

Anticipated acquisition by SK hynix Inc of Intel Corporation's NAND and SSD business

Decision on relevant merger situation and substantial lessening of competition

ME/6913/20

The CMA's decision on reference under section 33(1) of the Enterprise Act 2002 given on 28 June 2021. Full text of the decision published on 30 July 2021.

Please note that [X] indicates figures or text which have been deleted or replaced in ranges at the request of the parties or third parties for reasons of commercial confidentiality.

SUMMARY

1. SK hynix Inc. (**SK hynix**) has agreed to acquire Intel Corporation's NAND and SSD business (the **Target**) (the **Merger**). SK hynix and the Target are together referred to as the **Parties** and, for statements relating to the future, the **Merged Entity**.
2. The Competition and Markets Authority (**CMA**) considered whether, as a result of horizontal unilateral effects, the Merger may give rise to a substantial lessening of competition (**SLC**). The Parties overlap in the supply of NAND flash memory (**NAND**) and solid-state disks (**SSDs**). The CMA focused its assessment on the segments for 3D NAND and PCIe enterprise SSD.
3. In relation to the supply of 3D NAND, the CMA found that, while the Parties will have a moderate combined market share in the supply of 3D NAND of [20-30]%, they are not particularly close competitors. In addition, the CMA found that there will be strong remaining competitors post-Merger, and a number of these competitors told the CMA that they had plans to expand their capacity. The vast majority of third parties which engaged with the CMA were either neutral or positive in their views towards the Merger.

4. In PCIe enterprise SSDs,¹ the CMA found that the Parties will have a relatively high combined share of [30-40]% and that the market is concentrated. However, the CMA again found that the Parties are not particularly close competitors, based on evidence from third parties and internal documents as well as the limited customer overlap between the Parties. The CMA also found that the dynamics of competition within the wider enterprise SSD market mean that the Parties will face strong remaining competitors post-Merger. The CMA found that SK hynix has grown its PCIe SSD market share rapidly, but that the growth has come primarily from [✂]. The CMA believes this growth is reflective of the market transitioning from enterprise SSDs with different interfaces (SATA and SAS) to PCIe enterprise SSDs. Based on the evidence the CMA has received from third parties, as part of this transition, the CMA expects several other significant competitors to expand in the PCIe enterprise SSDs segment and the CMA further expects that this will provide a growing constraint on the Parties.
5. The CMA believes that these constraints, taken together, are sufficient to ensure that the Merger does not give rise to a realistic prospect of a substantial lessening of competition (**SLC**) as a result of horizontal unilateral effects.
6. The Merger will therefore **not be referred** under section 33(1) of the Enterprise Act 2002 (the **Act**).

ASSESSMENT

Parties and transaction

7. SK hynix is a multinational company which is active in the design and manufacturing of semiconductor products. SK hynix primarily designs and manufactures memory storage devices such as dynamic random-access memory (**DRAM**), NAND flash memory, NAND-based SSDs and managed NAND products, as well as system semiconductors such as complementary metal oxide semiconductor (**CMOS**) image sensors.

¹ SSDs for enterprises are SSDs used for business storage applications such as corporate datacentres and high workload servers. PCIe is a common industry standard interface that connects the SSD to the wider computer system.

8. SK hynix's NAND business includes various technological variations of NAND and SSDs which incorporate NAND technology. This business accounts for approximately [X]% of SK hynix's global revenues.²
9. SK hynix has its headquarters and production sites in South Korea. It also has production sites in China, as well as R&D centres and sales offices across the world. SK hynix's turnover in the financial year ending 31 December 2019 was approximately GBP 17,791 million, of which approximately GBP [X] was attributable to the UK.
10. The Target includes the NAND and SSD business of Intel Corporation (**Intel**). The Target is active in the design and manufacture of NAND flash memory and SSDs which incorporate NAND flash memory technology.
11. Intel is headquartered in Santa Clara, California, USA. The Target's turnover for the financial year ending December 2019 was approximately GBP [X]¹ million, of which approximately GBP [X] million was attributable to the UK.
12. Pursuant to a Master Purchase Agreement (**MPA**) dated 19 October 2020, SK hynix has agreed to acquire the Target from Intel.³ Under the MPA, SK hynix will acquire certain of Intel's equipment and other tangible assets, including supply contracts and intellectual property for the manufacture and development of NAND wafers, as well as related employees (the **NAND Business Assets**); and (ii) certain of Intel's assets used for its SSD business, including the related equipment and tangible assets, contracts, employees and intellectual property for the design and production of NAND SSDs, as well as related employees (the **SSD Business Assets**).⁴ The Merger is expected to complete over two stages, with an initial transfer of certain assets and operations in late 2021 (after which the Target will no longer compete in respect of NAND or NAND-based SSD or have an independent market facing roles in these product areas) and final completion expected on or after 15 March 2025.⁵

² SK hynix has two other key business areas under its semiconductor business, namely: 1) SK hynix offers DRAM chips that are used in data and graphic processing applications in data centres as well as in a wide array of information technology ('IT') devices for consumer applications. This business accounts for approximately [X]% of SK hynix's global revenues; and 2) CMOS image sensors, ie non-memory semiconductors that serve the role of digital film in many IT devices. SK hynix's CMOS image sensors are used in digital cameras, smartphones and miniature medical imaging systems. This business and all other associated revenues account for approximately [X]% of SK hynix's global revenues.

³ Final Merger Notice, paragraph 2.57.

⁴ Final Merger Notice, paragraph 2.57.

⁵ Final Merger Notice, paragraph 2.58.

Jurisdiction

13. The initial period for consideration of the Merger under section 34ZA(3) of the Act started on 10 May 2021 and the statutory 40 working day deadline for a decision is therefore 5 July 2021.

SK hynix and the Target

14. Each of SK hynix and the Target is an enterprise. In particular, the Target is an enterprise because, as described at paragraph 12 above, it comprises an extensive collection of business assets (the NAND Business Assets and the SSD Business Assets), the transfer of which will allow SK hynix to carry on the activities of the Target's business in the supply of SSDs and NAND.⁶
15. As a result of the Merger, these enterprises will cease to be distinct.
16. The Act also requires the CMA to assess whether either the turnover of the target in the UK exceeds GBP 70 million (the **turnover test**) or the merger results in a combined share of supply or acquisition of goods or services of any description of 25% or more (the **share of supply test**).⁷

The turnover test

17. The Target's UK turnover in 2019 was below GBP 70 million (as noted at paragraph 11 above, approximately GBP [X] million). The turnover test is therefore not met.

The share of supply test

18. The Parties' activities overlap in the supply of NAND and SSDs in the UK.
19. The Act gives a wide discretion to the CMA to apply whatever measure, or combination of measures, it considers appropriate to calculate the merging parties' share of supply or procurement and to determine whether the 25% threshold under section 23 of the Act is satisfied. Section 23(5) of the Act provides that the CMA shall apply such criterion as it considers 'appropriate' and, in doing so, specifically cites 'value' and 'some other criterion, of whatever nature' as examples of an appropriate criterion. The CMA's wide

⁶ Guidance on the CMA's jurisdiction and procedure (CMA2, December 2020) (**Jurisdiction and Procedure Guidance**), paragraph 4.13.

⁷ Section 33(1)(a) and section 23 of the Act.

ranging discretion as to the criterion or combination of criterion to apply was recently confirmed by the Competition Appeals Tribunal.⁸

20. In 2019,⁹ as set out in Table 1 below, in respect of certain categories of SSDs, the Parties combined shares of supply in the UK on the basis of revenue¹⁰ were as follows:

- (a) [20 – 30]% for all SSDs with an increment of [0 – 5]%;
- (b) [50 – 60]% for all enterprise SSDs with an increment of [0 – 5];%; and
- (c) [30 – 40]% for enterprise SSDs SATA with an increment of [0 – 5]%.¹¹

Table 1: UK SSD shares of supply in revenues (2019)

Competitor	UK SSD shares of supply (%) based on revenues		
	Total SSD	Enterprise SSD	SATA enterprise SSD
SK hynix	[0 – 5]%	[0 – 5]%	[0 – 5]%
The Target	[20 – 30]%	[50 – 60]%	[30 – 40]%
Merged Entity	[20 – 30]%	[50 – 60]%	[30 – 40]%

Source: Parties' shares of supply estimates provided in the Parties' response to CMA's Request for Information, dated 3 February 2021, Annex 5.1, supplemented by the revenues submitted by competitors.

21. The CMA has also considered, as an additional quantitative criterion in assessing the share of supply test, the proportion of end products supplied in the UK which use the Parties' SSDs and/or NAND as a component part. The CMA considers that considering this additional criterion is reasonable in the circumstances of this case. As many of the end products using SSDs / NAND as a component part tend not to be manufactured in the UK, focusing solely on SSDs and NAND shipped to the UK or sold to UK based entities may underestimate the importance of SSDs and NAND (and the Parties' activities in respect of these products) to UK markets and, ultimately, consumers.
22. The Parties submitted that their global shares of supply in SSDs and NAND would be a reasonable approximation of the number of end products supplied

⁸ *Sabre Corporation v CMA*, [2021] CAT 11, at paragraphs 293 - 294.

⁹ Throughout this decision, the CMA has considered both 2019 and 2020 share of supply data. This is to take into account the potential impact of the COVID-19 pandemic on the 2020 data, given the impact of the pandemic on the global economy and the potential for disruption in global supply chains, including those related to NAND and SSDs, and to reflect the dynamic nature of the NAND and SSD markets. The CMA considers that doing so for the purpose of assessing the share of supply test under section 23 of the Act is also appropriate for the same reasons.

¹⁰ For the purpose of collating the UK shares of supply referred to in this paragraph and in Table 1, revenue was calculated on a 'shipped to' basis (ie based on the location of the delivery address).

¹¹ The CMA discusses SSDs and the various interfaces which can be manufactured with an SSD at paragraphs 45 to 48.

in the UK which used their SSDs or NANDs as a component part.¹² The CMA considers that, as set out in Table 5 below, in 2019 and 2020, the Parties' combined UK shares of supply on the basis of the proportion of end products supplied in the UK which use the Parties' SSDs as a component were as follows:

- (a) [20-30]% for all enterprise SSDs with an increment of [0-5]% in 2019 and of [30-40]% with an increment of [5-10]% in 2020; and
- (b) [40-50]% for PCIe enterprise SSDs with an increment of [5-10]% in 2019 and of [40-50]% with an increment of [10-20]% in 2020.

23. All of the shares of supply outlined at paragraphs 20 and 22 above are of 25% or more, with an increment resulting from the Merger. The CMA therefore believes that the share of supply test is met.

Conclusion on jurisdiction as regards SK hynix and the Target

24. On the basis of the above, the CMA believes that it is or may be the case that arrangements are in progress or in contemplation which, if carried into effect, will result in the creation of a relevant merger situation.

SK hynix investment in Kioxia

25. SK hynix also maintains [redacted] investments in Kioxia Corporation (**Kioxia**). Kioxia is a Japanese multinational computer memory manufacturer that also supplies NAND and SSDs.

26. The CMA has therefore considered whether Kioxia may form part of the relevant merger situation comprising the Merger, due to the links between Kioxia and SK hynix. In particular, the CMA notes that an assessment of material influence requires a case-by-case analysis of the overall relationship

¹² Parties' response to CMA's Request for Information, dated 3 February 2021, paragraphs 6.1 – 6.3. The Parties told the CMA that they were not aware of any industry data which reported shares of supply on the basis of devices and applications sold in the UK. The Parties submitted that they considered that the best proxy for their shares in products that use NAND flash memory and SSDs, was their global NAND and SSD shares, respectively. The Parties further submitted that this approach was reasonable because:

- the share of end-products using the Parties' products globally is a reasonable approximation for the position in the UK, as there is no reason to believe that any end product segment is substantially more tilted towards products that use the Parties' SSD or NAND in the UK compared to the position globally; and
- the Parties' share in SSD or NAND revenues is a reasonable approximation for revenues accounted for by end products that use the Parties' SSD/NAND, because it is reasonable to consider that (i) the Parties' global revenue share in client SSDs is a reasonable approximation for the revenue share of PCs that include the Parties' client SSDs out of all PCs sold globally and (ii) the Parties' global revenue share in enterprise SSDs is a reasonable approximation for the share of enterprise servers that include the Parties' enterprise SSDs out of all enterprise servers sold globally.

between the acquirer and the target and, in making its assessment, the CMA will have regard to all the circumstances of the case.¹³

27. In 2017, SK hynix participated in a consortium led by Bain Capital which acquired a stake in Kioxia. [REDACTED].
28. [REDACTED]:
 - (a) [REDACTED];
 - (b) [REDACTED];
 - (c) [REDACTED]; or
 - (d) [REDACTED].¹⁴
29. [REDACTED].¹⁵ [REDACTED].¹⁶
30. SK hynix's own public statements are consistent with it not having any control or influence over Kioxia; for example, SK hynix's annual report and accounts for 2019 state that it is 'is unable to exercise significant influence over decision-making for KIOXIA's operation and management'.¹⁷
31. The CMA considers that the [REDACTED] do not confer, individually or cumulatively, control or material influence over Kioxia to SK hynix. In reaching this conclusion the CMA considered, in particular, the following factors:
 - (a) [REDACTED]:
 - (i) [REDACTED];
 - (ii) [REDACTED];
 - (iii) [REDACTED]; or
 - (iv) [REDACTED]¹⁸.

¹³ [Mergers: Guidance on the CMA's jurisdiction and procedure](#) (CMA2), paragraph 4.22.

¹⁴ Annex 3.5.2 of the Parties' response to CMA's Request for Information, dated 3 February 2021.

¹⁵ [REDACTED]

¹⁶ [REDACTED]

¹⁷ See <https://www.skhynix.com/board/download.do?seq=2479>, page 99

¹⁸ [REDACTED]

(b) [REDACTED].¹⁹ [REDACTED]. The CMA also notes that [REDACTED].²⁰

(c) [REDACTED].

(d) [REDACTED].

(e) As set out in paragraph 28 above, [REDACTED].

(f) There are no wider commercial arrangements between SK hynix and Kioxia which the CMA is aware of which may be relevant to SK hynix's ability to exercise material influence as they, for example, create a degree of commercial dependency between SK hynix and Kioxia.

32. On the basis of the above, having regard to all the circumstances of this case, the CMA believes that Kioxia does not form part of the relevant merger situation created by the Merger because the [REDACTED] do not confer, individually or cumulatively, on SK hynix control or material influence over Kioxia, for the purposes of section 26 of the Act.

33. However, the CMA considers that [REDACTED], and this may alter the incentives that SK hynix has when it competes with Kioxia. This is further discussed in the Competitive Assessment below.

Counterfactual

34. The CMA assesses a merger's impact relative to the situation that would prevail without the merger (ie the counterfactual).²¹ In an anticipated merger the counterfactual may consist of the prevailing conditions of competition, or conditions of competition that involve stronger or weaker competition between the merger firms than under the prevailing conditions of competition.²²

35. In determining the appropriate counterfactual, the CMA will generally focus only on potential changes to the prevailing conditions of competition where there are reasons to believe that those changes would make a material difference to its competitive assessment.²³

36. In this case, there is no evidence supporting a different counterfactual, and the Parties and third parties have not put forward arguments in this respect.

¹⁹ For the avoidance of doubt, the CMA in this decision has made no findings as regards any future [REDACTED] and whether, in whatever circumstances may apply at the time, such [REDACTED] would lead to the acquisition of control or material influence over Kioxia by SK hynix.

²⁰ Section 27(3) of the Act.

²¹ [Merger Assessment Guidelines \(CMA129\), 18 March 2021 \(Merger Assessment Guidelines\)](#), paragraph 3.1.

²² Merger Assessment Guidelines, paragraph 3.2.

²³ Merger Assessment Guidelines, paragraph 3.9.

Therefore, the CMA believes the prevailing conditions of competition to be the relevant counterfactual.

Background

37. Data storage solutions allow for the creation, management and preservation of digital content. They are used in a variety of devices and applications such as personal computers and servers, as well as in industrial and consumer electronic applications, such as automotive applications. Data storage solutions used in these devices and applications include SSDs, Hard Disk Drives (**HDDs**),²⁴ memory cards, USB flash drives and embedded flash storage.²⁵
38. Data storage solutions require computer memory to retain digital data. There are two types of computer memory: volatile and non-volatile. Volatile memory retains the stored information only while powered,²⁶ whereas non-volatile memory can retain information after the device is powered off.

NAND flash memory

39. NAND flash memory is a type of non-volatile storage technology that stores data in transistors. NAND is produced in factories called fabrication sites (or fabs). The output of the production process is a raw NAND wafer. These are large dishes which contain numerous NAND memory cells. NAND flash memory is used for high capacity storage solutions because it is hard wearing when compared with other types of flash memory, such as NOR memory.²⁷ SK hynix and the Target are active solely in NAND memory products.
40. NAND products can be differentiated between raw NAND and managed NAND. Raw NAND refers to the NAND wafer. Managed NAND is the combination of raw NAND and a controller. An example of managed NAND is an Embedded MultiMedia Card (**eMMC**) which is a small storage device which incorporates NAND flash memory and a storage controller on a single integrated circuit. Managed NAND is commonly used in personal devices

²⁴ An HDD is a traditional storage solution that performs the same basic storage function as SSDs, but stores data using a different technology, ie HDDs are based on magnetic media.

²⁵ See paragraph 40.

²⁶ Volatile memory comes in two main types: Static Random Access Memory (or SRAM) and DRAM.

²⁷ Flash memory utilises one of two different technologies to map and store data, either NOR or NAND. The names refer to the type of logic gate used in each memory cell ('Not AND' and 'Not OR'). Data stored on NOR memory can be read quicker when compared with NAND memory, while data can be stored on NAND memory quicker than NOR.

such as mobile phones and tablets to provide internal storage. SK hynix is active in managed NAND, while the Target is not active in this segment.

41. NAND can be further classified by its structure: 2D NAND and 3D NAND. 2D NAND (otherwise known as planar NAND) was the first NAND technology brought to market. 3D NAND is a technological evolution of 2D NAND, whereby the memory cells are stacked vertically so as to increase the storage density of the wafer while using less space on the wafer. Due to this innovation 3D NAND quickly became a more efficient product than 2D NAND.
42. Innovation is an important dimension of competition in the NAND industry. Innovation reduces costs by maximising the memory capacity of raw NAND memory cells whilst at the same time decreasing their size. One third party told the CMA that the market is constantly demanding lower prices with larger memory capacity.²⁸ Falling behind a product generation could be costly to competitors because future innovation builds on accumulated product development experience, whereby one innovation typically builds on the previous technology. 3D NAND is quantified by the number of bits per cell²⁹ and the number of layers stacked in a device (eg 128 layers, 176 layers). Generally, suppliers are scaling 3D NAND roughly by one technology generation every year.
43. In this regard, the Parties submitted that 2D NAND is being increasingly displaced by 3D NAND for many applications, due to the industry drive to reduce the size of memory cells, costs and the need to increase storage capacity.³⁰ In particular, the Parties' noted that the Target has ceased producing 2D NAND and switched to solely producing 3D NAND in 2019.³¹ This view was supported by a number of third parties, with some in particular noting that 2D NAND was now used primarily for legacy applications. The CMA therefore believes that the market for NAND flash memory is transitioning to 3D NAND.

SSDs

44. As noted above, NAND flash memory is typically one of the key inputs into SSDs. SK hynix and the Target are active solely in NAND-based SSDs.

²⁸ [REDACTED]

²⁹ NAND can include single-level cell (**SLC**), multi-level cell (**MLC**), triple-level cell (**TLC**) or quad-level cell (**QLC**).

³⁰ Final Merger Notice, paragraph 13.22.

³¹ Final Merger Notice, paragraph 15.13 (see also Table 8).

45. There are broadly two main classes of SSDs, namely:
- (a) **enterprise SSDs** which are used for business storage applications such as corporate datacentres and high workload servers; and
 - (b) **client SSDs** which are used for client storage applications such as portable electronic devices and personal computers.
46. SSDs can be separated into further classifications by the type of interface the SSD has been designed with. The interface connects the SSD to the wider system in which it is used. Interfaces help to determine the functionalities and performance of SSDs. The most common industry-standard interfaces used for SSDs are SATA, SAS and PCIe.
47. The Parties submitted that PCIe enterprise SSDs have been increasingly outperforming and replacing SATA SSDs for enterprise applications due to their increased capacity and their versatility in end-use.³² This view was supported by a number of third parties who suggested that the market was increasingly shifting towards PCIe enterprise SSD and away from SATA SSD.
48. Similar to NAND, innovation is an important dimension of competition in the SSD industry. Innovation aims to reduce costs while at the same time maximising performance and memory capacity. The CMA understands that innovation usually takes the form of a technological evolution of successful products. For example, the Parties submitted that, in 2019, Samsung upgraded the performance and efficiency of its existing PCIe enterprise SSD 3.0 and released the next generation PCIe enterprise SSD 4.0.³³ This development was then followed by other competitors, including Kioxia, Western Digital and SK hynix who each released their own iteration of PCIe enterprise SSD 4.0 to match the performance and efficiency of Samsung's product.³⁴

Competitive assessment

Introduction

49. Horizontal unilateral effects may arise when one firm merges with a competitor that previously provided a competitive constraint, allowing the merged firm profitably to raise prices or to degrade non-price aspects of its competitive offering (such as quality, range, service and innovation) on its

³² Final Merger Notice, paragraph 13.96.

³³ Final Merger Notice, paragraph 15.56.

³⁴ Final Merger Notice, paragraph 15.56.

own and without needing to coordinate with its rivals.³⁵ Horizontal unilateral effects are more likely when the merging parties are close competitors.³⁶

50. The Parties' activities overlap in the global supply of SSDs and NAND flash memory. Within NAND, the Parties' activities overlap only in 3D NAND as the Target is no longer active in 2D NAND.³⁷ The Parties are active in the supply of enterprise and client SSDs. Within enterprise SSDs, at a global level the Parties only overlap in SSDs with PCIe and SATA interfaces. Neither party sells SAS SSDs.³⁸
51. Based on the Parties' overlapping activities, and the Parties' position and activity in the particular segments of SSDs, the CMA assessed whether it is or may be the case that the Merger may be expected to result in an SLC in relation to horizontal unilateral effects in the global supply of i) 3D NAND and ii) enterprise SSDs, focusing on PCIe enterprise SSDs.³⁹

Kioxia in the competitive assessment

52. As discussed in paragraphs 25 to 27 above, SK hynix holds [X]. [X], SK hynix may have an incentive to compete less strongly with Kioxia than it would otherwise. This incentive to compete less strongly with Kioxia may be exacerbated by the Merger if Kioxia is a close competitor to the Target (ie because, post-Merger, the Target will form part of the Merged Entity). Thus, as well as leading to the loss of competition between SK hynix and the Target, the Merger could also lead to a lessening of competition between the Target (as part of the Merged Entity) and Kioxia.
53. The CMA considers that, [X], this reduces its incentive to dampen competition between the Target and Kioxia relative to a situation where it wholly owned Kioxia.
54. In addition, the evidence provided to the CMA (from the Parties' internal documents and from third parties) did not indicate that SK hynix currently

³⁵ Merger Assessment Guidelines, paragraph 4.1.

³⁶ Merger Assessment Guidelines, paragraph 4.8.

³⁷ Final Merger Notice, paragraph 15.13.

³⁸ Final Merger Notice, paragraph 15.30-15.31.

³⁹ The CMA considered whether the Merger could lead to vertical effects in relation to the upstream markets for 3D NAND or DRAM and the downstream market for SSDs. With regard to 3D NAND and SSD, as the Parties will not be in a position of market power in the markets for 3D NAND or SSDs (or any of the sub-segments) post-Merger, the CMA believes that there is no realistic prospect of an SLC as regards vertical effects in either of these markets. With respect to DRAM, there is no increment resulting from the Merger as the Target does not produce DRAM and SK hynix has a moderate share of supply [20-30]% with several other competitors active in the supply of DRAM. Downstream, the Target is not a significant purchaser of DRAM. Therefore, the CMA believes there is no realistic prospect of an SLC as a result of vertical effects (either customer foreclosure or input foreclosure).

competes less strongly with Kioxia than with other competitors. The CMA found [REDACTED].⁴⁰

55. Furthermore, as discussed in the following sections, the available evidence indicates that Kioxia does not compete more closely with the Target than a number of other strong competitors. [REDACTED].⁴¹
56. Finally, as discussed above at paragraphs 25 to 33 above, SK hynix does not have the ability to materially influence or control Kioxia.⁴² [REDACTED]. In addition, Kioxia has introduced a number of new products in SSD in the past three years and announced plans to expand its production capacity in NAND flash memory.⁴³ The CMA considers that this reflects the incentive of Kioxia to continue competing with SK hynix since if it was to dampen competition with SK hynix, it would lose any sales diverted to SK hynix while receiving none of the financial benefit.
57. Overall, in light of all the circumstances of this case, the CMA considers that SK hynix's financial interest in Kioxia will not prevent Kioxia from exercising a material degree of competitive constraint on the Merged Entity, as discussed in more detail below in the competitive assessment.

Horizontal unilateral effects in the supply of 3D NAND

58. In assessing whether the Merger will lead to an SLC in relation to the global supply of 3D NAND, the CMA considered:
 - (a) Frame of reference;
 - (b) Shares of supply;
 - (c) Closeness of competition between the Parties;
 - (d) Competitive constraints from rivals; and
 - (e) Innovation.

⁴⁰ In both Annex 5.4.1.41 and Annex 5.4.1.49 of the Final Merger Notice, [REDACTED].

⁴¹ As discussed in the following sections, the evidence indicates Samsung exerts the strongest constraint on the Target.

⁴² A third party expressed concerns that SK hynix might be able to [REDACTED]. The third party's concern was that the Merged Entity could [REDACTED]. The CMA considers that this concern is unlikely to materialise because, as indicated in paragraphs 25 to 33, while SK hynix has a financial interest in Kioxia, it does not have a control or material influence over its strategic decisions. [REDACTED].

⁴³ Parties' response to CMA's Request for Information, dated 19 April 2021, footnote 5

Frame of reference

59. The assessment of the relevant market is an analytical tool that forms part of the analysis of the competitive effects of the merger and should not be viewed as a separate exercise.⁴⁴ Market definition involves identifying the most significant competitive alternatives available to customers of the merger firms.⁴⁵ In some cases market definition can be an important part of the overall merger assessment process. In other cases, the evidence gathered as part of the competitive assessment, which will assess the potentially significant constraints on the merger firms' behaviour, will capture the competitive dynamics more fully than formal market definition.⁴⁶ There may be no need for the CMA's assessment of competitive effects to be based on a highly specific description of any particular market (including, for example, descriptions of the precise boundaries of the relevant markets and bright-line determinations of whether particular products or services fall within it).⁴⁷ The approach taken by the CMA will reflect the circumstances of the case.
60. As stated above in paragraph 43, the market for NAND is moving from 2D NAND to primarily 3D NAND. The Parties submitted that this transition is evidenced by the Target no longer supplying 2D NAND and focusing solely on 3D NAND. A number of third parties also confirmed this trend and explained that 2D NAND would remain only for legacy applications. On this basis, the CMA focused its assessment on 3D NAND and considers that the appropriate product frame of reference is the supply of 3D NAND.
61. In relation to the geographic scope of the market, the Parties submitted that the market for the supply of NAND is global.⁴⁸ While the CMA has not previously looked at this market, the CMA notes that this is in line with the past decisional practice of the European Commission.⁴⁹ The evidence received by the CMA from third parties also indicates that the market is global and that there are not any unique aspects to competition at a national or regional level. The CMA therefore assessed the market for the supply of 3D NAND on a global basis.

⁴⁴ Merger Assessment Guidelines, paragraph 9.1.

⁴⁵ Merger Assessment Guidelines, paragraph 9.2.

⁴⁶ Merger Assessment Guidelines, paragraph 9.2.

⁴⁷ Merger Assessment Guidelines, paragraph 9.5.

⁴⁸ Final Merger Notice, paragraph 13.110

⁴⁹ Case No COMP/M.7772 – *Western Digital/SanDisk*, decision of 4 February 2016, paragraph 72.

Shares of supply

62. The Parties submitted shares of supply for 3D NAND, based on information from Forward Insights, a third-party data provider. Table 2 below sets out the shares of supply by volume (in bits), including the sales to third parties and captive sales⁵⁰, for 2019 and 2020.⁵¹
63. As shown by the table below, the Merger will reduce the number of main 3D NAND suppliers from six to five. Samsung will remain the largest provider, with a share of supply of about [30-40]%. While the Merged Entity will be the second largest supplier post-Merger, with a combined market share of about [20-30]%, the remaining main competitors – Kioxia, Western Digital and Micron – will have similar shares of supply.

Table 2: 3D NAND global shares of supply in bits (m 1GB equiv.) including sales to third parties and captive sales (2019 and 2020)

Competitor	Shares of supply (%), based on bits (m 1GB equiv.)	
	2019	2020
SK hynix	[10-20]%	[10-20]%
The Target	[10-20]%	[5-10]%
Merged Entity	[20-30]%	[20-30]%
Samsung	[30-40]%	[30-40]%
Kioxia	[10-20]%	[10-20]%
Western Digital	[10-20]%	[10-20]%
Micron	[10-20]%	[10-20]%
YMTC	[0-5]%	[0-5]%
Macronix	[0-5]%	[0-5]%

Source: Forward Insights Supplier Status NAND Quarterly Insights Q1/21 Report, submitted by the Parties as Annex 10.1 in the response to CMA's Request for Information, dated 15 March 2021.

64. Suppliers facing capacity constraints may not be able to serve customers switching away from rivals and may provide a less effective constraint to the Parties.⁵² Given that building capacity is a lengthy process and suppliers cannot quickly bring additional capacity to the market, the CMA has also considered shares of supply based on capacity.
65. Table 3 below sets out projected 3D NAND capacity shares.⁵³ Similarly to the shares of supply based on volume, Samsung has the highest capacity share of more than [30-40]% and the Parties will have a combined share of

⁵⁰ Sales for internal use.

⁵¹ The Parties provided estimates for shares of supply in 3D NAND based on bits shipment because Forward Insights does not include revenue-based share data for 3D NAND.

⁵² Merger Assessment Guidelines, paragraph 4.12.

⁵³ Data are based on TrendForce's NAND Flash Platinum Datasheet from March 2021. Figures were provided by the Parties in Table 7 of the Final Merger Notice.

approximately [20-30]%. Kioxia and Western Digital jointly have more than [30-40]%,⁵⁴ and Micron around [5-10]% of the capacity. YMTC, which is a new entrant in the 3D NAND market, is projected to more than double its capacity over 2021 and reach [5-10]%.⁵⁵ As the capacity shares are in line with the shares of supply based on revenues and, as discussed in paragraph 79 below, a number of competitors are expanding their capacity further, the CMA does not consider that the Parties' competitors are constrained by capacity.

Table 3: 3D NAND capacity shares in wafers per month (k units)

Competitor	Shares of supply (%), based on wafers per month (k units)	
	2020	2021
SK hynix	[10-20]%	[10-20]%
The Target	[5-10]%	[5-10]%
Merged Entity	[10-20]%	[10-20]%
Samsung	[30-40]%	[30-40]%
Kioxia & Western Digital JV	[30-40]%	[30-40]%
Micron	[10-20]%	[10-20]%
YMTC	[0-5]%	[5-10]%

Source: Data from TrendForce's NAND Flash Platinum Datasheet from March 2021, provided by the Parties as Table 7 of the Final Merger Notice.

66. The Parties submitted that a significant share of their NAND supply⁵⁶ is used internally and that neither of them purchase NAND from other suppliers. The Parties sell the remaining part of their manufactured NAND to third parties in the merchant market. The CMA therefore has also considered the shares of supply of 3D NAND in the merchant market.
67. The CMA constructed estimates of global shares of supply for the 3D NAND merchant segment (ie excluding captive sales) based on the data provided by the Parties and their main competitors. Table 4 below sets out the shares of supply by revenues for i) raw 3D NAND,⁵⁷ and ii) total 3D NAND (including raw NAND and managed NAND) sold to the merchant segment. The Parties submitted that the Target is not active in managed NAND.
68. Table 4: 3D NAND merchant shares of supply in value (excluding captive sales and SSD) Table 4: 3D NAND merchant shares of supply in value (excluding captive sales and SSD) below indicates that the Parties' shares of supply in the 3D NAND market are very similar regardless of whether they are estimated by including

⁵⁴ Kioxia and Western Digital have a joint venture on 3D NAND manufacturing.

⁵⁵ The Parties submitted that YMTC has already entered the second phase of construction for its expanded production facility. Final Merger Notice, paragraph 15.9 and see <https://www.chinasdg.org/article/china-s-first-domestically-made-nand-chip-will-be-available-in-2020-ymtc>.

⁵⁶ Share of NANDs supply used internally by the Parties: [X]% for Hynix and [X]% for the Target in 2019, but [X]% for the Target in 2020.

⁵⁷ Raw NAND includes sales of packed NAND and wafers.

captive sales or not, although the increment is lower in the merchant segment especially in 2020.⁵⁸

Table 4: 3D NAND merchant shares of supply in value (excluding captive sales and SSD)

Competitor	Shares of supply (%) in the merchant segment, based on revenues			
	Raw 3D NAND		Total NAND	
	2019	2020	2019	2020
The Target	[10 – 20]%	[5 – 10]%	[5 – 10]%	[0 – 5]%
SK hynix	[5 – 10]%	[5 – 10]%	[10 – 20]%	[10 – 20]%
Merged Entity	[20 – 30]%	[10 – 20]%	[20 – 30]%	[20 – 30]%
Samsung	[✂]	[✂]	[30 – 40]%	[20 – 30]%
Kioxia	[20 – 30]%	[40 – 50]%	[20 – 30]%	[20 – 30]%
Western Digital	[5 – 10]%	[5 -10]%	[10 – 20]%	[10 – 20]%
Micron	[10 – 20]%	[20 – 30]%	[5 – 10]%	[5 – 10]%

Source: figures in the table were constructed using information provided by the Parties (Annexes 12.1 and 12.2 to the response to CMA's Request for Information, dated 19 April 2021) and their competitors.

[✂]

69. The above indicates that irrespective of the measure adopted to consider shares of supply for the 3D NAND, the Merged Entity will have a moderate combined share of around [20-30]% and will continue to face competition from a number of other suppliers post-Merger.

Closeness of competition

70. The Parties submitted that they are not close competitors in the supply of 3D NAND because to a great extent they serve different customers and applications. The Parties submitted that [✂]% of SK hynix's NAND revenues are derived from NAND flash memory for mobile phone applications, an area where the Target is not active. The Target supplies NAND that is not suitable for mobile phones and would therefore be unable to meet the requirements of SK hynix's NAND mobile phone customers.⁵⁹

71. The Parties' internal documents support the view that the Parties are not particularly close competitors in the supply of 3D NAND. In Intel's internal

⁵⁸ The Target had unusually high sales of raw NAND in 2019 and sales in 2020 are more closely in line with its sales in the previous years.

⁵⁹ Final Merger Notice, paragraph 15.20.

documents,⁶⁰ [REDACTED]. A few SK hynix's internal documents prepared for the purposes of the Merger indicate that [REDACTED]⁶¹).⁶²

72. Third party responses indicated that the Parties are generally not considered to compete particularly closely in the supply of 3D NAND. The majority of customers considered the Target to be a medium competitor to SK hynix; about half of customers considered SK hynix to be a strong competitor to the Target, but these customers also considered alternative suppliers to be equally strong or stronger competitors. Several customers⁶³ noted that the Target is mainly focused on servers, while SK hynix products are not limited to server applications and a few customers⁶⁴ noted that all main suppliers are similar and close competitors.
73. Competitors submitted that all main suppliers compete with each other. However, a few competitors also noted that the Target is a weaker competitor than SK hynix, as it is considered less effective in NAND.
74. Overall, based on the evidence above, the CMA believes that, while the Parties compete with each other, they are not particularly close competitors.

Competitive constraints

75. The Parties submitted that competition for NAND flash memory sales is intense and they face a number of strong, well-resourced competitors – Samsung, the segment leader, Kioxia, Western Digital and Micron. YMTC is implementing significant expansion plans and is expected to become a leading player in NAND.⁶⁵
76. The Parties' internal documents indicate that the Parties consider all of the main suppliers, listed in the preceding paragraph, as credible competitors. SK hynix, in an internal document [REDACTED].⁶⁶ Intel in its internal documents regularly monitors and benchmarks against [REDACTED]. In particular:

⁶⁰ [REDACTED]

⁶¹ [REDACTED]

⁶² Case M.10059 - Form CO -Annex 5.4.1.c_CONFIDENTIAL.PDF, Case M.10059 û Form CO - Annex 5.4.1.g_CONFIDENTIAL.pdf.

⁶³ [REDACTED]

⁶⁴ [REDACTED].

⁶⁵ Final Merger Notice, paragraph 15.24.

⁶⁶ SK hynix/Intel 50974 - SKhynix_IntelNANDand SSD s109 20 April Annex 2a.pdf.

(a) In its internal documents, Intel considers [REDACTED].⁶⁷ The documents indicate that [REDACTED].

(b) [REDACTED].⁶⁸ The CMA however notes that this [REDACTED].

(c) Intel also [REDACTED].

(d) Intel's internal documents indicate that [REDACTED].⁶⁹

(e) [REDACTED].⁷⁰

77. Third parties who responded to the CMA's questionnaire did not express concerns as regards 3D NAND in relation to the Merger and noted that there will remain a sufficient number of competitors.⁷¹ One customer also noted that the Merger will improve the overall competition in the market, as SK hynix will be better positioned to compete with Samsung.

78. Third parties said that Samsung, Kioxia, Western Digital and Micron are credible alternative suppliers to both Parties.

(a) Customers considered Samsung to be the market leader and nearly all customers considered it to be either the strongest or among the strongest competitors to both Parties.

(b) Micron is also seen as a strong competitor, in particular as regards SK hynix and a few customers said that this is because Micron is active in all NAND applications as is SK hynix. A few customers noted that Micron's competitive constraint on Intel is weaker because of their former partnership and because of Intel's focus on supplying data centres (which uses enterprise SSDs).

(c) Kioxia is considered as a rather strong competitor in general and some customers commented that it is a 'key player' and a 'strong competitor to everyone in NAND'.

(d) Western Digital was also considered to be among the 'key players'. However, half of the customers considered it as a 'strong competitor',

⁶⁷ [REDACTED].

⁶⁸ [REDACTED].

⁶⁹ [REDACTED]

⁷⁰ [REDACTED].

⁷¹ One customer expressed concerns, but these were in relation to changes in dealing with a new entity rather than to competition.

whereas the other half considered it as a ‘medium competitor’ to the Parties.

79. The main competitors in 3D NAND considered that the market is competitive and generally indicated that they all compete with each other. Nevertheless, a number of competitors considered Samsung to be the market leader. One competitor noted that while there are some differences between competitors, the NAND produced by all is very similar. In addition, the CMA has received evidence that a number of competitors have expansion plans. [REDACTED], whereas [REDACTED].
80. Customer and competitor responses indicate that YMTC is currently considered to be a weak competitor, concentrating mainly on low-end products and still developing its business. Nonetheless, it is expected to become a strong competitor in the coming years and third parties said that it was ‘[a] strong new player with great potential’ and ‘behind at the moment, but investing heavily and may catch-up’. In In this regard, one customer submitted that it has recently started to purchase from YMTC, whereas another is currently working with YMTC for its inclusion in its portfolio. According to third parties and analysts,⁷² YMTC is building capacity rapidly and is expected to reach an expected capacity of 80,000 wafers per month by the end of 2021, which is approximately the same as the Target’s current capacity.
81. Based on the evidence above, the CMA believes that the Parties will continue to face a material and sufficient competitive constraint from a number of remaining 3D NAND suppliers post-Merger.

Innovation

82. The Parties submitted that there is significant and constant innovation in NAND flash memory. In order to remain competitive, suppliers must continue to innovate and scale the number of layers stacked in a product. It is crucial for each player to quickly introduce advanced technologies to gain competitiveness.⁷³
83. Intel’s internal documents indicate that [REDACTED]. Furthermore, Intel [REDACTED]. For instance, [REDACTED].⁷⁴
84. Third parties did not raise concerns in relation to the Merger’s impact on innovation. Third parties indicated that all main suppliers are similarly

⁷² [REDACTED]

⁷³ Final Merger Notice, para 15.26.

⁷⁴ [REDACTED]

innovative, with the exception of Samsung, which was mentioned slightly more often as leading innovations. In addition, competitors noted that the suppliers need to constantly innovate and evolve to compete. For instance, a third party said that the market (NAND and SSD) is highly innovative and the company with the newest technology gets an advantage: the lead may thus change as sometimes one competitor is ahead of the others in a particular segment, but others catch up and then another competitor may be ahead.

85. Overall, the available evidence indicates that innovation plays a major role in competition in the 3D NAND market, and the CMA does not consider it likely that this will be negatively affected by the Merger.

Conclusion on 3D NAND

86. As set out above, the CMA considers that the Parties do not compete more closely with each other than other alternative suppliers. The CMA also considers that the Merged Entity will continue to face competitive constraints from a number of credible alternative suppliers and that innovation will not be negatively impacted by the Merger. Accordingly, the CMA does not believe that the Merger gives rise to a realistic prospect of an SLC as a result of horizontal unilateral effects in relation to the supply of 3D NAND.

Horizontal unilateral effects in the supply of enterprise SSDs

87. As explained at paragraph 45, the SSD market can be split into client and enterprise SSDs, based on the type of customer and end use. The CMA considered that the Merger is unlikely to lead to an SLC with respect to client SSDs given the Parties' low combined share of supply ([10-20]% in 2020).⁷⁵ The CMA has therefore focused its assessment on the enterprise SSD segment and, in particular, for the reasons set out in this section, on the PCIe enterprise SSD segment.
88. In assessing whether the Merger will lead to an SLC in relation to the global supply of enterprise SSD on a global basis, the CMA considered:
- (a) Frame of reference;
 - (b) Shares of supply;
 - (c) Market dynamics;

⁷⁵ Based on Forward Insights Supplier Status Reports, submitted by the Parties as Annex 10.1 in the Parties' response to CMA's Request for Information, dated 15 March 2021.

- (d) Closeness of competition between the Parties; and
- (e) Competitive constraints from rivals; and
- (f) Innovation.

Frame of reference

89. As explained at paragraph 46, within the enterprise SSD segment, products can be further segmented according to the type of interface they use. In relation to the segmentation of enterprise SSDs with different interfaces (SATA, SAS and PCIe), the Parties submitted that the definition of the market could be left open.⁷⁶ The Parties noted however that PCIe enterprise SSD have been increasingly outperforming and replacing SATA SSDs.⁷⁷ This view was supported by third party analysts⁷⁸ and a number of third parties who told the CMA that the market was increasingly shifting towards PCIe enterprise SSD over SATA SSD. Neither of the Parties supply SAS SSDs.⁷⁹
90. The CMA asked customers and competitors of the Parties whether it would be easy for them to switch between enterprise SSDs with different interfaces. Customers generally indicated that switching between interfaces becomes impossible once their system requirements have been designed or set up to accommodate a particular interface.⁸⁰ Such customers typically design their systems to suit the needs of their downstream customers, switching therefore can be both time-consuming and involve high costs.
91. On the other hand, competitors told the CMA that switching production between enterprise SSDs with different interfaces is relatively easy, with little time and investment required. Competitors also told the CMA that the processes and equipment involved in the production of SATA, SAS and PCIe enterprise SSDs are common across the different interfaces. One third party competitor told the CMA that switching manufacturing between interfaces within enterprise SSD may only require a relatively small investment, while another competitor submitted that it periodically switched production between

⁷⁶ Final Merger Notice, paragraph 13.99

⁷⁷ Final Merger Notice, paragraph 13.96. SK hynix also submitted that [REDACTED]. See Final Merger Notice, paragraph 15.61-15.62.

⁷⁸ For example, Omdia projects the following compound annual growth rates (in revenues) for a period between 2020 and 2025: SATA (-[10-20]%), SAS (-[5-10]%), PCIe ([10-20]%). Omdia, SSD and HDD Storage Market Tracker 4Q20 Database, submitted in the Parties' response to the CMA's Section 109 Request, dated 20 April 2021.

⁷⁹ Final Merger Notice, paragraph 13.97, Table 5

⁸⁰ For example, where a data centre customer sets up its servers to accommodate a specific interface those servers will not be able to accommodate other interfaces unless the servers are modified to facilitate a different interface.

different NAND-based products. The CMA therefore considers that SSD suppliers can switch production of SSDs with different interfaces with relative ease.

92. For the purposes of the competitive assessment, the CMA has considered the enterprise SSD segment as a whole and does not consider it is necessary to conclude definitively whether different enterprise SSD interfaces are within the same frame of reference. However, in light of the above evidence suggesting that the market is shifting towards PCIe enterprise SSD, and taking into account that the Parties' main activities are in the PCIe enterprise SSD segment, where they have a relatively high combined market share (discussed further at paragraphs 93 to 94 below), the CMA focused its assessment on the horizontal overlap between the Parties in PCIe enterprise SSDs.

Shares of supply

93. The Parties provided shares of supply for enterprise SSD, based on information from third party industry reports. Table 4 below sets out the shares of supply by value for enterprise SSD (all interfaces in aggregate) and separately for PCIe enterprise SSD only for the years 2019 and 2020.⁸¹
94. In the enterprise SSD segment, the Parties have a combined share of supply of [30-40]%. Samsung will remain the largest provider with a share of [30-40]%, and three other main suppliers – Kioxia, Micron and WD – will have each have a share of between [5-10]% and [5-10]%. Considering a narrower PCIe enterprise SSD segment, the Parties will be the largest supplier with a combined share of [40-50]%, closely followed by Samsung ([30-40]%). Other main suppliers have relatively low shares of supply, each having less than [5-10]%. However, as discussed in detail in paragraphs 95-97 below, the CMA considers that the static shares of supply do not fully reflect the competitive conditions and competitive constraints in the enterprise SSD market.

⁸¹ The CMA has not considered SAS enterprise SSD segment in detail in this decision because neither or the Parties are active in this segment. The CMA has not considered SATA enterprise segment in detail in this decision because all main suppliers, including the Parties, have been decreasing their sales of SATA enterprise SSDs in the last few years and SK hynix submitted that [REDACTED].⁸² In the enterprise use, data that is accessed infrequently can be stored on either SSDs or HDDs. Intel's and SK hynix's internal documents show that [REDACTED]. See, for example, SK hynix/Intel 50974 - Case M.10059 û Form CO û Annex 5.4.1.g_CONFIDENTIAL.pdf, Case M.10059 û Form CO û Annex 5.4.1.j_CONFIDENTIAL.pdf.

Table 5: Shares of supply by value for years 2019 and 2020

Competitor	Share of supply, based on revenues (%)			
	Enterprise SSD		PCIe enterprise SSD	
	2019	2020	2019	2020
SK hynix	[0-5]%	[5-10]%	[5-10]%	[10-20]%
The Target	[20-30]%	[20-30]%	[20-30]%	[20-30]%
Merged Entity	[20-30]%	[30-40]%	[40-50]%	[40-50]%
Samsung	[30-40]%	[30-40]%	[30-40]%	[30-40]%
Kioxia	[10-20]%	[5-10]%	[5-10]%	[0-5]%
Micron	[5-10]%	[5-10]%	[0-5]%	[0-5]%
Western Digital	[5-10]%	[5-10]%	[5-10]%	[5-10]%
Seagate	[0-5]%	[0-5]%	[0-5]%	[0-5]%
Kingston	[0-5]%	[0-5]%	-	[0-5]%
Other	[5-10]%	[5-10]%	[5-10]%	[5-10]%

Source: Forward Insights Supplier Status Reports, submitted by the Parties as Annex 10.1 in the response to CMA's Request for Information, dated 15 March 2021.

Market dynamics

95. While shares of supply can be useful evidence in assessing the closeness of competition between suppliers, where markets are dynamic and there is a degree of differentiation between suppliers and their products, shares of supply may not fully reflect the competitive constraints in the market or be a good indicator of the likely future evolution of competitive conditions.
96. In its assessment, the CMA has considered the following factors in relation to PCIe enterprise SSD suppliers and market dynamics.
- (a) The enterprise SSD market is transitioning from the SATA interface, and to a lesser extent from the SAS interface, to the PCIe interface (see paragraphs 46-47 above). There is also some transition from HDDs to PCIe enterprise SSDs.⁸² A number of suppliers, [X], indicated that they expect to expand their offering in PCIe.⁸³ In particular, a third party told the CMA that [X] (see paragraphs 110(a)); [X] is planning to invest more in PCIe (see paragraph 110(b)); and [X] is also planning to expand product line-up and business in PCIe (see paragraph 110(c) below).

⁸² In the enterprise use, data that is accessed infrequently can be stored on either SSDs or HDDs. Intel's and SK hynix's internal documents show that [X]. See, for example, SK hynix/Intel 50974 - Case M.10059 û Form CO û Annex 5.4.1.g_CONFIDENTIAL.pdf, Case M.10059 û Form CO û Annex 5.4.1.j_CONFIDENTIAL.pdf.

⁸³ Based on the revenues generated in 2020, [X].

- (b) Competitors⁸⁴ submitted that switching production between different enterprise SSD interfaces is easy as most of the processes and equipment involved are common (see paragraph 91 above).
- (c) Past changes in the shares of supply indicate that the market structure can change rapidly in response to new developments. For example, in 2015, Samsung's share of supply in PCIe enterprise SSDs was [0-5]%, which rapidly increased to [30-40]% in 2016 and then nearly [50-60]% in 2017, after it was the first to mass produce 3D NAND.⁸⁵
- (d) SK hynix is a relatively new supplier, which has grown its share of supply rapidly from [0-5]% in 2018 to [10-20]% in 2020. However, [X]% of its revenues in 2018 and more than [X]% in 2019 and 2020 were [X] (see paragraph 100).
97. The CMA considers that these factors indicate that the shares of supply do not fully reflect the competitive constraints in the PCIe enterprise SSD segment. While both the Target (and post-Merger the Merged Entity) and Samsung have high shares of supply, these are likely to be challenged as more suppliers will transition to PCIe enterprise SSD. In addition, as noted above, SK hynix's scale in PCIe enterprise SSD is primarily attributable to [X].

Closeness of competition

98. The Parties submitted that the Merger would not lead to competition concerns under any sub-segmentation of enterprise SSDs based on interface. [X]. In the PCIe enterprise SSD segment, SK hynix is a small competitor and almost all of its revenues come from [X]; and in relation to this customer, the Parties are not close competitors given that their products address different customer needs.⁸⁶
99. The Parties' internal documents support their position that they do not compete particularly closely in the PCIe enterprise SSD market. A document produced by SK hynix in relation to the Merger states that [X].⁸⁷ Another SK hynix internal document produced in relation to the Merger indicates that the

⁸⁴ Responses to the CMA's questionnaire: [X].

⁸⁵ Based on Trendforce reports and data.

⁸⁶ Final Merger Notice, para 1.5.

⁸⁷ Case M.10059 - Form CO - Annex 5.4.1.a_CONFIDENTIAL.pdf.

Parties primarily overlap in mid/low end PCIe.⁸⁸ Internal documents submitted by Intel [REDACTED].

100. The Parties' customer data indicate a limited customer overlap between the Parties. Only [REDACTED] of Intel's customers in 2020 were also customers of SK hynix. While these overlapping customers are about [REDACTED] of SK hynix's ([REDACTED]) customers, as noted previously in paragraph 96(d) above, SK hynix generated more than [REDACTED]% of its PCIe SSD revenues from [REDACTED]. A third party submitted that it did not consider the Parties to be close competitors and viewed their portfolios as complementary. In addition, customers responding to the CMA's questionnaire rarely mentioned SK hynix as an alternative to their current suppliers, including the Target.⁸⁹
101. Customer responses indicated that while the Target is a strong supplier of PCIe enterprise SSDs, the Parties are not generally considered to compete closely. About half of responding customers considered the Target to be a strong competitor to SK hynix, but only a few customers considered SK hynix to be a strong competitor to the Target. However, one customer noted that while SK hynix is not a competitor to the Target, it is entering a business area where Intel already has a mature share. Another customer noted the differences between the Parties – SK hynix has a better relationship with cloud customers and limited product offering for OEMs, where the Target provides better support.
102. Competitors' views on the closeness of competition between the Parties were mixed and ranged from 'strong' to 'weak' competitors to each other. A few competitors submitted that the Parties are focused on different segments: the Target is concentrated on enterprise SSD for data centres, while SK hynix is a weak competitor in enterprise SSD – it is focused on client SSD and is active in the mobile segment. However, both competitors also noted that SK hynix has recently increased its production of enterprise SSDs.
103. Overall, based on the evidence above, the CMA considers that while the Parties compete with each other, they are not particularly close competitors in the supply of enterprise SSD generally or PCIe enterprise SSD in particular.

Competitive constraints

104. The Parties submitted that the enterprise SSD segment is highly competitive: most of the Merged Entity's largest competitors are well-resourced and

⁸⁸ Case M.10059 - Form CO - Annex 5.4.1.c_CONFIDENTIAL.PDF

⁸⁹ The Target and Samsung were the most commonly used suppliers, followed by Kioxia, Micron and Western Digital.

vertically integrated in the production of NAND flash memory and customers have significant countervailing buyer power because they are powerful hyperscale cloud service providers. Moreover, the Parties said that in the PCIe enterprise SSD segment, competition will remain intense post-Merger, with Samsung being the largest competitor after the Merged Entity, followed by Western Digital and Kioxia. Micron has a share of [0-5]%, but it is rapidly catching up as it more than doubled its share between 2017 and 2019.⁹⁰

105. The Parties' internal documents indicate that the Parties consider the remaining suppliers as credible competitors. While an SK hynix internal document discussing the Merger notes that [REDACTED].⁹¹
106. Intel's internal documents indicate that [REDACTED].
- (a) Intel's internal documents indicate that [REDACTED].⁹² A few internal documents [REDACTED].⁹⁴
- (b) In its internal documents, [REDACTED].⁹⁵ While the documents primarily [REDACTED],⁹⁶ [REDACTED]⁹⁷ and [REDACTED].⁹⁸ [REDACTED].⁹⁹
- (c) [REDACTED].¹⁰⁰
107. Intel's internal documents indicate that [REDACTED].¹⁰¹
108. Third parties who responded to the CMA's questionnaire did not express concerns in relation to the Merger, except for one customer.¹⁰² Third party responses noted that the market will remain competitive, there are 'plenty of alternative options', and that the Parties' offerings are complementary. A few customers submitted that the Merger might bring a positive impact to the

⁹⁰ Final Merger Notice, para 15.43-15.69.

⁹¹ [REDACTED].

⁹² [REDACTED].

⁹³ [REDACTED].

⁹⁴ [REDACTED].

⁹⁵ One of the enterprise SSD applications is for use in data centres (eg by hyperscale providers such as Google, Microsoft, Amazon Web Services).

⁹⁶ [REDACTED].

⁹⁷ [REDACTED].

⁹⁸ [REDACTED].

⁹⁹ [REDACTED].

¹⁰⁰ [REDACTED].

¹⁰¹ [REDACTED].

¹⁰² The customer submitted that the acquisition reduces the number of competitors, which could lead to worse price as there will not be enough competitive pressure. However, the customer considered there will not be much effect on itself if they are going to be able to access the full SK hynix product portfolio.

enterprise SSD market as the Merged Entity may be able to invest in innovation and might compete more aggressively.

109. Third party views indicated that Samsung is the strongest competitor to the Parties, followed by Micron, while the remaining main suppliers – Kioxia and Western Digital – are also credible alternative suppliers to both Parties.
- (a) Customers considered Samsung as the market leader and the strongest competitor to both Parties. About half of customers considered Micron to be a strong competitor to both Parties. One customer noted that Micron's PCIe enterprise SSD roadmap is behind that of the Target and on par with that of SK hynix. However, a few other customers submitted that Micron is financially strong and increasing its investment in the PCIe segment. Kioxia and Western Digital were considered as slightly weaker, but still credible competitors to both Parties. Customer comments about Kioxia and Western Digital were mixed and included descriptions such as: 'robust offering', 'trying to enlarge its presence', 'roadmap behind that of Intel and on par with that of SK hynix'.
 - (b) Competitors considered Samsung as the strongest competitor to the Parties, but they also considered the other main suppliers to be credible competitors. One competitor noted that all main competitors are similar and compete on the same parameters.
 - (c) Customers and competitors considered YMTC to be a weak competitor because it does not have a strong enterprise solution, but some customers noted that it has potential in the long term.
 - (d) Customers did not consider non-vertically integrated suppliers (Kingston, Seagate, Shannon etc) to be strong competitors to the Parties. Similarly, while competitors considered non-vertically integrated suppliers to be relevant, they considered them to be weaker competitors than the main suppliers. A non-vertically integrated competitor told the CMA that it is not among the leading provider in SSDs, and that it has similar although slightly worse performing products.
110. Given the dynamic nature of the enterprise SSD market, the CMA has also considered the expansion plans of the main competitors.¹⁰³ While currently having a relatively low market shares in the PCIe enterprise SSD, a significant number of the main players [REDACTED] indicated that they expect to expand their offering in PCIe.

¹⁰³ [REDACTED].

- (a) [REDACTED] told the CMA that [REDACTED]. [REDACTED].
- (b) [REDACTED] told the CMA that it plans to grow its market shares in enterprise SSD and invest in the PCIe segment (but it is exiting the SAS segment). [REDACTED] said that it has a fully-fledged enterprise SSD R&D team and is mature in its R&D process. It has strong relationships with enterprise customer through its HDD business and understands their needs. [REDACTED] stated that it had launched new products in enterprise SSD and ‘are in a big transition’. [REDACTED] also noted that they expect to grow and ‘get better and better’, while ‘going through a lot of qualifications’^{104, 105}
- (c) [REDACTED] told the CMA that since PCIe enterprise SSD is a fast growing market, [REDACTED] is aiming to expand product line-up and expects their PCIe expansion to be accretive to their existing SSD portfolio. [REDACTED].¹⁰⁶
- (d) [REDACTED], submitted [REDACTED]. [REDACTED], another [REDACTED] submitted that it will increasingly focus on eSSD and PCIe in the future, but does not foresee a material change in its relative market position.

111. In light of the evidence above, the CMA believes that the Merged Entity will continue to face a strong competitive constraint from Samsung. The CMA also believes that the Merged Entity faces a material constraint from the remaining vertically integrated suppliers, which are, in particular, likely to grow in the PCIe enterprise SSD segment, and to a certain – albeit weaker – extent from the non-vertically integrated suppliers, as the market transitions to PCIe enterprise SSDs.

Innovation

- 112. The Parties submitted that the SSD segment is dynamic and highly competitive characterized by significant leapfrog innovation with competitors constantly attempting to differentiate their offerings through the development and release of new products and technologies.¹⁰⁷
- 113. Intel’s internal documents indicate that [REDACTED].¹⁰⁸ Nevertheless, [REDACTED].
- 114. Third parties did not raise concerns in relation to the Merger’s impact on innovation. Third parties indicated that all main suppliers are similarly

¹⁰⁴ Enterprise SSD customers use qualification procedures where a product needs to successfully undergo a series of tests for the product (and the supplier) to be included among the customer’s approved products.

¹⁰⁵ [REDACTED]

¹⁰⁶ [REDACTED]

¹⁰⁷ Final Merger Notice, paragraph 15.56.

¹⁰⁸ [REDACTED]

innovative, with the exception of Samsung, which was mentioned slightly more often as leading innovations. Competitors also noted that it is important for suppliers to continue innovating. For example, a third party told the CMA that to be competitive in the SSD market, it is important to constantly develop new technologies; some companies may have a market lead in a new technology for a few months and then lose it when a newer technology is introduced.

115. Overall, the available evidence indicates that innovation plays a major role in competition in the supply of enterprise SSD generally and the PCIe enterprise SSD segment, in particular. The CMA considers that it is unlikely to be negatively affected by the Merger.

Conclusion on enterprise SSDs

116. As set out above, while the Merged Entity will have a relatively high share of supply in enterprise SSD generally and the PCIe enterprise SSD segment in particular, the CMA believes that the market shares do not fully reflect the competitive constraints the Merged Entity will face post-Merger. The CMA considers that the Parties do not compete more closely with each other than with a number of other alternative suppliers. The Merged Entity will continue to face competitive constraints from a number of credible alternative suppliers, who are making significant efforts to strengthen their product portfolio and, in particular, expand in PCI enterprise SSD as the market transitions to that interface. Accordingly, the CMA does not believe that the Merger gives rise to a realistic prospect of an SLC as a result of horizontal unilateral effects in relation to the supply of PCIe enterprise SSD or in the wider supply of all enterprise SSDs.

Barriers to entry and expansion

117. Entry, or expansion of existing firms, can mitigate the initial effect of a merger on competition, and in some cases may mean that there is no SLC. In assessing whether entry or expansion might prevent an SLC, the CMA considers whether such entry or expansion would be timely, likely and sufficient.¹⁰⁹
118. However, the CMA has not had to conclude on barriers to entry or expansion as the Merger does not give rise to competition concerns on any basis.

¹⁰⁹ *Merger Assessment Guidelines*, from paragraph 5.8.1.

Third party views

119. The CMA contacted customers and competitors of the Parties. Third party comments have been taken into account where appropriate in the competitive assessment above.

Decision

120. Consequently, the CMA does not believe that it is or may be the case that the Merger may be expected to result in an SLC within a market or markets in the United Kingdom.

121. The Merger will therefore **not be referred** under section 33(1) of the Act.

Eleni Gouliou
Director Mergers
Competition and Markets Authority
28 June 2021

ⁱ Intel submitted that the Target's global turnover is