Competition Commission SINGAPORE

Section 57 of the Competition Act (Cap. 50B)

Grounds of Decision issued by the Competition Commission of Singapore

In relation to the Notification for Decision of the Proposed Acquisition of Sole Control by Western Digital Corporation of SanDisk Corporation

19 January 2016

Case number: CCS 400/015/15

Confidential information in the original version of this Decision has been redacted from the published version on the public register. Redacted confidential information in the text of the published version of the Decision is denoted by [✂].

TABLE OF CONTENTS

I. Introduction

The Notification

1. On 4 December 2015, Western Digital Corporation ("WDC") and SanDisk Corporation ("SanDisk") (collectively, "the Parties") filed a joint notification pursuant to section 57 of the Competition Act (Cap. 50B) ("the Act") for a decision by the Competition Commission of Singapore ("CCS") as to whether the acquisition by WDC of sole control of SanDisk ("the Acquisition"), if carried into effect, will infringe the prohibition under section 54 of the Act.

2. In reviewing the Acquisition, CCS carried out a public consultation which included obtaining feedback from the Parties' competitors and customers (i.e. end-users of enterprise class Solid State Drives ("SSDs") ("Enterprise SSDs")). Ten responses were received from five customers[1] and five competitors[2].

3. After evaluating the submissions from the Parties, together with the views and feedback from third-parties during the public consultation, CCS concludes that the Acquisition will not result in a substantial lessening of competition ("SLC") and, hence, will not infringe section 54 of the Act.

II. The Parties

WDC

4. WDC is the ultimate parent company of a multi-national group of companies comprising 74 principal subsidiaries[3] involved in the development and manufacturing of storage solutions for the creation, management and preservation of digital content. WDC produces Hard Disk Drives ("HDDs") for a number of uses, including personal computers, consumer electronics, cloud computing and datacentre applications, and Enterprise SSDs and hybrid drives. WDC also produces certain external and business storage solutions.[4] WDC supplies storage solutions across a range of industries globally.

5. WDC's registered office is in California, United States of America ("USA"). The company has five subsidiaries incorporated in Singapore:

(i) HGST Asia Pte. Ltd.;
(ii) HGST Singapore Pte. Ltd.;
(iii) Viviti Technologies Pte. Ltd.;

[1] Responses from [✂].
[2] Responses from [✂].
[3] Exhibit 21 of Annex 2 to Form M1.
[4] Paragraph 10.5 of Form M1.

(iv) WD Media (Singapore) Pte. Ltd.; and
(v) Western Digital (S. E. Asia) Pte. Ltd. [5]

6. In 2015, the products sold by WDC in Singapore are as follows:

[✂][6]

7. WDC has sales, manufacturing, and R&D facilities in Singapore.[7]

8. For the fiscal year ending 3 July 2015, the total worldwide turnover for WDC was approximately [✂]. For the same period, WDC's total Singapore turnover was approximately [✂].[8]

SanDisk

9. SanDisk is the ultimate parent company of a multi-national group of companies, with 15 significant subsidiaries. [9] SanDisk and its subsidiaries specialise in the production of flash storage solutions, including Enterprise SSDs and SSDs for consumer-operated devices ("Client SSD"s). Sandisk also produces removable cards, USB flash drives and embedded flash products for mobile and connected applications and consumer electronics. In addition, SanDisk is active in software, including storage solution software that is used in its consumer and enterprise products, such as music and video players that use its storage solutions. SanDisk supplies flash storage solutions to a range of industries globally.

10. SanDisk's registered office is in California, USA. SanDisk has three subsidiaries and branch offices incorporated in Singapore, namely:

(i) Fusion-io Singapore Private Ltd.;
(ii) SanDisk Hong Kong Limited Singapore Branch; and
(iii) SMART Storage Systems (SG) Pte. Ltd. [10]

11. In the fiscal year ending 28 December 2014, SanDisk sold the following products in Singapore:

(i) [✂][11]

[5] Paragraph 10.1 of Form M1 and Exhibit 21 of Annex 2 to Form M1.
[6] Annex 6 to Form M1.
[7] Paragraph 10.9 and 10.11 of Form M1.
[8] Paragraphs 13.1. and 13.3 of Form M1.
[9] Annex 4 of Form M1.
[10] Paragraph 10.2 of Form M1.
[11] Annex 7 to Form M1.

12. SanDisk's has a sales office in Singapore but does not have any manufacturing facilities in Singapore.[12]

13. For the year ending 28 December 2014, SanDisk's total group worldwide revenue was [✂] and its total group Singapore turnover was [✂].[13]

III. The Acquisition

14. The Acquisition involves the acquisition of sole control by WDC of SanDisk.[14] It will be implemented in accordance with the terms of the Agreement and Plan of Merger entered into by the Parties on 21 October 2015 ("Merger Agreement"), [✂]. On completion of the Acquisition, WDC will own 100% of the common stock in, and control, of SanDisk.[15]

15. The Acquisition is valued at approximately [✂], payable in cash and stock.[16] The Acquisition is expected to be completed in mid-2016, [✂].[17]

16. The Parties are of the view that the Acquisition will facilitate innovation and allow the Parties to offer customers enhanced, lower cost and better integrated enterprise storage solutions. The Acquisition will provide WDC with dedicated and guaranteed access to NAND[18] (also referred to as negative-AND), reduce WDC's costs in NAND supply, and provide a better understanding of the technical and operational characteristics of NAND, thereby facilitating innovation. As WDC currently sources all of its NAND requirements from external manufacturers, the Acquisition will reduce double marginalisation in WDC's NAND purchases and ensure the continued supply of this key SSD component.[19]

17. Further, the Parties submit that the Acquisition will combine their complementary product ranges, customer bases and specialised know-how. They are of the view that the Acquisition will bring about minimal overlaps between the Parties, and even where there are overlaps, the Parties' focuses are different. While WDC's main business is HDDs, SanDisk's main businesses are removable

---

[12] Paragraph 10.12 of Form M1
[13] Paragraphs 13.2 and 13.4 of Form M1.
[14] Paragraph 11.1 of Form M1.
[15] Paragraphs 11.3 and 11.4 of Form M1.
[16] Paragraph 11.6 of Form M1.
[17] Paragraph 11.8 of Form M1.
[18] NAND is a Boolean operator which gives the value zero if and only if all the operands have a value of one, and otherwise has a value of one (equivalent to NOT AND). In digital electronics, a NAND gate (negative-AND) is a logic gate which produces an output which is false only if all its inputs are true; thus its output is complement to that of the AND gate. Where SSDs are concerned, the flash memory cells share the internal characteristics of the NAND gate and is a key component in the said product.
[19] Paragraph 12.1 of Form M1.

flash products and Client SSDs. Although the Parties are active in the production and sale of SSDs, their strengths are different and complementary.[20]

18. The Parties also submit that, post-Acquisition, the vertical integration and the combination of the Parties' research and development ("R&D") capabilities will facilitate innovation in technologies such as internal media, controllers, Non-Volatile Memory Express Peripheral Component Interconnect Express ("NVMe PCIe") products and flash solutions for All Flash Arrays ("AFAs"). In addition, the acquisition of SanDisk's software assets will allow the Parties to improve their existing product offering. The acquired software assets will enhance the integration and optimisation of both stand-alone SSDs as well as appliances for specific applications, and boost the overall storage solution performance and lower the total solution-level cost of ownership, allowing the Parties to offer customers enhanced, lower cost and better integrated enterprise storage solutions.[21]

IV. Competition Issues

19. The Parties submit that they only overlap in the supply of Enterprise SSDs ("the Overlapping Product"), which accounts for a small proportion of the Parties' business globally[22] and the relevant product market is the worldwide market for Enterprise Solid State Storage.[23] CCS notes that WDC and SanDisk currently overlap in their operations in Singapore.

20. Given the contrasting responses from the Parties and third-parties on the ease of switching between specific interfaces of Enterprise SSDs, CCS considered whether the Acquisition will substantially lessen competition in the narrow market for interface-specific Enterprise SSDs, as elaborated in Section VII, below.

21. The global market shares by revenue and volume estimates in 2014 submitted by the Parties for the Overlapping Product, i.e. Enterprise SSDs irrespective of interface-type, do not exceed the indicative thresholds set out in the *CCS Guidelines on the Substantive Assessment of Mergers.*[24] CCS notes, however, that the revenue and volume estimates in 2014 submitted by the Parties specifically for SAS interface Enterprise SSDs and PCIe interface Enterprise SSDs exceed the indicative merger thresholds.[25]

---

[20] Paragraph 12.2 of Form M1.
[21] Paragraph 12.3 of Form M1.
[22] Paragraph 17.1 of Form M1.
[23] Paragraphs 20.1 and 20.2 of Form M1.
[24] Paragraph 21.9 of Form M1, considered in light of the thresholds set out at paragraph 5.15 of the *CCS Guidelines on the Substantive Assessment of Mergers*.
[25] For PCIe interface Enterprise SSDs, the indicative merger thresholds are exceeded only by revenue shares and not volume shares.

22. The Parties further submit that strong competition will continue to be maintained post-Acquisition due to the following factors:

a. The Enterprise Solid State Storage market is characterised by the presence of a significant number of strong, well-resourced competitors, namely Intel, Samsung, Micron, Toshiba and Seagate, in a bidding market; [26]
b. The Parties are not close competitors, and thus the Acquisition will not result in the loss of competitive constraint on the merged entity;[27]
c. Post-Acquisition, the Parties will continue to be significantly constrained by the new memory technologies that are likely to put severe pressure on Enterprise SSD prices;[28]
d. The Parties face competition from NAND-based AFAs, which they submit belong to the same market as Enterprise SSDs, and that any increase in the price of Enterprise SSDs would cause Original Equipment Manufacturers ("OEMs") to switch to producing their own Enterprise SSDs or NAND-based AFAs;[29]
e. The barriers to entry are low as the Enterprise SSD market is characterised by high levels of innovation and market growth, which facilitates entry and expansion;[30] and
f. The Parties will remain constrained by significant countervailing buyer power and customers' in-house solid state storage production.[31]

On account of the above reasons, the Parties submit that the Acquisition will not give rise to non-coordinated effects in Singapore.[32]

V. Counterfactuals

23. As stated at paragraph 4.6 of the *CCS Guidelines on Substantive Assessment of Mergers*, CCS will, in assessing mergers and applying the SLC test, evaluate the prospects for competition in the future with and without the merger. The competitive situation without the merger is referred to as the "counterfactual".

24. The *CCS Guidelines on Substantive Assessment of Mergers* also states that in most cases, the best guide to the appropriate counterfactual will be prevailing conditions of competition, as this may provide a reliable indicator of future competition without the merger. However, CCS may need to take into account

[26] Paragraphs 24.1 and 34.1.6 of Form M1.
[27] Paragraph 34.1.3 of Form M1.
[28] Paragraph 34.1.4 of Form M1.
[29] Paragraph 34.1.5 of Form M1.
[30] Paragraph 34.1.7 of Form M1.
[31] Paragraphs 34.1.8 and 34.1.9 of Form M1.
[32] Paragraph 34.1 of Form M1.

likely and imminent changes in the structure of competition in order to reflect as accurately as possible the nature of rivalry without the merger.[33]

(i) The Parties' submissions

25. The Parties submit that in the absence of the Acquisition, they will continue to operate separately and independently. However, there will be loss in opportunity for the Parties to rationalise and achieve the efficiencies described in paragraph 42 of Form M1, which have been summarised below at paragraphs 100 to 102 below.[34]

26. The Parties opined that their competitors are likely to continue to compete for customers with, or without, the Acquisition. They submit that the Acquisition will not result in an SLC for Enterprise Solid State Storage in Singapore or worldwide, or result in any adverse effect relative to the counterfactual scenario.[35]

(ii) CCS's assessment

27. CCS notes that WDC, [✂][36] CCS also notes that SanDisk and Toshiba have established three NAND manufacturing joint ventures, but that SanDisk does not have any NAND production facilities or capacity in Singapore.[37] While the Parties have submitted NAND-based AFAs are part of the relevant product market, i.e. the Enterprise Solid State Storage market alongside Enterprise SSDs, for the reasons set out below at paragraph 42, CCS is of the view that WDC's [✂] do not affect the determination of the counterfactual.

28. CCS considers that the Parties are competitors in the market for interface-specific Enterprise SSDs, particularly SAS interface and PCIe interface Enterprise SSDs, and consequently, would be competitors in the potentially wider markets of all Enterprise SSDs or Enterprise Solid State Storage products. Without the acquisition, the Parties will continue to operate separately as competitors in the relevant market.

29. As such, CCS is of the view that the prevailing conditions of competition would be the likely scenario without the Acquisition and accordingly, CCS applies the SLC test to this counterfactual scenario.

---

[33] Paragraph 4.7 of the *CCS Guidelines* on *Substantive Assessment of Mergers*.
[34] Paragraph 23.1 of Form M1.
[35] Paragraph 23.2 of Form M1.
[36] Paragraph 24.63 of Form M1.
[37] Paragraphs 24.64 to 24.67 of Form M1.

VI. Relevant Markets

30. The Parties submit that the relevant market for the purpose of this notification is the global supply of all Enterprise Solid State Storage.[38]

(a) Product markets

(i) The Parties' submissions

31. The Parties submit that the Enterprise Solid State Storage market,[39] includes (at least):

a. SSDs of all interfaces used for enterprise applications (workstations, servers, network attached storage, storage area networks, other computing systems, and network communication) (also known as "Enterprise SSDs"); and
b. NAND-based AFAs.[40]

32. While Enterprise SSDs is the only Overlapping Product produced by the Parties, the Parties submit that NAND-based AFAs constitute part of the much broader Enterprise Solid State Storage Market.

Relevant Market ought not to be delineated by interface, form factor or sales channel

33. Given the demand- and supply-side substitutability of Enterprise SSDs, the Parties submit that there are no separate product markets delineated by interface, form factor or sales channel. According to the Parties, Enterprise SSDs typically use one of three types of interfaces – SAS, SATA, or PCIe.[41] Nevertheless, the Parties submit that segmentation by interface would not be appropriate. Many of their major customers are OEMs that build storage solutions and servers that include Enterprise SSDs and sell these systems to enterprise customers. When designing a new system, the Parties submit that the OEMs allow for multiple interface options from enterprise solid state storage suppliers and the three interfaces are generally substitutable for the same end user.[42] In support of their submission, the Parties provided CCS with [✂].[43]

---

[38] Paragraphs 19.2 and 20.1 of Form M1.
[39] Paragraph 20.1 of Form M1.
[40] Paragraphs 19.2 and 19.6 of Form M1.
[41] Paragraph 19.11 of Form M1.
[42] Paragraph 19.13 of Form M1.
[43] Annex 1 of the Parties' Response to CCS's information request dated 23 December 2015.

34. The Parties also submit that there is an appreciable degree of compatibility/conversion between the interfaces with the availability of multi-interface backplane connectors such as U.2 which is compatible with any Enterprise SSD in the 2.5" form factor, regardless of interface, and SATA to SAS interposer which allow for the use of certain SAS features in SATA Enterprise SSDs.[44]

35. Further, on the supply-side, components used by manufacturers to produce Enterprise SSDs are common across the various Enterprise SSD interfaces. Most existing Enterprise SSDs suppliers already manufacture SSDs with all types of interfaces or can readily adapt their production.[45] As such, the Parties submit that segmentation by interface would not be appropriate.

36. The Parties also submit that there are no requirements for SSD to conform to HDD form factors (i.e. physical size and shape of the drive). NAND-based AFAs contain NAND modules that are designed to be used in an AFA system, and as such, form factor is not crucial for functionality.[46] Therefore, segmentation by form factor would not be appropriate.

37. On account of the above, the Parties submit that there are no separate markets delineated by interface, form factor or sales channel.

NAND-based AFAs are in the same product market

38. The Parties also submit that NAND-based AFAs and SSD-based AFAs are substitutable from the perspective of the OEM's end customers as they deliver the same functionalities, are equally reliable and are offered in similar performance and endurance ranges. Further, the Parties also submit that there is limited cost to be incurred in switching from producing SSD-based AFAs to producing NAND-based AFAs.[47]

39. As such, the Parties submit that the relevant product market is that of all Enterprise Solid State Storage products, encompassing minimally the supply of all forms of Enterprise SSDs and NAND-based AFAs.[48]

---

[44] Paragraphs 19.13.6 and 19.13.8 of Form M1
[45] Paragraph 19.22 of Form M1.
[46] Paragraph 19.15 of Form M1.
[47] Paragraph 19.5 of Form M1.
[48] Paragraphs 19.2 and 20.1 of Form M1.

(ii) CCS's assessment

40. CCS first considered the possibility of a narrower product market definition i.e. by interface. Third-party feedback indicates that a narrower market (i.e. SAS-interfaced Enterprise SSDs, SATA-interfaced Enterprise SSDs, PCIe-interfaced Enterprise SSDs etc.) may be plausible. Competitors, such as [✂], provided feedback that customers may not be able to transition easily to a new interface without incurring significant cost. Often, customers are reluctant to change software, making the adoption of a new interface a lengthy process.[49]

41. Responses from third-parties further suggest that purchasing tends to be for specific interfaces and switching would occur between competitors that provide SSDs of common interfaces.[50] Specifically, [✂] noted that end-customers for storage solutions tend to specify the interface to be used and, hence, they would be unlikely to readily switch to using other interfaces.[51]

42. Further, third-parties indicated that it would be difficult for a typical supplier to switch from producing SSDs of one interface to another.[52] [✂] noted that particular interfaces of Enterprise SSDs would require specific technology and engineering resources. Not every supplier has the capability to produce its own controllers for the various interfaces but they may be able to procure them from makers of these said controllers.[53]

43. The information received by CCS from third-parties in respect of this narrower market definition contradicts the contents of [✂].[54] However, the feedback from third-parties, as set out in the preceding paragraphs, suggests that once an interface has been adopted, switching from one interface to another would incur costs and therefore, does not appear to be common practice for customers of Enterprise SSDs to do so.

44. CCS also considered the possibility of the wider product market definition, i.e. Enterprise Solid State Storage market, as submitted by the Parties. Two competitors, [✂], note that Enterprise HDDs can be considered a substitute for Enterprise SSDs because they are both used for enterprise storage, and the price gap between HDDs and SSDs has become smaller.[55] Several other third-party responses suggest that there is constant innovation and a migration of technologies for storage solutions, with SSDs displacing reliance on HDDs. Further, within

[49] Public consultation responses from [✂].
[50] Public consultation responses from [✂].
[51] Public consultation response from [✂].
[52] Public consultation responses from [✂].
[53] Public consultation response from [✂].
[54] Annex 1 of Responses by the Parties to CCS's information request dated 23 December 2015.
[55] Public consultation responses from [✂].

SSDs, there is potential for SAS and SATA interfaces to be displaced by PCIe interfaces.[56]

45. For the purposes of this assessment, CCS is of the view that it is unnecessary to conclude on the exact product market definition, given that no SLC concerns will arise even in the narrowest possible market (i.e. Enterprise SSDs by specific interface) due to existence of sufficiently credible competitors post-Acquisition, strong countervailing buyer power and surmountable barriers to entry. Each of these reasons will be elaborated in turn at Section VII, below.

(b) Geographic Market

(i) The Parties' submissions

46. The Parties submit that the geographic scope of the market is worldwide as Enterprise Solid State Storage products are manufactured to the same standards and sold world-wide. Transport costs do not play a significant role and there are no significant barriers to trade.[57] Further, the Parties also submit that in general, sale prices are negotiated on a worldwide basis and do not distinguish between shipment destination. [58]

(ii) CCS's assessment

47. CCS agrees with the Parties' submission that the geographic scope of the market is global to global (i.e., suppliers and customers sell and buy Enterprise Solid State products respectively on a global level/scale), following a review of the Parties' submissions and third-party feedback.

48. Competitors, [✂], consider Enterprise SSDs to be sold and purchased on a worldwide basis.[59] [✂], in particular, noted that geographic location is generally not a critical factor in deciding whom to purchase from. Rather, it is important to have field engineering support - the location of the headquarters is generally not significant.[60] [✂] noted that all major companies selling Enterprise SSDs have worldwide distribution networks. This is corroborated by customer feedback received from [✂] indicating that they procure Enterprise SSDs from locations within and outside of Singapore.[61] CCS further notes that customers, [✂] have provided consolidated public consultation responses to CCS from their

[56] Public consultation responses from [✂].
[57] Paragraph 19.27 of Form M1.
[58] Paragraph 19.28 of Form M1.
[59] Public consultation responses from [✂].
[60] Public consultation response from [✂].
[61] Public consultation responses from [✂].

headquarters, suggesting that procurement is likely to be done on a global level by the headquarters as well.

49. One competitor, [✂], however notes that each region has specific customers, competitors and products demanded. This competitor is of the view that they would not categorise the geographic market as necessarily global in nature.[62] In this regard, CCS notes that [✂]'s main customers are headquartered in [✂], where the bulk of the procurement takes place. However, [✂] still requests for a portion of products procured in [✂] to be shipped to Singapore customer-affiliates.[63] This suggests that [✂]'s customers also procure on a global basis.

50. On account of the above, CCS finds that it is not necessary to define the relevant product and geographical markets for the purposes of this notification. However, for the purposes of the assessment in the following sections, CCS will consider that the market for the global supply of interface-specific Enterprise SSDs to customers globally.

VII. Market Structure

(a) Market shares and market concentration

(i) The Parties' submissions

51. The Parties have provided data on the market shares of the world's leading Enterprise Solid State Storage suppliers based on revenue and market share figures of Enterprise SSD suppliers based on volume revenue (see **Table A1 to Table A3** of **Annex A**). The Parties also provided a further breakdown of global market share figures for Enterprise SSDs by specific interfaces based on volume and revenue at **Tables 2 to 7**[64], below. The data on the worldwide revenues and volumes of the Enterprise Solid State Storage suppliers to customers worldwide were obtained from International Data Corporation ("IDC")[65], as well as other industry sources such as Trendfocus.[66]

---

[62] Public consultation response from [✂].
[63] Public consultation response from [✂].
[64] Table 2 on SAS Interface Enterprise SSD market shares by volume; Table 3 on SAS Interface Enterprise SSD market shares by revenue; Table 4 on PCIe Interface Enterprise SSD market shares by volume; Table 5 on PCIe Interface Enterprise SSD market shares by revenue; Table 6 on SATA Interface Enterprise SSD market shares by volume; and Table 7 on SATA Interface Enterprise SSD market shares by revenue.
[65] Paragraph 21.1 of Form M1.
[66] Ibid.

Table 2 SAS interface Enterprise SSD market shares by volume (Global to Global)[67]

	Units ('000)			Market Share (%)		
	2012	**2013**	**2014**	**2012**	**2013**	**2014**
WDC	[✂]	[✂]	[✂]	[40-50]%	[50-60]%	[40-50]%
SanDisk	[✂]	[✂]	[✂]	[20-30]%	[20-30]%	[20-30]%
Combined	**[✂]**	**[✂]**	**[✂]**	**[60-70]%**	**[70-80]%**	**[60-70]%**
Intel	-	-	-	-	-	-
Samsung	-	[✂]	[✂]	[0-10]%	[0-10]%	[10-20]%
Micron	[✂]	[✂]	[✂]	[0-10]%	[0-10]%	[0-10]%
Toshiba	[✂]	[✂]	[✂]	[0-10]%	[0-10]%	[10-20]%
sTEC (now WDC)	[✂]	[✂]	-	[20-30]%	[0-10]%	-
SMART (now SanDisk)	[✂]	[✂]	-	[0-10]%	[0-10]%	-
Seagate	-	-	[✂]	-	-	[0-10]%
Others	[✂]	[✂]	-	[0-10]%	[0-10]%	-
Total	**[✂]**	**[✂]**	**[✂]**	**100%**	**100%**	**100%**

Source: Gartner, IDC and the Parties

[67] Table 1 of the Parties' Response to CCS's information request dated 30 December 2015.

Table 3 SAS interface Enterprise SSD market shares by revenue (US$) (Global to Global)[68]

	Revenue (US$ million)			Market Share (%)		
	2012	**2013**	**2014**	**2012**	**2013**	**2014**
Western Digital	[✂]	[✂]	[✂]	[30-40]%	[40-50]%	[40-50]%
SanDisk	[✂]	[✂]	[✂]	[20-30]%	[20-30]%	[30-40]%
Combined	**[✂]**	**[✂]**	**[✂]**	**[60-70]%**	**[60-70]%**	**[70-80%]**
Intel	-	-	-	-	-	-
Samsung	-	[✂]	[✂]	[0-10]%	[0-10]%	[10-20]%
Micron	[✂]	[✂]	[✂]	[0-10]%	[0-10]%	[0-10]%
Toshiba	[✂]	[✂]	[✂]	[0-10]%	[0-10]%	[10-20]%
sTEC (now WDC)	[✂]	[✂]	-	[20-30]%	[0-10]%	-
SMART (now SanDisk)	[✂]	[✂]	-	[0-10]%	[0-10]%	-
Seagate	-	-	[✂]	-	-	[0-10]%
Others	[✂]	[✂]	-	[0-10]%	[10-20]%	-
Total	**[✂]**	**[✂]**	**[✂]**	**100%**	**100%**	**100%**

Source: Gartner, IDC and the Parties

[68] Table 2 of the Parties' Response to CCS's information request dated 30 December 2015.

Table 4 PCIe interface Enterprise SSD market shares by volume (Global to Global)[69]

	Units ('000)			Market Share (%)		
	2012	**2013**	**2014**	**2012**	**2013**	**2014**
Western Digital	-	-	[✂]	-	-	[0-10]%
SanDisk	-	-	[✂]	-	-	[20-30]%
Combined	**-**	**-**	**[✂]**	**-**	**-**	**[20-30]%**
Intel	[✂]	[✂]	[✂]	[0-10]%	[0-10]%	[0-10]%
Samsung	-	-	[✂]	-	-	[0-10]%
Micron	[✂]	[✂]	[✂]	[0-10]%	[0-10]%	[0-10]%
Toshiba	-	-	[✂]	-	-	[0-10]%
Fusion-io (now SanDisk)	[✂]	[✂]	-	[40-50]%	[20-30]%	-
OCZ (now Toshiba)	[✂]	-	-	[0-10]%	-	-
LSI (now Seagate)	[✂]	[✂]	[✂]	[10-20]%	[20-30]%	[30-40]%
NetApp	[✂]	[✂]	[✂]	[0-10]%	[0-10]%	[0-10]%
Others	[✂]	[✂]	[✂]	[30-40]%	[30-40]%	[10-20]%
Total	**[✂]**	**[✂]**	**[✂]**	**100%**	**100%**	**100%**

Source: Gartner, IDC and the Parties

[69] Table 3 of the Parties' Response to CCS's information request dated 30 December 2015.

Table 5 PCIe interface Enterprise SSD market shares by revenue (US$) (Global to Global)[70]

	Revenue (US$ million)			Market Share (%)		
	2012	2013	2014	2012	2013	2014
Western Digital	-	-	[✂]	-	-	[0-10]%
SanDisk	-	-	[✂]	-	-	[30-40]%
Combined	**-**	**-**	**[✂]**	**-**	**-**	**[40-50]%**
Intel	[✂]	[✂]	[✂]	[0-10]%	[0-10]%	[0-10]%
Samsung	-	-	[✂]	-	-	[0-10]%
Micron	[✂]	[✂]	[✂]	[0-10]%	[0-10]%	[0-10]%
Toshiba	-	-	[✂]	-	-	[0-10]%
Fusion-io (now SanDisk)	[✂]	[✂]	-	[50-60]%	[40-50]%	-
OCZ (now Toshiba)	[✂]	-	-	[0-10]%	-	-
LSI (now Seagate)	[✂]	[✂]	[✂]	[0-10]%	[10-20]%	[20-30]%
NetApp	[✂]	[✂]	[✂]	[20-30]%	[10-20]%	[10-20]%
Others	[✂]	[✂]	[✂]	[10-20]%	[20-30]%	[10-20]%
Total	**[✂]**	**[✂]**	**[✂]**	**100%**	**100%**	**100%**

Source: Gartner, IDC and the Parties

[70] Table 4 of the Parties' Response to CCS's information request dated 30 December 2015.

Table 6 SATA interface Enterprise SSD market shares by volume (Global to Global)[71]

	Units ('000)			Market Share (%)		
	2012	**2013**	**2014**	**2012**	**2013**	**2014**
Western Digital	-	-	[✂]	-	-	[0-10]%
SanDisk	-	[✂]	[✂]	-	[0-10]%	[0-10]%
Combined	**-**	**[✂]**	**[✂]**	**-**	**[0-10]%**	**[0-10]%**
Intel	[✂]	[✂]	[✂]	[50-60]%	[50-60]%	[50-60]%
Samsung	[✂]	[✂]	[✂]	[10-20]%	[10-20]%	[10-20]%
Micron	[✂]	[✂]	[✂]	[0-10]%	[10-20]%	[10-20]%
OCZ	[✂]	-	-	[0-10]%	-	-
SMART (now SanDisk)	[✂]	[✂]	-	[0-10]%	[0-10]%	-
Others	[✂]	[✂]	[✂]	[10-20]%	[10-20]%	[0-10]%
Total	**[✂]**	**[✂]**	**[✂]**	**100%**	**100%**	**100%**

Source: Gartner, IDC and the Parties

Table 7 SATA interface Enterprise SSD market shares by revenue (US$) (Global to Global)[72]

	Revenue (US$ million)			Market Share (%)		
	2012	**2013**	**2014**	**2012**	**2013**	**2014**
Western Digital	-	-	[✂]	-	-	[0-10]%
SanDisk	-	[✂]	[✂]	-	[0-10]%	[0-10]%
Combined	**-**	**[✂]**	**[✂]**	**-**	**[0-10]%**	**[0-10]%**
Intel	[✂]	[✂]	[✂]	[50-60]%	[50-60]%	[50-60]%
Samsung	[✂]	[✂]	[✂]	[10-20]%	[10-20]%	[20-30]%
Micron	[✂]	[✂]	[✂]	[0-10]%	[10-20]%	[10-20]%
OCZ	[✂]	-	-	[0-10]%	-	-
SMART (now SanDisk)	[✂]	[✂]	-	[0-10]%	[0-10]%	-
Others	[✂]	[✂]	[✂]	[0-10]%	[10-20]%	[0-10]%
Total	**[✂]**	**[✂]**	**[✂]**	**100%**	**100%**	**100%**

Source: Gartner, IDC and the Parties

[71] Table 5 of the Parties' Response to CCS's information request dated 30 December 2015.
[72] Table 6 of the Parties' Response to CCS's information request dated 30 December 2015.

52. The Parties submit that they compete in bidding markets, where competition takes place at two stages: (i) the pre-qualification phase where all interested suppliers submit proposals to become qualified; and (ii) the post-qualification phase where the qualified suppliers compete for the actual share award. The bidding process is described as follows:

a. In the pre-qualification phase, customers would request tenders from suppliers with products that meet their general specifications. In this early stage, customers might not specify a particular interface but may issue interface-agnostic descriptions of their respective product lines;
b. Following which, there would be a qualification process which consists of various test and trials on the characteristics of the suppliers' products. Customers will award qualification to selected suppliers based on technical and price criteria. Typically, at least two to three suppliers will be qualified, to help customers ensure they receive competitive prices;
c. Post-qualification, customers would allocate volume shares amongst the qualified suppliers. Pricing would generally be determinant for the SSD suppliers to obtain volume. Customers would then typically ask for a refresh on the price list to determine the majority-share supplier. [✂].[73]

53. The Parties submit that the key factor in assessing the competitive effects of the Acquisition in bidding markets is not the Parties' historical market shares but the number of credible competitors.[74] This is because historical market shares would have limited value as an indicator of how competition in future bids will unfold, as these shares do not necessarily reflect, for example, a given supplier's current strengths and weaknesses or recent investments in technological development.[75] The Parties further submit that, following the Acquisition, there will remain a significant number of credible competitors in the Enterprise Solid State Storage market, more than enough to sustain robust competition in the context of a bidding market.[76]

[73] Paragraph 24.44 to 24.50 of Form M1
[74] Paragraph 21.4 of Form M1.
[75] Paragraph 24.51 of Form M1
[76] Paragraph 21.4 of Form M1.

(ii) CCS's assessment

54. As set out in the *CCS Guidelines on Substantive Assessment of Mergers*, CCS is unlikely to intervene in a merger situation unless:

a. The merged entity will have a market share of 40% or more; or
b. The merged entity will have a market share between 20% to 40%, and the post-merger CR3 is 70% or more. [77]

55. CCS will assess the Proposed Acquisition based on the market for the global supply of interface-specific Enterprise SSDs to customers globally.

56. From **Table 2** above, pre-Acquisition, the Parties are the largest and second largest players in the SAS interface Enterprise SSD market by volume and will be the largest player post-Acquisition with a combined market share of [60 – 70]%. This crosses the threshold of 40%.

57. From **Table 3** above, pre-Acquisition, the Parties are the largest and second largest players pre-Acquisition in the SAS interface Enterprise SSD market by revenue and will be the largest player post-Acquisition with a combined market share of [70 – 80]%. This crosses the threshold of 40%.

58. From **Table 4** above, pre-Acquisition, SanDisk is the second largest player while WDC is one of the smaller players in the PCIe interface Enterprise SSD market by volume. Post-Acquisition, the Parties will be the second largest player with a combined market share of [20 – 30]%. This does not cross the threshold of 40%. CCS notes that the three largest firms post-Acquisition, namely the Parties, Intel and Seagate will have a post-Acquisition CR3, again based on the 2014 figures, of [60 – 70]%. This too does not cross the CR3 threshold of 70%.

59. From **Table 5** above, pre-Acquisition, SanDisk is the largest player while WDC is one of the smaller players in the PCIe interface Enterprise SSD market by revenue. Post-Acquisition, the Parties will still be largest player with a combined market share of [40 – 50]%. This crosses the threshold of 40%.

60. From **Table 6** above, the Parties only have a small market share pre-Acquisition in the SATA interface Enterprise SSD market by volume and have a combined market share of [0 – 10]% post-Acquisition. This does not cross the threshold of 40%.

---

[77] Paragraphs 5.14 and 5.15 of *CCS Guidelines on the Substantive Assessment of Mergers*. CR3 refers to the combined market shares of the three largest firms.

61. From **Table 7** above, the Parties only have a small market share pre-Acquisition in the SATA interface Enterprise SSD market by revenue and have a combined market share of [0 – 10]% post-Acquisition. This does not cross the threshold of 40%.

62. CCS agrees with the Parties that the market for Enterprise SSDs by specific interfaces is categorised as that of a bidding market with suppliers competing through both the pre-qualification and post-qualification phases. In markets such as these, competition takes place for the market, as opposed to in the market. As such, historical market shares are less relevant as they only take into account the activity of the winners in a given contract but do not show how many credible competitors actually participated as bidders and thus provided competitive constraints.

63. As evidenced by the market share figures provided by the Parties above, the merged entity will still face a multitude of competitors post-Acquisition. This is reflective of the competition that occurs in the post-qualification phase of the entire bidding process. In this phase, suppliers would share a common interface which is comparable in functionality, and would compete for the majority-share of volume orders from customers on a quarterly or potentially longer-term basis.

64. Third-party feedback on this matter on the basis that the market is the global supply of interface-specific Enterprise SSDs to customers globally has been neutral to slightly positive. In particular, [✂] believes that the Acquisition should have little or no effect on competition as there will continue to be a number of suppliers in the segment.[78] Another competitor, [✂], notes that post-Acquisition, the Parties will be a larger player, but there remain other large players, such as [✂], in the Enterprise SSD markets.[79] [✂], a customer, notes that the proposed Acquisition is likely to promote increased competition between Enterprise SSD suppliers.[80]

65. Having considered both the Parties' submissions and third-party feedback, CCS is of the view that the existing competitive conditions will prevail post-Acquisition even in the narrowest product market in view of the surmountable barriers to entry for the supply of Enterprise SSDs by interfaces to global customers and relatively strong countervailing buyer power discussed in the later sections of this decision.

(b) Barriers to entry and expansion

[78] Public consultation response from [✂].
[79] Public consultation response from [✂].
[80] Public consultation response from [✂].

66. The likelihood, scope and timeliness of entry by new competitors or expansion by existing competitors may be sufficient to deter or defeat any attempt by a merged entity or their competitors to exploit any possible reduction in rivalry flowing from a merger (whether through coordinated or non-coordinated strategies).[81] CCS considered, for completeness, the likelihood, scope and timeliness of entry into and expansion in the market.

(i) The Parties' submissions

67. The Parties submit that the barriers to entry even for the Enterprise SSD by interfaces market are low. Based on their estimation, a new entrant with no previous track-record in producing HDDs or SSDs would have to invest [✂] sourcing inputs from third-parties who are widely available in order to enter the market on a scale necessary to gain a 5% market share.[82] In addition to the product development costs, the development of an infrastructure for manufacturing and selling the product could also require investments of up to [✂].[83] The Parties also submit that due to the take-off nature of the Enterprise SSD market, the infrastructure costs and development costs are likely to be easily and readily recoverable.[84]

68. Further, the Parties submit that if a company already possesses controller, firmware, and manufacturing facilities, and has a secured supply of NAND, it can start producing Enterprise SSDs in a relatively short time frame if it also has the necessary know-how and expertise.[85]

69. The Parties further submit that intellectual property rights are not a significant barrier to entry in the relevant market as potential entrants can obtain access to necessary intellectual property rights through the use of cross-licensing agreements or by acquiring components from third-party suppliers. The Parties are not aware of any regulations that apply specifically to the Enterprise Solid State Storage market.[86]

70. In addition, the Parties submit that the Enterprise Solid State Storage market has seen a number of notable entries over the last five years. **Table 8** below lists entries in the Enterprise Solid State Storage market over the past five years.

---

[81] Paragraph 7.2 of *CCS Guidelines on Substantive Assessment of Mergers*.
[82] Paragraph 26.1 of Form M1.
[83] Paragraph 26.2 of Form M1.
[84] Paragraph 26.3 of Form M1
[85] Paragraph 26.6 of Form M1.
[86] Paragraphs 28.1 and 28.2 of Form M1.

Table 8 Market entry in Enterprise Solid State Storage over the past five years[87]

		Entrant	Year of Entry
Enterprise SSDs		Kingston	2012
		SK Hynix	2014
		Seagate	2015
Enterprise SSD interfaces	SATA	Kingston	2012
		SK Hynix	2014
		Toshiba	2014
	SAS	Samsung	2012
		Micron	2013
		Seagate	2015
	PCIe	Micron	2011
		Lite-On	2014
		WDC	2014
		Toshiba	2014
		Samsung	2014
NAND-based AFAs		IBM	2013
		Violin Memory	2011

Source: WDC

71. Lastly, the Parties also submit that Hyperscale Cloud Service Providers who are currently producing Enterprise Solid State Storage products for its own use by procuring NAND and other components, could enter the market and supply to third-parties customers.[88] However, the Parties submit that they are not aware of any Hyperscale Cloud Service Providers supplying Enterprise SSDs to third-parties.[89]

(ii) CCS's assessment

72. CCS notes that entry into the SAS interface Enterprise SSD and PCIe interface Enterprise SSD markets in Singapore is not regulated. Prospective entrants do not need to be physically present in Singapore, given that the supply of SAS interface Enterprise SSD and PCIe interface Enterprise SSD is global.

73. The Parties' views on the pre-requisites required to enter the interface-specific Enterprise SSD market are supported by competitors, [✂], who informed that the barriers to entry to the SAS interface Enterprise SSD or PCIe interface

[87] Table 6 of Form M1.
[88] Parties' Responses to CCS's information request dated 23 December 2015.
[89] Parties' Responses to CCS's information request dated 23 December 2015.

Enterprise SSD market will include the need to possess assets, intellectual property, economies of scale, existing relationship with customers, access to NAND flash memory supply and know-how specific to the products.[90] Another competitor, [✂] notes that it would be difficult for a typical supplier to switch from producing Enterprise SSDs of one interface to another as the Application-specific Integrated Circuit ("ASIC") design and firmware is very different among the interfaces.[91]

74. Based on third-party feedback, barriers to expansions appear to be low. Competitors, [✂], informed that there are minimal capacity constraints on inputs and that they will be able to meet a significant increase in demand for SAS interface Enterprise SSDs or PCIe interface Enterprise SSDs, relative to its currently supplied products levels.[92]

75. Overall, based on the Parties' submissions and third-parties' feedback, CCS is of the view that barriers to entry and expansion in the SAS interface Enterprise SSD or PCIe interface Enterprise SSD market are present but not insurmountable.

(c) Countervailing buyer power

(i) The Parties' submissions

76. The Parties submit that a limited number of OEM customers account for a significant portion of demand for Enterprise SSDs, with the seven largest customers making up approximately [70 – 80]% or more of the Parties' global sales.[93] [✂[94]].[95]

77. Storage solution customers are, by and large, sizeable, sophisticated OEMs or distributors with significant technical understanding and expertise, such as EMC, IBM, HP, Dell, Cisco and Oracle, and Hyperscale "I-8"[96] Cloud Service Providers.[97] [✂].[98]

78. Each of these customers select their supplier(s) for new platform(s) based on RFQ processes and would refresh their supplier(s) on a regular basis via those

[90] Public consultation responses from [✂].
[91] Public consultation response from [✂].
[92] Public consultation responses from [✂].
[93] Paragraph 31.1 of Form M1.
[94] [✂].
[95] Paragraph 31.4 of Form M1.
[96] The "I-8" Hyperscale Cloud Storage Providers include Google, Amazon Web Services, Apple, Microsoft, Facebook, Baidu, Yohoo/Alibaba and Tencent.
[97] Paragraph 31.4 of Form M1.
[98] Paragraph 31.5 of Form M1.

same RFQ processes, which allow for comparison of technical, business, operational and legal vectors. Further, they purchase a variety of products from the Parties and can react to any attempts to raise prices for a single product by switching partially or completely to alternate suppliers on future platforms or to alternate suppliers of other products previously (or potentially) supplied by the Parties.[99]

79. OEMs and Hyperscale Cloud Service Providers are also capable of purchasing NAND directly to build their own Enterprise SSDs and/or NAND-based AFAs. For example, Microsoft and other hyperscale providers are already developing PCIe SSDs by procuring NAND from suppliers such as Toshiba and leveraging design houses (e.g. Lite-On, Kingston) to develop custom solutions for their own datacentres.[100]

80. Further, customers use bidding procedures (e.g. "winner-takes-most" bidding processes) to sustain competition pressure on storage suppliers even in the presence of reduced number of competitors.[101]

(ii) Third-party views

81. Third-party feedback indicated the existence of countervailing bargaining power by large, sophisticated customers for Enterprise SSDs, which include OEMs, such as [✂], or large distributors.[102] Even for Enterprise SSDs of specific interfaces, customers are able to procure SSDs from multiple suppliers and shift shares between suppliers.[103] Distributors, specifically, have little brand loyalty and would tend to diversify the portfolio of brands they carry and distribute.[104]

82. Additionally, [✂] corroborated that some customers can choose to procure components to develop their own Enterprise SSDs or sponsor potential new entrants as a single OEM can provide sufficient volume to cover associated fixed costs.[105]

(iii) CCS's assessment

83. On account of the above, CCS is satisfied that there will be relatively strong countervailing buyer power which would pose a competitive constraint on the Parties post-Acquisition.

---

[99] Paragraphs 32.2.2 and 32.2.4 of Form M1.
[100] Paragraph 32.2.5 of Form M1.
[101] Paragraph 32.2.9 of Form M1.
[102] Public Consultation responses from [✂].
[103] Public Consultation responses from [✂].
[104] Public Consultation response from [✂].
[105] Public Consultation responses from [✂].

VIII. Competition Assessment

(a) Non-coordinated effects

84. Non-coordinated effects may arise where, as a result of the Acquisition, the merged entity finds it profitable to raise prices (or reduce output or quality) because of the loss of competition between the merged entities. Other firms in the market may also find it profitable to raise their prices because the higher prices of the merged entity's product will cause some customers to switch to rival products, thereby increasing demand for the rivals' products.[106]

(i) The Parties' submissions

85. Considering the market for Enterprise SSDs, the Parties submit that the Acquisition will not give rise to non-coordinated effects in Singapore in view of the following:

a. The Parties combined shares are modest at approximately [20 – 30]% of the Enterprise SSD market (excluding own-use SSD sales and equivalent sales of NAND-based AFAs) by revenue and [10 – 20]% by volume (refer to Tables A2 and A3 in Annex A);[107]

b. The Parties are not close competitors to each other. WDC focuses on mixed-use and write-intensive Enterprise SDD products that require sophisticated controllers, which it develops in-house and combines with NAND memory components procured by third-parties. WDC's closest competitors are [✂]. SanDisk is, instead, strong in read-intensive Enterprise SSD products, using its in-house NAND Flash memory components and a combination of in-house and merchant controllers;[108]

c. There is presence of a significant number of competitors that will ensure effective competition. The Parties offer a broad range of Enterprise SSDs intended for the needs of each type of customer. [✂] are all, similarly, in a comparable situation;[109]

d. The Parties submit that they compete in bidding markets, where competition takes place at both the pre-qualification and post-qualification stages. Post-Acquisition, there will be more than

[106] Paragraph 6.3 of *CCS Guidelines on the Substantive Assessment of Mergers*.
[107] Paragraph 34.1.1 of Form M1.
[108] Paragraphs 33.1 and 33.4 of Form M1.
[109] Paragraphs 34.1.2 and 33.2 of Form M1.

enough credible competitors to sustain robust competition in the context of a bidding market;[110] and

e. The merged entity will be constrained by significant countervailing buyer power.[111]

86. Further, it is submitted that the relevant market is likely to be wider than that of Enterprise SSDs:

a. The Parties consider NAND-based AFAs to belong to the same market as Enterprise SSDs because OEMs would select between producing AFAs using SSDs or AFAs using NAND components. Both types of AFAs deliver the same functionalities, are equally reliable and are offered in similar performance and endurance ranges;[112]

b. The Parties will be constrained by new memory technologies, including that of 3D NAND, 3D XPoint technology and NVDIMM. These new technologies outstrip NAND and SSD in terms of performance and are likely to be offered at competitive prices.[113]

(ii) CCS's assessment

87. CCS assessed the non-coordinated effects arising from the Acquisition in the narrow market for the global supply of Enterprise SSDs by interface to global customers. In this connection, CCS notes that the analysis below will remain unchanged for the potentially wider markets of all forms of Enterprise SSDs or Enterprise Solid State Storage products.

88. Firstly, CCS is of the view that the merged entity will have significant market shares (≥40%) in the market for SAS interface Enterprise SSDs and PCIe interface Enterprise SSDs which cross the indicative merger thresholds.[114] That being said, market shares are not conclusive indicators of market power given that the market is categorised as a bidding market.

89. CCS considers that there will still be a number of credible competitors post-Acquisition. Particularly, it is noted that there has been several qualification

[110] Paragraph 34.1.6 of Form M1.
[111] Paragraph 34.1.8 of Form M1.
[112] Paragraphs 19.5 and 19.5.3 of Form M1.
[113] Paragraphs 34.2, 34.3, 34.4 and 34.6 of Form M1.
[114] For PCIe interface Enterprise SSDs, the indicative merger thresholds are exceeded only by revenue shares and not volume shares.

opportunities in the last five years where OEMs had selected other suppliers over WDC:

a. [✂].[115]

90. Third-party feedback obtained by CCS corroborates the Parties' submissions that the Acquisition should have little or no effect on competition as there would be other large players that provide competitive constraints on the Parties, including Samsung and Intel.[116] [✂] indicated that Samsung, instead of the merger parties, appears to be the market share leader for Enterprise SSDs.[117] [✂] considers that the Parties are not each other's closest substitutes, but rather Samsung and Toshiba are closer substitutes to either of the Parties' products.[118] As discussed in the section above, there is also relatively strong countervailing buyer power that would pose competition constraints on the Parties.

91. Further, CCS has also obtained corroborating feedback that the Enterprise SSD market is dynamic and has seen continuous innovations with the strong possibility of displacing current products.[119]

92. In light of the above, CCS concludes that the Acquisition is unlikely to lead to an SLC by way of non-coordinated effects.

(b) Coordinated effects

93. A merger may also lead to an SLC by increasing the possibility that, post-merger, firms in the same market may coordinate their behaviour to raise prices, or reduce quality or output. Given certain market conditions, and without any express agreement, tacit collusion may arise merely from an understanding that it will be in the firms' mutual interests to coordinate their decisions. Coordinated effects may also arise where a merger reduces competitive constraints in a market, thus increasing the probability that competitors will collude or strengthen a tendency to do so.[120]

(i) The Parties' submissions

94. The Parties submit that they will not be able to align their behaviour in the relevant market for the following reasons:

---

[115] Paragraphs 25.1.1, 25.1.2 and 25.1.3 of Form M1.
[116] Public Consultation responses from [✂].
[117] Public Consultation response from [✂].
[118] Public Consultation response from [✂].
[119] Public Consultation responses from [✂].
[120] Paragraph 6.7 of *CCS Guidelines on Substantive Assessment of Mergers*.

a. There is a lack of price transparency given that contracts for Enterprise SSDs are awarded through non-transparent multi-stage biding contests. Pricing of competitors is not publically disclosed during or after a bid due to the existence of non-disclosure agreements;
b. Products tend to be customised in each bidding situation, making coordination across multiple platforms unlikely; and
c. There is a high level of innovation which makes reaching terms of coordination difficult, if not impossible.[121]

95. The Parties further submit that competitors do not have the incentive to maintain coordinated behaviour as there is no credible deterrent mechanism. The relevant market is characterised by infrequent, large-volume orders, which makes contracts for the supply of Enterprise SSDs rather valuable. Hence, the gains from deviating at the right time may be large, certain and immediate. On the other hand, losses from punishment is relatively uncertain and would only materialise after some time as bids for Enterprise SSD contracts typically take place on a quarterly basis. This reduces the deterrence factor for deviating from coordination, making coordination harder.[122]

96. Additionally, customers exercise significant countervailing buyer power and can defeat attempts to coordinate behaviour through splitting contracts, sponsoring new entrants or switching to the use of other SSD interfaces.[123]

(ii) CCS's assessment

97. For coordination to work effectively, market players ought to be able to monitor compliance with the said coordination. On account of the evidence available, CCS considers that it would be unlikely that competitors will be able to effectively monitor compliance with any supposed coordination. This is due to the existence of a number of credible competitors and countervailing buyer power, even for the market for the global supply of Enterprise SSDs by interface to global customers. Third-party feedback has been in line with the Parties' submissions in this regard.

98. This assessment remains unchanged if we consider the wider markets of all forms of Enterprise SSDs or for Enterprise Solid State Storage. In fact, there

[121] Paragraphs 35.2.1 to 35.2.3 of Form M1.
[122] Paragraphs 35.4.1 and 35.4.2 of Form M1.
[123] Paragraph 35.5 of Form M1.

would be an increase in the number of credible competitors[124] should these wider markets be considered, thus, making coordination even more difficult.

99. As such, CCS concludes that the Acquisition is unlikely to lead to an SLC by way of coordinated effects.

IX. Efficiencies

(i) The Parties' submissions

100. The Parties submit that the Acquisition will enable them to integrate upstream into the production of NAND. This vertical integration into NAND production will have the following benefits:

a. Lowering input costs, as NAND is the single most expensive component of SSDs. The Parties expect that vertical integration could result in [✂], which is expected to be realised [✂]. The cost savings will be passed on to customers in terms of more competitive prices;
b. Allow WDC to better compete against major SSD suppliers, all of whom are vertically integrated into NAND. [✂];
c. Increase WDC's ability to innovate as WDC will have access to proprietary NAND intellectual property. Access to the full design features of NAND would allow said features to be implemented at the right place in the hierarchy of design, thereby enabling WDC to more efficiently "tune" the various drive components to better meet the technology needs of customers.[125]

101. The Parties further submit that the Acquisition will combine WDC's and SanDisk's complementary expertise to better serve combined customer needs. Currently, WDC's main business is HDDs, focusing solely on Enterprise SSDs; whereas SanDisk's main businesses are removed flash products and Client SSDs. Post-Acquisition, WDC will have better capability to deliver SanDisk's existing Enterprise SSDs to enterprise customers, banking on their long-standing experience with enterprise customers. In the client sector, WDC can expand its total sales for client applications, benefitting from SanDisk's reputation as a supplier of SSDs for consumer applications.[126]

[124] Refer to Table A2 in Annex for list of credible competitors.
[125] Paragraphs 42.3.1 – 42.3.3 and 42.3.6 of Form M1.
[126] Paragraphs 42.4, 42.4.1 and 42.4.2 of Form M1.

102. The Parties also submit that the Acquisition is expected to lead to other cost savings from consolidating general and administrative expenses, sales and distribution activities, and efficiencies in R&D expenditures.[127] In total, the Parties submit that the efficiencies realised will provide the merged entity with incentive to reduce prices, expand output, and increase quality of products. This has been demonstrated in recent years where cost savings from falling NAND prices in the SSD industry have been passed on to consumers in the form of rapidly falling SSD prices.[128]

(ii) CCS's assessment

103. CCS notes that claimed efficiencies may be taken into account at two separate points in the analytical framework: first, where they increase rivalry in the market so that no SLC will result from the Acquisition and second, efficiencies can be taken into account where they do not avert a SLC, but will nevertheless bring about lower costs, greater innovation, greater choice or higher quality and be sufficient to outweigh the detriments to competition caused by the Acquisition in Singapore.

104. Given that the above competition assessment did not point to any SLC, CCS is of the view that it is not necessary to make an assessment on the claimed efficiencies by the Parties.

105. CCS notes that some third-parties have indicated that the Acquisition could potentially result in additional resources being devoted to research and development. In this regard, continued innovations in the Enterprise SSD space could result in more competitive offerings in terms of lower prices or new technologies.[129]

X. Ancillary Restraints

(i) The Parties' submissions

106. The Parties submit that there are no ancillary restrictions in the Merger Agreement to the Acquisition.[130]

---

[127] Paragraphs 42.5 and 42.6 of Form M1.
[128] Paragraph 42.7 of Form M1.
[129] Public Consultation responses from [✂].
[130] Paragraph 43.1 of Form M1.

(ii) CCS's assessment

107. Based on the information available to CCS, CCS has found no ancillary restraints present in the Merger Agreement. As such, no assessment was made under this section.

XI. Conclusion

108. For the reasons set out above, following a consideration of the Parties' submissions and the feedback received from the public consultation, CCS concludes that the Acquisition is unlikely to lead to an SLC in the relevant market in Singapore and accordingly is unlikely to infringe the prohibition under section 54 of the Act. In accordance with section 57(7) of the Competition Act, this decision shall be valid for a period of one year from the date of this decision.

Toh Han Li
Chief Executive
Competition Commission of Singapore

Annex A

Table A1 Enterprise Solid State Storage Market Shares by Revenue (includes own-use SSD sales and equivalent sales of NAND-based AFAs) (Global to Global)[131]

	Revenue (S$ million approx.)			Market Share (%)		
	2012	**2013**	**2014**	**2012**	**2013**	**2014**
WDC	[✂]	[✂]	[✂]	[10-20]%	[10-20]%	[10-20]%
SanDisk	[✂]	[✂]	[✂]	[0-10]%	[0-10]%	[10-20]%
Combined	**[✂]**	**[✂]**	**[✂]**	**[10-20]%**	**[10-20]%**	**[20-30]%**
Intel	[✂]	[✂]	[✂]	[10-20]%	[10-20]%	[20-30]%
Samsung	[✂]	[✂]	[✂]	[0-10]%	[0-10]%	[10-20]%
Micron	[✂]	[✂]	[✂]	[0-10]%	[0-10]%	[0-10]%
Toshiba	[✂]	[✂]	[✂]	[0-10]%	[0-10]%	[0-10]%
Fusion-io *(now SanDisk)*	[✂]	[✂]	-	[10-20]%	[0-10]%	-
OCZ *(now Toshiba)*	[✂]	-	-	[0-10]%	-	-
sTEC *(now WDC)*	[✂]	[✂]	-	[0-10]%	[0-10]%	-
SMART Storage *(now SanDisk)*	[✂]	[✂]	-	[10-20]%	[0-10]%	-
LSI *(now Seagate)*	[✂]	[✂]	[✂]	[0-10]%	[0-10]%	[0-10]%
NetApp	[✂]	[✂]	[✂]	[0-10]%	[0-10]%	[0-10]%
Google	[✂]	[✂]	[✂]	[10-20]%	[0-10]%	[0-10]%
Hitachi	-	-	[✂]	-	-	[0-10]%
Huawei	-	-	[✂]	-	-	[0-10]%
Others	[✂]	[✂]	[✂]	[10-20]%	[20-30]%	[10-20]%
NAND-based AFAs (Enterprise SSD equivalent)	[✂]	[✂]	[✂]	[0-10]%	[0-10]%	[0-10]%
Total	**[✂]**	**[✂]**	**[✂]**	**100%**	**100%**	**100%**

Source: Gartner, IDC and the Parties

[131] Table 1 of Form M1.

Table A2 Enterprise SSD Market Shares by Volume (i.e. excluding own-use SSD sales and equivalent sales of NAND-based AFAs) (SSD Units Sold) (Global to Global)[132]

	[Units ('000)			Market Share (%)		
	2012	**2013**	**2014**	**2012**	**2013**	**2014**
WDC	[✂]	[✂]	[✂]	[0-10]%	[0-10]%	[0-10]%
SanDisk	[✂]	[✂]	[✂]	[0-10]%	[0-10]%	[0-10]%
Combined	**[✂]**	**[✂]**	**[✂]**	**[10-20]%**	**[10-20]%**	**[10-20]%**
Intel	[✂]	[✂]	[✂]	[40-50]%	[30-40]%	[40-50]%
Samsung	[✂]	[✂]	[✂]	[10-20]%	[10-20]%	[10-20]%
Micron	[✂]	[✂]	[✂]	[0-10]%	[10-20]%	[10-20]%
Toshiba	[✂]	[✂]	[✂]	[0-10]%	[0-10]%	[0-10]%
Fusion-io *(now SanDisk)*	[✂]	[✂]	-	[0-10]%	[0-10]%	-
OCZ *(now Toshiba)*	[✂]	-	-	[0-10]%	-	-
sTEC *(now WDC)*	[✂]	[✂]	-	[0-10]%	[0-10]%	-
SMART Storage *(now SanDisk)*	[✂]	[✂]	-	[0-10]%	[0-10]%	-
LSI *(now Seagate)*	[✂]	[✂]	[✂]	[0-10]%	[0-10]%	[0-10]%
NetApp	[✂]	[✂]	[✂]	[0-10]%	[0-10]%	[0-10]%
Others	[✂]	[✂]	[✂]	[10-20]%	[10-20]%	[0-10]%
Total	**[✂]**	**[✂]**	**[✂]**	**100%**	**100%**	**100%**

Source: Gartner, IDC and the Parties

[132] Table 2 of Form M1.

Table A3 Enterprise SSD Market Shares by Revenue (i.e. excluding own-use SSD sales and equivalent sales of NAND-based AFAs) (Global to Global)[133]

	Revenue (S$ million approx.)			Market Share (%)		
	2012	**2013**	**2014**	**2012**	**2013**	**2014**
WDC	[✂]	[✂]	[✂]	[10-20]%	[10-20]%	[10-20]%
SanDisk	[✂]	[✂]	[✂]	[0-10]%	[0-10]%	[10-20]%
Combined	**[✂]**	**[✂]**	**[✂]**	**[10-20]%**	**[10-20]%**	**[20-30]%**
Intel	[✂]	[✂]	[✂]	[20-30]%	[20-30]%	[20-30]%
Samsung	[✂]	[✂]	[✂]	[0-10]%	[0-10]%	[10-20]%
Micron	[✂]	[✂]	[✂]	[0-10]%	[0-10]%	[0-10]%
Toshiba	[✂]	[✂]	[✂]	[0-10]%	[0-10]%	[0-10]%
Fusion-io *(now SanDisk)*	[✂]	[✂]	-	[10-20]%	[10-20]%	-
OCZ *(now Toshiba)*	[✂]	-	-	[0-10]%	-	-
sTEC *(now WDC)*	[✂]	[✂]	-	[0-10]%	[0-10]%	-
SMART Storage *(now SanDisk)*	[✂]	[✂]	-	[0-10]%	[0-10]%	-
LSI *(now Seagate)*	[✂]	[✂]	[✂]	[0-10]%	[0-10]%	[0-10]%
NetApp	[✂]	[✂]	[✂]	[0-10]%	[0-10]%	[0-10]%
Others	[✂]	[✂]	[✂]	[10-20]%	[20-30]%	[10-20]%
Total	**[✂]**	**[✂]**	**[✂]**	**100%**	**100%**	**100%**

Source: Gartner, IDC and the Parties

[133] Table 3 of Form M1.