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Magic Quadrant for Data Center Networking

Published 15 July 2019 - ID G00368926 - 42 min read

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The data center networking market includes diverse vendors from broad, “full stack” infrastructure suppliers to focused networking specialists, and is being driven by the adoption of cloud computing. Much of the value is moving from hardware to software, with a focus on manageability and automation.

Strategic Planning Assumptions

Through 2022, fewer than 10% of enterprises will decommission an existing production data center network.

By 2022, 25% of data center switch hardware failures will be proactively avoided, due to predictive analytics embedded in vendors’ management platforms.

In 2023, 60% of data center networking operational activities will be automated, which is twice the number in 2019.

Market Definition/Description

This document was revised on 16 July 2019. The document you are viewing is the corrected version. For more information, see the Corrections (http://www.gartner.com/technology/about/policies/current_corrections.jsp) page on gartner.com.

Vendors covered in this research provide hardware and/or software solutions to deliver network connectivity and agility, primarily in enterprise data centers. Specific components are helping to deliver data center networking solutions. These include core/spine switches, access switches (e.g., top of rack [ToR] and leaf); virtual switches; Ethernet fabric software; network OSs (NOSs); network overlays; APIs; and the requisite management, automation and orchestration of these components. Furthermore, data center networking vendors have begun to extend network policy, visibility and management capabilities into public cloud infrastructures.

Historically, the data center network was just a fast, scalable LAN that connected all data center equipment, mainly servers. Although high-speed Ethernet ports (10/25/50/100GbE) are still important, the market extends far beyond just the hardware “speeds and feeds” affiliated with switches and switch ports. Increased enterprise adoption of cloud computing models and support for digital business initiatives demand improved data center network agility.

Specifically, enterprises need better automation, orchestration, integration with the rest of the data center infrastructure and consistency across heterogeneous infrastructures.

This research evaluates data center networking solutions for enterprises that procure and manage their own data center networking infrastructures, for installation on-premises or in colocation facilities. We also evaluate the ability to extend data center networking functionality onto public cloud providers' offerings, to better manage hybrid cloud networks. That said, we are not evaluating the internal physical networking infrastructures in public cloud providers' networks.

(Refer to the Market Overview section for an extended market definition.)

Magic Quadrant

Figure 1. Magic Quadrant for Data Center Networking



Vendor Strengths and Cautions

Arista Networks

Arista Networks is a publicly traded vendor based in California, U.S., with approximately 4,000 enterprise data center networking customers. The vendor's flagship data center networking offering is Universal Cloud Network, which includes hardware switches, the Extensible Operating System (EOS) switching software, and the CloudVision management and visibility platform. Based on Gartner's estimates, Arista grew data center switching revenue at two to three times the market rate in 2018.

We anticipate that Arista will continue to invest in its portfolio, with a focus on automation, predictive analytics and delivering operational capabilities via "as a service" (aaS) consumption models. Large enterprises should include Arista on their shortlists for all data center networking opportunities globally.

Strengths

- Arista has a deep and wide portfolio of hardware switches, with solid NOS feature depth, and its products natively support a number of third-party automation tools (e.g., Ansible, Puppet and Salt).
- The vendor's vision for delivering increasing levels of automation and using predictive analytics to enable self-healing networks is aligned with emerging customer requirements.
- The vendor has extensive experience in demanding, high-performance and large-scale environments, including cloud providers and financial services companies.

Cautions

- Arista lacks expertise in small and midmarket environments, particularly outside North America and Europe.
- Based on our analysis and client feedback, CloudVision is quite expensive. We believe this is a primary reason that the adoption of CloudVision remains below 15% of the Arista installed base.
- Arista has traditionally focused exclusively on the data center, but is now expanding into campus and wireless LAN (WLAN). This could affect software and support quality.

Big Switch Networks

Big Switch Networks (BSN) is a privately held company, based in California, U.S., with approximately 200 enterprise data center networking customers. The vendor's flagship data center offering is Big Cloud Fabric (BCF), which is software that enables physical switches to be managed as a single fabric with embedded automation and external programmability. BCF runs on multiple hardware vendors' certified network switches, including Quanta, Accton Technology,

Hewlett Packard Enterprise (HPE) and Dell EMC. Based on Gartner's estimates, BSN added data center networking customers above market rates in 2018.

We expect Big Switch to continue investing in its portfolio, focusing on public cloud functionality and edge data centers. BSN should be considered by customers in North America, Europe and Asia that want an automated fabric.

Strengths

- Big Switch has deep and turnkey technical integrations with several hyperconverged integrated system (HCIS) vendors, which dramatically improves deployment and operations in these environments.
- Customers report a high degree of satisfaction with the vendor, particularly around ease of management, integrations with other data center infrastructure and cost-effectiveness, along with the option to acquire via a trusted mainstream vendor, such as Dell.
- The vendor has a vision and a roadmap for bringing cloud-native networking concepts on-premises, providing predictive analytics and supporting edge environments. These align with emerging customer needs.

Cautions

- Big Switch has the smallest installed base of data center networking customers in this research, with limited traction outside Asia and North America. The vendor lacks direct expertise in midmarket environments.
- The vendor relies heavily on hardware partners that may ultimately compete with Big Switch. When combined with its limited installed base, this could affect its ability to sustain in the market over the long term.
- The vendor lacks several turnkey integrations (e.g., Puppet, Salt, and Chef) that many competitors have.

Cisco

Cisco is a publicly traded company, based in California, U.S., with an estimated 100,000 enterprise data center networking customers. The vendor's flagship enterprise data center networking offering is Cisco ACI, which includes Nexus 9000 hardware switches and APIC controllers. The vendor also offers its Tetration and Network Assurance Engine (NAE) products for additional visibility, security and configuration assurance. Based on Gartner's estimates, Cisco grew data center switching revenue below market rates in 2018.

We anticipate that the vendor will continue to invest in its portfolio, with a focus on extending ACI to more cloud providers, 400G switches, and better analytics and visibility. Cisco should be shortlisted for all data center networking opportunities globally.

Strengths

- Cisco has high visibility among Gartner clients, a large and loyal installed base, and deep global sales channels and coverage, which contribute to the vendor's long-term viability in this market.
- The vendor's vision and product roadmap to deliver increasing levels of automation and uniform policy across multicloud environments align with emerging customer needs.
- The vendor has a broad portfolio of hardware switches, including a variety of form factors, interfaces and performance characteristics, as well as feature depth in its NOS.

Cautions

- Cisco's data center networking solutions are higher in price than those of most of the vendors evaluated in this research, based on the deals Gartner reviews, inquiries and our market share research.
- Based on client feedback, Cisco ACI is complex for a combination of financial, technical and cultural reasons. We believe this has limited ACI's usage and adoption.
- Cisco's data center networking solution includes several separate products, such as ACI, DCNM, Tetration and NAE, which lack full integration and common management interfaces. This can increase costs and complexity, as well as confuse customers.

Cumulus Networks

Cumulus Networks is a privately held company, based in California, U.S., with more than 1,000 enterprise data center networking customers. The company's flagship product is Cumulus Linux, an NOS that is supported on a range of certified hardware partners, including Dell, Lenovo, Mellanox, Quanta and others. The vendor also offers its own branded hardware (Cumulus Express) and NetQ software for management, analytics and troubleshooting. Based on Gartner estimates, the vendor added data center networking customers above market rates in 2018.

Moving forward, we expect Cumulus to make investments in this market, including support for 400G, and enhancements to the NetQ platform. Consider Cumulus for data center deployments in Europe, North America, Asia and Australia, that want a high degree of automation or hardware/software independence.

Strengths

- Cumulus is well-aligned with customers that have Linux expertise, are highly automated, apply DevOps principles and/or implement infrastructure as code.
- The vendor's vision to apply automation and webscale operations inside the enterprise data center network aligns with emerging customer requirements.
- Cumulus supports multiple hardware switches, providing customer choice and reducing the likelihood of vendor lock-in. It partners with vendors such as Dell, Lenovo and Mellanox

Technologies that can provide support from larger, more-established vendors.

Cautions

- We assess that Cumulus lacks expertise in mainstream environments, because most of its customers are technologically advanced and/or are in large-scale environments. Customers without deep Linux or automation expertise will struggle to deploy and operate Cumulus switches.
- Cumulus is one of the smaller vendors in this research from a revenue perspective, which may affect its ability to sustain in this market in the long term.
- The vendors' branded hardware portfolio, Cumulus Express (CX), is limited in terms of form factor and interface depth. Also, the vendor does not offer four-hour hardware replacement for CX switches.

Dell EMC

Dell EMC is the enterprise products division of Dell Inc., a subsidiary of Dell Technologies that is a publicly held corporation headquartered in Texas, U.S. The division was created through the acquisition of EMC Corp. in 2016 and is estimated to have more than 15,000 enterprise data center customers. The vendor's flagship product is its Open Networking (ON) switches. Dell has its own NOS offering, but it also supports NOS and associated fabric offerings from several others, including Big Switch, Cumulus and Pluribus Networks. Based on Gartner estimates, Dell EMC grew data center switching revenue above market rates in 2018.

We expect the vendor to continue investing in its portfolio, around the manageability of the overall system and improved analytics/visibility. Dell should be considered for midmarket enterprise data center networking opportunities globally, enterprises running Dell servers, and for all enterprises looking for switching hardware/NOS independence.

Strengths

- Customers report strong support with Dell EMC, especially in the midmarket.
- Based on customer feedback and our quantitative enterprise network equipment market share research, Dell offers cost-effective solutions.
- The vendor's support for open, disaggregated networking continues to drive the market and to alter the way many customers (and competitors) think about data center networking.

Cautions

- The vendor lacks fabric management capability for its ToR switches running the Dell EMC NOS. We anticipate the vendor to address this by the end of the 2019 calendar year.
- Dell lacks several capabilities within its Dell-branded offering, including chassis-based spine switches and integrations with Docker and Kubernetes.

- Lack of visibility with customers in which Dell isn't an existing supplier could hinder future growth in this market.

Extreme Networks

Extreme Networks is a publicly traded vendor, based in California, U.S., with an estimated total of more than 5,000 enterprise data center networking customers. The vendor's flagship enterprise data center networking offering is Agile Data Center, which includes SLX and VDX switches, Extreme Management Center (XMC) and Extreme Workflow Composer (EWC) for event-driven automation. Based on Gartner's estimates, Extreme grew above market rates for data center switching revenue in 2018, due to its acquisitions of the Brocade and Avaya data center portfolios.

Moving forward, we anticipate that Extreme will continue to invest in its portfolio, including continued integration of Brocade/Avaya portfolios, and a focus on using artificial intelligence (AI) and machine learning to improve automation. Include Extreme on shortlists for data center networking opportunities globally outside Africa.

Strengths

- EWC StackStorm provides a solid set of multivendor automation capabilities that extends beyond the company's own products.
- The vendor's management system provides good application-centric troubleshooting and predictive analytics.
- The vendor has strong expertise, a sizable installed base and a history of strong support in midmarket enterprise environments.

Cautions

- Extreme is still integrating the disparate portfolios of several acquisitions, including Avaya and Brocade. This has slowed its ability to keep pace with the market in terms of feature innovation. For example, Extreme has been late to market to address a graphical user interface (GUI) for centralized fabric management and RoCEv2.
- We observe Extreme leading with suboptimal 10/40G platforms in the data center, instead of 25/100G platforms, particularly in the midmarket for ex-Avaya customers.
- Based on Gartner's estimates, the combined data center switching revenue from Extreme, Brocade and Avaya has declined substantially since 2017, indicating that many Brocade and Avaya customers have switched to alternative vendors.

H3C

H3C, a joint venture of Tsinghua Holdings (51%) and HPE (49%), is based in Beijing and Hangzhou, China, with more than 2,000 enterprise data center networking customers. The

vendor's flagship enterprise data center networking offering is the Application-Driven Data Center, which is composed of physical switches and Seer Network Architecture (SNA) management software. Based on Gartner's estimates, the vendor grew at more than twice the market rate for data center switching revenue in 2018.

We anticipate H3C will continue to invest in its portfolio, with a focus on improved analytics, underpinned by machine learning and AI. Include H3C on shortlists for all data center networking opportunities in China and Hong Kong.

Strengths

- This vendor has a solid portfolio of hardware switches, and has grown well above market rates for the past several years.
- The vendor has demonstrated the ability to win in and support large-scale environments, such as hyperscale cloud providers.
- The vendor offers aggressive pricing, with an average price per 10G switchport well below $65, which is better than most vendors in this research.

Cautions

- Outside the APAC region, H3C has a limited installed base and less experience with enterprise customers. We estimate that the vendor has fewer than 50 customers outside APAC.
- The vendor is one of few in this research that don't provided turnkey integrations for VMware vRealize or Salt.
- The vendor has limited ability to support customers on a global basis, because it offers 24/7 support in less than 20 countries, with four-hour hardware support limited to fewer than 10 countries. Most vendors in this research offer these capabilities in more than 100 countries.

HPE

HPE is a publicly traded company, based in California, U.S., with more than 1,000 enterprise data center networking customers. Its primary offering is FlexFabric switches and associated software, although the vendor also proposes Aruba-branded switches running AOS-CX in some opportunities as well. It offers embedded data center networking software in its integrated systems. FlexFabric products are derived via its joint venture with H3C, in which HPE maintains a minority ownership at 49%. Based on Gartner's estimates, HPE lost revenue share in data center switching in 2018.

Moving forward, we anticipate that the vendor will make continued product investments in its portfolio, primarily focused on the Aruba portfolio of switches and AOS-CX software to address broader set of data center use cases. HPE should be shortlisted for midmarket data center networking opportunities and HPE-sourced data centers globally.

Strengths

- The Aruba switching NOS is modern and embeds analytics, which can circumvent the need for multiple networking tools and management consoles.
- HPE's FlexFabric portfolio supports typical data center networking use cases and high-performance storage networking via nonvolatile memory express (NVMe) remote direct memory access (RDMA) over Converged Ethernet (RoCE)/Ethernet fabric.
- The vendor moved ownership of the data center networking group to HPE's Aruba division in November 2018, and the Aruba team has a solid history of delivering high-quality, scalable software.

Cautions

- We believe that HPE's strategy in this market during the past several years has been varied and inconsistent.
- The vendor's data center portfolio, which includes FlexFabric, Aruba and Plexxi, has different codebases and management platforms. This limits deep integration and investment protection across its portfolio and confuses potential customers.
- HPE is leading with Aruba switches, instead of FlexFabric, in several scenarios today. We expect that, during the next 36 months, HPE will shift its primary focus toward Aruba.

Huawei

Huawei is a privately held company headquartered in Shenzhen, China, with an estimated more than 5,000 enterprise data center networking customers. The vendor's flagship data center networking offering is the CloudFabric Intent-Driven Network, which includes physical switches, NOS, Agile Controller and the FabricInsight analytics engine. Based on Gartner's estimates, Huawei grew at two to three times the market rate for data center switching revenue in 2018.

We anticipate that the vendor will make continued product investments in this market, with a focus on high-performance workloads and intent-driven operations. Huawei should be shortlisted for all enterprise data center networking opportunities in the Asia/Pacific (APAC) region, Africa, South America and Europe.

Strengths

- Huawei's AI Fabric is well-suited to the needs of highly demanding workloads that require low latency and zero packet loss, such as AI or RoCEv2.
- Huawei's broad portfolio supports flexible architectural options, many based on open standards.
- Based on client feedback and Gartner market data, Huawei provides cost-effective solutions, including some of the lowest per-port pricing in the market.

Cautions

- Huawei has a small presence in North America. Gartner estimates that it has only about 100 enterprise customers on the continent, which is less than 2% of its global installed base. Similarly, geopolitical concerns are a gating factor to adoption in the U.S.
- We assess that Huawei has not consistently demonstrated the ability to drive and shape the broader market and customers' data center networking expectations from a thought leadership standpoint.
- Huawei lacks some of the turnkey vendor integrations that are available with other vendors included in this research, such as vRealize, Salt and Chef.

Juniper Networks

Juniper Networks is a publicly traded company based in California, U.S., with more than 7,000 enterprise data center customers. The vendor's flagship data center networking offering consists of QFX switches running Junos software, which can be offered with its Contrail Enterprise Multicloud orchestration software. Contrail can be deployed on Juniper's switches or other vendors' hardware. Based on Gartner's estimates, Juniper lost revenue share in data center switching in 2018.

Moving forward, we anticipate the vendor to continue investing in its enterprise portfolio, with a focus on embedded security, application visibility and self-healing. Juniper should be shortlisted for all enterprise data center networking opportunities globally.

Strengths

- The vendor has a deep portfolio of hardware and software feature depth that can address nearly all enterprise requirements.
- Juniper's roadmap to deliver self-healing capabilities should improve data center networking operations, and is well-aligned with emerging customer requirements.
- The vendor has a strong history of providing high-performance solutions for large-scale environments, including service providers and large enterprises.

Cautions

- Juniper is leading with suboptimal 10/40G platforms, instead of 25/100G platforms, particularly in the midmarket and/or when specific software features, such as Virtual Chassis Fabric (VCF), are needed. Juniper is likely to add VCF functionality to its 25G switches by the end of 2019.
- Juniper has limited integration with HCIS vendors, and lags most competitors in this area.
- The vendor's sales channel and marketing are not as strong as others in this research, which can limit its ability to reach customers. We believe this contributed to the vendor's lost share

in 2018.

Mellanox Technologies

Mellanox Technologies is a publicly traded company headquartered in Sunnyvale, California, and Yokneam, Israel, with more than 2,000 enterprise data center networking customers. The vendor's flagship product is its Ethernet Storage Fabric (ESF), which is intended for high-performance storage workloads. The company also provides the Ethernet Cloud Fabric (ECF) for standard data center workloads. Mellanox provides its own NOS (Onyx) and management system (NEO); however, it also supports third-party NOSs, including Cumulus and open-source (SONIC) options. Based on Gartner's estimates, Mellanox grew data center networking product revenue above market rates.

Mellanox is likely to make continued product investments in its data center portfolio, with a focus on adding to its high-speed, low-latency portfolio and self-healing. Companies with NVMe-oF/RoCE v2 storage networking or high-speed, low-latency switching requirements should include Mellanox on their shortlists.

Note: *In March 2019, NVIDIA announced its intention to purchase Mellanox, which is not part of Gartner's analysis.*

Strengths

- Mellanox has considerable expertise in high-performance, low-latency data center environments, and its management system extends into the server to manage network interface cards (NICs). This improves performance and management for demanding workloads, such as high-performance computing (HPC), Ethernet-based storage, high-frequency trading (HFT) and AI/machine learning.
- Mellanox has its own NOS, but also supports Cumulus and additional open-source NOSs on its hardware. This helps support fit-for-purpose software requirements and reduces vendor lock-in.
- The vendor's "What Just Happened" feature supports granular, packet-level troubleshooting and visibility in a cost-effective manner.

Cautions

- The vendor lacks several capabilities that most vendors in the market offer, including certified or turnkey integration with vRealize and NetConf, and a chassis-based spine.
- Mellanox lacks expertise in traditional data center environments, compared with most vendors in this research, because most of its deployments involve high-performance use cases.
- The vendor's solution is more complex to operate, compared with others in this research. For example, its management system lacks depth of capabilities around design and automated

configuration.

VMware

VMware is a publicly traded vendor, based in California, U.S. We estimate more than 4,000 enterprise data center networking customers. The vendor's flagship enterprise data center product is NSX Data Center, which is a software-based network overlay (and associated management), which can run on top of most IP-based data center networks. VMware also bundles NSX into other offerings, including VMC on Amazon Web Services (AWS), and Horizon virtual desktop infrastructure (VDI). VMware is one of only two vendors in this research that does not provide its own branded hardware switches. Based on Gartner's estimates, the vendor added data center networking customers above market rates in 2018.

Moving forward, we anticipate that VMware will continue to invest in NSX, with a focus on improving manageability, expanding security capabilities and supporting more public cloud providers. Organizations should include VMware on shortlists when aiming to add agility to new or existing data center networks.

Strengths

- NSX can add agility to an existing data center network infrastructure via improved automation, security and tie-in with broader orchestration tools. This can extend the life and value of hardware investments.
- NSX provides east-west firewalling in the data center (microsegmentation), which can lower operational complexity and cost, compared with traditional firewall approaches.
- The vendor's vision for delivering increasing levels of automation, and treating network infrastructure as code across hybrid and multicloud environments, is aligned with emerging customer requirements.

Cautions

- Customers commonly inform us that NSX is quite expensive and can be difficult to justify. We believe this is a primary reason that the adoption of NSX Data Center remains less than 10% of the VMware ESX installed base.
- During the past year, customers have expressed concerns as VMware has pivoted its primary offering from NSX-V to NSX-T. Adoption of NSX-T is limited, and NSX-V customers will need to migrate to NSX-T during the next two to three years, which can be operationally challenging.
- Customers report that the platform is complex to install and operate, particularly in smaller environments and/or where there are not large numbers of technical personnel.

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. 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

No vendors were added this year.

Dropped

Pluribus was dropped, because it failed to meet inclusion criteria, based on our assessment and estimates regarding its relevance to Gartner clients.

Lenovo was dropped, because it failed to meet inclusion criteria, based on our assessment and estimates regarding its relevance to Gartner clients.

Inclusion and Exclusion Criteria

Inclusion Criteria

To qualify for inclusion in the Magic Quadrant, vendors need to:

- Provide hardware and/or software addressing the emerging enterprise data center networking requirements outlined in the Market Definition/Description and Extended Market Definition. This requires at least two of the following product capabilities:
  - **Physical switch:** a physical network switch with at least 48 ports of 10 Gbps or greater, supporting multiple L2/L3 protocols
  - **Virtual switch:** a virtual network switch that can run on a host, with support for multiple L2/L3 protocols, and provides switching between virtual machines (VMs) on the host
  - **NOS:** an NOS that can run on a physical switch or host, with support for multiple L2/L3 network protocols
  - **Fabric:** the ability to manage a collection of physical and/or virtual switches as a single construct
  - **Overlay:** network overlay software that can run on top of a network-switching infrastructure
  - **Centralized management:** centralized visibility, configuration and reporting capability for the vendor's data center networking components
- Produce and release enterprise data center networking products for general availability as of 1 February 2019. All components must be publicly available, shipping and included on the vendors' published price list as of this date. Products shipping after this date will only have an influence on the Completeness of Vision axis.

- Provide commercial support and maintenance for their enterprise data center networking products (24/7). This includes hardware/software support, access to software upgrades, and troubleshooting and technical assistance.
- Show relevance to Gartner's enterprise clients on a global basis by demonstrating at least 110 current enterprise data center networking customers (under active support contracts) and meeting at least one of the following two criteria:
  - At least 15 current enterprise data center networking customers, based in each of three separate continents (with active support contracts)
  - At least 25 current enterprise data center networking customers, based in two separate continents (with active support contracts)

  Note: *This may require proof in the form of a customer list certified by an officer of the company.*

- Show relevance to Gartner's enterprise clients by meeting at least one of the following:
  - More than 1,000 current enterprise data center networking customers (with active support contracts).
  - **Note:** *This may require proof in the form of a customer list certified by an officer of the company.*
  - More than $60 million of recognized product revenue (generally accepted accounting principles [GAAP]) in the data center networking market during the past four quarters (i.e., as of February 2019).
  - **Note:** *This may require proof in the form of attestation by a financial officer of the company.*
  - More than $30 million of recognized product revenue (GAAP) in the data center networking market during the past four quarters, and growth at more than 30% from the prior four quarters (as of February 2019).
  - **Note:** *This may require proof in the form of attestation by a financial officer of the company.*

Exclusion Criteria

We exclude service providers offering managed network services that do not own their data center networking technologies, because they build their offerings with commercial vendor products as the underpinning technology.

Evaluation Criteria

Ability to Execute

Product or Service

This capability involves core goods and services that compete in and/or serve the defined market. It includes current product and service capabilities, quality, feature sets, skills, etc. This can be offered natively or through OEM agreements/partnerships, as defined in the market definition and detailed in the subcriteria.

This evaluates vendors by looking at their data center networking portfolios. We focus primarily on products the vendor leads with in enterprise accounts (i.e., flagship). This includes Ethernet fabrics, network overlays, physical switches, virtual switches, NOS, network automation, and the requisite management and control of these components. Particular attention will be paid to network automation, turnkey integration with common cloud, virtualization and orchestration, as well as automation systems used in the broader data center infrastructure and the ability to support DevOps practices. We evaluate the vendor’s portfolio and product architecture, including feature depth and breadth, as it relates to the enterprise.

Overall Viability

Viability includes an assessment of the organization’s overall financial health, as well as the financial and practical success of the business unit. Views the likelihood of the organization to continue to offer and invest in the product, as well as the product position in the current portfolio.

We assess the vendor’s overall financial health, and the health of the organization’ data center networking business unit, to determine the vendor’s likelihood to continue investing in and advancing the state of the art in the organization’s data center offerings. Geopolitical issues may also affect the overall viability of vendors in this market.

Sales Execution/Pricing

This involves the organization’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.

We evaluate the capabilities and effectiveness of the vendors and their associated channels, including the depth and breadth of their sales channel and coverage. We also evaluate how the vendors interact with their current and potential customers, primarily in presales activities, including account responsiveness and product positioning. The second aspect of this criterion involves our evaluation of the cost-effectiveness and cost flexibility of the proposed solutions, including purchase and support.

Market Responsiveness/Record

This includes the ability to respond, change direction, be flexible and achieve competitive success as opportunities develop, competitors act, customer needs evolve and market

dynamics change. We assess the vendor's track record in delivering new capabilities when the market needs them. This means exhibiting flexibility when necessary or staying the course in the face of fickle trends, and the ability to drive technology trends, instead of just reacting to them. This includes how well vendor's offerings match enterprise functional, financial and operational requirements at the time of purchase.

Marketing Execution

This includes the clarity, quality, creativity and efficacy of programs designed to deliver the organization's message to influence the market, promote the brand, increase product awareness, drive lead generation and establish a positive identification in the minds of customers. This "mind share" can be driven by a combination of publicity, promotional, thought leadership, social media, referrals and sales activities.

This focuses on how the vendor is perceived in the market, and how well its marketing programs are recognized. A key indicator for the effectiveness of this criterion is how often potential buyers consider a vendor as a possible supplier in a shortlist evaluation.

Customer Experience

This involves products and services and/or programs that enable customers to achieve anticipated results with the products evaluated. Specifically, this includes quality supplier/buyer interactions, technical support or account support. It may also include ancillary tools, customer support programs, availability of user groups, service-level agreements (SLAs), etc.

We assess multiple aspects of the customer interaction, with a heavier weighting on postsales service and support activities. This includes customers' experience with the vendors' data center networking products and services used in their environments, including initial (Day 0) deployment, as well as day-to-day (Day 2) operation and management. This includes hardware and software quality, overall solution stability and how existing customers describe their experiences with the vendors' products.

Operations

This category was not rated.

Table 1: Ability to Execute Evaluation Criteria

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

Evaluation Criteria ↓	Weighting ↓
Marketing Execution	Low
Customer Experience	High
Operations	Not Rated

Source: Gartner (July 2019)

Completeness of Vision

Market Understanding

This involves the ability to understand customer needs and translate them into products and services. Vendors that demonstrate clear vision of their markets listen, understand customer demands, and can shape or enhance market changes with their added vision.

We assess the vendor's understanding of existing and emerging enterprise data center network requirements. This includes how well the vendor understands key data center buyers/influencers in the various sizes of enterprise on a global basis. We also assess how well the vendor understands their current market positions, including their own strengths and weaknesses.

Marketing Strategy

Here, we assess whether the vendor's marketing strategy is clear, relevant and differentiated in a way that will drive business. We look at the vendor's plans to influence the market through its messaging and marketing campaigns. This includes clear, differentiated messaging and thought leadership aligned with product roadmaps.

Sales Strategy

We assess the clarity and relevancy of the vendors' sales strategies. This evaluates the vendor's strategy to maintain and extend the scope and depth of its market reach. It includes go-to-market strategies, new use cases for products, alliances and partnerships. In addition, we assess how the vendor exploits emerging business and technology transitions, including new pricing models.

Offering (Product) Strategy

This approach to product development and delivery emphasizes market differentiation, functionality and features, as they map to current and future requirements. It evaluates how the vendor plans to address the key market transitions identified in the Market Definition/Description and Extended Market Definition sections. We primarily assess product-related roadmaps and planned capabilities the vendor intends to deliver. We focus on functionality that delivers increasing levels of network automation/agility, as well as addressing emerging technological changes in the data center.

Business Model

This involves the design, logic and execution of the organization's business proposition to achieve continued success. Vendors are evaluated on their overall value proposition and strategy for providing solutions for enterprise use cases, not just raw infrastructure elements. Furthermore, this includes how data center networking fits into the vendor's broader product portfolio and product strategy.

Vertical/Industry Strategy

This category was not rated.

Innovation

This includes direct, related, complementary and synergistic layouts of resources, expertise or capital for investment, consolidation, defensive or preemptive purposes. Innovation is not a simple checkbox of current and proposed product features. It is not limited to products, and can cover multiple aspects of the vendor's strategy. Innovations can deliver functional, financial and/or operational benefits to enterprise data center networking customers. This measures the vendor's ability to drive and shape the market by delivering capabilities that address customer challenges and/or provide increasing value to customers. It includes the ability to address emerging data center networking requirements. We look at how the vendor plans to invest in new capabilities to move its business and the market forward, with a focus on capabilities that are differentiated and offer high value to the enterprise buyer.

Geographic Strategy

This category was not rated.

Table 2: Completeness of Vision Evaluation Criteria

Evaluation Criteria ↓	Weighting ↓
Market Understanding	High
Marketing Strategy	Low
Sales Strategy	Medium
Offering (Product) Strategy	High
Business Model	Medium
Vertical/Industry Strategy	Not Rated
Innovation	High

Evaluation Criteria ↓	Weighting ↓
Geographic Strategy	Not Rated

Source: Gartner (July 2019)

Quadrant Descriptions

Leaders

A Leader has demonstrated sustained ability to address changing requirements for enterprise data centers, including a complete product portfolio. A Leader also has high visibility in the market; the ability to drive, shape and transform the market; and can maintain strong relationships with its channels and customers.

Challengers

A Challenger has demonstrated sustained execution in the marketplace, and has clear, long-term viability and visibility in the market and a solid product portfolio. However, a Challenger has not shown the ability to drive, shape and transform the market.

Visionaries

A Visionary has innovated in some key areas of data center networking, such as automation, open networking, operational efficiency and cost reductions. Visionaries often help to transform the market by driving new ideas for solving enterprise challenges.

Niche Players

A Niche Player has a complete or near-complete product offering, but has limitations, such as geographic reach or vertical market focus. A Niche Player has a viable product offering, but has not shown the ability to transform the market or maintain sustained execution.

Context

Despite the rapid adoption of public cloud for new applications, few enterprises are actually decommissioning data center networks. We predict that, through 2022, fewer than 10% of enterprises will decommission an existing production data center network. Thus, we see continued interest and investment from most Gartner clients involved with data center networking infrastructure.

For the past decade, clients have been building data center networks with a strong desire for high availability. Outages in the data center affect the business financially and reputationally — for example, 32% of surveyed customers estimate that a one-hour data center network outage costs more than $1 million, and 83% said it was more than $100,000. This translates to a need for stable software, hardware and great customer support. These characteristics remain core needs in this market.

During the past several years, clients have been building private cloud data centers, and are looking for data center networks that are well-aligned with those initiatives. Specifically, during

the past 12 to 24 months, customers are increasingly interested in agility, DevOps and HCIS.

Automation and Agility

Many data center networking changes are manually, command line interface (CLI)-driven (more than 70% for many enterprises). Gartner clients mention a desire to improve automation and agility in nearly all our data center networking conversations, often as part of a private cloud effort. This is reiterated in reference survey data. When asked, “What future technology that you would like to implement in the next two years in your data center architecture?” the No. 1 answer was “automation.” Furthermore, this is aligned with broader CIO objectives, because 22% of CIOs plan to increase investments in automation, whereas only 2% plan to decrease such investments. Overall, this is driving investment in data center networking beyond just hardware refresh/expansion, with clients often looking at VMware NSX and Ansible in these scenarios (see “Building Data Center Networks in the Digital Business Era”).

DevOps

DevOps practices are increasingly popular within the enterprise, which impacts design and operation of data centers networks (see “Best Networking Practices in a DevOps World”). Clients are asking how to better integrate with DevOps practices and tools as they refresh or modernize their data center network environments. Although many vendors have solid technological capabilities to support this, they are underutilized in practice for technical and nontechnical reasons. For example, most vendors in this research provide turnkey integration for popular automation tools, including Ansible, Puppet, Chef and Salt, in their products. These tools are used in 62% of surveyed customer data center environments. However, only 24% of customers use them for network automation.

HCIS

We see increasing interest in deploying workloads on HCIS in the data center aiming for “cloud-in-a-box,” and 49% of surveyed customers have now deployed HCIS in their data centers. This has downstream operational and performance ramifications in data center networks. Enterprises increasingly want tight integration between their network vendors and HCIS vendors that includes the ability to automatically provision networking configurations from the HCIS console. From a performance perspective, most enterprise simply overprovision the network, but this is increasingly challenging, as more-demanding workloads move to HCIS. As a result, HCIS vendors are integrating greater network orchestration and optimization in their offerings. This is a point of differentiation among solutions in the market.

Emerging and Future Market Drivers

We expect several technologies to drive the market during the next two to five years, including:

- Multicloud networking
- Visibility and analytics
- Brite-box switching (open/disaggregated hardware/software)

- Programmable chips
- 400G
- NVMe over Fabrics (NVMe-oF)
- Kubernetes/container networking

(For a more in-depth view into these, refer to the “Hype Cycle for Enterprise Networking, 2019.”)

Public Cloud Impact

Data center networking vendors, such as Cisco (ACI Anywhere), VMware (NSX Everywhere) and Juniper (Contrail Enterprise Multicloud), are starting to extend their on-premises capabilities into public cloud infrastructures. Meanwhile, the public cloud providers are doing the same in reverse, with offerings such as AWS Outposts, Microsoft AzureStack and Google GKE On-prem. We expect these two groups of vendors to continue investing in this area, and the capabilities will converge and blur. This will potentially disrupt the market landscape during the next three years.

Market Overview

Extended Market Definition

Typical Business Outcomes

The primary business outcome is local connectivity within enterprise data centers, between servers, data center appliances (e.g., firewalls and application delivery controllers [ADCs]), and IP storage. This local connectivity is needed to support applications and services running in the data center.

Market

Data center networking provides network functions that support connectivity primarily in enterprise data centers. Connectivity can be provided by physical switches, which comprise hardware and software and may be acquired in bundled or unbundled form. However, with the emergence of network virtualization and new architectural models, such as software-defined networking (SDN), software overlays have become an additional option in the market and are considered in this Magic Quadrant. In addition, vendors are extending their management and policy functionality to public cloud provider infrastructures.

Typical Buyers

Within the enterprise, CIOs, CTOs, vice presidents of infrastructure and operations (I&O), directors of networking, and network managers are typically the buyers of data center networking infrastructure. Personnel responsible for cloud infrastructure, DevOps teams, security and data center automation are increasingly influencing personnel who are making buying decisions as well.

How Buyers Shape Their Buying Decisions

Data center networking equipment is business-critical and has a long life cycle, so buyers are strongly influenced by historical vendor relationships, experiences with the quality of their existing solutions, including support and technical familiarity with previously installed products. In terms of feature/functionality, buyers typically focus on several factors, including performance, form factor, deployment options, supplier availability and ease of management. They also focus on integration with higher-level infrastructure orchestration platforms, automation tools, programmability through an API, visibility/analytics, customer experience, brand visibility and overall solution architecture.

In particular, automation, ease of management and the ability to support hybrid cloud use cases are increasingly important. Price, for both equipment and support, is also a factor, although not the main driver for most enterprise buyers.

Deliverables

Common deliverables include switches (physical or virtual) or a switching fabric, and the requisite management and control affiliated with the switches. Deliverables also include software-only solutions, such as virtual switches, network overlays and management/policy. The switches provide physical and logical data network connectivity for IT infrastructure residing in the data center (e.g., servers, IP storage systems, security platforms and other network appliances). The most common network technology deployed in data centers is Ethernet, in all speed variants from 1 to 100 gigabits, with copper or fiber cables. Virtual network overlays provide logical connectivity over the physical network, leveraging virtual switches and creating virtual tunnels with protocols such as Virtual Extensible LAN (VXLAN).

Typical network functions include the ability to create virtual network segments and manage logical connectivity at Layer 2 (VLANs and VXLANs) and Layer 3 (IP routing). Some solutions are referred to as Ethernet fabrics, and can be managed as a single logical entity through a GUI or API, rather than at the individual switch level, providing low-touch provisioning on its devices.

How Providers Package, Market and Deliver

Buyers typically source their data center network directly from network vendors or via a reseller or system integrator. The data center network is normally purchased and maintained for a number of years under a support contract. Hardware is generally charged as a one-time cost. Vendors charge for software in several ways, including as a perpetual license, subscription license or bundled with a hardware purchase. During the past few years, we have seen a trend toward disaggregation of hardware from software from vendors.

Alternative software options are often selected for the same hardware platform, and some vendors propose software licenses and price software support separately from hardware support. Data center networking solutions can also be procured from some vendors via leasing, pay-as-you-grow or other consumption-based pricing models.

Element of Data Center Networking Solutions

Physical Interfaces

Physical interfaces to plug-in devices are a common component of products in this market. The most common interface speed we see in enterprise data center proposals is 10G; however, we are also seeing the rapid introduction of new Ethernet connectivity options at higher speeds (e.g., 25GbE). Interface performance is rarely an issue for new implementations. Speeds and feeds are less relevant as buying criteria for most enterprise clients, when compared with automation and ease of operations (see “40G Is Dead — Embrace 100G in Your Data Center!”).

Physical Topology and Switches

The spine-and-leaf (folded Clos) topology is the most common physical network design, proposed by most vendors. It has replaced the historical three-tier design (i.e., access, aggregation and core). The reduction in physical switching tiers is better suited to support the massive east-west traffic flows created by new application architectures (see “Building Data Center Networks in the Digital Business Era”). Vendors deliver a variety of physical form factors for their switches, including fixed-form factor, and modular or chassis-based switches. In addition, this includes software-based switches, such as virtual switches that reside inside physical virtualized servers.

Automation and Orchestration

Vendors in the market often provide their own automation and orchestration tools, as well as integrate with commonly used third-party automation and orchestration tools. Automation and orchestration are increasingly important to buyers in this market, because enterprises want to improve speed to deliver data center network infrastructure to businesses, including on-demand capability. This includes support and integration with popular automation tools (e.g., Ansible, Chef and Puppet); integration with broader platforms, such as VMware vRA; inclusion of published/open APIs; and support for scripting tools, such as Python (see “Building Data Center Networks in the Digital Business Era”).

Switching/Infrastructure Management

Ethernet fabrics provide management for a collection of switches as a single construct, and programmable fabrics include an API. Fabrics are commonly adopted as logical control planes for spine-and-leaf designs, replacing legacy protocols, such as Spanning Tree Protocol (STP), and better enabling the use of all available paths. Fabrics automate several tasks affiliated with managing a data center switching infrastructure, including autodiscovery of switches, autoconfiguration of switches, etc. (see “Innovation Insight for Ethernet Switching Fabric”).

Network Overlays

Network overlays create a logical topology abstracted from the underlying physical topology. We see overlay tunneling protocols, such as VXLAN, used with virtual switches to provide Layer 2 connectivity on top of scalable Layer 3 spine-and-leaf designs. This enables the support of multiple tenants and more-granular network partitioning (microsegmentation) to increase data center security. Overlay products also typically provide an API to enable programmability and integration with orchestration platforms.

Multicloud/Hybrid Cloud

This involves the ability to provide visibility, troubleshooting, configuration and management for workloads in a public cloud provider's infrastructure. In this case, vendors are not providing the underlying physical infrastructure in the cloud provider network, but providing the ability to manage that infrastructure in a consistent manner with on-premises/colocated workloads. This is referred to as a "multicloud capability."

Evidence

Gartner analysts conducted more than 300 inquiries on the topic of data center networking from 31 January 2018 through 31 January 2019.

Revenue and port share for data center networking is derived from "Market Share: Enterprise Network Equipment by Market Segment, Worldwide, 4Q18 and 2018."

All vendors in this research responded to a questionnaire regarding their current/future data center networking solutions. We surveyed reference customers provided by vendors in this research (n = 79).

Analysts reviewed Gartner's Peer Insights reviews for this market.

The 2019 Gartner CIO Survey was conducted online from 17 April through 22 June 2018 among Gartner Executive Programs members and other CIOs. Qualified respondents are the most senior IT leaders (CIOs) for their overall organizations or parts of their organizations (for example, business units or regions). The total sample is 3,102, with representation from all geographies and industry sectors (public and private). The survey was developed collaboratively by a team of Gartner analysts, and was reviewed, tested and administered by Gartner's Research Data and Analytics team.

Social Media Analytics: Automated social media listening tools were used to track user responses on social media and public discussion forums as leading indicators for consumer sentiment, preferences and activities. The data tracked is specific to quantifiable keywords (e.g., vendor flagship products) and phrases, as well as qualitative assessments, and evaluations of results and use cases. The time period considered for analysis of the overall mention count was from 1 July 2016 to 31 March 2019.

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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