Miniaturize, mobilize and mesh: A new paradigm for military cellular communications

Communications systems in military and government spheres must be secure, reliable, and usable, above all else. However, as consumer communications technology has advanced almost unfathomably over the last decade, military solutions have failed to keep up. Carsten Brinkschulte, CEO at Core Network Dynamics, outlines today's solutions to what should be a problem of the past.

Carsten Brinkschulte, CEO at Core Network Dynamics

Imagine a world in which soldiers have their own ultra-portable cellular network in their pockets – a smartphone and a fully functioning cellular network merged into a single device. And then imagine that these pocket-sized mobile networks are connected to each other - using a mesh topology - to create a swarm of autonomous, distributed mobile networks with no single point of failure.

Suddenly, soldiers have at their disposal a fully functional, miniaturized voice and data network available wherever they go: This mobile 'bubble' moves with them – in densely populated urban areas, mountains or deserts. When connected via a mesh to other bubbles, it becomes a network of networks, dynamically extending the reach of the combined network with every bubble added.

Giving soldiers their very own mobile network and the latest smartphone technology in the palms of their hands offers the prospect of richer, real-time communications and more effective operations. Maps and images of key targets can be sent and received, while support for bi-directional video lets soldiers out in the field get live video updates from the commander back at base.

This technology is set to transform mobile military communications over the next few years, with one international OEM we are working with already making inroads.

Roll back to today and it seems ludicrous that the military still relies on the antiquated Tetra network with its limited data capabilities (no vital maps or video images) and clunky 1980s-style walkie-talkie handsets, when as consumers, we all have access to so much advanced tech via smartphones and mobile apps.

Not only is the Tetra network outdated, it is expensive too, because it is used only by a small group of users, compared to billions of smartphone users in the commercial space, resulting in spiraling device costs for clunky devices.

There have been a number of recent attempts to break the mold and establish a workable alternative based on established cellular standards from the private sector. But these haven't yet delivered enough of a step change from a functionality perspective.

Take the Nokia backpack solution, for example, which was demonstrated at Mobile World Congress 2017. This delivers a full mobile network (the core network in software integrated with the radio access layer) in one backpack. Nokia may be late to the game, but it is definitely a move in the right direction.

But it is still quite a large form factor, and most importantly, only a single network cell, limiting reach – perhaps 2-3 miles, depending on the terrain, and barely useful in urban scenarios. Creating an autonomous and dynamic network of networks based on a distributed mesh topology that automatically extends network coverage is not possible with this approach. And so, its appeal is probably limited for the military.

Fortunately, a number of industry standards-based mobile technologies that will revolutionize the way our armed forces communicate in the field are now converging. Let's look in detail at this fresh approach and the key features/functionality that underpin it.

Integrated EPC and Radio Access Layer

The first technological advance that serves as a foundation for this new approach is the embedding of a multi-access core network in software (the software Evolved Packet Core or EPC), together with the radio access layer on a System on a Chip (SoC). This creates a small cell that is an ultra-portable mobile network that can be carried in a backpack, or attached to a vehicle out in the field.

Miniaturization and Low Power

Miniaturization of the SoC onto a single board with even tighter integration between the software EPC and the radio access layer goes one step further, and enables an even smaller footprint. The ultimate goal could be to create a portable Smartphone network in a pocket: A handset the size of a Smartphone that comprises both the mobile network and the Smartphone.

The ARM SoCs, noted for their low-power/energy-efficiency credentials, are ideal for these types of small form factor environments because the batteries can be smaller and lighter.

Mobile Edge Computing (MEC)

MEC provides an IT service environment and cloud-computing capabilities at the edge of the network, close to or even right at the base station. Combining EPC and MEC aims to apply the Internet topology - a decentralised mesh network combined with a star-of-stars topology - to the architecture of a mobile network. Instead of deploying a single core network with the EPC located at a central location and backhauling all signaling and traffic over satellite to the central network, an EPC deployed on MEC enables decentralised core networks providing connectivity and computing at the edge.

A Mesh Topology

A key feature is the concept of meshing together multiple mobile

EPCs with dynamic, multi-hop routing. This makes it possible to create a swarm of fully functioning, ultra-portable, autonomous mobile networks for both voice and data communications. This decentralized model provides far greater resilience than a traditional star topology-based mobile network too because it avoids the single point of failure. The goal is to support ultra-mobile mobile networks where the mesh network reconfigures itself as the cells move.

Inter-EPC Handover

Once a mesh network is up and running, the next stage is to enable synchronization between the EPCs so that the cells hand over to each other automatically and at the same time a hand over between the EPC is performed without disrupting communications. 3GPP does not define how to do inter-EPC handovers so there is a technical issue here, which requires a proprietary extension beyond the existing standards. But this is not insurmountable, and in fact, we are working on doing just that - enabling inter-EPC handover across networks without disrupting sessions.

Moving from concept to reality

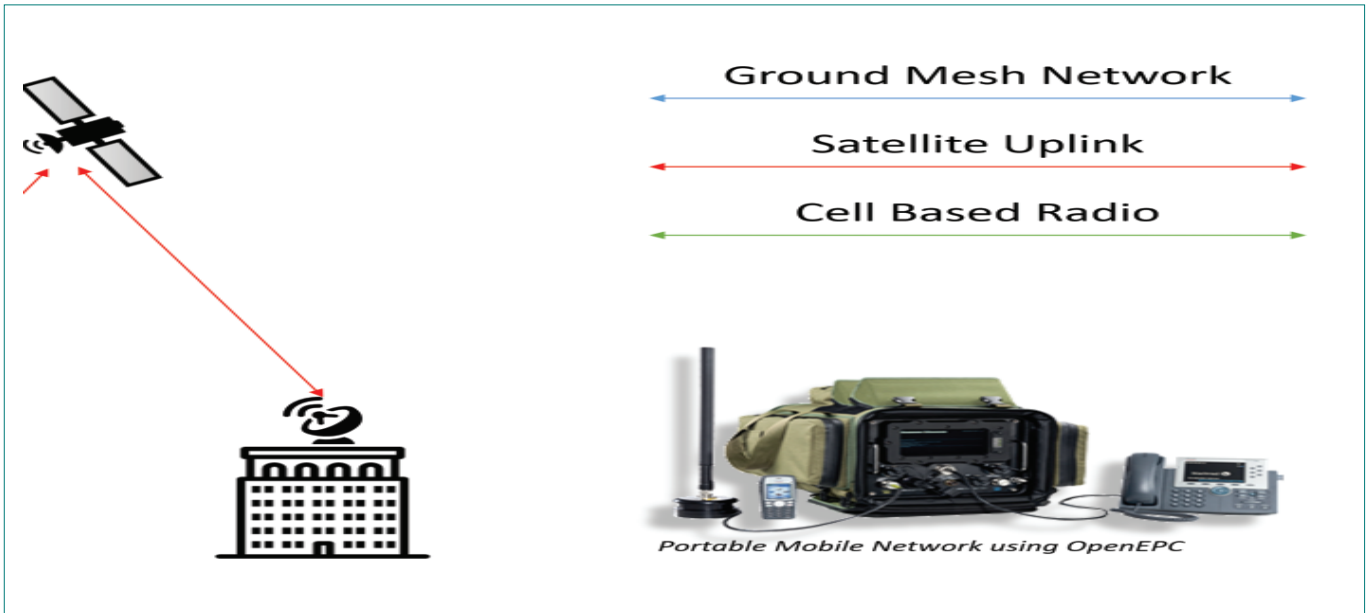
Growing demand for a pocket-sized mobile network means that this approach is now moving from concept to reality. My own firm is seeing considerable interest from organisations wanting to use our software EPC (OpenEPC) to create portable, mobile networks using small cells that are meshed together for unparalleled resilience and mobility. And we are already working with an international OEM partner to build an ARM-based communications solution of this type for a military use case.

The benefits are obvious:

- A standards-based approach means that commodity smartphones, tablets and laptops can be used rather than expensive, proprietary (and generally outdated) Tetra handsets – to put this in context, a smartphone is a tenth of the cost of a Tetra handset;
- Using the latest smartphone platforms enables rich applications for command-and-control, media sharing and mapping;
- There is built-in resilience, because of the distributed mesh architecture;
- Our armed forces get a cost-effective voice and data service that works even in built-up urban environments and in mountainous regions; and
- It is a highly cost-effective option for resource-constrained environments where weight and size are important.

In summary, the military deserves a state-of-the-art mobile communications infrastructure for voice and rich data that is always connected, ultra portable, highly resilient and utilizes the latest technology from the smartphone sector. The industry is turning away from Tetra and embracing a new mobile industry standards-based approach built on software EPCs, MEC, mesh and miniaturisation. **GMC**

Photo courtesy Sgt Elyssa Quesada and DVIDShub



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