PUBLIC SAFETY NETWORK
TE KUPENGA MARUTAU

Public Safety Network
Appendix 4.1
Services Guidelines
Cellular

Contents

1. Introduction

The Public Safety Network (PSN) programme is an Emergency Services initiative of behalf of Fire and Emergency New Zealand (Fire and Emergency), New Zealand Police (Police), St John New Zealand (St John), and Wellington Free Ambulance (WFA). The PSN programme is tasked with delivering Mission Critical communication services to the Emergency Services sector.

This document should be read in conjunction with the *Appendix 1. Service Requirements* document.

2. Document Purpose

This document is one of a set of Services Guidelines which outlines the network services required for the successful delivery the PSN and should be read as a guide (except where items are specified) for potential suppliers to propose their own solutions for PSN's requirements.

3. Services Scope

This document describes the Cellular Services that will be available to the Emergency Services agencies and how Service Providers may choose to deliver the supporting technologies, including LTE (Long Term Evolution) and beyond[1], in order to meet the PSN Service Requirements. The scope of Cellular Services includes a Standard Cellular Service and a Mission Critical Cellular Service. How these services will be used, (e.g. as part of a Push-to-Talk over Cellular solution), or how users access the services via devices and device management are covered elsewhere in the Services Guidelines documents.

It is expected that the Cellular Services will be integrated with agency networks and applications and will interwork with non-cellular technology. This is covered in document *Appendix 5.4 Functional Guidelines - Integration Target State*.

It is expected that Priority Cellular Services are available over dedicated, temporary and shared radio access networks.

4. Services Outline

Emergency Services agencies will access Cellular Services through the PSN Service Catalogue. The services are expected to reflect commercial service structures to maintain usability with standard devices and applications, however support of 3GPP defined Mission Critical and Quality of Service features is required. Furthermore, where the device supports it, Cellular Services will support Mission Critical Push-to-Talk (MCPTT) services which are described in the document *Appendix 4.2 Services Guidelines Mission Critical Push-to-Talk (Cellular).*

It is expected that Cellular Services for Emergency Services are available over dedicated, temporary and shared radio access networks.

[1] LTE/LTE-A/LTE-A Pro/5G etsi.org/technologies/mobile

4.1 Voice

Voice calling services to and from Emergency Services personnel will be available for Cellular connections, enabling calls to and from all domestic and international PSTN and mobile networks (as per standard commercial arrangements with the mobile network operator) wherever coverage is available. Where LTE (or above) is not available, voice calling will still be supported on 3G or any other legacy voice network available.

Emergency Services use voice calling for communications in the field and require the ability to call any number at any time subject to agency call barring policies. Emergency Service voice calling includes, but is not limited to, the following scenarios:

- Between staff in the field;
- Between Communications Centre staff and the field;
- Between staff in the field and other operational or administration staff;
- Between staff in the field and external parties such as specialists (e.g. in a hospital) or other third parties (e.g. tow-truck drivers);
- Between field, Communications Centre, operational, or administrative staff and the general public; and
- Between field, Communications Centre, operational, or administrative staff and voice calling services such as audio conferencing.

4.1.1 Voice Quality

Voice in both directions needs to be audible without repetition, including when high background noise is present around the person transmitting when devices are being used in the normal manner. Examples of normal manner could be in a vehicle with wind and siren noise, a person walking around with high background speech noise or inside a helicopter.

In terms of mean opinion score (MOS), a minimum of 3.5 (out of 5) shall be provided. The method described in the ITU-T P-863 shall be used where quantitative measurement of voice quality is required.

4.1.2 Voice Mail

Voice mail services will be available to use and configured as required by agency policy.

4.1.3 Call Recording

Agencies may make use of call recording services for all or some calls.

4.1.4 Voice Supplementary Services

Supplementary services will be supported, including all standard VoLTE services as defined in GSMA IR.92 or the equivalent capability when LTE not available:

- Originating and terminating identification presentation;
- Originating and terminating identification restriction;
- Communication Forwarding;

- Barring;
- Communication Hold;
- Message Waiting Indication;
- Communication Waiting;
- Ad-Hoc Multi Party Conference.

Service Providers will offer provisioning tools for agencies to set policies and configure settings for individual users.

4.2 Messaging

Human- and machine-readable messages (low bandwidth data) play an important role in Emergency Services operations and have the advantage that they can be sent via (cellular or other) lower-bandwidth networks in locations where cellular broadband is not available. Messages are two-way and are as follows:

- Application to person (and vice versa):
    - Human-readable messages from Computer-Aided Dispatch (CAD) systems to alert and inform field staff and volunteers about an incident.

      Currently, Police use broadband applications or SMS for personal messaging. However, Fire and Emergency and St John currently use network paging, which is a sunset technology and needs to be replaced. The replacement personal messaging system should have:
        - The coverage of the current pager network;
        - The resilience afforded by using cellular (e.g. SMS) plus another network; and
        - The ability to reply (not currently available via paging).

      Fire and Emergency have plans to extend the use of a personal messaging application which works over cellular broadband, Wi-Fi and PSTN, but this is of limited use across beyond areas of cellular coverage. Both Fire and Emergency and St John currently utilise infill paging to supplement network paging, and some form of this (cellular or otherwise) could persist into the future.
    - Duress alerts, call requests, predefined messages sent by people in the field to a CAD system.
- Person to person:
    - Human-readable messages sent between Emergency Services personnel, or between personnel and other operational or administration staff or third parties. Comments above relating to human-readable messages from CAD systems apply here as well.
- Application to application:
    - Remote automation triggered from the CAD system, such as turning on a siren or opening a door.

- Information automatically sent to the CAD system, such as vehicle or device location, or station alarms.

Short Message Services (SMS) and Multimedia Messaging Service (MMS) will be supported as per the PSN Service Requirements.

Short Message Services (SMS) and Multimedia Messaging Service (MMS) will be supported for cellular connections, enabling messaging to and from all domestic and international cellular networks (as per standard commercial arrangements with the mobile network operator).

Data

Data services will enable IP connectivity from a cellular device to either the internet, Virtual Private Network (VPN) or a private APN (as per the agency's preferred configuration) whenever suitable coverage is available. Data is used today to a varying extent by all Emergency Services agencies mobility initiatives to:

- Help manage resources in the field;
- Provide and capture information related to incidents; and
- As part of other operational responsibilities.

Cellular devices include:

- Machines with telemetry requirements (e.g. specialist machines or Automatic Vehicle Location (AVL) systems);
- Users with devices running applications; and
- Devices that aggregate connectivity (such as routers) or vehicle-mounted interfaces (such as mobile data terminals).

Examples of applications include:

- NZ Police – Query Person/Query Vehicle;
- St John/WFA – Electronic Patient Report Form, Mobile Data Terminal; and
- Fire and Emergency – AMS (Alert & Messaging System).

Data services must provide reliable and rapid connectivity to agency systems including Data Centres, Communications Centres and cloud-hosted applications.

4.2.1 Application Prioritisation

Where the entire data bearer is not or cannot be prioritised, the ability to prioritise specific applications is required. This is to cover certain use cases (e.g. for a volunteer's personal device, or if a more granular per-app approach to Quality of Service (QoS) is taken in the service implementation).

Frontline officers will access their own agency's mobility applications and may also access public applications such as Facebook which could be used in an operational manner (e.g. to publish an alert). Prioritisation must be configurable for both agency and public applications. Possible options to configure an application for prioritisation include:

- Application specification (i.e. a specification for a particular application is provided to the Service Provider to use to identify the traffic on the network). This could include

aspects such as where it is hosted, platform, URL, region etc. that (dependent on network capability) could be used to identify the traffic;

- IP address – where the address is known and/or fixed at the application end, all traffic to or from this address is prioritised across the mobile network;
- VPN (e.g. back to the agency network) – via IP address with all applications using the VPN would be prioritised in a coarse manner with no per-app differentiation;
- APN – similar to VPN in that the whole connection is prioritised;
- Device/application sets the Quality of Service (DSCP or QCI) value and the network is configured to trust and honour the packet header end-to-end;
- Device – via SIM card/connection, device-type or identifier, or other option;
- User – via SIM card/connection – for shared devices another method would be required; and
- Another Service Provider capability not listed above.

GoodSam is an example of an application that volunteers use on their own personal devices for Mission Critical functions. Prioritisation needs to support this class of application in addition to regular frontline Emergency Services connections. For this class, identifying and prioritising the connections may be logistically challenging, so in this case prioritising all access to the app itself may be a better solution.

The following diagram shows how application prioritisation, as described above, would apply across a network connection:

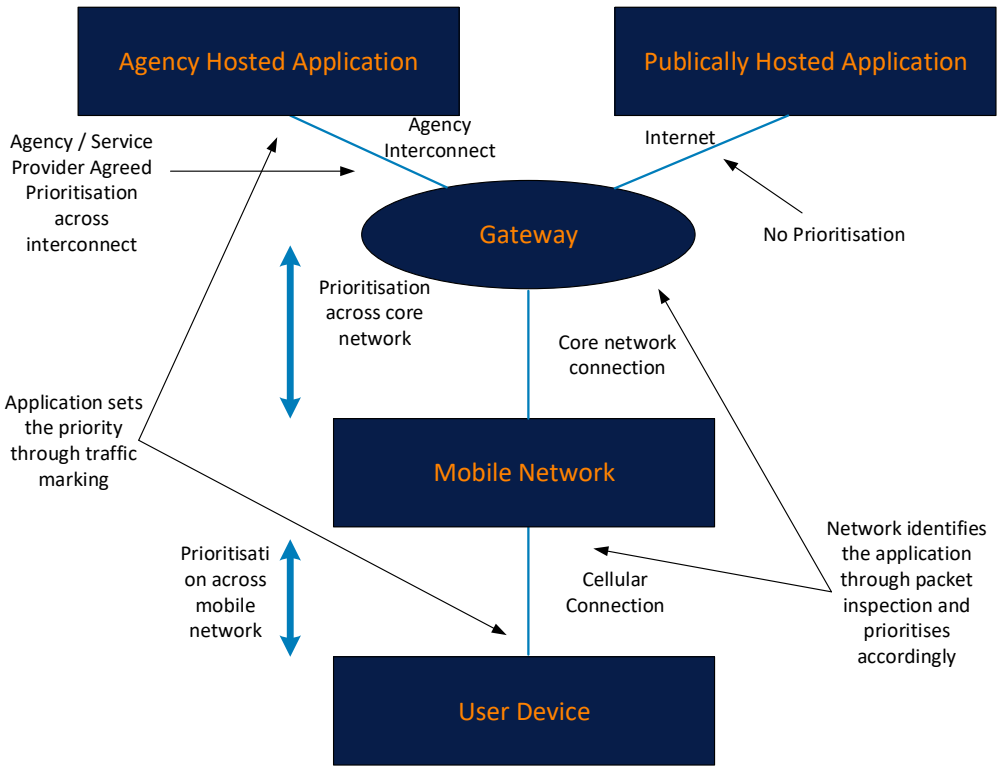

Figure 1: Per-Application Prioritisation

4.3 Location

Support for location-based services delivering emergency, and non-emergency, event-triggered and on-demand location in support of Mission Critical services, (e.g. for an emergency alert (imminent peril) that may or may not be part of a MCPTT service). It could be built into other standalone applications or be a dedicated function. It is anticipated that, where appropriate, this will be aligned to 3GPP standards as documented in 3GPP Common Functional Architecture to Support Mission Critical Services TS23.280.

This feature or equivalent functionality is required for all Mission Critical connections.

4.4 Proximity Services

Support for direct-mode connectivity between devices is a requirement for Emergency Services. This is a feature that is supported by Land Mobile Radio (LMR) and has been used both as a back-up to the terrestrial network, and when local communications only are required. Standards for the development of this capability in 3GPP are continuing and this is certainly a capability that will be of interest to Emergency Services when it matures. This includes direct-mode Push-to-Talk communication, and relay where a device connected to the network is able to offer services to another local device that is unable to reach the network itself.

Specifications that are, where appropriate, in line with 3GPP Proximity-based Services (ProSe) TS 23.303 or similar are of interest, however the device and spectrum limitations of implementation are likely to influence the implementation timelines and realities for vendor implementations.

This feature or equivalent functionality will be a service for Mission Critical cellular connections and is expected to be device dependent. LMR devices may fill this gap for some time yet from a MCPTT perspective.

4.5 Using Cellular for Emergency Services

Emergency Services require dependable access to predictable and reliable communications services so they can depend on these services for frontline emergency response operations. As a result, Emergency Services performance levels are above those provided with existing commercial Cellular Services. The higher capability is expected in the following categories:

- Accessibility – priority and pre-emption, coverage;
- Reliability – quality of service as experienced by Mission Critical users;
- Resiliency – network resilience to failure and disasters, isolated cell sites;
- Maintainability – network transparency, support;
- Configurability – common consistent interfaces and processes for service and user configuration; and
- Interoperability – interoperability for multi-operator services such as PTT.

In addition to these enhanced capabilities, Mission Critical features are needed to provide equivalence to existing LMR features.

Performance standards must fully support agency requirements, and where possible be 3GPP standards based. Where a standard exceeds the agencies requirements, the standard will be the default.

The following sections provide guidance for which 3GPP features are anticipated to enable Mission Critical services over cellular where applicable.

4.6 Accessibility and Reliability

4.6.1 Priority

When cellular network resources are scarce or overloaded, Mission Critical connections and applications require priority access to the end-to-end network over and above regular business and consumer services. Where appropriate, this will be aligned to 3GPP standards and use cases relating to service accessibility, pre-emption, SIM/USIM/ESIM characteristics and quality of service features as summarised in 3GPP Priority Service Guide TR 22.952, 3GPP Policy and Charging Control Architecture TS23.203, or equivalent.

In some use cases priority of an Emergency Services application will be required on devices and/or cellular connections that are not supplied directly by Emergency Services agencies. For example, Emergency Services applications loaded onto volunteer personal devices.

111 calls require priority access but cannot exclude Emergency Services from reasonable access.

Priority features (such as access class barring) or equivalent functionality are required for all Emergency Services connections and applications.

4.6.2 Pre-emption

When cellular network resources are scarce to the point that no new connections can be accommodated, non-Emergency Services voice, data and text connections must be displaced (pre-empted) in favour of Emergency Services connections. Pre-emption capability is required to ensure network access for voice, data, MCPTT and text calls originating and terminating from Emergency Services' users even when one party is not an Emergency Services user. It is anticipated that, where appropriate, this will be aligned to 3GPP standards for call initiation and call termination as documented in 3GPP Enhanced Multi-Level Precedence and Pre-emption Service (eMLPP) TS 23.067, 3GPP Policy and Charging Control Architecture TS23.203, or equivalent.

This feature or equivalent functionality is required for all Emergency Services connections.

4.6.3 Quality of Service

In order to ensure a predictable, reliable, quality experience for Mission Critical users, end-to-end Quality of Service is required to ensure the network characteristics are appropriate to support the particular application(s) being used. At a minimum, voice (including PTT), data and text services will be required. It is anticipated that, where appropriate, this will be aligned to 3GPP standards as documented in 3GPP Quality or Service (QoS) Concept and Architecture TS 23.107, 3GPP Policy and Charging Control Architecture TS23.203, 3GPP Common Functional Architecture to Support Mission Critical Services TS23.280, or equivalent.

This feature or equivalent functionality is required for all Emergency Services connections and applications.

Consistency of service experience is required across all cellular networks that provide Emergency Services voice, (including MCPTT), data and text capability.

It is expected that as standards evolve the capability to assure service accessibility, retainability and experience for Emergency Services will continue to improve.

4.6.4 Temporary Coverage

Where there is no cellular coverage at all, a significant outage occurs that impacts all terrestrial networks, or where there is a short-term increase in demand for capacity, temporary coverage (e.g. CoW – Cell on Wheels) is a useful addition to support network resiliency.

Emergency Services anticipate holding a number of transportable coverage solutions that can be deployed in urgent scenarios without intervention by the mobile operator, to extend the macro-network, or to provide isolated operations. These may use dedicated spectrum for Emergency Services for this purpose, most likely in the 1800MHz band. For planned, or longer-term requirements, it is expected that the mobile operator will provide the infrastructure and manage this using their own spectrum.

Regardless of the technical approach to this, usage must be simple for the end-users, (i.e. their existing SIM/connection will work with the temporary coverage solution).

Service Provider delivered temporary coverage solutions (e.g. CoW – Cell on Wheels) must also support the priority, pre-emption, quality of service and roaming requirements.

4.6.5 Effective Coverage

Specific coverage requirements are not part of this document, however the ability to extend effective coverage for capable devices is an important part of the Cellular Service. This could be achieved through a combination of the following types of technologies:

- HPUE (High Power User Equipment) where the device itself (e.g. in-vehicle router) broadcasts at a higher power level;
- Use of antenna on a vehicle to improve performance; and
- Use of repeater technology in vehicle to improve performance.

Multiple bearers are another way to extend effective coverage and improve service reliability through maintaining multiple sessions and bonding them together. Future integration with additional bearers (such as mobile satellite) should be considered as a complementary roadmap capability. SD-WAN technology improves the end-user experience significantly with transparent bonding, least-cost routing and failover preferences all highly configurable.

Conceptually this looks like:

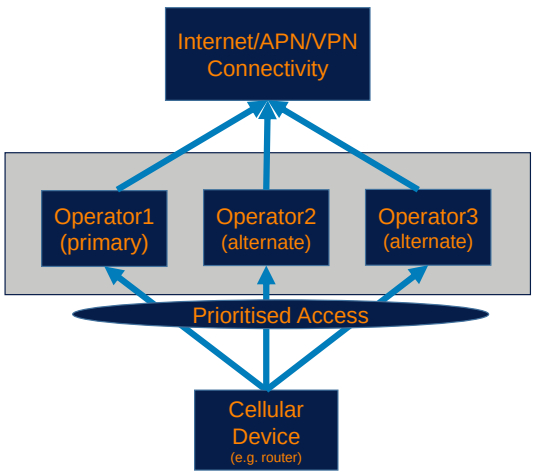

Figure 2: Access to Multiple RANs (simultaneously)

4.7 Resilience

Resiliency of critical communications for Emergency Services is crucial to day-to-day operations, as well as in disaster scenarios, and in major technical or service failure scenarios. A multi-tiered approach will be taken including using different network technologies as back up, as well as targeted investment in increased resiliency of critical components.

In the context of critical communications services over cellular, the areas of interest include but are not limited to:

- Infrastructure enhancement;
- Access to Multiple RANs; and
- Isolated E-UTRAN.

4.7.1 Infrastructure Enhancement

It is expected that the existing core network resilience within the mobile networks in New Zealand may be sufficient to provide a high level of availability, however the distributed nature of the radio access network means that outages in particular areas do occur. Power failures to cell sites and backhaul infrastructure are believed to be the cause of most localised outages, therefore investment in the resilience of these aspects and aggregation nodes in strategic locations should result in a higher level of availability.

A strategy to improve availability through targeted infrastructure enhancement is expected as part of the Cellular Service for Emergency Services. This would need to ensure that there was no duplication of investment, that the marginal cost of the investment is proposed, and that an effective return on investment was achieved.

4.7.2 Access to Multiple RANs

During a planned or unplanned service outage that occurs for a particular mobile network, or a user loses coverage of their primary network, the ability to make use of alternative connectivity is an important element of the multi-tiered approach to resiliency. It is anticipated that the ability to connect to other network(s) is part of the Cellular Service proposition in order to meet the resiliency needs of Emergency Services. This should be as seamless as possible to the end-user with no end-user action required, and all services should still work (including Push-to-Talk) with the experience the same as if they were still on the original network (e.g. the connection should still present the same phone number). Conceptually this would look like the following:

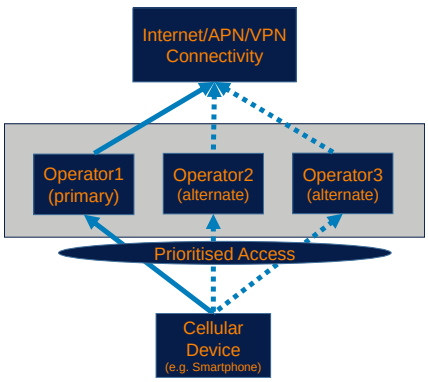

Figure 3a: Access to Multiple RANs (one at a time)

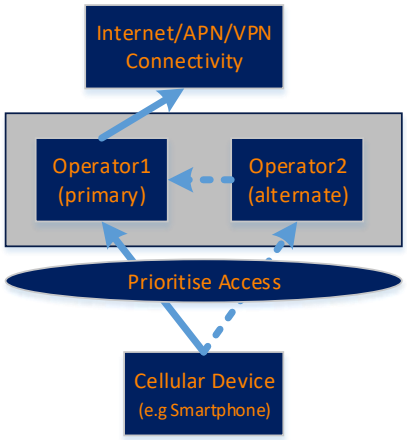

Figure 3b: Access to Multiple RANs (one at a time)

4.7.3 Isolated E-UTRAN

Isolated E-UTRAN operation allows cell sites to function without a backhaul network during disaster or network failure scenarios, a capability that is potentially of immense value to Emergency Services. The exact implementation of this will depend on detailed requirements and optimal solution design, but options from standalone, portable cellular solutions through to targeted deployment of isolated operations into key macro-cell sites should be considered.

It is anticipated that, where appropriate, this will be aligned to 3GPP standards as documented in 3GPP Isolated E-UTRAN Operation for Public Safety TS 22.346.

This feature or equivalent functionality is a service requirement as part of an overall resiliency strategy provided by the Service Provider to achieve the expected service levels. The Service Provider will need to provide details of the limitations to Cellular Services as a result of isolated E-UTRAN operation.

4.8 Maintainability

As part of the provision of Cellular Services for critical communications, Emergency Services will require increased visibility of network status, both reactive and proactive, in addition to the delivery of service against agreed service levels.

4.8.1 Service Levels

Agreed Service Level Agreements (SLAs) will be required to cover aspects such as coverage, network availability, throughput and capacity.

4.8.2 Operating Model

The PSN Operating Model outlines the relationships between Service Providers, Emergency Services agencies and the Lead Entity.

4.8.3 Transparent Network Status

See document *Appendix 4.5 Services Guideline - Transparent Network Management.*

4.8.4 User Usage Monitoring

See document *Appendix 1. Service Requirements.*

4.8.5 Exception Reporting

See documents *Appendix 4.5 Services Guidelines Transparent Network Management* and *Appendix 1. Service Requirements.*

4.8.6 Change Management

See document *Appendix 4.5 Services Guidelines Transparent Network Management.*

4.8.7 Configurability

Provisioning and management of cellular connections (and their profiles), as well as the management of mobile devices, applications, and users are all requisite components of the end-to-end PSN capability. Management of mobile devices, applications and end-user management are all covered in *Appendix 4.4 Services Guidelines Device and Application Management.*

Configuration management of the connection itself is an important aspect of the Cellular Service, and the following capability (at a minimum) will be required with the ability to integrate to Emergency Services Agency's ICT management processes:

- Add, modify or remove connection;
- Modify the available profiles (including application of QPP/MC settings) for a specific connection;
- Modify any other configurable elements of the profile that are specific to the PSN capability; and
- Ability for agencies to integrate their provisioning processes with the Service Providers.

See *Appendix 4.5 Services Guidelines Transparent Network Management* for detail on the Application Programming Interface (API) and web portal.

4.8.8 Interoperability

Many agency services require excellent interoperability to ensure smooth operation. The Service Providers will put in place the system and processes necessary to ensure that multi-provider services can operate at Mission Critical service levels, in particular priority and pre-emption traversing network providers.

Appendix One. Cellular Use Cases

Current Use Cases

Current Use Cases require different profiles of data, text and voice usage ranging from data-only high volume to low volume use cases.

The following table highlights some example usage profiles in addition to the information included above:

Use Case	Comment
Officer with smartphone	Usage in line with a typical mobile user demanding a mix of data, voice and text capabilities. Likely to use Wi-Fi when in-vehicle or on-station.
In-vehicle router	Data-only connectivity provided to multiple Wi-Fi-connected in-vehicle devices such as mobile data terminals, specialist equipment such as 12 Lead Monitor/Defibrillators, telemetry information, and potentially video streaming cameras. The profile of use could be considered more akin to a fixed wireless broadband connection (albeit mobile) than a typical user's smartphone connection. It is possible that multiple SIMs on a different network may be used to increase performance and provide resiliency with SD-WAN 2technology to bond the connections and provide failover.
Tablets	Data-only connection for accessing mobility applications such as electronic patient report forms and building or vehicle schematics. Likely to use Wi-Fi when in-vehicle or on-station.
Specialist devices	Specialist portable devices such as ECG machines which can transmit information to a specialist in a hospital may require direct cellular access if not close to a vehicle-based Wi-Fi connection. Likely to use Wi-Fi when in-vehicle or on-station.
PC access	Access from command vehicles back to agency applications.
Video streaming	Standard definition streaming from stationary vehicles in the field.
Volunteers/BYOD	Ability to provide specific services to other authorised users such as alerting or applications such as PTT.

[2] SD-WAN or Software-Defined Networking in a Wide Area Network implements virtualisation technology to decouple the networking hardware from its control mechanism. This allows the traffic path and security to be managed independently of the underlying network(s).

Future Use Cases

Reliable critical communications capability supporting voice, video, messaging and data will enable new business processes and opportunities for using new technology in new ways. Examples include:

Use Case	Comment
Body camera	Evidential and safety purposes with store and forward, and streaming capability.
Other bearers for in-vehicle router	Over time, routers could include other non-cellular bearers as well (e.g. satellite).
Video monitoring	Ambulance on-board monitoring for health and safety purposes.
Vehicle monitoring	Telemetry information such as measuring if the vehicle accelerates quickly, maintains a high speed, rolls, or if the gun safe is opened.
High definition video streaming	High definition streaming from mobile and stationary vehicles in the field, e.g. for remote medical support.
Tablets for PTT	Tablets in vehicles could potentially have the PTT app loaded and work with accessories (e.g. hands-free buttons) to perform the task of the in-vehicle radio.