Private Networks

A regular column on the information industries

Peter Curwen and Jason Whalley

Peter Curwen is an independent scholar based in Leeds, UK. Jason Whalley is based at the Northumbria University, Newcastle upon Tyne, UK.

A dedicated private network involves micro towers and small cells that can be assembled very quickly with a view to servicing a particular geographical area to improve coverage and increase control and security. Such a network can deliver voice, text, data and video services and can be used to connect machines, sensors and devices (Internet of Things) and computing systems, as well as people.

Due to their relatively small scale, private networks provide opportunities for new vendors of core equipment to enter the market on competitive terms with the big incumbents – Cisco, Ericsson, Huawei, Nokia, Samsung and ZTE. The latter have tended to show little interest in deployments by SMEs and the advent of Standalone 5G that does not build on an existing network, in particular, has led to the appearance of the likes of Casa Systems, HPE, Mavenir and Microsoft/Affirmed which have an insignificant foothold in LTE network cores. It is also possible that smaller vendors in the LTE core market will migrate to the 5G standalone market. However, if the smaller vendors prove to be successful, they may well end up being acquired by their bigger rivals.

A thorough review of private LTE and 5G networks was published by Global mobile Suppliers Association (GSA) in February 2020. This listed (in Table 1: p. 3) the relevant organisation types as follows: ports and airports and other transport hubs; power generation facilities; manufacturers; neutral host companies; sports stadia; large enterprise campus networks and conference centres; mines and extractive industries; town and city networks; emergency services, government departments, civil contingency and critical national infrastructure operations; railways; shipping; healthcare; and utilities.

The industries where such networks are expected to have a bright future are in effect those where having machines communicating wirelessly among themselves can potentially much reduce the need for human supervision. The absence of cabling can potentially make it much easier to switch production facilities as demand ebbs and flows. Furthermore, not only can a private network be restricted in terms of access, but it can be "sliced" to prioritise specific functions.

According to the GSA in October 2020, the benefits can include:

- "Security and data control".
- "Access to services in locations not reached by public mobile

  ISSN 2398-5038 DOI 10.1108/DPRG-06-2021-181

networks" including indoors, in remote locations and underground.

- "Flexibility".
- "Improved quality of service".
- "Customisation" to meet the specific needs of organisations.

The GSA claims that there are a number of approaches to depicting private networks: "Organisations can build and operate their own networks, buy solutions from equipment vendors or systems integrators or even buy private LTE-as-a-service from a mobile operator". Some companies will "build the network but outsource operation, maintenance or support". Needless to say, there are issues concerning the availability of spectrum. Licensed spectrum can in principle be sub-licensed from a mobile operator, but it is preferable for it to be specifically allocated to a private network by the regulator. It is quite common for emergency services and utilities to have been allocated licensed spectrum in the pre-5G era, but the presence of additional spectrum dedicated to 5G usage provides new opportunities to allocate spectrum for private networks. Alternatively, either spectrum could be shared within a geographical area or unlicensed spectrum could be used.

According to the GSA, the most significant developments in specific countries as of February 2020 were as follows:

- Chile: In November 2019, the regulator identified the 3750-3800 MHz band for deployment using 5G NR.
- France: In March 2019, private network trials were authorised using the 26 GHz band and the regulator indicated a willingness to permit wider use of the 2575–2615 MHz band. This was confirmed in September on the basis of a regional allocation for rural enterprises. The 3490–3800 MHz band is also under consideration.
- Germany: In November 2019, the government offered spectrum in the 3.7–3.8 GHz band by way of regional licences for industrial and local usage, and in particular the agriculture and forestry sectors, with prices to be determined according to the bandwidth, licence duration and size of area to be covered. The 24.25–26.5 GHz band is also under consideration for 5G small cell and fixed-wireless applications and the 26.5–27.5 GHz band for local land-related applications.
- Hong Kong: In July 2019, the 27.95–28.35 GHz band was made available for Localised Wireless Broadband Licences on a geographical sharing basis.
- Japan: In December 2019, the government began accepting applications – other than from the incumbents – for local licences in the 28.2–28.3 GHz band for the provision of fixed-wireless services in an applicant's own buildings or on its own land. The 4.6-4.8 GHz and 28.3-29.1 GHz bands may be added later. In March 2020, Fujitsu was granted the first commercial private licence in Kanto province.
- Malaysia: It is intended that the 24.9–26.5 GHz band will be allocated via a beauty contest on a nationwide basis and that the 26.5–28.1 GHz band will be allocated on a first-come first-served basis for any appropriate purpose such as local/private networks.
- Netherlands: Spectrum in the 3.5–3.7 GHz band is to be made available on a national basis from September 2022. The 3400–3450 MHz and 3750–3800 MHz bands are subsequently to be made available for local use from 2026. The "Digital Connectivity Action Plan" envisages the use of the 26 GHz band either for a very large number of local permits or for shared use commencing in 2020.
- New Zealand: The 2575–2620 MHz band is available for local or regional Managed Spectrum Park (private) licences. Six-year licences have been on offer since 2009 when 80 licences were awarded, currently on a first-come first served basis.
- UK: In July 2019, the regulator opened up for immediate applications, on a coordinated first-come first-served basis, the 3.8–4.2 GHz band, the 1781.7–1785 MHz paired with 1876.7–1880 MHz (1800 MHz shared spectrum) bands and the 2390–2400 MHz (2300 MHz shared spectrum) band. There is also to be localised access to the 24.25–26.5 GHz band for shared use indoors.

In terms of equipment provision, it may be noted that in July 2020, Nokia launched a new platform for industrial companies developing their own standalone networks. Users have the choice between rolling out the Nokia Di Automation Cloud – a compact plug and play system – or customising their network with Nokia Modular Private Wireless.

An update to the above was published by the GSA in October 2020. Additional developments in the following countries were noted:

- Australia: The regulator intends to make available parts of the 24.7–30 GHz band on a nationwide basis via an administrative process to support private networks and local services.
- Belgium: Considering the issue of licences in the 3.8–4.2 GHz band.
- Brazil: A potential auction in 2021H1 for licences in the

2390–2400 MHz, 3700–13800 MHz and 27.5–27.9 GHz bands.

- Croatia: An auction is proposed to include a 90 MHz block in the 3410–3800 MHz band for potential use by private or local networks.
- Finland: At some future point, spectrum in the 24.25–25.1 GHz band will be reserved for private networks.
- Germany: The regulator was claimed to have issued 74 licences for private 5G networks by end-September 2020 including one to Huawei. In an interesting development, Vodafone Germany got together with Lufthansa to set up a standalone private network in an aircraft hangar – interesting because the licences were not intended to be attractive to national incumbents but rather to bypass them.
- Norway: Local/regional licences are under consideration in the 2.3 GHz, 3.6 GHz and 26 GHz bands.
- Russia: It is intended to offer blocks in the 400 MHz and 24.25–24.65 GHz bands for the creation of private networks.
- Slovenia: In the forthcoming auction, 2300–2320 MHz and 2390–2400 MHz is expected to be reserved for local use including private networks. This is also the case for 3400–3420 MHz.
- Sweden: Telenor Sweden claimed to have signed the world's first commercial agreement for a private 5G network with Atlas Copco in September 2020 using the 3.7 GHz band and based on Ericsson Industry Connect. An administrative award of spectrum in the 24.25–25.1 GHz is in hand with licences for indoor use to be issued before end-2021 and terminating at end-2025.
- USA: The FCC's Auction 105 covers the relevant spectrum. In October, AT&T Private Cellular Networks expanded its on-premises edge portfolio that included AT&T Multi-Access Edge Computing by linking up with Ericsson's Industry Connect in the CBRS shared spectrum band to provide private CBRS networks.

The two updates from the GSA clearly illustrate the scope of the developments that are occurring. While many countries are making progress with regards to spectrum, arguably less well developed are the pilots and trials that would demonstrate the feasibility of private networks. Similarly, while some countries have sought to integrate their initiatives into wider digitalisation plans or have focused their attention on specific sectors or industries, many have not.

In October 2020, Taiwanese industrial manufacturer Inventec launched a project that introduced automation and intelligence to its production line. This, the first fully-virtualised 5G SA network used in commercial industrial manufacturing, involved system integrator Wave-in, Affirmed Networks for the 5G Network Core and ASOCS for the 5G RAN. The spectrum was not specified. In December, Verizon began to develop its Ultra-Wideband mmWave service, in conjunction with Corning's indoor cells, to carry private networks in the USA, of which a major early example was WeWork.

An alternative source of detailed information on private networks has been published by 5G Americas. This 2020 White Paper "discusses how 5 G private networks are suitable for different groups of applications and details the specific architectures that are applicable in building a private network. The paper also analyzes how different types of spectrum (licensed, unlicensed and shared) can be utilized". However, much of the discussion is highly technical.

In February 2021, there was some surprise expressed at a deal whereby Anterix sold roughly 6 MHz of spectrum in the 900 MHz band to San Diego Gas & Electric for $50m – equivalent to $2.3/MHz/pop – as this indicated that spectrum bought for mission-critical LTE private networks operated by utilities in the USA to deal with matters such as power line failure was far more valuable than had previously been estimated. In August, NTT announced that it had launched the first globally available LTE/5G Network-as-a-Service platform branded as "NTT P5G".

Although there is a growing momentum behind private networks, with spectrum being set aside and companies developing their business models, there is also a degree of uncertainty. Private networks will appear in many different industries and geographical locations, with a multitude of different business models emerging. Within some of these emerging business models, telecommunication companies will play a more prominent role than they will in other cases. Mobile operators, who are searching for new revenue streams as they roll out 5G networks, may partner with the users of private networks, equipment vendors or IT companies to provide whatever services are being demanded. In some cases, mobile operators will play a prominent role in the business model being adopted, but in other cases they will play second fiddle to their partners or may even be excluded altogether as industrial companies or equipment vendors build and operate the networks themselves. It is likely that as private networks are rolled out and companies experiment with them a plethora of business models will emerge, but it is also equally likely that the range of business models will narrow as a better understanding of how they operate develops.

Corresponding author

Jason Whalley can be contacted at: whalley@northumbria.ac.uk