market for the tied or bundled good) and/or to maintain market power (in the market for the tying or leveraging good).⁹⁹⁵ Furthermore, according to the Non-Horizontal Merger Guidelines, it is only when a sufficiently large fraction of market output is affected by foreclosure resulting from the merger that the merger may significantly impede effective competition.⁹⁹⁶
- (875) The Commission has found that, first, Broadcom does not have significant degree of market power in the worldwide market for storage adapters as it has a moderate market share and faces strong competition. Second, when faced with potential foreclosure behaviour by the merged entity through the delay of the development and certification process of rival storage adapters that are interoperable with VMware's server virtualization software, storage adapter rivals would not be hampered in their ability to compete effectively.
- 8.4.4.2.3.1. The market for storage adapters is fragmented and Broadcom has no significant degree of market power
- (876) In assessing Broadcom's market power in the worldwide market for storage adapters, the Commission has considered Broadcom's market position based on market shares, internal documents and the results of the market investigation.
- (877) As set out in Section 8.2.5. and **Tables 24-25**, the worldwide market for storage adapters is fragmented. As explained in Section 8.4.4.2.2.1., Broadcom's market share is reflected in "Broadcom's board", whereas "Broadcom-based boards" represent the storage adapter competitors that build their storage adapters using Broadcom controllers.
- (878) In 2022, Broadcom held a share of [30-40]% of storage adapter sales. Broadcom faces competition from a large number of competitors, including Microchip as well as OEMs who develop their own storage adapters based on Broadcom, Microchip and to some extent Marvell storage controllers. Broadcom's storage controllers are sold to more than [Business secret – quantities sold] customers.⁹⁹⁷

⁹⁹⁵ Non-Horizontal Guidelines, paragraph 111.

⁹⁹⁶ Non-Horizontal Guidelines, paragraph 113.

⁹⁹⁷ Parties' reply to RFI 27.

Table 24: Storage adapters market shares (revenue, worldwide)⁹⁹⁸

	2017 (%)	2018 (%)	2019 (%)	2020 (%)	2021 (%)	2022 (%)
Broadcom's Boards	[20-30]	[20-30]	[20-30]	[20-30]	[30-40]	[30-40]
Broadcom-based boards	[40-50]	[40-50]	[40-50]	[40-50]	[40-50]	[40-50]
Microchip boards and Microchip-based boards	[20-30]	[20-30]	[20-30]	[20-30]	[20-30]	[10-20]
Marvell-based boards ⁹⁹⁹	[5-10]	[5-10]	[5-10]	[5-10]	[5-10]	[0-5]
Total	100	100	100	100	100	100

Source: Form CO, Table 73 and Annex Q6 to RFI 21 response

Table 25: Storage adapters market shares (volumes, worldwide)

	2017 (%)	2018 (%)	2019 (%)	2020 (%)	2021 (%)	2022 (%)
Broadcom's Boards	[10-20]	[10-20]	[10-20]	[10-20]	[20-30]	[20-30]
Broadcom-based boards	[50-60]	[50-60]	[40-50]	[50-60]	[40-50]	[40-50]
Microchip boards and Microchip-based boards	[20-30]	[20-30]	[20-30]	[10-20]	[20-30]	[10-20]
Marvell-based boards ¹⁰⁰⁰	[10-20]	[10-20]	[10-20]	[10-20]	[10-20]	[10-20]
Total	100	100	100	100	100	100

Source: Form CO, Table 73 and Annex Q6 to RFI 21 response

⁹⁹⁸ These shares are based on the Parties' best estimates. See Annexes (Conglomerate) 20-21 to the Form CO for a methodology note. No third-party data is available.

⁹⁹⁹ Marvell supplies certain chip solutions (SATA controllers, SATA-to-PATA Bridges, SAS/SATA Controllers, and SAS to SATA Protocol Converts) to customers that then use the chip to create their own board-level storage adapters. Marvell does not build or sell any of these adapters. Marvell has a single production board solution (NVMe) that it sells to HPE, which relabels the card with their logo and sells to their end-customers. See e-mail exchange with Marvell between 3 and 17 February 2023 [ID 3661].

¹⁰⁰⁰ Marvell supplies certain chip solutions (SATA controllers, SATA-to-PATA Bridges, SAS/SATA Controllers, and SAS to SATA Protocol Converts) to customers that then use the chip to create their own board-level storage adapters. Marvell does not build or sell any of these adapters. Marvell has a single production board solution (NVMe) that it sells to HPE, which relabels the card with their logo and sells to their end-customers. See e-mail exchange with Marvell between 3 and 17 February and 2023 [ID 3661].

- (879) There are two other companies that supply storage controllers for storage adapters: Microchip and Marvell. OEMs and other hardware rivals sell produce custom-made storage adapters based on controllers purchased from Broadcom, Microchip and Marvell and play an important role in the market for storage adapters. Although relying on Broadcom for the most critical part of the storage adapter, OEMs’ storage adapters should be seen separately from the storage controller provider upstream for the following reasons.
- (880) First, as described above in Section 7.6., the storage controller amounts to approximately [20-30]% of the value of the complete storage adapter. A significant portion of the value of the storage adapter is therefore created by the rest of the adapter surrounding the controller. When OEMs build a storage adapter based on a Broadcom, Microchip or Marvell controller, they offer different storage adapter configurations or form factors with proprietary customized software and features. The custom-made OEM adapters are therefore differentiated products, marketed under the OEMs own name and competing with Broadcom’s own storage adapters. From an end-customer perspective, they are fully substitutable.
- (881) Custom-made OEM adapters represent over [Business secret – quantities sold] of storage adapter sales as well as the associated revenue, and Broadcom sells more than [Business secret – quantities sold] times more storage controllers than storage adapters, indicating the clear demand of end-customers for this product.
- (882) Second, as described above in Section 7.6., it is the storage adapter including the storage controller that is certified for interoperability with VMware’s virtualization software, rather than the controller in itself. Depending on the level of customization of the storage adapter, the OEMs could rely on Broadcom’s source code to develop and certify their adapters, or they could create their own drivers.¹⁰⁰¹ The OEM as the device manufacturer ensures certification for its storage adapter and has the capability to build its own driver. Whereas the market investigation has revealed that the suppliers of the storage controller provide support to the server OEMs in the certification process, it has not brought forward any indication that any change in such support would affect the OEMs’ ability to continue to sell storage adapters competing with Broadcom’s own products. Therefore, they do not depend on the hardware supplier for getting their storage adapters certified. For example, Microchip submitted that “*the OEM customers are the ones engaging in the certification process*”¹⁰⁰², and a server OEM explained that it “*certifies compatibility with its chosen connectivity technologies as it develops and releases its servers and storage devices*”, such that it is not dependent on suppliers’ certifications.¹⁰⁰³
- (883) Based on Broadcom’s moderate market share and the presence of important competitors, the Commission therefore concludes that Broadcom has no dominant or strong position in the market for storage adapters.
- 8.4.4.2.3.2. Delaying or degrading interoperability would not significantly impede effective competition
- (884) In addition to the absence of significant market power for Broadcom on the market for storage adapters, the Commission has concluded that any foreclosure by delaying or degrading interoperability by the merged entity between rivals’ storage adapters

¹⁰⁰¹ Parties’ reply to RFI 27.

¹⁰⁰² Microchip’s non-confidential response to RFI 4, question 3 c) ii) [ID – 4217].

¹⁰⁰³ Replies to Q4 – questionnaire to customers of VMware and Broadcom, questions 38.1, 40.1 and 49.1 [ID 1537].

and VMware's virtualization software would not significantly impede effective competition.

- (885) The Notifying Party has put forward a quantitative effects analysis based on three hypothetical long-term delays in certification: three months, six months and twelve months. In its analysis, it has taken account only those devices requiring full certification (*i.e.*, excluding devices certified via equivalency) and only the [20-30]% of instances in which VMware actively engages with hardware vendors for technical support. Furthermore, it has prepared models both for the putative effects of partial foreclosure on servers virtualized with VMware virtualization software, as well as on all servers.¹⁰⁰⁴
- (886) According to such analysis, if Microchip were to be subject to a year of delay in sales, whether for VMware-virtualized servers or all servers, any impact on Microchip's total sales would be less than [0-5]%. Even if this model were to take account of all instances requiring full certification and not only the [20-30]% in which VMware actively engages with hardware vendors for technical support, the impact would be negligible.¹⁰⁰⁵
- (887) In combination with the fact that Broadcom does not hold a dominant position or significant degree of market power on the market, such loss in revenues is unlikely to result in Microchip exiting the market for storage adapters, being marginalised or deprioritizing investment in storage adapters.

8.4.4.2.4. Conclusion

- (888) In light of the above, the Commission concludes that the Transaction does not result in a significant impediment of effective competition on the worldwide market for storage adapters as a result of the foreclosure by the merged entity of rival providers of storage adapters by restricting or degrading interoperability of rival storage adapters with VMware's server virtualization software.

8.4.5. *Foreclosure of suppliers of NICs by restricting or degrading interoperability between rival NICs and VMware's server virtualization software*

- (889) The Transaction gives rise to a conglomerate relationship between VMware's activities in the market for server virtualization software and Broadcom's activities in the market for NICs. Broadcom's NICs are server components which interact with virtualization software (see Section 6.3. above).
- (890) The Commission has examined whether the merged entity would have the ability, post-Transaction, to foreclose rival providers of NICs by leveraging VMware's strong position in the market for server virtualization software in the on-premises and private cloud environment. In this regard, in its market investigation, the Commission has sought to verify whether the merged entity would likely have the **ability** and the **incentive** to degrade the certified interoperability between these rival NICs and VMware's server virtualization software.
- (891) This could be achieved in several ways by impacting the certification procedure, as set out above in Section 8.4.3.2.1.3.2.
- (892) The Commission has likewise sought to establish whether such a foreclosure strategy may have a negative **impact** on competition in the market for NICs.

¹⁰⁰⁴ SO Response, paragraphs 693-694.

¹⁰⁰⁵ SO Response, paragraph 695 and Figures 47-48.

8.4.5.1. The Notifying Party's view

- (893) The Notifying Party submits that the merged entity will not have the ability or the incentive to foreclose rival providers of NICs through restricting or degrading the certified interoperability between these rival NICs and VMware's server virtualization software. Moreover, the Notifying Party submits that such foreclosure strategy would have no impact on effective competition in the worldwide market for NICs.

8.4.5.1.1. Ability to foreclose

- (894) As explained in more detail in Section 8.4.3.1.1., the Notifying Party submits that the merged entity will lack the ability to foreclose competing hardware providers by degrading the interoperability of their hardware with VMware's virtualization software. This is based on the following arguments.
- (895) First, the Notifying Party submits that the merged entity will not have the market power to pursue such a foreclosure strategy, pointing at VMware's market share on the overall market for server virtualization software and competitive constraints emanating from other virtualization software providers, CSPs, and containerization providers.¹⁰⁰⁶
- (896) Second, the Notifying Party submits that the merged entity will not be able to technically engage in foreclosure. The merged entity would not be able to selectively target those customers who would be less likely to migrate workloads to alternative server virtualization software providers, thereby rendering any putative foreclosure unsuccessful.¹⁰⁰⁷ Furthermore, the Notifying Party submits that the value proposition of virtualization software and its commercial viability is inherently linked the software's compatibility with as much hardware as possible.¹⁰⁰⁸

8.4.5.1.2. Incentive to foreclose

- (897) As explained in more detail in Section 8.4.3.1.2., the Notifying Party submits that the merged entity will also lack the incentive to foreclose competing hardware providers by degrading the interoperability of their hardware with VMware's virtualization software. In brief, this is based on the following arguments.
- (898) First, the Notifying Party submits that foreclosure would undermine VMware's neutrality and stepping away from this policy would risk reputational damage.¹⁰⁰⁹
- (899) Second, according to the Notifying Party's analysis, a foreclosure strategy would only be profitable if more than [Business secret – Margins calculations]% of VMware server virtualization software customers that do not currently use Broadcom NICs switched to Broadcom NICs. The Notifying Party submits that such significant switching is highly unlikely and that any foreclosure strategy would therefore not be profitable.¹⁰¹⁰
- (900) Third, according to the Notifying Party, VMware's past ownership supports the lack of foreclosure strategy.¹⁰¹¹

¹⁰⁰⁶ Form CO, paragraphs 724-730.

¹⁰⁰⁷ Form CO, paragraphs 736-739.

¹⁰⁰⁸ Article 6(1)(c) Response, paragraph 149. .

¹⁰⁰⁹ Form CO, paragraphs 740-749.

¹⁰¹⁰ Form CO, paragraphs 752-762; Article 6(1)(c) Response, paragraphs 234-241.

¹⁰¹¹ Form CO, paragraphs 769-770.

- (901) Fourth, the Notifying Party submits that customers have countervailing buyer power. Broadcom's top ten NICs customers account for [Business strategy – Customers lists]% of Broadcom's total sales. In short, if Broadcom were to foreclose, the Notifying Party submits that OEMs would switch to alternative suppliers or produce more in-house, and end-customers would switch to alternative server virtualization software or migrate away from on-premises or private cloud workloads altogether.¹⁰¹²
- (902) Finally, the Notifying Party believes that Broadcom's rivals would retaliate when faced with foreclosure. The Notifying Party refers, in particular, to [Business secret sales policy and strategy] on whom VMware depends because [Business secret - sales policy and strategy].¹⁰¹³ Similarly, [Business secret – business plans]. If VMware refused to certify [Business secret – business plans] products on VMware – or degrade their interoperability – said companies could retaliate by terminating or degrading their technical support for VMware.¹⁰¹⁴

8.4.5.1.3. Impact on effective competition

- (903) The Notifying Party submits that, even if the merged entity had both the ability and incentive to foreclose rival NICs vendors by degrading the interoperability of their products with VMware, there would be no significant impediment to effective competition.
- (904) First, the Notifying Party submits that Broadcom **does not have a significant degree of market power** in the market for NICs. According to the Notifying Party, rival NICs vendors would have ample opportunities to sell their products for servers that do not use VMware. These include servers without hypervisors and servers with other hypervisors, both on-premises, off-premises, and in the public cloud.¹⁰¹⁵ In its Article 6(1)(c) Response, the Notifying Party submits that at least [90-100]% of the available demand for NICs would be unaffected by the foreclosure strategy.¹⁰¹⁶
- (905) Further, as explained in more detail in Section 8.4.3.1.3. above, the Notifying Party considers that any putative degradation of interoperability would not deprive rival hardware vendors that compete with Broadcom of “*minimum viable scale*”.¹⁰¹⁷
- (906) Finally, the Notifying Party submits that VMware is profit-maximizing at pre-merger prices and any increase in the price, reduction in the quality of, or reduction in innovation related to the hardware products when used with VMware would reduce the appeal of VMware relative to the alternatives. This would trigger switching away from VMware as customers would continue using their preferred hardware component, which in turn would reduce the addressable market that could be foreclosed.¹⁰¹⁸

¹⁰¹² Form CO, paragraphs: 774-782; Article 6(1)(c), paragraphs 271-274.

¹⁰¹³ Form CO, paragraphs 783 and 784.

¹⁰¹⁴ Form CO, paragraph 785; Article 6(1)(c) Response, paragraph 260.

¹⁰¹⁵ Form CO, paragraph 787.

¹⁰¹⁶ Article 6(1)(c) Response, paragraph 281.

¹⁰¹⁷ Article 6(1)(c) Response, paragraph 278.

¹⁰¹⁸ Article 6(1)(c) Response, paragraph 279.

8.4.5.2. The Commission's assessment

8.4.5.2.1. Ability to foreclose

- (907) The Commission considers that, post-Transaction, the merged entity would **have the ability** to foreclose rival providers of NICs by restricting or degrading interoperability of rival NICs with VMware's server virtualization software.
- (908) The Commission's assessment of the merged entity's ability to foreclose rival providers of NICs as a result of the conglomerate relationship between VMware's activities in the worldwide market for server virtualization software in the on-premises and private cloud environment and Broadcom's activities in the NICs market runs parallel to its assessment of the relationship with Broadcom's activities in the worldwide market for FC HBAs in a number of ways.
- (909) First, certified interoperability with VMware's hypervisor is equally important and necessary for NICs as it is for FC HBAs (see Sections 6.3. and 8.4.3.2.1.1. above).
- (910) Second, VMware has a significant degree of market power on the worldwide market for server virtualization software in an on-premises and private cloud environment (see Section 8.4.3.2.1.2. above).
- (911) Third, the merged entity has the ability to engage in partial foreclosure by delaying or degrading certified interoperability between Broadcom's rivals in NICs and VMware's server virtualization software (see Section 8.4.3.2.1.3. above).
- (912) Fourth, Broadcom's NICs are not able to deploy effective and timely counterstrategies, as they do not own any server virtualization software solutions, would not be able to sponsor the entry of new suppliers in the market for server virtualization software, and would continue to be heavily reliant on VMware's software even if they were to combine their NICs with other server virtualization software provider's products (see Section 8.4.3.2.1.4. above).
- (913) In light of the foregoing, the Commission finds that the merged entity would have the ability to foreclose competing suppliers of NICs by degrading the certified interoperability between these rival hardware products and VMware's server virtualization software in the on-premises and private cloud environment.

8.4.5.2.2. Incentive to foreclose

- (914) The Commission considers that, post-Transaction, the merged entity would **not have the incentive** to foreclose rival providers of NICs by restricting or degrading interoperability of rival NICs with VMware's server virtualization software.
- (915) The Commission's assessment of the merged entity's incentive to foreclose rival providers of NICs as a result of the conglomerate relationship between VMware's activities in the worldwide market for server virtualization software in the on-premises and private cloud environment and Broadcom's activities in the NICs market runs parallel to its assessment of the relationship with Broadcom's activities in the worldwide market for FC HBAs in a number of ways.
- (916) First, in order to assess whether the merged entity would have the incentive to engage in the partial foreclosure strategies set out above in Sections 8.4.3.2.1.3. and 8.4.5.2.1, the Commission has assessed the critical switching rate implied by a standard static "vertical arithmetic" as proposed by the Notifying Party, which concluded that the foreclosure strategy would be profitable if at least [Business secret – margins calculations]% of VMware server virtualization software customers that do not currently use Broadcom NICs switched to Broadcom NICs. Despite the high

critical switching rate, the Commission considers that further elements need to be taken into account to determine whether actual switching would exceed the rate presented by the vertical arithmetic (as explained above in Section 8.4.3.3.2.). A high critical switching rate is not in itself suggestive that there will be no incentive to foreclose.¹⁰¹⁹

- (917) Second, VMware's past ownership by EMC and Dell provides no guarantee about Broadcom's conduct (see Section 8.4.3.2.2.3.5. above).
- (918) However, **certain market dynamics specific to NICs lead to different conclusions** as to the merged entity's incentive to engage in foreclosure by delaying or degrading the certified interoperability between rival NICs and VMware's server virtualization software.
- (919) In the NICs market, Broadcom faces competition from several important players, including Intel, AMD and NVIDIA. Contrary to Broadcom, these companies also sell and manufacture CPUs and GPUs, two central server components that are critical for VMware's viability.
- (920) With regard to CPUs, the vast majority of vSphere deployments run on Intel's and AMD's x86 CPUs, which account for approximately 95% of all server CPUs.¹⁰²⁰ [Business secret – business plans].¹⁰²¹
- (921) With regard to GPUs, [Business secret – business plans].¹⁰²²
- (922) In light of Intel and AMD's 95% share in server CPUs and [Business secret – business plans], VMware is entirely dependent on these companies for interoperability of its software and CPUs and [Business secret – business plans] in servers. In the event the merged entity would attempt or threat to degrade interoperability between VMware's software and Intel and AMD's NICs, these vendors could retaliate by terminating or degrading their technical support of VMware's server virtualization software. Without Intel and AMD's collaboration, VMware would be at a serious disadvantage compared to competing virtualization software providers that continue to benefit from Intel and AMD's support. The merged entity would risk customer satisfaction if VMware customers were not able to take advantage of Intel's and AMD's hardware.
- (923) In a similar way, if Broadcom refused to certify a NIC from [Business secret – business plans] for interoperability with VMware's server virtualization software, [Business secret – business plans].
- (924) As a result, the importance of ensuring interoperability with Intel's and AMD's CPUs, as well as with [Business secret – business plans], would eliminate all incentives by the merged entity to degrade interoperability with VMware's server virtualization software at the expense of these vendors. The Commission considers that Broadcom's rivals would likely retaliate against threats to their products and more generally to the x86 ecosystem, thus also providing protection to the smaller competitors in the market.
- (925) Therefore, the Commission considers that, post-Transaction, the merged entity would not have the incentive to engage in a foreclosure strategy *vis-à-vis* NICs suppliers.

¹⁰¹⁹ See Section 8.4.3.2.2.1.

¹⁰²⁰ Commission decision of 19 December 2019 in case M.9424 – *NVIDIA/Mellanox*, paragraph 234.

¹⁰²¹ AMD's non-confidential reply to RFI 1, question 11 [ID 3889].

¹⁰²² Commission decision of 19 December 2019 in case M.9424 – *NVIDIA/Mellanox*, paragraph 143.

8.4.5.2.3. Impact on effective competition

- (926) As set out above in Section 8.4.3.2.3., the Non-Horizontal Merger Guidelines set out that bundling or tying may result in a significant reduction of sales prospects faced by single-component rivals in the market. The reduction in sales by competitors is not in and of itself a problem. Yet, in particular industries, if this reduction is significant enough, it may lead to a reduction in rivals' ability or incentive to compete. This may allow the merged entity to subsequently acquire market power (in the market for the tied or bundled good) and/or to maintain market power (in the market for the tying or leveraging good).¹⁰²³ Furthermore, according to the Non-Horizontal Merger Guidelines, it is only when a sufficiently large fraction of market output is affected by foreclosure resulting from the merger that the merger may significantly impede effective competition.¹⁰²⁴
- (927) In assessing Broadcom's market power in the worldwide market for NICs, the Commission has considered Broadcom's market position based on market shares, internal documents and the results of the market investigation.
- (928) As set out in **Table 26**, the worldwide market for NICs is fragmented. In 2022, Broadcom held a share of [10-20]% in NICs sales. Broadcom faces competition in this market from several strong players, including NVIDIA (with a market share of [40-50]%) and Intel (with a market share of [30-40]%).

Table 26: Ethernet NICs (worldwide, by revenue)

	2020		2021		2022	
	Revenue (USD M)	Share (%)	Revenue (USD M)	Share (%)	Revenue (USD M)	Share (%)
Broadcom	[...]	[5-10]	[...]	[10-20]	[...]	[10-20]
Intel	[...]	[40-50]	[...]	[30-40]	[...]	[20-30]
NVIDIA	[...]	[30-40]	[...]	[40-50]	[...]	[50-60]
Cisco	[...]	[0-5]	[...]	[0-5]	[...]	[0-5]
Marvell	[...]	[0-5]	[...]	[0-5]	[...]	[0-5]
AMD	[...]	[0-5]	[...]	[0-5]	[...]	[0-5]
Chelsio	[...]	[0-5]	[...]	[0-5]	[...]	[0-5]
Myricom	[...]	[0-5]	[...]	[0-5]	[...]	[0-5]
Other	[...]	[0-5]	[...]	[0-5]	[...]	[0-5]
Total	[...]	100	[...]	100	[...]	100

Source: Form CO, Table 66; Parties' Response to RFI 31

- (929) Based on Broadcom's limited market share and the presence of important competitors in the NICs market, the Commission therefore concludes that Broadcom has no dominant or strong position in the market for NICs.

¹⁰²³ Non-Horizontal Guidelines, paragraph 111.

¹⁰²⁴ Non-Horizontal Guidelines, paragraph 113.

- (930) Therefore, the Commission considers that a foreclosure strategy against Broadcom's rival providers of NICs is not likely to have a significant impact on competition in the worldwide market for NICs by reducing the ability of NICs rivals to compete.

8.4.5.2.4. Conclusion

- (931) In light of the above, the Commission concludes that the Transaction does not result in a significant impediment of effective competition on the worldwide market for NICs as a result of the foreclosure by the merged entity of rival providers of NICs by restricting or degrading interoperability of NICs with VMware's server virtualization software.

8.4.6. *Foreclosure of suppliers of SmartNICs by delaying or hindering the development of SmartNICs through Project Monterey*

- (932) Project Monterey is VMware's plan to build a version of its virtualization software hypervisor (ESXi) that runs on SmartNICs. SmartNICs (also sometimes referred to as "DPUs" or "IPUs") are designed to be more efficient at running certain processing tasks, such as networking, security and storage. This reduces the burden on the server CPU, allowing it to focus on running applications. Project Monterey has been developed in collaboration with three SmartNICs vendors: NVIDIA, Intel and AMD Pensando, with the aim to increase the efficiency of VMware's virtualization software by leveraging the additional hardware processing capabilities in SmartNICs.
- (933) Broadcom has legacy sales of SmartNICs, a business which it terminated in 2021.
- (934) The Commission has sought to assess whether the Transaction could lead to a hampering of innovation resulting from the merged entity delaying or hindering the development of SmartNICs through Project Monterey.
- (935) Respondents to the market investigation have expressed concerns that the merged entity's incentives to engage in Project Monterey could change post-Transaction.¹⁰²⁵
- (936) In its investigation, the Commission has sought to assess whether the merged entity could have an interest to block the development of SmartNICs by other providers. This could be achieved in one of the following scenarios (or a combination of them): (i) re-entering into the SmartNICs market and recapturing diverted sales from SmartNICs competitors, (ii) preventing the migration from NICs to SmartNICs to protect Broadcom's position in the NICs market, as SmartNICs may be a competitive threat for Broadcom's NICs business, and/or (iii) encouraging customers to use Broadcom's Smart Top of Rack ("ToR") product StrataXGS® Trident SmartToR¹⁰²⁶ instead of SmartNICs.

8.4.6.1. The Notifying Party's view

8.4.6.1.1. Ability to foreclose

- (937) The Notifying Party submits that Broadcom exited the SmartNIC business in 2021 after concluding that [Business secret – strategic decisions]. According to the Notifying Party, Broadcom also has no [Business secret – strategic decisions] given its decision to [Business secret – strategic decisions]. As a result, the Notifying Party argues that post-Transaction, Project Monterey will not provide Broadcom with the ability or incentive to re-enter SmartNIC production and exploit any information or

¹⁰²⁵ Replies to Q3 – questionnaire to competitors of Broadcom, question 41.1.

¹⁰²⁶ See Broadcom, "Trident SmartToR". Available at: <https://www.broadcom.com/products/ethernet-connectivity/switching/strataxgs/smarttor>.

expertise acquired by VMware from its collaboration with Project Monterey participants. In addition, the Notifying Party notes that SmartNIC vendors will have gained a significant head start that will be hard for Broadcom to overcome.¹⁰²⁷

- (938) The Notifying Party further submits that Project Monterey is not critical for the use or success of SmartNICs, which were first developed by CSPs for use in the public cloud and can also be used in the datacentre (mainly on bare-metal servers).¹⁰²⁸
- (939) In addition, the Notifying Party notes that other hypervisor providers are working on projects similar to Project Monterey to enable the optimisation of SmartNICs.¹⁰²⁹

8.4.6.1.2. Incentive to foreclose

- (940) The Notifying Party submits that the merged entity would have no incentive to foreclose SmartNICs providers in the context of Project Monterey for the following reasons.
- (941) First, the Notifying Party notes that the aim of Project Monterey is to increase VMware's competitiveness with public cloud providers and offer new business opportunities to sell additional VMware software for use with a SmartNIC to customers with bare metal or non-VMware virtualized servers. As such, degrading Project Monterey would put VMware at a competitive disadvantage and remove the business opportunity for VMware to deploy on bare-metal servers via SmartNICs.¹⁰³⁰
- (942) Second, the Notifying Party submits that a strategy seeking to foreclose SmartNICs providers in order to protect Broadcom's NICs business would not be profitable since SmartNICs and NICs are not close substitutes in terms of features, complexity and price, and Broadcom only accounts for [10-20]% of the NICs market.¹⁰³¹ In addition, the Notifying Party has submitted that VMware's projected additional margins for customers using vSphere together with SmartNICs would be at least USD [Business secret – margin calculation] per server. These margins would be driven by licensing VMware for bare metal servers, upselling server virtualization software, and cross-selling network virtualization software.¹⁰³² As such, the Project Monterey-induced margins lost by VMware would vastly exceed any margins Broadcom could earn on sales of additional NICs.¹⁰³³
- (943) Third, the Notifying Party considers that Broadcom's activities in SmartTOR switching chips would not give the merged entity the incentive to foreclose SmartNIC providers because SmartTOR switches are not substitutable with SmartNICs as they operate at different network layers and have fundamentally different capabilities. In particular, Broadcom's SmartTOR switching chips do not interoperate with VMware's virtualization software.¹⁰³⁴

¹⁰²⁷ Form CO, paragraph 709.

¹⁰²⁸ Article 6(1)(c) Response, paragraphs 305-308.

¹⁰²⁹ Article 6(1)(c) Response, paragraph 306.

¹⁰³⁰ Article 6(1)(c) Response, paragraph 289.

¹⁰³¹ Article 6(1)(c) Response, paragraph 318 and 323.

¹⁰³² Article 6(1)(c) Response, paragraph 322.

¹⁰³³ The Notifying Party submits that the incremental margin for Broadcom's NICs is – on average – USD [Business secret – margins calculations], which would only be recouped in a limited number of cases and entirely lost where the customer chooses a competing NIC.

¹⁰³⁴ Article 6(1)(c) Response, paragraphs 326-330.

8.4.6.1.3. Impact on effective competition

- (944) According to the Notifying Party, terminating or degrading Project Monterey cannot prevent SmartNICs from expanding across the vast majority of servers worldwide.¹⁰³⁵ The Notifying Party submits that there are significant alternative use cases for SmartNICs that are not dependent on VMware, including in the cloud and on non-VMware virtualized servers, as well as on bare metal servers.¹⁰³⁶ The Notifying Party points out that Project Monterey is [Business secret – know-how: discussion of business and product strategy]. Within a vSphere environment, Project Monterey [Business secret – know-how: discussion of business and product strategy].¹⁰³⁷
- (945) Therefore, the Notifying Party considers that the Transaction will not have an impact on effective competition in the market for SmartNICs.

8.4.6.2. The Commission's assessment

8.4.6.2.1. Ability to foreclose

- (946) For the reasons set out below, and based on the results of the market investigation, the Commission has reached the conclusion that the merged entity would likely have the ability to engage in a foreclosure strategy *vis-à-vis* SmartNICs suppliers by delaying or hindering the development of SmartNICs through Project Monterey.
- (947) First, as explained above in Section 8.4.3.2.1.2., for the purposes of this Decision, the Commission considers that VMware holds a significant degree of market power on the market for server virtualization software for on-premises and private cloud environments.
- (948) Second, the Commission considers that the merged entity has the technical ability to block the development of SmartNICs through Project Monterey:
- (a) VMware currently employs [Business secret – production secrets and processes] people involved in Project Monterey.¹⁰³⁸ This includes [Business secret – production secrets and processes] VMware employees who commit more than [Business secret – production secrets and processes] of their time to the project [Business secret – production secrets and processes]. In addition, VMware has [Business secret – production secrets and processes] who commit between [Business secret – production secrets and processes] of their time to Project Monterey. As such, VMware provides the necessary resources for the design, development and implementation of the project.
 - (b) VMware has contributed [Business secret – strategic decisions] to the project since its launch in 2020, which represents approximately [Business secret – strategic decisions] of the total contributions to Project Monterey. In 2022, VMware has invested [Business secret – strategic decisions] in the project, while its three partners (NVIDIA, Intel and AMD Pensando) have together contributed [Business secret – strategic decisions]. VMware's contribution in 2022 amounts to [Business secret – strategic decisions] of the total amount invested in the project that year ([Business secret – strategic decisions]).¹⁰³⁹

¹⁰³⁵ Article 6(1)(c) Response, paragraph 332.

¹⁰³⁶ Article 6(1)(c) Response, paragraph 335.

¹⁰³⁷ Article 6(1)(c) Response, paragraph 307.

¹⁰³⁸ Parties' reply to RFI 7, question 2.b).

¹⁰³⁹ Parties' reply to RFI 7, question 2.a).

- (c) VMware's involvement in Project Monterey is critical to its success. This is confirmed by respondents to the Commission's market investigation who explained that VMware's continued support on this project was essential to enable the adoption of SmartNICs in the enterprise and multi-cloud environments.¹⁰⁴⁰ While one of the SmartNICs suppliers could step out or be replaced by another SmartNIC provider without jeopardising the success of the project, the same cannot be said of VMware, since it plays a central role and provides the engineering resources required for the project. One respondent to the Commission's market investigation also explained that VMware's support is critical to be able to develop effective SmartNICs, to enable the introduction of additional features in the next versions of its SmartNICs (such as security and storage), to ensure compatibility with future versions of the OS/hypervisor, and to access the customer base.¹⁰⁴¹
- (949) Third, compatibility with VMware's hypervisor is a critical feature for hardware manufacturers of SmartNICs.¹⁰⁴² VMware's internal documents [Details on internal document describing VMware's market positioning].¹⁰⁴³ Respondents to the Commission's market investigation confirmed that Project Monterey is important for the development of SmartNICs for use on-premises and could not be replicated by a similar cooperation between SmartNICs provider and another server OS/hypervisor, e.g., Microsoft or Red Hat.¹⁰⁴⁴ Such cooperation would only be complementary to Project Monterey and address another set of use cases for SmartNICs, but would not replace the on-premises use cases where VMware is particularly important and widely used by end-customers.
- 8.4.6.2.2. Incentive to foreclose
- (950) The Commission considers that, post-Transaction, the merged entity would not have the incentive to engage in a foreclosure strategy *vis-à-vis* SmartNICs suppliers.
- (951) As indicated above, the Commission has considered whether the merged entity would have an incentive to foreclose SmartNICs competitors in one of the following scenarios (or a combination of them): (i) re-entering into the SmartNICs market and recapturing diverted sales from SmartNICs competitors, (ii) preventing the migration from NICs to SmartNICs to protect Broadcom's position in the NICs market, and/or (iii) encouraging customers to use SmartTOR switches instead of SmartNICs.
- (952) With regard to re-entry, Broadcom has provided evidence showing that it has effectively stopped the development of their SmartNICs in February 2021¹⁰⁴⁵ and [Business secret – strategic decisions].¹⁰⁴⁶ The Commission understands that [Business secret – strategic decisions].¹⁰⁴⁷ While some market respondents explained that Broadcom might be able to re-enter,¹⁰⁴⁸ the Commission considers that

¹⁰⁴⁰ Replies to Q3 – questionnaire to competitors of Broadcom, question 41.1; AMD's non-confidential response to RFI 1, questions 3, 4 and 5 [ID 3889]

¹⁰⁴¹ NVIDIA's non-confidential reply to RFI 1, question 7 [ID 4006].

¹⁰⁴² NVIDIA's non-confidential reply to RFI 1, question 7 [ID 4006]; AMD's non-confidential reply to RFI 1, questions 2 and 5.b) [ID 3889].

¹⁰⁴³ Parties' RFI 7, Annex RFI 7 Q2.3, page 23.

¹⁰⁴⁴ NVIDIA's non-confidential reply to RFI 1, question 6 [ID 4006]; AMD's non-confidential reply to RFI 1, questions 5.b), 7 and 8 [ID 3889].

¹⁰⁴⁵ Parties' reply to RFI 5, question 1.

¹⁰⁴⁶ Parties' reply to RFI 5, question 4.

¹⁰⁴⁷ Parties' reply to RFI 5, question 3.c).

¹⁰⁴⁸ AMD's non-confidential response to RFI 1, question 10 [ID 3889].

circumstances have not changed materially since Broadcom's exit, and Broadcom would face the same challenges as before. Although Broadcom continues to be active in NICs, SmartNICs require different manufacturing capabilities, in relation to processors and software, which makes it a distinct product, and unlike Intel, Nvidia, and AMD – the largest SmartNIC manufacturers – Broadcom is not active in the processor (CPU) space. Broadcom also decided [Business secret – strategic decisions].¹⁰⁴⁹ Therefore, the Commission considers that the merged entity will not be able to re-enter the SmartNICs market and recapture diverted sales from SmartNIC competitors.

(953) With regard to protecting Broadcom's position in NICs, the Commission has sought to assess whether SmartNICs could replace NICs and reduce the sales of NICs so that foreclosing SmartNICs by withdrawing from Project Monterey would lead to increased sales of NICs. For the following reasons, and based on the results of the market investigation, the Commission considers that the merged entity would not have an incentive to foreclose SmartNICs suppliers in order to recapture sales in NICs:

- (a) First, SmartNICs, with their substantially greater functionality than NICs, are no substitute for NICs.¹⁰⁵⁰ One SmartNICs supplier explained that a customer wishing to replace SmartNICs with NICs would need to add not just NICs to perform the networking functionality, but also other computing capability (in the form of servers with CPUs and perhaps specialised processors), which would come at a great expense.¹⁰⁵¹ Because SmartNICs and NICs are not substitutes in terms of features, complexity and price, delaying or hindering the development of SmartNICs through Project Monterey would be unlikely to benefit Broadcom in any significant way by increasing its NICs sales.
- (b) Second, even if the merged entity could prevent migration from NICs to SmartNICs, it would recapture only a relatively [Business secret – know-how] share of the diverted sales since it only has a [10-20]% share in the worldwide NICs market where it faces effective competition from strong rivals in the NICs market (including Intel and NVIDIA, two of VMware's other partners in Project Monterey). Therefore, even if the hindering of Project Monterey were to result in increased sales of NICs, this would first and foremost increase sales of other NIC players with a larger market share, and not have a material impact on Broadcom's NICs business.
- (c) Third, the adoption of SmartNICs will allow the merged entity to generate additional margin through three use-cases: licensing VMware for bare metal servers, upselling server virtualization software, and cross-selling network virtualization software.¹⁰⁵² These additional margins induced by Project Monterey would vastly exceed any potential NICs margins Broadcom could gain through additional or retained NICs sales: while the Project Monterey-induced margins would amount to at least USD [Business secret – margin calculation] per server, the margin on Broadcom NICs per server stands only at USD [Business secret – margin calculation]. Since Broadcom only has a [10-20]% market share in NICs, this margin would only be recouped in a limited

¹⁰⁴⁹ Parties' reply to RFI 8, questions 31-34.

¹⁰⁵⁰ Intel's non-confidential reply to RFI 1, questions 2, 3 and 7 [ID 4258].

¹⁰⁵¹ Intel's non-confidential reply to RFI 1, question 3 [ID 4258].

¹⁰⁵² Article 6(1)(c) Response, paragraph 322.

number of cases and entirely lost where the customer chooses a competing NIC.

- (d) Fourth, VMware's partners in Project Monterey are important hardware players, including Intel and NVIDIA [Business secret - customers] (as explained in Section 8.4.5.2.2. above). As such, if the merged entity attempted or threatened to foreclose SmartNICs players, these players would likely retaliate against threats to their products by terminating their collaboration with Broadcom.

- (954) With regard to encouraging migration to SmartTOR switching chips, [Business secret – know how] there might be a degree of substitution between SmartNICs and SmartTOR switches. [Other confidential information] one Broadcom board document from December 2020 discusses that one of the paths for growth is [Business secret – details on internal documents describing product demand and usage patterns].¹⁰⁵³ [Business secret – details on internal documents describing product demand and usage patterns].¹⁰⁵⁴ Therefore, Broadcom could not immediately recapture any diverted sales from SmartNICs. In addition, the Commission considers that SmartTOR switches are not alternatives for SmartNICs as they operate at different network layers and have fundamentally different capabilities. In particular, Broadcom's SmartTOR switching chips do not interoperate with VMware's virtualization software, as it is technically impossible for these products to run virtualization software.¹⁰⁵⁵ Therefore, the Commission considers that the merged entity could not recapture diverted rival SmartNICs sales by selling more SmartTOR switching chips.

8.4.6.2.3. Impact on effective competition

- (955) Since the Commission has concluded, in Section 8.4.6.2.2. above, that the merged entity would not have the incentive to foreclose suppliers of SmartNICs by delaying or hindering the development of SmartNICs through Project Monterey, the question whether such a foreclosure strategy would have a detrimental effect on competition can be left open for the purposes of the present Decision.

8.4.6.2.4. Conclusion

- (956) In light of the above, the Commission concludes that the Transaction would not significantly impede effective competition on the market for SmartNICs .

8.4.7. *Bundling of VMware's virtualization software with Broadcom's software*

- (957) The Commission investigated a potential competition concern whereby Broadcom would start bundling VMware's virtualization software with Broadcom's (enterprise, security or mainframe) software and no longer offer VMware's virtualization software as a stand-alone product, thereby forcing customers to buy other (potentially unwanted) software in addition to VMware's software at a price higher than VMware's software on a stand-alone basis.
- (958) In the context of the Commission's market investigation, a number of market participants mentioned that, following the acquisition of CA Technologies by Broadcom¹⁰⁵⁶, Broadcom started offering bundles of the acquired software together

¹⁰⁵³ Form CO, CMA documents, [Business secret - Broadcom's internal documents].

¹⁰⁵⁴ [Business secret – know-how]. See Article 6(1)(c) Response, paragraph 329.

¹⁰⁵⁵ Article 6(1)(c) Response, paragraphs 326-330.

¹⁰⁵⁶ Commission decision of 12 October 2018 in case M.9054 – *Broadcom / CA*.

with other software at high prices, for a long duration and not offering customers the mainframe software as a stand-alone product. Given the alleged limited number of alternatives to CA Technologies mainframe software and the high switching costs, customers reported they had no choice but to accept the bundle.

- (959) These market participants expressed a concern that the same will happen following the VMware acquisition (*i.e.*, that VMware software will be bundled with other Broadcom software tools, namely the mainframe and security software obtained following the acquisitions of CA Technology and Symantec¹⁰⁵⁷ respectively).
- (960) The Commission has examined whether post-Transaction the merged entity would have the ability and incentive to engage in such a strategy, as well as the potential resulting detrimental effect on competition.

8.4.7.1. The Notifying Party's views

8.4.7.1.1. Ability to foreclose

- (961) As regards the potential commercial bundling of different types of software, the Notifying Party argues that the merged entity would not have the ability to engage in anti-competitive bundling because VMware will not have market power in the market for server virtualization software.¹⁰⁵⁸
- (962) Even if VMware had such market power, the Notifying Party submits that enterprises' IT departments purchase virtualization software whereas security software is typically purchased by enterprises' Chief Information Officers' department at different times (and are therefore not susceptible of bundling practices).¹⁰⁵⁹
- (963) The Notifying Party also submits that VMware's software cannot be used with mainframes which would mean there are no merger-specific opportunities to bundle mainframe tools.¹⁰⁶⁰ Moreover, there are strong alternative competitors to Broadcom's mainframe software, such as IBM or BMC and customers often use a combination of different vendors (*e.g.*, Broadcom's tool to monitor one mainframe system and IBM's tool to monitor another).¹⁰⁶¹
- (964) Further, the Notifying Party submits that all Broadcom's software products are available on a stand-alone basis (either pro-actively sold on a stand-alone basis or at the customer's request subject to certain requirements). Customers may also negotiate multi-year enterprise-software license agreements to cover a broader software [Business secret – sales policy and strategy] including an enterprise portfolio license agreement ("PLA") which [Business secret – sales policy and strategy].¹⁰⁶² As for VMware's products, these [Business secret – sales policy and strategy].¹⁰⁶³
- (965) Finally, the Notifying Party submits that any potential software bundle could easily be replicated by the Parties' rivals which have equally broader or even broader, portfolios. The Notifying Party submits rivals already provide such bundled offers:

¹⁰⁵⁷ Commission decision of 30 October 2019 in case M.9538 – *Broadcom / Symantec Enterprise Security Business*.

¹⁰⁵⁸ Form CO, paragraph 836.

¹⁰⁵⁹ Form CO, paragraph 836.

¹⁰⁶⁰ Form CO, paragraph 840.

¹⁰⁶¹ Form CO, paragraph 840.

¹⁰⁶² Form CO, paragraph 841.

¹⁰⁶³ Form CO, paragraphs 842 and 843.

e.g., Red Hat bundles virtualization software as part of a suite, including security and mainframe software; Microsoft provides a hypervisor, security software, and cloud devices (among other things) in bundles with its Windows OS; and large CSPs such as AWS, Google, and Microsoft provide the ability to deploy virtual machines across public and private clouds as part of tightly integrated bundles.¹⁰⁶⁴ The Notifying Party considers that the few rivals that do not have similarly broad portfolios can also team up with other companies to make joint offerings.¹⁰⁶⁵

- (966) In its Article 6(1)(c) Response, the Notifying Party further argues that the merged entity will not have a significant degree of market power in the narrow market for server virtualization software in the on-premises and private cloud environment. The Notifying Party invokes the Commission’s findings in *Dell/EMC*, as well as (i) VMware’s [Business secret - financial situation of the company] share, (ii) the significant increase in competition from virtualization since *Dell/EMC* both with on-premises suppliers and private cloud suppliers, as well as with public cloud providers who are equally, if not better placed, than VMware to support customers’ hybrid/multi-cloud strategies, (iii) VMware’s pre-existing ordinary course documents that demonstrate customers’ increasing practice to use several virtualization software providers in parallel and multi-home their workloads across different deployment environments, and (iv) the many recent example of customers switching to rival solutions.¹⁰⁶⁶
- (967) The Notifying Party also considers that Broadcom’s mainframe software is not “closely related” to VMware’s virtualization software and that the Commission has previously dismissed concerns about tying Broadcom’s mainframe and security software due to lack of complementarity¹⁰⁶⁷.
- (968) Further, the Notifying Party argues that the products are not susceptible of bundling practices because: (i) mainframe software and server virtualization software are [Business secret – sales policy] within a customer organization, or on the same [Business secret – know how]; (ii) similarly, security software and server virtualization software are typically [Business secret – sales policy] within a customer organization, or on the same timetables because VMware’s server virtualization software runs on datacentres that can be located either on-premises or in a private or public cloud, whereas Broadcom’s Symantec security software is not designed to protect cloud end-points or workloads running in a cloud environment, is not sold for use with virtualization software on individual servers, but is instead used on employee devices, in specialized network appliances, and in IT management to protect the network as a whole¹⁰⁶⁸.
- (969) Finally, according to the Notifying Party, Broadcom’s rivals in the mainframe software segment (IBM and BMC) do not depend on VMware or its virtualization software to sell their products. With respect to Broadcom’s security software, VMware’s experience serves as an indication that demand for bundles of the Parties’ software is likely to be [Business secret – know-how]: VMware already offers enterprise security software – Carbon Black – yet it never bundled it with vSphere as it has no ability and incentive thereto since Carbon Black and vSphere are seldom purchased together (only [Business secret – quantities sold] out of [Business secret –

¹⁰⁶⁴ Form CO, paragraphs 845, 846 and 860.

¹⁰⁶⁵ Form CO, paragraph 849.

¹⁰⁶⁶ Article 6(1)(c) Response, paragraphs 345 and section III.B.

¹⁰⁶⁷ Article 6(1)(c) Response, paragraphs 347-348.

¹⁰⁶⁸ Article 6(1)(c) Response, paragraphs 349, 352.

quantities sold] purchase orders placed with VMware in FY2022 included both these products).¹⁰⁶⁹

8.4.7.1.2. Incentive to foreclose

- (970) The Notifying Party submits that Broadcom would lack the incentive to create anticompetitive bundles. This is because few customers are likely to switch to any Broadcom software bundle as they prefer to mix and match and would select their preferred products from one of Broadcom’s numerous software rivals.¹⁰⁷⁰
- (971) Moreover, the Notifying Party submits that VMware has never bundled its virtualization software with Carbon Black (VMware’s endpoint security software) which suggests the bundling would be unattractive to consumers.¹⁰⁷¹
- (972) The Notifying Party also submits that the incentive to bundle VMware’s software with Broadcom’s software is reduced by VMware’s comparatively [Business secret – margin calculations].¹⁰⁷²
- (973) Finally, the Notifying Party submits that any potential software bundle could easily be replicated by large software players and intermediate customers such as server OEMs and system integrators could purchase the bundles and unpick it by selling components to their end users separately.¹⁰⁷³
- (974) In its Article 6(1)(c) Response, the Notifying Party further submits that Broadcom’s past commercial practice shows that Broadcom has not engaged in anticompetitive software-to-software bundling and all of Broadcom’s products offered [Business secret – sales policy and strategy].¹⁰⁷⁴
- (975) Moreover, the Notifying Party considers that Broadcom’s portfolio license agreements (“PLAs”) are not bundles in an economic sense, but purely a means of increasing administrative efficiency and driving greater value for customers. According to the Notifying Party, unlike bundles, PLAs [Business secret – sales policy and strategy].¹⁰⁷⁵
- (976) Furthermore, the Notifying Party submits that Broadcom uses PLAs to better compete with similar offerings from rivals, including CSPs. Broadcom’s PLAs cannot foreclose—and have not foreclosed—rivals, as evidenced by the fact that Broadcom does not have market power in any software segment covered by PLAs. There are no IDC functional markets or sub-segments where Broadcom’s software share exceeds 30%. The only software segments where Broadcom’s share exceeds 30% are Gartner’s (i) ITOM Mainframe Tools and (ii) AD (“Application Development”) Mainframe Tools sub-segments, which are not covered in PLAs¹⁰⁷⁶.
- (977) Finally, the Notifying Party submits that the Transaction will not result in a merger specific incentive to engage in anticompetitive bundling for the following reasons: (i) the Transaction will not change the incentive to bundle server virtualization and security software since there is no reason to believe that Broadcom’s security software would be more suitable for bundling with vSphere than VMware’s own

¹⁰⁶⁹ Article 6(1)(c) Response, paragraphs 351, 353.

¹⁰⁷⁰ Form CO, paragraphs 852 and 853.

¹⁰⁷¹ Form CO, paragraph 854.

¹⁰⁷² Form CO, paragraph 855.

¹⁰⁷³ Form CO, paragraph 857.

¹⁰⁷⁴ Article 6(1)(c) Response, paragraphs 356-359.

¹⁰⁷⁵ Article 6(1)(c) Response, paragraphs 360-362.

¹⁰⁷⁶ Article 6(1)(c) Response, paragraph 363.

Carbon Black (which was not bundled with vSphere); (ii) Broadcom's mainframe software is less susceptible to bundling with VMware's server virtualization software than VMware's other software products as VMware's virtualization software cannot be used with mainframes; (iii) any potential bundle is unlikely to be profitable; (iv) any potential bundle can readily be replicated by rivals and, in addition, intermediate customers such as server OEMs and system integrators can purchase the bundle and unpick it by selling the components (including VMware licenses) to their end users separately or even buy from single software providers and replicate the bundle¹⁰⁷⁷.

8.4.7.1.3. Impact on effective competition

- (978) The Notifying Party submits that even if Broadcom were to engage in a bundling strategy, there would be no impact on effective competition. This is because VMware's virtualization rivals already bundle their offerings.¹⁰⁷⁸ Smaller vendors can continue to provide their software as part of a suite – combined by system integrators with other software in a single offering or made available for use on a public cloud.¹⁰⁷⁹
- (979) In its Article 6(1)(c) Response, the Notifying Party further submits that the test for exclusionary effects is whether the merged entity's bundling practice will be able to anticompetitively foreclose rivals from a "large fraction" of the respective market, which is not met in the present case. According to the Notifying Party, the Parties' main competitors supply a wide range of software products enabling them to readily replicate any hypothetical software bundle the merged entity could offer post-Transaction, with their own key software offering, thus constituting intense competition for the merged entity. Further, according to the Notifying Party, the few rivals that do not have similarly broad portfolios can team up with other companies to replicate the merged entity's putative bundled offering by making joint offerings.¹⁰⁸⁰
- (980) Moreover, the Notifying Party argues that any putative exclusionary effects would only occur if the merged entity were able to induce a rival's exit by charging an effective price below the rival's unit costs for the bundled security software or mainframe software products in the long run. But software vendors typically have low marginal and variable costs. Hence, any price decrease would be procompetitive and could likely be matched without causing the exit of rivals¹⁰⁸¹.
- (981) Finally, according to the Notifying Party, not only are the potential foreclosure effects unlikely, but putative bundles offered by the merged entity would only increase bundle-to-bundle competition, thereby benefiting customers.¹⁰⁸²

8.4.7.2. The Commission's assessment

- (982) For the reasons set out below and based on the results of the market investigation, the Commission considers, for the purposes of the present Decision, that the merged entity would not have the ability to bundle virtualization software with Broadcom's (enterprise, security or mainframe) software. Therefore, for the purposes of the present Decision, the Commission considers that the question whether the merged

¹⁰⁷⁷ Article 6(1)(c) Response, paragraphs 364-366.

¹⁰⁷⁸ Form CO, paragraph 860.

¹⁰⁷⁹ Form CO, paragraph 861.

¹⁰⁸⁰ Article 6(1)(c) Response, paragraphs 367-372.

¹⁰⁸¹ Article 6(1)(c) Response, paragraph 373.

¹⁰⁸² Article 6(1)(c) Response, paragraph 374.

entity would have the incentive to foreclose competitors by bundling VMware's virtualization software with Broadcom's (enterprise, security or mainframe) software and whether there would likely be a significant detrimental effect on competition on the targeted software markets (enterprise, security or mainframe software) as a result, are not relevant and can be left open.

8.4.7.2.1. Ability to foreclose

- (983) For the reasons set out below, the Commission considers that the merged entity would not have the ability to engage in a strategy of bundling VMware's server virtualization software with Broadcom's software.
- (984) As mentioned above in Section 8.4.3.2.1.2., for the purposes of this Decision, the Commission considers that VMware holds a significant degree of market power on the market for server virtualization software in the on-premises and private cloud environment.
- (985) Further, several respondents to the market investigation voiced a concern that the merged entity would bundle VMware's virtualization software with Broadcom's software.¹⁰⁸³ The results of the market investigation revealed that for the vast majority of customers (intermediaries and end-customers) that expressed an opinion, even though list prices are made available by their virtualization software providers, there are bilateral customer-specific negotiations (where customers often get specific discounts on top of these list prices).¹⁰⁸⁴ Even if the discount is negotiated between VMware and a reseller, the merged entity may have access to information regarding its end-customer which would allow the merged entity to target such a potential bundle strategy towards customers having mainly workloads on-premises, or on-premises and in the private cloud, or customers that purchase the VMware virtualization software specifically to be used on-premises or in an on-premise and private cloud setting.
- (986) However, the Commission notes that respondents concerned about potential bundling did not set out concretely which specific Broadcom software (enterprise, security or mainframe) would be at risk of being bundled with VMware's virtualization software. In fact, some of the concerns expressed are not necessarily merger-specific: they appear to be related to Broadcom's past aggressive business practices described in Section 8.4.3.2.2.5. above.
- (987) Based on its investigation, the Commission found that VMware's virtualization software and Broadcom's (enterprise, mainframe or security) software do not appear to be complementary and are purchased by different divisions in a customer organization and / or at different points in time. The majority of respondents that expressed a view in the market investigation indicated that they tend to purchase their virtualization software and other software (such as mainframe or cybersecurity software) separately (*i.e.*, at different points in time).¹⁰⁸⁵ One respondent explained that *"software is purchased at various times throughout the year as required by the business or as certain lifecycle dates from the vendors are reached"*.¹⁰⁸⁶ The majority of the members of an association confirmed that *"in their scope, currently the*

¹⁰⁸³ Replies to Q3 – questionnaire to competitors of Broadcom, question 41.1, replies to Q4 – customers of Broadcom and VMware, questions 41.1.

¹⁰⁸⁴ Replies to Q4 – customers of Broadcom and VMware, question 35.

¹⁰⁸⁵ Replies to Q4 – questionnaire to customers of Broadcom and VMware, question 37.

¹⁰⁸⁶ Reply to Q4 – questionnaire to customers of Broadcom and VMware, question 37.1. [ID: E.ON]

*virtualization software like VMware/Nutanix hasn't any link/interaction with other Broadcom's (enterprise, mainframe and/or security) software products".*¹⁰⁸⁷

- (988) The different purchasing patterns of virtualization software on the one hand, and for each of mainframe software, security software and enterprise software on the other hand, are explained in more detail below.
- (989) **Virtualization software** is typically purchased by enterprises' IT departments, with the procurement and legal functions involved in contract negotiations and the Chief Security Officer ("CSO") involved in the data privacy and security aspects of the actual contract.¹⁰⁸⁸
- (990) VMware's virtualization software is primarily sold through VMware's [Business secret – sales policy]. These [Business secret – sales policy] offer customers mix and-match solutions integrating products and functionality from different vendors.¹⁰⁸⁹
- (991) VMware's virtualization software is licensed, on average, for [Business secret – sales policy and strategy] years, including [Business secret – sales policy and strategy].¹⁰⁹⁰
- (992) **Mainframe software** is typically purchased by a centralized procurement office or specialized mainframe software specialists, such as Head of Mainframe, Mainframe Manager, Mainframe Technology Officer or Mainframe Director. Although these are typically part of the IT department and report to the Chief Technology Officer, they are typically not involved in the selection of a virtualization software provider.¹⁰⁹¹
- (993) Around [Business secret – quantities sold]% of Broadcom's mainframe software revenue is generated through [Business secret – sales policy] sales with the remaining [Business secret – quantities sold]% of revenues generated [Business secret – sales policy].
- (994) The median duration of Broadcom's mainframe software license is [Business secret – know-how] years and it is typically renewed for [Business secret – know-how] (licenses with this renewal term account for [Business secret – quantities sold]% of renewal license revenue).
- (995) It should also be noted that VMware's virtualization software cannot be used with mainframes¹⁰⁹², as they are different environments/platforms.¹⁰⁹³ As such, virtualization and mainframe software are not worth more to a customer when used together and are therefore not complementary.¹⁰⁹⁴
- (996) **Security software** is typically purchased by Chief Information Officers ("CIO") or CSO.¹⁰⁹⁵ The CIO typically is the highest corporate executive in charge of the enterprise's information technology strategy and implementation and manages the IT department. The CSO or Chief Information Security Officer ("CISO") is often a member of the IT department but in some cases, they could report separately to the

¹⁰⁸⁷ Cigref's reply to RFI 1 to the Associations, question 3.

¹⁰⁸⁸ Parties' reply to RFI 19, question 5.

¹⁰⁸⁹ Cigref's reply to RFI 1 to the Associations, question 2.

¹⁰⁹⁰ Parties' reply to RFI 19, question 5. vSphere and the vRealize suite [Business secret – sales policy and strategy] – Form CO, paragraph 868.

¹⁰⁹¹ Parties' reply to RFI 19, question 5 and Reply to RFI 32, question 4.

¹⁰⁹² Form CO, paragraphs 447-351.

¹⁰⁹³ CIO's Platform reply to RFI 1 to the Associations, question 5 [ID 3951].

¹⁰⁹⁴ Parties' reply to RFI 19, question 3.

¹⁰⁹⁵ Parties' reply to RFI 19, question 7.

CEO, depending on the security needs of the organization. The CSO is responsible for the overall security of corporate data and systems. The CSO is concerned with the security of (i) the infrastructure managed by the IT department; (ii) the software that runs on top of the infrastructure and (iii) the data and applications that use this infrastructure. A CSO oversees how various IT environments impact the overall cybersecurity across the organization.

- (997) Given their importance and the need for security governance (including audits and risk assessments), security aspects are typically managed separately from the rest of the IT department. The CSO/ CISO typically makes decisions independently, even if they report to the CIO.
- (998) The primary decision makers on purchasing decisions for server virtualization software are the IT departments of organizations with the support from their legal and procurement departments. CSOs or teams in charge of security within those organizations are only involved in those purchases to validate that any software purchased (and not just virtualization software) meets the organization's security standards. However, CSOs or the security team within the IT department would not be making the purchasing decision concerning server virtualization software.¹⁰⁹⁶
- (999) Around [Business secret - quantities sold]% of Broadcom's security software revenues are made through [Business secret – sales policy] sales. The median duration of Broadcom's security software licenses is between [Business secret – know-how] years.¹⁰⁹⁷
- (1000) VMware already offers enterprise security software (Carbon Black), which is not bundled with server virtualization software and according to the Notifying Party it has never been so. Broadcom's Symantec security software is not more related to server virtualization than VMware's Carbon Black. In fact, Carbon Black is designed to interoperate with VMware's vCenter, whereas Symantec products are not.¹⁰⁹⁸
- (1001) VMware's server virtualization software runs on datacentres that can be located either on-premises or off-premises and deployed in a traditional datacentre or private or public cloud setting, whereas Broadcom's Symantec security software is not designed to protect cloud end-points or workloads running in a cloud environment. Symantec security software is also not sold for use with virtualization software on individual servers, but is instead used on employee devices, in specialized network appliances, and in IT management to protect the network as a whole.¹⁰⁹⁹
- (1002) Security software defends data, users, systems, and companies from a wide range of cybersecurity threats. These include threats to multiple environments, such as infrastructure and data inside the datacentre (*e.g.*, servers and databases), end-user / end-point devices (*e.g.*, laptops and mobile devices), compute and data assets in a public cloud, and networks. Server virtualization software is not deployed in all of these environments.
- (1003) Broadcom's (Symantec) security software is designed to protect end-point devices and networks. It is therefore designed to support general-purpose devices and to secure a network of applications as a whole, which demands that the solution be

¹⁰⁹⁶ Parties' reply to RFI 32, question 4.

¹⁰⁹⁷ Parties' reply to RFI 19, question 7.

¹⁰⁹⁸ Parties' reply to RFI 19, question 3. Note that there was no clear or substantiated reply by CIO Platform or Cigref's members regarding past bundling practices.

¹⁰⁹⁹ Parties' reply to RFI 19, question 3.

agnostic to the underlying platform or infrastructure. Server virtualization software, if used at all, is deployed for a particular application or a set of tasks.

- (1004) As such, both types of software tend to be purchased separately, for different use cases, and by different teams.¹¹⁰⁰
- (1005) **Other enterprise software** is provided primarily by Broadcom’s Agile Operations Division (“AOD”), whose offerings are focused on helping customers with non-technical business processes like financial reporting or workflow approvals and therefore are not designed for the same end use as VMware’s virtualization software that helps customers deploy actual workloads or IT infrastructures on which the workloads run.¹¹⁰¹
- (1006) The purchase decision for Broadcom’s other enterprise software (software offered by Broadcom’s AOD business unit) typically belongs to [Business secret – quantities sold policy and strategy].¹¹⁰²
- (1007) Around [Business secret - quantities sold]% of Broadcom’s other enterprise software revenues are made through [Business secret – sales policy] sales, with the remaining c. [...] % of revenues generated indirectly.¹¹⁰³
- (1008) The median duration of Broadcom’s other enterprise software licenses is [Business secret – know-how] years.¹¹⁰⁴
- (1009) Further, between 2020 and 2022, only [Business secret - quantities sold]% – [Business secret - quantities sold]% of the total non-virtualization software booking value each year (excluding not only virtualization software but also Carbon Black – VMware’s security software) has been purchased in the same order with vSphere. In addition, Broadcom’s products are even less suitable than VMware’s for using together with server virtualization software. VMware’s CloudHealth is only used in virtualized environments, providing explicit recommendations to reduce costs of virtualized cloud infrastructure by identifying unutilized resources or alternative more cost effective options, and Broadcom does not offer a comparable product. Tanzu (VMware’s portfolio of products that allow organizations to build, run, and operate modern applications – including containers – at scale) encompasses different types of features and products, but it is typical for the Tanzu products to either support non-vSphere environment in a limited fashion or otherwise not providing the same features.¹¹⁰⁵
- (1010) Finally, although the results of the market investigation are mixed¹¹⁰⁶, it is likely that the merged entity’s bundling of virtualization software with Broadcom’s (enterprise, security or mainframe) software could be replicated.
- (1011) The Notifying Party submits that large rival software players could create alternative bundles, either alone or in partnership with other firms: (i) IBM, Microsoft, and IBM/RedHat offer or can offer software bundles involving virtualization products;

¹¹⁰⁰ Parties’ reply to RFI 32, question 3.

¹¹⁰¹ Parties’ reply to RFI 19, question 3.

¹¹⁰² Parties’ reply to RFI 19, question 5.

¹¹⁰³ Parties’ reply to RFI 19, question 5.

¹¹⁰⁴ Parties’ reply to RFI 19, question 5.

¹¹⁰⁵ Parties’ reply to RFI 19, question 3.

¹¹⁰⁶ One association considered only Microsoft would be able to replicate such offer.

and (ii) Amazon and Microsoft, Cisco and Google, and Google and Dell in cooperation provide bundles involving virtualization software.¹¹⁰⁷

- (1012) In addition, server OEMs and system integrators can purchase the (merged entity's) bundle and unpick it by selling the components to their end users separately or buy from single software providers and replicate the bundle.¹¹⁰⁸ The Notifying Party explains that *"these intermediaries are well placed to offer tailor-made software combinations to their customers because customers' preferences across combinations of enterprise software are heterogeneous. Customers' IT needs differ, for example, in the type of workloads, preferred infrastructure and cloud service model (IaaS, PaaS, SaaS), the importance that they place on security, and their propensity to use open source software. In addition, new technologies continuously emerge. The heterogeneity in consumer preferences, and continuously evolving technology, explain why many customers prefer to mix and match complementary software and service offerings from different vendors and avoid being locked into a particular vendor. In such an environment, intermediaries have the advantage of being able to offer a very complex menu of bundles to capture customers' heterogeneous needs, and to continuously update this menu, as the customers' needs evolve"*.¹¹⁰⁹
- (1013) Neither Broadcom nor VMware restrict the ability of OEMs or system integrators to sell separate software products to end-customers.¹¹¹⁰ By way of example, system integrators are not prevented from selling Broadcom's mainframe software together with third-party security software or re-selling Broadcom software products separately (for example, reselling different software products separately and at different times). Similarly, VMware does not impose such resale restrictions on system integrators or OEMs when its software products are sold individually: where a systems integrator purchases a VMware product, it can supply this virtualization product with software products of VMware's rivals.¹¹¹¹
- (1014) In light of the above, taking into consideration the overall market results and, in particular, given the different purchasing patterns of virtualization software and Broadcom's (enterprise, security and mainframe) software, for the purposes of the present Decision the Commission considers that the merged entity would not have the ability to engage in a strategy of bundling its virtualization software with Broadcom's (enterprise, security or mainframe) software.

8.4.7.2.2. Incentive to foreclose

- (1015) Since the Commission has concluded above in Section 8.4.7.2.1. that the merged entity would not have the ability to bundle virtualization software with Broadcom's (enterprise, security or mainframe) software, the question whether the merged entity would have the incentive to engage in such a bundling strategy can be left open for the purposes of the present Decision.

¹¹⁰⁷ Article 6(1)c Response, paragraphs 369-374.

¹¹⁰⁸ CIO's Platform non-confidential reply to RFI 1 to the Associations, question 10.

¹¹⁰⁹ Parties' reply to RFI 19, question 12.

¹¹¹⁰ Neither Broadcom nor VMware [Business secret – sales policy]. For example, [Business secret – sales policy].

¹¹¹¹ Parties reply to RFI 32, question 5.

8.4.7.2.3. Impact on effective competition

(1016) Since the Commission has concluded above in Section 8.4.7.2.1. that the merged entity would not have the ability to bundle virtualization software with Broadcom's (enterprise, security or mainframe) software, the question whether such a bundling strategy would have a detrimental effect on competition in the targeted software markets (enterprise, security or mainframe software) can be left open for the purposes of the present Decision.

8.4.7.2.4. Conclusion

(1017) In view of the above considerations and in light of the market investigation and the evidence and information available to it, for the purposes of the present Decision, the Commission concludes the Transaction would not significantly impede effective competition as a result of bundling of VMware's virtualization software and Broadcom's (enterprise, security or mainframe) software, considering that the merged entity would not have the ability to engage in such a strategy.

9. COMMITMENTS

9.1. Introduction

(1018) In order to remove the competition concerns arising from the Transaction described in Section 8.4.3., the Notifying Party submitted commitments pursuant to Article 8(2) and 10(2) of the Merger Regulation on 16 May 2023 (the "Initial Commitments").

(1019) On 23 May 2023, the Commission launched a market test of the Initial Commitments, seeking responses from market participants, including Marvell as the only competing provider of FC HBAs, and server OEMs as the direct customers of FC HBAs. The Commission informed the Notifying Party of the results of the market test on 8 June 2023.

(1020) Based on the Commission's additional feedback, the Notifying Party submitted the final set of commitments on 14 June 2023 (the "Final Commitments"). These Final Commitments are annexed to this Decision and form an integral part thereof.

9.2. Analytical Framework

(1021) Where the Commission considers that a concentration raises competition concerns, the parties may seek to modify the concentration in order to resolve such competition concerns and thereby gain clearance of their merger.¹¹¹²

(1022) Under the Merger Regulation, the Commission only has the power to accept commitments that are deemed capable of rendering the concentration compatible with the internal market. The commitments must eliminate the competition concerns entirely and must be comprehensive and effective from all points of view.¹¹¹³ The commitments must also be proportionate to the competition concerns identified.¹¹¹⁴ Furthermore, the commitments must be capable of being implemented effectively

¹¹¹² Commission notice on remedies acceptable under Council Regulation (EC) No 139/2004 and under Commission Regulation (EC) No 802/2004 (the "Remedies Notice"), OJ 2008/C 267/01, paragraph 5.

¹¹¹³ Remedies Notice, paragraph 9.

¹¹¹⁴ Merger Regulation, recital 30.

within a short period of time as the conditions of competition on the market will not be maintained until the commitments have been fulfilled.¹¹¹⁵

- (1023) In assessing whether the proposed commitments will likely eliminate the competition concerns identified, the Commission considers all relevant factors including inter alia the type, scale and scope of the proposed commitments, assessed by reference to the structure and particular characteristics of the market in which the competition concerns arise, including the position of the parties and other participants on the market.¹¹¹⁶
- (1024) When assessing the commitments proposed by the merging parties, the Commission has the legal duty to ensure that such commitments are effective. In order for the commitments to remove the competition concerns entirely and be comprehensive and effective, there has to be an effective implementation and ability to monitor the commitments. Whereas divestitures once implemented do not require any further monitoring measures, other types of commitments require effective monitoring mechanisms in order to ensure that their effect is not reduced or even eliminated by the parties. Otherwise such commitments would have to be considered as mere declarations of intentions by the parties and thus would not amount to any binding obligations as, due to the lack of effective monitoring mechanisms, any breach of them could not result in the revocation of the decision in accordance with the provisions of the Merger Regulation.¹¹¹⁷
- (1025) While divestiture commitments may be the best means of resolving problems resulting from horizontal, vertical or conglomerate concerns, other structural commitments may be suitable to resolve all types of concerns if those remedies are equivalent to divestitures in their effects,¹¹¹⁸ such as access remedies foreseeing the granting of access to key infrastructure, key technology, or essential inputs, and which are normally granted on a non-discriminatory and transparent basis.¹¹¹⁹ Such access commitments may be submitted in order to ensure that competition is not significantly impeded as a result of foreclosure and/or in order to facilitate market entry by competitors.¹¹²⁰ Where applicable, it has to be further ensured that the terms and conditions, including the pricing, under which the access is granted (*e.g.*, via a licence) do not impede the effective implementation of such a remedy. However, the Commission will only accept such access commitments if it can be concluded that these commitments will be effective and competitors will likely use them so that foreclosure concerns will be eliminated.¹¹²¹
- (1026) Access commitments are often complex in nature and necessarily include general terms for determining the terms and conditions under which access is granted. In order to render them effective, those commitments have to contain the procedural requirements necessary for monitoring them, which normally has to be done by the market participants themselves, *i.e.*, by those undertakings wishing to benefit from the commitments. Measures allowing third parties themselves to enforce the commitments may in particular involve access to a fast dispute resolution mechanism via arbitration proceedings (together with trustees). If the Commission can conclude

¹¹¹⁵ Remedies Notice, paragraph 9.

¹¹¹⁶ Remedies Notice, paragraph 12.

¹¹¹⁷ Remedies Notice, paragraph 13.

¹¹¹⁸ Remedies Notice, paragraph 17.

¹¹¹⁹ Remedies Notice, paragraph 62.

¹¹²⁰ Remedies Notice, paragraphs 63-64.

¹¹²¹ Remedies Notice, paragraphs 64-65.

that the mechanisms foreseen in the commitments will allow the market participants themselves to effectively enforce them in a timely manner, no permanent monitoring of the commitments by the Commission may be required. However, the Commission will only be able to accept such commitments where the complexity does not lead to a risk of their effectiveness from the outset and where the monitoring devices proposed ensure that those commitments will be effectively implemented and the enforcement mechanism will lead to timely results.¹¹²²

(1027) It is against this background that the Commission reviews the proposed commitments in this case.

9.3. The Initial Commitments

9.3.1. Description of the Initial Commitments

(1028) The Initial Commitments comprise three main elements:

- (a) guaranteeing Marvell's access to the Interoperability APIs¹¹²³, the Driver Development Kit¹¹²⁴, the Certification Suite¹¹²⁵, Certification¹¹²⁶, and Technical Support¹¹²⁷ at the same time and in the same manner as they are provided to ECD¹¹²⁸, Broadcom's division that operates Broadcom's FC HBA business ("**Open Access to APIs and Certification Commitment**"),¹¹²⁹
- (b) giving Marvell full visibility into Broadcom's FC HBA¹¹³⁰ Drivers¹¹³¹ and the possibility to reuse and modify them for Marvell's own use, including for potential troubleshooting and accelerating the development of Marvell's own Drivers ("**Open Source Driver Grant Commitment**"),¹¹³² and

¹¹²² Remedies Notice, paragraphs 66.

¹¹²³ Under the Commitments, Interoperability APIs are application programming interfaces of Server Virtualization Software needed to develop, certify, and release Drivers for FC HBAs.

¹¹²⁴ Under the Commitments, the Driver Development Kit is a software development kit (also known as a certification kit) for developing Drivers and related documentation, such as training information, and other information, tools, resources, and processes that are made available to Marvell to explain how to use the Interoperability APIs and to enable the development, Certification, and release of Drivers for Server Virtualization Software.

¹¹²⁵ Under the Commitments, the Certification Suites are testing suites and related documentation used for Certification.

¹¹²⁶ Under the Commitments, Certification is the validation, engineering testing, test result and other verification of FC HBAs, including access to a Driver Development Kit, a Certification Suite, and the VMware Integration Validation automated testing platform, and to certification by equivalency, undertaken by VMware and Marvell with a view to testing and ensuring that the latter's Drivers are compatible with the Interoperability APIs.

¹¹²⁷ Under the Commitments, Technical Support is engineering and other technical support or feedback, development consulting, troubleshooting, debugging, and post-release support activities, including (i) pre-release support and support provided through the VMware Developer Center Partner Network, that VMware makes available when a partner runs into an issue in the development, Certification, or release of Drivers, and (ii) technical support to Marvell's end-customers using the FC HBA or the Driver.

¹¹²⁸ Emulex Connectivity Division. Under the Commitments, ECD is the division inside Broadcom that operates the FC HBA business of Broadcom (currently known as the Emulex Connectivity Division).

¹¹²⁹ Initial Commitments, section B.1.

¹¹³⁰ Under the Commitments, FC HBA is a Fibre Channel Host Bus Adapter, i.e., a board with firmware used mostly in servers to interconnect the server's processor with storage hard drives or solid-state drives using the Fibre Channel protocol. FC HBA shall cover any current or future generation of FC HBAs.

¹¹³¹ Under the Commitments, Driver is a computer program that provides a software interface to FC HBAs, enabling Server Virtualization Software to access functions of FC HBAs, and vice versa.

¹¹³² Initial Commitments, section B.2.

- (c) establishing an organizational separation between the merged entity's team working on Broadcom's FC HBAs and the merged entity's team responsible for Certification and Technical support as well as ensuring protection for Marvell's Confidential Information ("**Organizational Separation and Confidentiality Commitment**").¹¹³³
- (1029) The Commitments would have a duration of 10 years¹¹³⁴ and provide for the appointment of a Monitoring Trustee¹¹³⁵ and a fast-track dispute resolution mechanism.¹¹³⁶
- 9.3.1.1. Open Access to APIs and Certification Commitment
- (1030) Under the Open Access to APIs and Certification, the merged entity commits to make the Interoperability APIs, the Driver Development Kit, and the Certification Suite available to Marvell at the same time and in the same manner as they are provided to ECD¹¹³⁷.
- (1031) The merged entity further commits:
- (a) To provide Technical Support in accordance with VMware's past practice in the case where Marvell runs into an issue in developing, certifying, or releasing the Drivers.¹¹³⁸
 - (b) To take measures necessary to provide Marvell with at least the same level of Certification that the merged entity provides at any point in time to ECD for its Drivers, including by providing Marvell with the same level of Technical Support during the Certification process and in the same timely manner as the merged entity provides to ECD.¹¹³⁹
 - (c) Not to discriminate between Marvell and the merged entity by designing or engineering Server Virtualization Software¹¹⁴⁰ or implementing any changes to Server Virtualization Software (including, but not limited to, additions, changes, or removals of functionalities in the software, firmware, or interfaces) so that it interoperates with Broadcom HBAs¹¹⁴¹ in a manner that would favour Broadcom HBAs or negatively affect Marvell HBAs¹¹⁴² (including, but not limited to, in terms of degree of product reliability, timing of Certification or market release, performance (speed), and feature richness).¹¹⁴³

¹¹³³ Initial Commitments, section B.3.

¹¹³⁴ Initial Commitments, clause 52.

¹¹³⁵ Initial Commitments, section C.

¹¹³⁶ Initial Commitments, section D. The Monitoring Trustee is one or more natural or legal persons who are approved by the Commission and appointed by Broadcom, and who have the duty to monitor Broadcom's compliance with the conditions and obligations attached to the Commission's decision pursuant to Article 8(2) of the Merger Regulation.

¹¹³⁷ ECD (Emulex Connectivity Division) is the Broadcom division that operates the FC HBA business.

¹¹³⁸ Initial Commitments, clause 2a.

¹¹³⁹ Initial Commitments, clause 2b.

¹¹⁴⁰ Under the Commitments, Server Virtualization Software is the supported releases of VMware's ESXi software that provides virtualization of x86-based servers by making it possible to run multiple operating systems and multiple applications on the same server at the same time, by separating it into virtual machines. Server Virtualization Software shall cover any current or future generation of ESXi.

¹¹⁴¹ Under the Commitments, Broadcom HBA is any FC HBA that is developed or manufactured by the merged entity.

¹¹⁴² Under the Commitments, Marvell HBA is any FC HBA that is developed or manufactured by Marvell.

¹¹⁴³ Initial Commitments, clause 2c.

- (d) To certify a Driver as compatible with Server Virtualization Software except if the merged entity provides due justification in accordance with objective criteria that shall be no more onerous than past certification practices.¹¹⁴⁴
 - (e) To apply a VMware digital signature to the certified Drivers (which identifies it at the “VMware Certified” level of acceptance) and update the VMware Compatibility Guide website to include the applicable certified version of the Drivers and its associated devices that are supported, and, if requested by Marvell, make the certified driver available on the vmware.com website.¹¹⁴⁵
- (1032) Under the Initial Commitments, the merged entity shall be permitted to develop APIs and other functionalities of Server Virtualization Software for internal use within the merged entity or to be made available to third parties, provided it is exclusively for Development and Testing¹¹⁴⁶ purposes.¹¹⁴⁷

9.3.1.2. Open Source Driver Grant Commitment

- (1033) Under the Open Source Driver Grant Commitment, the merged entity shall provide Marvell, within 30 days from Closing, with a source code library for the current and future versions of the Drivers of Broadcom FC HBAs, and grant Marvell an irrevocable license to such source code (“Driver License”) under the Open Source License. The Driver License will enable Marvell to verify that it and the merged entity have access to the same information necessary to ensure interoperability with Server Virtualization Software and to reuse and modify the Drivers of Broadcom FC HBAs for Marvell’s own use.¹¹⁴⁸
- (1034) Under the Commitments, Open Source License is the Apache Software Foundation’s Apache License, Version 2.0, available here: <http://www.apache.org/licenses/>.

9.3.1.3. Organizational Separation and Confidentiality Commitment

- (1035) Under the Organizational Separation and Confidentiality Commitment, the merged entity commits to ensure that:
- (a) the Marvell Confidential Information¹¹⁴⁹ received from Marvell in the context of Certification and Technical Support is held in strict confidence and is disclosed only to Authorized Staff^{1150,1151} and

¹¹⁴⁴ Initial Commitments, clause 2e.

¹¹⁴⁵ Initial Commitments, clause 2f.

¹¹⁴⁶ Under the Commitments, Development and Testing is the process by which the merged entity develops and tests new versions of APIs and other functionalities of Server Virtualization Software, prior to their release to Marvell. For the avoidance of doubt, this may include the merged entity’s use of a lead device to develop and test new software.

¹¹⁴⁷ Initial Commitments, clause 3.

¹¹⁴⁸ Initial Commitments, clause 5.

¹¹⁴⁹ Under the Commitments, Marvell Confidential Information is any and all non-public technical and non-technical information provided by Marvell to the merged entity for purposes of Certification and Technical Support, including interoperability testing, feature development, and specification and roadmap alignment (if any) between the Marvell HBAs and Server Virtualization Software (whether required for these purposes or not), including but not limited to Marvell’s (a) patent and patent applications, (b) trade secrets, and (c) proprietary information, including ideas, samples, media, techniques, sketches, drawings, works of authorship, models, inventions, know-how, processes, apparatuses, equipment, algorithms, software programs, software source documents, network traces and diagnostic traces related to the current, future and proposed products and services of Marvell, and including, without limitation, Marvell’s information concerning research, experimental work, development, design details and specifications, engineering, financial information, procurement requirements, purchasing, manufacturing, customer lists, investors, employees, business and contractual

- (b) the merged entity does not use such Marvell Confidential Information except for Certification and Technical Support.¹¹⁵²
- (1036) To meet its Commitments, the merged entity commits to implement a strict organizational separation between the ECD and VMware business units in accordance with the following:
- (a) Ensuring the organizational separation of the VMware and ECD business units, with a different Vice President and General Manager for each. Accordingly, the personnel involved in Certification and Technical Support will report up to a VMware General Manager and the merged entity's personnel responsible for developing the Broadcom FC HBAs will report up to the ECD General Manager;
 - (b) Not allowing any movement of employees between ECD and VMware without at least three months prior notice to the Monitoring Trustee and subject to a minimum of 12-month waiting period after the employee stops working for the former team;
 - (c) Maintaining the activities relating to the design and development of the Broadcom FC HBAs in separate physical locations from the merged entity's activities relating to Certification and Technical Support;
 - (d) Ensuring that any merged entity's team working on Certification and Technical Support uses storage and hardware access systems separate from, and inaccessible to, the ECD team working on the Broadcom FC HBAs;
 - (e) Ensuring that data related to the Broadcom FC HBAs is separated through a logical separation of networks from Marvell Confidential Information;
 - (f) Preventing any storage of Marvell Confidential Information outside the organizational separation created for the merged entity's personnel working on Certification and Technical Support without Marvell's prior written consent;
 - (g) Enlisting a third-party auditor in the event of an audit initiated by VMware, or any other mechanism by which VMware exercises contractual rights to review Marvell's business; and
 - (h) Committing adequate resources to educating staff about the requirements of the organizational separation measures.¹¹⁵³

9.3.1.4. Implementation, Monitoring Trustee and Dispute Resolution

- (1037) The Initial Commitments provide that the Notifying Party shall appoint the Monitoring Trustee before it can close the Transaction. The Monitoring Trustee may in turn appoint advisors to assist in the performance of his or her duties and obligations.¹¹⁵⁴

relationships, business forecasts, sales and merchandising, marketing plans and information that Marvell provides regarding third parties.

¹¹⁵⁰ Under the Commitments, Authorized Staff are the merged entity's employees and contractors who have a bona fide need to have access to Marvell Confidential Information solely for the purposes of Certification and Technical Support.

¹¹⁵¹ Initial Commitments, clause 6a.

¹¹⁵² Initial Commitments, clause 6b.

¹¹⁵³ Initial Commitments, clause 7.

¹¹⁵⁴ Initial Commitments, clause 8, 19.

(1038) A fast-track dispute resolution mechanism is included and will apply in cases where Marvell claims that the merged entity is failing to comply with its obligations arising from the Commitments.¹¹⁵⁵

(1039) The Initial Commitments would remain in effect for ten years from the adoption of the Commission’s decision under Article 8 (2) of the Merger Regulation.¹¹⁵⁶

9.3.2. *Results of Markets Tests of the Initial Commitments*

(1040) The Commission initiated a market test of the Initial Commitments on 23 and 24 May 2023 and received responses from Marvell as the only competing provider of FC HBAs, and server OEMs as the direct customers of FC HBAs.

(1041) Overall, the outcome of the market test was positive. All respondents that expressed a view considered that the Initial Commitments would ensure that, post-Transaction, Marvell would be able to obtain timely Certification of compatibility of its FC HBAs¹¹⁵⁷, that the merged entity would not misuse commercially sensitive/confidential information relating to Marvell’s FC HBAs¹¹⁵⁸, and that Marvell would be able to compete effectively with the FC HBAs of the merged entity.¹¹⁵⁹

9.3.2.1. Open Access to APIs and Certification Commitment

(1042) The large majority of server OEMs responding to the market test did not express an opinion as to the effectiveness of the Open Access to APIs and Certification commitment. A number of them indicated that Marvell would be best placed to assess whether the modalities of this commitment suffice to protect its competitiveness on the market.¹¹⁶⁰

(1043) Marvell expressed concerns with respect to some of the wording of the Commitments, and suggested additional wording to further clarify the scope or meaning of a number of clauses, including the definitions of “Certification” and “Technical Support” and the clause ensuring access to the Interoperability API, the Driver Development Kit and the Certification Suite to ensure that they would be made available to Marvell in a timely manner such that Marvell can develop and introduce any new features without delay compared to the merged entity’s own FC HBAs.¹¹⁶¹

(1044) Marvell submitted that the Initial Commitments would be sufficient to ensure that FC HBAs of Marvell will obtain the same level of interoperability with the merged entity’s Server Virtualization Software as the merged entity’s own FC HBAs.¹¹⁶² However, Marvell flagged the possibility of timing issues in the sense that the

¹¹⁵⁵ Initial Commitments, clause 25-49.

¹¹⁵⁶ Initial Commitments, clause 52. Section A “Definitions”.

¹¹⁵⁷ Reply to questionnaire on commitments offered by Broadcom, question 13 [ID 5745] and question 22.1 [ID 5685, 5690, 5694, 5718, 5725, 5732, 5741, 5747].

¹¹⁵⁸ Reply to questionnaire on commitments offered by Broadcom, question 13 [ID 5745] and question 22.2 [ID 5685, 5690, 5694, 5718, 5725, 5732, 5741, 5747].

¹¹⁵⁹ Reply to questionnaire on commitments offered by Broadcom, question 13 [ID 5745] and question 22.3 [ID 5685, 5690, 5694, 5718, 5725, 5732, 5741, 5747].

¹¹⁶⁰ Reply to questionnaire on commitments offered by Broadcom, questions 4-11 [ID 5685, 5690, 5694, 5718, 5725, 5732, 5741, 5747].

¹¹⁶¹ Reply to questionnaire on commitments offered by Broadcom, questions 4, 5 and 7 [ID 5745].

¹¹⁶² Reply to questionnaire on commitments offered by Broadcom, question 9.1 [ID 5745].

merged entity could have a time advantage by only informing Marvell of technical changes with a lead time.¹¹⁶³

- (1045) With respect to the clause in the Initial Commitments that the merged entity shall be permitted to develop APIs and other functionalities of Server Virtualization Software for internal use within the merged entity or to be made available to third parties for Development and Testing purposes, Marvell observed that this would allow the merged entity to build APIs and functionalities that are tailored to its own FC HBA architecture, but that are of no practical use to Marvell's FC HBAs.¹¹⁶⁴ Furthermore, Marvell submitted that this could permit the merged entity to charge excessive fees to third parties. More generally, Marvell suggested making it clearer throughout the Commitments *"that the Combined Entity may not impose a fee on Marvell that exceeds that paid by any other VMware customer for the same level of access to the APIs and other functionalities referred to."*¹¹⁶⁵
- (1046) Marvell did not consider that any further commitments by the merged entity would be required in order to guarantee access to the Interoperability APIs, the Driver Development Kit, the Certification Suite, Certification and Technical Support at the same time and in the same manner as they are provided to Broadcom.¹¹⁶⁶

9.3.2.2. Open Source Driver Grant Commitment

- (1047) None of the respondents to the market test that expressed a view considered that additional commitments from the merged entity are needed in order to provide full visibility for Marvell into Broadcom's FC HBA Drivers and to reuse and modify them for Marvell's own use, including for potential troubleshooting and accelerating the development of Marvell's own Drivers.¹¹⁶⁷

9.3.2.3. Organizational Separation and Confidentiality Commitment

- (1048) In its response to the market test, Marvell indicated that it believed that the modalities of the Organizational Separation and Confidentiality Commitment are adequate to guarantee that no commercially sensitive or confidential information in relation to FC HBAs of Marvell would be potentially misused by the merged entity to favour its own FC HBAs.¹¹⁶⁸ Marvell did not consider that the protection of its Confidential Information required commitments in addition to the clauses of the Initial Commitments in order to create an organizational separation between the merged entity's FC HBA team and the team responsible for Certification and Technical Support.¹¹⁶⁹ However, Marvell had one observation aimed at improving the definition of "Marvell Confidential Information", to ensure that it would cover all confidential information shared with the merged entity in the certification process or to obtain technical support, *i.e.*, including confidential information related to Marvell products other than its FC HBAs.¹¹⁷⁰

¹¹⁶³ Reply to questionnaire on commitments offered by Broadcom, question 9.2 [ID 5745].

¹¹⁶⁴ Reply to questionnaire on commitments offered by Broadcom, question 11.2.1 [ID 5745].

¹¹⁶⁵ Reply to questionnaire on commitments offered by Broadcom, question 11.1.1 [ID 5745].

¹¹⁶⁶ Reply to questionnaire on commitments offered by Broadcom, question 12 [ID 5745].

¹¹⁶⁷ Reply to questionnaire on commitments offered by Broadcom, question 13 [ID 5745] and question 12 [ID: 5685, 5690, 5694, 5718, 5725, 5732, 5741, 5747].

¹¹⁶⁸ Reply to questionnaire on commitments offered by Broadcom, question 14 [ID 5745].

¹¹⁶⁹ Reply to questionnaire on commitments offered by Broadcom, question 15 [ID 5745].

¹¹⁷⁰ Reply to questionnaire on commitments offered by Broadcom, question 6 [ID 5745].

9.3.2.4. Implementation, Monitoring Trustee and Dispute Resolution

- (1049) With respect to the duration of all three parts of the Initial Commitments, all respondents that expressed a view submitted that the 10-year duration is sufficient to address the competition concerns identified by the Commission.¹¹⁷¹
- (1050) With respect to the scope of application of the Initial Commitments, the majority of respondents expressing a view considered that it is sufficient that the Commitments target Marvell specifically and do not target potential new entrants in the market for FC HBAs.¹¹⁷² One respondent considered that while Broadcom and Marvell are currently the only two FC HBA suppliers, not applying the Initial Commitments to possible new entrants would “*decrease the possibility that there will be additional entry into the market for HBAs, making it even more unlikely for them to consider entering the market.*”¹¹⁷³
- (1051) All respondents to the market test that expressed a view submitted that a Monitoring Trustee is necessary to ensure effective implementation of the Commitments.¹¹⁷⁴ The server OEMs considered that the provisions regarding monitoring are sufficient to ensure that the Initial Commitments are correctly implemented.¹¹⁷⁵ However, Marvell submitted that the scope of the functions of the Monitoring Trustee required improvement and suggested that (i) Broadcom should commit to providing the Monitoring Trustee with any required documentation and information “without delay”, and (ii) that the reporting frequency of the Monitoring Trustee to the European Commission should be increased.¹¹⁷⁶ Marvell made a few further suggestions which the Commission considered were already covered by the wording of the Initial Commitments.
- (1052) Regarding the fast-track dispute resolution mechanism, the majority of respondents to the market test that expressed a view submitted that it ensures an effective means for resolutions of any disputes concerning the Commitments.¹¹⁷⁷
- (1053) All respondents that expressed a view considered that the provisions of the Initial Commitments are sufficiently clear and capable of being implemented and present no risks or uncertainties.¹¹⁷⁸

9.3.3. Commission’s assessment of the Initial Commitments

- (1054) The Commission assessed the appropriateness of the Initial Commitments in light of the principles underlying its commitments policy and the results of the market test.
- (1055) The Commission considered that, overall, the Initial Commitments proposed by the Notifying Party seem capable of addressing the Commission’s competition concerns.

¹¹⁷¹ Reply to questionnaire on commitments offered by Broadcom, question 20 [ID 5745] and question 17 [ID 5685, 5690, 5694, 5718, 5725, 5732, 5741, 5747].

¹¹⁷² Reply to questionnaire on commitments offered by Broadcom, question 17 [ID 5745] and question 14 [ID 5685, 5690, 5694, 5718, 5725, 5732, 5741, 5747].

¹¹⁷³ Reply to questionnaire on commitments offered by Broadcom, question 14 [ID 5725].

¹¹⁷⁴ Reply to questionnaire on commitments offered by Broadcom, question 18 [ID 5745] and question 15 [ID 5685, 5690, 5694, 5718, 5725, 5732, 5741, 5747].

¹¹⁷⁵ Reply to questionnaire on commitments offered by Broadcom, question 16 [ID 5685, 5690, 5694, 5718, 5725, 5732, 5741, 5747].

¹¹⁷⁶ Reply to questionnaire on commitments offered by Broadcom, question 19 [ID 5745].

¹¹⁷⁷ Reply to questionnaire on commitments offered by Broadcom, question 21 [ID 5745] and question 18 [ID 5685, 5690, 5694, 5718, 5725, 5732, 5741, 5747].

¹¹⁷⁸ Reply to questionnaire on commitments offered by Broadcom, question 22 and 23 [ID 5745] and question 19 and 20 [ID 5685, 5690, 5694, 5718, 5725, 5732, 5741, 5747].

The market test resulted in generally positive feedback to the questions asking whether the Initial Commitments overall could address the identified competition concerns in the market for FC HBAs. In particular, the Commission notes that while several observations were made about the scope of the Initial Commitments, no market participants raised fundamental concerns.

- (1056) On the basis of the results of the market test and the Commission's analysis, the Commission considered that the Initial Commitments required further refinements in order to ensure the full effectiveness of the Commitments.
- (1057) First, the Commission considered that a number of definitions required further clarification or a broadening of scope in order to ensure full effectiveness of the Commitments.
- (1058) Second, with respect to the Open Access to APIs and Certification commitment, the Commission considered that Marvell should have access to the Interoperability APIs at any point in time as relevant and necessary for Marvell to compete and such that Marvell does not have to wait for the merged entity's innovation cycle.
- (1059) Third, the Commission considered that Marvell should have access to at least the same level of technical support to be provided in the same timely manner as the merged entity provides to Broadcom's FC HBAs.
- (1060) Fourth, the Commission considered that the merged entity should ensure that the listing of certified products on the VMware Compatibility Guide occurs in a neutral fashion and without showing preference.
- (1061) Fifth, the Commission considered that the Commitments should ensure that Certification and Technical Support shall occur in line with past practice and that associated fees should be kept in line with past practice. Eventual fee increases to Marvell should not exceed the fees paid by other VMware customers for similar services.
- (1062) Sixth, the Commission considered that the application of a clause regarding access to APIs for development and testing should be clarified in order to ensure that the Merged Entity would be enabled to tailor its APIs and functionalities to its own FC HBA architecture.
- (1063) Seventh, the Commission considered that the role of the Monitoring Trustee should be further strengthened in order to ensure correct implementation of the Commitments and to remove any concerns raised in the market test, notably by clarifying the scope of its tasks and increasing the frequency of reporting in the first two years of the duration of the Commitments.
- (1064) Eighth, the Commission considered that the Commitments should be made future-proof by extending their application to potential new entrants in the market for FC HBAs, even if such entry is perceived as unlikely at this stage, in order to avoid an increase of barriers to entry.

9.4. The Final Commitments

9.4.1. Description of the Final Commitments

- (1065) In order to address the concerns expressed by the Commission and based on the replies of the market participants to the market test, the Notifying Party submitted revised commitments incorporating all points for improvement as listed in this Section.
- (1066) The Notifying Party submitted the Final Commitments on 14 June 2023.

- (1067) Compared to the Initial Commitments, the Notifying Party has introduced a series of refinements in the Final Commitments, mainly clarifying the scope of the Commitments and the role of the Monitoring Trustee.
- (1068) The main changes in the Final Commitments are:
- (a) A clarification that any fees for access to the Interoperability API, the Driver Development Kit, the Pre-Release Materials and the Certification Suite as well as the fees for certification and certification support are minimal today and will remain in line with past practice.¹¹⁷⁹
 - (b) The clause included in the Initial Commitments relating to the possibility for the merged entity to develop APIs (for internal use within the merged entity, provided that it is exclusively for Development and Testing purposes) was removed.
 - (c) A clarification that Broadcom will make interoperability APIs, the Driver Development Kit, the Pre-Release Materials and the Certification Suite available to Marvell in a timely manner such that Marvell can develop and introduce any new features without delay, but in any event in the same timely manner as they are provided to ECD.¹¹⁸⁰
 - (d) The role of the Monitoring Trustee was strengthened by clarifying that (i) Broadcom should commit to providing the Monitoring Trustee with any required documentation and information “without delay”, and (ii) the frequency period of reporting by the Monitoring Trustee was increased to every quarter for the first two years of the duration of the Commitments.¹¹⁸¹
 - (e) A clarification that the application of the Commitments would extend to potential new entrants in the FC HBA market, if any.¹¹⁸²

9.4.2. *Commission’s assessment of the Final Commitments*

- (1069) The Final Commitments constitute an improvement of the Initial Commitments and fully address the observed shortcomings. The Commission concludes that the Final Commitments are capable of eliminating the Commission’s competition concerns entirely, are comprehensive and effective from all points of view, proportionate, and capable of being implemented effectively within a short period of time. The Final Commitments address shortcoming identified by the Commission and by market participants in the market test of the Initial Commitments.
- (1070) The large majority of changes as compared to the Initial Commitments concern clarifications or limited amendments to the existing definitions. The Final Commitments also contain two substantial changes. First, following the Commission’s concerns, based on input from the market test as well as its own assessment, about the scope of the clause regarding access to APIs for the purposes of Development and Testing, the Notifying Party suggested to remove this clause in its entirety. The Commission obtained confirmation from Marvell, the only respondent to the market test who expressed concerns in this regard, that removing this clause would alleviate its concerns. Second, the Final Commitments include a

¹¹⁷⁹ Final Commitments, clause 2.g.

¹¹⁸⁰ Final Commitments, clause 1.

¹¹⁸¹ Final Commitments, clauses 17.c and 18.

¹¹⁸² Final Commitments, clause 7.

provision extending their application to any potential new entrant in the market for FC HBAs in the future.

- (1071) With these clarifications, Broadcom has addressed all issues raised during the market test and following the Commission's assessment of the Initial Commitments that the Commission considered relevant for the effectiveness of the Commitments. On this basis, the Commission considered that it did not need feedback from market participants during an additional market test in order to assess the Final Commitments and provided positive feedback to the Notifying Party.
- (1072) The Open Access to APIs and Certification Commitment, the Open Source Driver Grant Commitment, and the Organizational Separation and Confidentiality Commitment presented by the Notifying Party address the Commission's conglomerate competition concerns regarding the foreclosure of competing suppliers of FC HBAs.

9.4.2.1. Open Access to APIs and Certification Commitment

- (1073) By committing to make interoperability APIs, the Driver Development Kit, the Pre-Release Materials and by making the Certification Suite available to Marvell or any future entrant in a timely (*i.e.*, as timely as they are provided to ECD) manner such that they can develop and introduce any new features without delay, and by not discriminating between Marvell or any future entrant and Broadcom in relation to Certification or Technical Support, the Final Commitments will guarantee interoperability of Marvell's or any future entrant's new FC HBAs with VMware's server virtualization software and a timely Certification thereof. This commitment will eliminate any risk of foreclosure through delaying the interoperability and certification process of FC HBA rivals or delaying the technical support required from VMware during the certification process.
- (1074) The clarification in the Final Commitments that any access fees or fees for certification and certification support are minimal and will remain in line with past practice addresses concerns raised in the market test and avoid circumvention whereby the merged entity could have favoured Broadcom by increasing any applicable fees to Marvell or any future entrant.
- (1075) Following the removal of the clause regarding access to APIs for the internal purposes of Development and Testing, the clause that now fully applies to all situations is that access to interoperability APIs, the Driver Development Kit, the Pre-Release Materials and the Certification Suite is made available to Marvell or any future entrant in a timely manner such that they can develop and introduce any new features without delay, but in any event in the same timely manner as access is provided to ECD. This removes concerns that the merged entity could build APIs and applications tailored to its own FC HBA architecture and allows Marvell or any future entrant to obtain access to all required instruments and materials in the same timely manner and no later than ECD.

9.4.2.2. Open Source Driver Grant Commitment

- (1076) By committing to provide Marvell or any future entrant with a source code library for the current and future versions of the Drivers of Broadcom FC HBAs and by granting them an irrevocable license to such source code under the Open Source License, Marvell or any future entrant will be able to verify that it has access to the same necessary information as the merged entity. This will ensure interoperability with server virtualization software and will allow Marvell or any future entrant reusing and modifying of the drivers of Broadcom FC HBAs for its own use. This

commitment will eliminate any risk of foreclosure through prioritizing the exchange of information regarding VMware's newest software releases and features with Broadcom.

9.4.2.3. Organizational Separation and Confidentiality Commitment

- (1077) Under the Final Commitments, the merged entity commits to an organizational separation within the merged entity between ECD and VMware business divisions, as well as confidentiality provisions ensuring that Marvell Confidential Information is held in strict confidence and only disclosed to Authorized Staff. On that basis, any information received for purposes of Certification and Technical Support is strictly kept confidential, and any such information is not shared with the competing business divisions of the merged entity. In the Final Commitments, the definition of Marvell Confidential Information was amended in line with concerns arising from the market test and now covers all confidential information shared by Marvell in the FC HBA certification process or to obtain technical support. This commitment will ensure that the merged entity will be precluded from using Marvell's confidential information to its own benefit. The same protection will apply to the Confidential Information of or any future entrant.

9.4.2.4. Implementation, Monitoring Trustee and Dispute Resolution

- (a) The Commission considers that the strengthened role of the Monitoring Trustee ensuring provision of required information without delay and increasing the reporting frequency to quarterly reporting for the first two years is sufficient to ensure that the monitoring mechanism will ensure the effective implementation and compliance with the commitments.
- (b) Moreover, the dispute resolution provisions in the Final Commitments will ensure the effective implementation of and compliance with these commitments, as confirmed by the response to the market test.
- (c) Furthermore, the Commission considers that the 10-year duration was deemed to be sufficient by market participants responding to the market test and, in line with the Remedies Notice, that means that the commitments may be considered, in this case and taking into account the characteristics of the relevant markets, to be "*equivalent to divestitures in their effects*".¹¹⁸³
- (d) Lastly, the additional clause ensures that the Final Commitments apply equally to any potential new entrant on the market for FC HBAs, renders the Final Commitments future-proof.

9.4.2.5. Conclusion

- (1078) The Commission therefore concludes that the Final Commitments are capable of eliminating the Commission's competition concerns and are capable of being implemented effectively in a timely manner. Moreover, they are proportionate to the competition concerns identified by the Commission.

¹¹⁸³ Remedies Notice, paragraph 17.

9.5. Conclusion

- (1079) In the light of the above, the Commission considers the Final Commitments capable of rendering the Transaction compatible with the internal market and the EEA Agreement as it will not create a significant impediment to effective competition in the market in which competition concerns were identified, namely the worldwide market for the supply of FC HBAs.

10. CONDITIONS AND OBLIGATIONS

- (1080) Pursuant to the second subparagraph of Article 8(2) of the Merger Regulation, the Commission may attach to its decision conditions and obligations intended to ensure that the undertakings concerned comply with the commitments they have entered into *vis-à-vis* the Commission with a view to rendering the concentration compatible with the internal market.
- (1081) The fulfilment of the measure that gives rise to the structural change of the market is a condition, whereas the implementing steps which are necessary to achieve this result are generally obligations on the parties. Where a condition is not fulfilled, the Commission's decision declaring the concentration compatible with the internal market is no longer applicable. Where the undertakings concerned commit a breach of an obligation, the Commission may revoke the clearance decision in accordance with Article 8(6) of the Merger Regulation. The undertakings concerned may also be subject to fines and periodic penalty payments under Articles 14(2) and 15(1) of the Merger Regulation.
- (1082) In accordance with the basic distinction described in paragraph (1080) of this Decision as regards conditions and obligations, this Decision should be made conditional on the full compliance by the Notifying Party with the Section B of the Final Commitments submitted by the Notifying Party on 14.06.2023 and all other Sections of the Final Commitments should be obligations within the meaning of Article 8(2) of the Merger Regulation. The full text of the commitments is attached as an Annex to this Decision and forms an integral part thereof.

HAS ADOPTED THIS DECISION:

Article 1

The notified operation whereby Broadcom, Inc. acquires sole control of VMware, Inc. within the meaning of Article 3(1)(b) of the Merger Regulation is hereby declared compatible with the internal market and the EEA Agreement.

Article 2

Article 1 is subject to compliance with the conditions set out in the Section B of the Annex to this Decision, read in connection with Section A thereof.

Article 3

Broadcom, Inc. shall comply with the obligations set out in the Section(s) C-F of the Annex to this Decision, read in connection with Section A thereof.

Article 4

This Decision is addressed to:

Broadcom, Inc.
1320 Ridder Park Drive
San José, CA 95131
United States of America

Done at Brussels, 12.7.2023

For the Commission

(Signed)
Margrethe VESTAGER
Executive Vice-President

June 14, 2023

**Case M.10806 - BROADCOM/ VMWARE
COMMITMENTS TO THE EUROPEAN COMMISSION**

Pursuant to Article 8(2) and 10(2) of Council Regulation (EC) No 139/2004 (the "Merger Regulation"), Broadcom Inc. hereby enters into the following Commitments (the "Commitments") vis-a-vis the European Commission (the "Commission") with a view to rendering its proposed acquisition of VMware, Inc. (the "Concentration") compatible with the internal market and the functioning of the EEA Agreement.

This text shall be interpreted in light of the Commission's decision pursuant to Article 8(2) of the Merger Regulation to declare the Concentration compatible with the internal market and the functioning of the EEA Agreement (the "Decision"), in the general framework of European Union law, in particular in light of the Merger Regulation, and by reference to the Commission Notice on remedies acceptable under Council Regulation (EC) No 139/2004 and under Commission Regulation (EC) No 802/2004.

Section A. Definitions

For the purpose of the Commitments, the following terms shall have the following meaning:

Affiliated Undertakings: undertakings controlled by the Combined Entity and/or by the ultimate parents of the, Combined Entity, whereby the notion of control shall be interpreted pursuant to Article 3 of the Merger Regulation and in light of the Commission Consolidated Jurisdictional Notice under Council Regulation (EC) No 139/2004 on the control of concentrations between undertakings.

Authorized Staff: the Combined Entity's employees and contractors who have a bona fide need to have access to Marvell Confidential Information solely for the purpose of Certification and Technical Support.

Broadcom: Broadcom Inc. and any Affiliated Undertakings of Broadcom Inc.

Broadcom FC HBA: any FC HBA that is developed or manufactured by the Combined Entity.

Certification: the validation, engineering testing, test result and other verification of FC HBAs, including, but not limited to, access to a Driver Development Kit, a Certification Suite, and the VMware Integration Validation (VIVa) automated testing platform, and to certification by equivalency, undertaken by VMware and Marvell with a view to testing and ensuring that the latter's Drivers are compatible with the Interoperability APIs.

Certification Suite: testing suites and related documentation used for Certification.

Closing: the closing date of the Concentration.

Combined Entity: the combined Broadcom and VMware businesses together with their successors, assigns and affiliates including as a result of the Concentration, following the consummation of the Concentration.

Conflict of Interest: any conflict of interest that impairs a person's objectivity and independence in discharging its duties under the Commitments.

Driver: a computer program that provides a software interface to FC HBAs, enabling Server Virtualization Software to access functions of FC HBAs, and vice versa.

Driver Development Kit: a software development kit (also known as a certification kit) for developing Drivers and related documentation, such as training information, and other information, tools, resources, and processes that are made available to Marvell to explain how to use the Interoperability APIs and to enable the development, Certification, and release of Drivers for Server Virtualization Software.

ECD: the division inside Broadcom that operates the FC HBA business of Broadcom (currently known as the Emulex Connectivity Division).

Effective Date: the date of the adoption of the Decision.

FC HBA: a Fibre Channel Host Bus Adapter, i.e., a board with firmware used mostly in servers to interconnect the server's processor with storage hard drives or solid-state drivers using the Fibre Channel protocol. FC HBA shall cover any current or future generation of FC HBAs.

Interoperability APIs: application programming interfaces of Server Virtualization Software needed to develop, certify, and release Drivers for FC HBAs.

Marvell: Marvell Technology, Inc. or undertakings controlled by Marvell Technology, Inc. and/or by the ultimate current or future parents of Marvell Technology, Inc., whereby the notion of control shall be interpreted pursuant to Article 3 of the Merger Regulation and in light of the Commission Consolidated Jurisdictional Notice under Council Regulation (EC) No 139/2004 on the control of concentrations between undertakings.

Marvell Confidential Information: any and all non-public technical and non-technical information provided by Marvell to the Combined Entity for purposes of Certification and Technical Support of Marvell FC HBAs, including interoperability testing, feature development, and specification and roadmap alignment (if any) between the Marvell products and Server Virtualization Software (whether required for these purposes or not), including but not limited to Marvell's (a) patent and patent applications, (b) trade secrets, and (c) proprietary information, including ideas, samples, media, techniques, sketches, drawings, works of authorship, models, inventions, know-how, processes, apparatuses, equipment, algorithms, software programs, software source documents, network traces and diagnostic traces related to the current, future and proposed products and services of Marvell, and including, without limitation, Marvell's information concerning research, experimental work, development, design details and specifications, engineering, financial information, procurement requirements, purchasing, manufacturing, customer lists, investors, employees, business and

contractual relationships, business forecasts, sales and merchandising, marketing plans and information that Marvell provides regarding third parties.

Marvell FC HBA: any current or future generation of FC HBA that is developed or manufactured by Marvell.

Monitoring Trustee: one or more natural or legal persons who are approved by the Commission and appointed by Broadcom, and who have the duty to monitor Broadcom's compliance with the conditions and obligations attached to the Decision.

Open Source License: the Apache Software Foundation's Apache License, Version 2.0, available here: <http://www.apache.org/licenses/>.

Pre-Release Materials: pre-release versions of the Driver Development Kit and VMware products, including beta-type builds, that are provided by VMware to partners of the VMware I/O Vendor Partner Program via official (such as the official beta program) and unofficial milestones, and as listed in the VMware program guide that applies to the VMware I/O Vendor Partner Program.

Server Virtualization Software: the supported releases of VMware's ESXi software that provides virtualization of x86-based servers by making it possible to run multiple operating systems and multiple applications on the same server at the same time, by separating it into virtual machines. Server Virtualization Software shall cover any current or future generation of ESXi.

Technical Support: engineering and other technical support or feedback, development consulting, troubleshooting, debugging, and post-release support activities, including, but not limited to, (i) pre-release support and support provided through the VMware Developer Center Partner Network, or any other necessary engagement model, that VMware makes available when a partner runs into an issue in the development, Certification, or release of Drivers, and (ii) technical support to Marvell's end-customers using the FC HBA or the Driver.

VMware: VMware, Inc. or any Affiliated Undertakings of VMware, Inc, and following the consummation of the Concentration, the VMware business unit(s) of the Combined Entity.

Section B. Commitments

B.1 Open Access to APIs and Certification

1. The Combined Entity shall make the Interoperability APIs, the Driver Development Kit, the Pre-Release Materials and the Certification Suite available to Marvell in a timely manner such that Marvell can develop and introduce any new features without delay, but in any event in the same timely manner as they are provided to ECD.
2. The Combined Entity further commits:
 - a. To provide Technical Support in accordance with VMware's past practice in the case where Marvell runs into an issue in developing, certifying, or

releasing the Drivers and at least the same level of Technical Support and in the same timely manner as the Combined Entity provides to ECD.

- b. To take measures necessary to provide Marvell with at least the same level of Certification that the Combined Entity provides at any point in time to ECD for its Drivers, including by providing Marvell with the same level of Technical Support during the Certification process and in the same timely manner as the Combined Entity provides to ECD.
 - c. Not to discriminate between Marvell and the Combined Entity by designing or engineering Server Virtualization Software or implementing any changes to Server Virtualization Software (including, but not limited to, additions, changes, or removals of functionalities in the software, firmware, or interfaces) so that it interoperates with Broadcom FC HBAs in a manner that would favor Broadcom FC HBAs or negatively affect Marvell FC HBAs (including, but not limited to, in terms of degree of product reliability, timing of Certification or market release, performance (speed), and feature richness).
 - d. To provide the VMware Integration Validation (VIVa) automated testing platform to enable Marvell itself to certify or validate its Drivers as compatible with Server Virtualization Software by running certification test suites and automatically validating test results and listing certified products on the VMware Compatibility Guide in a neutral fashion and without preference.
 - e. To certify a Driver as compatible with Server Virtualization Software except if the Combined Entity provides due justification in accordance with objective criteria that shall be no more onerous than past certification practices.
 - f. To apply a VMware digital signature to the certified Drivers (which identifies it at the "VMware Certified" level of acceptance) and update the VMware Compatibility Guide to include and list in a neutral fashion and without preference the applicable certified version of the Drivers and its associated devices that are supported, and, if requested by Marvell, make the certified drivers available on the vmware.com website.
 - g. To not impose any fee increase to Marvell that exceeds the fees paid by any other VMware customer for the same level of certification, certification support, as well as other participation in VMware's Software-Defined Data Center Integration Program and VMware's Technology Alliance Partner program or in any successor program that provides access to packages, tools and resources to develop, certify, and release Drivers for the Marvell FC HBAs and to maintain the level of such fees at a level in line with past practice.
3. Provided that the Combined Entity remains in material compliance with Sections B.1-B.3, the Combined Entity shall not be in breach of these Commitments in the event of any degradation of interoperability between a server and a Marvell FC HBA that is

attributable in whole or in part to any acts or omissions of a server OEM, a developer of a server operating system, or Marvell.

B.2. Open Source Driver Grant

4. Within 30 days from Closing, the Combined Entity shall provide Marvell with a source code library for the current and future versions of the Drivers of Broadcom FC HBAs, and grant Marvell an irrevocable license to such source code ("Driver License") under the Open Source License. The Driver License will enable Marvell to verify that it and the Combined Entity have access to the same information necessary to ensure interoperability with Server Virtualization Software and to reuse and modify the Drivers of Broadcom FC HBAs for Marvell's own use.

B.3. Organizational Separation and Confidentiality

5. The Combined Entity shall ensure that:
 - a. the Marvell Confidential Information received from Marvell in the context of Certification and Technical Support is held in strict confidence and is disclosed only to Authorized Staff; and
 - b. the Combined Entity does not use such Marvell Confidential Information except for Certification and Technical Support.
6. To meet its Commitments under paragraph 5, the Combined Entity shall implement a strict organizational separation between the ECD and VMware business units in accordance with the following:
 - a. Ensuring the organizational separation of the VMware and ECD business units, with a different Vice President and General Manager for each. Accordingly, the personnel involved in Certification and Technical Support will report up to a VMware General Manager and the Combined Entity's personnel responsible for developing the Broadcom FC HBAs will report up to the ECD General Manager;
 - b. Not allowing any movement of employees between ECD and VMware without at least three months prior notice to the Monitoring Trustee and subject to a minimum of 12-month waiting period after the employee stops working for the former team;
 - c. Maintaining the activities relating to the design and development of the Broadcom FC HBAs in separate physical locations from the Combined Entity's activities relating to Certification and Technical Support;
 - d. Ensuring that any Combined Entity's team working on Certification and Technical Support uses storage and hardware access systems separate from, and inaccessible to, the ECD team working on the Broadcom FC HBAs;

- e. Ensuring that data related to the Broadcom FC HBAs is separated through a logical separation of networks from Marvell Confidential Information;
 - f. Preventing any storage of Marvell Confidential Information outside the organizational separation created for the Combined Entity's personnel working on Certification and Technical Support without Marvell's prior written consent;
 - g. Enlisting a third-party auditor in the event of an audit initiated by VMware, or any other mechanism by which VMware exercises contractual rights to review Marvell's business; and
 - h. Committing adequate resources to educating staff about the requirements of the organizational separation measures.
7. The Combined entity shall make the terms of the Commitments applicable to a new entrant in the supply of FC HBAs (other than Marvell and the Combined Entity). In the event such company desires to benefit from the terms of the Commitments, it shall provide the Combined Entity with a 60-day prior written notice. For the avoidance of doubt, the term "Marvell" as it is used in the Commitments will be construed to mean either Marvell or the new entrant, if any.

Section C. Monitoring Trustee

C.1 Appointment procedure

- 8. No later than the date of Closing, Broadcom shall appoint a Monitoring Trustee to carry out the functions specified in these Commitments for a Monitoring Trustee.
- 9. The Monitoring Trustee shall:
 - a. At the time of appointment, be independent of the Combined Entity and each of their Affiliated Undertakings;
 - b. Possess the necessary experience, competence, and qualifications to carry out its mandate; and
 - c. Neither have nor become exposed to a Conflict of Interest.
- 10. The Monitoring Trustee shall be remunerated by Broadcom in a way that does not impede the independent and effective fulfillment of its mandate.
- 11. Proposal by Broadcom. No later than four weeks after the Effective Date, Broadcom shall submit the name or names of one or more natural or legal persons whom Broadcom proposes to appoint as the Monitoring Trustee to the Commission for approval. The proposal shall contain sufficient information for the Commission to verify that the person or persons proposed as Monitoring Trustee fulfil the requirements set out in paragraph 9 and shall include:

- a. The full terms of the proposed mandate, which shall include all provisions necessary to enable the Monitoring Trustee to fulfil its duties under these Commitments; and
 - b. The outline of a work plan that describes how the Monitoring Trustee intends to carry out its assigned tasks.
- 12. Approval or rejection by the Commission. The Commission shall have the discretion to approve or reject the proposed Monitoring Trustee(s) and to approve the proposed mandate subject to any modifications it deems necessary for the Monitoring Trustee to fulfil its obligations. If only one name is approved, Broadcom shall appoint or cause to be appointed the person or persons concerned as Monitoring Trustee, in accordance with the mandate approved by the Commission. If more than one name is approved, Broadcom shall be free to choose the Monitoring Trustee to be appointed from among the names approved. The Monitoring Trustee shall be appointed within one week of the Commission's approval, in accordance with the mandate approved by the Commission.
- 13. New proposal by Broadcom. If all the proposed Monitoring Trustees are rejected, Broadcom shall submit the names of at least two more natural or legal persons within one week of being informed of the rejection, in accordance with paragraphs 8 and 12 of these Commitments.
- 14. Monitoring Trustee nominated by the Commission. If all further proposed Monitoring Trustees are rejected by the Commission, the Commission shall nominate a Monitoring Trustee, whom Broadcom shall appoint, or cause to be appointed, in accordance with a Monitoring Trustee mandate approved by the Commission.

C.2 Functions of the Monitoring Trustee

- 15. The Monitoring Trustee will act on behalf of the Commission as a trusted expert in the fast track dispute settlement procedure described in Section D.
- 16. The Monitoring Trustee shall assume its specified duties and obligations in order to ensure compliance with the Commitments. The Commission may, on its own initiative or at the request of the Monitoring Trustee or Broadcom, give any orders or instructions to the Monitoring Trustee in order to ensure compliance with the conditions and obligations attached to the Decision.
- 17. The Monitoring Trustee shall:
 - a. Monitor the performance of the Commitments by Broadcom;
 - b. Send, within one month of its appointment, its first report to the Commission containing a detailed work plan describing how it intends to monitor compliance with the obligations and conditions attached to the Decision;
 - c. Provide to the Commission a written report, sending Broadcom a non-confidential copy at the same time, within fifteen working days after the end of

every quarter during the first two years since the Effective Date, and within fifteen working days after the end of each six-month period as of the third year since the Effective Date, so that the Commission can assess whether the Commitments are being complied with;

- d. Propose, as applicable, to Broadcom such measures as the Monitoring Trustee considers necessary to ensure Broadcom's compliance with the Commitments;
- e. Promptly report in writing to the Commission, sending Broadcom a non-confidential copy at the same time, if it concludes on reasonable grounds that Broadcom is failing to comply with the Commitments;
- f. Act as a contact point for questions from third parties, and in particular Marvell, about the nature and scope of the Commitments; and
- g. Assume the other functions assigned to the Monitoring Trustee under the conditions and obligations attached to the Decision.

C.3 Duties and obligations of the Combined Entity

- 18. The Combined Entity shall provide and shall cause its advisors to provide the Monitoring Trustee without delay with all such cooperation, assistance and information as the Monitoring Trustee may reasonably require to perform its tasks. The Monitoring Trustee shall have full and complete access to any of the Combined Entity's books, records, documents, management or other personnel, facilities, sites and technical information reasonably necessary for fulfilling its duties under the Commitments and Broadcom shall provide the Monitoring Trustee upon request with copies of any documents except where such disclosure would give rise to a loss of any applicable legal privilege.
- 19. Broadcom shall indemnify the Monitoring Trustee and its employees and agents (each an "Indemnified Party") and hold each Indemnified Party harmless against, and hereby agrees that an Indemnified Party shall have no liability to Broadcom for, any liabilities arising out of the performance of the Monitoring Trustee's duties under the Commitments, except to the extent that such liabilities result from the willful default, recklessness, gross negligence or bad faith of the Monitoring Trustee, its employees, agents or advisors.
- 20. At the expense of Broadcom, the Monitoring Trustee may appoint advisors, subject to Broadcom's approval (this approval not to be unreasonably withheld or delayed) if the Monitoring Trustee considers in good faith the appointment of such advisors necessary or appropriate for the performance of its duties and obligations under the mandate, provided that any fees and other expenses incurred by the Monitoring Trustee are reasonable. Should Broadcom refuse to approve advisors proposed by the Monitoring Trustee the Commission may approve the appointment of such advisors instead, after having heard Broadcom. Only the Monitoring Trustee shall be entitled to issue instructions to the advisors. Paragraph 19 of these Commitments shall apply mutatis mutandis.

21. Broadcom agrees that the Commission may share Confidential Information proprietary to Broadcom with the Monitoring Trustee. The Monitoring Trustee shall not disclose Confidential Information received from the Commission or the Combined Entity to any third party other than the Commission. The principles contained in Article 17(1) and (2) of the Merger Regulation apply mutatis mutandis.
22. Broadcom agrees that the contact details of the Monitoring Trustee are published on the website of the Commission's Directorate-General for Competition and they shall inform interested third parties of the identity and the tasks of the Monitoring Trustee.

C.4 Replacement, discharge and reappointment of the Monitoring Trustee

23. If the Monitoring Trustee ceases to perform its functions under the Commitments or for any other good cause, including the exposure of the Monitoring Trustee to a Conflict of Interest:
 - a. The Commission may, after hearing the Monitoring Trustee and Broadcom, require Broadcom to replace the Monitoring Trustee; or
 - b. Broadcom may, with the prior approval of the Commission, replace the Monitoring Trustee.
24. If the Monitoring Trustee is removed according to paragraph 23 of these Commitments, the Monitoring Trustee may be required to continue its function until a new Monitoring Trustee is in place to whom the Monitoring Trustee has effected a full hand over of all the relevant information. The new Monitoring Trustee shall be appointed in accordance with the procedure referred to in paragraphs 8-14 of these Commitments.
25. Unless removed according to paragraph 23 of these Commitments, the Monitoring Trustee shall cease to act as Monitoring Trustee only after the Commission has discharged it from its duties after all the Commitments with which the Monitoring Trustee has been entrusted have been implemented.

Section D. Fast Track Dispute Resolution

26. In the event that Marvell claims that the Combined Entity is failing to comply with its obligations arising from the Commitments set out in Section B, the fast track dispute resolution procedure as described herein shall apply.
27. Marvell (the "Requesting Party") shall send a written request to the Combined Entity (with a copy to the Monitoring Trustee) setting out in detail the reasons why it believes that the Combined Entity is failing to comply with the Commitments. The Requesting Party and the Combined Entity shall use their best efforts to resolve all differences of opinion and to settle all disputes that may arise through co-operation and consultation within a reasonable period of time not to exceed fifteen 15 working days after receipt of the request.

28. The Monitoring Trustee shall present its own proposal (the "Trustee Proposal") for resolving the dispute within eight (8) working days, specifying in writing the action, if any, to be taken by the Combined Entity or an Affiliated Undertaking in order to ensure compliance with the Commitments vis-a-vis the Requesting Party, and be prepared, if requested, to facilitate the settlement of the dispute.
29. Should the Requesting Party and the Combined Entity (together the "Parties to the Arbitration") fail to resolve their differences of opinion in the consultation phase, the Requesting Party shall serve a notice (the "Notice"), in the sense of a request for arbitration, to the International Chamber of Commerce ("ICC", hereinafter the "Arbitral Institution"), with a copy of such Notice and request for arbitration to the Combined Entity.
30. The Notice shall set out in detail the dispute, difference or claim (the "Dispute") and shall contain, inter alia, all issues of both fact and law, including any suggestions as to the procedure, and all documents relied upon shall be attached, e.g., documents, agreements, expert reports, and witness statements. The Notice shall also contain a detailed description of the action to be undertaken by the Combined Entity (including, if appropriate, a draft contract comprising all relevant terms and conditions) and the Trustee Proposal, including a comment as to its appropriateness.
31. The Combined Entity shall, within 10 working days from receipt of the Notice, submit its answer (the "Answer"), which shall provide detailed reasons for its conduct and set out, inter alia, all issues of both fact and law, including any suggestions as to the procedure, and all documents relied upon, e.g., documents, agreements, expert reports, and witness statements. The Answer shall, if appropriate, contain a detailed description of the action which the Combined Entity proposes to undertake vis-a-vis the Requesting Party (including, if appropriate, a draft contract comprising all relevant terms and conditions) and the Trustee Proposal (if not already submitted), including a comment as to its appropriateness.

Appointment of the Arbitrators

32. The Arbitral Tribunal shall consist of three persons. The Requesting Party shall nominate its arbitrator in the Notice; the Combined Entity shall nominate its arbitrator in the Answer. The arbitrator nominated by the Requesting Party and by the Combined Entity shall, within five working days of the nomination of the latter, nominate the chairman, making such nomination known to the parties and the Arbitral Institution which shall forthwith confirm the appointment of all three arbitrators.
33. Should the Requesting Party wish to have the Dispute decided by a sole arbitrator it shall indicate this in the Notice. In this case, the Requesting Party and the Combined Entity shall agree on the nomination of a sole arbitrator within five working days from the communication of the Answer, communicating this to the Arbitral Institution.

34. Should the Combined Entity fail to nominate an arbitrator, or if the two arbitrators fail to agree on the chairman, or should the Parties to the Arbitration fail to agree on a sole arbitrator, the default appointment(s) shall be made by the Arbitral Institution.
35. The three-person arbitral tribunal or, as the case may be, the sole arbitrator, are herein referred to as the "Arbitral Tribunal".

Arbitration Procedure

36. The Dispute shall be finally resolved by arbitration under the ICC Rules of Arbitration, with such modifications or adaptations as foreseen herein or necessary under the circumstances (the "Rules"). The arbitration shall be conducted in Santa Clara County, California, USA, in the English language.
37. The procedure shall be a fast-track procedure. For this purpose, the Arbitral Tribunal shall shorten all applicable procedural time-limits under the Rules as far as appropriate in the circumstances. The Parties to the Arbitration shall consent to the use of e-mail for the exchange of documents.
38. The Arbitral Tribunal shall, as soon as practical after the confirmation of the Arbitral Tribunal, hold an organizational conference to discuss any procedural issues with the Parties to the Arbitration. Terms of Reference shall be drawn up and signed by the Parties to the Arbitration and the Arbitral Tribunal at the organizational meeting or thereafter and a procedural timetable shall be established by the Arbitral Tribunal. An oral hearing shall, as a rule, be established within two months of the confirmation of the Arbitral Tribunal.
39. In order to enable the Arbitral Tribunal to reach a decision, it shall be entitled to request any relevant information from the Combined Entity or the Requesting Party, to appoint experts and to examine them at the hearing, and to establish the facts by all appropriate means. The Arbitral Tribunal is also entitled to ask for assistance by the Monitoring Trustee in all stages of the procedure if the Parties to the Arbitration agree.
40. The arbitrators shall not disclose confidential information and apply the standards attributable to confidential information under the Merger Regulation. The Arbitral Tribunal may take the measures necessary for protecting confidential information in particular by restricting access to confidential information to the Arbitral Tribunal, the Monitoring Trustee and outside counsel and experts of the opposing party.
41. The burden of proof in any dispute governed under the Rules shall be borne as follows: (i) the Requesting Party must produce evidence of a prima facie case; (ii) if that the Requesting Party does so, the Arbitral Tribunal must find in favor of the Requesting Party unless the Combined Entity can produce evidence to the contrary.

Involvement of the Commission

42. The Commission shall be allowed and enabled to participate in all stages of the procedure by:
- a. receiving all written submissions (including documents and reports, etc.) made by the Parties to the Arbitration;
 - b. receiving all orders, interim and final awards and other documents exchanged by the Arbitral Tribunal with the Parties to the Arbitration (including Terms of Reference and procedural time-table);
 - c. giving the Commission the opportunity to file *amicus curiae* briefs; and
 - d. being present at the hearing(s) and being allowed to ask questions to parties, witnesses and experts.
43. The Arbitral Tribunal shall forward, or shall order the Parties to the Arbitration to forward, the documents mentioned to the Commission without delay.
44. In the event of disagreement between the Parties to the Arbitration regarding the interpretation of the Commitments, the Arbitral Tribunal may seek the Commission's interpretation of the Commitments before finding in favor of any party to the Arbitration and shall be bound by the interpretation.

Decisions of the Arbitral Tribunal

45. The Arbitral Tribunal shall decide the dispute on the basis of the Commitments and the Decision. Issues not covered by the Commitment and the Decision shall be decided (in the order as stated) by reference to the Merger Regulation, EU law and general principles of law common to the legal orders of the Member States without a requirement to apply a particular national system. The Arbitral Tribunal shall take all decisions by majority vote.
46. Upon request of the Requesting Party, the Arbitral Tribunal may make a preliminary ruling on the Dispute. The preliminary ruling shall be rendered within one month after the confirmation of the Arbitral Tribunal, shall be applicable immediately and, as a rule, remain in force until a final decision is rendered.
47. The Arbitral Tribunal shall, in the preliminary ruling as well as in the final award, specify the action, if any, to be taken by the Combined Entity in order to comply with the Commitments vis-a-vis the Requesting Party (e.g., specify a contract including all relevant terms and conditions). The final award shall be final and binding on the Parties to the Arbitration and shall resolve the Dispute and determine any and all claims, motions or requests submitted to the Arbitral Tribunal. The arbitral award shall also determine the reimbursement of the costs of the successful party and the allocation of the arbitration costs. In case of granting a preliminary ruling or if otherwise appropriate, the Arbitral Tribunal shall specify that terms and conditions determined in the final award apply retroactively.

48. The final award shall, as a rule, be rendered within six months after the confirmation of the Arbitral Tribunal. The time-frame shall, in any case, be extended by the time the Commission takes to submit an interpretation of the Commitments if asked by the Arbitral Tribunal.
49. The Parties to the Arbitration shall prepare a non-confidential version of the final award, without business secrets. The Commission may publish the non-confidential version of the award.
50. Nothing in the above-described arbitration procedure shall affect the powers of the Commission to take decisions in relation to the Commitments in accordance with its powers under the Merger Regulation.

Section E. General Provisions

51. The Commitments shall take effect upon Closing.
52. If the Concentration is abandoned, unwound or otherwise terminated, these Commitments shall automatically cease to apply.
53. The Commitments shall remain in effect for ten years from the Effective Date.

Section F. Review

54. With the exception of the period referred to in paragraph 53 above, the Commission may extend the time periods foreseen in the Commitments in response to a request from Broadcom or, in appropriate cases, on its own initiative. Where Broadcom requests an extension of a time period, it shall submit a reasoned request to the Commission no later than one month before the expiry of that period, showing good cause. This request shall be accompanied by a report from the Monitoring Trustee, who shall, at the same time send a non-confidential copy of the report to the Notifying Party. Only in exceptional circumstances shall Broadcom be entitled to request an extension within the last month of any period.
55. The Commission may in response to a reasoned request from Broadcom showing good cause, waive, modify, or substitute, in exceptional circumstances, one or more of the undertakings in these Commitments. This request shall be accompanied by a report from the Monitoring Trustee, who shall at the same time send a non-confidential copy of the report to Broadcom. The request shall not have the effect of suspending the application of the undertaking and, in particular, of suspending the expiry of any time period in which the undertaking has to be complied with.

[Signed]

Duly authorized for and on behalf of Broadcom Inc.