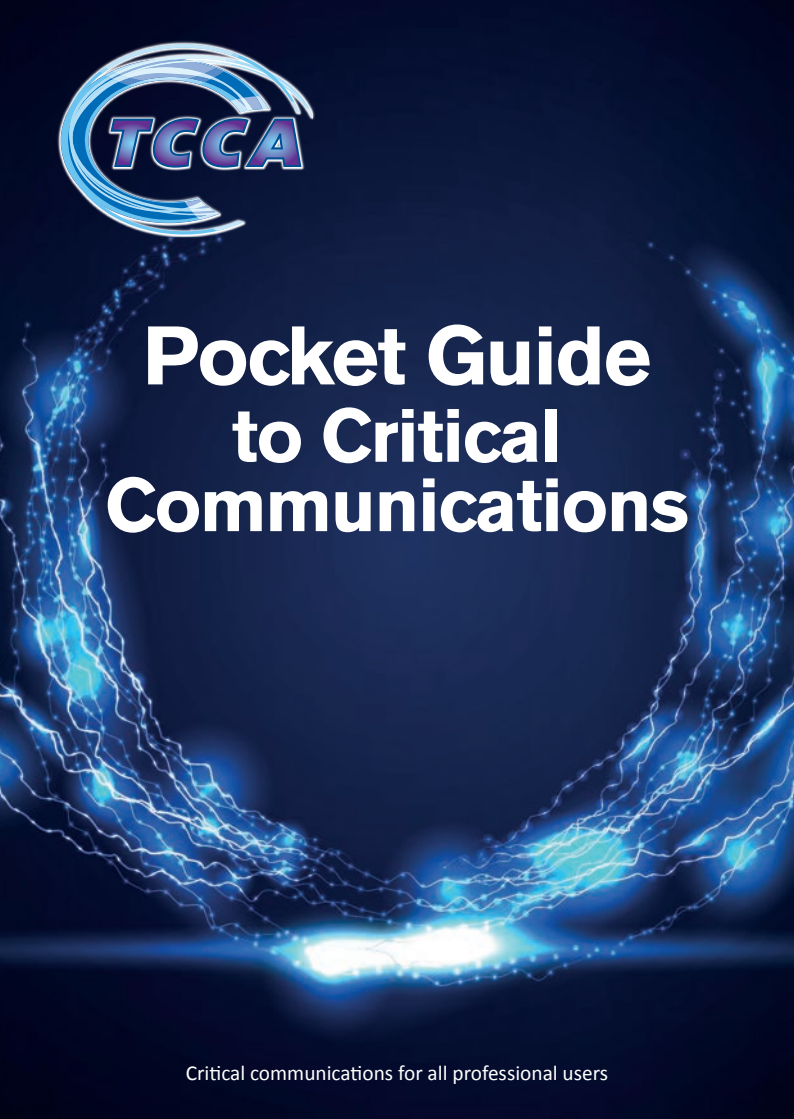

Pocket Guide to Critical Communications

Critical communications for all professional users

About TCCA

TCCA represents organisations from all continents of the world, bringing together all those with an interest in the provision of wireless communications in a mission critical or business critical environment. TCCA believes in and promotes the principle of open and competitive markets worldwide through the use of common standards and harmonised spectrum. As well as other PMR open standards, TCCA continues to support and promote the use of TETRA technology and is driving industry synergy in the development of future mobile broadband capability for the users and providers of critical communications.

For more information please contact admin@tcca.info

This Pocket Guide was produced in association with P3

About P3

P3 Group is a leading international consulting, engineering and testing company providing a broad portfolio of services through individual practices covering the telecoms, automotive, aerospace, energy and governmental sectors. P3's critical communications services include network planning, standards development, engineering, optimisation, security and testing for clients such as public safety authorities, mobile network operators, equipment manufacturers and regulators around the world.

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Contents

For details on TCCA's Critical Communications Series of events, and other exhibitions and conferences supported by TCCA, please visit **www.tcca.info**

Introduction

TCCA leads the global development and promotion of standardised critical communications solutions for professional users. We provide the forum for governments, regulators, manufacturers, operators, end-users – for any and every stakeholder in the critical communications sector – to discuss, debate, deliver and evolve the market for the benefit of all.

We influence key decision makers on the need for and benefits of open and competitive markets, and lobby for the spectrum required for critical communications to operate effectively.

We represent the interests of our members by working to ensure the delivery of secure, reliable, standardised critical communications for a global market, now and in the future. By working together, we can continue to create success for the critical communications market, and continue to safeguard end-users and the wider public.

This booklet is designed to give an overview of the critical communications market, and the work we are doing to ensure its continued success.

'We provide the forum for governments, regulators, manufacturers, operators, end-users – for any and every stakeholder in the critical communications sector – to discuss, debate, deliver and evolve the market for the benefit of all.'

Effective communications are essential to ensure the best outcome in a critical situation

Image courtesy of Motorola Solutions

What makes communications critical?

"Critical communications" are exactly that: communications services that are critical for the successful delivery and completion of the missions, tasks and operations of professional users who rely on being in contact when it counts.

There are many and varied types of operation which need critical communications. These include public safety and security, emergency services, critical infrastructure, public utilities, transportation and related operations, where failures in critical communications would lead to catastrophic degradation of services. This in turn could place critical services and citizen safety and security at immediate risk.

The voice and data services provided to critical communications users must closely match and support those users' operational needs and ways of working, wherever and whenever required. These Professional Mobile Radio (PMR) services may be of different addressing types, such as point-to-point, point-to-multipoint or broadcast. Services may also include:

- immediate call connection
- group call
- broadcast call
- emergency call (targeting either an individual or a group)
- short data messaging, including status messages, and
- IP-based data transmission

Critical services must be able to cope with high peak demands and provide ubiquitous coverage, as well as extremely high guaranteed availability, reliability and resilience. Disasters, whether natural or man-made, and other events putting safety of life, property or public security at risk, can occur anywhere and at any time. They are not limited to areas of dense

population. For example an aircraft or train can crash anywhere along its route and the resultant major incident may be a long way from the closest populated area.

Major events such as extreme weather, or unexpected critical situations such as acts of terrorism, can typically severely degrade or even completely destroy commercial communications links and networks. Even if still available during such an event, commercial networks have traditionally quickly become overloaded and saturated as citizens use them to try to cope with the situation.

PMR-like capabilities will soon, for the first time, be available from commercial 4G LTE mobile phone technology as used by today's smartphones. Traditionally, commercial mobile phone standards such as 2G, 3G and 4G have not provided the critical facilities required by critical users in their everyday work. Additionally, commercial mobile network operators (MNOs) will quite reasonably dimension and design their networks and services to satisfy the needs of mass commercial operations. These provide a 'best efforts' service generally in areas of high user population, and hence revenue. Commercial MNOs have not targeted or provided the degrees of coverage, capacity, availability and reliability required and demanded by critical operations, but that is changing as a new paradigm comes into play.

Critical communications are a niche but vital service, traditionally only properly addressed by specialist technologies and dedicated networks. For the future this may change as critical communications requirements and use cases are increasingly taken into account in mainstream commercial standards such as 4G LTE-Advanced Pro.

It is becoming more evident that the demand for broadband data services is increasing rapidly. Critical users use applications on their own smartphones for work purposes in the same way as they communicate away from the workplace. The ways in which people communicate in their daily life will inevitably find an effective use in a professional capacity, especially as the

importance of data communication continues to grow. The possibilities of transmitting live broadcast footage, criminal profiles, maps and other large files will support and add to the functionality of mission-critical communication. The most important and lowest common denominator must-have feature, however, will always be 'voice' communication at every emergency site and in every emergency situation.

TCCA is actively supporting, representing and promoting the needs of critical users and operators globally, and is the pre-eminent forum for all those interested in the future of critical communications.

'Critical services must be able to cope with high peak demands and provide ubiquitous coverage, as well as extremely high guaranteed availability, reliability and resilience. Disasters, whether natural or man-made, and other events putting safety of life, property or public security at risk, can occur anywhere and at any time.'

Critical users need complete confidence in their communications to ensure the most effective response

Image courtesy of Motorola Solutions

Standards

Technology standards serve a variety of purposes. They exist to support all aspects of conformity assessment, and to facilitate the implementation of integrated solutions. They provide the assurance that products, services and systems are compatible and will interconnect. They create a constantly evolving ecosystem of investment, development and manufacturing, a competitive price environment, and can signify confidence and security.

In its simplest term and as defined by ETSI, a standard is:
"a document, established by consensus and approved by a recognised body, that provides, for common and repeated use, rules, guidelines or characteristics for activities or their results, aimed at the achievement of the optimum degree of order in a given context".

In the Information and Communication Technologies (ICT) industry, which includes TCCA's critical mobile communications sector, standards have special significance in the following areas:

- **Interconnection and interoperability:** this is particularly important for enabling open and competitive markets, where users can 'mix and match' equipment and services from different sources and suppliers, and where suppliers can benefit from, and pass on, economies of scale. The ability of networks and devices to work together relies on products and services complying with standards.

- **Regulations and legislation:** standards are frequently referenced by regulators and legislators to protect user and business interests, and in support of international policies.

- **Safety and reliability:** adherence to standards helps ensure safety, reliability, fitness for purpose and environmental care. As a result, users perceive standardised products and services as more dependable – this

in turn raises user confidence, increasing sales and the take-up of new technologies.

- **Business benefits:** standards provide a solid foundation upon which to develop new technologies and to enhance existing practices. Specifically they:
  - open up market access and enable suppliers to compete on a level playing field
  - provide economies of scale and support sustainable cost
  - encourage innovation
  - increase awareness of technical developments and initiatives
  - enhance consumer choice by acting as a foundation for new features and options - mass production based on standards provides a greater variety of accessible products to consumers

Technologies that have been developed by a single company are called proprietary technologies, and are not standardised. Such technologies typically can only be procured from that supplier. As a result, there is no competitive ecosystem or competitive pricing, and purchasers cannot choose from a variety of suppliers as compatibility is not assured.

'Technology standards provide the assurance that products, services and systems are compatible and will interconnect. They create a constantly evolving ecosystem of investment, development and manufacturing, a competitive price environment, and can signify confidence and security.'

Sometimes manufacturers offer to make the details of their technology open and available for others to copy and then claim that the technology is a standard. But such technologies have not undergone the rigorous evaluation of a Standards Development Organisation (SDO) and cannot therefore be classed as a standard. Similarly, suppliers who create a technology whilst standards development is in progress sometimes describe their technology as a "pre-standard". This is not a definition that is recognised by any SDO and is simply a marketing exercise.

If a standard is not yet issued then any technology offered in advance of the standard must, by definition, be classed as proprietary. There is no guarantee that equipment purchased ahead of a standard will become compliant to that standard, or that it is capable of being upgraded to that standard. Purchasers should be aware of the risks associated with purchasing equipment in advance of a recognised standard being issued.

Today's PMR standardised technologies include TETRA, DMR and P25, and deliver narrow- and wideband services. For critical broadband, TCCA has catalysed the SDOs to develop and enhance the LTE standard to ensure the incorporation of the unique features required by critical users. This work is ongoing.

'Suppliers who create a technology whilst standards development is in progress sometimes describe their technology as a "pre-standard". This is not a definition that is recognised by any Standards Development Organisation and is simply a marketing exercise.'

Image courtesy of Airbus Defence and Space/Tapio Makinen

The market today

The total global market for critical communications devices – PMR fixed, mobile and handportable terminals – is estimated to be somewhere between 40-50 million units, depending on various methodologies. In this age of rapidly emerging 5G-ready networks, it is reassuring to know that the critical communications market continues to grow, as security-conscious administrations and end-users recognise the continued importance of specialised PMR technologies.

TETRA remains the dominant mission-critical, public safety-grade digital PMR standard around the world. TETRA is a 4-slot TDMA technology operating in 25 kHz bands, and is an open standard where the focus is on meeting the critical communications needs of public safety and security agencies.

The TETRA standard is in practice, a suite of standards covering different technology aspects such as air interfaces, network interfaces and its services and facilities. Because TETRA is an evolving standard, work continues within ETSI Technical Committee (TC) TETRA & Critical Communications Evolution (TCCE) to further enhance the standard to satisfy new user requirements as well as leveraging the benefits of new technology innovations.

Although large European public safety organisations have been the focus of the largest TETRA suppliers, TETRA has become a truly global standard with networks deployed worldwide and in all major industry sectors. Major European TETRA networks are enjoying significant new investments, and Latin America, Asia-Pacific, the Middle East and Africa and North America continue to witness increased TETRA adoption in public safety as well as many vertical sectors including transport, oil & gas, industrial, manufacturing and utilities.

Large public safety organisations now understand that the next generation of broadband critical communications solutions based on 3GPP standards will in the main be built on top of existing TETRA infrastructure and complement its capabilities.

DMR has become the most popular digital PMR standard globally in terms of volumes of devices sold around the world. DMR is a 2-slot TDMA solution that can offer more traditional, price-sensitive, business-critical customers a straightforward migration path from legacy analogue solutions by allowing greater voice and slow data capacity within existing frequency allocations. The greatest volume of sales has occurred within the non-trunked DMR Tier 2 market, although the trunked version, DMR Tier 3, has now been available since 2013, opening up opportunities for wider-area networks such as utilities, where spectrum for TETRA might not be available.

P25 was developed jointly by US TIA and APCO for the US law enforcement community. The North American standard received a boost when it was designated as the national standard for public safety interoperability following the 9/11 attacks in September 2001. P25 has also had limited success in other English-speaking and Latin American markets where the US influence is strong or where geography makes wide-area TETRA deployments unfeasible. Although P25 never achieved nationwide coverage in USA, it does have a strong presence in urban areas and will continue to be used well into the 2020s, as the FirstNet nationwide public safety broadband solution will focus initially on high-speed data and multimedia rather than voice.

PDT has emerged as the national Chinese standard for police communications. A number of TETRA networks were deployed for public safety in Beijing, Shanghai and other major markets during the 2000s, but DMR, proprietary and even analogue networks were also chosen by police authorities in smaller jurisdictions. A number of Chinese and foreign PMR equipment suppliers have cooperated with Chinese authorities to develop a home-grown standard in the designated 350 MHz band that claims to be

compatible with other global standards. Similar to TETRA, it is hoped that PDT will allow a relatively smooth migration path to critical communications broadband solutions as they become available.

dPMR is another digital PMR standard that has emerged as an off-shoot of the DMR standardisation process within ETSI. Whereas DMR is a 2-slot TDMA technology operating in 12.5 kHz bands, dPMR is a FDMA technology that is able to operate in very narrowband channels - 6.25 kHz. A number of traditional PMR manufacturers have developed equipment that is dPMR-compliant, but it is fair to say that dPMR has not had the same market success as DMR.

In the very near future, the number of digital PMR units deployed in the global market will overtake the number of analogue PMR units. This clearly demonstrates that digital PMR has a guaranteed healthy future. However, it is also clear that the critical communications sector is undergoing significant changes. New devices and solutions will appear as the critical communications world works more closely with 3GPP.

TCCA is a 3GPP Market Representation Partner, offering market advice to 3GPP and bringing a consensus view of market requirements such as services, features and functionality that fall within the 3GPP scope.

Some solutions such as Internet of Things (IoT) may require only relatively small amounts of data and may still be provided over existing technologies. The increased deployment of smartphones, wearables, drones, connected and autonomous vehicles requiring increased use of big data and analytics will open up exciting new opportunities for the critical communications market.

New devices and solutions will appear as the critical communications world works more closely with 3GPP

Image courtesy of Motorola Solutions

How the market is evolving

LTE – bringing new possibilities for professional users

It's the kind of incident that first responders dread – a large chemical leak at a factory has released dangerous gases into the atmosphere. But with a complex layout and uncertainty about which gases are involved, rescue workers are faced with a major challenge.

A drone with heat sensitive cameras and chemical sampling equipment finds several people lying prone and detects deadly chlorine gas, sending data straight to rescuers' radios. A layout of the factory is sent to them so they can plan their route into the facility, minimising exposure. Once they have rescued the casualties, they will send their symptoms via a connected bio monitor to the casualty unit so medical staff can prepare the right treatments.

Live video streaming, large file transfer, instant telemetry from ambulances to hospitals – all these apps and features are made possible by adding broadband LTE capability to professional mobile radio networks.

Commercial LTE is available in a wide spectrum, ranging from 450 MHz to 3.5 GHz. It can also accommodate different channel bandwidths from 1.4 MHz to 20 MHz and both FDD and TDD duplex modes. The spectrum considered for dedicated broadband public safety networks is usually below 1 GHz (450 MHz band 31, 700 MHz band 14 and 28), with bandwidth usually 5+5 MHz or 10+10 MHz for coverage. There could be the need for additional 20-40 MHz in higher bands for capacity.

The foundations for mission-critical LTE have been standardised by 3GPP and the relevant features are being enhanced as specific use cases for critical applications are developed. Several countries are already allocating spectrum specifically for public safety LTE, including, the United States, Canada, South Korea, Spain, the Middle East, Brazil, Chile, Australia and China.

Building the network

There are several ways to implement an LTE network:

- A public safety operator deploys a private LTE radio access and core network to provide critical communications services and applications over mobile broadband
- A critical communications operator shares network and/or spectrum with a commercial mobile operator
- A critical communications operator acts as a mobile virtual network operator (MVNO) - it does not own the wireless network but provides the critical communications service over an existing network and deploys its own database, applications and billing information
- A critical communications operator provides only the related applications while a mobile network operator owns and provides the infrastructure service

Critical communications agencies looking to deploy LTE must consider factors such as budget, regulations, resources, coverage and reliability targets, spectrum and number of end users.

'Live video streaming, large file transfer, instant telemetry from ambulances to hospitals – all these apps and features are made possible by adding broadband LTE capability to professional mobile radio networks. The foundations for mission-critical LTE have been standardised by 3GPP and the relevant features are being enhanced as specific use cases for critical applications are developed.'

One important implication of the introduction of broadband critical communications networks is reflected in the designing and equipping of control rooms.

Image courtesy of Motorola Solutions


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Market perspective from TCCA

When we ask the users of critical telecommunications what they expect from the ideal future communication system, all their answers cover the same things: They want a system that will provide them with maximum situational awareness and help them to make the right decisions and take appropriate actions in the shortest possible time. Such a system must ensure first and always uncompromised, safe, quality and reliable voice communication as well as the possibility to access all types of data, including real time video streaming.

Although user needs are a decisive factor in the development of technology and the introduction of new technical solutions, we are also aware that the emergence of new technological solutions may contribute to the creation of needs that have not yet been envisaged.

TCCA's Critical Communications Broadband Working Group (CCBG) is tasked with driving the development and adoption of common, mobile broadband standards and solutions for users who operate in a mission-critical or business critical environment. These standards are part of the fourth generation of mobile communications (4G LTE Advanced Pro) and future 5G standards, and as such are global, mainstream standards. But the creation of the necessary standards and technology is only part of the solution. Delivering services that take advantage of such capabilities in a timely, cost effective and affordable manner is also a significant task.

TCCA believes that dedicated networks owned and operated by the user and/or operators are the best choice for critical communications end users. Typically the special requirements for coverage, security, resilience, accessibility and performance necessary for critical communications services have only been met up to now by dedicated networks owned and

operated by the user and/or operators. However broadband networks are costly and, if separate from commercial networks, require their own frequency spectrum.

Given that the same standards and technology will be used for critical communications networks and for commercial ones, and that in certain regions it might be difficult to obtain dedicated frequencies, it is likely that future broadband critical communications services will be offered by commercial MNOs and based on their networks .

Of course, where commercial networks are used for carrying mission-critical traffic, guaranteed coverage, capacity, resilience and reliability service levels will be paramount. Current experience shows that there is significant interest from MNOs and that they believe that the business case is feasible. However it should not be assumed that all MNOs will be willing to take on the responsibility for providing sufficient coverage, reliability and functionality for mission-critical users.

One of the possible solutions is dedicated network infrastructure combined with service from one or more commercial MNOs. The potential benefit of such an arrangement is that mobile broadband applications can be taken advantage of more quickly and with lower capital investment for public administrations than building a private nationwide dedicated broadband network.

One important implication of the introduction of broadband critical communications networks is reflected in the designing and equipping of control rooms. When broadband data over critical LTE networks becomes available and widely used, the corresponding equipment will be used in control rooms. This will enable dispatchers to send, retrieve and receive all kinds of high-speed data that can help to provide more efficient and effective responses.

The International Critical Control Room Alliance (ICCRA), a TCCA Working Group, has a focus on this issue, with the goal of contributing to the standardisation of the related control room equipment and interfaces.

It is also important that the interoperability process is maintained. TCCA has established and managed a very successful Interoperability (IOP) Testing and Certification process for TETRA – see www.tcca.info for full details.

For certification of mission-critical features in broadband (LTE and beyond) users and operators will have similar expectations. This process will be more complicated, due to factors including the variety of applications and interfaces that will exist. Interoperability tests are expected to be needed with the several interfaces such as user equipment operating system APIs, user equipment device management, air interfaces, MCPTT client-server and others.

TCCA is collaborating with relevant bodies including the Global Certification Forum (GCF) on testing and certification of standards compliant mission critical devices and services.

'When we ask the users of critical telecommunications what they expect from the ideal future communication system, all their answers cover the same things: They want a system that will provide them with maximum situational awareness and help them to make the right decisions and take appropriate actions in the shortest possible time.'

Spectrum requirements for critical communications

Today's mission-critical systems – whether based on TETRA or other technologies – are all dedicated systems on dedicated spectrum. The success of TETRA is based on two pillars – one common standard and harmonised spectrum.

All radio systems require spectrum in which to operate. Spectrum is a finite resource and, with the increasing demands of a mobile society, the available airwaves are under real pressure. Governments will need to balance the revenue potential from auctioning spectrum against the importance of ensuring the Public Protection and Disaster Relief (PPDR) community has excellent mobile communications, especially in the increasingly turbulent society in which we all live.

With broadband entering the scene as a future addition to critical communications services, one would automatically believe that harmonised spectrum would be guaranteed. TCCA has been working on that objective for the last decade and we have the international agreements in place.

According to the International and European regulators such as ITU, ECC and the EC, spectrum for critical LTE serving public safety and other critical communications operations has to be found in the 700 MHz band, but it is up to each country to determine how, and how much. In many countries, there is an immediate opportunity to secure sufficient spectrum for public safety operations and such an opportunity may not occur again for a very long time. But that is not the end result; allocation of spectrum is a national matter, so each country will decide how its spectrum will be allocated.

In the majority of countries, regulators believe that spectrum is best utilised by those who are willing to pay the most for access. That is not a model

that works for PPDR operators – only for commercial companies. Spectrum in 700 MHz will in most cases be auctioned off to commercial operators. Regulators are driving coverage conditions into the licences, but mission-critical services and implementations are up to each operator.

There are only three parameters available when discussing mission critical service:

- having control over spectrum
- having funding available to buy the service you need from the market
- exercising government regulation

If commercial operators are not willing to provide the required service, and regulation in a much liberalised sector is not an option, then governments must retain control of specific spectrum or accept the consequences of inadequate control over the service provided by commercial operators.

Public safety and other critical communications operators should engage with their national MNOs at the earliest possible opportunity and present them with the required Service Level Agreements and associated legal frameworks. The discussions should also cover the functionality that is required in the 700MHz implementations. The outcome of such discussions should determine if spectrum allocation or regulation is required.

A clear way ahead on spectrum is essential to ensure a smooth route for future critical communications

Image courtesy of Airbus/Tapio Makinen

Roadmap for critical communications

The evolution of critical communications from its current narrow/wideband basis towards a broadband future will be mainly predicated upon the development of suitable standards incorporating the fundamental features and facilities required by, and mandatory for, critical users.

Of course standards development is only one half of the equation: unless and until manufacturers decide to adopt particular features and then develop conformant equipment, standards remain a written record of the aspirations and requirements of particular markets, in this case critical communications.

The availability of adequate spectrum to accommodate critical services, whether such spectrum is dedicated or shared, for example with commercial services, is also a fundamental prerequisite for future critical broadband provision.

Figure 1 (opposite) gives an indication of the standards-making process for critical broadband LTE. Also shown are the predicted timelines for development by manufacturers of equipment conformant to each new standards release.

In Figure 2 (opposite), the likely timelines for implementations of the various 3GPP standards releases are predicted. Also shown is the relative perceived risk sensitivity according to time and technology generation.

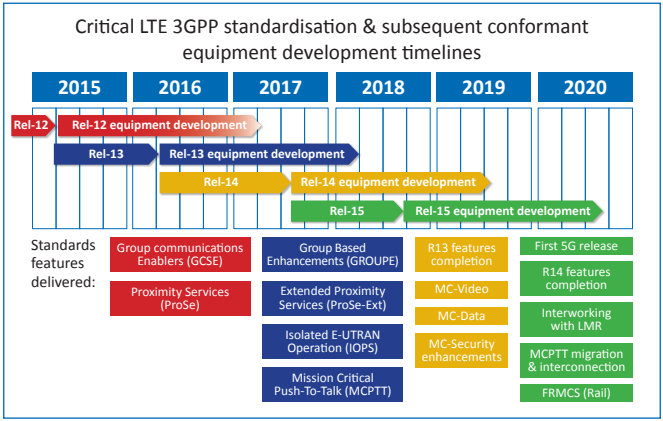

Figure 1: Standards & equipment development timelines

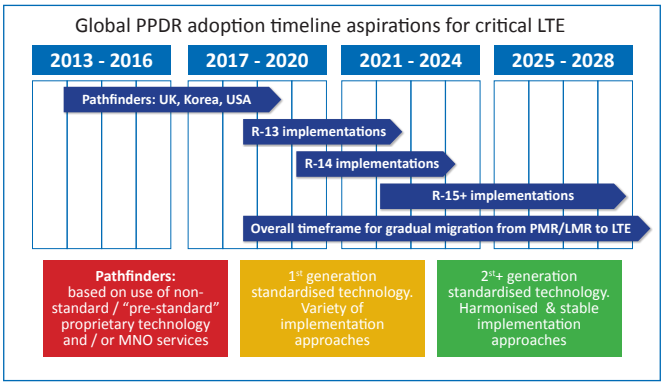

Figure 2: Critical broadband implementation timelines

There are various ways of implementing a critical communications network but all are aimed at the same goal - to provide the best possible service for the users

Image courtesy of Motorola Solutions

Case implementations

The evolution of the critical communications market today is represented by the different approaches taken by national network operators and governments – a short overview of some implementation cases follows:

Germany – the brand-new TETRA network

The Federal Agency for Public Safety Radio runs and operates a uniform digital voice and data radio system for all PPDR agencies and organisations throughout Germany.

In June 2016, the deployment of the new TETRA digital network was finalised. This is the largest TETRA network in the world and is expected to grow to eventually surpass one million users.

Deploying, financing and operating the German digital radio network is a joint project between all 16 federal states of Germany and the German federal government.

The Federal Agency for Public Safety Radio is responsible for the coordination and development of the project and for ensuring that the interests of all users are taken into account. However, federal states run and manage their own regional access network. As of February 2017, the network consisted of 4,528 base stations, thereby ensuring an area of coverage spanning 99% of Germany.

In all federal states, the public safety digital radio is used by PPDR organisations and agencies and has not only proven its value in daily routine use, but also in numerous demanding and large-scale operations. These are now routinely prepared and carried out in close cooperation with the technical operator and the single points of contact within the different PPDR organisations and federal states.

The Netherlands – replacement TETRA network

The Dutch public safety TETRA communication system C2000 has been in use by police, fire brigade, ambulance services and military police for more than 13 years, and the existing network equipment is at the end of its technical life. For the network renewal the European procurement regulation had to be followed.

To be able to continue to guarantee uninterrupted communication to the 85,000 C2000 users, the Dutch ministry of Safety and Justice started a European procurement procedure in 2012 for renewal of the C2000 network.

In the preparation period before the procurement it was decided to choose to use TETRA technology again. The contract for the network renewal was awarded in 2015 to three new suppliers, who will implement the network renewal under control of the "Implementatie Vernieuwing C2000" (IVC) program organisation, which is part of the Dutch ministry of Safety and Justice.

Saudi Arabia – TETRA + private LTE networks

The Middle East is one of the most dynamic regions for the adoption and expansion of critical communications networks and services. Within this market, Saudi Telecom Company (STC) subsidiary Bravo serves more than 160,000 subscribers for more than 3,000 customers.

Bravo's network was previously based on a proprietary Push to Talk (PTT) technology. Bravo has implemented an on-going replacement programme utilising TETRA solutions and mission-critical LTE 4G. This approach

underpins Saudi Arabia's Vision 2030, which is about optimisation, digitisation of different verticals and enhancing public/private partnerships.

To complement the new mission-critical TETRA network, mission-critical private LTE networks, based on 3GPP Release 13, will be rolled out on a zone-by-zone basis according to customer needs.

Bravo must meet very high standards, mostly around TETRA functionality and the use of dedicated, highly resilient fully redundant networks requirements in order to serve critical sectors such as oil and gas, pilgrimage, healthcare, airports, seaports, mass transportation, public safety and more.

Belgium – TETRA + services using the commercial mobile networks

To continue to guarantee quality communications systems for the Belgian public safety and security services into the future, ASTRID is renewing its TETRA infrastructure and developing new services.

ASTRID is ensuring the reliability and continuity of the network by replacing the core network infrastructure, maintaining the capacity and coverage of the network in Belgium, and looking to expand the network in critical areas such as larger cities, airports and hazardous industrial plants.

After the attacks in Brussels on March 22nd 2016, priority was given to the Brussels area TETRA network where additional capacity can be activated in case of crisis situations. For mobile data, ASTRID customers have Blue Light Mobile service, which uses the 2G, 3G, 3G+ and 4G mobile networks of the three national operators via roaming for fast mobile data traffic.

Public safety and security services can rely on Blue Light Mobile across Belgium as well as just over the country's borders without additional charge. This is particularly advantageous for teams who regularly operate across the international boundaries.

United Kingdom Emergency Services Network (ESN) — Commercial LTE network serving critical communications users (not yet launched)

The UK Home Office-led Emergency Services Mobile Communications Programme (ESMCP) has been established to develop and deliver a new 4G broadband communications service to replace the current TETRA Airwave system. The new service is called the Emergency Services Network (ESN).

ESN will rely on enhancing a commercial mobile network operator's 4G network to provide public safety features including group calling and push to talk, as well as additional coverage and resilience that the Emergency Services in England Scotland and Wales require.

Although the Programme is being led by the UK Home Office, all three emergency services were closely involved in defining the requirements of the future service provision.

ESN provides the emergency services with an opportunity to radically change the way they operate in the future through the provision of broadband data devices and services, such as live video feed from / to incidents, and access to databases.

Be part of the success

TCCA is the front line force that drives the development and promotion of open standard critical communications solutions worldwide. As a stakeholder in critical communications, you can play a key role in ensuring the success of an open and competitive market, today and in the future.

TCCA advises and informs the critical communications market and its stakeholders, from government to end-users, and has a strong influence on the direction of the industry.

TCCA is catalysing the evolution of LTE towards becoming a true critical communications bearer. In parallel, we provide the central role in the development and enhancement of the TETRA standard, and support users with advice on other open standards.

Some of the benefits of membership are listed below.

- **Significant discounts on exhibiting and attending TCCA's Critical Communications series of events, and other TCCA-led events**
- **Access to knowledge and information**
- **All TCCA members are welcome to participate in the many influential Working Groups within the Association. These include:**

  Applications Working Group (Apps WG)
  Applications offer many efficiencies and possibilities for critical communications users. The Apps WG works on enabling mission critical data and applications in an interoperable way on TETRA and broadband networks.

The Broadband Industry Group (BIG)
Drives the market adoption of standardised mission-critical LTE/5G capabilities for the benefit of critical communication operators, service providers and users.

The Critical Communications Broadband Group (CCBG)
Drives the development and adoption of common mobile broadband standards and solutions for critical communications, and works with global stakeholders to lobby for appropriate harmonised spectrum for critical broadband.

The International Critical Control Room Alliance (ICCRA)
ICCRA covers all aspects of running an effective critical control room, including the technologies involved, the processes and operations, the environment and ergonomics of the rooms, and the people who bring them to life.

The Marketing Group (MG)
Develops and co-ordinates the integrated marketing communications activity of TCCA, positioning and raising the profile of the Association's work through the events programme, media engagement and other market-facing activities.

The Operator User Association (OUA)
A forum for knowledge exchange between operators and users of critical communications systems. In close co-operation with ETSI Working Groups, new user requirements are identified, and converted into Service Overviews. The OUA carries the responsibility of collecting and submitting user priorities to the Technical Forum.

SCADA, Smart Grid and Telemetry Working Group (SSTWG)
A forum for users, manufacturers, system integrators and developers to share experiences and requirements, and catalyse the market for critical communications. Its aim is to encourage and support the

development of suitable solutions, both for traditional SCADA and telemetry and for new application areas such as smart grids.

The Security and Fraud Prevention Group (SFPG)
Prepares and manages recommendations on use of encryption in critical communications networks, and controls access to restricted technical information.

The Technical Forum (TF)
Among other responsibilities this group interfaces to ETSI for Standards work; oversees the TETRA Interoperability Testing and Certification Process, and provides a key forum for technical knowledge exchange.

TETRA Industry Group (TIG)
TIG works to promote TETRA, develop the technology and advocate an evolutionary path towards future solutions for the mission-critical communications market that TETRA serves, based on open standards. It develops expertise on the strengths of TETRA and LTE as competing, complementary or integrated solutions for this market.

Transportation Group (TG)
A platform for everyone interested in critical communications implementation in the transportation sector, including railways, metros, trams, buses, sea ports, harbours and airports. Participants share experiences and information, focusing on the market potential for future projects as well as representing users' interests.

- **TCCA website and social media channels**
  - Access members-only technical and marketing information and reports
  - Benefit from your company's press releases and news posted on www.tcca.info and across social media channels
  - Be listed as a member on the website – all member logos appear on the front page in rotation

- **Media Opportunities**
  - TCCA regularly secures opportunities for media profile, and all members have the opportunity to contribute. A selection of TCCA's news coverage can be found at www.tcca.info/tcca-in-the-news
- **Member-only resources including a Business Advice Helpline**
- **Impact on the future of critical communications**

As a member you will join other like-minded organisations globally whose success is dependent upon critical communications – you can help secure that success. As a member of TCCA you have the opportunity to be part of the ongoing success of our industry, to share the knowledge and expertise of other TCCA members and partner organisations, and to actively participate in determining the future of critical communications. Only by working together can we continue to make the difference that creates success for our members.

Membership Application

To join TCCA, please contact us at:
admin@tcca.info
+44 (0) 191 231 4328

We would be delighted to hear from you.

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The Grainger Suite
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Critical Communications Events

TCCA runs its own Critical Communications Series of events, as well as supporting other industry events around the world - the map below shows just some of the locations where we have exhibited.

For details of upcoming events, please see **www.tcca.info** or contact us at **admin@tcca.info**

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Glossary

2G	2nd Generation (of mobile cellular standards)
3G	3rd Generation (of mobile cellular standards)
3GPP	3rd Generation Partnership Project
4G	4th Generation (of mobile cellular standards)
5G	5th Generation (of mobile cellular standards)
APCO	Association of Public Safety Communications Officials
API	Application Programming Interface
CCBG	Critical Communications Broadband Group (TCCA working group)
CEPT	Conference of European Postal and Telecommunications Administrations (regulator)
DMR	Digital Mobile Radio (ETSI standard)
dPMR	Digital PMR (ETSI standard)
E-UTRAN	Evolved Universal Terrestrial Radio Access Network (LTE RAN)
EC	European Commission
ECC	Electronic Communications Committee (a committee of CEPT)
eMBMS	evolved Multimedia Broadcast and Multicast Services
ETSI	European Telecommunications Standards Institution
FDD	Frequency Division Duplex
FDMA	Frequency Division Multiple Access
GCF	Global Certification Forum
GCSE	3GPP Work Item: Group Communications Service Enablers
GROUPE	3GPP Work Item: Group communications Extensions
GSM	Global System for Mobile Communications (2G standards)
ICT	Information and Communication Technologies
IOP	Interoperability (of TETRA equipment)
IOPS	3GPP Work Item: Isolated E-UTRAN Operation for Public Safety
IoT	Internet of Things
IP	Internet Protocol

ITU	International Telecommunications Union (regulator)
KHz	Kilohertz
LTE	Long Term Evolution (4G mobile cellular standards)
LTE-A Pro	LTE Advanced Pro (LTE equipment conforming to 3GPP specifications from Release 13 onwards)
MC-Messaging	3GPP Work Item: Mission Critical Messaging
MC-Video	3GPP Work Item: Mission Critical Video
MCPTT	Mission-Critical Push-To-Talk
MHz	Megahertz
MNO	Mobile Network Operator
MVNO	Mobile Virtual Network Operator
P25	Project 25 (also APCO-25): a suite of standards maintained by the TIA (Telecommunications Industry Association) for digital radio communications
PDT	Police Digital Trunking (Chinese standard)
PMR	Professional Mobile Radio
PPDR	Public Protection and Disaster Relief
ProSe	3GPP Work Item: Proximity Services
ProSe-Ext	3GPP Work Item: Proximity Services Extensions
RAN	Radio Access Network
Rel-12 (etc)	3GPP standards Release no. 12 (etc)
SDO	Standards Development Organisation
TCCA	The Critical Communications Association
TC-TCCE	ETSI Technical Committee TETRA & Critical Communications Evolution
TDD	Time Division Duplex
TDMA	Time Division Multiple Access
TETRA	TErrestrial Trunked RAdio, the ETSI standard for digital trunked radio communications
TIA	Telecommunications Industry Association

Visit us at www.tcca.info
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To request copies of this booklet, please contact **admin@tcca.info**

Contributors and Credits:

This Pocket Guide has been compiled from contributions kindly provided by a number of TCCA member organisations.

TCCA is extremely grateful to, and hereby acknowledges the contributions of:

- Airbus Defence and Space
- ASTRID (Belgium)
- The Federal Agency for Public Safety Radio (Germany)
- Bravo (Kingdom of Saudi Arabia)
- Ericsson
- Motorola Solutions
- Nokia
- The Police of The Netherlands, division MDC
- P3 Group
- Quixoticity
- Sepura
- United Kingdom Home Office

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