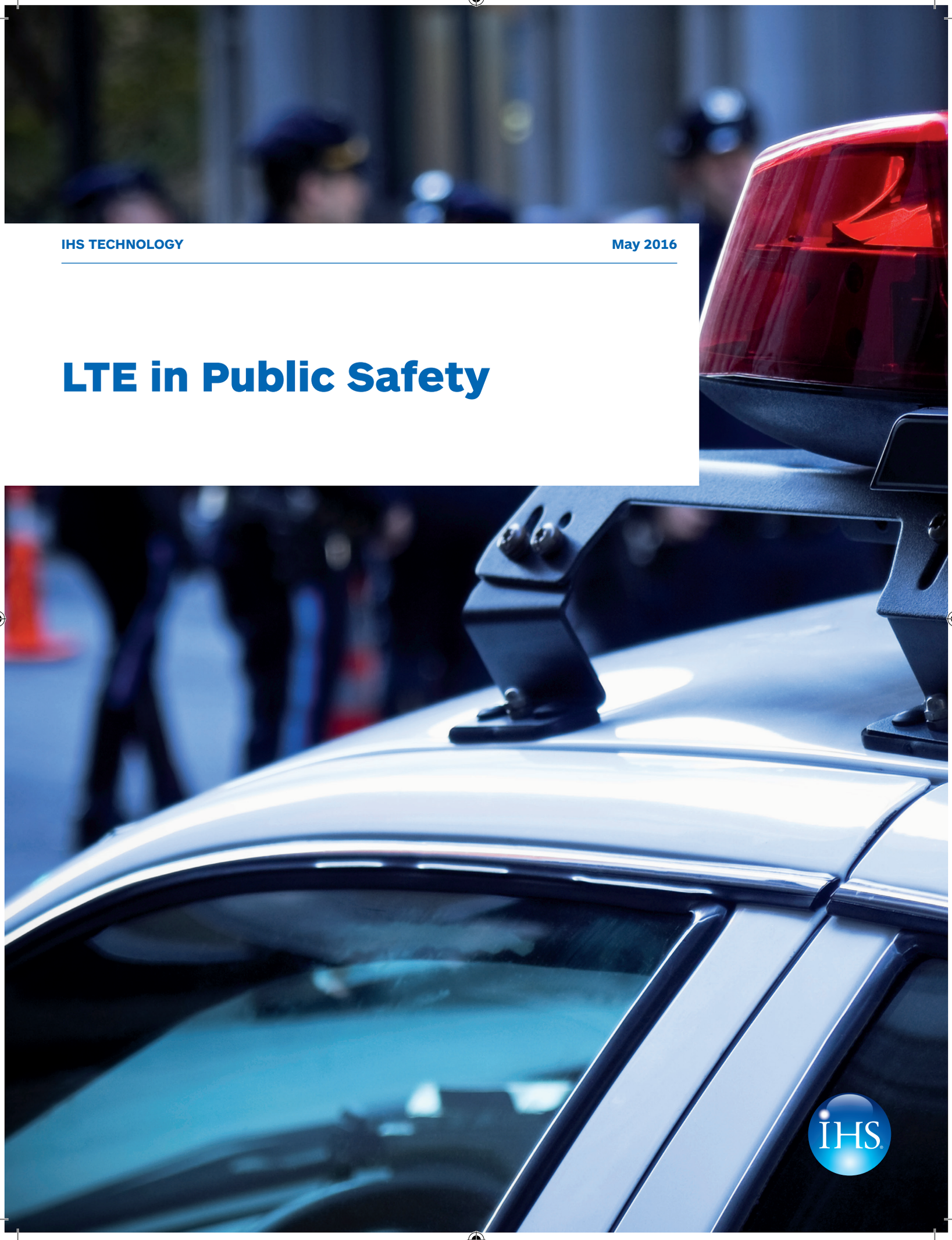


IHS TECHNOLOGY

May 2016

LTE in Public Safety

LTE in Public Safety

In 2015 globally:

$108 million	63 thousand	$539 million
in device sales for private LTE networks.	devices shipped for use on private LTE networks.	in private LTE infrastructure/ eNodeB sales.

Thomas Lynch, Director

The public safety sector is currently undergoing substantial change around the world. Over the past few years the industry has begun to understand the great benefit of LTE's influence on operations. Whereas in the past narrowband technologies, both analogue and digital, have been the communications technologies of choice, a desire for the capacity to accommodate high bandwidth data is pushing a transition to broadband communications. With suppliers now offering more LTE solutions, countries building national networks and with law enforcements' changing expectations surrounding their technology usage, it is evident broadband is the future of critical communications.

Background – Why LTE?

LTE's viability as an extension to operations in the critical communications industry has increased rapidly over the past 5 to 8 years. Previously, however, licensed mobile radio was always thought of as the sole communications technology of choice, and as such has had great success globally. Its reliability in mission-critical environments is unparalleled, and its wide-scale uptake is proof of its strong success. Over the past few years, the transition from conventional analogue radio systems to digital systems like TETRA and DMR has continued to gain traction. By 2019, over 60% of narrowband users will have migrated to digital, which means there is still significant opportunity for additional users to migrate to digital or perhaps an LTE capable solution providing broadband data capability on top of digital voice. Revenues for digital technologies currently account for 81% of the total market revenues indicating that users need the enhanced functionality of digital and are willing to make a greater investment in the technology.

These statistics offers great promise for LTE uptake. It is clear end-users require the more advanced features of a digital protocol for instance where additional features like "man-down", messaging, and group chat among other applications are possible integrations. LTE networks will facilitate these higher bandwidth-requiring technologies tremendously.

Currently the private LTE footprint is in an early growth phase, but this continues to change as the industry observes more successful use-cases and trial deployments. It is important that these successful use-cases, the opportunities and the advantages that LTE provides are communicated to the industry; this is especially true for the public safety sector, which tends to take up new technology much slower than the commercial sector. Education on LTE and its application in a mission-critical environment is imperative to promoting greater uptake of this technology.

Frequency

Spectrum is one of the most important considerations in the debate over LTE network usage in the public safety and Public Protection & Disaster Relief (PPDR) community.

For many high-bandwidth applications, such as real-time video/CCTV and biometric data analysis, narrowband data networks cannot deliver the same operational performance as broadband networks. However, where spectrum has already been allocated worldwide for the use of public safety communications over narrowband, the same cannot be said for broadband. Thus far, and with gaining momentum, several countries have allocated broadband spectrum specifically for PPDR and public safety use, with new announcements expected in 2016 and early 2017 notably in Europe, especially now after the World Radio Conference in 2015 where the ITU identified PPDR spectrum in the 694 – 894MHz frequency band to facilitate mobile broadband communications for mission-critical use.

As well as identifying spectrum in the 694-894 MHz range the resolution also identified that spectrum would continue to be used in other frequency ranges such as those above 1 GHz where already in China there have been a number of successful roll-outs at 1.4 GHz and 1.8GHz. This is similar in Brazil where 450MHz spectrum was installed in preparation for the FIFA World cup. Further references to spectrum roll-out are contained later in this white paper.

Open standards

For the LTE ecosystem to truly develop in the public safety sector, as traditional narrowband technologies have done, the ecosystem needs to grow around a standardised, open technology which encourages interoperability and cross-industry collaboration to provide the best technology for mission- and business-critical usage in the public safety market. Thus far, standards such as the LTE based broadband trunking 3GPP (3rd Generation Partnership Project) is making headway in this process, and the following sections explore the opportunities that the standard presents for the future of mission-critical LTE.

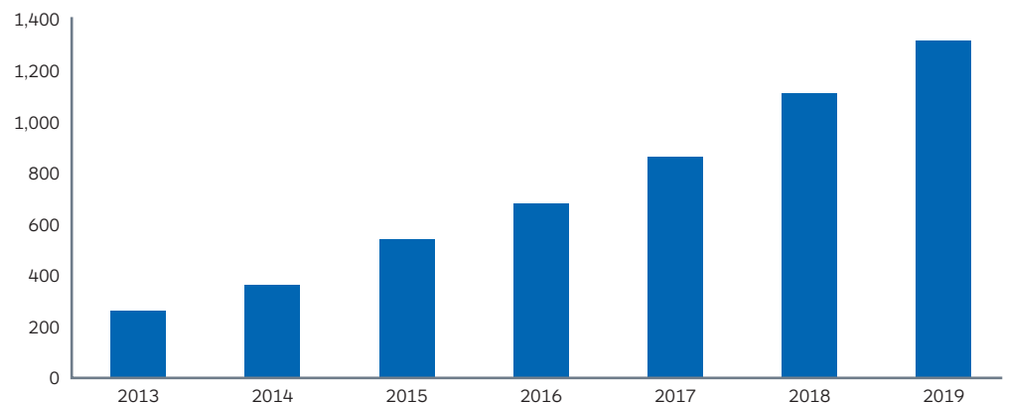
Governments and industry customers are actively involved in the development of 3GPP LTE broadband trunking standards in the PPDR, and other industries like railway sectors, with the latest release (release 13) delivered in March 2016. The major focus for all 3GPP releases is to make the system backwards and forwards compatible wherever possible, to ensure that the operation of user equipment is uninterrupted. According to 3GPP, "3GPP has approved a new LTE marker that will be used for the appropriate specifications from Release 13 onwards...intended to mark the point in time where the LTE platform has been dramatically enhanced to address new markets as well as adding functionality to improve efficiency". Release 13 was significant for the public safety community as it included a number of specific mission critical requirements including Mission Critical Push to Talk (MCPTT), Group Communication System Enabler (GCSE), Proximity Services (ProSe) enhancements, Isolated E-UTRAN Operation (IOPS). It also defined an agile broadcast/multicast mechanism Single-Cell point-to-multipoint transmission (SC-PTM), uses the eMBMS system architecture, providing enhancements for group communications in the air interface, with the character of high radio efficiency, short latency and easy deployment. The standard has been specifically designed with the requirements of PPDR users in mind. The LTE trunking and components of the release 13 described above are intended to provide broadband trunking for calls, video, real-time data and other features. Release 14 due in June 2017 carries this agenda forward.

Certainly, the development of any open standard for Mission Critical LTE is set to expand the LTE ecosystem even wider, and provides a solid, open platform for manufacturers of LTE to comply with and gives user the confidence of implementing a safe and reliable mission critical communications system which meets mission critical voice as well as broadband data requirements.

Current market and forecasts

IHS projects that the market for eNodeBs (for private LTE systems) will reach over $1.3 billion by 2019; longer term forecasts show even higher growth. For example by 2021 IHS project that there will be more than one million users utilizing private LTE systems. The technological capability already developed for the use of base stations for commercial markets has driven the development of eNodeB technology adapted for critical communications users. IHS expects that initially there may be a low number of devices per eNodeB, as the private networks first start rolling out radio coverage later increasing in subscriber numbers as end-users choose to adopt the technology across their organization. For national networks transitioning from traditional narrowband technologies, this may be reversed. However, within the critical communications space, complete coverage is essential. Therefore, in the longer term, IHS expects that the number of devices relying on a single base station at any one time will decrease as more eNodeBs are deployed to ensure greater coverage.

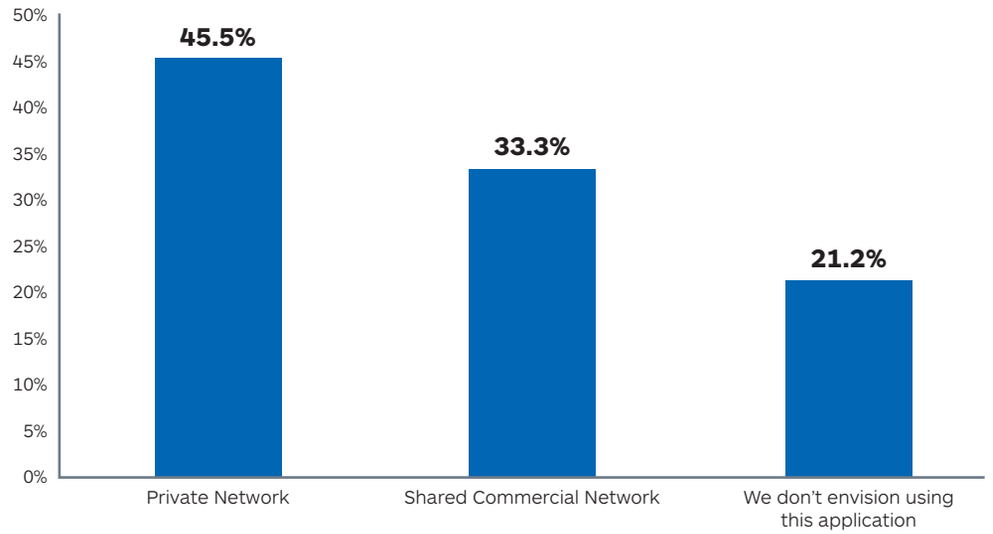
World - private LTE eNodeB market
LMR user agencies only
(Millions of USD)



Source: IHS

With a private network, users can be assured of guaranteed network access at broadband speeds without having to worry about commercial users saturating network capacity, particularly during crises. In addition, private mobile broadband networks would eliminate any recurring monthly fees and data caps associated with commercial networks. In a global survey sent to end-users in the critical communications industry across various sectors, 46% of respondents indicated they envision using private networks in the future. IHS expect that as per the operational requirements that have been used on narrowband, with dedicated access and ubiquitous coverage and reliability, that this will remain a requirement for broadband and expect high uptake of private LTE systems.

LMR users were asked, which type of LTE network would you envision using for your mission-critical operations?



Source: IHS

Deployment strategy and recommendations

Overview of private LTE models

Considering a global context private LTE is a relatively new offering for public safety; IHS believes much of the growth will take place at the end of the broadband research forecast period (2018-2020). As such, the most efficient routes to market and the collaboration between different industry parties are yet to be determined. While most in the critical communications industry use analogue or narrowband technologies, they need to look to the future and determine the ways that LTE can be monetized. End-users are facing a dilemma in the implementation of LTE, whether opting for a commercial MVNO or private network operation; if they choose private, how will the set-up and the maintenance of the network be ensured?

There are a number of approaches being pursued in the market today. These include routes either directly from an end-user perspective, a vendor perspective, or a combination of both: the hybrid approach. IHS has also identified an emerging model based on public and private convergence which is further discussed below. Ultimately, the most important aspect of selecting an effective business model for the private LTE system will depend heavily on how the end-users adopt the network (entirely or little by little), the budgetary constraints they might face, as well as the potential ways the network might be used (only data, voice and data or only voice).

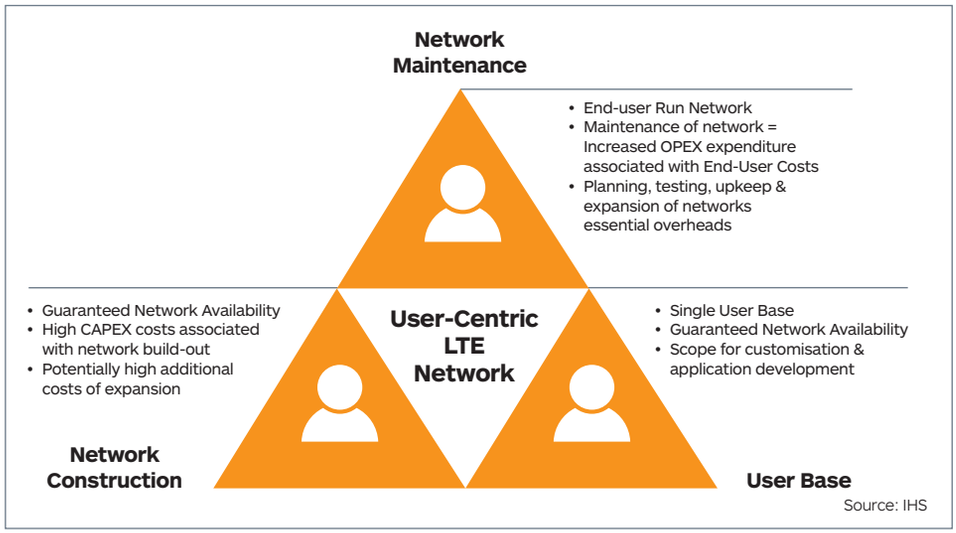
IHS highlights just three of these approaches, and a top-level analysis of each, also with a detailed look at the growing interest in the public and private convergence model

User-Centric	Hybrid approach	Vendor-centric
Constructed and maintained by the end-user This model is recognised core approach: a self-built and self-maintained private network, such as those built-out at a government of high-end national public safety level, and can be adapted to the requirements of a specific end-user. There is high CAPEX associated with this model, but network availability and longer term cost saving advantages may excel.	**End-user built, third party maintained** A hybrid approach can bring a number of benefits: CAPEX may be high, but the maintenance of the network falls outside of the end-user's remit. In this approach, the end-user can be assured of network availability, and reduced total spending by keeping OPEX with the third party.	**Constructed and maintained by third party** Some end-users will distance themselves from the network build-out and maintenance, offering seamless use of the system. The network may be simultaneously used by a number of end-users, which may be a concern for some organizations with regard to network access. However, reduced CAPEX is a substantial benefit.

User-Centric Private LTE

The primary advantage of a user-run and user-built network is that the network availability and access are guaranteed, with full customization options available. Undoubtedly, many national or government-funded organizations will opt for this route to maintain control of the network.

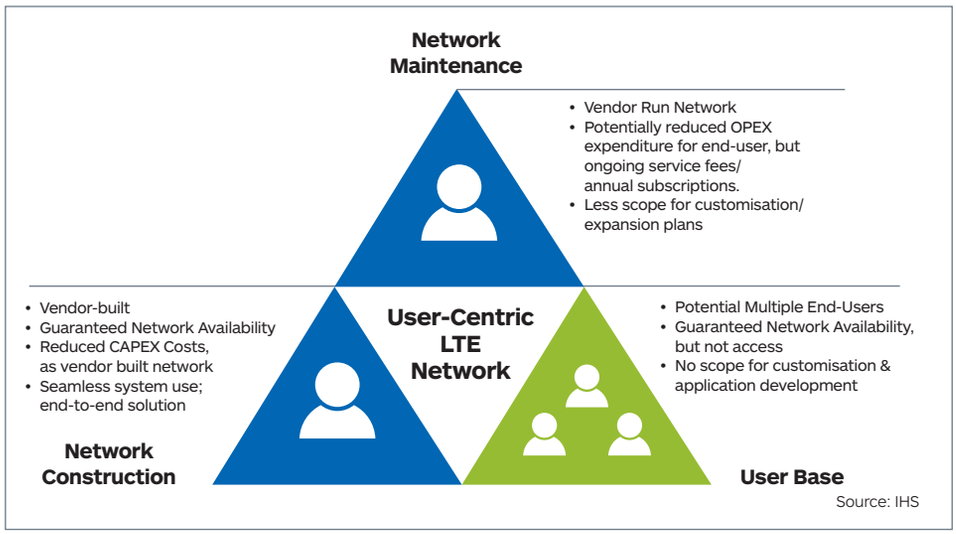
However, CAPEX and OPEX costs are relatively high for this type of network build-out. This is another reason why the majority of end-users operating this type of network will be national public safety or government-run organizations. User-centric private networks are the most common deployment strategy seen in the Narrowband market.



Vendor-Centric Private LTE

The primary advantage for the end-user of vendor-centric LTE systems is the initial expenditure is swallowed by the vendor, so investment is not that high. However, these systems will typically offer service fees and subscriptions to use the network. Similarly, as the network is vendor-built, the vendor is able to open the network up to multiple end-users. This may pose a concern for the end-user but offer opportunities to reduce the OPEX for the individual end-user due to sharing operational costs and overheads.

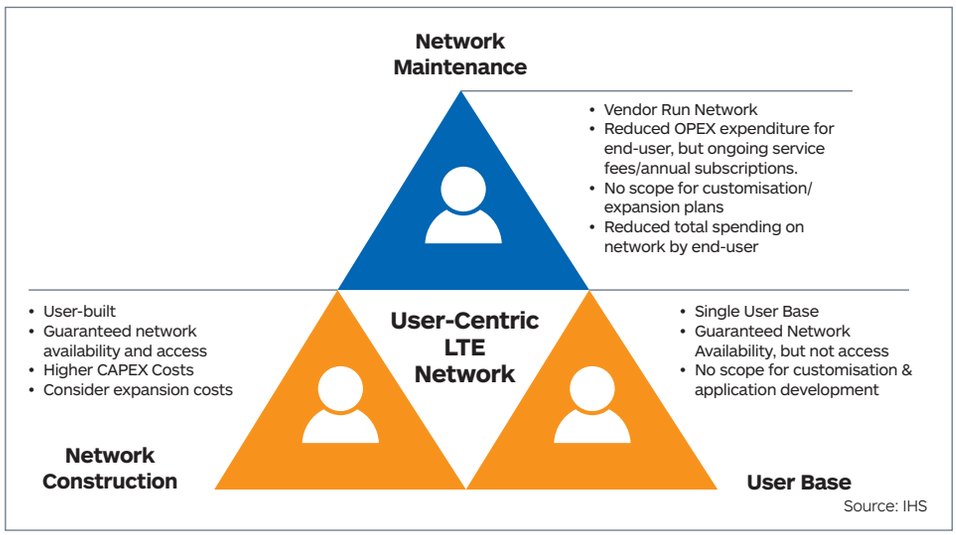
Typically, this type of network is most appropriate for smaller end-users looking to migrate to LTE without raising capital to do so.



Hybrid Approach to Private LTE

The hybrid approach – a self-built and externally-maintained network – can be beneficial for many end-users looking to guarantee network access and invest long-term in LTE network construction, yet reduce overall expenditure. By keeping maintenance vendor-led, the high ongoing costs of upkeep are substantially reduced.

This type of model would be suitable for larger end-users with a specific, complex requirement, with access to capital, but possibly not wishing to continually invest in network maintenance.



Public and private partnerships

This model allows users to both operate a private network as detailed above but also allows users to extend coverage by utilizing an existing public 2G/3G/4G networks. In the US where the FirstNet mission-critical network is already being rolled out many of the conversations around ensuring state wide coverage involve creating the link between the public and private networks. In this case, once the trunking user moves out of the private network, it will access the public network through an upper layer IP data connection back to the PTT server, meaning that the user can still access the full range of services, broadband and otherwise, regardless of location. For example, for trunking services crossing national borders, it is possible to connect two countries' LTE networks via an international roaming service provided by the public network.

There are also developments in mobile applications that can as well as being installed on a broadband trunking device can be installed on any commercial smart phone allowing the user to access trunking specific services through the public network's data connection.

The primary advantage being that because of LTE, as this has never been possible with legacy narrowband systems, it is now possible to utilize a cost effective strategy to expand private network coverage, perhaps into more rural locations where a private LTE system may not have been considered.

Implementation strategy

Demand for data is increasing, as more users expect more sophisticated, high bandwidth and high capacity applications on their networks. IHS notes that there will be a 15% increase in shipments of Narrowband LMR data devices between 2014 and 2019. IHS anticipates that while spectrum develops, users using technologies such as TETRA, TETRAPOL, P25 and DMR are well positioned for a transition to broadband technologies.

Even with the growing discussions around the 'broadband future' of the LMR industry, IHS projects that for the LTE ecosystem to become effectively established a transition phase must occur from traditional narrowband networks to the broadband networks. There will be some users, especially those operating national or large-scale networks, willing to switch off existing narrowband networks immediately for a swift transition to LTE; there will also be new projects/sites and users (Greenfield) adopting mission critical LTE communications. The need for an end-to-end solution will be needed more than ever as end users undergo a significant increase in operational capability through the use of applications, network, terminal evolution and partner collaboration. This will happen over time but already organisations such as the TCCA and the eLTE Industry Alliance has been focused on creating this ecosystem through an open and collaborative approach.

Further, IHS understands that there will also be a level of convergence in the LMR industry, with LMR suppliers offering both narrowband and broadband solution simultaneously. High-end customers, such as those operating national public safety networks, or large-scale operational networks, are those most likely to consider a switch across to LTE in the near future. Many of these organizations are currently operating higher-end narrowband technologies such as TETRA, TETRAPOL or P25. With a migration strategy looking likely from TETRA to LTE technology – especially in the United Kingdom – there is a chance that those operating TETRA networks may consider a quicker transition to LTE than those using other technologies. Of course, a total transition may need managing in the short term, and therefore a migration over a number of years is the most likely for current TETRA operators. There are the potential pitfalls around double coverage to also consider and the requirements for even further stringent testing on multiple layers LTE/TETRA dual mode operations. TETRA is a mature, tried and tested narrowband technology but standardisation of TETRA/LTE gateways are yet to be rolled out to ensure interoperability of such multiple layers networks. The industry should consider the benefits of continuing to use TETRA for voice communications: certainly when coming from a brownfield scenario. MCPTT (mission critical push-to-talk) has now been standardised in the latest LTE release and eases difficulties to migrate from narrowband with identical feature sets as well as it offers the opportunity for Greenfield situations to avoid the costs of multiple layer implementations.

IHS considers those operating the mature TETRA, P25 and TETRAPOL networks to be early adopters of new communication technologies; but those currently migrating to newer technologies such as DMR may not consider a second transition to LTE quickly since broadband services would not be on their scope. However, there is of course an opportunity for DMR users to migrate to LTE in the longer term once they require broadband services.

Users operating on trunked analogue networks, however, have a unique opportunity. Whereas users operating a digital narrowband technology may still be waiting for a refresh cycle, or a return on capital investment, those operating trunked analogue networks may be considering next options. Some end-users may consider it important to leapfrog digital narrowband technology; and migrate directly from analogue to LTE. IHS is already starting to note this trend.

With continued national network trials and rollouts as well as successful use cases, LTE will become commercially viable to the mass public safety market. The increased demand from the public safety sector for better intelligence and situational awareness means that LTE and predictive policing will ultimately go hand-in-hand. Mobile broadband can help emergency services by creating more efficient processes, using live mobile video, situational aware dispatching and remote diagnostics with all of this only possible with a diverse ecosystem of contributors working together on an open platform and communications standard approved by global standards bodies such as the 3GPP.

Ecosystem development

As with a single vendor narrowband system, a private LTE system can also be procured from a single vendor and can involve very little complexity given the benefits involved with having an open standard platform and implementation strategy focused around a more flexible and contained ecosystem. However, as the network used for private public safety communications is typically owned by the public safety organizations themselves, or by government-owned arrangements, ecosystem development can become more complex. As such, there are a multitude of procurement channels that need to be assessed before a private LTE system is put in place, as well as a much wider ecosystem stakeholder group involved with the opportunities presented by using LTE. One consideration in the procurement of a private LTE system is the ownership of the system, and therefore which procurement channel is best placed for the situation.

There are a number of ecosystem opportunities in the development of private LTE but two different layers that must be taken into account when considering the potential for the ecosystem stand out: the service & operation layer and the LTE network layer. The operation of the mission-critical services are almost independent of the LTE-based network operation, and all services, systems and LTE radios communicate via the IP interfaces and the backhaul LTE network.

The operation of the service layer is typically set up, run and managed by either the network operator in conjunction with the public safety organization; this creates a number of opportunities for system design and managed services. If government-led, the management of these systems and the applications and terminals will also be the onus of the government organization. This layer can primarily be implemented as application services within the public safety organizations control room systems, and can run across LTE connectivity services – it is in this instance that applications suppliers can provide innovative solutions to connect the control room to the end user devices. This allows the network set-up, planning and installation of services and public safety systems to be completed almost independently of the private LTE backhaul network. IHS suggest that having a supplier that fully understands such complexities or at least a partnership program in place is paramount to ensuring successful large scale project roll outs and another reason why IHS believe that ecosystem development is important.

IHS has determined that, as a result, there are a number of supply chain variations in the private mission-critical LTE ecosystem as noted previously. However, in the case of an operator-led network, mobile network operators (MNOs), infrastructure vendors or system integrators could also own parts of the network. Added to this there now exist additional layers of value being added such as those where an LTE system vendor may concentrate on the network, with device suppliers ensuring a device that is ready to maximize the opportunities in applications such as video as well as independent software vendors developing the next generation of mission-critical applications. Ultimately, the ecosystem could become extremely complex and will require an important and significant level of cooperation to ensure an end to end solution for the public safety end user.

Actual deployment status and progress in select regions

Asia Pacific

South Korea has already dedicated frequencies in the 700MHz channels, and there are trials in South Korea and Hong Kong for the 700MHz frequencies. Australia, however, has designated channels in the 800MHz frequency bands, along with Singapore; and Hong Kong is operating trials in the 400MHz and 700MHz channels. China has commercial projects for public safety in the 1.4GHz and 1.8GHz channels.

North America

In the United States, the roll-out of broadband data over LTE is currently positioned as an overlay system to existing LMR voice systems with separate funding allocated to both agencies. As part of the Middle Class Tax Relief and Job Creation of February 2012, the allocation of the 700 MHz D-Block spectrum for a nationwide public safety network was granted. IHS further notes that, in gaining the D Block spectrum, 11 of the largest metropolitan areas were to forfeit by 2023 their spectrum, known as T-Band, which currently supports mission-critical voice. There are heavy costs (estimated as billions of dollars) in moving from the T-Band spectrum; IHS understands that currently some major areas, such as Chicago, New York, Boston, and Philadelphia, have yet to create plans to do so. Three years ago, Industry Canada reserved 20 MHz of the 700 MHz band for the development of a Public Safety Broadband Network. The first 10 MHz was allocated in February 2012. Canada has also indicated that an additional 10 MHz of broadband spectrum would be allocated to public safety communications along with funding in 2016–2017.

Latin America

Some countries are leading the way in assigning spectrum and carrying out trials using the data applications available with a broadband network. An example is Brazil, with the Sao Paulo Military Police, which is using video and data at its police centers on 700MHz LTE. For the 2014 World Cup, a two-year trial of the Brazil's public safety LTE broadband network was needed, as well as enhancements to its P25 network. IHS projects there will be continued investment in both networks in place for the 2016 Olympics. In Chile, the government reserved 700 MHz spectrum for public safety following studies that measure digital TV broadcasting in the adjacent band. The frequencies allocated are 703-713 and 758-768 MHz bands for total or partial use by the public safety sector.

Europe

In Europe, the World Radio Communication Conference 2015, held in Geneva, identified spectrum within the 694-894 MHz range for public safety and disaster related mobile broadband communications. Many organizations within Europe have been waiting for this decision for some time, and the identification of this spectrum for public safety use offers a realistic prospect of an expanded LTE ecosystem in Europe. However, it does require individual European countries to approach the topic of public safety spectrum. IHS remains optimistic in regard to the cellular future of public safety and believes the industry will ensure this ecosystem is developed. The ECC report 199 identifies a need for a minimum of 2 x 10 MHz of spectrum below 1 GHZ for PPDR broadband in Europe, not including requirements for voice communication, Direct Mode Operation (DMO), Air-Ground-Air (AGA), or ad hoc networks. France also has ongoing trials in the 400MHz frequency bands. In July 2015, France chose to exercise its right under European law to allocate a 2 x 5 MHz and a 2 x 3 MHz block in 700 MHz for use by the PPDR sector. The decision for the 698 – 703/753 – 758 MHz and 733 – 736/788 – 791 MHz allocations was incorporated into the legal corpus but will be enacted in July 2019. The UK as part of its ESMCP project is also in the process of adopting LTE.

Middle East

Currently, there are several trials in the Middle East, particularly in the public safety sector. In 2012, the United Arab Emirates (in both Abu Dhabi and Dubai) announced its intention to allocate the 700 MHz band for mobile broadband services. Qatar has already built its own public safety LTE network with commercial LTE equipment in the 800 MHz band, while maintaining its existing TETRA network for critical communications. There is no suggestion yet of a unified spectrum allocation for countries in the Middle East, although so far trials indicate that a sub-1GHZ channel set will be used.

Africa

There has been little development in the allocation of broadband spectrum in Africa. However, a few trials have been conducted in some countries and Kenya has rolled out a high-end public safety network as part of its wider safe cities upgrade. Africa continues to be a development market for LTE. With limited existing infrastructure in parts, it is much easier to move straight to an LTE model, especially if a project such as a safe city is in development. IHS is also aware of a number of other projects in Kenya, Nigeria, South Africa, Ghana and Ethiopia, although there is some debate over which frequencies will be used if moved to commercially operational networks.

Regional progress of LTE

Americas

FirstNet - initial deployment phase complete. An example is the completion of 77/78 proposed sites for LA-RICS, with a five year extension secured to complete rollout.

Inhibitors to further development may prove to be a concern, such as legislation and public safety co-operative partnerships. The finalisation of FirstNet will contribute to the LTE ecosystem.

EMEA

United Kingdom, Finland and France all have unique roadmaps to the deployment of public safety LTE. While currently not private networks, each will contribute to the expansion of the LTE ecosystem.

Middle East - construction of two major private LTE networks already underway for public safety use. IHS forecasts further developments during 2016.

Asia Pacific

SafeNet - South Korea - dedicated public-safety LTE network to be deployed by 2017.

China - deployment of two major private LTE networks for the Shanghai police and for the Nanjing LTE Municipal Network.

Source: IHS

Industry associations involved with mission-critical broadband communications

Inevitably, the expansion of the LTE ecosystem will not be possible without the influence, the expertise, the open framework and the political capital of industry alliances. Industry associations (the eLTE Alliance and the TCCA CCBG–TETRA and Critical Communications Association; Critical Communications Broadband Group) are pivotal to the transition from narrowband data to broadband, and will ultimately help the industry establish best-practice protocols and combat interoperability concerns as the ecosystem widens. Partnerships will be essential moving forward as there are approximately 80 member companies in the eLTE Alliance, each providing unique solutions.

TCCA CCBG

The TCCA CCBG drives the development and adoption of common global mobile broadband standards and solutions for users who operate in a mission critical or business critical environment. The CCBG also works with the TCCA's Spectrum Group and PSC-Europe to lobby for appropriate harmonised spectrum in which to deploy critical broadband services and applications.

The aim of the CCBG is to enable all mission critical and business critical users to access their information systems, intranet and internet at broadband speeds using their professional mobile devices wherever they are and whenever they have the need. This broadband capability should meet the specific needs of the user in the same way that critical voice and narrowband data services are currently delivered by technologies such as TETRA, Tetrapol, P25 and others.

eLTE Industry Alliance

The goal of the eLTE Alliance is to develop and promote LTE solutions for enterprises (eLTE), relying on joint-member innovation. The alliance is promoting a 3GPP standard based LTE voice trunking and broadband data solution for the mission critical sector, with the aim of enhancing end customer experience of the mission-critical features like voice trunking or end to end encryption.

Conclusion

The demand for broadband capability on mission critical systems and in particular for public safety and PPDR agencies is ever increasing with the ability to provide an end to end solution key to a successful migration. As well demand, work to standardize a global standard through the 3GPP and the formation of industry alliances such as the TCCA CCGB and eLTE Industry Alliance is pivotal as more public safety end users look towards a broadband future.

Harmonization of frequencies and spectrum allocation are also critical in ensuring end users have the most effective capability to ensure interoperability as the ability to utilize the latest applications such as video based technology in a cost effective and value driven environment. Spectrum has already been assigned in some key nations including in the United States, China, and the Middle East and in parts of Europe – IHS expects further announcements during 2016 and 2017 that will allow an even faster migration to private LTE for public safety users. IHS also believe that the demand for private LTE systems with the choice of options of a number of different adoption models will allow public safety users to migrate or invest in greenfield sites in a way that is most appropriate for that particular agency. Market indications from IHS research indicate that the market will more than double in the next three years and grow exponentially from 2019 – now is the time to be planning and investing in a public safety broadband future.

To support such acceleration in mission-critical broadband demand, there will also need to be a strong collaborative ecosystem of vendors across multiples tiers offering network, device and application services. This creates many opportunities for the vendor community to come together and deliver best practice operational solutions but more importantly ensures that public safety end users have the right applications (broadband capability), in the right place at the right time!

For more information

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