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The Private LTE & 5G Network Ecosystem: 2024 – 2030 – Opportunities, Challenges, Strategies, Industry Verticals & Forecasts

https://marketpublishers.com/r/P3CA27E047AAEN.html
Date: November 2024
Pages: 2764
Price: US$ 2,500.00 (Single User License)
ID: P3CA27E047AAEN

Abstracts

Historically a niche segment of the wider wireless telecommunications industry, private cellular networks – also referred to as NPNs (Non-Public Networks) in 3GPP terminology – have rapidly gained popularity in recent years due to privacy, security, reliability and performance advantages over public mobile networks and competing wireless technologies as well as their potential to replace hardwired connections with non-obstructive wireless links. With the 3GPP-led standardization of features such as MCX (Mission-Critical PTT, Video & Data), URLLC (Ultra-Reliable, Low-Latency Communications), TSC (Time-Sensitive Communications), RedCap (Reduced Capability) for IIoT (Industrial IoT), NTN (Non-Terrestrial Network) connectivity, SNPNs (Standalone NPNs), PNI-NPNs (Public Network-Integrated NPNs) and network slicing, private networks based on LTE and 5G technologies have gained recognition as an all-inclusive connectivity platform for critical communications, Industry 4.0 and enterprise transformation-related applications. Traditionally, these sectors have been dominated by LMR (Land Mobile Radio), Wi-Fi, industrial Ethernet, fiber and other disparate networks.

The liberalization of spectrum is another factor that is accelerating the adoption of private LTE and 5G networks. National regulators across the globe have released or are in the process of granting access to shared and local area licensed spectrum. Examples include the three-tiered CBRS (Citizens Broadband Radio Service) spectrum sharing scheme in the United States, Canada's NCL (Non-Competitive Local) licensing framework, Germany's 3.7-3.8 GHz and 28 GHz licenses for 5G campus networks, United Kingdom's shared and local access licensing model, Ireland's planned licensing regime for local area WBB (Wireless Broadband) systems, France's vertical spectrum and sub-letting arrangements, Spain's reservation of the 26 GHz band for self-

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provisioned local networks, Netherlands' 3.5 GHz licenses for plot-based networks, Switzerland's NPN spectrum assignment in the 3.4-3.5 GHz band, Finland's 2.3 GHz and 26 GHz licenses for local 4G/5G networks, Sweden's 3.7 GHz and 26 GHz permits, Norway's regulation of local networks in the 3.8-4.2 GHz band, Poland's spectrum assignment for local government units and enterprises, Bahrain's private 5G network licenses, Japan's 4.6-4.9 GHz and 28 GHz local 5G network licenses, South Korea's e-Um 5G allocations in the 4.7 GHz and 28 GHz bands, Taiwan's provision of 4.8-4.9 GHz spectrum for private 5G networks, Hong Kong's LWBS (Localized Wireless Broadband System) licenses, Australia's apparatus licensing approach and Brazil's SLP (Private Limited Service) licenses. Vast swaths of globally and regionally harmonized license-exempt spectrum are also available worldwide that can be used for the operation of unlicensed LTE and 5G NR-U equipment for private networks. In addition, dedicated national spectrum in sub-1 GHz and higher frequencies has been allocated for specific critical communications-related applications in many countries.

LTE and 5G-based private cellular networks come in many different shapes and sizes, including isolated end-to-end NPNs in industrial and enterprise settings, local RAN equipment for targeted cellular coverage, dedicated on-premise core network functions, virtual sliced private networks, secure MVNO (Mobile Virtual Network Operator) platforms for critical communications, and wide area networks for application scenarios such as PPDR (Public Protection & Disaster Relief) broadband, smart utility grids, railway communications and A2G (Air-to-Ground) connectivity. However, it is important to note that equipment suppliers, system integrators, private network specialists, mobile operators and other ecosystem players have slightly different perceptions as to what exactly constitutes a private cellular network. While there is near universal consensus that private LTE and 5G networks refer to purpose-built cellular communications systems intended for the exclusive use of vertical industries and enterprises, some industry participants extend this definition to also include other market segments – for example, 3GPP-based community and residential broadband networks deployed by non-traditional service providers. Another closely related segment is neutral host infrastructure for shared or multi-operator coverage enhancement in indoor environments or underserved outdoor areas.

Despite the somewhat differing views on market definition, one thing is clear – private LTE and 5G networks are continuing their upward trajectory with deployments targeting a multitude of use cases across various industries. These range from localized wireless systems for dedicated connectivity in factories, warehouses, mines, power plants, substations, offshore wind farms, oil and gas facilities, construction sites, maritime ports, airports, hospitals, stadiums, office buildings and university campuses to regional

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and nationwide sub-1 GHz private wireless broadband networks for utilities, FRMCS (Future Railway Mobile Communication System)-ready networks for train-to-ground communications and hybrid government-commercial public safety LTE networks. Custom-built cellular networks have also been implemented in locations as remote as Antarctica, and there are even plans for installations on the moon's surface and outer space.

The expanding influence of the private LTE and 5G network market is evident from the recent use of rapidly deployable private cellular network-in-a-box systems for professional TV broadcasting, enhanced fan engagement and gameplay operations at major sports events, including Paris 2024 Olympics, 2024 UEFA European Football Championship, North West 200 Motorcycle Race, 2024 World Rowing Cup III, New York Sail Grand Prix, 2024 PGA Championship, 2024 UFL Championship Game and 2024 NFL International Games, as well as the Republican and Democratic national conventions in the run up to the 2024 United States presidential election.

Other examples of high-impact private LTE/5G engagements include but are not limited to multi-site, multi-national private cellular deployments at the industrial facilities of Airbus, BMW, Chevron, John Deere, LG Electronics, Midea, Tesla, Toyota, Volkswagen, Walmart and several other household brand names; Aramco's (Saudi Arabian Oil Company) 450 MHz 3GPP network project and ADNOCS' (Abu Dhabi National Oil Company) 11,000-square kilometer private 5G network for connecting thousands of remote wells and pipelines; defense sector 5G programs for the adoption of tactical cellular systems and permanent private 5G networks at military bases in the United States, Germany, Spain, Norway, Japan and South Korea; service territory-wide private wireless projects of 450connect, Ameren, CPFL Energia, ESB Networks, Evergy, Neoenergia, PGE (Polish Energy Group), SDG&E (San Diego Gas & Electric), Tampa Electric, Xcel Energy and other utility companies; and the recent implementation of a private 5G network at Belgium's Nobelwind offshore wind farm as part of a broader European effort to secure critical infrastructure in the North Sea.

There has also been a surge in the adoption of private wireless small cells as a cost-effective alternative to DAS (Distributed Antenna Systems) for delivering neutral host public cellular coverage in carpeted enterprise spaces, public venues, hospitals, hotels, higher education campuses and schools. This trend is particularly prevalent in the United States due to the open accessibility of the license-exempt GAA (General Authorized Access) tier of 3.5 GHz CBRS spectrum. Some examples of private network deployments supporting neutral host connectivity to one or more national mobile operators include Meta's corporate offices, City of Hope Hospital, SHC (Stanford Health

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Care), Sound Hotel, Gale South Beach Hotel, Nobu Hotel, ASU (Arizona State University), Cal Poly (California Polytechnic State University), University of Virginia, Duke University and Parkside Elementary School.

SNS Telecom & IT estimates that global spending on private LTE and 5G network infrastructure for vertical industries will grow at a CAGR of approximately 20% between 2024 and 2027, eventually accounting for more than $6 Billion by the end of 2027. Close to 60% of these investments – an estimated $3.5 Billion – will be directed towards the buildout of standalone private 5G networks, which will become the predominant wireless communications medium to support the ongoing Industry 4.0 revolution for the digitization and automation of manufacturing and process industries. This unprecedented level of growth is likely to transform private LTE and 5G networks into an almost parallel equipment ecosystem to public mobile operator infrastructure in terms of market size by the late 2020s. By 2030, private networks could account for as much as a fifth of all mobile network infrastructure spending.

The “Private LTE & 5G Network Ecosystem: 2024 – 2030 – Opportunities, Challenges, Strategies, Industry Verticals & Forecasts” report presents an in-depth assessment of the private LTE and 5G network ecosystem, including the value chain, market drivers, barriers to uptake, enabling technologies, operational and business models, vertical industries, application scenarios, key trends, future roadmap, standardization, spectrum availability and allocation, regulatory landscape, case studies, ecosystem player profiles and strategies. The report also presents global and regional market size forecasts from 2024 to 2030. The forecasts cover three infrastructure submarkets, two technology generations, four spectrum licensing models, 16 vertical industries and five regional markets.

The report comes with an associated Excel datasheet suite covering quantitative data from all numeric forecasts presented in the report, as well as a database of over 7,300 global private LTE/5G engagements – as of Q4’2024.

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