

Magic Quadrant for Solid-State Arrays

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Solid-state arrays offer storage guarantees that reduce IT project risk, optimize costs, and offer extensive software features and transparent integration with hypervisors and applications. This Magic Quadrant will help IT leaders better understand SSA vendors' positioning in the market.

Strategic Planning Assumptions

By 2021, solid-state arrays (SSAs) that use Nonvolatile Memory Express (NVMe) internally will represent more than 30% of revenue, up from less than 1% in 2017.

By 2021, solid-state arrays that use external NVMe over Fabrics (NVMe-oF) connections to servers and SANs will represent less than 30% of revenue, up from less than 1% in 2018.

Market Definition/Description

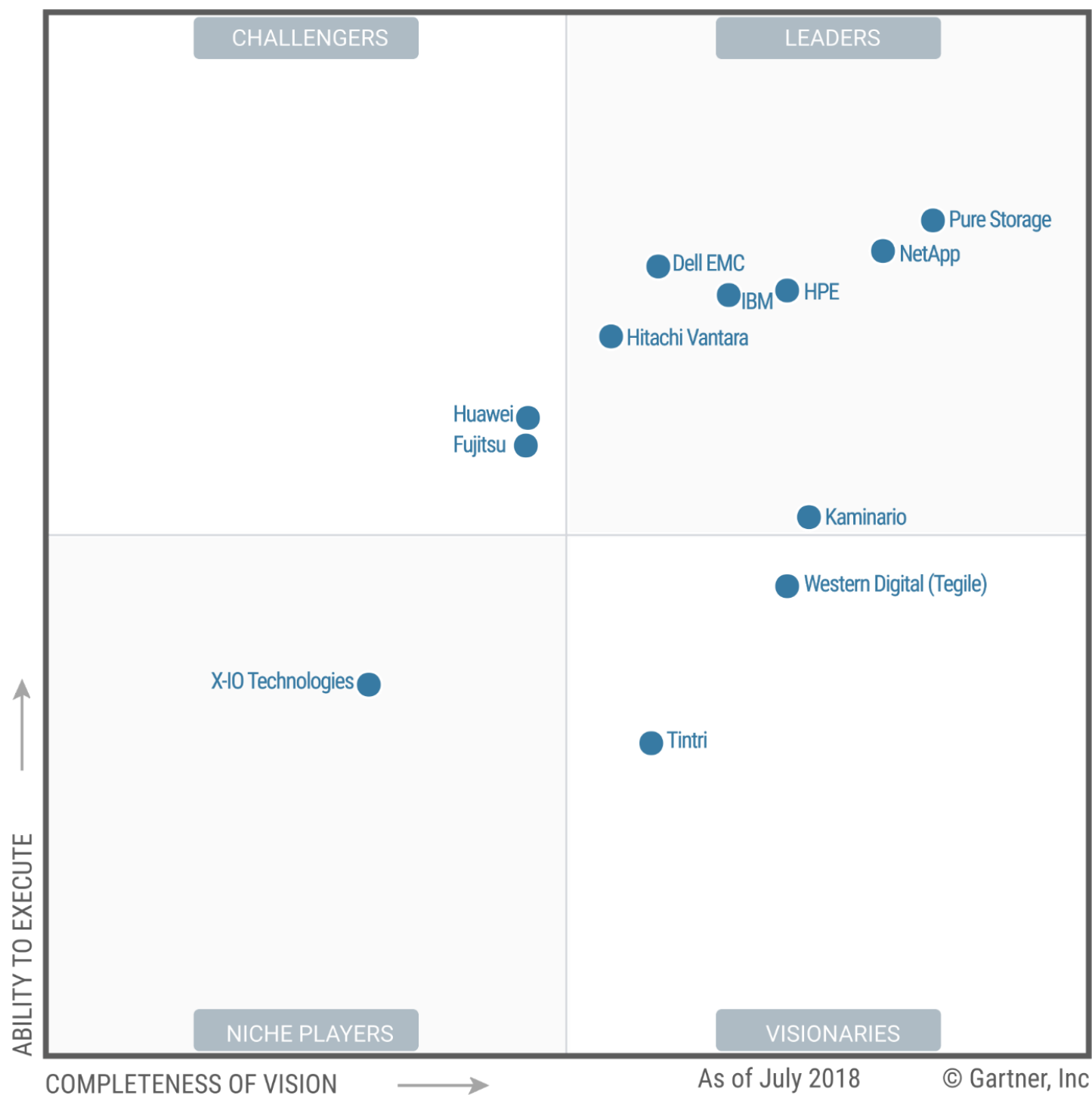
The SSA market is defined by customer requirements for highly automated, guaranteed low latency solid-state storage arrays compared to older larger and slower electromechanical storage array offerings which use hard-disk drives (HDDs). Solid state arrays that are developed, offered, sold and marketed by vendors in this market must have a dedicated model, name and cannot be configured with HDDs at any time. However, many different types of solid-state storage can be used within the SSAs in this market. This is why colloquially this market is often called the "flash array" market, but this is quite limited as "flash" refers to only one type of relatively slow solid-state technology called NAND. Therefore, SSAs within this market can use many other types of solid state other than "flash." Even though many types of solid-state storage are in different stages of development (Phase Change Memory and Memristors) examples of other types of solid-state storage within this market are Storage Class Memory (SCM), 3D XPoint and Z-NAND. This market has become mature due to extensive features, unique guarantees, very good product reliability and service offered by legacy storage array and new mature SSA vendors. But the Solid-State Array Market remains very dynamic due to fast changing storage array designs, features, large improvements in performance, highly competitive pricing, many new entrants and some existing vendors which struggle to remain in this market. The size of the SSA market was \$6.3 billion in 2017 and it grew by 27% compared to 2016. The SSA market is expected to continue to grow and in the long term replace the electromechanical storage arrays and other electromechanical storage offerings such as tape.

This Magic Quadrant reports only on vendors that qualify as an SSA vendor. We do not consider hybrid general-purpose disk array configurations in this research. To meet these inclusion criteria, SSA vendors must have a dedicated model and name, generally available by 4 March 2018, and the product cannot be

configured with hard-disk drives (HDDs) at any time. These systems typically (but not always) include an OS and data management software optimized for solid-state technology.

Magic Quadrant

Figure 1. Magic Quadrant for Solid-State Arrays



Source: Gartner (July 2018)

Vendor Strengths and Cautions

Dell EMC

The Dell EMC solid-state array portfolio is managed under the Infrastructure and Solution Group (ISG) within Dell. ISG develops and sells all the Dell and Dell EMC solid-state arrays such as the Dell SC series, which was previously sold as the Dell Compellent array. ISG group also develops and sells the Dell EMC VMAX All Flash, Unity All-Flash and XtremIO, which were inherited from the EMC acquisition. Dell EMC Isilon arrays are also available as solid-state arrays, and these are called Isilon F800. However, the most popular SSAs – which Dell leads with, and which are also the main focus of this Magic Quadrant and the companion Critical Capabilities – are the Dell EMC VMAX All Flash series and Unity All-Flash series. In comparison, the XtremIO array is seen in fewer proposals, and Dell EMC sales and marketing emphasis has begun to focus XtremIO as an enterprise SSA starting at midrange price points. The 4.3 version of software for the Unity All-Flash series (350/450/550/650F) became available in December 2017, which added the deduplication feature to the existing compression data reduction features. The Unity All-Flash series, at 16PB, scales to larger capacities than the VMAX All Flash, which scales to 4.4PB, indicating the erosion between midrange and high-end array positioning. The VMAX All Flash still only provides compression, but the newly announced Dell EMC PowerMax, which became available in May 2018 now offers deduplication and is solely based on faster NVMe Peripheral Component Interconnect Express (PCIe) technology. However, it is too early to rate the PowerMax and the effectiveness of the deduplication features.

Dell EMC is still the largest supplier of solid-state arrays in the market, but, although it does have the largest market share, Dell EMC SSA adoption grew at a lower rate than the SSA market in 2017. The Dell EMC SSA portfolio continues to broaden with many data sharing and tiering options. A software-defined storage (SDS) version of Unity enables servers with internal solid-state drives (SSDs) to become virtual storage arrays and locations for Unity All-Flash array snapshots. Also, a new, no-cost Cloud Tiering Appliance, which enables data to be transferred from the Unity All-Flash arrays to cloud storage vendors, became available. Dell EMC is following the industry trend of providing the CloudIQ feature, which uses predictive analytics to report on the status of the array, performance/capacity forecasting and predictive fault monitoring. However, to date, the CloudIQ feature is only available with the Unity array, and SC Series.

Strengths

- Dell EMC offers a portfolio of SSAs that can address a variety of block and file workloads.
- Dell EMC SSAs have strong ecosystem support and now offer broader data reduction features supported by guarantees.
- The company offers a new storage loyalty program, focused on customer experience, which is highly competitive.

Cautions

- Customers with existing VNX-F and VMAX All Flash models may need migration services and forklift upgrades to the newer models, which have deduplication.
- The integration of EMC is still continuing, and it has disrupted the customer sales and support relationships for existing and new SSA customers.
- The VMAX All Flash, Unity All-Flash, XtremIO, Dell EMC SC and Isilon SSA product families have different administration and configuration GUIs, and require extra options/products if data is to be replicated

between them.

Fujitsu

Fujitsu continues to have a consistent cadence of investment and upgrades to its ETERNUS SSA product family with the release of the AF250 S2 and AF650 S2, which became available in January 2018. This update mainly consisted of performance and scalability improvements. With more bandwidth, more controller processing, larger controller caches and support for 32 Gbps FC added to the AF250 S2 and AF650 S2 arrays. Compared with most solid-state array vendors, for Fujitsu, the Americas market is not the largest or most important market. Fujitsu concentrates on the EMEA and Asia/Pacific (APAC) markets, with EMEA being the largest with 60% of all Fujitsu SSA sales, APAC with 35% of SSA sales and the Americas with only 5%. Nevertheless, in 2017, Fujitsu successfully continued its transition from disk arrays to solid-state storage; Fujitsu SSA adoption grew significantly faster than most of its competitors, as shown by its threefold increase in SSA business. For existing Fujitsu ETERNUS disk-based storage array customers, the Fujitsu AF SSA series uses the same administrative GUI and has very simple migration paths from disk-based arrays to SSAs. Purchasing ETERNUS AF systems is simple, as all ETERNUS AF systems come with the All-in FlashPack, a software package that includes licenses for configuration, management and administration; local and remote copy; automated quality of service (QoS); and deduplication/compression – all without additional charge. Customers who wish to have their own data center and storage, but do not want to purchase storage arrays, can use the Fujitsu ETERNUS Capacity on Demand (CoD) offering. This allows customers to pay for only the IT infrastructure that they actually use, and enables customers to have a monthly operational storage charge or bill. This is offered by the Fujitsu Cloud Services organization.

Strengths

- Fujitsu offers one compatible ETERNUS AF series product line, which can be replicated and clustered with other ETERNUS AF arrays, and has a consistent look and feel administration GUI throughout the ETERNUS product line.
- All software features are included in the purchase price of the ETERNUS array.
- The Fujitsu AF series offers all the data reduction and resiliency features required of a solid-state storage array.

Cautions

- Fujitsu continues to have limited sales, support coverage and marketing in the Americas.
- There are currently no guaranteed business programs for data reduction or performance.
- The company lacks predictive analytics capabilities.

Hitachi Vantara

Hitachi Vantara, formed in September 2017, is a new entity resulting from the amalgamation of Hitachi Data Systems, Hitachi Insight Group and Pentaho. The company focuses on delivering solutions that support digital transformation using the Internet of Things (IoT), analytics and artificial intelligence (AI)

technologies. Existing and future data center products should be viewed as critical components that enable industry-specific solution stacks, many of which are targeted toward IoT and analytics. The Hitachi Vantara SSA portfolio consists of four models in one compatible family – Hitachi Virtual Storage Platform (VSP) F400, VSP F600, VSP F800 and VSP F1500 – that address different levels of performance and scalability requirements. However, a new refreshed series (VSP F350, F370, F700 and F900) became generally available in May 2018. All VSP systems now support SSDs in addition to Hitachi Vantara's own flash module drives (FMDs) that were developed in-house. FMDs provide built-in compression that has negligible CPU performance overhead when compared to executing these processes at the storage file system layer. VSP supports a broad range of hypervisors, including container technologies such as Docker. It also supports a range of backup software and cloud management platforms, and releases OpenStack drivers at a regular cadence. Monitoring, troubleshooting and service-level management of the VSP system is provided by Hitachi Vantara's remote service management tool, Hi-Track, and by Hitachi Infrastructure Analytics Advisor (HIAA), a tool that provides end-to-end visibility of the infrastructure – from host to the storage subsystem. The VSP series offers two all-inclusive licensing models – foundation and advanced. Foundation includes core Storage Virtualization Operating System (SVOS) services, management software (Hitachi Storage Advisor) and HIAA. The latter includes all base software, remote replication, active-active support and Hitachi Automation Director (HAD), which enables automation and orchestration of storage workflows.

Strengths

- Hitachi VSP offers native tiering of data to public clouds such as Amazon Web Services (AWS) and Microsoft Azure without the need for an additional gateway device.
- Enterprise customers continue to express very high satisfaction rates when deploying mission-critical workloads on the Hitachi VSP F series.
- Hitachi Vantara offers strong data protection and resiliency features underpinned by a 100% uptime guarantee.

Cautions

- Restructuring has resulted in disruptions in customer sales and support relationships.
- Based on Gartner client feedback, the Hitachi Vantara rebranding, which specifically omits the previous reference to "data," and overall change in direction, have impacted customer confidence in Hitachi Vantara as a storage vendor.
- The ability to make an in-place controller upgrade is not available, but migration services, which come at an additional cost, are available.

HPE

2017 was a transitional year for Hewlett Packard Enterprise (HPE)'s SSA portfolio, as HPE integrated its acquisition of Nimble Storage in April 2017 into its solid-state portfolio. While there is overlap between the products at the low end, HPE is investing significant time to simplify positioning for the two product families based on customer buying profile, requirements and competitive situation. The 3PAR StoreServ is positioned to grow within the data center market, where scalable performance and resiliency are critical.

The Nimble AF-series is positioned for new-style storage buyers where absolute simplicity, resiliency and cloud integration are important criteria. InfoSight, Nimble Storage's predictive analytics engine, is an advanced AI-based platform that can proactively analyze issues throughout customers' infrastructure and automate Level 1 and Level 2 support. HPE InfoSight is planned for use throughout HPE's offerings and was made available in December 2017 for the HPE 3PAR StoreServ products, although full functionality is not yet available compared to Nimble arrays. HPE offerings have very good scalability with a scale-up/scale-out architecture, which benefits from robust resiliency and manageability services. HPE now offers cloud integration for both StoreServ and Nimble products, but with different capabilities. StoreServ has HPE Cloud Bank Storage, which enables cloud storage backup, while Nimble offers HPE Cloud Volumes, which has native integration with public cloud providers. Lastly, both products leverage efficient use of cost-effective SSD technology, and both feature data reduction capabilities, such as deduplication and compression supported by recently improved data efficiency guarantees to match any competitive program.

Strengths

- The continuous roll out of InfoSight support provides detailed analytics and proactive resolutions that can identify issues outside the storage infrastructure, which helps to automate support and simplifies management.
- The HPE SSA storage portfolio is based upon efficient architectures that allow cost-effective use of SSD technology. It is supported by data reduction guarantees that enable attractive pricing for customers.
- Both the 3PAR and Nimble series are capable of fully utilizing NVMe PCIe SSDs and storage-class memory.

Cautions

- The HPE portfolio lacks an established stand-alone network-attached solid-state storage platform for file and object workloads.
- 3PAR and Nimble products do not allow for a homogeneous customer experience, as they have different GUIs and cloud integration abilities, and cannot replicate or share data between each other.
- HPE's integration of the full functionality of InfoSight into 3PAR products is ongoing. It will need to be thoughtfully deployed across the HPE installed base to avoid degradation of high service levels.

Huawei

Huawei expanded its existing flash array product portfolio with the new OceanStor Dorado V3 and OceanStor F V5 series, a flash-based scale-out unified storage solution. Huawei continues to lead with Dorado V3, its flagship product introduced in early 2017. While Dorado V3 is positioned as a solution for low-latency, mission-critical workloads such as databases, and mixed workloads in virtualized environments, the OceanStor F V5 is positioned for hosting unstructured data and secondary enterprise block-based applications. Huawei continues to improve and achieve software feature parity with its competitors by providing a rich set of data services, namely compression, deduplication, snapshots, cloning, QoS, and synchronous and asynchronous replication. Both products provide Amazon Simple Storage Service (S3) APIs that enable data migration or backup to AWS- or S3-compatible cloud storage platforms.

All software features, including replication, are bundled into the base license, thus ensuring a transparent and simpler procurement experience. The company also introduced eService, a cloud-based platform for predictive maintenance and capacity management. The platform is physically hosted in all three major geographies. The Dorado V3 supports a large number of independent software vendors (ISVs), including OS, backup, cloud management platform, public cloud and storage virtualization vendors. When selling outside China, Huawei has been able to successfully leverage its reputation as a global supplier of telecommunication products to upsell its storage products in this vertical. It continues to increase its efforts to expand its reach into other geographies by partnering with system integrators, and distributes in all major regions.

Strengths

- Huawei manufactures its own SSDs and controllers, which provides both architecture flexibility and the ability for the company to use aggressive pricing to grow market share.
- Huawei has high customer awareness, and support and success in emerging regions such as APAC, Latin America, and Eastern and Southern Europe.
- Synchronous and asynchronous solutions are natively supported and can be deployed as a "three-hop" combination across three data centers.

Cautions

- Customers that wish to migrate to NVMe-based SSDs will need to purchase new NVMe-enabled storage systems. In-place upgrades with existing Dorado V3 systems are not supported.
- Huawei only offers a 3-to-1 data reduction guarantee, which lags leading competitor offerings, and lacks other loyalty programs around performance, upgrade and reliability.
- Geopolitical challenges continue to impede Huawei's aspiration to enter the U.S. market, which is still by far the largest consumer of enterprise storage.

IBM

IBM improved its SSA product portfolio through hardware and software enhancements. The FlashSystem A9000 series witnessed performance gains and administration and packaging improvements that can reduce operational costs. The improvements are enabled by greater density and capability from the IBM FlashSystem 900 product, which is the foundation of the A9000. IBM FlashSystem solutions are built upon IBM's proprietary flash module technology, which further optimizes the flash drive components for performance and reliability. IBM continues to utilize industry-standard SSDs for its DS8000F and Storwize series of products, which saw incremental improvements in performance and capacity. Spectrum Storage Suite is a software-defined storage offering that spans IBM's SSA portfolio and provides a common software and management platform for users. IBM's Storwize product, based upon Spectrum Virtualize software, recently debuted its in-line block-level deduplication; however, its DS8000F products lack data reduction capabilities. IBM offers hybrid cloud support across the Spectrum portfolio, allowing for data mobility and backup between a variety of cloud providers. It also offers Spectrum Control for predictive analytics. The Spectrum storage suite offerings can be purchased individually or through a unified licensing

model. IBM now offers a consumption-based utility model, and many customer-friendly extended support and maintenance programs.

Strengths

- IBM Spectrum Storage Suite allows customers the flexibility to manage IBM and/or external storage solutions, and provides hybrid cloud support.
- IBM offers a broad portfolio that features standard SSD technology for its midrange and entry-level products, and its own custom flash modules for customers with high-performance needs.
- IBM has global sales and support abilities, and offers flexible consumption and payment models that are attractive to customers.

Cautions

- The IBM Storwize series deduplication capabilities are new and may require further refinement, while the DS8000F series offers neither compression nor deduplication.
- IBM Spectrum Control software does not currently offer predictive analytics beyond storage, which may limit the extent of proactive resolutions.
- IBM offers a "five nines" high-availability guarantee across its products, which lags competitor offerings, but can be improved with HyperSwap at additional cost and effort for customers.

Kaminario

Kaminario has been designing and offering solid-state arrays for over a decade, and therefore has been in the SSA market longer than most other competitors. Kaminario continues to grow its business in terms of revenue, and it successfully outperformed the market during 2017. It offers scale-up, scale-out K2 arrays, which are mature seventh-generation products. In May 2018, Kaminario made available the K2.N software-based solution, which provides an NVMe-oF-enabled, disaggregated and distributed storage solution that continues to offer the scale-up/scale-out features of the K2 via a software-only consumption model called Cloud Fabric. To promote growth and profitability, Kaminario has implemented a significant but innovative new business model that outsources all hardware sourcing, inventory, delivery and manufacturing to a large global distributor/integrator, Tech Data. Tech Data has 115,000 worldwide resellers, which broadens and widens the reach of Kaminario. Nevertheless, Kaminario manages all customer support calls, from the simplest Level 1 to all other more complex customer support issues. However, field support and repair are provided and managed by Tech Data. This model and direction of outsourcing hardware sourcing, product manufacture and distribution method, although not widely used, is not new; it is similar to how some integrated system vendors operate. The purpose of this change is to lower operational costs and enable Kaminario to focus on R&D and engineering, while simultaneously leveraging Tech Data's purchasing power, operations and distribution capabilities. This partnership also enables cost-efficient usage-based storage software consumption models for Kaminario customers. Kaminario's ForeSight offers many guarantees, such as assured performance, availability and a lifetime SSD wear-out guarantee — as long the system is under an active support contract — as well as a 4-to-1 guaranteed effective capacity program. Kaminario Flex is a new administration tool available for K2 that automates and simplifies updates, changes and

reconfigurations. Kaminario has partnerships with backup and restore vendors such as Cohesity and Commvault, for integration of backup and restore with snapshots taken by the K2 array.

Strengths

- Kaminario has very good backward compatibility and investment protection, which reduces the requirement for customers to perform forklift upgrades.
- Its usage-based software-only consumption model enables customers to pay a monthly service charge to Kaminario, instead of making a large outright capital purchase.
- The core of Kaminario's strength lies in its proven scale-up/scale-out VisionOS, now enhanced by Flex (orchestration, automation) and Clarity (analytics, machine learning).

Cautions

- The partnership with Tech Data is new and still needs to be proven.
- Kaminario is a private company that lacks financial transparency to assess its long-term viability.
- Kaminario has considerable customer concentration within the SaaS and cloud-based application providers segments.

NetApp

NetApp continued to make incremental investments to its flash portfolio, which includes AFF, SolidFire and EF-Series. Each product is based on a different architecture and, therefore, the different models use different administration GUIs. All product enhancements are clearly aligned with NetApp's Data Fabric strategy, the goal of which is to facilitate data management in distributed IT environments encompassing edge, cloud and the data center. NetApp ONTAP provides the deepest integration with top public cloud providers among all SSA vendors. NetApp SnapMirror can replicate or archive data to ONTAP Cloud, a compute instance that can be deployed in AWS and Microsoft Azure, among other top cloud service providers. ONTAP can also tier data from AFF systems to native protocols in public cloud or to NetApp object storage deployed on-premises. In May 2018, NetApp was first to market with an end-to-end NVMe-based solid-state array, the AFF A800, a system that connects to internal SSDs via high-performance NVMe. It also released ONTAP 9.4, which supports NVMe-oF, cloud tiering, new REST APIs, and Server Message Block multichannel protocols. With this update, customers can connect existing AFF systems to servers via FC-NVMe host bus adapters (HBAs), resulting in further reduction in latency. NetApp offers workload-specific data reduction guarantee programs, as well as free controller upgrades at the beginning of the fourth year, provided that customers purchase six years of premium support. It also introduced NextCredit, a rewards program that provides credits for purchase of the AFF product line, which can be used to procure other NetApp products in the future including cloud and SaaS-based solutions.

NetApp released two new SolidFire storage models — SF38410 and FlexPod SF. The latter is based on the Cisco UCS C220 M4 Rack Server and is offered as a part of the FlexPod series. It released a new version of its OS, SolidFire Element OS, which now supports policy-based QoS and also provides customers with an option to replicate SolidFire volumes to ONTAP-based systems using SnapMirror. The SolidFire product line

integrates with AFF systems and the OnCommand software suite, thus providing customers with a seamless storage management experience. A new version of NetApp EF-Series, the EF570, was also made available in September 2017. The EF570 offers 32Gb FC and an optional 100Gb NVMe-oF over InfiniBand.

Strengths

- NetApp Data Fabric strategy resonates well with forward-looking enterprises that are aiming to use a single platform to manage data across multiple infrastructures – cloud, data center or edge.
- Customers can add the new AFF A800 NVMe storage system as a part of an existing NetApp cluster, thus reducing the risk of forklift upgrades and the downtime associated with migration.
- The Active IQ tool, NetApp's cloud-based predictive analytics engine, supports all NetApp product lines, thus simplifying the postsales support experience.

Cautions

- NetApp's proactive predictive health monitoring data analytics service currently lacks visibility beyond storage, which limits proactive resolution capabilities.
- SolidFire systems support in-line compression and deduplication, which cannot be disabled on a per-volume basis.
- The EF-Series is strictly focused on cost-effective performance use cases, and lacks key features, such as data reduction technologies, including compression and deduplication.

Pure Storage

Pure Storage offers two families of solid-state arrays: the primarily block-protocol-based FlashArray family, which consist of the FlashArray//M and FlashArray//X; and the second family of storage arrays, the FlashBlade, which is for file and object workloads. Despite different model names, the //M and //X models use the same controller software, and even though the FlashBlade is based on different hardware and controller software, the administration GUI is the same look and feel across all product families. Pure Storage has always emphasized that it is a software company with the value being in the combination of its controller Purity Operating Environment, optimized hardware, and cloud-based Pure1 management and support software. Within the//X series and FlashBlade, Pure Storage has chosen to design its own storage modules with commodity NAND, such as the NVMe DirectFlash module for the //X series and blade-based DirectFlash for the FlashBlade. The purpose of this is to achieve a faster time to market and increased performance with very dense and cost-effective NVMe PCIe-based technology and integrated, highly parallel system-level software. The //M series still uses standard SSDs.

Pure Storage is quickly bringing to market new SSA technologies such as NVMe/NVMe-oF, and moving into new high-growth, unstructured data workloads, such as AI, machine learning, and analytics with its FlashBlade product. Pure Storage has often set the pace and direction of the SSA market. This can be seen by its movement into a new area: ready-made solutions for AI. This is a partnership with NVIDIA, which offers an integrated system called AIRI, using FlashBlade and NVIDIA DGX-1 servers. Pure Storage offers a new subscription called the Evergreen Storage Service that enables customers to pay for effective GB (not

raw) storage usage as a monthly operational cost. The vendor is growing slightly faster than the SSA market, which is positive, as price, feature, guarantee and service competition is very fierce in this market. Furthermore, Pure Storage addressed concerns of its viability when it achieved financial profitability at the end of 2017.

Strengths

- Pure Storage in-house engineering creates a cost, packaging and time-to-market advantage against competing NVMe-based solutions.
- Pure Storage has been able to diversify and move into new growth markets with partnerships and joint solutions with vendors such as NVIDIA.
- The vendor became financially profitable at the end of 2017, while also achieving \$1 billion in revenue.

Cautions

- Compression, deduplication, and encryption are always on and cannot be disabled for the FlashArray//M or //X.
- The FlashBlade does not have data deduplication or replication.
- Pure Storage still needs to increase its international presence and expand its business within key industry verticals, such as government.

Tintri

Due to ongoing financial difficulties, Tintri is exploring structural alternatives, including the sale of assets to DDN. Tintri focuses its flagship EC6000 series of solid-state arrays on the hypervisor and server virtualization market, with a core value proposition of very simple storage administration that is deeply integrated with the hypervisor. However, it also has the T1000 for small remote office or departments that do not have any storage expertise. Tintri has achieved its core value proposition of being highly integrated into the hypervisor API so that little if any storage array administration is required. Very detailed performance and workload behavior information is also provided, which enables the storage administrator or a nonstorage administrator to view and analyze end-to-end application performance from the application within the virtual host to the Tintri storage array. Thus, the Tintri array, albeit a separate piece of hardware, becomes equivalent to an integrated system. The EC series also offers cloud integration and can save snapshots in the cloud. The Tintri snapshot implementation is not just for the storage; rather, it snapshots the whole virtual machine (VM). This is very useful if the customer's data center, server or storage were lost in a disaster situation, because the whole VM and storage environment could be restored from the cloud. Tintri cloud storage can also be used as a remote replication target. All of the cloud integration is in EC series software and no gateway is required. Tintri's model is to sell smaller arrays in the 10TB to 184TB raw capacity range, rather than single, large petabyte-size arrays. This may seem to be more complex to manage, but since the targeted customer environments are highly virtualized and often have high data reduction ratios the effective capacities are often three- to five-times larger than the arrays' raw capacity. From a customer management perspective, the Tintri Global Center can successfully monitor and analyze hundreds of thousands of virtual machines over many Tintri modular storage arrays. Tintri has not grown as

fast as the SSA market as a whole; it has financial challenges and the vendor's executive management team has implemented various business and structural changes to improve the company's business performance.

Strengths

- Tintri's SSA requires hardly any administration, due to very close array controller software integration with hypervisors.
- Tintri offers end-to-end application performance monitoring within virtualized server environments.
- Virtual host restoration via Tintri snapshots is very fast.

Cautions

- Tintri is going through difficult financial conditions and executive-level reorganizations to manage costs and cash flow to achieve profitability.
- The Tintri arrays have modest scalability compared to competitors, and can only be used with virtualized servers that use hypervisors.
- The company's EC series of solid-state offerings lack formal guarantees for performance, upgrade or data reduction.

Western Digital (Tegile)

Tegile was acquired by Western Digital in September 2017 and IntelliFlash remains a brand within the Western Digital Data Center Systems business. Western Digital also acquired SanDisk, a flash storage vendor, in May 2017, and Hitachi Global Storage Technologies (HGST), an HDD manufacturer, in March 2012. Only Western Digital SSDs are used in IntelliFlash SSAs, which guarantees cost-effective supply continuity regardless of market dynamics. Being part of a larger vendor has helped to expand the integration of IntelliFlash technology, because IntelliFlash software is now also used as SDS to manage the storage within the converged Western Digital IntelliStack active archive system. The acquisition also provides more investment and engineering resources, but all sales remain indirect through channel partners. As a complement to the existing T4600, T4700 and T4800 series, two new models in the IntelliFlash SSA family have become available in the last 12 months. The first was the high-density HD series, which became available in July 2017. The second was the N Series, which uses the high-performance NVMe internal storage protocol; it became available in December 2017. The storage software that manages all IntelliFlash arrays is also used in the company's hybrid arrays, which enables replication capabilities among all IntelliFlash solid-state or hybrid systems; and all arrays share the same administrative GUI. During 2017, IntelliFlash SSA sales overtook hybrid array sales, and 60% of the revenue is now generated by SSA deployments. With the introduction of the new high-capacity HD and low-footprint, high-performance NVMe-based N5200 and N5800 arrays, the company has continued its cadence of innovation. The breadth of the product portfolio, combined with unified storage protocol support, ease of use and comprehensive guarantees, enable IntelliFlash arrays to be used in virtually any workload or environment.

Strengths

- All IntelliFlash arrays are compatible families that can be used for block and file workloads.
- IntelliFlash arrays are simple to implement with minimum requirements for extra chargeable installation or consultancy services.
- IntelliFlash arrays are highly competitive in price, features and guarantees, and there is no competitive overlap among the product families.

Cautions

- In the APAC region, IntelliFlash SSAs can be purchased only in China through a joint venture with Beijing-based UNIS, which sells the IntelliFlash families under the UniverFlash brand.
- Customer awareness of the IntelliFlash brand and Western Digital as an SSA vendor lags behind the company's larger competitors.
- The IntelliFlash families do not currently offer a cloud gateway or interface to public cloud storage services.

X-IO Technologies

2017 was a critical year for X-IO to execute on its reorganization and go-to-market goals with its new Intelligent Storage Element (ISE) 900 Series G4 All Flash Array product, which was released in September 2017. Compared to the previous ISE 800 Series, the 900 Series is a more complete solution offering most of the expected features of a modern SSA, including the commonly requested deduplication ability. The vendor also refreshed its business programs to provide extensive and competitive guarantees in an effort to enhance customer satisfaction. With a reinvigorated company and product, X-IO has re-established momentum with its existing customer base as well as net-new customers. In the process, R&D spending has increased, which has impacted profitability in the short term. As a result, the company has fortified its standing with a strategic partnership with Toshiba and others in order to potentially expand beyond its installed base. Toshiba will use the ISE array software on the Toshiba Flashmatrix, which is a good proof point for X-IO's array design and engineering skills. X-IO continues to promote its Axellio product, which currently can be used as an integrated system, and is planned for future use as a high-performance, low-latency NVMe-based SSA. The company intends these products to be the impetus behind its appeal to solution stack providers, such as cloud service providers, and also to focus on micro data centers at the edge. X-IO's customers are mainly in North America and APAC, with less than 10% in EMEA.

Strengths

- X-IO's new management team has made necessary cost reductions and clarified the strategic direction, which could improve the company's financial performance.
- Low and consistent latency and response times are a primary value proposition for X-IO.
- X-IO offers the ability to consolidate multiple applications and to manage via QoS policies.

Cautions

- The products lack integration with cloud vendors and support for hybrid cloud features.
- The products currently lack a cloud-based predictive analytics capability.
- X-IO Technologies is privately held and lacks the financial transparency important for customers to assess its long-term viability.

Vendors Added and Dropped

We review and adjust our inclusion criteria for Magic Quadrants as markets change. As a result of these adjustments, the mix of vendors in any Magic Quadrant may change over time. A vendor's appearance in a Magic Quadrant one year and not the next does not necessarily indicate that we have changed our opinion of that vendor. It may be a reflection of a change in the market and, therefore, changed evaluation criteria, or of a change of focus by that vendor.

Added

Huawei

Dropped

No vendors were dropped.

Inclusion and Exclusion Criteria

To be included in the Magic Quadrant, vendors need to meet the following criteria:

- The SSA must be a self-contained, solid-state-only system that has a dedicated model name and model number.
- The solid-state-only system must be exactly that. It must be initially sold with 100% SSDs and cannot be reconfigured, expanded or upgraded at any future point in time with any form of HDD within expansion trays, or via any vendor special upgrade or specific customer customization or vendor product exclusion process into a hybrid or general-purpose SSD and HDD storage array.
- The vendor must sell its product as a stand-alone product, without the requirement to bundle it with other vendors' storage products in order for the product to be implemented in production.
- The vendor must provide an enterprise-class support and maintenance service, offering 24/7 customer support (including phone support). This can be provided via other service organizations or channel partners.
- The company must have established notable market presence, as demonstrated by Gartner inquiry volume, amount of terabytes sold, the number of clients or significant revenue.
- The product and a service capability must be available in at least two of the following three markets — Asia/Pacific; EMEA; and Latin, Central and North America — by either direct or channel sales.

Please note the SSA Magic Quadrant reviews the SSA market and takes a wider approach orientated to a vendor's overall vision, execution, activity, positioning, competence and customer satisfaction within the SSA market. The Critical Capabilities research reviews a vendor's specific product capabilities and offering.

The solid-state arrays evaluated in this research include scale-up, scale-out and unified storage architectures. Because these arrays have different availability characteristics, performance profiles, scalability, ecosystem support, pricing and warranties, they enable users to tailor solutions against operational needs, planned new application deployments, forecast growth rates and asset management strategies.

Evaluation Criteria

Ability to Execute

We analyze the vendor's capabilities across broad business functions. Vendors that have expanded their products across a wider range of use cases and applications, improved their service and support capabilities, and focused on improving mission-critical applications will be more highly rated in the Magic Quadrant analysis. Ability to Execute reflects the market conditions and, to a large degree, it is our analysis and interpretation of what we hear from the market. Our focus is assessing how a vendor participates in the day-to-day activities of the market:

- **Product or Service** evaluates the capabilities of the products or solutions offered to the market. Key items to be considered for the SSA market are how well the products and/or services address enterprise use-case needs, the critical capabilities of the product (see "Critical Capabilities for Solid-State Arrays") and the breadth of product and/or solutions.
- **Overall Viability** includes an assessment of the organization's financial health, the financial and practical success of the business unit, and the likelihood that the individual business unit will continue to invest in the product, offer the product and advance the state of the art in the organization's product portfolio.
- **Sales Execution/Pricing** looks at the vendor's capabilities in all presales activities and the structure that supports them. This includes deal management, pricing and negotiation, presales support, and the overall effectiveness of the sales channel.
- **Market Responsiveness/Record** focuses on the vendor's capability to respond, change direction, be flexible and achieve competitive success as opportunities develop, competitors act, customer needs evolve, and market dynamics change. This criterion also considers the provider's history of responsiveness.
- **Marketing Execution** reflects unaided awareness (that is, Gartner end users mentioned the vendor without being prompted) and a vendor's ability to be considered by the marketplace. Vendor references, Gartner inquiries and end-user client search analytics results are factored in as a demonstration of vendor awareness and interest.
- **Customer Experience** looks at a vendor's capability to deal with postsales issues. Because of the specialized nature of the storage market and the mission-critical nature of many of the storage environments, vendors are expected to escalate and respond to issues in a timely fashion with dedicated

and specialized resources, and to have relevant detailed expertise. Another consideration is a vendor's ability to deal with increasing global demands. Additional support tools and programs are indications of a maturing approach to the market.

- **Operations** considers the ability of the organization to meet its goals and commitments. Factors include the quality of the organizational structure, including skills, experiences, programs, systems, and other vehicles that enable the organization to operate effectively and efficiently on an ongoing basis.

Table 1: Ability to Execute Evaluation Criteria

Evaluation Criteria ↓	Weighting ↓
Product or Service	High
Overall Viability	High
Sales Execution/Pricing	Medium
Market Responsiveness/Record	High
Marketing Execution	Medium
Customer Experience	High
Operations	Medium

Source: Gartner (July 2018)

Completeness of Vision

Completeness of Vision distills a vendor's view of the future, and of the direction of the market and its role in shaping that market. We expect the vendor's vision to be compatible with our view of the market's evolution. A vendor's vision of the evolution of the data center and of the expanding role of SSAs is an important criterion. In contrast with how we measure Ability to Execute criteria, the rating for Completeness of Vision is based on direct vendor interactions and on our analysis of the vendor's view of the future:

- **Market Understanding** looks at the technology provider's capability to understand buyers' needs, and to translate those needs into an evolving roadmap of products and services. Vendors must show the highest degree of vision, listen to and understand buyers' wants and needs, and be able to shape or enhance those wants and needs with their own added vision.
- **Marketing Strategy** relates to what vendor solution message is described, how that message is communicated, what vehicles are used to effectively deliver it, and how well the buying public resonates

with and remembers the message. In a market where many vendors and/or products can sound the same, or sometimes not even be known, message differentiation and overall awareness are vital.

- **Sales Strategy** considers the strategy for selling products that uses the appropriate network of direct and indirect sales, marketing, service, and communication affiliates that extend the scope and depth of market reach, skills, expertise, technologies, services, and the customer base.
- **Offering (Product) Strategy** looks at a vendor's product roadmap and architecture, which we map against our view of enterprise requirements. We expect product direction to focus on catering to emerging enterprise use cases for solid-state arrays.
- **Business Model** assesses a vendor's approach to the market. Does the vendor have an approach that enables it to scale the elements of its business (for example, development, sales/distribution and manufacturing) cost-effectively, from startup to maturity? Does the vendor understand how to leverage key assets to grow profitably? Can it gain additional revenue by charging separately for optional, high-value features? Other key attributes in this market are reflected in how the vendor uses partnerships to increase sales. The ability to build strong partnerships with a broad range of technology partners and associated system integrators demonstrates leadership.
- **Vertical/Industry Strategy** measures the vendor's strategy to direct resources, skills and offerings to meet the specific needs of individual market segments, including vertical markets.
- **Innovation** measures a vendor's ability to move the market into new solution areas, and to define and deliver new technologies. In the SSA market, innovation is key to meeting rapidly expanding requirements and to keeping ahead of new (and often more agile) competitors.
- **Geographic Strategy** measures the vendor's ability to direct resources, skills and offerings to meet the specific needs of geographies outside the "home" or native geography, either directly or through partners, channels and subsidiaries, as appropriate for that geography and market.

Table 2: Completeness of Vision Evaluation Criteria

Evaluation Criteria ↓	Weighting ↓
Market Understanding	High
Marketing Strategy	Medium
Sales Strategy	Medium
Offering (Product) Strategy	High
Business Model	High

Evaluation Criteria ↓	Weighting ↓
Vertical/Industry Strategy	Low
Innovation	High
Geographic Strategy	Medium

Source: Gartner (July 2018)

Quadrant Descriptions

Leaders

Vendors in the Leaders quadrant have the highest scores for their Ability to Execute and Completeness of Vision. A vendor in the Leaders quadrant has the market share, credibility, and marketing and sales capabilities needed to drive the acceptance of new technologies. These vendors demonstrate a clear understanding of market needs; they are innovators and thought leaders; and they have well-articulated plans that customers and prospects can use when designing their storage infrastructures and strategies. In addition, they have a presence in all three major geographical regions, consistent financial performance and broad platform support.

Challengers

Vendors in the Challengers quadrant participate in the SSA market and execute well enough to be a serious threat to vendors in the Leaders quadrant. They have strong products, as well as sufficient credible market position and resources to sustain continued growth. Financial viability is not an issue for vendors in the Challengers quadrant, but they lack the size and influence of vendors in the Leaders quadrant.

Visionaries

A vendor in the Visionaries quadrant delivers innovative products that address operationally or financially important end-user problems at a broad scale, but it has not demonstrated the ability to capture market share or sustainable profitability. Visionary vendors are frequently privately held companies and acquisition targets for larger, established companies. The likelihood of acquisition often reduces the risks associated with installing their systems.

Niche Players

Vendors in the Niche Players quadrant often excel by focusing on specific market or vertical segments that are generally underpenetrated by the larger SSA vendors. This quadrant may also include vendors that are ramping up their SSA efforts, or larger vendors having difficulty developing and executing upon their vision.

Context

This Magic Quadrant represents vendors that sell into the enterprise end-user market with specific branded SSAs. An insatiable demand for storage, new applications and workloads requires a more capable high-performance tier that can deliver low-latency storage more reliably in order to create tangible benefits. I&O

leaders will require simpler storage administration, deeper cloud integration and intelligent analytics, emphasizing the perpetual need for storage efficiency, resiliency and manageability to counter this trend.

Market Overview

The overall solid-state array market grew by 27%, with a total revenue of \$6.3 billion in 2017. Similar to 2016, the customer purchase price continues to drop — but at a slower rate of approximately 20% in 2017 compared to 40% in 2016. The arrays within the solid-state array market are the only IT products that are sold with performance, capacity, reliability and extensive upgrade guarantees. While this is extremely useful for the customers, it makes the solid-state array market extraordinarily competitive and therefore challenging for vendors selling these solutions. Nevertheless, this also makes the solid-state array market transformational, because customers cannot ask or receive such guarantees from other storage products or even from integrated systems, where the whole stack is controlled by a single vendor. Similarly, servers, network switches, software-defined storage or application software solutions do not offer performance, reliability or capacity guarantees. Combined with the high levels of security offered by disaggregated storage arrays, the end result is that compared to the purchase vagaries of other IT solutions, solid-state storage arrays are the lowest risk purchase for IT leaders who buy storage for their private data centers. This is also substantiated by the high customer satisfaction for solid-state storage arrays.

Ultimately, storage is a smaller problem for IT leaders than many other challenges. However, data growth, archiving and legal compliance are often much more complex, and many IT leaders confuse data management with storage. This is because bad data management leads to spiraling storage costs and data issues appear as storage issues. IT leaders do not ask for an increase in the budget for data, rather they ask for increases in storage budgets. Improvements in solid-state array performance and density guarantee that the IT industry does not have a storage problem, it has a data management problem. Until this data management problem is addressed, storage demand for solid-state arrays will increase. Many SSAs are offering predictive analytics based on AI-driven data management, which proactively resolves issues and helps to automate storage management. This capability helps improve availability, reduce service outages and enhance customer satisfaction, especially when predictive support visibility extends beyond storage and into the hardware infrastructure and application layer.

In 2018, many solid-state arrays will use the new high-performance, internal NVMe protocol within solid-state arrays. However, external connections that encapsulate NVMe over Fibre Channel or Ethernet, with the faster FC-NVMe and NVMe-oF, will take much longer to implement. This is because the transition is tied to and dependent on the upgrade cycle for servers and faster Ethernet network switches. In comparison, the Fibre Channel NVMeoF implementation (i.e., FC-NVMe) has been available in some existing 16 Gbps and most 32 Gbps FC switches, and this makes the transition to fast NVMe-oF storage with Fibre Channel simpler than with Ethernet. NVMe-oF is also transformational because it makes the performance (latency and bandwidth) of an externally connected solid-state array the same performance as internal solid-state storage within a server. This is due to the low overhead of NVMe-oF, which is offloaded to the HBA, network interface card (NIC) and storage network. Storage software becomes the bottleneck within the storage stack. There will be no performance reason to have storage isolated within servers. Over time, when NVMe-oF within storage area networks (SANs) becomes a standard low-cost feature, it will make extra investments in storage software or proprietary performance enhancers obsolete and financially difficult to justify. IT leaders will have to upgrade or expand their SANs and storage networks with faster interconnects

such as 50/100 GigE and 32 Gbps Fibre Channel to get the most of their solid-state array investment. The effect of fast, small, simple and disaggregated solid-state array storage, which exploits NVMe and other types of memory access such as RoCE, can already been seen. For example, in analytics, AI and machine learning workloads customers are demanding faster and simpler real-time infrastructures, where slow batch-type processing is no longer good enough (see "Use Top-of-Rack Flash for Analytics and Emerging Applications"). Solid-state arrays that use storage-class memory such as Fast Flash (Z-NAND or 3D XPoint technologies) ultimately become an extension of the server's memory, with highly parallelized access over NVMe-of networks. With the technology changes in the solid-state array market, storage becomes server memory, and all traditional ideas about external storage are disrupted and obsoleted.

Evidence

- More than 2,000 Gartner client inquiries in 2017 and 1H18
- Vendor interviews and product demonstrations in 2017 and 1H18
- Surveys of included vendors
- Customer reference surveys in 1H18
- Gartner's dedicated SSA market share forecasts and research between 2013 and 2018
- Public information, such as U.S. Securities and Exchange Commission filings, press releases, vendor websites and community support forums

Evaluation Criteria Definitions

Ability to Execute

Product/Service: Core goods and services offered by the vendor for the defined market. This includes current product/service capabilities, quality, feature sets, skills and so on, whether offered natively or through OEM agreements/partnerships as defined in the market definition and detailed in the subcriteria.

Overall Viability: Viability includes an assessment of the overall organization's financial health, the financial and practical success of the business unit, and the likelihood that the individual business unit will continue investing in the product, will continue offering the product and will advance the state of the art within the organization's portfolio of products.

Sales Execution/Pricing: The vendor's capabilities in all presales activities and the structure that supports them. This includes deal management, pricing and negotiation, presales support, and the overall effectiveness of the sales channel.

Market Responsiveness/Record: Ability to respond, change direction, be flexible and achieve competitive success as opportunities develop, competitors act, customer needs evolve and market dynamics change. This criterion also considers the vendor's history of responsiveness.

Marketing Execution: The clarity, quality, creativity and efficacy of programs designed to deliver the organization's message to influence the market, promote the brand and business, increase awareness of the

products, and establish a positive identification with the product/brand and organization in the minds of buyers. This "mind share" can be driven by a combination of publicity, promotional initiatives, thought leadership, word of mouth and sales activities.

Customer Experience: Relationships, products and services/programs that enable clients to be successful with the products evaluated. Specifically, this includes the ways customers receive technical support or account support. This can also include ancillary tools, customer support programs (and the quality thereof), availability of user groups, service-level agreements and so on.

Operations: The ability of the organization to meet its goals and commitments. Factors include the quality of the organizational structure, including skills, experiences, programs, systems and other vehicles that enable the organization to operate effectively and efficiently on an ongoing basis.

Completeness of Vision

Market Understanding: Ability of the vendor to understand buyers' wants and needs and to translate those into products and services. Vendors that show the highest degree of vision listen to and understand buyers' wants and needs, and can shape or enhance those with their added vision.

Marketing Strategy: A clear, differentiated set of messages consistently communicated throughout the organization and externalized through the website, advertising, customer programs and positioning statements.

Sales Strategy: The strategy for selling products that uses the appropriate network of direct and indirect sales, marketing, service, and communication affiliates that extend the scope and depth of market reach, skills, expertise, technologies, services and the customer base.

Offering (Product) Strategy: The vendor's approach to product development and delivery that emphasizes differentiation, functionality, methodology and feature sets as they map to current and future requirements.

Business Model: The soundness and logic of the vendor's underlying business proposition.

Vertical/Industry Strategy: The vendor's strategy to direct resources, skills and offerings to meet the specific needs of individual market segments, including vertical markets.

Innovation: Direct, related, complementary and synergistic layouts of resources, expertise or capital for investment, consolidation, defensive or pre-emptive purposes.

Geographic Strategy: The vendor's strategy to direct resources, skills and offerings to meet the specific needs of geographies outside the "home" or native geography, either directly or through partners, channels and subsidiaries as appropriate for that geography and market.

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