Market Outlook

Market Outlook: Software-Defined WAN (SD-WAN), 2019-2024, Worldwide

March 2019

Quadrant
Knowledge Solutions

Executive Overview

This research service includes a detailed analysis of the global software-defined WAN (SD-WAN) market regarding short-term and long-term growth opportunities, emerging technology trends, market trends, and future market outlook. The study also provides a detailed market forecast analysis of the global SD-WAN market in various geographical regions, revenue type, and industry segmentation. This research provides strategic information for technology vendors to better understand the market supporting their growth strategies and for users to evaluate different vendors capabilities, competitive differentiation, and its market position.

Key Research Findings

Followings are the key research findings:

Deployment Trend:
*SD-WAN market is expected to grow exponentially during 2019-2024*

SD-WAN market is expected to increase significantly in the next five to six years from the market size of $1364.4 million in 2018 to over $17.92 billion by 2024. The global SD-WAN market is expected to grow at a compound annual growth rate (CAGR) of 53.6% from 2019-2024.

Regional Trends:
Americas region continues to dominate global SD-WAN market throughout 2019-2024

Majority of the SD-WAN market revenue is coming from the Americas region, which constitutes 83.3% of the total market revenue, followed by the EMEA region which holds

Figure: Revenue Share by Geographical Regions 2018 vs 2024
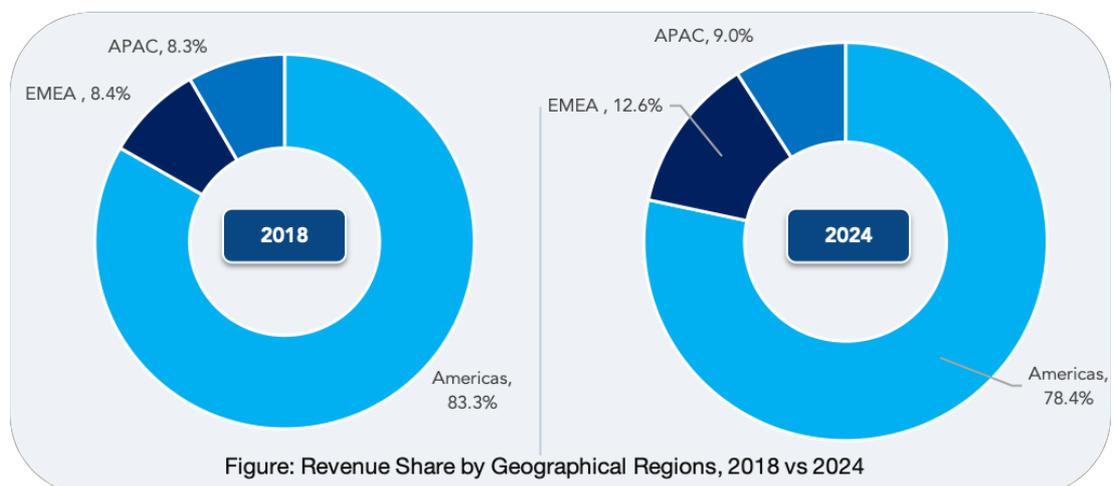
Figure: Revenue Share by Geographical Regions, 2018 vs 2024

8.4% of the total market revenue in 2018. The long-term trend for SD-WAN market indicates that the developed regions of North America and Western Europe market continue to provide the highest business opportunities for vendors. Americas and EMEA region are expected to grow at a CAGR of 52.0% and 64.5% respectively during 2019-2024.

Competition Dynamics & Trends:
The sophistication of technology platforms, multi-layered security, and advanced analytics, are amongst the top competitive differentiators

VMware, Versa Networks, and Cisco are the top performers and the top three technology leaders in the global SD-WAN market. These vendors provide a comprehensive technology platform with breadth and depth of SD-WAN functionalities to simplify networking and improve application performance & visibility. Cradlepoint, with its differentiated strategy in targeting mobile and IoT-specific use cases, has gained strong technology ratings. Silver Peak and Citrix is focusing on improving their SD-WAN value proposition and consistently growing its presence in the SD-WAN space compared to their traditional WAN-optimization business.

Market Background, Key Trends, and Market Drivers

SD-WAN uses software-defined networking techniques in managing and controlling multiple WAN connections such as broadband internet, wireless, MPLS, 4G, 5G, LTE, and others. It provides separation of network data and control planes and includes a centralized application-aware controller to manage network traffic flows, packet priority, routing policy, and network policy. SD-WAN solution helps to create a network overlay to decouple network software-defined services from the enterprise underlying hardware systems. SD-WAN's software-centric approach helps in simplifying branch office networking, improves branch agility, optimizes application performance, and provides a significant reduction in capital and operational expenditure.

Driven by global trends towards the adoption of the cloud-first strategy, explosion of smart internet of things (IoT) devices in the enterprise networks, and growing investments in realizing digital transformation strategies are creating enormous demand for reliable and faster WAN connections. Enterprise WAN networks require agility, reliability, and uptime to ensure optimum application performance. Conventional networking solutions were not designed to support the performance expected from the present generation of applications in a multi-cloud environment. Traditionally, organizations have primarily used MPLS (multiprotocol label switching) and single function CPE (customer premises equipment) for enterprise WAN connectivity and security functions. While it helped in providing a reliable WAN connection, it is often associated with higher capital and operational costs in addition to complex network architecture, slower IT responses, and difficulty in managing branch network and security infrastructure.

SD-WAN is increasingly being perceived as a next-generation of networking technology to support enterprise digital transformation and cloud-first strategies. SD-WAN uses virtual WAN connections which are used to connect enterprise networks to achieve faster, reliable and uninterrupted network connections at optimum costs. SD-WAN provide network administrator flexibility to choose appropriate network which connects enterprise networks, including branch office, remote office, and cloud-based centres over vast geographical distances. This architectural arrangement enables administrators to break free from being solely dependent on traditional MPLS connections, thus providing relief on the traffic load in any specified path and creating better bandwidth economics for per-bit-transferred. SD-WAN solutions also help administrators in setting up automated policies to ensure data transmission is policed to meet technical and business targets in an optimum and effective manner.

Market Adoption and Deployment Trends

Software-Defined SD-WAN market is expected to grow significantly in the next five to six years.

- ♦ Driven by the value proposition in simplifying the WAN and branch networks, improvement in WAN and application performance, reduced capital and operational expenditure, improved agility of WAN management, enhanced network visibility and security, and quick ROI, global SD-WAN market is expected to grow from an estimated market size of $1364.4 million in 2018 to reach over $17.92 billion by 2024.

- ♦ Additionally, vendors continued efforts in improving the awareness and overall value proposition in terms of enhanced integration with best-of-breed security and networking products, orchestration and automation of network processes, improved zero-touch deployment, advanced analytics and application visibility, and improvements in machine learning & artificial intelligence capabilities to drive next-generation of SD-WAN solution is contributing to the market growth. Vendors are also looking at providing enhanced support for full-fledged IoT infrastructure and mobility by supporting future wireless technologies, 5G, and Gigabit LTE.

- ♦ The global SD-WAN market which has grown by 62.7% in 2018 is expected to grow at a CAGR of 53.6% from 2018-2024. Global SD-WAN vendor continues to gain significant market traction with direct inquiries from large enterprises and service provider organizations as well as from their partner networks.

- ♦ SD-WAN market is rapidly moving from early adoption to the rapid growth stage of the overall product lifecycle. Vendors are focusing on improving the awareness about their technical capabilities, SD-WAN value proposition in optimizing WAN performance, and demonstrating ROI with measurable KPIs.

- ♦ Several large organizations from multiple industry segments are looking at adopting SD-WAN solutions and are expanding deployments from dozens to thousands of SD-WAN branch locations. These organizations are increasingly replacing their traditional hardware models for functions such as VPN, WAN optimization, application delivery controller (ADC), and other networking hardware with advanced SD-WAN solution.

- ♦ SD-WAN is currently seen as a transformational technology and the first approach towards organizations journey in adopting software-defined networking (SDN) philosophies in creating a self-adaptive and secure networking systems.

Figure: Market Adoption Trend

Software Defined WAN market is expected to grow at a CAGR of 53.6% from a forecasted period of 2019-2024.
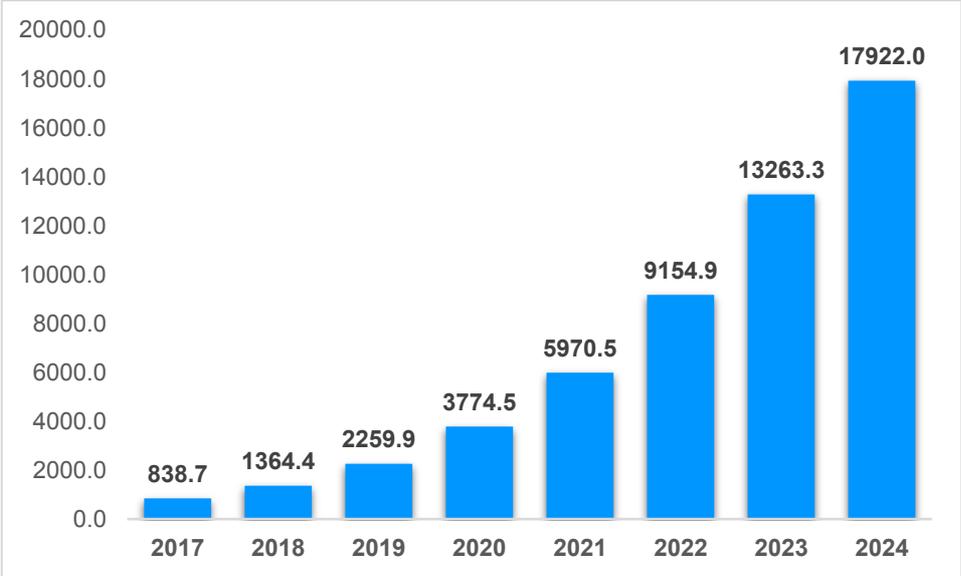
Key Market Drivers and Trends

The followings are the dominant technology and market development influencing the overall global SD-WAN market and market growth:

Widespread Adoption of Cloud Platforms and Services

The primary growth driver for rapid increase in SD-WAN market revenue is due to the growing business and operational needs driven by widespread adoption of cloud (SaaS, PaaS, IaaS), mobility, and Big Data solution in multiple branch locations. Organizations are continuously looking at improving the performance of cloud services and bandwidth availability at affordable costs. SD-WAN solutions help in connecting users and devices from multiple locations directly to the cloud data centres and ensure the connections are optimized and secured. It also offers centralized management and orchestration of these connected endpoints across locations. SD-WAN solution significantly reduces the organization's network complexities of managing dynamic workloads and provides automation capabilities for simplified management of networking.

SD-WAN helps in Transforming Network Performance and Management

Followings are the fundamental value proposition of implementing an SD-WAN solution to improve organization network and application performance.

♦ **Simplifies WAN Management**: Enterprises with multiple branch offices often face challenges in managing their WAN and branch networks due to ever-growing bandwidth requirements resulting in rising network complexities. SD-WAN solution helps in streamlining and simplifying the network operations and management. SD-WAN solution promotes network function virtualization (NFV) to replace several hardware components in the networks with virtual equivalents making the network simpler to manage. SD-WAN's automation and centralized orchestration capability provide network manager to configure dynamic responses based on the traffic flows and network conditions to ensure that optimum link is available for enhanced application performance based on pre-defined routing policy. It also enables the network manager to create a policy template for specific site types that can be applied to multiple sites instantly. SD-WAN solution provides performance dashboards to provide visibility into application and WAN performance over the network.

♦ **Improves Application Performance and Visibility**: Traditional networking architecture was mainly designed to support consistent traffic flow treating all data packets equally. In the present digital services economy, organizations are required to support mobile, collaboration tools, productivity applications, voice communications, video communications, and other applications. The stable

performance of these applications requires dynamic bandwidth allocation to maintain networks characteristics that support speed, reliability, and other performance factors. With SD-WAN, all networking appliances, connections and traffic flows are managed centrally through SD-WAN solution. It provides organizations with a high degree of programming capability to direct the best path available for traffic to the essential applications based on the current network condition and organization's policies.

♦ **Reduces Network Complexities**: SD-WAN using SDN techniques promises to eliminate or minimize the need for dedicated network routers, load balancers, application delivery controller (ADC), WAN optimization appliances, and other networking devices that increases network complexities. SD-WAN solution also enables the organization to move from traditional MPLS to broadband connections and optimizes the use of available bandwidth.

SD-WAN Helps in Delivering a Robust User Experience for Unified Communications

Organizations are increasingly using unified communication tools including real-time voice, screen sharing, file sharing, and video applications that require higher bandwidth and reliable connectivity for a continuous quality performance. As the demand for unified communications applications is growing, network administrators are facing significant challenges in maintaining the reliability of business communications impacting the organization's productivity. Unified communication applications are significantly affected by network performance issues, such as latency, jitters, packet loss, and often requires continuous streams of bandwidth to be available for optimum user experience. SD-WAN solutions help organizations in providing reliable network resources for a stable voice, video streaming and communications. SD-WAN solution by performing application prioritization and multi-path steering can measure performance characteristics and ensure the best performing path is available for high-priority voice, video, and other essential applications. In case of packet loss in a single or multi-path environment, SD-WAN solution utilizes Forward Error Correction feature which duplicates the data packets and ensures that critical application data packets (voice, video, or other high-priority application) reach the destination for a better VoIP and video performance. SD-WAN solution also provides Jitter Buffering feature to reduce jitters and maintain the cadence of voice and video streams.

Security Capability Continue to Remain an Important Differentiator

Organizations are increasingly adopting virtualization, cloud services (IaaS, PaaS, SaaS), and smart IoT devices to realize their vision towards a digital enterprise strategy. However, due to the scalability of cloud services and the dynamic nature of applications and resource deployed in these hybrid environments, it significantly expands the attack surface. It

requires enhanced protection and control measures to address ever-growing security risks, internal threats, external malware, and compliance requirements.

♦ Organizations across global locations are increasingly focusing on improving their security defenses. Large enterprise customers and service providers expect SD-WAN solution to support integration with their existing/new security infrastructure to ensure secure network traffic that meets reliability and Quality of Experience (QoE) expectations.

♦ Almost all major SD-WAN vendors are improving their security capabilities with advanced built-in security features and are increasingly offering integration capabilities with the third-party best-of-breed network, cloud, and IoT security products.

♦ Security capability is expected to remain an important differentiator and is likely to play a key role in evaluating SD-WAN solutions and vendor selection process.

SD-WAN to Play a Key Role in Enabling Enterprise IoT and Digital Transformation Strategies

Global organizations continue to make a significant investment in adopting smart IoT-technologies and application in their journey towards digital transformation strategy. In most of the cases, the primary focus of these organizations is towards deploying IoT devices and provisioning for data collection, storage, and management. These organizations are facing significant challenges in managing and monitoring of unprecedented and uneven IoT traffic.

♦ IoT applications often require real-time data collection from multiple sources to perform real-time analytics in providing actionable insights to drive business performance. These applications require a reliable underlying networking infrastructure to support smooth connectivity for IoT devices, applications, and data repositories.

♦ Traditional networking architecture lacks network intelligence capability to support IoT-specific traffic in an optimum manner. Additionally, MPLS-based architecture doesn't support the scalability or the flexibility necessary for the smooth functioning of IoT devices. This is why SD-WAN technology is increasingly seen as an essential solution in addressing the complexity and scalability requirements of full-fledged IoT infrastructure.

♦ SD-WAN is designed to function on a variety of network connectivity, including broadband, cellular, or IoT-specific low-power wide-area network (LP-WAN). It means IoT devices or endpoints can be easily connected even from a remote location. It enables network administrators to apply integrated network services

◆ easily to those connected endpoints and manage the same from a central or regional hub.

◆ SD-WAN solution also helps in improving the network visibility in managing devices or endpoints for reduced security risks and at the same time ensures the level of connectivity is available for optimum performance. SD-WAN solution enable IT teams to create granular policies to govern their network traffic and assign priorities of connections based on the types of data packets.

◆ In conclusion, SD-WAN solution, by simplifying the WAN architecture, supports organizations digital transformation and IoT initiative to scale quickly and securely.

SD-WAN is Expected to be an Integral Part of Organization Network to Support 5G Communication

5G is gaining significant traction across the world with countries such as the United States, South Korea, China, the UK, and others are either performing 5G trials or planning for commercial rollouts. With significant faster performance than 4G, 5G is driving tremendous interest amongst business and consumer communities for the seamless performance of applications, such as IP-based video conferencing, video streaming, data sharing, and other applications with higher bandwidth requirement. SD-WAN is expected to be an integral part of the journey towards 5G networks. SD-WAN with intelligent routing capability automatically prioritizes traffic based on criticality and bandwidth requirements to optimize performance for online video streaming and other unified communication tools. SD-WAN vendors are expected to incorporate advanced wireless capability by integrating 5G and gigabit LTE technologies into their SD-WAN solution.

Services Providers are Improving SD-WAN Market Penetration

SD-WAN is increasingly finding acceptance across global regions and hence to remain competitive service providers are increasingly offering managed SD-WAN services and creating an additional revenue stream. Major services providers, such as AT&T, Orange Business, Verizon, Sprint, MegaPath and others are increasingly partnering with SD-WAN vendors targeting SMB organizations in providing managed services for smaller branch services. Businesses are increasingly buying from service provides to avoid complexities in deploying and managing SD-WAN solutions while migrating from the legacy network infrastructure. The trend is helping in improving overall technology penetration and market growth.

Mergers and Acquisitions Trend is Expected to Continue During the Forecasted Years

As the SD-WAN market is gaining increasing market traction amongst enterprise as well as service provider customers, the market is expected to continually witness market consolidation, with vendor's strategy of market expansion through mergers and acquisition. Driven by promising market opportunities, large networking and IT vendors are looking at improving their product portfolio with SD-WAN solution. This is expected to drive increased acquisitions and mergers to improve managed services and improved offerings during the forecasted years of 2019-2024.

♦ In 2017, Cisco acquired Viptela, a major SD-WAN specialist, to offer cloud-based SD-WAN solution with advanced routing, complex topologies and granular segmentation capabilities.

♦ In 2017, another announcement came from VMware which acquired VeloCloud, a leading SD-WAN vendor, strengthening its SD-WAN capabilities for large enterprise and service provider customers.

♦ In 2018, Oracle acquired Talari Networks to complement its session border controller (SBC) and network management infrastructure with Quality of Experience (QoE) connectivity and cloud application access across any IP network.

♦ This trend is expected to impact the vendor's competitive positioning during the forecasted years of 2018-2023. Growing competition in the global SD-WAN market is expected to drive continued investments in technology innovation and further improvements in routing, security, and management functionalities.

Regional Trends and Forecasts
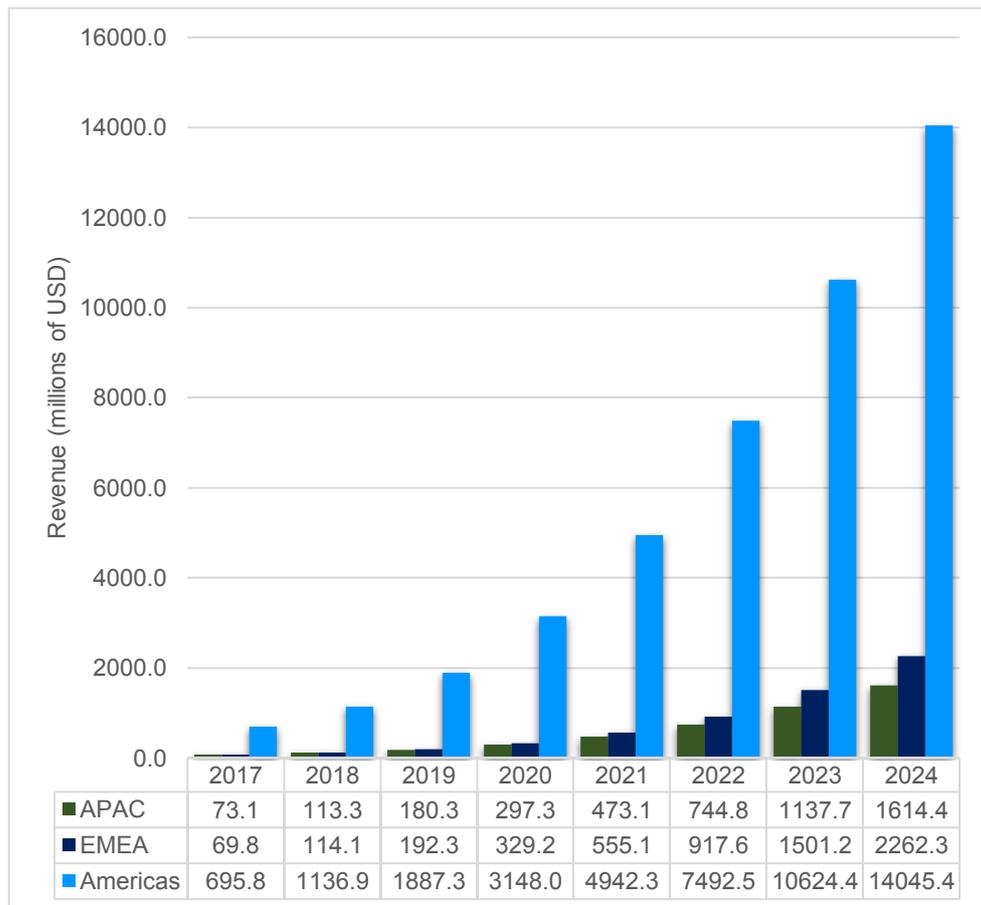### Large enterprise companies in the North America region is driving the overall market growth

Majority of the SD-WAN market revenue is coming from the America region, which constitutes 83.3% of the total market revenue, followed by the EMEA region which holds 8.4% of the total market revenue in 2018. The long-term trend for SD-WAN market indicates that the developed regions of North America and Western Europe market continue to provide the highest business opportunities for vendors.

◆ North America region is considered to be an early adopter in embracing next-generation of emerging technologies. North America region is also the front-runner in embracing various next generation of technologies including internet of things (IoT), connected industries and infrastructure, advance telecommunication technologies (4G, 5G, LTE), advanced analytics, AI & machine learning platform, and such others. In the global SD-WAN market analysis, the Americas region which currently holds 83.3% of the market share in 2018, is expected to grow at a CAGR of 52.0% from 2019-2024.

◆ EMEA market growth is primarily driven by increasing adoption in markets, including Germany, UK, France, Middle East countries, South Africa and others. SD-WAN demand is growing in these regions because of increased investment in various digital transformation strategy, such as Industry 4.0 initiatives. EMEA region is expected to grow at a CAGR of 64.5% during 2019-2024.

◆ Large enterprise organizations in the APAC region is actively evaluating SD-WAN solution in improving WAN performance and support branch office connectivity. Most of the SD-WAN vendors are currently approaching the APAC market with their partnership initiatives in building robust sales channel partners and systems integrators. SD-WAN market in the APAC region, which constitutes 8.3% of the total market in the year 2018, is expected to grow at a CAGR of 55.7% during 2019-2024 driven by rapid adoption in Japan, Australia, China, and improved penetration rate in India, Malaysia, and Thailand.

Figure: Market Forecast by Geographical Regions

Large enterprise companies in the North America region is driving the overall market growth

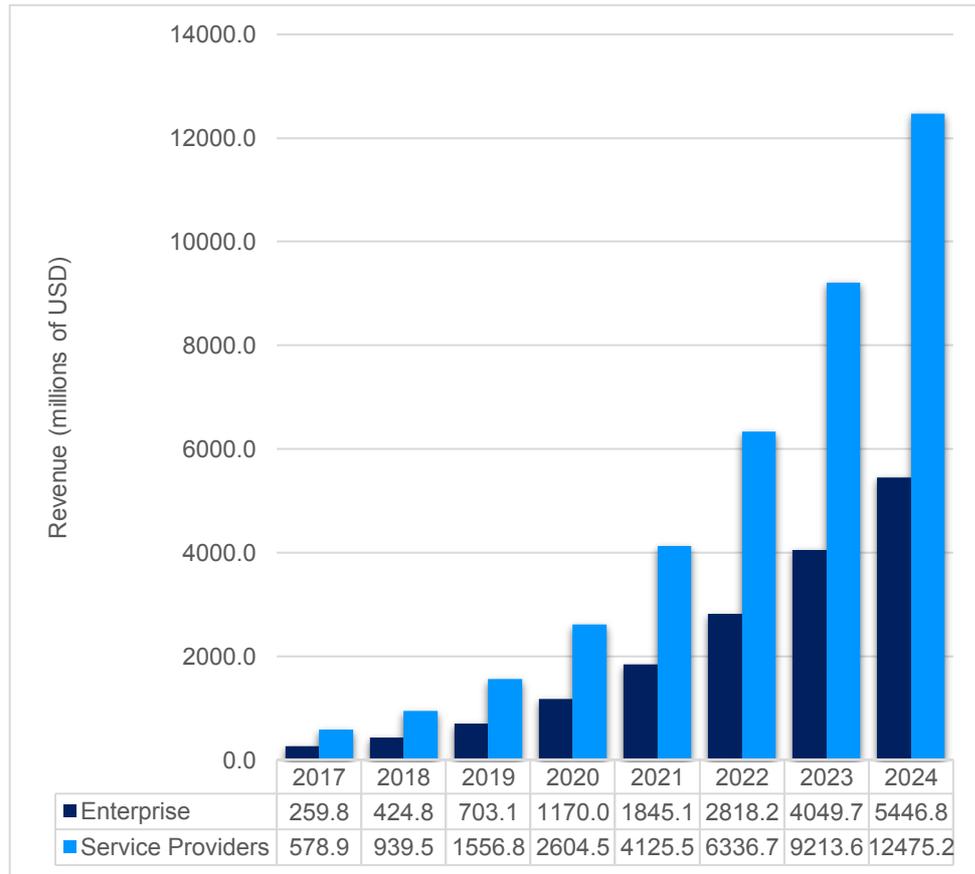|	2017	2018	2019	2020	2021	2022	2023	2024
■ APAC	73.1	113.3	180.3	297.3	473.1	744.8	1137.7	1614.4
■ EMEA	69.8	114.1	192.3	329.2	555.1	917.6	1501.2	2262.3
■ Americas	695.8	1136.9	1887.3	3148.0	4942.3	7492.5	10624.4	14045.4

Market Adoption Trends by Customer Type
Enterprise versus service providers adoption trends

SD-WAN solution can be deployed as DIY (do it yourself) approach where users themselves install and manage the software and services or as a managed service where vendors take the responsibility of the installation, updates, and support services of the SD-WAN deployments.

♦ Large enterprise organizations prefer DIY (do-it-yourself) approach as they have substantial in-house resources to manage the deployments, on-going support, re-architecting WAN connections to branch offices and remote sites, and its maintenance to ensure optimum performance. However, mid-sized organizations prefer to managed deployments as they often lag in terms of in-house expertise or human resources to manage SD-WAN deployments.

♦ As per the overall market analysis, hybrid-approach of deployment is increasingly becoming popular where vendor organization manage critical aspects of the installation and maintenance, and users can manage customization based on their evolving business and operational requirements.

♦ Hybrid deployment enables companies to control essential aspects of implementations, including provisioning of new connections, creating application policies, setting up compliance rules, and such others. This trend is expected to play a crucial role in improving the penetration rate amongst mid-sized and large organizations, and overall market growth of SD-WAN solution during the forecasted years of 2019-2024.

♦ SD-WAN market growth is primarily driven by increasing adoption by service providers specializing in the mid-market segments. As the global SD-WAN market is expected to reach over $12 billion by 2024 with increased acceptance across global regions, to remain competitive service providers are increasingly combining their networks with the managed SD-WAN services. Major services providers, such as AT&T, Century Link, Comcast, Earthlink, Masergy, Mitel, Orange Business, Verizon, Sprint, MegaPath, TelePacific, Vonage, Windstream, and others are increasingly partnering with SD-WAN vendors to offer their own SD-WAN managed services to their customers.

♦ On customer type, service provider customer segment constitutes 68.9% of the total market compared to enterprise segment revenue with a market share of 31.1% in the year 2018. The service provider segment is expected to grow at a CAGR of 53.9% compared to enterprise segment which is expected to grow at a CAGR of 53.0% during 2019-2024.

Figure: Market Adoption Trends by Customer Type
Enterprise vs service providers adoption trends

	2017	2018	2019	2020	2021	2022	2023	2024
Enterprise	259.8	424.8	703.1	1170.0	1845.1	2818.2	4049.7	5446.8
Service Providers	578.9	939.5	1556.8	2604.5	4125.5	6336.7	9213.6	12475.2

Competitive Landscape and Analysis

Quadrant Knowledge Solutions conducted an in-depth analysis of major software-defined WAN vendors by evaluating their products, market presence, and value proposition. The evaluation is based on the primary research with expert interviews, analysis of use cases, and Quadrant's internal analysis of the overall SD-WAN market. This study includes analysis of key vendors including Aryaka, Cisco, Citrix, CloudGenix, Cradlepoint, Fatpipe, Mushroom Networks, Nuage Networks, Oracle (Talari), Silver Peak, Versa Networks, VMware, and Zenlayer.

The global SD-WAN market constitutes of SD-WAN specialist, networking, and WAN optimization vendors. Network security vendors are also looking at offering SD-WAN solution to tap the attractive growth opportunities. Driven by technology advancements and innovation, SD-WAN technology value proposition from these vendors are equally compelling. Cisco and VMware have integrated technology from Viptela and Velocloud respectively and have significantly improved their overall SD-WAN technology and customer value proposition. SD-WAN specialists are gaining increasing market traction from both enterprise and service providers and are competing successfully against larger vendors driven by technology innovation in providing advanced capabilities.

VMware, Versa Networks and Cisco are the top performers and has been positioned as the top three technology leaders in the global SD-WAN market. Cisco is continuing to gain market share leveraging its existing enterprise customers for upsell opportunities with a large installed base of networking hardware. VMware has acquired significant market by integrating VeloCloud with its NSX platform to provide a comprehensive virtualized networking solution to their enterprise customers. Amongst the large networking vendors, VMware has gained a significant reputation for delivering extensive SD-WAN capabilities to support the requirements of large enterprise and service providers. Versa Networks continues to differentiate with its innovative technology offerings and positioning itself as a "software-defined branch" with beyond SD-WAN and SD-Security capabilities. The company has successfully partnered with a large number of leading CSPs and also have a strong customer base in the large enterprise segment.

Cradlepoint SD-WAN strategy is targeted for mobile and IoT-specific applications to provide SD-WAN solution using cellular connectivity. Cradlepoint with its differentiated offerings is gaining significant market traction especially from industries including retail, transportation, financial services, and food & beverage. Silver Peak is a well-established WAN optimization vendor and is focusing on growing its presence into SD-WAN market. In recent years, the company has acquired several enterprise customers for its SD-WAN solution and is also focusing on partnering with service providers for managed SD-WAN services. Talari Networks, after acquisition by Oracle, is well positioned to deliver advanced SD-WAN capabilities to SMB and large global customers for improving the performance of real-time communication and mission-critical applications. Aryaka's fully

managed network as a service (NaaS) offerings is well received amongst both SMB and large enterprise customers globally for different SD-WAN use cases. Nuage Networks is increasingly partnering with service providers that are leveraging Nuage Virtualized Network Service (VNS) to build their own SD-WAN and NFV services. Citrix and Fatpipe are leveraging their existing relationship from its WAN optimization and networking customers to deliver SD-WAN solutions. CloudGenix and Mushroom Networks with strong product value-proposition and price/performance ratio are also gaining market traction and consistently improving their market share. Zenlayer has a strong focus on Chinese SD-WAN market, and it continues to increase customers in the regions.

Key Competitive Factors and Technology Differentiators

Primary SD-WAN value proposition now exceed its initial use case of offering hybrid WAN architecture, replacing MPLS with cheaper broadband internet connectivity, and reducing WAN operational expenses. Driven by increasing competition, vendors are increasingly looking at improving their SD-WAN technology capabilities and overall value proposition to remain competitive. Followings are the key competitive factors and differentiators for the evaluation of SD-WAN solutions and vendors. While the majority of the SD-WAN solutions may provide all the core functionalities, the breadth and depth of functionalities may differ by different vendors offerings. Some of the key differentiators include:

♦ **Comprehensive SD-WAN Technology Capability**: Technology is an important consideration when evaluating and selecting an SD-WAN solution and vendor. End-user organizations are advised to conduct a thorough evaluation of different SD-WAN technologies and vendors before making a purchasing decision. SD-WAN technology capabilities differ between various vendor offerings. Users should evaluate SD-WAN solution that offers comprehensive capabilities, including management of SD-WAN and network optimization, such as acceleration, dynamic path selection, hybrid WAN, and centralized administration, management, and orchestration of all connected endpoints, automation, WAN optimization, network security integration, zero-touch deployment, and such others. Organizations should evaluate a different set of vendors from fairly new SD-WAN specialists to well-established networking and WAN optimization vendors to get a better perspective of the overall value proposition.

♦ **Support for Multi-layered Security Strategy**: Driven by increased adoption of cloud and SaaS applications in a hybrid IT environment enterprise risk landscape is expanding significantly and becoming complex. Organizations are looking at improving their network defenses with robust and multi-layered security technologies. SD-WAN solution provides the capability to create secure WAN segments specific to virtual networks or virtual private clouds, thereby providing

isolation and security to application traffic over the WAN and cloud networks. Additionally, leading SD-WAN solution provides integrated firewall capability with level 4 to layer 7 control capabilities including URL filtering, next-generation firewall (NGFW), intrusion detection & prevention systems (IDS/IPS), and such others. SD-WAN technologies are increasingly being seen as the enabler for building enterprise network of the future that support multi-layered security strategy.

♦ **SD-WAN Analytics Capability**: SD-WAN solution includes analytics capability to monitor the application and network performance. However, the analytics capability may differ between different vendors offerings. Advanced analytics capability can be a part of the vendor's native technology or by integration with a third-party data analytics platform. Organizations should evaluate SD-WAN solution capability in providing advanced analytics and comprehensive visibility for comprehensive monitoring and optimization of application and network performance.

♦ **Support for Multi-Cloud**: Organizations are increasingly adopting multi-cloud architecture strategy where applications run on the multiple cloud platforms (IaaS), such as Amazon Web Services (AWS), Microsoft Azure, Google Cloud, and such others. Thereby organizations are required to manage multiple private clouds, public cloud, and SaaS platforms to enable applications to run on the most appropriate platform with the optimized user experience. SD-WAN vendors are increasingly partnering with leading IaaS platforms for a reliable and secure SD-WAN connectivity to SaaS and cloud applications. SD-WAN solution should provide seamless connectivity to multiple clouds and SaaS platforms based on the organization's business policies with traffic steering and application prioritization.

♦ **SD-WAN Vision that Supports Intent-Based Networking Philosophies**: SD-WAN solution is moving past from early adoption to rapid growth stage of the overall product lifecycle. SD-WAN has emerged as a proven solution to optimize application performance based on specific network conditions at any particular point of time. As organizations are looking at embracing the broader concept of intent-based networking systems, SD-WAN solution is expected to evolve and leverage machine learning (ML) and artificial intelligence (AI) technologies to create a self-healing, self-adaptive, and secure networking system. Organizations can further optimize their network based on the dynamic application policy that adapts with time-based on the changing business and technology environment. Leading SD-WAN vendors continue to improve their technology capability to incorporate intelligent automation, comprehensive visibility, and advanced analytics capabilities to support the next generation of networking philosophies.

♦ **Ease of Deployment and Use**: Organizations should evaluate SD-WAN vendors based on the understanding of their network architecture, scalability requirement, existing cloud and SaaS applications, remote sites, workload patterns, and transport models to support a seamless deployment and operations. Users should also look for existing case studies to assess the right model of deployment based on their networking needs and resources. SD-WAN vendors should clearly define the onboarding process for organizations to decide the right SD-WAN deployment.

SPARK Matrix: Software Defined WAN
Strategic Performance Assessment and Ranking

SPARK Matrix provides a visual representation of market participants and provides strategic insights on how each supplier ranks related to their competitors, concerning various performance parameters based on the category of technology excellence and customer impact. Quadrant's Competitive Landscape Analysis is a useful planning guide for strategic decision makings, such as finding M&A prospects, partnership, geographical expansion, portfolio expansion, and similar others.

Figure: 2019 SPARK Matrix
(Strategic Performance Assessment and Ranking)
Software Defined WAN Market
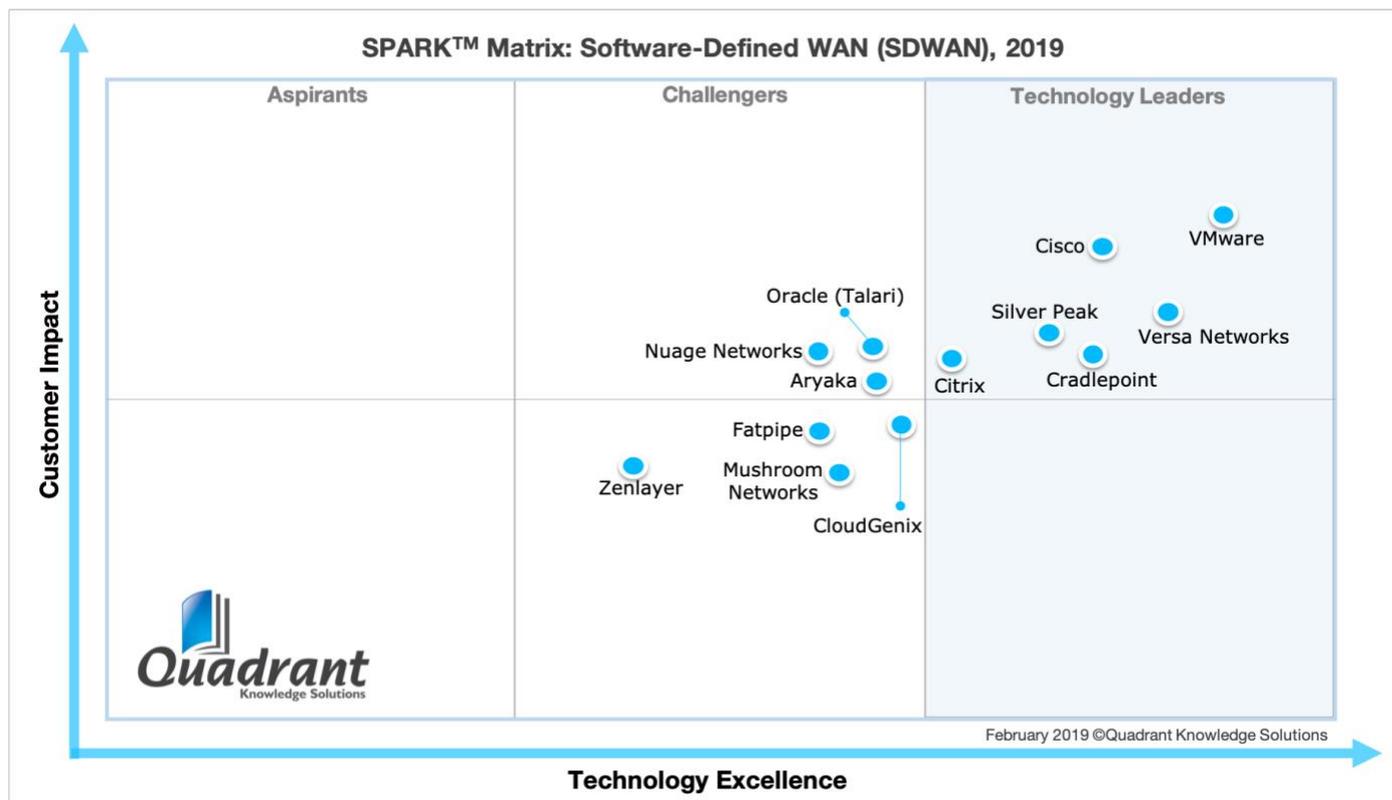
Leading Vendors Profile

Following are the profiles of leading SD-WAN vendors with a global impact. Quadrant research team derived this information from the company's website, whitepapers, and discussions with senior executives. A detailed vendor profile and analysis along with various competitive scenarios is available as a custom research deliverable to our clients. Users are advised to directly speak to respective vendors for a more comprehensive understanding of their technology capabilities. Users are encouraged to consult Quadrant Knowledge Solutions before making any purchase decisions, regarding SD-WAN solutions and vendors, based on research findings included in this research service.

VMware

Founded in 2012, VeloCloud was acquired by VMware in December 2017. VMware is headquartered in Palo Alto, California, USA. VMware SD-WAN by VeloCloud solution consists of VMware SD-WAN Edge, VMware SD-WAN Gateways, and VMware SD-WAN Orchestrator. VMware SD-WAN Edge is a compact and zero-touch enterprise-grade appliance that provides optimized and secured connections to applications and data. With Dynamic Multi-Path Optimization (DMPO) and deep application recognition (DAR), VMware SD-WAN Edge aggregates multiple links and performs application steering over the optimal WAN link, to ensure the end to end quality of services. It is also available as a virtual network function (VNF) for installation on a virtual CPE platform. VMware SD-WAN operates a global system of SD-WAN Gateways, deployed at top-tier cloud data centres, to provide optimized data paths to all applications, branches and data centres along with the ability to deliver network services from the cloud. VMware SD-WAN Gateways implement DMPO, cloud VPN, and Multisource Inbound QoS between global cloud services, and each VMware SD-WAN Edge to enable multiple broadband and private lease lines to appear as a single, high-performance WAN. VMware SD-WAN Orchestrator provides the capability for enterprise-wide business policy definition, configuration, service insertion, and real-time monitoring and analysis of application performance.

Key Strengths:

♦ VMware with its comprehensive solution portfolio has received strong ratings for its sophisticated technology platform, competitive differentiation strategy, product performance, ease of deployment & use, and overall customer impact. Based on the strong overall ratings, VMware has emerged as the clear leader in the global SD-WAN technology market.

♦ VMware SD-WAN with dynamic multi-path optimization and deep application recognition capabilities significantly improves application performance and availability by aggregating multiple available links, including broadband internet, 4G-LTE, and MPLS circuits and steering traffic over the most optimal link.

♦ VMware provides automation and orchestration capabilities to enable zero-touch branch deployment and policy-based centralized orchestration to simplify branch networking and management.

Versa Networks

Founded in 2012 and headquartered in Santa Clara, California, USA, Versa Network is amongst the early innovators and offers NFV-based SD-WAN and SD-security solution. Versa is unique among software-defined networking vendors, providing an end-to-end solution that both simplifies and secures the WAN/branch office network. Based completely on software, Versa's Cloud IP Platform delivers key capabilities for operating managed services cost-effectively and efficiently: full multi-tenancy from data center/cloud to the branch office, rich service chaining (Versa and third party), and zero-touch provisioning for all networking and security functions. Versa's software solution can be deployed on white box, grey box as well as Versa appliances. Versa's white box and its own appliances can be deployed as uCPE to host third party VNFs. In such a scenario Versa OS and its SD-WAN and Security services are running bare metal while the third party VNF's are running virtualized resulting in best performance with least latency for data path.

The company is known for its platform-level solution that supports the needs of large enterprise and communication service providers (CSPs) around the world. Versa Networks SD-WAN capabilities include Versa FlexVNF, Versa Director, and Versa Analytics. Versa FlexVNF is a multi-service, multi-tenant software platform that enables customers to deploy a fully software-defined secure branch (SD-Branch) with wide range of software-defined solutions, including SD-Routing, SD-Security, Secure SD-WAN and LTE/Wi-Fi connectivity.   in a single unified software platform coupled with low-cost hardware. The Versa FlexVNF can also be used as a SD-WAN/MPLS gateway to provide interoperability of MPLS and SD-WAN networks. All network and security components are centrally managed through the Versa Director, single pane of glass for complete life-cycle multi-tenant management and real-time monitoring of all services. a Versa Director is, management and service creation platform that simplifies the creation, automation and delivery of network and security services along with monitoring them. Versa Analytics is a purpose-build multi-tenant scalable big data platform for real-time and historical insights of networking, application and security services., prediction and feedback loop for adaptability. Versa Analytics provides contextual visibility for application, user, device and location, baselining, correlation, and predictive analytics for the network, application usage, trends, network and security events. It can be integrated into third-party systems.

Key Strengths:

♦ Versa Networks with its comprehensive SD-WAN capabilities and technology strategy has received strong ratings for its sophisticated technology platform, application diversity, competitive differentiation strategy, and overall customer impact. With its strong overall ratings, Versa Networks is positioned as the top three technology leaders in the 2019 SPARK Matrix.

♦ Versa Networks continue to differentiate with its innovative technology offerings and unique positioning for offering beyond SD-WAN capabilities, including SD-Security and SD-Branch solution to deliver agile and secure software-based infrastructure for the entire branch.

♦ The company, with its unified platform and strong managed service portfolio, has partnered with a large number of tier-1 service providers across geographic locations.

Cisco

In 2017, Cisco acquired Viptela, a major SD-WAN specialist, to offer cloud-based SD-WAN solution. Cisco has been positioned amongst the technology leaders in the global market. Cisco's leadership positioning is primarily driven by the integration of Viptela's SD-WAN solution into its enterprise routing platform. Cisco SD-WAN solution is built on SDN principles to create a secure overlay network that separates management-plane, control-plane, and data-plane. Cisco SD-WAN solution includes Cisco vManage, vSmart Controller, and vBond Orchestrator. The Cisco vManage is a GUI-based centralized management and provisioning platform for Cisco SD-WAN infrastructure. Users log in to vManage to centrally manage all aspects of the WAN from provisioning, monitoring, and upgrading routers to application visibility and troubleshooting the WAN. vSmart Controllers provides secure connectivity between SD-WAN branches to implement routing and security policies. The centralized policy engine in vSmart provides policy constructs to manipulate routing information, access control, segmentation, extranets, and service chaining. Cisco vBond orchestrator performs initial authentication and authorization of all elements into the network. Cisco vBond provides information on how each of the components connects to other components. Cisco SD-WAN provides security capabilities including application-aware enterprise firewall, intrusion prevention, DNS layer enforcement, and URL filtering. Cisco also offers Meraki SD-WAN solution as an all-in-one SD-WAN and security solution for lean IT environments.

Key Strengths

♦ Cisco has one of the largest installed base of its networking hardware amongst the large enterprise customers across geographical regions. The company with its strong SD-WAN product capabilities is gaining significant market share in the SD-

WAN market leveraging upsell opportunities as well as acquiring new enterprise customers.

♦ Cisco offers a comprehensive technology platform with comprehensive SD-WAN functionalities and provides a superior customer value proposition. Cisco with strong overall ratings has been positioned as the top three technology leaders in the 2019 SPARK Matrix for SD-WAN market.

♦ Cisco continues to focus on improving advanced SD-WAN capabilities and integrating functionalities to support improved automation, WAN optimization, enhanced network security, enhanced technology integration, and such others.

Cradlepoint

Founded in 2006 and headquartered in Idaho, USA, Cradlepoint is amongst the major vendors of cloud-delivered edge solutions for cellular connectivity including 4G LTE and 5G enabled branch, mobile, and IoT networks. Cradlepoint, with its comprehensive technology value proposition, is positioned amongst the technology leaders in the global SD-WAN market. Cradlepoint offers the NetCloud platform with its integrated components of NetCloud Manager and NetCloud OS for SD-WAN to enable seamless connectivity, security, and network management. NetCloud Manager provides a single pane of glass to deploy and dynamically manage networks at geographically distributed locations rapidly. It provides zero-touch deployment to enable remote deployment and management of network devices. Network administrators can monitor their device performance and status in real-time for optimized usage and cost management of cellular connectivity. NetCloud Manager also provides WAN/LAN analytics and visibility to manage data usage, performance, and costs. NetCloud OS delivers advanced routing and security features for the branch, mobile, and M2M/IoT. It provides advanced VPN and encryption features to secure the organization's networks supporting IKEv2 protocol for mobile and Suite B compliance for advanced encryption. It provides SD-WAN functionalities including connection manager, smart WAN selection, and auto QoS optimized for multi-WAN deployments combining wired and LTE to enable automated management and application reliability.

Key Strengths

♦ Cradlepoint, with its advanced SD-WAN strategy, has received strong ratings for its sophisticated technology platform, competitive differentiation strategy, and overall customer impact. With its strong overall ratings, Cradlepoint is positioned amongst the technology leaders in the 2019 SPARK Matrix of the global SD-WAN market.

♦ Cradlepoint SD-WAN offerings are uniquely positioned for branch, mobility, and IoT-specific use cases. The company's technology strategy is primarily focused on

cellular connectivity and support for advanced LTE and 4G/5G connectivity for branch connectivity.

♦ Cradlepoint is well positioned for IoT-specific use cases. The company offers NetCloud Perimeter service to securely connect M2M and IoT devices to enterprise networks leveraging automated PKI, advanced encryption, admission control, and a private IP address space.

Silver Peak

Founded in 2004 and headquartered in Santa Clara, California, USA, Silver Peak is leading WAN optimization vendor and has launched its Unity EdgeConnect SD-WAN solution in June 2015. EdgeConnect is a unified SD-WAN edge platform that includes integrated components Unity EdgeConnect, Unity Orchestrator, and Unity Boost. Unity EdgeConnect physical or virtual appliance is deployed in branch offices to create a secure, virtual network overlay. This enables organizations to move to a broadband WAN either site-by-site or via a hybrid WAN that leverages MPLS and broadband internet connectivity. Unity Orchestrator, included with EdgeConnect, enables zero-touch provisioning of EdgeConnect appliances in the branch. It provides centralized network visibility for both legacy and cloud applications and automates the assignment of business intent policies to secure and control all WAN traffic. Policy automation accelerates and simplifies the deployment of multiple branch offices. Unity Boost is an optional performance pack that service chains WAN optimization to the EdgeConnect SD-WAN solution. Unity Boost helps companies accelerate the performance of latency-sensitive applications and minimize transmission of repetitive data across WAN.

Key Strengths

♦ Silver Peak unified platform approach of integrating SD-WAN, WAN optimization, routing, WAN path conditioning, and security functions is well received amongst enterprise customers looking at transforming their networking infrastructure.

♦ Silver peak is getting increasing market traction amongst mid-sized and large enterprise customers leveraging its existing customer and channel-partner networks. The company is currently transforming its value proposition from its traditional WAN optimization focus to offer advanced SD-WAN solution capabilities.

♦ Silver Peak with its strong SD-WAN product value proposition, technology differentiation, and strong customer impact is positioned amongst the top five technology leaders in the 2019 SPARK Matrix of the global SD-WAN market.

Citrix

Headquartered in Santa Clara, California, Citrix is a well-established IT and WAN optimization vendor. The company is currently expanding its customer base beyond its existing Citrix customers. Citrix SD-WAN key capabilities include WAN virtualization, application QoS, dynamic routing, integrated firewall, and WAN optimization functionality. Citrix WAN virtualization creates a reliable WAN from a diverse range of network links including MPLS, broadband, and wireless. It continuously monitors each connection for loss, latency, jitters, and congestion and mitigates these network issues by moving traffic from poor-performing links for consistent application performance. Citrix SD-WAN includes application QoS that uses deep packet inspection technology to categorize applications and application elements with different priorities and bandwidths. Leveraging granular application awareness and network intelligence, Citrix SD-WAN solution ensure that the critical applications are prioritized and are routed across the highest quality link. With Dynamic Routing, Citrix SD-WAN can seamlessly participate in organizations routing topology in overlay mode for easy network insertion or operate in edge mode for a streamlined branch network with assured application delivery. Citrix WAN optimization includes features such as TCP flow control, data compression, de-duplication and protocol optimization to improve end-user experience and reduce WAN bandwidth expenses. With dynamic routing and branch simplification. Citrix SD-WAN includes an integrated firewall to provide multi-faceted data protection to the network. The firewall integrates with the application QoS to allow security policies to be defined centrally allowing IT to limit access by application or application elements. It also provides strong encryption as data crosses public and private networks while integrating with cloud web gateways.

Key Strengths

- ♦ Citrix is growing its SD-WAN market presence with successful upsell opportunities from its existing installed base of networking and WAN optimization deployments and leveraging its sales channel to offer SD-WAN solution with the product value proposition of integrated routing and WAN optimization capabilities.
- ♦ With its strong technology capability and customer value proposition, Citrix has received strong overall ratings for technology excellence and customer impact and has been positioned in the leadership section of the 2019 SPARK Matrix of the SD-WAN market.

Research Methodologies

Quadrant Knowledge Solutions uses a comprehensive approach to conduct global market outlook research for various technologies. Quadrant's research approach provides our analysts with the most effective framework to identify market and technology trends and helps in formulating meaningful growth strategies for our clients. All the sections of our research report are prepared with a considerable amount of time and thought process before moving on to the next step. Following is the brief description of the major sections of our research methodologies.
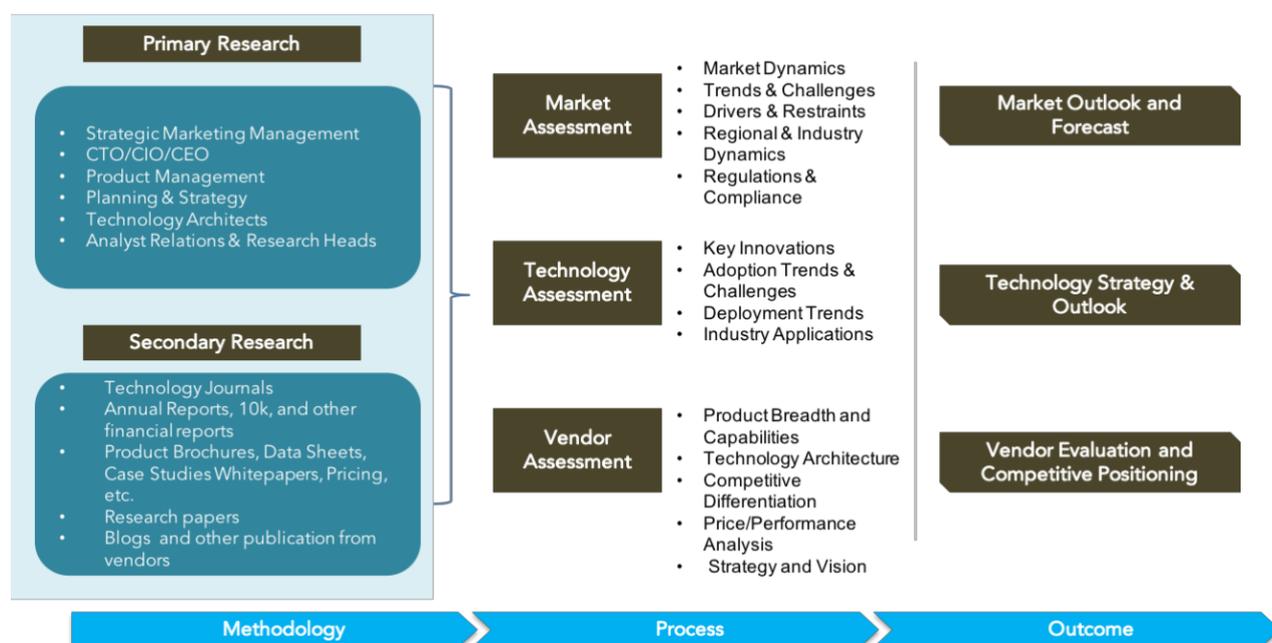
Secondary Research

Following are the major sources of information for conducting secondary research:

Quadrant's Internal Database

Quadrant Knowledge Solutions maintains a proprietary database in several technology marketplaces. This database provides our analyst with an adequate foundation to kick-start the research project. This database includes information from the following sources:

- Annual reports and other financial reports
- Industry participant lists
- Published secondary data on companies and their products
- Database of market sizes and forecast data for different market segments
- Major market and technology trends

Literature Research

Quadrant Knowledge Solutions leverages on several magazine subscriptions and other publications that cover the wide range of subjects related to technology research. We also use the extensive library of directories and Journals on various technology domains. Our analysts use blog posts, whitepaper, case studies, and other literature published by major technology vendors, online experts, and industry news publications.

Inputs from Industry Participants

Quadrant analysts collect relevant documents such as a whitepaper, brochures, case studies, price lists, datasheet, and other reports from all major industry participants.

Primary Research

Quadrant analysts use a two-step process for conducting primary research that helps us in capturing meaningful and most accurate market information. Below is the two-step process of our primary research:

Market Estimation: Based on the top-down and bottom-up approach, our analyst analyses all industry participants to estimate their business in the technology market for various market segments. We also seek information and verification of client business performance as part of our primary research interviews or through a detailed market questionnaire. Quadrant research team conducts a detailed analysis of the comments and inputs provided by the industry participants.

Client Interview: Quadrant analyst team conducts a detailed telephonic interview of all major industry participants to get their perspectives of the current and future market dynamics. Our analyst also gets their first-hand experience with the vendor's product demo to understand their technology capabilities, user experience, product features, and other aspects. Based on the requirements, Quadrant analysts interview with more than one person from each of the market participants to verify the accuracy of the information provided. We typically engage with client personnel in one of the following functions:

- Strategic Marketing Management
- Product Management
- Product Planning
- Planning & Strategy

Feedback from Channel Partners and End Users

Quadrant research team researches with various sales channel partners including distributors, system integrators, and consultants to understand the detailed perspective of the market. Our analysts also get feedback from end users from multiple industries and geographical regions to understand key issues, technology trends, and supplier capabilities in the technology market.

Data Analysis: Market Forecast & Competition Analysis

Quadrant's analysts' team gathers all the necessary information from secondary research and primary research to a computer database. These databases are then analyzed, verified, and cross-tabulated in numerous ways to get the right picture of the overall market and its segments. After analyzing all the market data, industry trends, market trends, technology trends, and key issues, we prepare preliminary market forecasts. This preliminary market forecast is tested against several market scenarios, economic scenario, industry trends, and economic dynamics. Finally, the analyst team arrives at the most accurate forecast scenario for the overall market and its segments.

In addition to market forecasts, our team conducts a detailed review of industry participants to prepare competitive landscape and market positioning analysis for the overall market as well as for various market segments.

SPARK™ Matrix: Strategic Performance Assessment and Ranking

Quadrant Knowledge Solutions' SPARK Matrix provides a snapshot of the market positioning of the key market participants. SPARK Matrix representation provides a visual representation of market participants and provides strategic insights on how each supplier ranks in comparison to their competitors, concerning various performance parameters based on the category of technology excellence and customer impact.

Each market participants are analyzed against several parameters of Technology Excellence and Customer Impact. In each of the parameters (see charts), an index is

Competitive Factor Analysis – Technology Excellence						
	Sophistication of Technology	Technology Application Diversity	Scalability	Competitive Differentiation & Strategy	Industry Impact	Final Rating
Weightages	20%	20%	20%	20%	20%	100%
Leader						
Competitor 1						
Competitor 2						
Competitor 3						

Source: Quadrant Knowledge Solutions

Competitive Factor Analysis – Customer Impact						
	Addressing Unmet Needs	Product Performance	Proven Record	Ease of Deployment	Customer Service Excellence	Final Rating
Weightages	20%	20%	20%	20%	20%	100%
Leader						
Competitor 1						
Competitor 2						
Competitor 3						

Source: Quadrant Knowledge Solutions

assigned to each supplier from 1 (lowest) to 10 (highest). These ratings are designated to each market participant based on the research findings. Based on the individual participant ratings, X and Y coordinate values are calculated. These coordinates are finally used to make SPARK Matrix.

Final Report Preparation

After finalization of market analysis and forecasts, our analyst prepares necessary graphs, charts, and table to get further insights and preparation of the final research report. Our final research report includes information including market forecast; competitive analysis; major market & technology trends; market drivers; vendor profiles, and such others.