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Powering Pervasive Mobility with MEC

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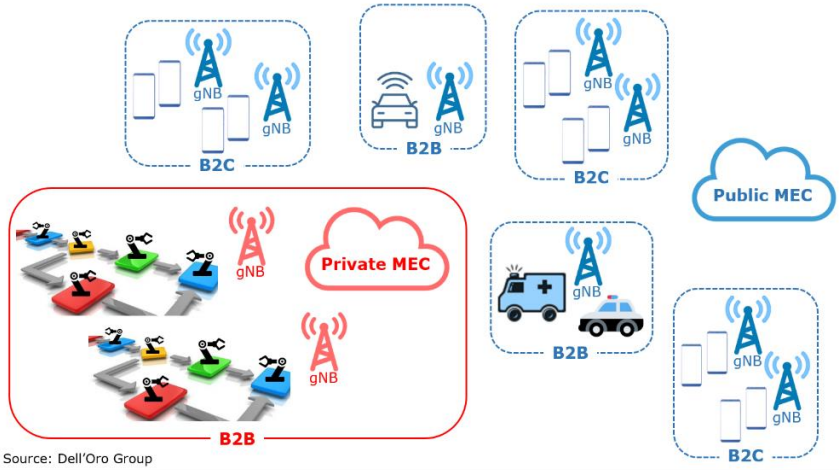
With the advent of the 5G Standalone (5G SA) era, 5G service providers (SPs) can deliver performance guarantees for pervasive mobile networking. A 5G SP can offer premium services and performance with guaranteed service-level agreements (SLAs).

One of the key features of 5G is multi-access edge computing (MEC), which can guarantee SLAs with lower latency and the option of keeping local traffic and data on-premises (also known as data sovereignty), if required. 5G is fundamentally more secure and more reliable compared to previous generations of wireless networks.

Dell'Oro Group defines MEC in two ways, Public MEC and Private MEC. Public MEC is a service available to all subscribers to 5G networks that can be classified as business-to-consumers (B2C) or business-to-business (B2B). Private MEC has specific MEC services on-premises, such as at enterprise campuses and factories, that are classified as B2B (Figure 1).



Source: Dell'Oro Group

Figure 1: Public MEC versus Private MEC

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Enterprises that need broad geographic coverage can take advantage of 5G Public MEC networks. Larger enterprises can take advantage of on-premises Private MEC deployments for their exclusive use. These enterprises are characterized as needing real-time or near-real-time communications, translating to a requirement for low latency, which can be enabled by MEC deployments.

Three network architectural options

NPN (non-public networks), per 3GPP, are intended for the sole use of a private entity, such as an enterprise. NPNs can be deployed in a variety of configurations utilizing both virtual and physical elements. NPNs might be offered as a network slice of a public land mobile network (PLMN), be hosted by a PLMN, or be deployed as completely standalone networks per 3GPP.

5G networks can meet the pervasive mobile networking needs of enterprises requiring wireless real-time communications or near-real-time communications with three architectural options:

The first, 5G PNI-NPN (w/Public MEC) (public network integrated - NPN) is a 5G private network offered as a network slice of a PLMN. All network functions are shared with the PLMN, with the proviso that the 5G SP has provided Public MEC nodes deep enough into the edge to meet the enterprise latency requirements. The second, 5G PNI-NPN (w/Private MEC) is a 5G private network hosted by a PLMN. The 5G SP must integrate its public network with an on-premises RAN and an on-premises MEC exclusively reserved for private enterprise use. The CP is shared with the PLMN. The RAN spectrum can be owned by the enterprise, supplied by the 5G SP, or utilize unlicensed spectrum.

Lastly, 5G SNPN (w/Private 5G Core) (Standalone NPN) is deployed as an on-premises 5G SA private network that includes on-premises RAN and on-premises 5G Core exclusively reserved for private enterprise use. No network functions are shared with the 5G PLMN.

Dell'Oro Group has identified seven important network characteristics:

Time-to-market

Each network architectural option has a different time-to-market. Regardless of the option, a 5G SP needs to be able to implement the option faster than its competition.

Coverage

Some enterprises need outdoor and/or indoor coverage. For those needing indoor coverage, the closest outdoor RAN site may provide enough indoor signal strength. If not, indoor coverage with an on-premises RAN site will be required.

Spectrum

RAN spectrum can be part of the PLMN supplied by the 5G SP, an enterprise's private spectrum, or unlicensed spectrum.

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Latency

Latency is dependent on how close the UPF is to the edge of the network. A 5G SP can meet the latency requirements of most enterprises when the MEC nodes are located deep in the edge of the network. The deepest edge site with the lowest possible latency is at the RAN location, whether for outdoor or indoor coverage.

Network Access

For PNI-NPN, a private network slice creates a virtual private network that restricts access to the enterprise's subscribers to their services (Public MEC) or only within the enterprise (Private MEC). For SNPN (w/private 5G core), network access is private and only available within the enterprise.

Data sovereignty

On-premises MEC and 5G core allow enterprises to retain data on campus for security reasons, isolating the data from the Internet and the PLMN.

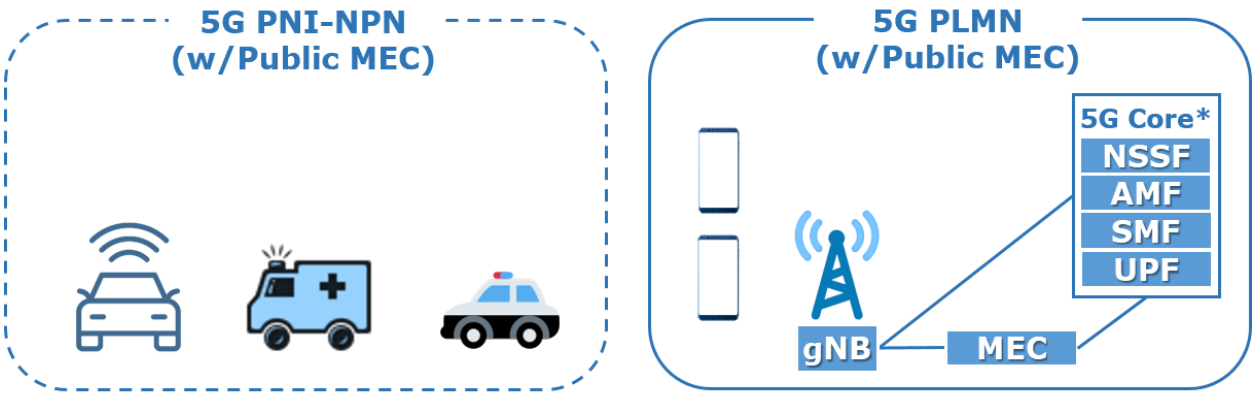
SP network control

Each architectural option has different degrees of control, from the 5G SP with total network control to a fully autonomous private network under enterprise control.

One network characteristic not listed above is reliability, which applies equally to all three network options. To meet the 3GPP specifications for Ultra-Reliable Low Latency Communications (URLLC), geo-redundancy is required, so there cannot be a single point of failure anywhere in the network, including the RAN, MEC, 5G core, or transport. The three network options are described below.

PNI-NPN (w/Public MEC)

The 5G PNI-NPN (w/Public MEC) is offered as a network slice of a PLMN, sharing PLMN network resources. PNI-NPN (w/Public MEC) is most viable for enterprises that need wide-area outdoor coverage, like smart health, or V2X application (Figure 2). The higher the density of its RAN and MEC sites, the more enterprises a 5G SP can potentially serve.



Source: Dell'Oro Group

*Only a subset of 5G Core Network Functions are shown

Figure 2: 5G PNI-NPN (w/Public MEC) Network Architecture

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5G PNI-NPN (w/Public MEC) is the quickest option to implement because no additional infrastructure needs to be added to get an enterprise up and running. The logical private network created by network slices affords the enterprise partial data sovereignty. The 5G SP retains full network control in this scenario (Figure 3). The 5G PLMN (w/Public MEC) can attract both B2B and B2C business (for example, cloud gaming) to gain a quicker return on investment in the Public MEC network. The network slice feature from the PLMN creates a virtual private network that differentiates the SLAs for each type of enterprise.

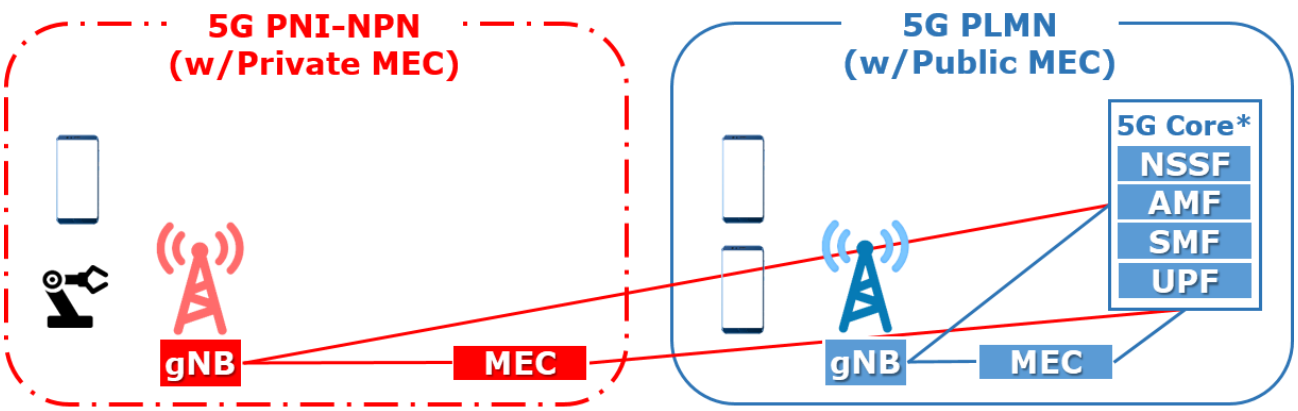
Time-to-Market	Optimized Coverage	Spectrum	Latency	Network Access	Data Sovereignty	SP Network Control
Quickest	Outdoors	PLMN	Low	Private Network Slice	Partial	Full

Source: Dell'Oro Group

Figure 3: 5G PNI-NPN (w/Public MEC) Network Characteristics

PNI-NPN (w/Private MEC)

5G PNI-NPN (w/Private MEC) is hosted by a PLMN with on-premises MEC for private use by an enterprise. This configuration provides the most flexible architecture for 5G SPs to meet the needs of industry with on-premises requirements for data sovereignty (Figure 4).



Source: Dell'Oro Group

* Only a subset of 5G Core Network Functions are shown

Figure 4: 5G PNI-NPN (w/Private MEC) Network Architecture

This configuration takes a little longer to deliver, requiring the addition of an on-premises Private MEC and RAN infrastructure on the enterprise campus. The 5G RAN can run on the 5G PLMN's public spectrum, run on the enterprise's private spectrum, or utilize unlicensed spectrum (Figure 5).

Time-to-Market	Optimized Coverage	Spectrum	Latency	Network Access	Data Sovereignty	SP Network Control
Slower	Indoors/Outdoors	PLMN/Private/ Unlicensed	Lowest Possible	Private Network Slice	Yes	Partial-Full

Source: Dell'Oro Group

Figure 5: PNI-NPN (w/Private MEC) Network Characteristics

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With the addition of a Private MEC on-premises, the enterprise receives the lowest latency possible and has data sovereignty (localized-traffic data that is isolated from the PLMN). The 5G SP still retains the operational control of the network but may have limited access to on-premises equipment, depending on the arrangement with the enterprise. Additional SLAs can be added with network slices from the 5G SP.

5G SNPN (w/Private 5G Core)

SNPN (w/Private 5G Core) deployed as a completely standalone 5G private network has 5G RAN and a 5G core on-premises and does not rely on the network functions provided by a 5G PLMN. An SNPN operator could be the enterprise itself, outsource operation to a 5G SP, or other entity. In this configuration, the RF spectrum is either private spectrum, spectrum from a PLMN, or unlicensed spectrum (Figure 6).

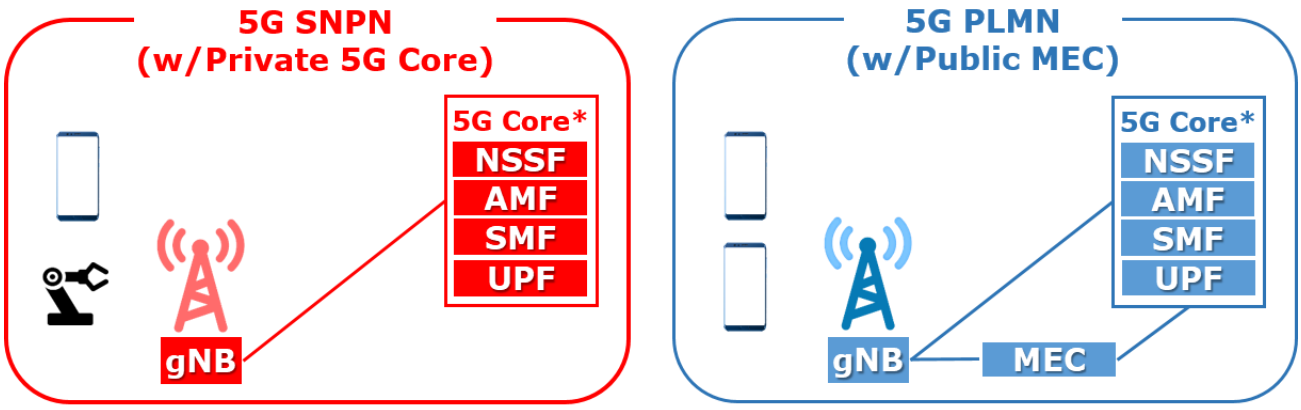

Figure 6: 5G SNPN (w/Private 5G Core) Network Architecture

For multi-site locations, the private 5G core would not have to be extended to every site. Private MEC nodes can be used to cost-effectively extend the SNPN to other locations. 5G SNPN (w/private 5G core) takes the longest time to implement, and the 5G SP loses network control, as the SNPN is an autonomous network as far as the PLMN is concerned (Figure 7).

Time-to-Market	Optimized Coverage	Spectrum	Latency	Network Access	Data Sovereignty	SP Network Control
Slowest	Indoors/Outdoors	PLMN/Private/ Unlicensed	Lowest Possible	Private Dedicated Network	Yes	None

Source: Dell'Oro Group

Figure 7: 5G SNPN (w/Private 5G Core) Network Characteristics

Conclusion

Three private networks options for pervasive mobile networks were reviewed: Public MEC, Private MEC, and private 5G core. The enterprise network options are summarized in (Figure 8), with the addition of relative cost to enterprises and relative size of the market opportunity for SPs.

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	5G PNI-NPN (w/Public MEC) (off-premises)	5G PNI-NPN (w/Private MEC) (on-premises)	5G SNPN (w/Private 5G Core) (on-premises)
Time-to-Market	Quickest	Slower	Slowest
Optimized Coverage	Outdoors	Indoors/Outdoors	Indoors/Outdoors
Spectrum	PLMN	PLMN/Private/Unlicensed	PLMN/Private/Unlicensed
Latency	Low	Lowest Possible	Lowest Possible
Network Access	Private Network Slice	Private Network Slice	Private Dedicated Network
Data Sovereignty	Partial	Yes	Yes
SP Network Control	Full	Partial/Full	None
Cost to Enterprise	$	$$	$$$
SP Market Potential	Largest	Large	Smallest

Source: Dell'Oro Group

Figure 8: Enterprise Network Architectural Options and Characteristics

In competing for private on-premises business, 5G SPs can make the case that 5G PNI-NPN (w/Private MEC) is a better option than a 5G SNPN (w/private 5G core) solution, because Private MEC can meet enterprise need for data sovereignty and have the best coverage and lowest latency possible, at a lower cost with quicker delivery, all without sacrificing performance, running on the enterprise's private spectrum. At the same time, the 5G SP would be able to keep the network up to date with the latest 3GPP standards. 5G MEC is the key infrastructure component that can enable 5G SPs to provide premium services and performance to enterprises needing real-time or near-real-time communications. A 5G SP that cultivates relationships with enterprises and deliver solutions faster than the competition will gain the most market share and generate new sources of revenue.

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