Comparing TETRA with other Technologies

Presentation to TETRA Experience 2006 Dubai

Duncan Swan, 27th November 2006

Agenda

1. Introduction

2. So many mobile radio technologies….

3. ETSI trunked radio standards

4. TETRA working with other radio technologies

5. A comparative look at TETRA and P25

6. Summary

Mason

So you want a PMR system ?

- **Analogue Conventional and Trunked**

    – FM Conventional, MPT1327 systems, LTR – Logic Trunked Radio, EDACS (Ericsson), Smartzone (Motorola)

- **Digital Conventional**

    – DMR (Tier I and II), Project 25

- **Digital Trunked**

    – DMR (Tier III), OpenSky, Project 25, TETRA, Tetrapol

- **Digital Cellular and Variants**

    – CDMA-PAMR, GSM-ASCI, GSM-R, iDEN

There is a huge choice of proprietary solutions available; and there are a smaller number of open standards of which TETRA is one…

Mason

And just what do you want to do with the system ?

Identifying the key requirements will quickly derive a technology short-list

- Spectrum

- Coverage & capacity

- Security

- Interoperability

- Resilience

- Set-to-set operation (direct mode)

- Multi-vendor

- Voice requirements

- Data requirements

- Support control room applications [GIS, CAD, Dispatch]

Open procurement procedures will quickly help achieve a technology short-list; and there will be vendor choice & competition for open standards.

Mason

ETSI is one of the leading standards bodies developing open industry standards –

What's in the ETSI digital radio tool kit ?

ETSI has three Digital Trunked Radio Standards…

- TETRA

- GSM and its variants
    - GSM Push-to-Talk
    - GSM-R

- DMR

- Each of these standards started life with:
    - Specific target markets
    - Specific user requirements to meet

- And they all have very motivated user groups…

- *But* there is a degree of cross-over between the standards and this has led to 'competition'.

TETRA has been defined by ETSI to meet the needs of the most demanding Professional Mobile Radio users

Mason

A quick look at DMR

- DMR comes in three flavours and is seen as a digital replacement for MPT1327 for 'business critical' rather than 'mission critical' users…

- Tier I
  - Peer-to-Peer mode
  - Intended for 446MHz, unlicensed operation

- Tier II
  - Operation through a base station or repeater
  - Peer-to-Peer mode
  - Generally for operation with licensed spectrum in VHF & UHF

- Tier III
  - A trunked radio network plus functions of Tier I & II
  - No suppliers have been identified yet…

- Vocoder standardisation is not currently in the plans – this may lead to interoperability issues.

Mason

And the GSM family

- There has been a significant and well documented lobby over the years to champion GSM as a credible alternative to TETRA for national public safety solutions

- And work undertaken to prove and disprove that one technology is better than the other…

- But there is a real place for public cellular networks alongside mission critical PMR systems such as TETRA – *more later !*

- Firstly, there is a key area where TETRA and GSM based technologies do, and will continue to, compete – Railways…

- TETRA has had significant success with urban transportation projects – buses, metro systems and light rail

- GSM-R, the GSM technology derivative for the railways, is the leading standard for national railway systems

Mason

# GSM-R remains the technology leader in the Railway industry

GSM-R focuses on safety, reliability, prevention of accidents, and emergency communication solely in the specific, and very specialised, domain of the Rail Industry

- GSM-R was developed specifically for the rail market following a decision in Europe back in 1993 to agree the correct solution for European railways – TETRA came second…

- A GSM-R network is a private network

  - separate infrastructure

  - separate base stations

  - can be integrated with public networks

- GSM-R has has success across Europe, Asia and Africa. And there is currently significant interest in Australia and a feasibility study being conducted in the USA.

- The key battleground between TETRA and GSM-R is in Asia

  - 20 of China's 31 provinces have GSM-R

  - The Tibet-Qinghai high-speed line is GSM-R

  - And GSM-R has been chosen in West Bengal, India

- But TETRA is also present, the Taiwan high speed line being an example of utilising this technical solution.

Mason

Key elements of GSM-R

- GSM-R Implementation:

    - employs the same basic network components as GSM but with additional functionality (e.g. Advanced Speech Call Items (ASCI))

    - 99.95% availability for all hardware elements – and significant in-built redundancy into both equipment and planning

    - PMR type voice calls

    - Data

        - SMS communication with dispatcher & driver

        - Automatic train control – ETCS

        - Information services

    - Cell Broadcasting

        - Data communications targeted at specific cells

GSM-R
The Railway System for mobile communication

Mason
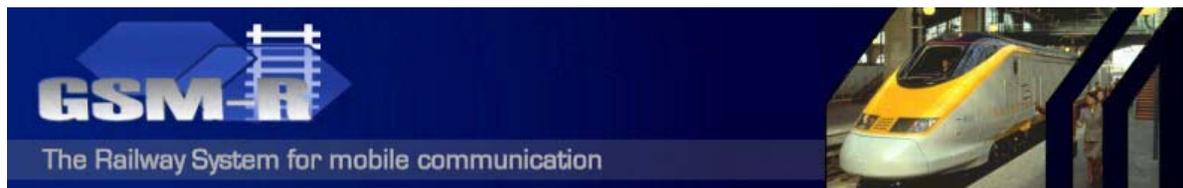
So what role can Public Cellular networks play in supporting Mission Critical Communications ?

Certainly Public Networks alone are not the answer…

- A number of White Papers have been written over the past few years looking at GSM as a solution for mission critical mobile communications

- Features and functionality aside, nearly all have concluded that during disasters and major incidents:

  - Public Mobile Networks struggle to cope … and often fail

  - Infrastructure may be critically damaged, at best limiting service

  - It is extremely difficult, and often impractical, to prioritise calls to guarantee access to specific user types

  - Interoperability necessary between public safety agencies cannot rely on public networks

Mason

Public Network Technologies have a number of key shortcomings for voice communication…

- Call set-up times are not acceptable for mission critical communication

- Cellular Push-to-Talk systems require too many channels to support reasonably sized talkgroups

- Out-of-network set-to-set coverage is an issue

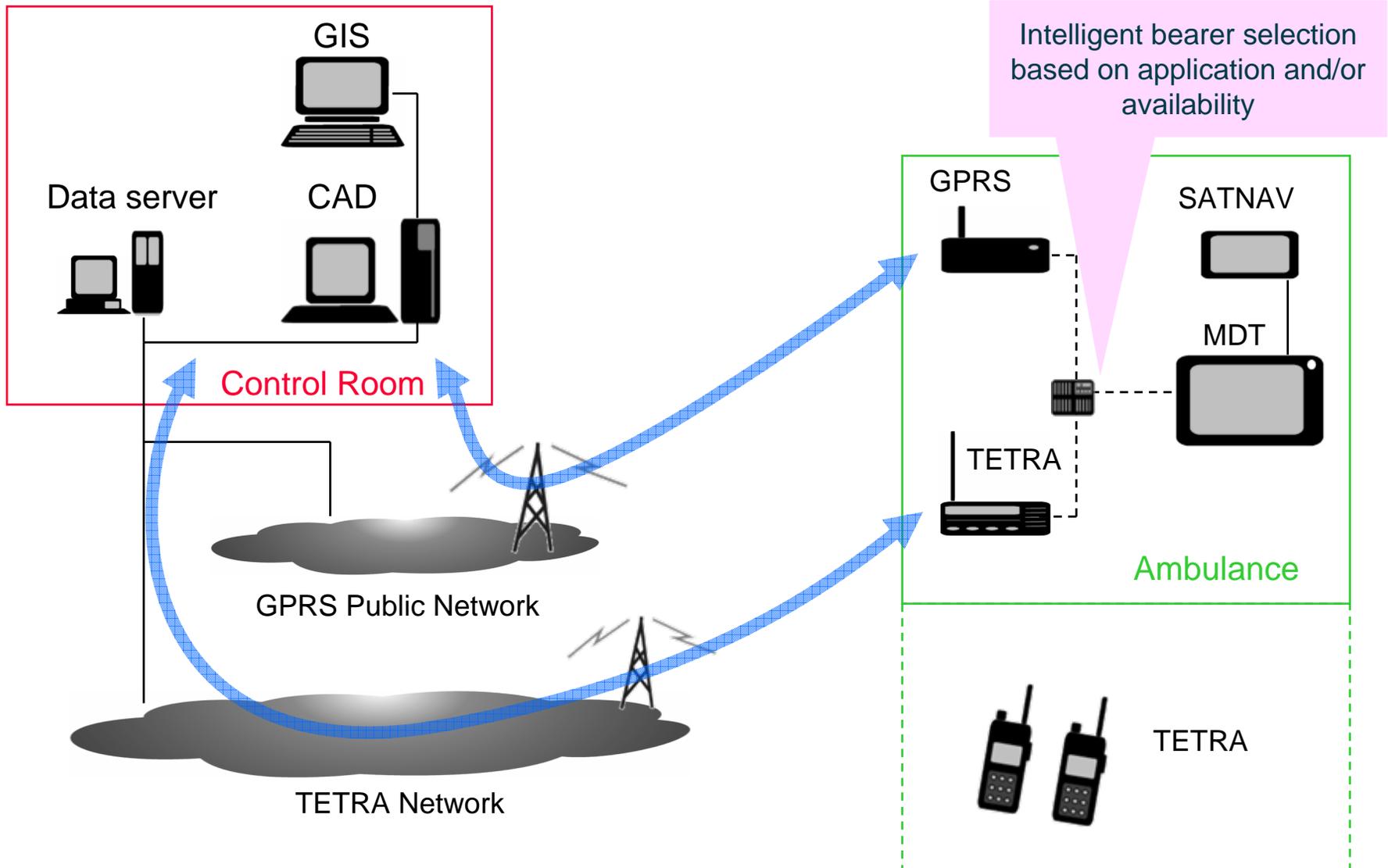- The ability to support any level of reasonable dispatch functionality is an issue

Public cellular systems are not able to provide mission critical voice communications: they may have a role for data communications though…

Mason

So what role can Public Networks and Other Technologies play ?

To help answer this question, the following are examples from the Ambulance Service in the UK…..

Mason

A typical multi-bearer application

GIS

Data server

CAD

Control Room

GPRS Public Network

TETRA Network

Intelligent bearer selection based on application and/or availability

GPRS

SATNAV

MDT

TETRA

Ambulance

TETRA

Mason

Data use for the Worlds Largest Ambulance Service

- London Ambulance – 1.5million patients every year

- Seamless network switching ensures data transmission in real time regardless of coverage issues and congestion

- Multiple Wireless Wide Area Networks and Wireless Local Area Network

- On station ambulance sits within an 802.11b WLAN environment

- In the mobile environment has available 2 networks supporting GPRS (packet data) and GSM (circuit switched) – with TETRA soon to be implemented as a third network.

Data has been recognised as being significantly more efficient than voice based radio communications – but voice remains an essential service
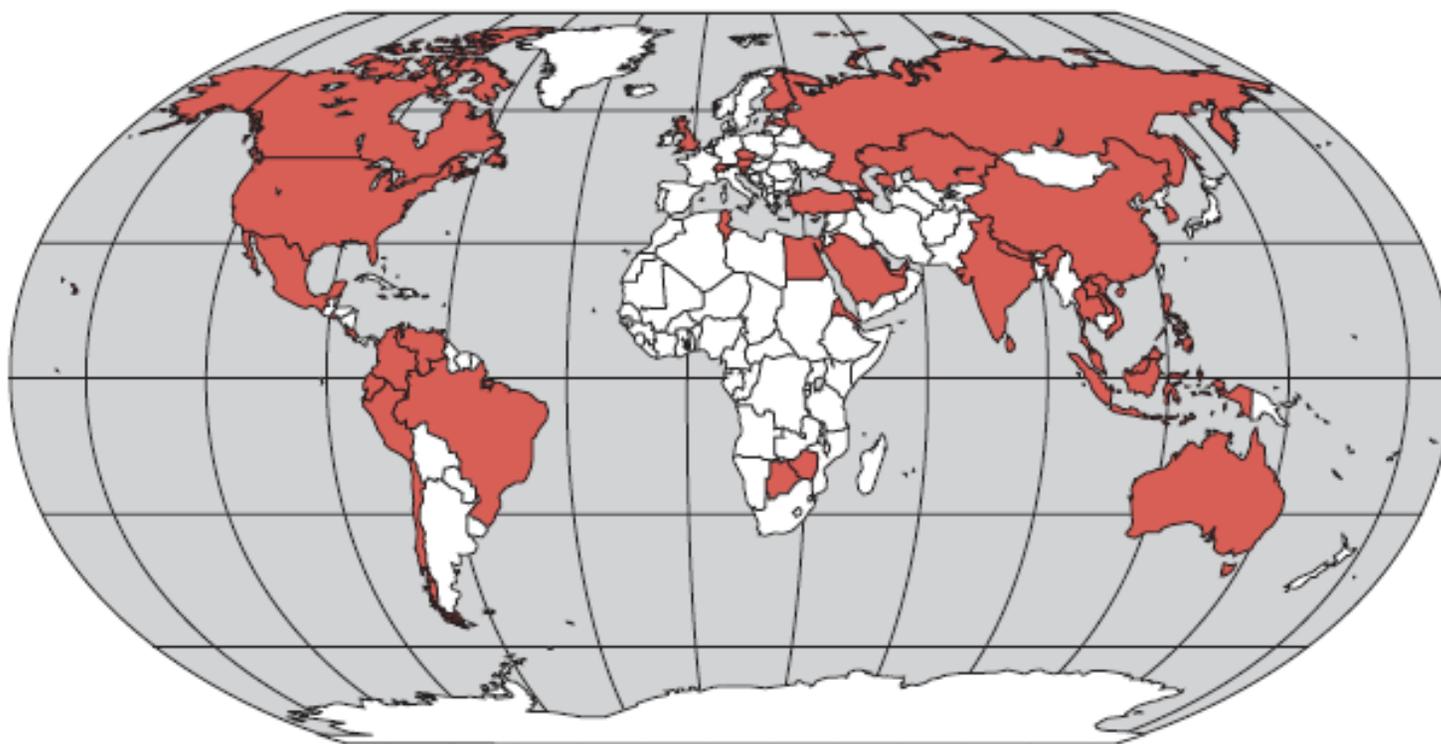
Mason

Thinking back to the original technology list, P25 is the remaining open standard that potentially matches the capabilities of TETRA.

How do TETRA and P25 compare ?

P25 – 600+ networks in 54 countries across all Continents

Countries with P25 - Interoperable Equipment or Networks

Australia	Canada	El Salvador	Kazakhstan	Philippines	Trinidad
Austria	Chile	Eritrea	Kuwait	Russia	Tunisia
Azerbaijan	China	Finland	Latvia	Saudi Arabia	Turkey
Bahrain	Colombia	India	Laos	Singapore	United Kingdom
Bermuda	Costa Rica	Indonesia	Malaysia	Slovenia	USA
Botswana	Czech Republic	Hong Kong Special	Mexico	South Korea	United Arab Emirates
Brazil	Ecuador	Administrative Region	Nepal	Sri Lanka	Venezuela
Brunei	Egypt	Jamaica	Peru	Switzerland	Vietnam
				Thailand	Zimbabwe

Mason

TETRA – 1000+ contracts in 88 countries

Africa 28
Confidential 3
Algeria 6
Congo 1
Kenya 1
Libya 4
Morocco 1
Nigeria 4
South Africa 6
Sudan 1
Tunisia 1

Asia Pacific 94
Azerbaijan 1
Brunei 1
China (incl HK) 43
Confidential 3
East Timor 1
Georgia 1
India 3
Indonesia 1
Kazakhstan 8
Malaysia 1
Singapore 6
South Korea 14
Taiwan 5
Thailand 2
Turkmenistan 3
Vietnam 1

Latin America 36
Argentina 3
Brazil 3
Chile 1
Confidential 2
Curacao 1
Ecuador 1
Haiti 1
Mexico 9
Panama 1
Peru 1
Trinidad 1
Venezuela 12

Middle East 42
Egypt 2
Iran 4
Iraq 4
Israel 1
Kingdom of Bahrain 1
Kuwait 1
Lebanon 2
Oman 4
Qatar 3
Libya 3
Saudi Arabia 5
Syria 1
Turkey 1
UAE 10

Scandinavia 50
Confidential 1
Denmark 8
Finland 20
Iceland 5
Norway 6
Sweden 10

South Europe 105
Andorra 1
Gibraltar 3
Greece 11
Italy 21
Malta 1
Portugal 10
Spain 58

East Europe 86
Belarus 1
Bosnia 1
Bulgaria 5
Croatia 5
Czech Republic 3
Hungary 1
Latvia 2
Macedonia 1
Poland 14
Romania 1
Russia 46
Slovakia 1
Slovenia 5

West Europe 323
Austria 8
Belgium 9
Confidential 1
France 58
Germany 32
Ireland 2
Luxemburg 1
Netherlands 49
Switzerland 13
UK 150

Mason

Which Standard – TETRA or P25 ?

- Feature rich, secure and scalable

- Provide enhanced functionality with equipment and capabilities focussed on Public Safety needs

- Improve spectrum efficiency

- Allow effective, efficient, and reliable intra-agency and inter-agency communications

- Ensure competition amongst multiple vendors through Open Systems Architecture

Mason

Some background to P25

P25 is seen as a standard to provide coverage rather than capacity as well as backwards compatibility…

- Provides a migration path from Analogue to Digital

- Multi-vendor – market prices are dropping [the same happened in TETRA…]

- Offers a mix of solutions [trunked, conventional, simulcast, etc)

- Supports secure communications from radio terminal to dispatch

- FDMA does not have same distance constraints as TDMA in relation to synchronisation – TETRA has a constraint of 56km

- As is the case in TETRA, there are mandatory functions that must be included; options in the standard that suppliers can choose whether to design into their solutions; and there a remains the option for manufacturer specific features to be offered

- As is the case with TETRA, IP technology is underpinning P25 bearer networks improving network resilience and flexibility

Mason

High Level Comparison…

TETRA

- Supports a range of user groups, including public safety, urban transport,and rail. And also provides a good platform for PAMR service offerings

- Build from scratch and don't expect to be able to use <u>any</u> elements of current mobile radio systems – *Revolution !*

- The standard has options for different configurations

- Mature multi-vendor environment

- Generally in UHF bands

P25

- Public safety focus but would suit needs of other 'orange light' groups and utilities

- Has been written with a clear migration path from analogue radio systems through to digital radio systems to the fore – *Evolution !*

- Can be conventional, simulcast, or trunked – a range of options to suit a variety of user needs all under the one air interface.

- Multi-vendor environment continues towards maturity

- Available in VHF and UHF bands

Mason

Both standards support similar voice functionality – the differences are elsewhere…

TETRA

- Protected 7.2kbit/s data channel using single timeslot – multi-slot will help increase this to 28.8kbit/s max.

- Good telephony functionality

- Over the air encryption as standard

- TETRA subscriber products are world-class in their design

- Has developed some excellent data centric products with TETRA PDAs, very accurate location systems, etc.

P25

- Protected 9.6kbit/s data channel

- Telephony functionality will be available

- End-to-end encryption as standard

- Subscriber equipment remains large and clumsy in comparison to TETRA

- Behind in terms of integrated applications across subscriber equipments (GPS, handheld functionality)

Mason

Looking ahead…

- As with TETRA, P25 as a standard is developed by consensus and steering committee. It has taken time for TETRA2 to achieve agreement of the technical specifications; P25 is no different.

- Similarly P25 is developing in phases – the second phase of the standard is close to reaching agreement although work continues in two key areas, modulation and data rate.

- Both standards are looking to achieving significantly higher data throughput rates than the initial implementations – P25 through what is termed High Performance Data

- P25 will improve its current spectrum efficiency in Phase 2 using TDMA to support two timeslots in a 12.5kHz channel – but P25 systems must still be able to support FDMA transmissions [dual mode transmission sites] termed dynamic dual mode operation

Mason

In Summary – what are TETRA's strengths ?

- TETRA is certainly more frequency efficient than other technologies – but is highly likely to require more base station sites to achieve similar coverage requirements (handheld or mobile)

- TETRA has shown the way to manage an open standard through interoperability certification

- The vast majority of TETRA networks have a mix of supplier equipments; few, if any, P25 networks are currently multi-vendor

- Competition has enabled rapid progress in the development of subscriber equipment, handportables and accessories in particular

- TETRA has available very competitively priced subscriber equipment – in fact pricing *may* have been driven down too low in some markets

- The TETRA Association has worked closely across the industry to ensure that standards work has flowed smoothly and reduced time to market

Mason

In Summary – What could TETRA learn ?

- **Multi-mode Operation**

  P25 has much of its success from supporting multi-mode platforms – TETRA must ensure that future technologies can springboard from the current TETRA implementations

  Evolution not Revolution !

- **Network/Technology Convergence**

  No one technology can be best at doing everything – TETRA solutions need to clearly show how future technologies can work alongside TETRA to provide yet stronger feature sets

- **Work with Competing Standards**

  All of the major mobile radio manufacturers have products spanning not only a number of open standards but also offering proprietary solutions… for many it is the same core 'engine' just a different Air Interface.

Mason

Duncan Swan
Associate Director
Mason Communications
Telephone: +44 207 061 3700
E-mail: duncan.swan@mason.biz