Written Evidence – BHV Broadcast Limited

This submission to the House of Commons Committee of Public Accounts is made in response to the publication of its 35th report "Upgrading emergency services communications"

It has been prepared by BHV Broadcast Limited's (BHV) Principal Consultant and is done so to highlight what we perceive as a limited number of areas of technology risk associated with the project. The Emergency Services Network (ESN) is a significant undertaking and the technical attributes and understanding necessary for such a system will not easily translate into layman's terms and therefore we have in some cases simplified issues to enable a general readership of this document. BHV has no commercial connection to the delivery of the ESN, but we offer this discussion paper from an informed industry view.

BHV does not doubt the perceived goals of the ESN programme however BHV believes there are a number of pertinent technical matters that may adversely affect the delivery of the solution, we therefore provide discussion points as follows.

Technology – System Functionality and Architecture

The strategy of the ESN has been to minimise service costs by sharing network capacity with an existing 4G (LTE) mobile phone network. This avoids the need to build a UK wide network solely for the use of the emergency services. For this to be effective the ESN must benefit from a traffic prioritisation mechanism to ensure it does not end up competing for access with conventional consumer mobile phones during high traffic periods.

Mobile Network Operators (MNOs) already deploy access priotisation capability within their networks. Emergency Services Staff with a service allocated conventional mobile phone are already likely to be on a top tier priority to ensure operation during high traffic. MNOs can allocate subscribers to one of 15 levels of access priority and this can be for a mix of reasons including public safety and commercial needs. This structure operates well and has proven effective during major incidents however all subscribers have been prioritised on the basis of the same access technology, in other words all devices are telephone handsets it is a matter of who's telephone handset is most important. What has not been tried to the best of my knowledge is a prioritisation mechanism which arbitrates between different access protocols. The ESN's LTE implementation will provide an "immediate push to talk" voice capability which will be inherently different to consumer mobile technology. Any detrimental effect on performance, however small, during high volume traffic generated by conventional mobile subscribers could adversely affect system usability. The choice to procure a solution based on sharing capacity on a commercial network is quite unique, accordingly research and development of appropriate and functional traffic prioritisation software is likely to be limited to a single vendor which may represent a risk to the successful delivery of this vital capability.

Operational Network Coverage and Spectrum Performance.

In previously submitted written evidence to the committee Omega 5 UK Ltd raised matters regarding operation of LTE services within buildings and offered the view that some network performance guidance figures could well require review. We support this view and believe that this area of interest presents significant impact risk of the ESN's future operation performance. The ESN will deliver a system based on a radio air interface operating at 800Mhz and 2.6Ghz (EE does operate some 4G delivery over its existing 1800Mhz spectrum and at the time of writing it is not known whether EE would use this band as a bearer for the network). The current Tetra solution operates at half of the lower of the ESN's frequency bands in the region of 400Mhz.

As a rule of thumb radio frequency propagation suffers greater absorption and therefore link capability as carrier frequency increases. In free space this is a positive attribute as it allows for predictable propagation and therefore easier implementation of the conventional cellular structure for geographical frequency re-use, it has therefore been favoured by MNOs. However reflection and absorption of RF energy by typical construction materials such as glass, brickwork and concrete can be as high as 35db effective insertion loss in the radio link at frequencies near to the 800Mhz band, resulting in just one twelfth of an airborne radio signal being present on the opposing side of a single 30cm concrete façade. This could easily mean good signal strength density and handset performance at street level is not matched within buildings.

"In building" radio operation has been a discussion issue within the industry for many years and there are a significant number of publications including ITU reference papers available in the public domain, a selection of which are listed at the end of this submission. The consensus of these is generally aligned around industry data for the effects of construction materials, more recent studies have highlighted that the situation is becoming more challenging. The construction industry has aimed to lower the environmental impact of buildings and as a result thermal insulation materials such as foils have been adopted to reduce the need for seasonal heating and cooling demands, these have had further adverse effects on radio signal propagation. Analogue public safety radio solutions in use prior to the introduction of Tetra Airwave were in the main operated in the 400 to 470 Mhz range, therefore the implementation of Tetra at 380-400 Mhz did not present a significant change to the basic carrier frequency and therefore the physics of the radio link. Previously service users would only have experienced a change in performance between analogue systems and the Airwave Tetra solution as a result of handset transmission power, location of network base stations and the implementation of digital encoding. It is therefore a matter of interest as to whether performance data for "in building" operation of the proposed solution exists, if so have service users been briefed?

The 4G spectrum auctions announced in February 2013 saw EE secure 2 allocations of 5 Mhz each in the 800 Mhz band. This limited bandwidth is half of the planned allocation for both South Korea's and the United States proposed LTE public safety solutions, both these proposed solutions have set aside the spectrum solely for emergency service operations. It is my opinion there exists uncertainty in the effective performance of the ESN in built up urban areas, such as city centres and its effectiveness inside buildings as a result of interaction between available spectrum, periods of high network traffic, prioritisation mechanisms and "in building" network performance.

Off Network Operations

Current Airwave Tetra services provide “off network” functionality known as Direct Mode Operation (DMO). It is intended to supplement operations where network coverage does not exist for example remote moorland areas. DMO allows handset and mobile devices to operate in a talkgroup (operating channel) in “device to device” communication without the need for any networking infrastructure, essentially like point to point “walkie talkies”. This functionality is further enhanced with some mobile terminals offering gateway network access. Gateway mode allows certain vehicle fitted radios to temporarily extend network access from a hilltop location, essentially if the mobile device has Airwave access it can act as a relay. LTE based services intend to provide similar capability through a function known as Proximity Services (ProSe) however this is in early stages of standards ratification and there is some debate as to the comparable performance with DMO. It is likely that any ProSe capability will have much lower output power than the equivalent Tetra DMO function, with the added impact that the LTE handsets will operate at much higher frequencies, the corresponding performance may fall short of service user expectations. I am unaware of any understanding service users may have about potential lower performance of LTE ProSe compared to existing Tetra DMO however I would draw attention to the TCCA report indicated at the end of this submission which gives a greater evaluation of the subject.

Future Service Development and Delivery

As an early adopter of LTE technology the ESN will be heavily reliant on pre-standard hardware and software. This approach raises a number of risks, firstly as has previously been highlighted by the committee a risk that technology components do not deliver in line with the project’s timeline. There is in my view a second risk that could impact the solution post delivery. As global uptake of public safety LTE grows once standards are set the ESN could be inherently borne on proprietary components. This could see support and development of the solution become expensive as off the shelf products intended for the later evolved and standardised industry do not inter-operate with the ESN’s infrastructure. There is also a potential outcome that the system quickly becomes unsupportable and a major refresh programme is needed to adopt later more mature LTE technology. With a contractual commitment period understood to be only to 2023 I am not aware of any awarded parties’ obligation to underwrite future interoperability.

Maintenance of the Incumbent Tetra Solution

Motorola Solutions acquired the Airwave network in late 2015 and have subsequently proposed an extension of one year to the existing contract to cater for potential late delivery of the ESN. This has been offered at a figure of £475M for 12 months. As far as is visible, there has been no commitment to operate the network beyond this 12 month period, which naturally raises questions about the ability to do so.

Prior to its acquisition by Motorola Solutions and at a time when it had decided to proceed no further in bidding for any part of the ESN, Airwave may have made business decisions to maximise the remaining contract value to the expected expiration of its contract in December 2019. There is a

possibility that Airwave made decisions to scale back some business operations in light of little economic opportunity for the Tetra Infrastructure beyond the end of the contract. The company may also have adopted a policy of "sweating assets" to a natural end of life.

The net effect of any such policies might mean that skills to operate and develop the network may be lost through the departure of key personnel. Certain approaches to equipment life cycle management may mean reliable network operation might only be predictable to the end of the contract plus the year extension offered by the new owners.

There are risks that the ESN programme does not deliver even within the year overrun contingency period placing a further need for reliable operation of the Airwave network. However in light of potential business decisions within Airwave there are theoretical constraints to the continued maintainability of the system. Some of these could be resolved financially but with considerable costs, other constraints may present different challenges. I must stress that these matters are offered as theoretical issues and I do not profess to hold knowledge of Airwave or Motorola's strategy for the incumbent system, however as Motorola Solutions was awarded Lot 2, the user services contract, they may potentially be focussed on the service provisioning business function of Airwave and not its network operation past December 2020. I believe it would be appropriate for the committee to request parties' assurances around the ability to manage the incumbent system's network infrastructure going forward. Below are a number of discussion bullet points for this matter.

- At what point would any significant capital spend be required for the Airwave Tetra radio network and switching infrastructure to maintain reliable operation beyond December 2020? – This could include the refresh of base station equipment, switching infrastructure and battery back up systems.

- How would any refresh effort take place and what would be the charging mechanism?

- What level of certainty does the incumbent operator have on the ability to renew occupancy leases for base station equipment and any temporary planning permissions for antenna arrays such that any expirations of these would not cause disruption to the system?

Summary

I have not addressed any part of the project's delivery function or architecture as I feel this submission is best placed focussing on technical matters however there is a simple overlap question between the technical and managerial threads being – "Who has the overall responsibility to make the system work?" There is a potential for disagreement between providers of Lot 2 and Lot 3, particularly around performance of network and terminal device connectivity which could see the procuring authority left to resolve the matter, such situations could cause delay and consequentially costs

I believe that it would be appropriate for the committee to have further understanding and key assurances on the following issues as these matters will have significant economic impact on the delivery of the programme and overall value of the eventual system;

1. Assurance of the effective operation of priority mechanisms deployed in the networking infrastructure, the purposes of which are to ensure reliable operation of ESN terminal devices (handheld and vehicle mounted radios) during high radio traffic resulting from EE's consumer subscribers. This assurance should also reference point 2 below.

2. Assurance the resulting move in radio interface link frequency from 400MHz for the TETRA solution to 800Mhz and 2.6Ghz of the ESN will not adversely affect performance of the system, particularly in respect of "in building" operation and that service users understand and accept any change in system performance.

3. Assurance that the capability of Proximity Services (off network operation and network relay linking) are effective and that service users understand and accept any change in operation and performance.

4. Assurances that the deployment of "pre-standard" technology does not risk later support and development issues and effectively a deployment of a proprietary system.

5. A clear understanding that the incumbent Airwave solution can be operated reliably through any agreed project overrun and that further contingency operation be assured should the ESN delivery schedule be delayed by more than one year.

It appears likely the availability of required ESN terminal equipment and network operation will not occur until late 2017 at the earliest meaning service user field trials may not occur until early 2018. There is a risk that service users do not achieve levels of comfort required to accept the proposed system at critical points in the delivery schedule. The net effect of service user "push back" may be further delays in what already appears an aggressive delivery timeline. It is difficult to overstate the risks of further delays in the roll out of the ESN particularly should it become apparent that there may be difficulties in maintaining operation of the existing Airwave Tetra solution at periods beyond what is already planned.

Bill Garrett - Director of Technology/Principal Consultant
BHV Broadcast Limited

Relevant documents

Upgrading emergency service communication HoC CoPA (report 35 Session 2016-17)

Electromagnetic Signal Attenuation in Construction Materials (United States Department of Commerce Technology Administration, National Institute of Standards and Technology – October 1997)

Building Materials and Propagation, Final Report (Ofcom - 2604/BMEM/R/3/2.0 14th September 2014)

A path-specific propagation prediction method for point-to-area terrestrial services in the VHF and UHF bands Recommendation ITU-R P.1812-4 (07/2015)

Effects of building materials and structures on radiowave propagation above about 100 MHz Recommendation ITU-R P.2040-1 (07/2015)

Compilation of measurement data relating to building entry loss Report ITU-R P.2346-0 (05/2015)

TETRA Direct Mode and LTE Proximity Services (ProSe) Compared - (Tetra and Critical Communications Association August 2016)

The need for PPDR Broadband Spectrum in bands below 1Ghz – (Wik Consult report for Tetra and Critical Communications Association October 2013)

Indoor path loss – Application Note – (digi.com June 2012)