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Enterprise-First Private Mobile Networks

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Contents

Enterprises are at a crossroads	2
How can private mobile networks really go mainstream?	4
Introducing a private mobile network solution built for the enterprise	8
Driving Private Mobile Network as an enterprise digitization tool	13
Appendix	17

Enterprises are at a crossroads

The state of the enterprise: Trends and priorities for the enterprise that are building toward a digital future

Enterprises are at a crossroads as they need to transform in order to optimize their costs and processes, and to embrace new applications and opportunities. This transformation is underpinned by multiple trends, including a change in cloud consumption, the need to use and integrate innovative technologies, and the need to guarantee security across end-to-end processes.

While a few years ago there was a move away from the in-house data center toward the cloud, this is now changing. The real protagonist of enterprise digitization is the continuum between different computing locations, among which edge locations play a pivotal role by delivering the ideal compromise between cost and computing power, while also helping in areas such as security and privacy.

Enterprises are using both cloud and edge computing for their workloads as the era of cloud consumption is constantly changing, with distinct trends in data usage, security, and confidentiality. In fact, according to Omdia's *Enterprise Edge Services Adoption Insights – 2021*, 45% of enterprises are using a mix of site and hosted edge, with the latter including local edge (less than 5ms) and regional edge (less than 20ms). The edge is gaining such relevance that enterprise transformation must now move its focus toward it. This is happening at a time when edge computing itself is undergoing a radical transformation since it needs to support legacy applications (e.g., VM-based applications) as well as new cloud native and container-based applications.

Innovative applications require an enterprise to rethink its approach to computing. Applications such as robotics, immersive experiences, industrial IoT, autonomous vehicles, and a massive number of devices require a service-level agreement (SLA)-driven approach, and the ability to often support high mobility and wide area needs. Edge and innovative applications create a complex environment and a continuum between multiple locations since many applications require computing in various locations to function. For instance, inferencing or data thinning can happen at the edge while the training model or critical data storage may need to happen in the cloud – either private or public.

Alongside new applications, new technologies must also be used to deliver on increasingly demanding performances. These new technologies can include the likes of AI, digital twins, and 5G.

The increased relevance of a distributed and connected edge also raises the question of security, which is a key challenge given the increase in locations and data points. In a distributed environment security cannot be addressed in a fragmented way but needs to be tackled with a comprehensive and cohesive single security posture. No digital transformation can happen without security being of paramount importance.

Why private mobile networks are a critical component of enterprise digital transformation

According to Omdia's *IT Enterprise Insights: IT Drivers and Technology Priorities – 2023*, 28% of surveyed enterprises see 5G and edge technologies as important for their digital strategy over the next 18 months. This shows how cellular technology and edge go hand in hand in realizing an enterprise digital transformation.

Most enterprises are embracing multicloud, using a combination of on-premises, private cloud, public cloud, and edge to build, operate, access, and secure their applications. As applications accelerate and become more distributed toward the edge, there is additional flexibility to choose from multiple edges, including the enterprise edge. Among them all, the enterprise edge appears to be the fastest-growing location for workload consumption as it matches perfectly with the enterprise needs of data security and governance, latency, data gravity, and cost efficiency.

While edge native applications are growing in numbers and significance, it would be a mistake to assume that an edge native application does not interact with the cloud (it does, for instance, for inferences or for training the algorithm). Applications (even edge ones) will interact with the local area network (LAN) but due to their mobility will also interact with the wide area network (WAN), and all set within a multicloud world.

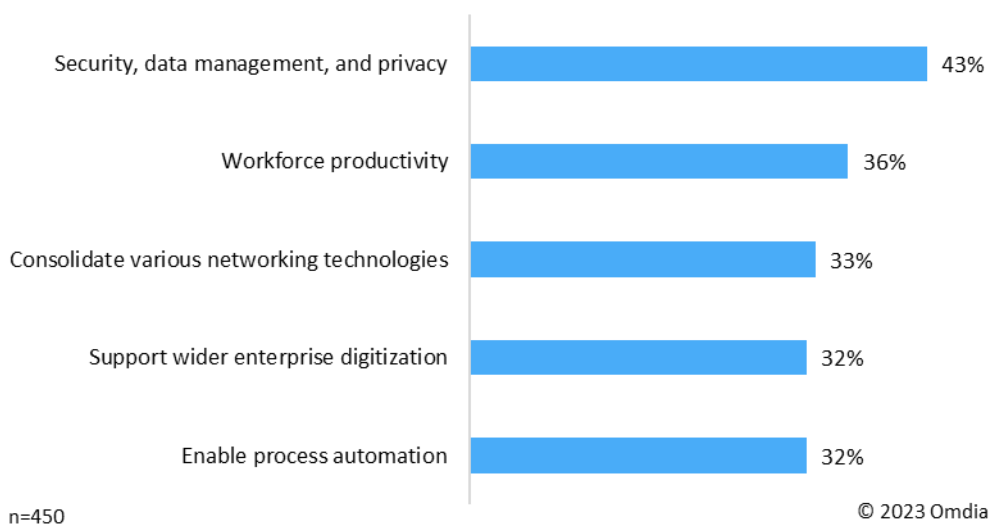
The applications that will be central to the future of the enterprise include immersive reality, automated guided vehicles (AGVs), factory automation, and many others. Common to all of them is the need for reliable, predictable, low-latency, and high-bandwidth networks. Private mobile networks reside between the LAN, WAN, and security needs of the enterprise and are therefore optimally placed to provide the reliable connectivity and guaranteed SLAs needed to support these innovative enterprises' applications.

How can private mobile networks really go mainstream?

The key trends shaping private mobile networks are creating opportunities but also showing market challenges

There are multiple trends driving the adoption of private mobile networks from spectrum liberalization, enterprise requirements for security and control, existing technologies struggling with new data-intensive applications, and wider digitization trends such as industry 4.0. According to Omdia’s *Private LTE and 5G Network Enterprise Survey Insight 2022 – Drivers, Technologies, and Applications* report, security, data management, and privacy is the leading driver of private mobile network adoption, ranked by 43% of respondents, followed by workforce productivity with 36% of respondents (see **Figure 1**).

Figure 1: Top five drivers for private mobile networks adoption



Source: Omdia’s *Private LTE and 5G Network Enterprise Survey Insight 2022 – Drivers, Technologies, and Applications*

In terms of the first driver relating to security, data management, and privacy, enterprises have a clear need for a solution that presents stronger security credentials and compliance and more predictable performance compared to other options. In relation to workforce productivity, enterprises also understand that their future will be dependent on a combination of innovative ways and technologies to support an ever-increasingly nomadic workforce. The need for such a mobile and even remote workforce has grown in relevance over the last few years as enterprises faced restrictions due to the COVID-19 pandemic.

A nomadic workforce is also tightly connected with another relevant trends that are shaping the market. Enterprises' appetites for private mobile networks are changing as they look to cover an ever-larger number of sites with their private mobile network. By 2024, 61% of surveyed enterprises will have covered six or more sites.

What are the key challenges for private mobile network adoption?

While there is a clear demand for private mobile networks, there are still multiple challenges to the adoption of this solution, including integration, cost, and the fact that many industries are not experts in cellular technology.

- **Cost.** Enterprises consider private mobile networks as costly and are often hesitant to deploy the solution because of a lack of flexibility in the business model adopted by the providers. It is important for an enterprise to be able to choose whether to use capex or opex, as well as be able to scale according to their needs, from connecting a handful of devices in a proof of concept (PoC) to connecting thousands of them in a multi-site deployment.
- **Integration and knowledge.** The private mobile network needs to be integrated with the existing IT systems of the enterprise to deliver on workloads and applications. One key challenge is the fact that existing IT teams are not familiar with cellular-specific platforms and would rather continue using platform and management tools that they are familiar with. The management of multiple mobile devices supported by different networks is a critical challenge for any enterprise. Currently, an enterprise would need to use different dashboards to manage devices on different networks, which creates complexity and provides a siloed view of enterprise devices.
- **Multi-site experience.** Many enterprises are by nature multi-site environments. For instance, a retail enterprise has multiple sites, including various retail stores and logistics centers. In a multi-site enterprise scenario, there will be a need for devices such as sensors or scanners attached to trucks or mobile devices for digital twins used by technicians for troubleshooting to move from one site to another. As these devices need to move, there is an expectation for the migration from one location to another to be as seamless as possible.
- **Lack of 5G expertise.** 5G and LTE are new technologies for many enterprises whose IT teams are not experts in dealing with the intricacies of cellular technologies. For instance, IT teams do not have expertise in cellular network radio planning and deployment, which is a key element to the

success of any private mobile network. Even in the case when an enterprise is testing cellular technology in an R&D lab, this does not mean that all IT personnel across their footprint has enough expertise to deploy and run cellular networks.

- **Silos and fragmentation.** As enterprises are undertaking their digital journey, another key challenge is the risk of continuing to create new device islands. Enterprises already use multiple technologies such as Wi-Fi, Bluetooth, and other IoT protocols, as well as Ethernet to connect different devices. Now they are adding cellular mobile devices to this mix. These different and separate device islands create the problem of having full visibility with anomaly detection with root cause analysis (RCA) across all device islands.

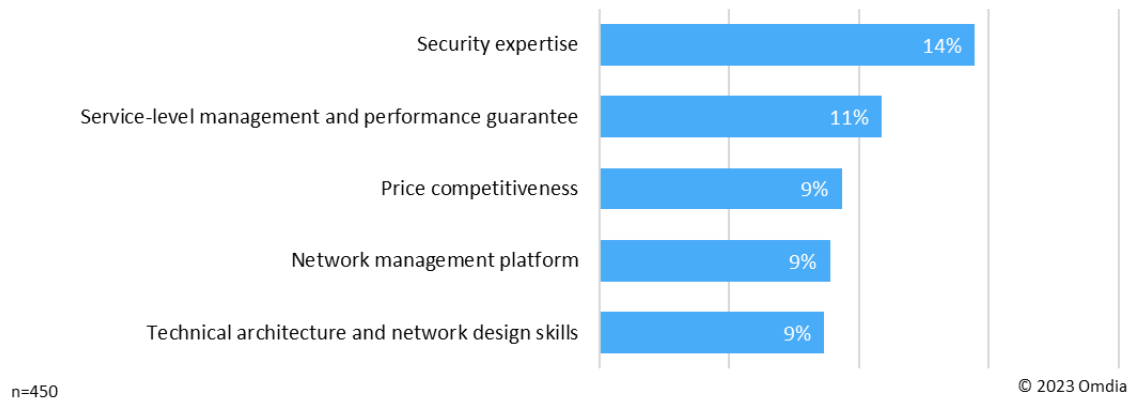
One additional challenge often overlooked in the market is the idea that this market can only be served by 5G. In fact, some countries provide spectrum ideal for 4G LTE deployments; the CBRS initiative in the US is an example of a country where all CBRS activity is still on 4G LTE not 5G. To drive market growth, it is important to be able to provide both 4G LTE and 5G, serving the customer with the private mobile network technology that best meets the customer's requirements rather than trying to push for a technology-led approach. The market needs an enterprise-first approach.

What does the enterprise require from a private mobile network provider?

Enterprises need providers that understand the enterprise world and its problems and that can bring an enterprise-centered conversation to the table rather than a telco-centered one. With security being a key driver for an enterprise, security expertise will also be a key attribute for any vendor and provider in this space.

In addition to security, being able to provide and guarantee SLAs is critical for the smooth running of applications, and having a network management platform that enables the enterprise and the provider to have full visibility into networks and devices is also extremely important. **Figure 2** shows the top five attributes that an enterprise seeks from its private mobile network provider according to data from Omdia's *Private LTE and 5G Network Enterprise Survey Insight 2022 – Drivers, Technologies, and Applications* report.

Figure 2: Top five attributes that an enterprise seeks in its private mobile network provider



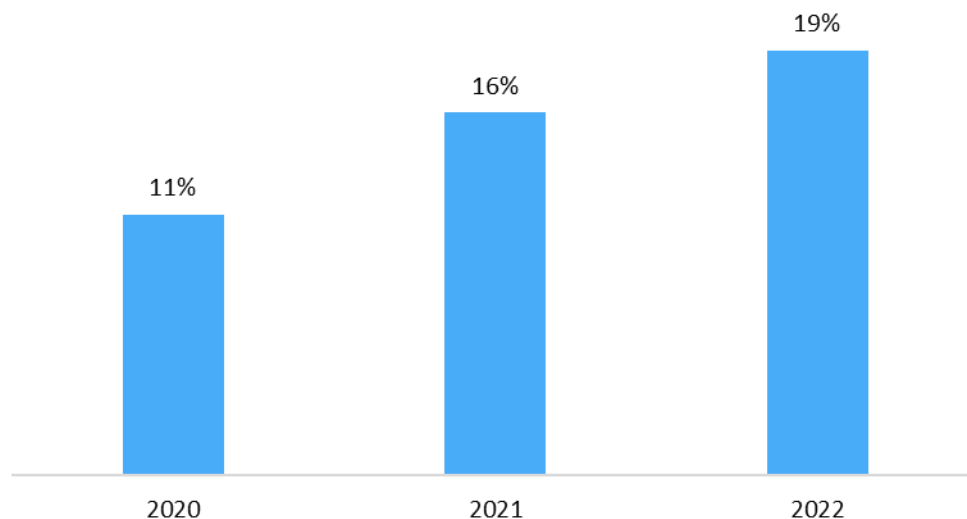
Source: Omdia's *Private LTE and 5G Network Enterprise Survey Insight 2022 – Drivers, Technologies, and Applications*

Introducing a private mobile network solution built for the enterprise

The VMware rationale for delivering private mobile networks

According to Omdia data, edge computing is becoming increasingly relevant in the private mobile network market as the market matures and realizes that digesting and analyzing data is essential for the success of a private mobile network deployment (see **Figure 3**). Any private mobile network solution must therefore be part of an edge strategy and product portfolio, as there are significant synergies that can be created with products such as SD-WAN, edge computing, and SASE.

Figure 3: Relevance of edge computing in private mobile network products and deployments



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Source: Omdia's Private LTE and 5G Network Tracker Database – 3Q22

IT is driving an enterprise digital transformation and even in an IT-operational technology (OT) convergence scenario it is leading the digitalization of OT products with all the risks and opportunities associated with it. Therefore, any innovative product must be built to target the IT competence and capabilities of the customer. VMware has roots in the enterprise market, counting on some 300,000 or more enterprise customers, and this is a strong starting point to evolve the conversation to include a private mobile network.

Besides strong relationships with the enterprise and the IT world, the company also has expertise, products, and solutions at the edge. VMware announced its Edge Compute Stack (a purpose-built infrastructure to run edge applications) in 2021. The company plays across multiple edge locations, including the enterprise edge (e.g., factory server) and the device edge (e.g., IoT gateway). Regarding its SD-WAN portfolio, the company can count on multitenant SD-WAN Gateways deployed by VMware and its partners at strategic network points of presence (PoPs) and cloud data centers around the world, optimizing access to cloud applications and public/private data centers.

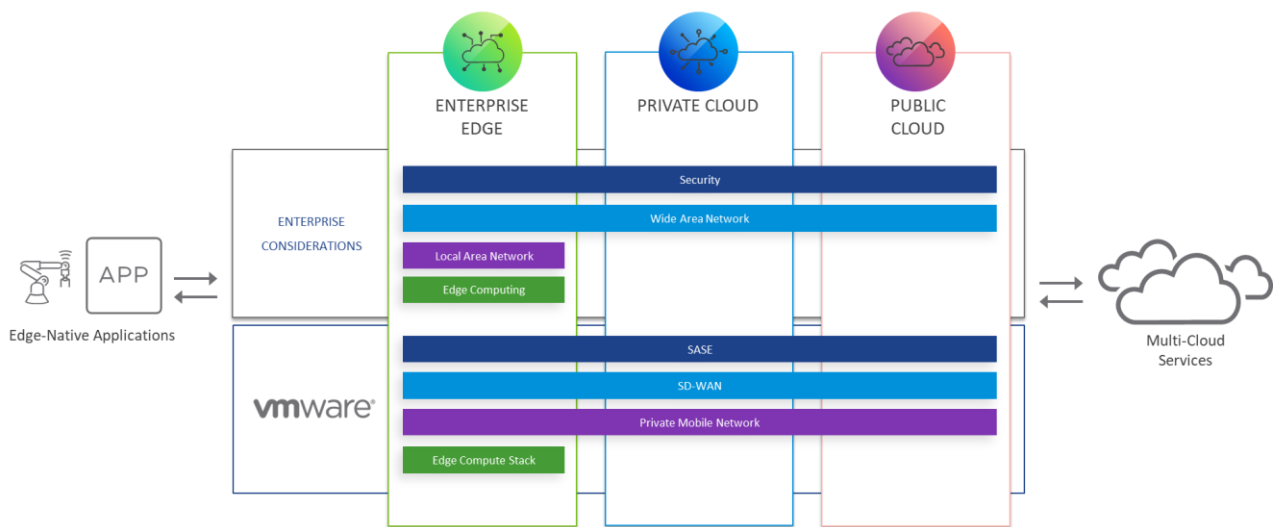
Common to all products is centralized lifecycle management, conformance and monitoring, open APIs, multicloud support, support of VMs and containers, Kubernetes workloads, support for real-time workloads, and other benefits. VMware also has its Edge Network Intelligence (ENI) solution, which is a holistic network intelligence framework that provides access-agnostic visibility, anomaly detection, and RCA.

In this scenario, private mobile networks become an extension or an add-on to what the enterprise is already doing at the edge.

Figure 4: VMware’s enterprise IT solutions

Enterprise IT Solutions

Delivering edge-native applications in multi-cloud world

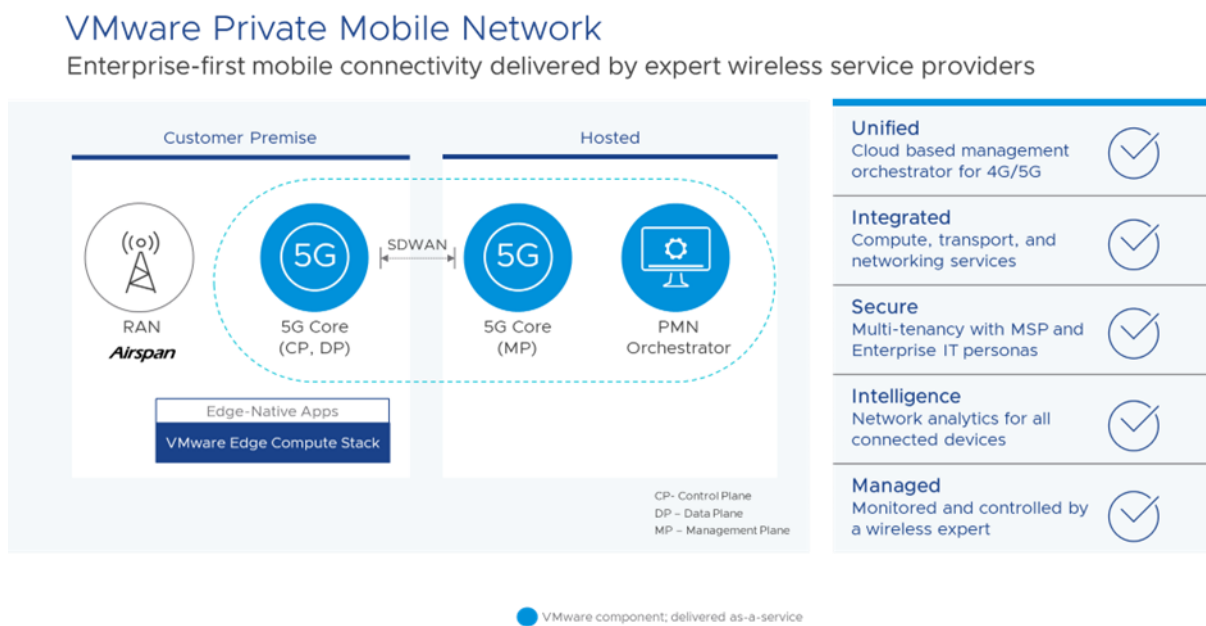


Source: VMware

An introduction to VMware’s offering and go-to-market strategy

VMware’s Private Mobile Network offering leverages the company’s strengths and existing assets, such as its edge presence, but also its existing SD-WAN infrastructure. The solution includes a private converged core, with a split architecture across two main PoPs – the control plane (CP) and data plane (DP) are deployed at the enterprise edge while the management plane (MP) is in the VMware-hosted public cloud, alongside the Private Mobile Network (PMN) Orchestrator (see **Figure 5**). The on-premises elements ensure data traffic locality and sovereignty and latency for data computing. Edge native applications can be deployed on the same VMware Edge Compute Stack that hosts the private core functions. In case an enterprise already has a vSphere environment (VMware’s enterprise-scale virtualization platform), the VMware Private Mobile Network can be deployed on top of vSphere as well.

Figure 5: VMware’s Private Mobile Network



Source: VMware

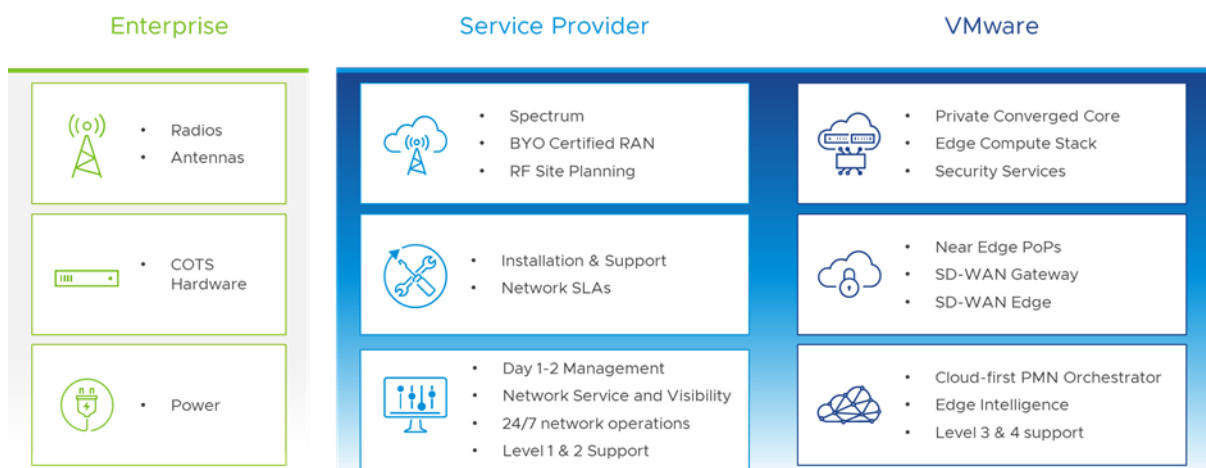
The PMN Orchestrator is a cloud-based platform that manages the entire private network. The architecture is built on VMware’s existing SD-WAN infrastructure, which can count on multi-tenancy and enterprise integration capabilities, with the PMN Orchestrator effectively being a module on top of the existing SD-WAN orchestrator.

From a radio access network (RAN) perspective, the VMware approach is bring-your-own RAN (BYO RAN) via a curated set of certified partners such as Airspan. Since the private mobile network market

requires a diverse set of skills, VMware is establishing partnerships with managed service providers for its go-to-market strategy, collaborating with expert wireless service providers to simplify cellular network complexities for the enterprise. VMware offers a comprehensive technical solution, enabling managed service providers to concentrate on providing and overseeing the private mobile network.

The managed service provider partners bring spectrum, certified RAN vendors, and oversee deployment, as well as level 1 and 2 support. The enterprise has access to certain functions of the PMN Orchestrator such as network alerts with the managed service provider overseeing more demanding management tasks and support. The dual personas provide both the enterprise and service providers with the necessary control and visibility.

Figure 6: VMware and partners' approach to PMN



Source: VMware

Highlights of the key strengths of VMware’s offering and its go-to-market strategy

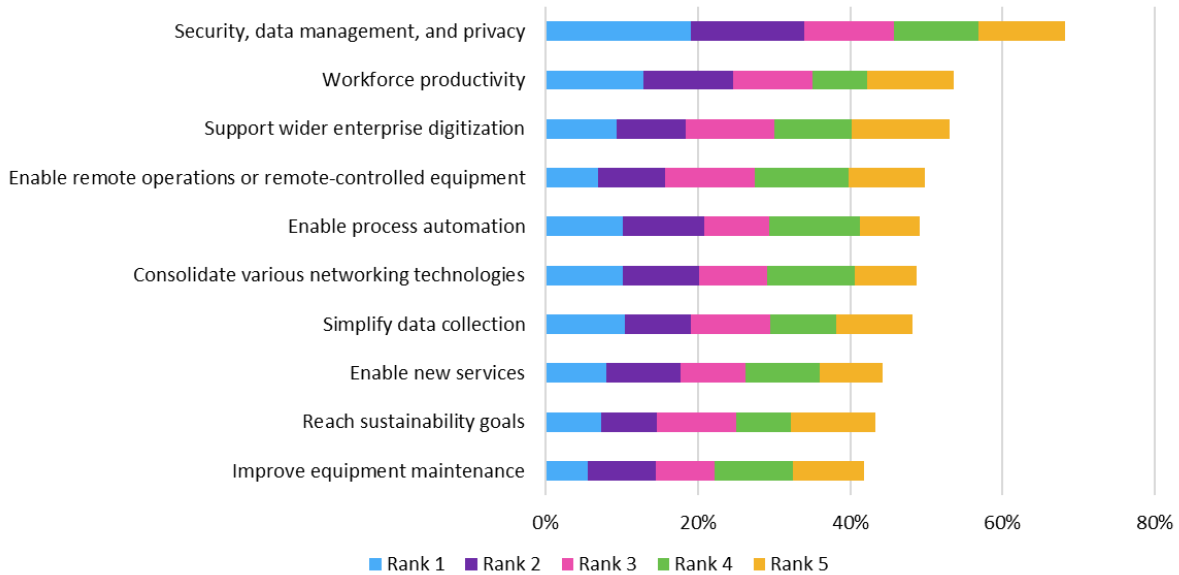
Figure 7: Key strengths of VMware’s Private Mobile Network

IT-centered proposition	VMware Private Mobile Network can be co-located with edge applications. It is designed to seamlessly integrate with existing IT systems and can support multiple quality of service (QoS).
VMware edge assets and locations	VMware can deliver both products and PoPs at the edge. These are 10ms away from 80% of the population and under 5ms away from all major cloud service providers.
Unified security	As this is part of a wider play, VMware can leverage a unified security posture across all its service and products.
Scale with use, consumption, and “aaS”	This is a solution meant to be consumed as an IT application and based on consumption. VMware has 10+ years of experience with as-a-service (aaS) infrastructure.
Zero touch deployment	The PMN Orchestrator can be used to preconfigure the network enablement for the automated site configuration, which includes RAN provisioning and converged core deployment and provisioning.
Single view of enterprise devices and networks	VMware Edge Network Intelligence can be integrated with a wide range of Wi-Fi products from various providers. The 4G/5G end-device visibility is a roadmap item. This will allow users to ingest information from all devices connected to those networks and create a comprehensive view across both cellular and Wi-Fi.
Best-of-breed approach	By working with managed service providers, the companies can combine their respective strengths rather than having a single company trying to do both the technology as well as the deployment and maintenance.

Driving Private Mobile Network as an enterprise digitization tool

Enterprise drivers for private networks and how these align with VMware’s offering

Figure 8: Enterprise drivers for private networks



n=450

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Source: Omdia’s Private LTE and 5G Network Enterprise Survey Insight 2022 – Drivers, Technologies, and Applications

Security and data and serving the workforce are key components of VMware’s offering

As mentioned above, security and supporting a mobile workforce are two key forces driving enterprise adoption of private mobile networks. Providing a split core architecture with the control and data planes located on site allows for sensitive data to remain on site, thus meeting the enterprise requirements for data privacy and compliance.

However, positioning the management plane and subscriber database in the cloud enables the solution to be well suited for nomadic use cases with a single SIM and authentication. For instance, a technician that has a head-mounted device with AR capabilities is an example of a highly nomadic type of worker as they may need to move to different factories for maintenance or troubleshooting purposes. By placing the subscriber database in the cloud, making it common across sites, it is possible for the technician to move from factory to factory and to immediately connect securely throughout the different sites.

Furthermore, in a market that is evolving toward multi-site deployment, a single management and orchestration platform allows the enterprise to gain consistent experience for all its deployments while being able to leverage VMware's existing SD-WAN presence. This means that enterprises will always be able to count on already existing infrastructure when adding new locations, with 625,000+ edge locations already served by SD-WAN infrastructure.

Market challenges and how these are addressed by VMware's offering

Mobile private networks as well as the enterprise digital transformation itself have multiple challenges:

- **An enterprise wants to transform but wants to use familiar tools underpinned by strong security credentials.** The private mobile network has struggled to really take off as enterprises are not interested in telco-centered products because they are simply not used to consuming those products and doing so would require them to acquire new knowledge. VMware is targeting the market on the back of its existing relationship and set of products for the enterprise market. All this must be underlined by a proven security posture with visibility across the whole IT stack.
- **The real value of private mobile networks is not in the network for the sake of it but in how it can integrate to support enterprise applications.** Providing a solution that comes from an application-first mentality makes it easier for the solution to support existing and new applications. While the enterprise transformation must be an edge-centered one, there is no doubt that a lot of enterprises are still struggling to integrate private mobile networks as well as legacy and new applications into a single framework. As private mobile networks are part of VMware's edge strategy, the company is easing the hurdle of integration.
- **Cost is a barrier that must be addressed with an XaaS offering.** Any solution designed for the enterprise needs to also have a business model drafted to support the preferred consumption of the enterprise, which is a consumption and "aaS" model. Even for private mobile networks, there is a clear tendency for enterprises to prefer opex-based models, with 81% of enterprises planning to deploy a private mobile network preferring opex over capex (according to data from Omdia's *Private LTE and 5G Network Enterprise Survey Insight 2022 – Providers, Solutions, and Business Models*).

Selected use cases and how these can benefit from VMware's approach

One of the strengths of the private mobile network market is that virtually every vertical can benefit from this solution. As of the third quarter of 2022, according to Omdia data, 12 different vertical industries from transport to media and entertainment have seen deployments of private mobile networks. Significantly, while a lot of momentum has been highlighted in studies in the manufacturing vertical with use cases such as AGVs and advanced predictive maintenance, this is not the only well-suited market for private mobile networks. Markets such as healthcare and retail also provide perfect scenarios for the expansion of private mobile networks.

Healthcare

Healthcare is a key vertical for the private mobile network market as the sector requires reliable connectivity across multiple buildings while connecting very diverse devices (for example, the internet of medical things, IoMT), which can include stationary machinery such as X-ray machines, occupancy sensors, patient sensors, and cameras.

Additionally, given the high degree of confidentiality, it is essential for this vertical to have a network capable of keeping sensitive data on site while also moving critical workloads, avoiding the risk of network congestions, channel interference, and loss of connectivity. Overall benefits include lightweight devices by moving compute from the device to the edge, and a better patient experience, for instance, via reading a patient's sensors at night without the need to wake them up, and locally storing data.

There are currently multiple deployments of private LTE and 5G networks to support the healthcare vertical. For instance, in North America, a private LTE network was deployed during the pandemic to bring coverage outside of the hospital, thus allowing the triage area to be expanded and to maintain connectivity for all personnel, both inside and outside the building. In another example from the EMEA region, a private LTE network was deployed to connect a variety of devices, including staff's smartphones, cameras, but also wearables used to monitor patients. Also in EMEA, a private 5G network is used to test new technologies, including IoT and VR. The network connects handheld devices used to update patient records and improve accuracy over manual tasks, sensors to monitor air quality, and AR devices to connect with experts from other hospitals.

A selection of use cases from the healthcare vertical includes:

- **Inventory management.** Real-time location and status of inventory to free up time for the healthcare specialists and improve the ability to promptly serve patient needs.
- **Patient monitoring.** The monitoring of various metrics of a patient, including O2 concentration, glucose, and heart rate. This increases the ability to better serve multiple patients at the same time.
- **Security video.** Connected cameras are essential to capture and process data and alerts to inform security and threat prevention within a hospital environment.

Retail

The retail sector is at a turning point with retailers needing to integrate new technologies to provide an immersive experience for their customers while also improving existing processes by optimizing existing use cases.

In the retail scenario, the benefits of private mobile networks include low latency and high bandwidth, essential for applications such as AR/VR, and scalability essential for large multi-site retail stores constantly looking at new ways of digitizing their operations.

There are various deployments in the retail space, which is a vertical that combines both the need to support customer-facing scenarios as well as supply chain and logistics needs. One private LTE deployment in North America uses the network to support IoT applications such as wayfinding systems in the outdoor areas of a large retail space. The network is also used to support smartphone connectivity both indoors and outdoors. Another private 5G network tests mobile robots within retail environments. This is because large numbers of mobile robots in a retail environment put a strain on technologies such as Wi-Fi and this creates the need to use a new wireless connectivity option such as private 5G. In the Asia Pacific region, a private 5G network was deployed to support a retail chain in its warehouses connecting AGVs, camera-based applications, and IoT devices.

Selected use cases that could be supported by a private mobile network in the retail vertical include:

- **Security video.** Capturing information to help with the security strategy of the store as well as covering the various areas of the location (e.g., warehouse).
- **Cashless payments.** The secure and real-time transaction and tracking of payments essential for an improved and smooth customer experience.
- **Customer experience augmentation.** By leveraging AR/VR technologies the store can increase the customer interaction with the products and can improve the whole buying experience for the customer.

Appendix

Methodology

This white paper was created leveraging Omdia's internal datasets and market and technological knowledge. In-depth conversations with VMware experts were also conducted to gain a comprehensive understanding of the company's offering and positioning.

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