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SD-WAN and SASE Enterprise Brief

An Exclusive by AvidThink for the ONUG Community

Software-defined wide-area networking (SD-WAN) and Secure Access Service Edge (SASE) have dominated enterprise wide-area and remote connectivity conversations for the past few years. Since the creation of the category a few years ago, wide swaths of vendors have jumped aboard — both traditional networking and security vendors, as well as a raft of upstarts and new entrants.

In this AvidThink Enterprise Brief, our analysts have extracted enterprise-relevant highlights and key observations from our recent SD-WAN and SASE report. While the market continues to evolve rapidly, we believe that many of our findings will prove useful to corporate IT leadership and their teams. Feedback is always welcome at research@avidthink.com.

SD-WAN and SASE Key Takeaways

Software-defined wide-area networking (SD-WAN) has been the star of the networking world for several years. Still, nothing prepared vendors, service providers, and customers for the explosion in interest and sales that followed the arrival of the pandemic. The last two years represent a unique turning point for SD-WAN because of the shift in enterprise networking endpoints from branch to home and SD-WAN's expansion to Secure Access Service Edge (SASE). SD-WAN and the broader category of enterprise end-to-end connectivity are evolving rapidly.

Macro Enterprise Trends

- **Working from anywhere:** The COVID-19 pandemic will have a long-term impact on enterprise IT. Enterprise end-to-end connectivity is evolving rapidly, not least because of the shift in enterprise networking endpoints from the office to the home. As a result, enterprises are increasingly embracing software-defined wide-area networking (SD-WAN) and secure access service edge (SASE) to ensure they have secure, cloud-based access for all employees, no matter where they are.
- **The move to the cloud:** According to Flexera, 90% of enterprises expect their cloud usage to increase due to COVID-19, with 36% of respondents spending more than $12 million per year on public clouds. Further, 92% reported having multiple clouds, and 82% have gone hybrid, combining public and private cloud use.This multi-cloud trend means that SD-WAN and SASE solutions need to improve secure connectivity to enterprise workloads in public and private clouds, supporting virtual gateways and high-performance backbone access to multiple public cloud locations.
- **Security threats and IoT:** As expected, the number and severity of threats continue to rise, and CISOs worldwide are understandably nervous. Rising threats make SD-WAN/SASE upgrades to enterprise WAN appealing, assuming these solutions don't come with new vulnerabilities. For instance, CISOs are experiencing increasing ransomware attacks, which, when combined with expansion of corporate networks to cover employees' homes, drive a growing demand for enterprise edge security solutions. A move to SASE helps protect the edge and remote access areas of the enterprise network with managed services. Meanwhile, IoT continues to be an area of investment for enterprises, adding to complexity in securing low-power devices that seldom have security as their number one design goal. IoT devices will increasingly utilize mobile 5G and SASE. When applied to mobile traffic, this is something enterprises need to consider as part of their strategies.
- **Popularity of network-as-a-service (NaaS):** NaaS options that bundle SD-WAN and network security features with a globally distributed fleet of POPs connecting to a private network backbone are gaining favor as CIOs continue to outsource non-core, non-strategic, IT functions and embrace the as-a-service movement.
- **Digital transformation and mobile-first strategies:** These remain strategic imperatives for enterprises as they seek to become digitally able and agile organizations while adopting a mobile-first approach to enterprise connectivity.

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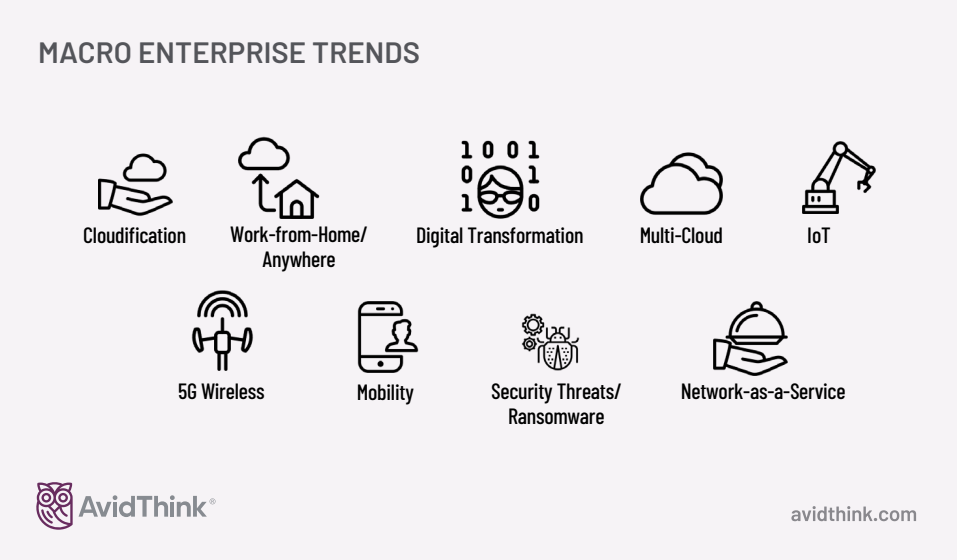
As 5G becomes increasingly available to enterprises, new capabilities will become unlocked that will enable them to rethink connectivity options. Emerging 5G-based fixed wireless access (FWA) offerings can serve as enterprise-grade WANs by leveraging SD-WAN's redundancy, security, packet optimization, and QoS features. 5G FWA can also provide connectivity for employees both at home and across branch offices. Thus, secure mobile access will become a crucial part of future SD-WAN or SASE offerings to protect these remote locations.



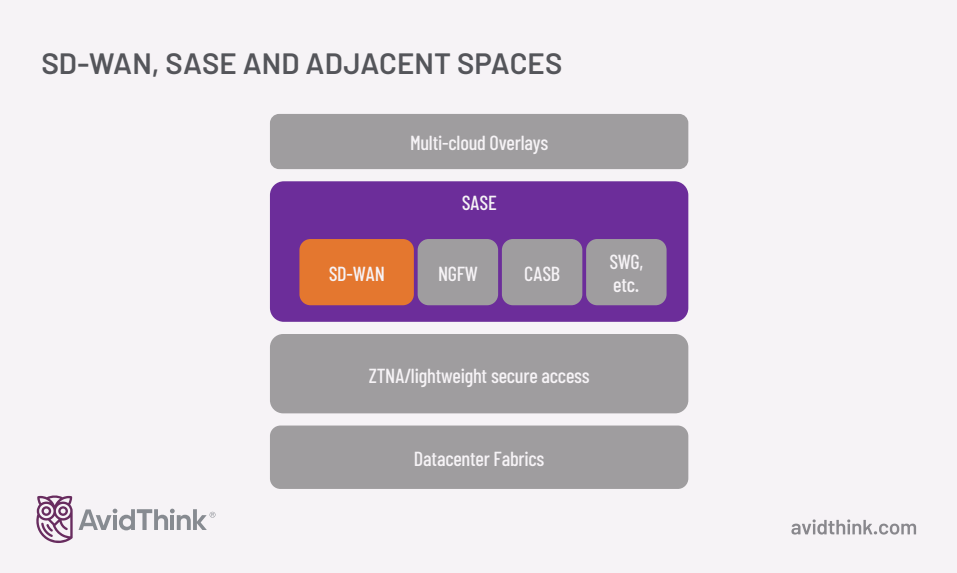
SD-WAN and SASE: Enterprise Market Landscape

SD-WAN has been the star of the networking world for several years and is evolving rapidly. Notably, 2020 proved to be a significant turning point because of the shift in enterprise networking endpoints from branch to home and SD-WAN's expansion to SASE.

In 2019, Gartner estimated that enterprise spending on managed SD-WAN services would hit $5.7 billion in 2023, growing at an annual rate of 76.1% as most enterprises adopt SD-WAN. Indeed, Gartner expected that, within three years, 60% of all new enterprise-managed WAN deployments would include SD-WAN. However, it should be noted that these projections predate the disruptive events of 2020.

SASE is expected to span both small and large enterprises as the recent, sudden shift to remote work accelerates adoption by all organizations. SASE builds on SD-WAN by adding multiple enterprise edge security services. While Gartner's list of services is long, for most enterprises the relevant ones are **secure web gateway** (SWG), an L7 proxy that augments L3 firewalls by inspecting and filtering Web traffic to block malware and content that violates enterprise policies; next-generation **firewall-as-a-service** (FWaaS), which replaces traditional router- or appliance-based

firewalls with virtual equivalents that can be inserted anywhere in the network; **cloud access security broker** (CASB), which supplements an SWG; and **zero-trust network access** (ZTNA), which replaces tunnel-based VPN encryption-authentication with a granular, distributed set of user- and application-specific controls.



The COVID-19 crisis, combined with the advent of SASE, promises the third phase in the SD-WAN story. Organizations are rapidly adapting enterprise networks to the new reality of the uber-distributed workforce. They are grabbing any available broadband option and relying on a mix of cloud services and on-premises systems. The pandemic has catalyzed technology developments propelled by the tailwind of increased sales.

Vendor Landscape

There is a growing roster of prominent SD-WAN and SASE vendors, including Aryaka, Barracuda Networks, Cato Networks, Cisco, Extreme Networks, Forcepoint, Fortinet, Juniper Networks, Masergy, Netskope, Palo Alto Networks, Silver Peak (HPE), Versa Networks, VMware, and Zscaler.

While SASE represents the most significant shift in the SD-WAN market to date, further changes in the market are ahead, including multi-cloud connectivity solutions (Aviatrix, Alkira, Prosimo) and secure fabric offerings (based on ZTNA) that are now popular in the IoT sphere.

Enterprise Guidance

Corporate budgets are tight, and IT spending will need to prioritize SD-WAN, SASE, and network/cloud services that allow uninterrupted business operations (lessons we have learned from the recent pandemic). However, it is critical to focus on business needs and not be dazzled by the kaleidoscope of available technologies.

At the same time, enterprises face several choices as they plan their SD-WAN/SASE strategies:

- How to procure and deliver SASE/SD-WAN services, whether from internal infrastructure, a carrier, or as-a-service from an OTT player
- How to structure SASE/SD-WAN projects and service introductions and balance planning rigor and overhead against achieving rapid ROI

There are two broad strategies: the big bang of simultaneously attacking problems across business units and solution domains, such as cloud and remote access; or the tactical attack of focusing on the most pressing challenges in particular areas. The right answer varies by organization, but it involves a mix of strategic planning and tactical implementation.

Enterprises should ensure they keep a watch on new emerging trends as they plan their strategies for the years ahead. Some noteworthy trends:

- Service providers are tying SD-WAN offerings with secure backends, which is expected to play a role in the move to mobile SASE.
- ZTNA continues to gain prominence, showing up across multiple SD-WAN and SASE vendor offerings.
- With enterprises continuing to adopt multiple public clouds and juggling hybrid clouds (public and private), the importance of having flexible virtual endpoints or gateways that can connect into virtual private clouds (VPCs) cannot be overstated.
- SASE feature-washing, where early products are little more than a set of existing offerings cobbled together through NFV service chains and lumped under a single management user interface, is something to be aware of — chaining together legacy products does not result in a compelling or efficient offering long-term and adds unnecessary latency.
- As 5G becomes increasingly available and more employees work from home, secure mobile access will be crucial to protecting remote locations. SASE, as it applies to mobile, should form part of enterprise strategies.

SASE is an opportunity for vendors and enterprises to rethink enterprise network security from the ground up. Enterprises should look for innovative thinkers building on a new foundation for the new breed of enterprise edge networking and security solutions.

Read the full report for additional in-depth analysis on SD-WAN and SASE.

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AvidThink Enterprise Brief

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Private Mobile Networks Enterprise Brief

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The AvidThink Enterprise Brief series provides easy-to-read short takeaways extracted from our **Research Briefs on infrastructure technologies**. For busy business and technology executives, we highlight key trends and important insights to help you understand their relevance and provide suggestions on the best way to evaluate and engage these new technologies.

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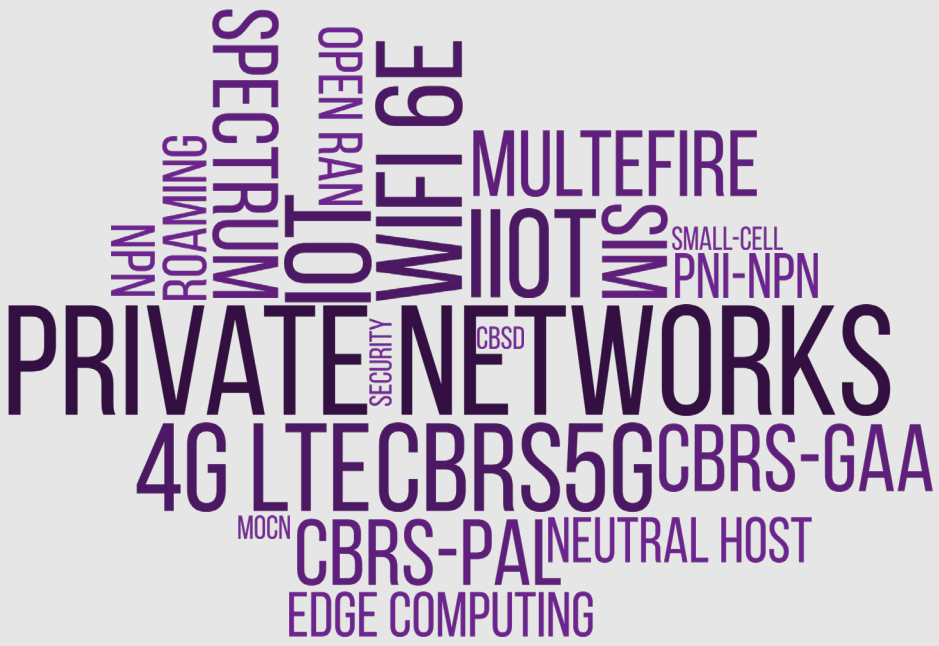

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Private Mobile Networks Key Takeaways

The arrival of 5G for public mobile networks has also ignited interest in the use of mobile technologies in dedicated private networks for enterprise use (including state and local government and educational institutions). With improved coverage, reliability, and consistency, plus potentially better security, 5G and 4G LTE technologies are being tapped to augment existing WiFi networks and replace legacy wired networks. While nascent, private 5G shows promise as the next big networking advancement in enterprise networking.

General Trends Driving Interest in Private Mobile Networks

- **5G vs WiFi:** The arrival of 5G has brought opportunity to enterprise private mobile networks (also called non-public networks or NPN in 3GPP specifications) with hundreds of enterprises, municipalities, and educational educations rolling out both private 4G LTE and 5G networks. Cellular technologies provide the reliability, security, performance, and user experience that many enterprise use cases demand but wired ethernet and WiFi cannot deliver. However, both access technologies will coexist for the foreseeable future. The focus will be on what use cases each will serve and how to seamlessly integrate both in a way that supports enterprise IT initiatives.
- **Digital transformation:** Digitization of the industry can unlock additional value through improved analytics, lower operational costs, increase agility, and reduce time-to-market. This was further reinforced during the pandemic, as evidenced by the varied performance of different businesses during this time. Digital-heavy companies proved more resilient than their counterparts, regardless of industry sectors.
- **IoT and IIoT:** The adoption of internet of things (IoT) and industrial IoT (IIoT) platforms. Many manufacturing, logistics, and supply chain-related enterprises are converting devices and production processes to digital forms (IIoT devices) to be programmed, observed, managed, and optimized via digital automation.
- **Mobile first:** Work from home (WFH) and work from anywhere (WFA) initiatives accelerated dramatically during the pandemic and are now accepted as usual for many enterprises. A tenet of WFH and WFA is enterprise mobility — the use of mobile technologies to ensure that employees are always connected.
- **Edge computing:** Many enterprises have adopted cloud computing but still have applications that remain on-premises. For workloads that generate a large amount of onsite data or that might be located in hard-to-reach places (e.g., oil rig in the ocean, remote mining operation), the high cost of data transfers to the cloud might mandate the use of local computing. This is where edge computing — the use of cloud computing principles and technology in a local context — comes into play.
- **Spectrum:** Enterprise-friendly licensing schemes are available in some markets, most notably in Germany. In the United States, a shared spectrum scheme, the Citizens Broadband Radio Service (CBRS), provides for a general authorized access (GAA) tier that's available to everyone, a county-by-county priority access license. The availability of 5G NR-U (5G unlicensed bands) will also help drive enterprise adoption of private 5G and 4G.

For more in-depth analysis, read the full report.

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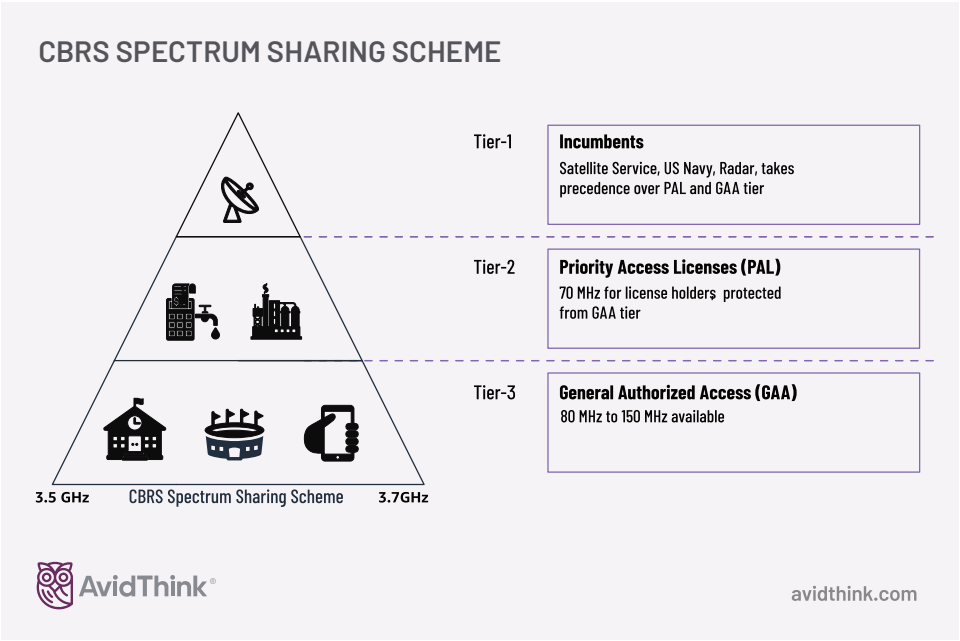
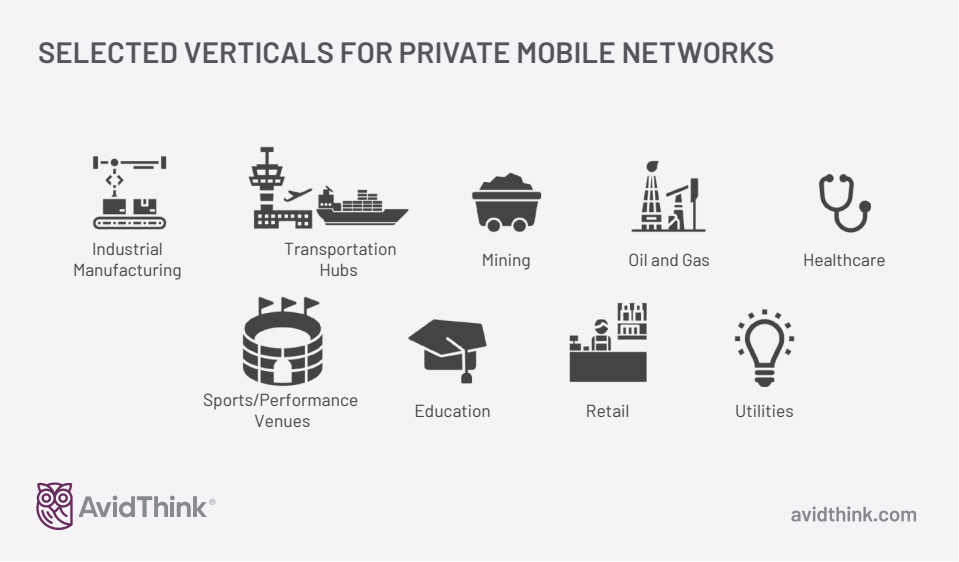


Private Mobile Networks: Enterprise Market Landscape

- The impact of private mobile networks on the enterprise connectivity market will be significant. The projected CAGR over the next few years ranges from 17% to 37%, with revenue estimates in 2027 spanning $5B to $12B.
- IDC measured WLAN revenue at $6.35B worldwide in 2020. AvidThink expects the private mobile network market to rival and potentially surpass that of the enterprise WLAN market. As discussed, private 5G (and 4G LTE) will not supplant WiFi but instead complement it.
- A number of vertical sectors are embracing private mobile networks in the early phases, with some obvious benefits. These sectors include:
    - **industrial manufacturing**, where the rollout of industrial IoT and the digitization and automation of previously manual processes require a reliable network fabric;
    - **transportation hubs**, where private mobile technologies provide improved range and penetration in shipping ports, airports, and transportation hubs;
    - **mining**, a popular industry for private networks in regions and countries like South America, South and West Africa, China, and Australia;
    - **oil and gas**, which like the mining industry operate in remote locations that sometimes have poor or no mobile coverage;
    - **healthcare**, which has a need for reliable and more secure connectivity across hospital campuses, tying together internet of medical things (IoMT) devices with edge computing stacks that provide analytics;
    - **sports arenas and performance venues**, where private 5G networks promise higher capacity and increased density;

- **education**, where private networks appeal to IT departments and also offer an alternative to keep lower-income students connected to the internet;
- **retail**, with use cases including surveillance, IoT sensors that aid with health and safety checks or that assist with inventory;
- **utilities**, which use private networks for critical sensor traffic, process and operational controls, video surveillance, and communications.



Vendor Landscape

- Major public mobile vendors including Ericsson, Huawei, Nokia are facing competition from other established firms such as NEC, Fujitsu, and Samsung in vying for the private mobile market.
- Other aggressive market entrants include Acceleran, Airspan, Altiostar, ASOCS, Celona, Expeto Networks, Federated Wireless, JMA Wireless, Mavenir, Parallel Wireless, Sercom, and Tango Networks. More players will enter the private mobile networks fray, particularly open RAN and ORAN-compliant solutions.
- Hyperscalers like Amazon Web Services (AWS) are touting their integration with private mobile networks and Microsoft Azure acquired mobile core provider, Affirmed Networks, and a mobile communications stack vendor, Metaswitch, hoping to provide enterprises with integrated private wireless solutions. There will be ongoing collaboration between the hyperscalers and mobile network operators (MNOs) but hyperscalers will also take a direct path into the enterprise market.
- MNOs and global system integrators (GSIs) are jumping into the fray, offering managed private mobile networks as a service. MNOs will continue to engage their customers in private 5G/LTE conversations, but they need to revisit business models and be more creative.
- Other vendors in the value chain see opportunity in both private networks and public networks, given the trends of disaggregation and open RAN. Innovations are rapid, including improved silicon from vendors like AMD/Xilinx, ADI, Broadcom, EdgeQ, Ericsson, Intel, Marvell, Nokia, Qorvo, Qualcomm, and Samsung.

- Orchestration and software vendors are simplifying their software stacks and optimizing them for open RAN in both private and public settings
- Vendors that have embraced disaggregation and open RAN are using the private mobile network as a route to market. These include RAN and core vendors and orchestration vendors, and integrated edge stacks, plus virtualization vendors like VMware and Red Hat, and newer Kubernetes-distribution vendors.

Guidance for Enterprises Looking to Deploy Private Mobile Networks

- **Skilling up:** Complexities in deploying private mobile networks need to be resolved, including a lack of skills and expertise in integrating enterprise IT with mobile infrastructure. There are numerous opportunities for improvement here, both on the enterprise and the supplier side.
- **Timely investment:** Enterprises looking for private mobile network solutions should do their homework in understanding the nature and pace of innovation in this arena, and time their investments appropriately to maximize return on capital. Due diligence is required as they evaluate options, and map their business needs to the offerings available.
- **Do your research:** As the ultimate end-user, it's important to be educated prior to making a decision. There are use cases for which private 4G LTE is a natural choice — transportation hubs, mining, manufacturing — and enough successful deployments to warrant early investment. Private 5G (versus 4G LTE) is still early and the ROI model is not yet proven. That could change rapidly over the next twelve to eighteen months as new solutions arrive, especially those based on disaggregated, open RAN that promise lower costs.
- **Pick the right partner:** opting for the right deployment partner and managed provider will be a critical decision, and depends on the enterprise and what private network model they deploy.
- **Define the parameters:** many aspects of public mobile networks remain unclear today, and it makes sense for enterprises to ensure they set out clear guidelines in advance. For example, who is going to pay for the infrastructure? Who operates the services and who is liable for service level agreements? How secure is the private network, and does an enterprise require a standalone network deployment or one that is integrated with the public network? Who will support SIM provisioning and identity management, and which devices support the spectrum band that supports the enterprise network?

Read the full report for additional in-depth analysis on private mobile networks.

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Edge Computing Enterprise Brief

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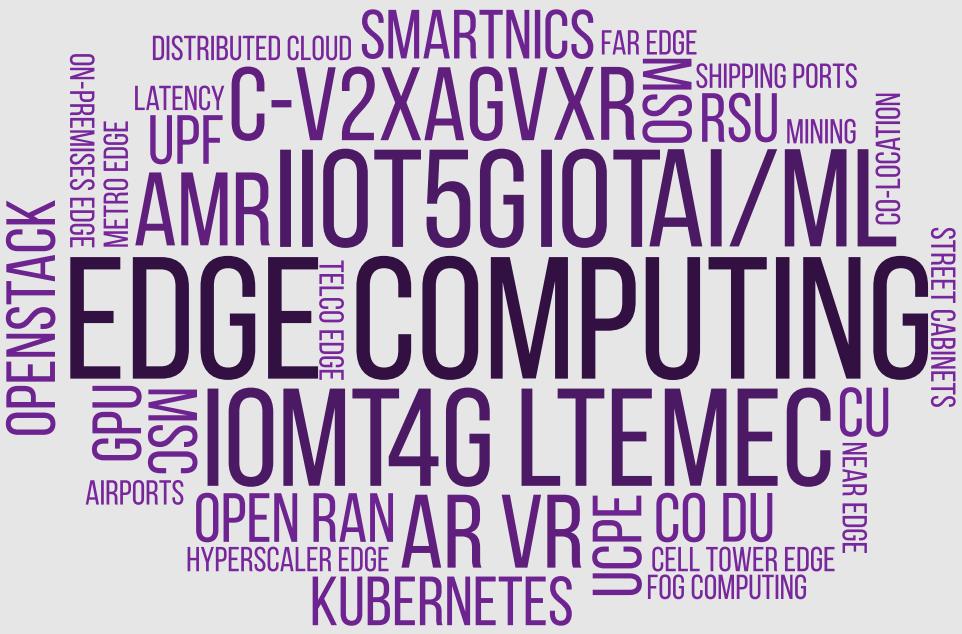

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Edge Computing Key Takeaways

The rise of cloud computing has transformed how businesses operate IT infrastructure and how businesses and consumers alike interact with applications. As part of the evolution of cloud infrastructure, and accelerated by the arrival of 5G wireless, there has been increasing enterprise interest in edge computing, making it one of the hottest topics in IT today.

General Trends

- **Edge computing is a natural evolution** of cloud computing. However, some analysts believe that the edge will be bigger than the cloud market, and that a majority of cloud workloads will migrate to the edge. Thus, estimates of the edge market size vary wildly, going up to tens of billions by 2025, dependent on what is included in that estimate.
- **Data has been called the new oil,** but like oil, data is a raw material, useless until processed. Enterprises now face such a gusher of data that processing using only centralized data centers and cloud infrastructure is impracticable.
- **Enterprise demand** for real-time, low latency applications will require a shift in computing architecture. With the rise of IoT and digital transformation, enterprises will generate the vast majority of data at or near the edge.
- **Edge is distributed computing:** edge infrastructure does not displace centralized systems, but coexists with them. The edge typically refers to more localized data centers, co-location sites, and on-premises enterprise infrastructure that sit outside hyperscale regional clouds.
- **The edge is not dependent on 5G**, and is more than just wireless. However, 5G is dependent on the edge to achieve its full promise of ultra-reliable, low-latency networking.

Edge Computing: Enterprise Landscape

- Enterprises in the digitization era are simultaneously consolidating resources in a few central data centers and cloud facilities, distributing infrastructure to locations that require local, real-time processing and analysis of data with low-latency application response.
- There are two edge areas of relevance to the enterprise:
    - The telco/cloud edge, or the last mile or near last-mile edge close to the enterprise.
    - On-premises edge, the infrastructure equipment located within an enterprise site but managed and operated by a third-party (cloud provider, carrier, system integrator, or other managed service provider).
        - This includes racks or half-racks of computing and storage, customer premises equipment (CPE) in the form of universal CPE (uCPE) for SD-WAN deployments, or remote office/branch office (ROBO) or industrial manufacturing or warehouse servers.

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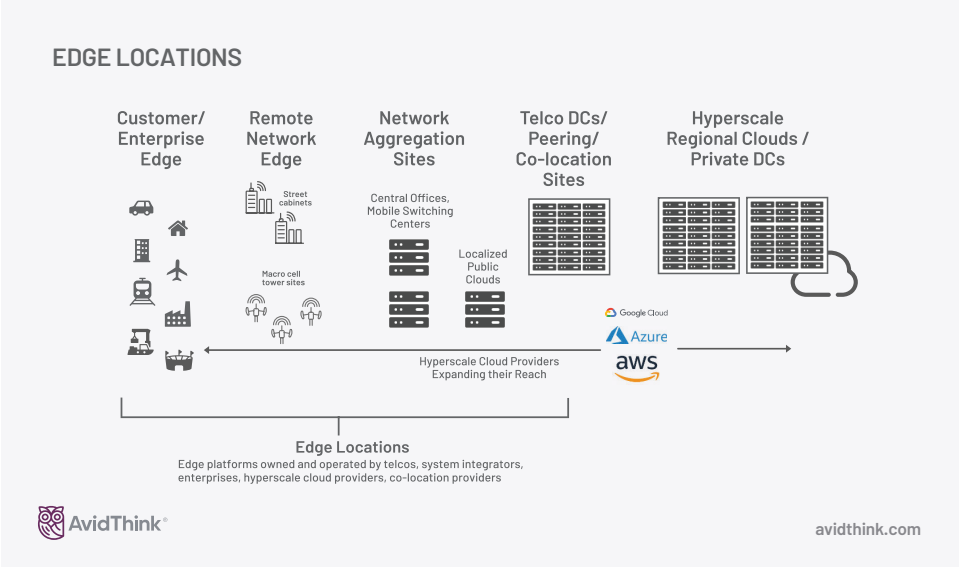
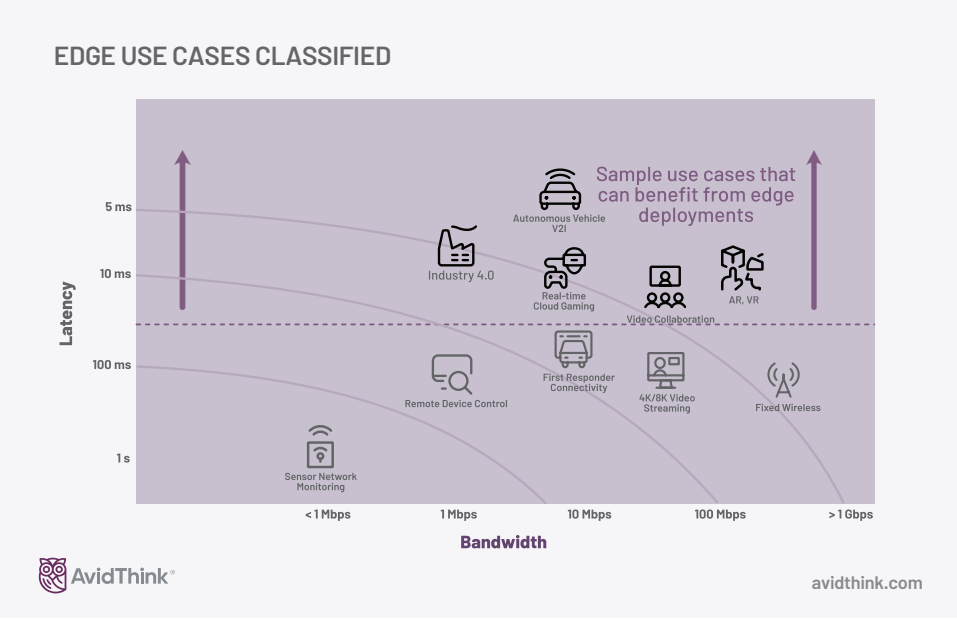


- Enterprise edge infrastructure is most commonly deployed at:
  - Branch locations to run a virtual network and hybrid cloud services like SD-WAN, SASE, enterprise security, and general VM or container platforms.
  - Manufacturing, logistics, and resource extraction sites that target the same network and hybrid cloud services plus data storage and industrial IoT telemetry analysis.
  - Logistics, distribution, and transportation hubs with a workload profile similar to manufacturing sites.
  - Retail and hospitality locations for network services, point-of-sale, video surveillance, IoT workloads.
- Digital natives that primarily provide digital goods and services face the same scaling problems as cloud providers. Indeed, video streaming and online gaming sites are most susceptible to performance degradation from consolidating cloud infrastructure workloads.

Enterprise Edge Use Cases

- The edge, in combination with the central clouds, represents a distributed computing platform. A large proportion of edge applications originating in the enterprise are expected to be extensions of central-cloud-hosted applications.
- One of the key value propositions for on-prem (and potentially near-prem) edge is as a host for running a private network core (both for 4G LTE and 5G).
- Hybrid cloud architecture and the need to balance control, data privacy, and performance in enterprise cloud infrastructure designs and where edge infrastructure provides a hybrid deployment option tuned for low-latency applications and Industry 4.0 manufacturing and logistical processes.

- Low latency application and network services including CDNs, real-time data analysis, deep learning applications, online gaming, and video streaming. The intense competition among online services puts pressure to differentiate based on performance and reliability, both of which can be addressed by scale-out edge infrastructure.
- IoT data analysis where edge infrastructure enables enterprises to use data from intelligent sensors, retail POS terminals, location tracking systems, and other IoT devices to gain competitive advantage by analyzing and acting upon data at its source and in real-time.
- Edge computing and IoT are also the basis for smart city infrastructure, public and private video surveillance systems, and emerging V2X communication and AV systems.



Vendor Landscape

- Efforts at standardizing the edge and frameworks for building applications at the edge continue today as seen by the GSMA's recent Operator Platform project, Akraino from Linux Foundation, StarlingX from OpenStack, and commercial alternatives from MobiledgeX and F5/Volterra.
- Solutions to manage and orchestrate edge platforms, many based on Kubernetes, abound, and include Red Hat's OpenShift, VMware's Telco Cloud Platform, Google's Anthos, and Mutable.io's unique approach that rounds-up idle servers across carriers, MSOs, and hosting companies into a federated edge cloud.

Call to Action

- **Identify enterprise applications** that might benefit from one or more of the attributes of running at the edge, such as latency, security, and privacy, and bandwidth savings.
- Determine if there are any **regulatory and compliance requirements** that impact the application and data being considered for the edge.
- Catalogue and understand the **nature of the application and its components**, as well as where data is generated, processed, consumed, and stored.
- Understand the **underlying topology of locations** involved in data generation, transport, and consumption and map out appropriate edge locations.
- Investigate **available edge platforms** available to the enterprise and determine the best partners in the enterprise's edge strategy.
- Understand the **underlying edge software platforms** and software services the edge platforms provide.
- Economies of scale matter: Work **out all the costs** involved in running parts of an application at the edge, calculate the ROI, and determine if the overall performance improvements are worthwhile.
- Enterprises **should not focus on latency** as the only important metric for considering the edge. The edge also provides improved isolation and security, enabling regulatory or corporate compliance; improved jitter (consistency in latency); reduced uplink costs; and resilience against intermittent connectivity.

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