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TETRA AND LTE WORKING TOGETHER

Important Note

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Introduction

TETRA, (Terrestrial Trunked Radio), was engineered from the outset to meet the particular needs of public safety users. Yet services such as power and water are also essential to the well being of society and can be considered to be critical services. TETRA is therefore ideal to serve the needs of users in those sectors, and in many others where reliable, robust and secure communications are essential.

Standardised by ETSI, TETRA shares many basic technology elements with cellular mobile telephony but with added unique mission critical features such as instant connection, push to talk, direct mode, and group calls. TETRA is continually evolving, with a rich range of additional capabilities meeting the increasing needs of its users. In the same way as cellular systems have developed to add higher speed data services, TETRA has also evolved with the introduction of TEDS (TETRA Enhanced Data Service) giving a significant increase in wideband data capability.

During this time cellular systems have moved through two generational shifts from 2G to 3G/HSDPA and now to 4G/LTE. With each step, data speeds have increased and now are much faster than is possible in TETRA even with TEDS. Although there is nothing on the horizon that can compete with TETRA voice services, some operators and prospective customers for TETRA are asking whether they should migrate to LTE for broadband data services now.

This paper discusses the potential for migration to a broadband data service which will still provide the necessary capabilities for public safety and critical users, working with TETRA's unrivalled voice capabilities.

The Essential Capabilities of Mission Critical Communications - Back to the basics

The specification for the TETRA standard was underpinned by a number of fundamental requirements that still hold true today.

- Prioritisation and pre-emption, allowing the most important calls to be connected at times of congestion.
- Emergency calls, prioritised above other traffic, which get through even if the network is busy, and automatically alert controllers.
- Wide area, fast call set-up, "all informed net" group calls
- Direct Mode Operation (DMO) allowing "back to back" communications between radio terminals independent of the network
- High level voice encryption to meet the security needs of public safety organisations
- Full duplex voice for PABX and PSTN telephony communications

In addition, TETRA networks are specified to work on frequencies that permit long range coverage for the base stations. They are designed to provide very high levels of coverage and availability, and include much higher levels of security than public cellular networks.

Public Cellular Performance in Emergency Situations

Public cellular mobile networks come under considerable strain at a time of emergency, or even during a significant incident such as a traffic jam on a busy highway. There are numerous examples of network congestion at such times. The examples which cause greatest concern are those that occur during major emergencies, the times when communications for public safety and other critical users are at their most important. In addition, well documented local and regional outages of the public networks due to technical issues continue to happen.

This is why dedicated public safety and other mission critical networks are still considered to be essential. It is known that many public safety officers and other critical personnel utilise public mobile communications systems during their working day. Engineers, detectives and senior staff use mobile phones, and with 3G or even 4G available in some areas, these work well for person to person voice and data calls under normal conditions. But at critical times the networks cannot offer the resilience, speed, and special features that are essential for emergency response staff to do their work properly. Time after time TETRA proves its ability to connect first responders in the high stress environments when they must perform to the limit of their ability.

Built for the Environment

TETRA terminals, whether handheld or vehicle mounted, are engineered to standards well beyond those used in the development of consumer mobile phones. All 'standard' TETRA terminals are rugged and robust. In addition, there is a range of further enhanced models designed to continue working in the most challenging of situations, including fire, flood and hazardous dust and gas environments. And TETRA terminals go on working well beyond the normal life of a mobile phone, ensuring an excellent return on the investment. A wide range of accessories enhances these radios for the different types of end user. These accessories are also engineered to operate successfully in the tough environments that are encountered on a daily basis and which cellular phones would be unable to survive.

The emergency button is now a standard feature on most TETRA radios. This immediately alerts colleagues and supervisory staff if a user is in difficulty. GPS receivers automatically inform control room staff of the individual's location, providing enhanced user safety.

More and more capability has been added to the radios, including secure Bluetooth, web browsers, larger screens, and cameras to increase the efficiency and effectiveness of the users.

Bluetooth offers interesting possibilities for linking the TETRA radio with other devices such as PDAs, mobile computers, or even body sensors that monitor vital signs.

At all times, reliable and secure TETRA radio systems ensure that communications are maintained under the most severe conditions.

Working Together, the Best of Both Worlds

A combination of TETRA and LTE can be considered as a medium term migration strategy for many critical communications users. Such a solution could be engineered either using the public LTE solutions rolling out now in many countries of the world, or with a dedicated LTE data network for critical users. There are advantages and drawbacks with both and these are discussed in the TCCA whitepaper "Mobile Broadband for Critical Communications Users - A review of options for delivering Mission Critical solutions". This document can be downloaded from the TCCA website at: www.tandcca.com/Library/Documents/Broadband/MCMBB%20Delivery%20Options%20v1.0.pdf

In both cases TETRA remains as the "safety-net" to ensure availability of resilient, reliable voice and some data communications under all conditions.

TETRA and Public LTE

This can be a financially attractive solution, taking advantage of the investments being made by public carriers in their commercial networks whilst continuing to leverage the existing TETRA infrastructure. Both networks would "do what they do best", LTE offering fast data service in the urban and high population areas where it will likely be most quickly deployed. As TETRA provides a very high level of geographical coverage, the public carrier will not need to replicate this and may be able to offer service to users at pricing similar to that offered to the general public. TETRA will continue to offer secure and resilient voice and some data services over a wide area. It should be noted that the upgrade of a TETRA network to TEDS will provide an increase in data speeds and to a great extent provide many of the applications that LTE offers in a suitably modified form. This option is the natural first step in a migration path for critical communications.

A variant of this approach would be to establish an MVNO who would contract with the critical services agencies and the public carrier(s) to ensure a high level of availability of LTE service even at times of congestion and/or emergency. The MVNO would be able to integrate some services such as location, device management, and command and control over both the LTE and the TETRA network.

TETRA and Private LTE

In this scenario a separate LTE network is deployed on its own frequencies and managed entirely separately from the public LTE network. This too would work alongside TETRA until nationwide coverage is achieved and the features embedded in TETRA are fully replicated in LTE. As both of these will take many years (and significant cost) to achieve, this "overlap" will last for many years to come. Such a solution will require the allocation of frequencies by the regulators in each administration and sizable investment unless the LTE coverage is to be limited to specific high value areas.

On the positive side such a system could maintain the high levels of security insisted on by some TETRA operators and integration of services could be more straightforward.

This option could be a second step after the TETRA/Public LTE step.

Straight to LTE

A single step migration to an LTE-only network without a TETRA underlay faces significant challenges at this time. Public LTE networks would be required to offer guaranteed service levels, coverage and resilience which will be costly and difficult for commercial carriers to provide. The unique features in TETRA that mission critical users rely on, such as group calls and direct mode, will take years to replicate in LTE. Whilst these have been raised as work items for the standardisation bodies, they are still some way off from becoming a reality for users. In the interim, critical communications users need to have a network which meets their needs now. For the foreseeable future this is TETRA.

Proprietary Solutions

A small number of manufacturers are proposing broadband solutions which are being positioned as suitable for public safety and critical communications. Such solutions will face significant challenges in adoption. Operators choosing such technologies will need to consider the risks of adopting non standardised solutions and the potential long term price penalties arising from being locked in to a single manufacturer. History shows that standards-based technologies force manufacturers to compete and innovate, keeping prices under control and encouraging a rich ecosystem of products, applications and services. The success of TETRA is underpinned by the industry leading interoperability testing programme developed by the TCCA in conjunction with all leading manufacturers. This programme ensures that all certified products and systems work seamlessly together, irrespective of the number of suppliers contributing equipment to a network.

Summary

It is clear that TETRA continues to deliver all the voice and data requirements for many existing and future critical communications users. This will remain the case for many years to come.

A migration path towards public safety and critical broadband service can begin today with the combination of TETRA/TEDS and commercial LTE. This will provide both mission critical voice and data services, and day-to-day voice and broadband services that meet the needs of critical users such a blue-light and essential service personnel.

Once broadband services establish themselves as essential elements of everyday operations the pressure to ensure availability at all times, even during major emergencies, will drive the need for guaranteed access and high quality of service. These are likely to require dedicated spectrum to ensure that Public Safety and other Critical Communications users continue to obtain access even during times of high network load either on publically provided or privately owned LTE networks. As the LTE standards do not yet include the TETRA features essential for critical communications users, even a private LTE network will need to work alongside TETRA for many years into the future.

Further Reading

The following documents on the TCCA web pages amplify and expand on the points made in this summary paper.

TCCA Broadband Group Page http://www.tandcca.com/assoc/page/18100

The Strategic Case for Mission Critical Broadband http://www.tandcca.com/Library/Documents/Broadband/MCMBB%20Strategic%20Case%20v1_0.pdf

Mission Critical Mobile Broadband: Practical standardisation and roadmap considerations http://www.tandcca.com/Library/Documents/CCBGMissionCriticalMobileBroadbandwhitepaper2013.pdf

For further information please see www.tandcca.com

Glossary

3GPP	3rd generation Partnership Project – the organisation responsible for the LTE standard
4G	4th Generation cellular radio technology
CAPEX	Capital Expenditure
CCBG	Critical Communications Broadband Group. A working group of the TETRA and Critical Communications Association
CEPT	European Conference of Postal and Telecommunications Administrations – a coordinating body for European state telecommunications
CGC	A Complementary Ground Component is a terrestrial infill system for a mobile satellite system that uses terrestrial base stations to provide connectivity in weak signal areas such as urban areas
CNI	Critical National Infrastructure typically includes the Utilities (Gas, Electricity and Water), Transportation (Rail and Metro, Buses and Trams, Ports and Airports) and other critical industries without whom society would quickly break down
DMO	Direct Mode Operation. A means of establishing communications between two radios without the intervention of a radio infrastructure
EC	European Commission
e-nodeB	e-nodeB (or ENB) is the radio base station and controller in an LTE network
ETSI	European Telecommunications Standards Institute
EUTC	European Utilities Telecom Council – an Association of Utility organisations in Europe similar to the UTC in the USA
e-UTRAN	e-UTRA is the air interface of 3GPP's Long Term Evolution (LTE) upgrade path for mobile networks. E-UTRAN is the radio access network based on that standard
EPC	Evolved Packet Core is the overall packet data handling system of a LTE network.
FCC	Federal Communications Commission – the US regulator
FirstNet	First Responder Network Authority (FirstNet)is an independent authority whose task is to provide emergency responders with the first high-speed, nationwide network dedicated to Public Safety in the USA
Group Call	A means of setting up a radio call to a large number of users simultaneously
HSPA	High Speed Packet Access is a 3G technology for delivering high speed data over a cellular telephone network
HSPA+	Evolved High-Speed Packet Access, is a technical standard for wireless, broadband telecommunication that provides increased data rates over HSPA
ITU	International Telecommunications Union – coordinates the shared global use of the radio spectrum
LMR	Land Mobile Radio is the US equivalent of PMR and also provides group based radio communications
LTE	Long Term Evolution – the latest standard for cellular communications. LTE provides higher data rates than 3G UMTS but is not quite a 4G technology
LTE-A	LTE Advanced – A further development of the LTE standard defining additional functionality including aggregation of separate frequency bands and the addition of voice services. LTE Advanced is considered a true 4G technology
M2M	Machine to Machine communications
MCMBB	Mission Critical Mobile Broadband
MNO	Mobile Network Operator – A commercial cellular network Operator

MSS	Mobile Satellite Service
MVNO	Mobile Virtual Network Operator
NIST	The US National Institute of Standards and Technology is a measurement standards laboratory, and is a non-regulatory agency of the United States Department of Commerce. NIST is currently leading the US input to 3GPP LTE standards making on behalf of the National Public Safety agencies.
NoC	Satellite Network Operations Centre
NPSTC	National Public Safety Telecommunications Council is a Federation of associations representing Public Safety telecommunications
NTIA	National Telecommunications and Information Administration (NTIA) is an agency of the United States Department of Commerce that serves as the President's principal adviser on telecommunications policies pertaining to the United States' economic and technological advancement and to regulation of the telecommunications industry
OPEX	Operational Expenditure
PMR	Private Mobile Radio technology provides group based radio communications for business and professional users
PPDR	Public Protection and Disaster Relief is a term that encompasses the traditional Public Safety organisations and also major incident rescue services
ProSe	Proximity Services - the 3GPP descriptor for Direct Mode (DMO) in LTE
PSS/PS	Public Safety Services or Public Safety - describes the emergency services and includes Police, Fire, Ambulance, Border Guards, Security Services etc.
RAN	Radio Access Network
RSPP	The Radio Spectrum Policy Programme (RSPP) defines the roadmap for how Europe can translate political priorities into strategic policy objectives for radio spectrum use
S-Band	Frequencies that range from 2 to 4 GHz
SDO	Standards Development Organisation
SIM	Subscriber Identity Module - is an integrated circuit that securely stores the international mobile subscriber identity (IMSI) and the related key used to identify and authenticate subscribers on mobile telephony devices
SLA	Service Level Agreement
TCCA	TETRA and Critical Communications Association (see www.tandcca.com)
TETRA	TErrestrial Trunked Radio - a digital trunked mobile radio technology
Tetrapol	A technology developed for the French Gendarmerie and in use by a number of Public Safety agencies in various parts of the world
UIC	Union Internationale des Chemins de fer' - the French-language acronym for the International Union of Railways
US	United States of America
UTC	Utilities Telecom Council – an Association of Utility organisations(in the USA)
VoLTE	Voice over LTE
VSAT	A very small aperture terminal (VSAT), is a two-way satellite ground station or a stabilized maritime VSAT antenna with a dish antenna that is smaller than 3 meters
Wi-Fi	A popular technology that allows an electronic device to exchange data or connect to the internet wirelessly using radio waves

Version Control

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1.0	April 2014	First published version