Is LTE ready to enhance forces’ awareness?

4G/LTE for military

Application note
Abstract

Two main elements make 4G/LTE attractive to military forces:

• Its broadband capability, a key enabler to ensures forces’ information superiority, so essential in network-centric warfare

• Its cost competitiveness, coming from a commercial off the shelf (COTS) technology, at a time where military programs’ budgets and effectiveness are heavily scrutinized.

But is this technology compliant and suitable for military requirements? In this paper we look at the latest technological and market developments that are making LTE a mission-critical, secure, highly relevant solution to fulfill numerous tactical communications needs of armies and allow those forces to have a much better situational awareness.
Introduction

When looking at the history of mobile communications, it is not surprising to see that military forces drove the development of these technologies for decades, given the critical importance to have superior situational awareness for the success of their operations. It is more astonishing to see that a vast majority of military forces still rely on voice-centric communication systems for many tactical communications, while at the end of 2016 more than 1.7 billion people in the world were consuming high-quality video and accessing information instantaneously almost anywhere, anytime on 4G/LTE mobile networks. To close this gap and benefit from the faster technological developments in the civilian industry, we start seeing many defense organizations looking deeply at LTE technology, particularly as it is expected to be a very competitive solution, offering best-in-class value for money. But can this technology, developed for consumer or commercial usage, be a credible solution for military forces and their specific needs?

Armies have specific communications requirements

With the widespread availability of LTE smartphones and tablets, of sensors and drones, armies are thinking that they can leverage these low-cost devices to improve their situational awareness during operations, and to get access to enhanced applications more easily. These applications include:

- Group video communications (one to many)
- Military base, camp, convoy video surveillance
- Shore and border control enhancement
- Real-time troops geolocation
- Real-time vital signs monitoring of soldiers

Some of these applications require specific network features to be properly handled. They also have very different traffic profiles (from high-speed upload of HD video feeds for surveillance, to large numbers of small individual traffic feeds for monitoring soldiers’ vital signs), which often differ from consumer applications in that they generate strong upload traffic.

A second key characteristic of an army’s need is the very strong network resiliency and security, to guarantee communications are kept up and running and secure even in very tough conditions. The levels of robustness required for the equipment may vary depending on the use case (i.e. from combat communications to providing internet in military bases), but in all cases they are much stronger than for commercial networks.

Finally, armies are operating everywhere in their national territory and also
abroad (e.g. in UN missions), and thus must be able to have transportable systems to make sure they have access to the service wherever they operate.

Fulfilling all these needs requires significant adaptation from the standard initially developed for commercial usage.

Moving from commercial to mission-critical and military grade

Fortunately, 4G/LTE has been adopted by the public safety community as their mobile broadband communications system. As a consequence many of their requirements have been added to the 4G/LTE standard over the past few years. Practically speaking it means that LTE is becoming a truly mission-critical grade technology. Many of the specific requirements expected by military forces are or will soon be available in COTS solutions, making 4G/LTE increasingly relevant for some military use cases. Here are some of the main features related to public safety brought by LTE standardization. (Keep in mind that most of them are also relevant for military purposes).

• Release 12: Encompasses group communication system enablers for LTE, QoS management for Public Safety, proximity services (direct discovery and device-to-device direct communication). It is to be rolled out in 2017.

• Release 13: Includes mission-critical Push-to-Talk (PTT), Isolated E-UTRAN Operation for Public Safety (IOPS or the ability for a base station to operate in a stand-alone mode), and enhancements to multimedia broadcast, multicast service. The perimeter of the release was completed in March 2016 and the product will reach the market this year in 2017.

• Release 14: Will support mission-critical video and data over LTE, enhancements to IOPS, and interworking with legacy LMR/PMR networks. Release 14 is expected to be finalized in the middle of this year, with first product readiness in 2018.

Network security

But beyond mission-critical networks, the military also need best-in-class security mechanisms. The 3GPP LTE standard defines some of them, for which COTS offers now exist. They typically cover:

• Authentication of the different network elements and identification of intrusions

• Firewalling of the different interfaces (SS7, DNS, Gi, Gp)

• Identity access management to protect the access of the different network elements by internal operations staff (each staff member is given...
appropriate rights given their mission, and alerts are raised if anomalies exist).

On top of these solutions, military-grade encryption between devices or between devices and applications (using techniques such as IPSec) should be added to hardened protection against cyber spying.

Concerning protection against jamming, LTE provides frequency hopping as a first protection against narrowband jamming. But to protect an LTE network from broadband jamming, very specific additional techniques are needed, which can be sourced from specialized third parties. Positioning LTE as a true combat tactical radio system requires consideration of such threats and technical adaptations.

LTE transportable systems

Recent developments in the field of commercial network densification and virtualization can be leveraged in the frame of military operations:

1. A broad range of small cells (small cells are full LTE nodeB, packed into a very compact form factor)
2. The ability to put all LTE core network functions on a very compact blade server, as well as applications managing videos and group communications.

By combining both, extremely compact 4G/LTE networks were developed that are easily transportable and deployable. They can provide broadband communications to a fairly large number of users, autonomously or by extending the coverage of a macro network to uncovered areas. This allows armies to deploy a macro network to cover areas needing permanent coverage (such as military bases or borders), and complement it with transportable systems for operations outside of the macro network coverage.

Nokia has developed several form factors to serve various needs:

- A compact network packed in a waterproof and shockproof box, in a form factor of approximately one cubic meter, installed in a military vehicle or ship, can provide broadband communication of tens of megabits per second, on tens of kilometers to several thousands of users.
- An ultra-compact network, which can be put in a form factor as small as a backpack, can provide broadband coverage of several hundred meters to up to 400 soldiers. Depending on use cases we can even think of extending the coverage of such cells to several kilometers by hanging the radio part to a balloon (as was tested by public safety teams in the UK).
How is LTE used by armies across the world?

Though LTE adoption is still at a fairly early stage, the technology is being trialed by several armies around the world, with some of them even deploying their own network. A view of some use cases is as follows:

- The German army conducted trials of convoy communications and video surveillance in which a compact LTE network was inside an armored vehicle. LTE was used for broadband data communications and convoy real-time geo-location tracking.

- The French navy trialed ship-to-shore communications with live video feed from ship or helicopter sent to a command and control room installed on the shore.

- The French army, in the frame of its homeland security mission following recent terrorist attacks, is using LTE for geo-location of patrols in the field and multimedia communications. French armies are leveraging both tactical LTE bubble (deployable) and commercial LTE networks to provide broadband connectivity.

- Several navies are trialing LTE to test broadband communications between ships for maritime convoys, as well as for ship-to-shore connectivity.

- In one Asian country, an air force is currently deploying LTE to provide high-speed internet access to soldiers in air force bases, as well as to inter-connect bases’ surveillance systems.

- The Indian army is part of these front-runners. It is in the process of modernizing tactical and backbone communication infrastructure to an all-IP network. The project, termed the Tactical Communication System (TCS), comprises LTE-based wireless communication systems (WCS). The army is looking for a solution for complete realization of TCS objectives.
Conclusion

With increased affordability and performance of drones, video devices and sensors, armies can expect deployment of many services to improve forces’ situational awareness at reasonable cost. To unlock such possibilities, they need to update their voice-centric tactical communication systems, with high-speed, low-latency, mobile broadband technology.

More than ever, LTE is becoming a technology of choice to support many, although not yet all, armies’ communications needs:

1. To date, it is the wireless technology delivering the highest throughput.
2. Being mature and increasingly based on COTS technology, it is cost competitive.
3. Driven by the public safety industry, it is becoming truly mission-critical grade, and can offer a significant level of protection against cyber-attacks.
4. Thanks to the progress in technology, most form factors required by armies for their multiple and specific usages are now available.

While the market is still nascent, armies that start trialing this technology now, using mission-critical grade COTS solutions to become familiar with their possibilities, will gain a competitive advantage by providing their forces with information superiority.
Acronyms

3GPP 3rd Generation Partnership Project
E-UTRAN Evolved Universal Terrestrial Radio Access Network
IOPS Isolated E-UTRAN Operations for Public Safety
IPSec Internet Protocol Security
LMR/PMR Land Mobile Radio/Private Mobile Radio
LTE Long Term Evolution
PTT Push to talk
QoS Quality of Service
TCS Tactical Communication System
WCS wireless communication systems