WHITEPAPER

MISSION CRITICAL BROADBAND: REALITY OR MYTH?

sepura

Going further in critical communications

APPLICATIONS

TERMINALS

SYSTEMS

Mission critical communications currently rely on dedicated private mobile radio (PMR) networks to provide a high grade of service for availability, reliability and security. Worldwide, many of these networks are based upon the TETRA standard, providing narrowband voice and data services to its users.

TETRA networks' voice services are of excellent quality, with good speech intelligibility in high ambient noise conditions – an important element of any mission critical operation. TETRA also provides a wide range of data services, from simple – but very fast – status messaging and text messages through to IP data capabilities.

Mission critical users have, until now, largely relied on voice services but are evolving their operations to encompass many more data services and applications, many of which can be carried over TETRA. However, there is an increasing need for the use of data services such as video and internet access, which have higher bandwidth requirement than narrowband systems can deliver, and thus require broadband data services, such as LTE, to satisfy demand.

But when will there be truly mission critical broadband? This whitepaper looks at the situation today and considers the possibilities for the future.

PMR NETWORKS & COMMERCIAL LTE NETWORKS: THE FUNDAMENTAL DIFFERENCES

PMR networks are specialist networks delivering mission critical communications services, a specific feature set and a high grade of reliability and availability.

These networks are designed to provide a high level of inherent resilience and redundancy in their architectures. Dimensioned to provide a specific grade of service at peak load to the user groups they serve, if peak demand is overreached, calls are queued, rather than dropped.

PMR networks are also typically designed to cater for coverage – usually based upon geographic coverage rather than being capacity-centric. The services on a PMR network are designed for command and control operation, focusing on group-oriented services to enable fast and efficient communication and dissemination of information.

By contrast, commercial LTE is a technology that is good at what it was designed for: point-to-point high-bandwidth data services.

LTE network architecture is hierarchical in design and therefore centralised; a failure at switch level can take out an entire network. Therefore, network resiliency is not present to the extent that it is in PMR. Commercial LTE networks are designed for capacity and are usually built on population – rather than geographic – coverage. They are also designed for 'busy hour' capacity, with blocked and dropped calls as part of the metric. This is to fit a commercial carrier economic model where failures and drops are an acceptable part of the quality of service (QoS) definition.

Capacity calculations are very different between PMR networks and commercial LTE networks.

For LTE, the cell edge has to be dimensioned for a targeted level of service. TETRA can deliver a group call to many participants (e.g. all users) using a single TETRA channel. However, to deliver the same group call capability in commercial LTE, the cell would have to be dimensioned for a large number of unicast bearers (equal to the maximum number of expected participants in the group, which could be hundreds). This will obviously significantly impact capacity on a cell. In addition, any multiplexing gain is reduced due to the fact that in group calls all traffic events are synchronised, which presents a dimensioning issue.

PMR AND LTE: FEATURE SETS TODAY

When looking at the differences between LTE and TETRA, it is important that the comparison is made of what is *available and deployed in the market today*. 3GPP standards are still being drafted; many feature sets are still at a theoretical stage and their implementation and deployment may still be some years away.

TETRA feature sets have been built to match the operational practices of mission critical end user organisations:

- **Priority**
  TETRA systems have a very sophisticated and complex feature set regarding the priority and QoS between users, including managing priority between groups, user communities, emergency calls, voice versus data, and priorities of individuals versus groups. This includes pre-emption of both radio resources and services, enabling the most critical users to always achieve their allocated QoS.

  These services are not replicated in commercial LTE.

- **High availability**
  TETRA has a very resilient architecture that provides fallback at many levels – including isolated cell operation when the backhaul to the network is compromised. This is particularly important in rural areas, where there are large cells with little overlap.

  There is no equivalent feature in LTE, as all information has to be retrieved from the core network. Site resiliency is usually achieved by cell overlap; however this can lead to very high infrastructure costs due to the high number of base stations required, especially in rural areas.

- **Device power**
  TETRA devices have a significantly higher transmit power than commercial LTE devices – typically between 32.5dBm and 34dBm (34.7dBm and 40dBm for vehicular devices), compared to 23dBm.

  This allows for much larger cells in TETRA – even at the same frequency band as LTE – and improved geographic coverage.

- **Direct mode**
  When network access is not available, TETRA provides a peer-to-peer communication service. The higher transmit powers of devices enable long-range communication between devices – in excess of 2km. There is no comparable service currently available in LTE.

  TETRA devices also support DMO gateway operation. Essentially extending the range of the network, this enables off-network users to communicate with on-network users, using the same equipment they use every day in their vehicles.

LTE relays are available, but are costly, requiring additional equipment and LTE spectrum, usually in a different band.

SECURITY

Mission critical communications enable confidential information to be passed safely over the network and held safely and securely on devices once delivered.

TETRA includes highly secure encryption mechanisms as standard – with robust mutual authentication of devices as well as air interface encryption to protect identities and content between the device and base station. End-to-end encryption provides strong protection across the entire network. Different algorithms and key length options are available to tailor the level of security to user needs.

User organisations may want control of their communications assets; they may demand detailed audits of the entire ecosystem's security mechanisms or impose specific security features on the equipment to ensure it will protect against particular threats and meet national security demands, protecting the confidentiality of the users and the information they are passing over the network.

LTE has its own security mechanisms and 3GPP are in the process of standardising additional mechanisms for MCPTT. However, depending on the network ownership model, control of these may not entirely be in the hands of the mission critical users. Specific security additions are unlikely to be available for mission critical users where they are using commercial equipment.

Most LTE devices use a standard commercial operating system and associated security models. If policies are applied rigorously, a level of security can be maintained on the device, but most of the security within commercial operating systems is designed to defend the systems themselves, not users' data. There is a large and determined industry involved in circumventing these security mechanisms to gain access to users' data.

Many of the security requirements of mission critical users will not be addressed by these operating systems and bespoke solutions will be required.

SPECTRUM: A PRECIOUS COMMODITY

Spectrum is an essential resource required to operate any wireless network. It is a finite resource and an expensive commodity – particularly in the most advantageous bands to deploy LTE networks.

To balance coverage and capacity requirements of a mission critical deployment, it is advantageous to operate in spectrum less than 1GHz. Using spectrum above this is possible, but as the frequency increases, the cell size decreases, making the cost of achieving coverage comparable to a PMR network very high – or prohibitive – due to the elevated number of base stations required. Consequentially, backhaul costs are also significantly increased.

The most popular bands are in the 700MHz range. Sought after by both commercial mobile operators and mission critical users, they typically come at a very high price. Government organisations responsible for spectrum allocation must balance the needs of their mission critical users against potentially high revenue opportunities from the auction of this spectrum to mobile operators.

There are over 70 frequency bands supported by the LTE standard, ranging from 450MHz up to 5GHz. However, the equipment available is generally limited to the relatively small number of bands used by commercial operators – particularly in the case of devices.

If the intention is to operate a LTE network with dedicated spectrum, the cost of the spectrum and network infrastructure must be carefully assessed alongside the business benefits it will deliver.

> "To operate a LTE network with dedicated spectrum, the cost must be carefully assessed alongside the benefits it will deliver"

COST VERSUS CONTROL

Using a dedicated LTE network – following the same deployment model as PMR networks – is a very attractive option to mission critical users, as it provides full control over communications and security and resilience that is tailored to suit the organisation's needs.

However, such a solution depends on the availability of dedicated spectrum, combined with the budget to deploy an LTE network with the coverage and resilience required for mission critical use. Due to the high infrastructure and spectrum costs – even using optimal spectrum – this is a very expensive approach and one that, in the current economic climate, may be difficult to accomplish. An alternative is to share a network with a commercial cellular operator to provide a service to mission critical users.

This could be in the form of a standard commercial contract providing a 'best efforts' service – the establishment of a managed virtual network operator (MVNO) run by the mission critical organisation providing a degree of control over users and potentially some differentiated level of QoS – or a partnership with a commercial operator to provide a hardened service for mission critical users.

The downside to this solution is that mission critical organisations may lose some or all control of the communications services provided to their users and, depending upon the sharing model adopted, may not have the same level of security as a mission critical PMR solution.

However, it is important to remember that, regardless of the deployment model selected for an LTE network, until the standardisation of both mission critical voice and data services is completed – or a proprietary LTE solution is adopted with mission critical functions implemented and available in both networks and devices – this will not be a truly mission critical solution. Rather, it will provide an overlay service with differing QoS, depending upon the model chosen.

TETRA-LTE: HYBRID OPERATION

How to best make available broadband services to mission critical users, balancing costs and benefits, is not an easy decision. Key services, such as video, cannot be supported by narrowband PMR networks: it is increasingly apparent that the majority of mission critical organisations are preparing to use hybrid solutions to gain access to the benefits of broadband as quickly and economically as possible.

PMR networks are planned to be operational for many years to come, for mission critical voice and applications that can utilise narrowband data and to ensure a coverage footprint appropriate for mission critical use.

These networks are being supplemented with a complementary broadband overlay network using a shared service – the choice of which depends upon the criticality of the services they are required to run, and range from MVNO operation by the mission critical organisation to using a standard commercial contract.

This hybrid solution supplies all the benefits of a mission critical service with the benefits of broadband access. Although the broadband will be non-mission critical, this service may still have a higher QoS than a commercial subscriber.

MISSION CRITICAL LTE: WHEN WILL IT TRULY HAPPEN?

Work is already in progress to define the next-generation technology for mission critical communications; this is widely accepted as being based upon the LTE standard.

LTE Release 12 is scheduled with some enablers; mission critical voice services will be added to Release 13, and mission critical data services to Releases 14 & 15. This is termed LTE Advanced Pro.

Planned work on the standards is due to complete in 2018, although deployment will be some time after this and will be determined by business reality, rather than the readiness of the standards. Features have to be implemented into the network equipment, but also into chipsets for user devices; this can take several years to filter through to chipsets available on the open market and will only be implemented by manufacturers if there is a business case to do so.

The market estimate for public safety users worldwide is 17 million, compared to an estimated 4.8 billion commercial subscribers today – a figure which is predicted to rise to 6 billion in 2020, according to the GSMA. Mission critical users thus form a very small percentage of the market and have limited leverage with commercial vendors.

Features specified in Release 12 in 2014 are not yet available in commercial chipsets in 2017. It is therefore expected that there will be a 5-6 year lag between specifications being finalised and true mission critical products becoming available.

CONCLUSION

Until such time as LTE products and networks are proven to be truly mission critical, today's PMR networks will be the only true mission critical service available. Through necessity, they will continue to operate for the next 10-20 years, enjoying a long co-existence with broadband technologies.

Only when sufficient spectrum is available to enable economically viable broadband solutions with the same grade of service and functionality as PMR networks is the situation likely to change. Until then, TETRA networks will retain their position as the dominant force in mission critical communications.

To discuss your communications requirements, get in touch with your Sepura contact or visit www.sepura.com