

Market Share Analysis: SSDs and Solid-State Arrays, Worldwide, 2013

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VIEW SUMMARY

2013 was a remarkable year in flash storage, as evidenced by the most active acquisition frenzy in flash history. The SSD market soared, despite flash chip shortages and stable prices. Solid-state array market share positions shuffled as battles between emerging and established players intensified.

Overview

Key Findings

The PC SSD market saw a surge in shipments and sales, led by Apple and other PC OEM customers; the delivery of new SSD technologies helped entice consumers and corporations. The top five vendors all have flash memory fabs and grew their share to nearly 80%, but not all of these vendors performed well.

Revenue for e-grade SSDs in both the server and storage segments expanded, but for different reasons. Hyperscale customers drove low-cost unit volume while storage OEMs fueled sales and margins for the higher-end drives, which benefited the select few vendors qualified.

The SSA market has been redefined, with a new methodology change tightening the inclusion criteria. As a result, revenue nearly tripled its sales, up from \$237 million in revenue in 2012 to \$667 million in 2013. Market share positions shifted, with IBM and Pure Storage leading the way as the No. 1 and No. 2 players, respectively.

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Market Share Process Methodology

Gartner conducted a market share survey of more than 30 SSD and SSA vendors to compile industry-sizing metrics for SSD and end-user SSA storage system sales. We define SSD vendors as companies that manufacture and sell their own products or that design and sell subcontract-manufactured products. We did not collect data from companies that rebrand SSD or provide assembly or contract-manufacturing services. We define SSA vendors as companies that sell stand-alone systems directly to end users or through channels such as VARs and resellers with a product that has a dedicated model name and number and does not in any way support HDDs, now or in the future. The SSA revenue does not include optional software license revenue or support and service revenue, strictly the system cost to the end customer.

Revenue in our SSD vendor rankings is "sell to" revenue, as opposed to "sell through" revenue. We define sell-to revenue as that which is recognized once an invoice has been signed and a product has left the factory; we define sell-through revenue as that which is recognized once a product is purchased by a consumer in the retail channel. As we report sell-to revenue, the revenue figures do not include any rebating, discounting or other promotional considerations that occur after products have left the distribution channel.

SSD Ranking

Our SSD ranking is based on all sales of entry-level PC (netbook) SSDs, mainstream PC (notebook and desktop) SSDs, enterprise (storage and server) SSDs, and industrial (industrial, networking, military, aerospace and other) SSDs. The SSD market share figures account for only self-contained SSDs for computing applications; they exclude traditional consumer-based applications, such as portable media players and gaming devices. The PC SSD ranking consists of the combined sales of the entry-level PC and mainstream PC SSDs, while the enterprise SSD ranking consists of the sales of the enterprise server and enterprise storage SSDs.

SSA Ranking

The SSA category is a new subcategory of the broader ECB storage market. Considering the potential disruptive nature of SSAs on the general-purpose ECB disk storage market, Gartner has elected to report only those vendors that have SSA platforms with a dedicated model and name and cannot be configured with HDDs at any time, now or in the future. To constitute an SSA sale, revenue must be recognized as an SSD-only system sale (combining SSD hardware to end users; however, optional software licensing, support and service revenue is excluded).

The inclusion criteria for the new SSA category in this report are tighter than in the 2012 report. In the 2012 report, in addition to purpose-built SSAs, Gartner included general-purpose ECB disk storage arrays that were configured solely with SSDs. General-purpose ECB disk storage arrays configured solely with SSDs are not SSAs; therefore, they are not included in the 2013

Dollars)

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report. Gartner has restated 2012 revenue in Table 4 to conform to the inclusion criteria used for 2013. Also, it is possible for a company to have both SSD and SSA revenue, but only if the company is involved in the manufacturing and design of the SSD hardware and also provides the data management software necessary to qualify to meet the SSA definition guidelines.

NOTE 1 DEFINITIONS

Solid-state drive — SSDs differ by their characteristics for different end markets. We distinguish several types of SSDs used in compute environments only: SSDs used in PCs serve as the primary storage element in mobile computing and in data centers only, SSDs act as storage network accelerators. SSD categories are not restricted to specific form factors or interfaces; rather, they are defined by the end-consumption requirements. This category excludes embedded solid-state storage deployments that use nonvolatile memory caching solutions and removable modules merely to complement other storage devices.

Entry-level PC — This is an extremely price-sensitive segment, typically embedded, with capacities and flash management solutions tailored to the media tablet (the majority of shipments later in the forecast), low-cost PC and mini-notebook (netbook) markets.

Mainstream PC — This segment is composed of SSDs that are used only in notebook and desktop PC markets, which can include thin-client usage models, but are kept out of industry sizing metrics.

Enterprise server SSD — This category comprises SSDs intended exclusively for direct-attached usage within servers for application acceleration; this segment also includes self-contained solid-state NAND dual in-line memory modules (DIMMs), which must be used in dedicated slots in servers. Mainstream PC SSDs being used in servers are counted in this category due to end consumption.

Enterprise storage SSD — This segment consists of SSDs used exclusively in dedicated storage systems with ECB architectures. This typically is the network-attached approach, whether it be via OEM or through the channel.

Solid-state array (SSA) — The SSA category is a new subcategory of the broader ECB storage market. SSAs are scalable, dedicated, solutions based solely on solid-state semiconductor technology for data storage that cannot be configured with HDD technology at any time. As distinct from SSD-only racks within ECB storage arrays, an SSA must be a stand-alone product denoted with a specific name and model number, which typically (but not always) includes an operating system and data management software optimized for solid-state technology.

Industrial SSD — This category offers a range of capacities, with strong performance, endurance and industrial specifications; this category is aimed at the networking, military and aerospace, industrial, and other markets. Often, this segment requires enhanced attributes for environmental disruptions, such as thermal, humidity and shock resistance.

Hyperscale — This refers to a particular class of companies that have very large data center requirements to serve external customers (examples include Google, Amazon and Facebook). As well as their size, these companies also differ from traditional IT environments by, typically, having highly uniform infrastructures. Generally, these companies have at least 50,000 servers deployed, but they can, in the very largest cases, have more than 1 million.

Market Share Data

Total SSD Markets

After a brutal pricing environment in 2012, during which the price per gigabyte of NAND flash components declined by 41%, total solid-state drive (SSD) revenue increased 53.1% in 2013, partially fueled by a tightly controlled NAND flash component market, which displayed a record-setting 2013 price-per-gigabyte decline of only 13%.

All five SSD segments (defined and quantified later in the report) produced a total of nearly \$10.99 billion in sales, up from a total of \$7.17 billion in 2012, as evident in Table 1. Vertical integration, which enables preferential procurement and pricing of NAND flash chips, will be increasingly crucial to ongoing success in the fiercely competitive SSD markets, but not all the vertically integrated SSD suppliers fared equally well in the expansive 2013 markets.

The largest supplier of NAND flash, Samsung, solidified and grew its No. 1 SSD ranking, achieving 88.1% revenue growth and increasing its overall share to 28.5%. Toshiba, the world's No. 2 supplier of NAND flash, experienced a 7.6% decline in overall SSD revenue while its market share fell from 9.2% to 5.6%. Intel's revenue increased (but its share declined slightly), while SanDisk displayed extraordinary growth in revenue and share, largely at the expense of Micron Technology, which retreated from the PC SSD market during the second half of 2013.

Table 1. Top 15 Worldwide Companies' Vendor Revenue From Shipments of Total SSDs (Thousands of U.S. Dollars)

2012 Rank	2013 Rank	Vendor	2012 Revenue	2013 Revenue	Change (%)	2012 Market Share (%)	2013 Market Share (%)
1	1	Samsung	1,666,077	3,134,711	88.1	23.2	28.5
2	2	Intel	1,056,233	1,442,120	36.5	14.7	13.1
5	3	SanDisk	355,428	1,289,791	262.9	5.0	11.7
8	4	Micron Technology	238,674	759,439	218.2	3.3	6.9
3	5	Toshiba	662,219	611,614	-7.6	9.2	5.6
10	6	Lite-On	207,888	487,464	134.5	2.9	4.4
9	7	Western Digital	215,999	473,259	119.1	3.0	4.3
4	8	Fusion-io	413,354	339,240	-17.9	5.8	3.1
7	9	Google	268,020	308,812	15.2	3.7	2.8
13	10	Kingston Digital	146,263	303,301	107.4	2.0	2.8
11	11	NetApp	193,644	277,430	43.3	2.7	2.5
6	12	OCZ Technology Group	287,938	125,338	-56.5	4.0	1.1
NA	13	LSI	51,293	116,755	127.6	0.7	1.1
NA	14	Seagate	NA	109,700	NA	NA	1.0
15	15	Apacer	93,447	75,832	-18.9	1.3	0.7

-	-	Others	1,316,976	1,130,799	-14.1	18.4	10.3
-	-	Total	7,173,454	10,985,604	53.1	100.0	100.0

NA = not applicable

Note: Numbers may not add to totals shown because of rounding.

Source: Gartner (June 2014)

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PC and Enterprise SSD Markets

In the PC SSD market, most vendors that possessed vertical integration and enjoyed preferential procurement and pricing of flash components had a competitive advantage, but not everyone exploited this advantage fully. While prices did begin to decline more aggressively later in 2013, the battleground lines were being drawn in the PC SSD segment as Peripheral Component Interconnect Express (PCIe)-interfaced SSDs debuted in Apple notebooks and the use of cheaper 3-bits-per-cell NAND technology increased. Samsung and SanDisk showed the strongest performance; their revenue grew 81% and 312%, respectively, as Samsung commanded the top position, followed by SanDisk. Intel grew its revenue but had to prioritize its own captive supply, which inevitably caused it to pull out of some aftermarket channels that are particularly competitive. Toshiba saw its revenue decline as it lost share within Apple and other OEMs, but it did battle back late in the year in both the OEM and aftermarket channels. Table 2 shows the worldwide revenue of leading vendors competing in the total PC SSD market (the combination of entry-level and mainstream PC SSDs) in 2013. It is important to note that the cache modules that complement hard-disk drives (HDDs) do not serve as primary storage; therefore, that revenue is not included as it does not meet the PC SSD definitions.

Table 2. Top 10 Worldwide Companies' Vendor Revenue From Shipments of Total PC SSDs (Thousands of U.S. Dollars)

2012 Rank	2013 Rank	Vendor	2012 Revenue	2013 Revenue	Change (%)	2012 Market Share (%)	2013 Market Share (%)
1	1	Samsung	1,370,553	2,486,287	81.4	34.9	39.2
5	2	SanDisk	221,780	914,323	312.3	5.6	14.4
3	3	Intel	509,010	620,590	21.9	12.9	9.8
2	4	Toshiba	630,686	561,572	-11.0	16.0	8.8
4	5	Micron	237,750	475,617	100.0	6.0	7.5
7	6	Lite-On	207,888	422,473	103.2	5.3	6.7
8	7	Kingston Digital	131,077	296,156	125.9	3.3	4.7
6	8	OCZ Technology Group	216,246	50,473	-76.7	5.5	0.8
NA	9	Adata Technology	38,038	49,435	30.0	1.0	0.8
10	10	Apacer	41,226	36,810	-10.7	1.0	0.6
-	-	Others	328,300	434,811	32.4	8.3	6.8
-	-	Total	3,932,555	6,348,546	61.4	100.0	100.0

NA = not applicable

Note: Numbers may not add to totals shown because of rounding.

Source: Gartner (June 2014)

Further evidence that the enterprise SSD segment was hotly contested is seen in the flurry of acquisition activity concentrated in this area. Themes similar to those in 2012 persisted as the enterprise SSD market was driven by hyperscale customers purchasing low-cost SATA SSDs in massive volumes while storage OEMs pursued more conservative, higher-quality SAS SSDs. High-performance PCIe SSDs were prominent in both hyperscale and server OEMs; however, lower-cost PCIe SSDs, driven by hyperscale customers and an immature competitive supply landscape, tempered revenue in 2013.

Intel expanded its No. 1 share to 18.5% (composed of high-volume, low-end server SSD revenue); Samsung, with growing OEM acceptance of its SATA-interface server enterprise-grade (e-grade) SSD families, grew its No. 2 share to 14.6% from 9.8%; Western Digital occupied the No. 3 position, with a significant 10.6% share (composed mostly of high-end storage revenue through its partnership with Intel, although the revenue from its acquisitions is included from the quarter of acquisition onward); SanDisk, with the help of its acquisition of Smart Storage in August 2013, nearly doubled its share, growing from 4.4% to 8.5%; and Fusion-io, the No. 2 supplier in 2012, despite a 17.3% revenue decline and a drop in share from 13.6% to 7.7% in

2013, slipped only to No. 5. Table 3 shows the worldwide sales market share for total enterprise SSDs (the combination of enterprise server and enterprise storage SSDs).

Table 3. Top 10 Worldwide Companies' Vendor Revenue From Shipments of Total Enterprise SSDs (Thousands of U.S. Dollars)

2012 Rank	2013 Rank	Vendor	2012 Revenue	2013 Revenue	Change (%)	2012 Market Share (%)	2013 Market Share (%)
1	1	Intel	547,223	821,530	50.1	18.1	18.5
3	2	Samsung	295,524	648,424	119.4	9.8	14.6
5	3	Western Digital (With Intel)	215,999	471,549	118.3	7.1	10.6
8	4	SanDisk	133,648	375,469	180.9	4.4	8.5
2	5	Fusion-io	410,187	339,137	-17.3	13.6	7.7
4	6	Google	268,020	308,812	15.2	8.9	7.0
NA	7	Micron	NA	283,821	NA	NA	6.4
6	8	NetApp	193,644	277,430	43.3	6.4	6.3
NA	9	LSI	51,293	116,755	127.6	1.7	2.6
NA	10	Seagate	NA	96,185	NA	NA	2.2
-	-	Others	906,335	690,317	-23.8	30.0	15.6
-	-	Total	3,021,873	4,429,430	46.6	100.0	100.0

NA = not applicable

Note: Numbers may not add to totals shown because of rounding.

Source: Gartner (June 2014)

SSA Markets

The solid-state array (SSA) category, formerly referred to as SSD appliance, is an emerging subcategory of the broader external controller-based (ECB) storage market. Considering the potential disruptive nature of SSAs on the general-purpose ECB disk storage market, Gartner has elected to report only those vendors that have SSA platforms with a dedicated model and name and cannot be configured with HDDs at any time, now or in the future. In addition to the companies that produce only SSAs, the following vendors and SSA products are included in Table 4:

EMC: XtremIO and VNX-F (XtremIO was in general availability in November 2013)

NetApp: EF540/550

IBM: Flash System 840 and older models

HP: 3PAR StoreServ 7450 (product was in general availability in June 2013)

Huawei: Dorado Series

The inclusion criteria for the new SSA category in this report are tighter than in the 2012 report. In the 2012 report, in addition to purpose-built SSAs, Gartner included general-purpose ECB disk storage arrays that were configured solely with SSDs. General-purpose ECB disk storage arrays configured solely with SSDs as options are not SSAs; therefore, they are not included in the 2013 report. Gartner has restated 2012 revenue in Table 4 to conform to the inclusion criteria used for 2013.

Gartner did track the SSD-only-configured general-purpose storage array market with product families such as Hitachi HUS VM, Dell Compellent, EMC VMAX, IBM DS8000, HP 7000 series, NetApp FAS and others. According to the 2012 Market Share report based on the original methodology of counting all SSD-only systems, these SSD-only options originally captured represented \$128 million in sales, which have now been stripped out with the restatement of 2012 revenue. Gartner estimates that in 2013, this market represented roughly \$170 million in SSD-only configuration array revenue. It is important to note that these systems and sales are included within the external storage Market Statistics report.

Table 4. Top 10 Worldwide Companies' Vendor Revenue From Shipments of SSAs (Thousands of U.S. Dollars)

2012 Rank	2013 Rank	Vendor	2012 Revenue	2013 Revenue	Change (%)	2012 Market Share (%)	2013 Market Share (%)
2	1	IBM	43,470	164,352	278.1	18.4	24.6
6	2	Pure Storage	15,368	114,078	642.3	6.5	17.1
1	3	Violin	72,056	88,321	22.6	30.5	13.2

		Memory					
NA	4	EMC	NA	73,852	NA	NA	11.1
3	5	NetApp	31,367	71,033	126.5	13.3	10.6
4	6	Nimbus Data	21,570	43,401	101.2	9.1	6.5
NA	7	Kaminario	NA	22,470	NA	NA	3.4
5	8	Cisco	17,783	21,365	20.1	7.5	3.2
NA	9	SolidFire	NA	20,443	NA	NA	3.1
NA	10	HP	NA	8,805	NA	NA	1.3
-	-	Others	34,897	39,188	12.3	14.8	5.9
-	-	Total	236,510	667,307	182.1	100.0	100.0

NA = not applicable

Notes: Gartner has restated 2012 SSA revenue to be consistent with the 2013 SSA inclusion criteria; Pure Storage's 2012 revenue was restated from \$20.6 million to \$15.4 million. Numbers may not add to totals shown because of rounding. For the original 2012 SSA sales, which captured all SSD-only revenue, see "Market Share Analysis: SSD Component and SSD-Based Appliances, Worldwide, 2012."

Source: Gartner (June 2014)

Overall Market Segment Performance Analysis

Vendors that performed best in their respective markets demonstrated an ability to navigate a stable NAND flash pricing environment by procuring the most-advanced NAND flash technology and pairing it with superior flash management capabilities suitable for the targeted market. However, to successfully produce, sell and simultaneously be profitable are key to victory within each market.

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SSD and SSA

SSDs differ by their characteristics for different end markets and, as such, we distinguish five types based on their end consumption, which are explained in the definitions section (see Note 1). For example, a high-end media tablet using an embedded SSD would be characterized as an entry-level PC SSD based on the functionality of the host, just as a Chromebook using mSATA SSD would also be. On the enterprise SSD side, the server SSD segment benefited from more than 4 million high-end SATA PC SSDs that were characterized as server SSDs based on their usage directly in some of the largest progressive data centers in the world. Here are some of the key abilities exhibited by the most successful vendors in 2013:

PC SSD

Engaging a dual strategy to be qualified at leading PC OEMs (such as Apple, Dell, HP, Lenovo and others) to provide primary storage (not cache modules) while also establishing a solid presence in the aftermarket channel (largely online retail [e-tail], corporate and retail).

Possessing a wide product portfolio capacity range, although with a greater focus on the 120GB up to 1TB capacities that also could include more aggressively priced 3-bits-per-cell technology, with limited compromise on reliability.

Successfully qualifying embedded form factors were critical in the volume play for the MacBook Air and also for the entry-level PC SSD for low-end PCs and higher-end media tablets.

Establishing PCIe SSD momentum, through Apple, as it was the only PC OEM in 2013, preferably through an internal flash controller strategy, but also through external controller suppliers if an internal controller solution is not immediately available.

Enterprise SSD

Pursuit of enterprise servers with consumer and enterprise multilevel cell (eMLC)-based solutions on SATA and PCIe at the most-advanced NAND process geometries. This was essential to court the hyperscale customers that continue to have enormous need for low cost and insatiable high-capacity appetites.

Enterprise storage — Fast qualification on enterprise SAS 6 Gbps technology, followed by 12 Gbps technology, with a wide offering of different drive write per day (DWPD) abilities as server and storage vendors look to shed costs through flexible overprovisioning.

Direct relationship with large customers enabled by a world-class technical support and sales organization in conjunction with strategic OEM and distribution/value-added reseller (VAR) partners and system integrators.

SSA

Leveraging advanced, low-cost, consumer-grade flash technology with a range of capacities to target large customers or smaller customers with low initial acquisition cost targets.

Delivering consistent sustained performance and latency without degradation over the life of the array.

Providing safety to customers with high-availability and nondisruptive upgrades supported with robust warranties and service-level agreements that protect them from downtime, wear-out and erratic behavior without caveats.

Offering flash-optimized data management software capabilities, such as compression, deduplication, encryption, snapshot and replication, thin provisioning, and other software-based management techniques that are developed to have minimal impact on performance and latency.

Providing credible, global support and service capabilities underpinned by existing customer relationships and long-standing financial stability. Aggressive pursuit and incentivized channel partner program focused on established and select emerging regions.

The environmental benefits of SSDs, such as lower power usage, lower cooling requirements and decreased weight and vibration tolerance, apply to all of the above. These advantages are inherent and often taken for granted, although they are a considerable driving force concerning SSD adoption within all of these markets.

Tables 5 through 8 give more details of SSDs by segment and capacity in 2013 in terms of revenue, unit shipments (physical product), unit shipments (in thousands of raw gigabytes, not just usable capacity) and average selling prices (ASPs), respectively. Table 9 shows enterprise server and storage component shipments by interface.

Table 5. Revenue From SSDs by Segment and Capacity, Worldwide, 2013 (Thousands of Dollars)

	Entry-Level PC	Mainstream PC	Enterprise Server	Enterprise Storage	Industrial	Total
<64MB	-	-	-	-	-	-
128MB	-	1,476	-	-	5,920	7,396
256MB	-	-	-	-	5,781	5,781
512MB	-	2	-	-	2,050	2,052
1GB	-	3,372	-	-	4,580	7,952
2GB	286	6,113	-	-	14,825	21,224
4GB	30	3,958	-	-	26,075	30,063
8GB	1,508	3,506	-	-	27,835	32,849
16GB	15,866	17,378	-	-	27,498	60,742
32GB-63GB	34,680	7,451	10,088	-	37,472	89,691
64GB-127GB	135,502	124,245	18,659	25,031	20,821	324,258
128GB-255GB	207,354	2,243,027	127,860	166,729	17,750	2,762,720
256GB-511GB	12,447	2,307,259	542,653	520,040	10,968	3,393,367
512GB-1023GB	-	980,090	936,120	834,118	361	2,750,689
1TB-1.99TB	-	242,995	422,906	261,453	5,691	933,046
2TB-4.99TB	-	-	182,351	12,438	-	194,789
5TB-9.99TB	-	-	339,490	-	-	339,490
10TB-19.99TB	-	-	29,495	-	-	29,495
20TB-49.99TB	-	-	-	-	-	-
≥50TB	-	-	-	-	-	-
Total	407,672	5,940,874	2,609,621	1,819,810	207,628	10,985,604

Notes: Revenue in the 16GB and below capacities in the mainstream PC SSD category is directly attributed to thin-client systems. Numbers may not add to totals shown because of rounding.

Source: Gartner (June 2014)

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Table 6. Unit Shipments of SSDs by Segment and Capacity, Worldwide, 2013 (Thousands of Units)

	Entry-Level PC	Mainstream PC	Enterprise Server	Enterprise Storage	Industrial	Total
<64MB	-	-	-	-	-	-
128MB	-	211	-	-	724	935
256MB	-	1	-	-	732	733
512MB	-	1	-	-	263	264
1GB	-	314	-	-	327	641
2GB	11	326	-	-	864	1,201
4GB	1	121	-	-	1,249	1,371
8GB	66	113	-	-	940	1,120
16GB	1,186	827	-	-	669	2,682
32GB-63GB	1,514	147	63	-	441	2,164
64GB-127GB	3,126	2,338	129	61	156	5,810
128GB-255GB	2,461	24,439	734	250	93	27,976
256GB-511GB	75	13,798	1,896	482	119	16,369
512GB-1023GB	-	3,016	1,818	433	1	5,267
1TB-1.99TB	-	387	533	56	3	980
2TB-4.99TB	-	-	115	6	-	121
5TB-9.99TB	-	-	90	-	-	90
10TB-19.99TB	-	-	5,000	-	-	5
20TB-49.99TB	-	-	-	-	-	-
≥50TB	-	-	-	-	-	-
Total	8,440	46,039	5,383	1,288	6,580	67,730

Notes: Revenue in the 16GB and below capacities in the mainstream PC SSD category is directly attributed to thin-client systems. Numbers may not add to totals shown because of rounding.

Source: Gartner (June 2014)

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Table 7. Unit Shipments of SSDs by Segment and Capacity, Worldwide, 2013 (Thousands of Gigabytes)

	Entry-Level PC	Mainstream PC	Enterprise Server	Enterprise Storage	Industrial	Total
<64MB	-	-	-	-	-	-
128MB	-	26	-	-	90	117
256MB	-	0	-	-	183	183
512MB	-	1	-	-	132	132
1GB	-	314	-	-	327	641
2GB	22	652	-	-	1,728	2,402
4GB	6	484	-	-	4,995	5,485
8GB	532	904	-	-	7,524	8,960
16GB	18,975	13,232	-	-	10,712	42,919

32GB-63GB	48,446	4,702	2,007	-	14,099	69,254
64GB-127GB	200,035	149,605	8,281	3,930	9,962	371,814
128GB-255GB	315,008	3,128,215	93,934	31,964	11,855	3,580,976
256GB-511GB	19,200	3,532,406	485,290	123,325	30,346	4,190,566
512GB-1023GB	-	1,544,037	930,691	221,500	665	2,696,893
1TB-1.99TB	-	396,488	546,154	57,504	3,072	1,003,218
2TB-4.99TB	-	-	235,846	12,317	-	248,163
5TB-9.99TB	-	-	461,717	-	-	461,717
10TB-19.99TB	-	-	51,200	-	-	51,200
20TB-49.99TB	-	-	-	-	-	-
≥50TB	-	-	-	-	-	-
Total	602,224	8,771,065	2,815,121	450,540	95,690	12,734,639

Note: Numbers may not add to totals shown because of rounding.

Source: Gartner (June 2014)

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Table 8. ASPs for SSDs by Segment and Capacity, Worldwide, 2013 (Dollars)

	Entry-Level PC	Mainstream PC	Enterprise Server	Enterprise Storage	Industrial	Total Average
<64MB	-	-	-	-	-	NA
128MB	-	7.00	-	-	8.18	7.91
256MB	-	-	-	-	7.90	7.89
512MB	-	2.00	-	-	7.79	7.77
1GB	-	10.74	-	-	14.00	12.40
2GB	26.29	18.75	-	-	17.16	17.68
4GB	20.20	32.71	-	-	20.88	21.92
8GB	22.69	31.03	-	-	29.60	29.33
16GB	13.38	21.01	-	-	41.07	22.64
32GB-63GB	22.91	50.71	160.85	-	85.05	41.44
64GB-127GB	43.35	53.15	144.20	407.63	133.76	55.81
128GB-255GB	84.26	91.78	174.23	667.67	191.65	98.75
256GB-511GB	165.95	167.21	286.26	1,079.51	92.53	207.30
512GB-1023GB	-	325.00	514.99	1,928.07	278.07	522.21
1TB-1.99TB	-	627.58	792.92	4,655.84	1,897.00	952.37
2TB-4.99TB	-	-	1,583.46	2,068.22	-	1,607.52
5TB-9.99TB	-	-	3,764.62	-	-	3,764.62
10TB-19.99TB	-	-	5,899.00	-	-	5,899.00
20TB-49.99TB	-	-	-	-	-	NA
≥50TB	-	-	-	-	-	NA
ASP (Overall)	48.30	129.04	484.78	1,413.28	31.55	162.20
Average Density (Overall, in	71.35	190.51	522.96	349.89	14.54	188.02

Gigabytes)

NA = not applicable

Note: Numbers may not add to totals shown because of rounding.

Source: Gartner (June 2014)

[Table of Contents](#)**Table 9. Unit Shipments of Enterprise Server and Storage SSDs by Interface, Worldwide, 2013 (Thousands of Units)**

	Enterprise Server	Enterprise Storage
SATA	4,696.3	463.3
SAS	225.1	751.9
Fibre Channel	-	3.8
PCIe	461.7	68.8
Total	5,383.1	1,287.7
Note: Numbers may not add to totals shown because of rounding.		

Source: Gartner (June 2014)

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The SSA market industry metrics are outlined in Table 10. These are system sales ultimately to end users in terms of revenue, shipments in both physical systems and the total capacities of the systems, along with overall average price and average price per gigabyte. It is important to note that the revenue does not include optionally licensed software, support and service revenue. Also, the capacity and pricing are based on uncompressed data.

Table 10. SSA Industry Metrics, Worldwide, 2013 (Thousands of Units)

SSA Capacities	Revenue (\$)	Shipments (Units)	Shipments (TB)	ASP (\$)	ASP/GB (\$)
1TB-1.99TB	1,120	43	43	26,051	25.44
2TB-4.99TB	28,087	604	1,208	46,502	22.71
5TB-9.99TB	53,334	708	3,540	75,331	14.71
10TB-19.99TB	252,244	2,126	21,260	118,647	11.59
20TB-49.99TB	294,359	1,629	32,580	180,699	8.82
≥50TB	38,162	171	8,550	223,169	4.36
Total	667,307	5,281	67,181	126,360	9.70
Note: Numbers may not add to totals shown because of rounding.					

Source: Gartner (June 2014)

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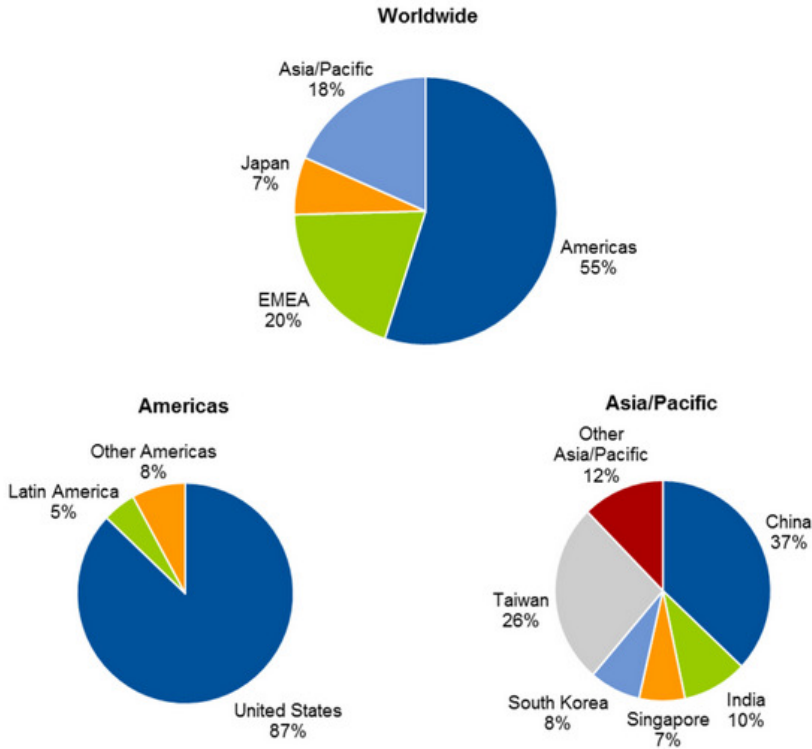
Regions

The regional segmentation for both the PC and enterprise SSD markets is much more concentrated in developed regions, and this remains most evident in the enterprise SSD segment. In the mainstream PC SSD market, a successful tactic was to have a dual strategy of promoting your brand in e-tail as well as supplying major PC OEMs. In the emerging countries, the smaller and most cost-conscious entry-level PC SSD products, as well as local PC OEM brands, drove the volume in the Asia/Pacific region. The high-growth enterprise SSD market was much more concentrated on North America and Western Europe, largely the result of the enterprise server segment, which was dominated by major hyperscale customers. However, China, in particular, outperformed the market growth in this segment; considering the presence of Web-scale, e-commerce and other major data centers, Gartner expects China to continue to outperform the market in coming years. The SSA regional distribution remains focused on developed regions, primarily the U.S. Outside of the established ECB storage providers, many of the startups remained limited in terms of true global support and service; as a result, they focused almost exclusively on North America and Western Europe, with some pockets of growth in Asia/Pacific in countries such as Australia, New Zealand, Singapore and South Korea.

Figures 1 and 2 show revenue share for total PC SSDs and total enterprise SSDs, respectively, by region for 2013, based on billing location. Statistics for major regions — the Americas, EMEA, Asia/Pacific and Japan — are shown with further country/market-level splits for the Americas (bottom left) and Asia/Pacific (bottom right). Figure 3 shows SSA regional consumption by only the

four major regions due to the infancy of the industry.

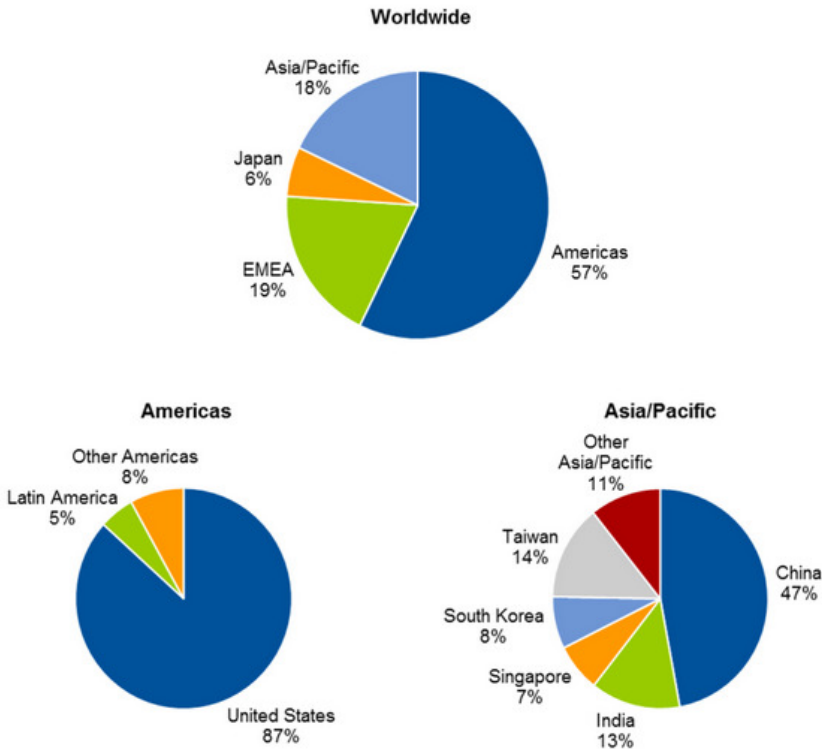
Figure 1. Total PC SSD Revenue Share by Region, Worldwide, 2013



Source: Gartner (June 2014)

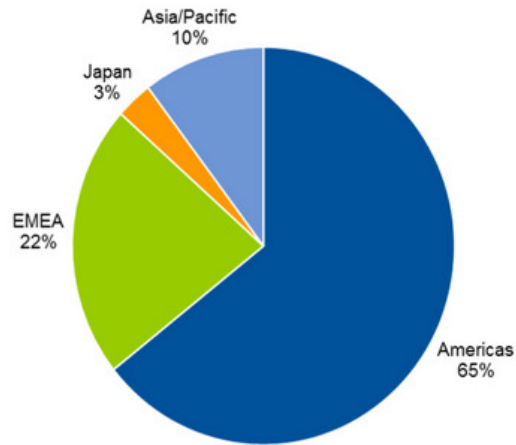
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Figure 2. Total Enterprise SSD Revenue Share by Region, Worldwide, 2013



Source: Gartner (June 2014)

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Figure 3. Total SSA Revenue Share by Region, Worldwide, 2013

Source: Gartner (June 2014)

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Top Vendors Analyzed

SSD and SSA

Samsung

Samsung again dominated the mainstream PC SSD segment, growing its share of the total segment to 39%. This is largely due to Samsung's particularly compelling solutions in terms of performance and reliability, such as the industry's only 3-bits-per-cell PC SSD. It also had a leading presence across a variety of PC OEMs that included the lead SSD supplier at Apple leveraging its own PCIe SSD. Samsung owes its industry-leading SSD position to its controller technology, which it develops internally and uses in its own SSDs. Samsung also has gained in the enterprise SSD space, despite relatively limited traction to date with its enterprise SAS and PCIe SSDs. Samsung was the main beneficiary of hyperscale SSD business when leading competitors struggled with technology transitions amid strong demand during the first half of 2013.

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SanDisk

SanDisk has struggled historically overall in the SSD segment but generated significant momentum in 2013, particularly in the PC SSD segment. SanDisk was able to execute across its SSD portfolio: in the PC SSD segment, gaining considerable OEM market share, including at Apple with its PCIe SSD, and in the enterprise SSD segment, through the acquisition of Smart Storage Systems, which helped catapult it to No. 2 in PCs and No. 4 in enterprise SSDs. SanDisk is the leader in entry-level PC SSDs, and although it is also a leader in flash cache solutions, this segment is not considered primary storage and thus does not count as SSD sales for SanDisk. SanDisk enhanced its position in server and storage OEMs with its acquisition, but more importantly, SanDisk became relevant with hyperscale customers. SanDisk has continued to pursue an active investment strategy and ratcheted up hiring sales and technical support for its enterprise SSD business, but the company expects its PC SSD to drive its SSD sales in the coming years.

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Western Digital

Western Digital has been the dominant vendor in enterprise SSD SAS with its partnership with Intel, but it also was able to gain additional share through a flurry of acquisitions that recognized revenue for the company during the calendar quarter of the final acquisition date close through the remainder of the year. Western Digital spent roughly \$1 billion to acquire longtime enterprise SSD player sTec, whose key IP was centered on its flash management technology; Virident, which was an emerging PCIe vendor boasting flash-optimized software; and VeloBit, a flash cache software company. Western Digital is expected to maintain its lead, thanks to industry-leading 12 Gbps SAS, but with a wider portfolio, it should be able to gain further traction within server and storage OEMs. However, Western Digital needs to solidify a NAND partnership to gain strategic access to NAND technology if it really expects to compete long term.

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Intel

Intel continued to deliver a strong portfolio of PC and enterprise SSD products targeted at hyperscale customers; however, it was hindered by NAND supply challenges during 1H13. As demand surged around it, Intel was caught by NAND technology transition challenges early in the

year and having access to only one-half of a fab. The company was able to battle back and refocus on its primary target, data center customers, by shedding some of the less profitable PC SSD business in the aftermarket channel. It's worth noting that Intel also participated in the enterprise SAS SSD market through its partnership with HGST (formerly Hitachi Global Storage Technologies, which was officially acquired in 1Q12 by Western Digital). This revenue is recognized under Western Digital, which remains the industry standard to beat with leading storage OEMs. Intel has the best sales and technical support capabilities of any of the vertically integrated vendors, but it will increasingly run into challenges as its captive NAND supply loses pace with demand.

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IBM

IBM soared in 2013, based on considerable traction in the SSA market by leveraging its 2012 acquisition of Texas Memory Systems (TMS), which was one of the initial pioneers of high-performance, RAM-based appliances. IBM was able to cultivate massive sales and shipments in 2013 through its procurement power and global reach as it incentivized and educated not only its own sales force, but also its channel partners. IBM has an extensive customer base; given the uncertainty around some of the emerging vendors, IBM was able to exploit this, and, coupled with an aggressive pricing strategy, it earned 25% of the SSA market. While IBM still lacks some data management features natively in its FlashSystem product line, many of these features are available when deployed in tandem with its SAN Volume Controller (SVC) product or in its next-generation V840 systems, which debuted in early 2014.

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Pure Storage

Pure Storage came to market in 2012 recognizing \$15.4 million in product revenue with a fresh and simple approach predicated on compelling data management software features. Data reduction features, such as deduplication and compression, are the bedrock of Pure Storage's success. Its software approach gives the company the capability to use consumer-grade PC SSDs with minimal compromise to performance and latency compared with competing SSAs using more expensive e-grade SSDs. As a result, Pure grew 642% from 2012 to 2013 to achieve the No. 2 position as product revenue reached \$114 million. While Pure Storage doesn't have the highest scale-up approach, because it procures consumer PC SSDs, it does have a wide variety of capacity and price entry points that appeal to a wide range of customers with highly virtualized server, hosted virtual desktop and database environments. Pure's use of clever and effective marketing has helped excite its channel partners, which it relies on exclusively, and it has had some of the best success of any emerging vendor in expanding globally into Europe and Asia. Customers' biggest concern is whether Pure Storage has long-term staying power, but with its \$150 million round of funding in early 2013 and subsequent \$225 million round of funding in 2014, Pure will have the ability to drive its own destiny.

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Violin Memory

Violin Memory dropped from the top position in the SSA market in 2012 to the No. 3 position in 2013, as the U.S. government shutdown and missed sales targets hampered the company after its initial public offering (IPO) in September 2013. Violin still has industry-leading hardware that boasts one of the best performance and wear-leveling technologies, as well as one of the best flash cost structures, which enabled the company to rebuild its margins in subsequent financial earnings to more than 54%. However, Violin has suffered from a less than optimal data management software approach that it is addressing through its GridIron Systems acquisition and the development of a comprehensive data management service software stack to provide customers a more cohesive software strategy. Violin continued to perform well in database/data warehousing; online transaction processing, particularly in the financial sector; high-performance computing environments; and virtual environments. The company is in the process of trimming operating costs and refocusing on core customers and geographies and returning to the channel now that a fresh, new management team is in place.

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Other Notable Vendors

The landscape remains crowded across all of the categories of SSDs. As a result, Gartner lists company revenue ranking across the subcategories within each of these segments in Table 11. Because of confidentiality agreements, however, Gartner is not allowed to divulge specific sales figures due to the granular nature of the financials.

Table 11. Revenue Market Share Ranking for SSD Subcategories, Worldwide, 2013

2013 Rank	PC SSD		Enterprise SSD			Industrial SSD
	Entry Level	Mainstream	SATA	PCIe	SAS	
1	SanDisk	Samsung	Intel	Fusion-io	Western	Apacer

					Digital	
2	Samsung	Toshiba	Samsung	Google	SanDisk	Viking Technology
3	Kingston	Intel	Smart Storage	NetApp	Seagate	Smart Modular
4	Adata	Micron	OCZ	LSI	Toshiba	Unigen
5	Lite-On	OCZ	SanDisk	Western Digital	Hitachi	Transcend

Source: Gartner (June 2014)

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Google, NetApp, and now Hitachi (not HGST under Western Digital), continue to factor into the SSD rankings because they are considered SSD vendors, even though they consume all of the SSDs captively within their own data center or products. These vendors procure NAND components and SSD controllers and have a contract manufacturer assemble and test their SSD solutions. Gartner will continue to track unique companies that have the ability to procure semiconductors directly for internal usage.

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Mergers and Acquisitions

2013 was exciting, with nine acquisitions, besting 2012's eight solid-state storage-related acquisitions. Substantial investment continued, although not for everyone, as some of the acquired vendors were in a downward spiral; SSA vendor Starboard Storage Systems had to close its doors. The most notable acquisitions that were finalized within 2013 include:

In January, Violin Memory acquired GridIron Systems, an application acceleration appliance vendor for an undisclosed amount.

In April, Fusion-io acquired NexGen Storage for approximately \$114 million in cash and approximately \$5 million in stock. The acquisition of an emerging hybrid storage array vendor was a means to widen its storage portfolio.

In May, PMC-Sierra acquired the PCIe controller and switch assets from Integrated Device Technology (IDT) for \$100 million.

In July, Western Digital acquired flash cache optimization software vendor VeloBit for an undisclosed amount.

In July, EMC announced its intention to acquire server-based storage software vendor ScaleIO to complement its PCIe SSD solutions.

In August, SanDisk acquired enterprise SSD and flash controller vendor Smart Storage for approximately \$307 million in cash and certain equity-based incentive awards.

In October, Cisco completed the acquisition of SSA vendor Whiptail for approximately \$415 million in cash and retention-based incentives.

In September, Western Digital completed its acquisition of enterprise SSD and enterprise flash controller vendor sTec for \$340 million.

In October, Western Digital expanded its SSD portfolio by acquiring PCIe SSD vendor Virident for \$685 million.

Note that OCZ was acquired by Toshiba in January 2014.

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