PUBLIC SAFETY NETWORK
TE KUPENGA MARUTAU

Public Safety Network
Appendix 5.7
Functional Guidelines
Communications Hub

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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* and *Appendices* and *4.1 to 4.5 Services Guidelines* documents.

2. Document Purpose

This document outlines the communications hub required for the successful delivery the PSN programme 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. Scope

The communication service is, in the context of this document, any communication between operational personnel, including dispatch, for the purpose of meeting the agency's objectives. Communications could be voice, video, or data.

In the majority of emergency response situations, operational personnel travel to incidents in Emergency Services vehicles (a vehicle may be considered to be on land, water, or air). These vehicles carry the equipment necessary for the incident and are usually able to be parked close to the incident. In some cases, the vehicle may be parked in a location determined by available coverage, as dictated by operational need or for the safety of operational personnel.

The vehicle communications hub will enhance the agency's communications capability by utilising the vehicles for their increased power output, ability to house larger antennas, and larger communications units compared to typical handheld devices. A vehicle communications hub also enables opportunities to use telemetry to provide information about the vehicle, its equipment and the operational personnel.

Vehicles will be equipped with communication hubs that extend the reach of in-vehicle communications systems and allow portable devices to connect in areas where they would not normally have coverage via localised cellular, Wi-Fi, and Land Mobile Radio (LMR) extensions. The hub will automatically switch between available services (initially cellular and digital radio), providing a seamless service experience for users. Extension services enable operational personnel to use their normal handheld device in more places, minimising the number of different devices required, simplifying training and reducing equipment costs.

Figure 1 below provides a conceptual overview of how the communications hub would be used to either extended coverage via normal coverage (LMR or cellular[1]) or provide an isolated bubble of coverage using alternative coverage (satellite).

[1] Cellular in the context of this document could mean use of 1 or more cellular networks e.g. through the use of dual SIM or eSIM

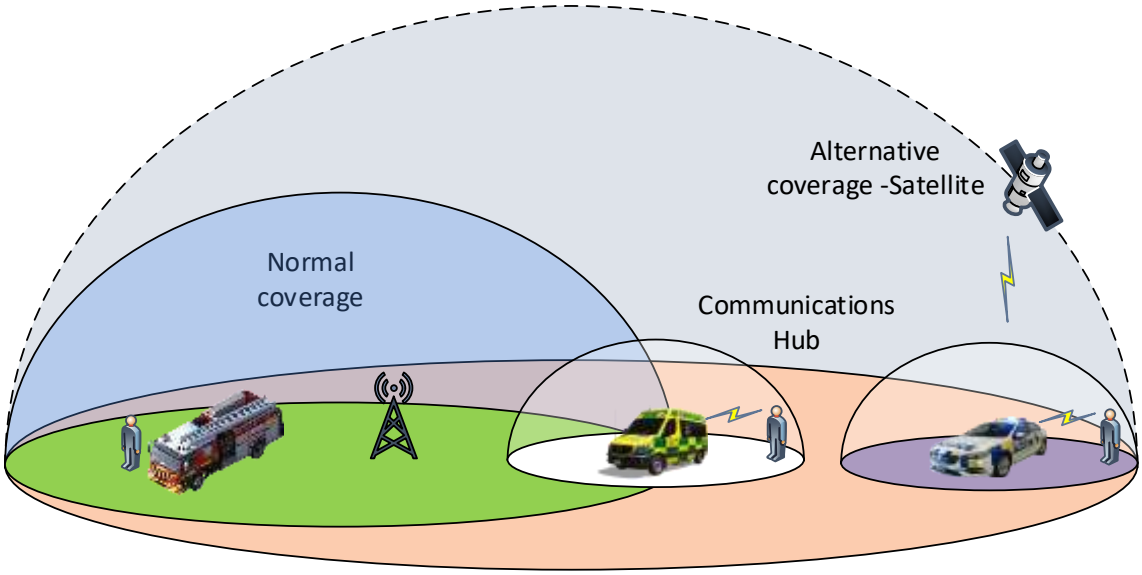

Figure 1: Vehicle communications hub concept

This document focuses on the vehicle communications hub as the primary use case. However, agencies are interested in a solution that may be usable in other scenarios, such as portable/deployable use or in a building which may be agency-owned or owned by a partner agency. In such cases a reduced capability version of the communications hub may be appropriate.

4. Outline

4.1 Communications Hub

Mobile devices and in-vehicle communications systems will be the main ways that field-based users communicate and access applications. Using in-vehicle communications hubs will improve performance in areas that have marginal coverage (particularly cellular). The hubs will also make it easier for users to access services as they reduce the number of devices needed.

The vehicle communications hub solution covers communications of all technologies within a vehicle. This includes all network capabilities including cellular, LMR, Wi-Fi and satellite, and the ability to switch between these as needed. It covers in-vehicle user interfaces such as MDTs (Mobile Data Terminals) and digital LMR. It also includes network access for handheld devices to relay via the vehicle communications hub, achieving extended access beyond the reach of handheld devices alone due to its increased power and real estate to mount larger antennas.

Figure 2 below provides a conceptual overview of the likely devices and applications that agencies would operate from a vehicle communications hub, as well as providing an indication of what the communications hub could be comprised of.

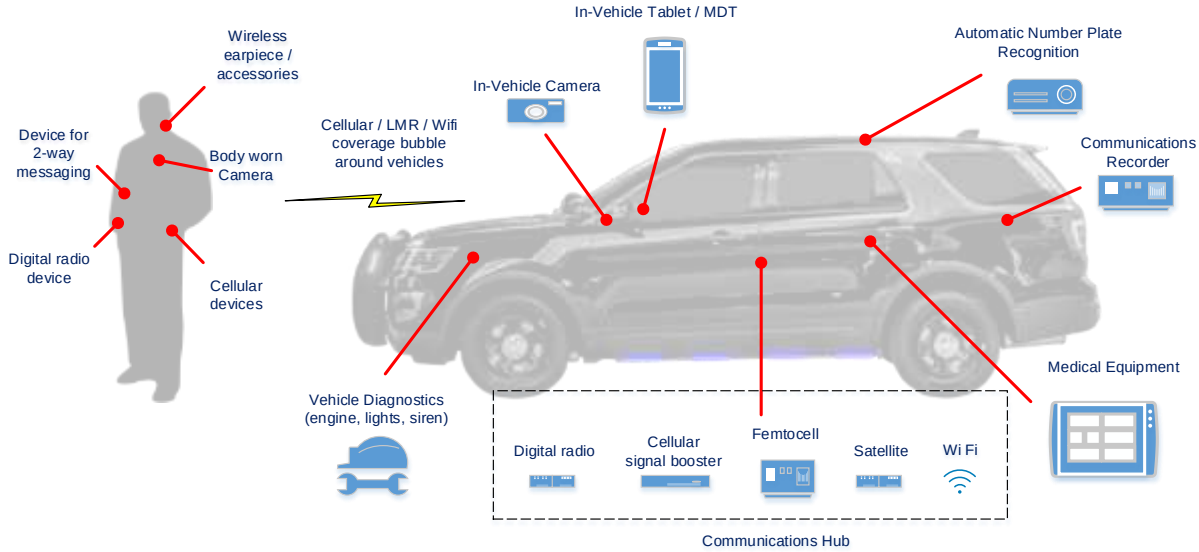

Figure 2: Devices likely to be used by agencies in a communications hub

Vehicle communications hubs will typically (at a minimum) have LMR and cellular connectivity. Typically, in rural areas the LMR coverage area will generally exceed cellular coverage, so LMR will be the primary communications technology outside cellular coverage areas. Inside cellular coverage areas, agencies will be able to make use of either technology. Where neither service is available it is expected that satellite capability will provide additional communication access (for vehicles that have satellite capability). The vehicle hub is intended to work on the network appropriate for the required application, as well as providing the ability to extend the coverage of a service to a user's hand held device (e.g. LMR, cellular phone, or PC/Tablet), which would normally be outside the available coverage offering.

The primary technology can differ per agency and/or per use case, and will likely change over time as the services evolve, and as each agency's use of technology evolves.

As the devices and any accessories used to access the respective network's capability are essential to the end-user experience, these are mentioned, but are not exhaustive. Supporting areas such as Service Level Agreements (SLAs) and coverage are covered in other documents: *Appendix 5.1 Functional Guidelines Coverage, Appendix 4.3 Services Guidelines Digital Land Mobile Radio,* and *Appendix 4.2 Services Guidelines Mission Critical Push-to-Talk.*

There are a number of features and functions which expand on the above that are often used to enhance the user experience, with a non-exhaustive list of these included in Section 4.1.1 below.

Public safety features will follow their respective standard(s) as they apply to the technology, (e.g. Telecommunications Industry Association (TIA), European Telecommunications Standards Institute (ETSI), and 3rd Generation Partnership Project (3GPP)). Where PSN service requirements exceed the standards, the requirements shall take precedent.

The key aspects of the communications hub are:

- User experience – the solution takes into consideration how the user operates in a day to day environment and is fit for purpose.

- Coverage extension for LMR and cellular services – the primary function of the solution is to allow the user to access the relevant services from a handheld device while leveraging off the superior performance that the vehicle may provide.
- Solution service agnostic (LMR, cellular, satellite, Wi-Fi, Bluetooth, ethernet) – the solution operates independent of the transmission technology (i.e. a cellular device connected to the hub where LMR is used for backhaul of voice and data applications, and vice versa).
- Seamless near instantaneous switching between services – where switching between one service technology and another has no operational impact on communications.
- Localised communication – the solution is able to provide near equivalent local communications in the absence of the wide area services. This could be provided from a single hub or multiple hubs working in linear and/or mesh network type solutions. Local communication may provide localised recording of communications and logging data.
- Scalability and flexibility – solution architecture is modular to allow bearer technology to be added, removed and/or modified as per agency's functional need and to accommodate new technology as it evolves over time.
- Resiliency and redundancy – ensuring that a fault in the solution for one service does not impact the operation of the other services.
- Remote visibility and management – in line with other service capability the need for mobile device and application management (MDM and MAM) for both the hub solution and any devices connected to the hub.
- Operational viability and safety – consideration given to the physical aspects of the hub solution (i.e. installation, power consumption, heat dissipation, interference, mounting, legislation, physical security).

4.1.1 Features and Functions

The following table summarises a set of features expected to be available from the communications hub solution which are of interest to Emergency Services. Features are taken from a solution point of view and may span multiple network services, rather than a specific device. This is not an exhaustive list and devices used within the solution shall meet the relevant Service Guidelines.

Feature	Description
PSN Services Extension	Solution acts as a PSN service extender to provide a localised coverage 'bubble' to multiple device users which are unable to access the network directly due to insufficient coverage from the device's primary network service. For example, the handheld device may be a cellular device working through the vehicle, which is operating off the LMR network due to insufficient cellular coverage for voice, video and data.

Local Area Network Capability	Capability to use multiple technology services for local area coverage (bubble) connectivity (e.g. LMR, Bluetooth, cellular, Wi-fi, and depending on application agency used, ethernet). Local area network coverage shall be in line with the device range section of the PSN document *Appendix 1. Service Requirements*.
Multi-bearer Backhaul	Capability to use multiple technologies or networks for wide area coverage backhaul (i.e. LMR, cellular, Wi-Fi and satellite).
Mesh Local Network	Multiple communication hubs are able to communicate with each other to create a single larger local area network.
Service Availability	Provides the user access to information relating to services available, what their coverage level is (e.g. RSSI) and which service they are currently operating on. This may also include any service outage notification for the operating area.
Choice of Service	User is able to change the current service in use, temporarily overriding any automatic switching.
Geo-fenced Services	Dynamic group membership and/or PSN service based on location which alerts the users and gives the ability for the user to override any automatic changes or make those changes manually.
Location Services	Send GNSS location data to agreed locations (e.g. consoles or other terminals) within an agency (or between agencies) for reporting, tracking, and staff safety.
Presence	Ability for authorised users to see the status of a vehicle via a defined periodic and/or on demand 'poll/ping'. (e.g. this could be the user status, current talkgroup, current operating service or location). Period or on demand could be vehicle, function (i.e. talkgroup), or PSN service specified.
Network Service Enhancement	Track, log and report on coverage and/or services received by the vehicle. This data could be used by the agency or service provider to indicate areas where service is degraded or not present.

Integration	
Interworking	Seamless interworking available between nominated cellular and LMR (and other) devices within the communications hub for voice, video, and data.
Applications/services	Allows the flexibility to extend to additional third-party capabilities through addition of devices and/or applications (e.g. in-vehicle camera(s), number plate recognition, coverage mapping).

Compliance	Comply with any agency (e.g. interference, standards, security) or legal (e.g. NZTA) requirements
Safety (Vehicle or Personnel)	Vehicle operation and safety systems (e.g. airbags, crash avoidance, and lane support) must not be adversely impacted by equipment installation, and the installed equipment must not present a safety risk in itself (e.g. installed in a location that does not allow heat to dissipate posing a personal harm or fire risk). Vehicles must retain their ANCAP rating as applicable.
Intuitive	Solution is intuitive to the user with minimal training requirements.
Vehicle Integration	Ability to integrate into the vehicle or other third-party vehicle management system for telemetry (e.g. CANBus, ECU).
Management	
Vehicle Fleet Management	Provide data back to an API for authorised users to access details about the vehicle. This could include access management, alerting user when a WoF/service is due, or when emergency equipment is used/accessed (e.g. lights, taser/firearm, medical equipment).
Mobile Device and Application Management	Refer to PSN document *Appendix 4.4 Services Guidelines – Device and Application Management.*
Profile	Different profiles need to be defined that include the ability to restrict access to specific features and/or functionality. Users may also have a level of personal configuration on the device stored against their profile.
Voice Recording	Any communications which are recorded need to contain sufficient information including time, date and user information to be used for audit purposes. Recordings should be securely stored for later review in such a way as to be usable for potential evidential purposes as required.
Recording Review	User-friendly search and playback of recorded communications for authorised users.
Logging (Solution)	On-board recording and logging functions will meet specified service and security requirements.
Logging (Service Enhancement)	Continual service availability logging to allow the service providers to verify coverage holes and how frequently a vehicle enters a particular coverage hole.
Security	
General	Information passed through and stored on the device must comply with agency specific information security and system policies and, where appropriate, any relevant New Zealand Information Security Management (NZISM) and Protection Security Requirement (PSR) guidelines and policies.

Multi-Tenancy	All subscribing agencies must be able to administer and use their own communications hub as completely distinct tenancies with complete autonomy and security between them. Any multi-agency functions must be explicitly authorised.
Authentication	All access must be authenticated with agency devices.
Encryption	Encryption standards will align with NZISM standards (as appropriate) in conjunction with the agency's security level requirement to ensure confidentiality and integrity of transmission. Where communications span different level requirements, where possible the higher level shall be used.
Managed Service	Service must be actively monitored and managed for service availability, performance, currency as well as proactive security protection. Full change management, incident management and cyber response must be in place for this service. Refer to PSN document *Appendix 4.5 Services Guidelines Transparent Network Management*.
Denial of Service	Denial of service prevention must be in place.
Intrusion Prevention	Intrusion prevention service must be in place to detect and prevent unauthorised access.
Physical	The solution installed in a vehicle shall be tamper proof and securely fashioned to prevent unauthorised removal (i.e. security cradle, security screws). The solution needs to be robust as to prevent damage or fault in an operational environment.

4.1.2 Performance Characteristics

Performance characteristics are addressed in the PSN documents *Appendix 1. Service Requirements, Appendix 4.2 Service Guidelines Mission Critical Push-to-Talk (Cellular),* and *Appendix 4.3 Service Guidelines Digital Land Mobile Radio.*

These parameters shall be achieved irrespective of traffic demands from users on any part of the system and irrespective of network backhaul delays.

Performance of the communication hub shall be such that operation of the solution is not detrimental to the ability of the agency to respond to an incident. For example, boot-up time on the solution is such that the user can operate communications without delay.

4.1.3 Communications Hub Status

The services that are available to an agency operator are important to understand before, during and after an incident. Service status information from the communications hub is expected to provide agencies of a view of network element or link status and what service is currently operating in real-time.

4.1.3.1 Communication Services Status (Coverage)

All network coverage and service status changes should be made available via an in-vehicle real-time secure Application Programming Interface (API) on a tablet type device to provide a common point of access for all services.

Service status should be in the form of:

- Reactive – which indicates real-time coverage and services status and automatically switches to the most appropriate based on criteria algorithms taking into consideration, least cost, performance and functional requirement. This may be agency, user, or service-based.
- Proactive – which the user can manually switch services as they are required, temporarily overriding the reactive system. Users may over time experience locations where the service is reported as useable but in reality it is not suitable and they wish to try an alternative service.

Network status of all services is expected to be displayed to the user in the form of a user understandable format, as the user may be driving a vehicle, (e.g. Excellent, Good, Poor, No Service).

Specific coverage guidelines are covered in the PSN documents *Appendix 4.1 Services Guidelines Cellular, Appendix 4.3 Services Guidelines Digital Land Mobile Radio* and *Appendix 5.1 Functional Guidelines Coverage.*

4.1.3.2 Vehicle Services Status (Telemetry)

Vehicle telemetry (primarily focused around vehicle status information) will be available for both real-time view, and data consolidation for reporting. Service status information is expected to provide agencies of a view of their assets currently in operation.

Service status should be in the form of:

- Real-time – which indicates real-time state and status of the vehicle (e.g. speed, location); and
- Offline – which sends data to a database storage on a semiregular basis for on demand processing (e.g. mileage, utilisation).

Vehicle status will be made available via API and web portal to service centres (including ICT and network help desks), Communication's Centres and directly to operational personnel either embedded in existing applications or as a stand-alone application.

4.1.3.3 Connected devices on the Local Area Network

Information on the devices connected to the communications hub shall be available. This shall at a minimum show the identity of the device (alias), how long it has been connected and what service it is utilising. Authorised operators shall be able to select and remove devices from the connection list as required.

4.1.4 Voice Quality

Voice in both directions needs to be understandable without discomfort or repetition, including when high background noise is present around the person transmitting, when devices are being used in the normal manner. Voice quality should not be degraded or reduced for any devices connected to the communications hub via its local area network.

4.1.5 Transparent Connection

Devices connected to the communications hub must appear to be part of the system, which is to say that the communications hub shall be transparent to the device and the wide area network(s). When a device is connected to the network services, the voice operation and functionality of the device shall not differ to that of a device that is directly connected. For example, the handheld device is still able to change talkgroups independently of the communication hub configuration.

The Communications Hub, however should be aware of all devices that are connected to it.

4.1.6 Communications and Data Recording

Voice and data recording are critical elements of the solution. It is expected that the primary point at which communications are recorded will be achieved via the respective services at a network layer. However, there remains a need to record any communications and data transactions while the communication hub is operating in a local area network mode in the absence of a network-based service.

In the absence of a wide area network (LMR or cellular) all communications (voice and data) from connected devices and the communications hub itself, as well as any applicable vehicle telemetry data shall be recorded and stored locally for uploading to a central service once the vehicle regains an available service. The upload could be via cellular or Wi-Fi-based services. Agencies may require different storage capacity depending on a number of factors including security or operational use case. The hub solution shall have the capability to scale and define the storage needs on a per hub basis, which may range from a few hours to a number of days.

Any communications which are recorded need to contain sufficient information including time, date and user information to be used for audit purposes. Recordings should be securely stored for later review in such a way as to be usable for potential evidential purposes as required.

4.1.7 Form Factor

Given the majority of use cases for the solution are in a vehicle, the end-user experience is not only subject to the performance characteristics of the hub, but also reliant on the devices and accessories used to access the service.

The user is required to use their hands, and keep their eyes up, and therefore consideration into hands-free devices, voice control, or steering wheel integrated solutions could be critical to being able to access communications. In other circumstances, accessing the device directly may be appropriate (e.g. when parked on the side of the road or at an incident).

Users require the ability to easily and quickly change talkgroups, volume or network service while retaining situational awareness. Specific dedicated devices with physical buttons and knobs in addition to a touch screen may be appropriate for most cases.

Usability and security are key to a fit-for-purpose service, that is to say that all equipment to be installed in the vehicle shall take into consideration the likely use cases and situations.

For example:

- Protected from water, mud, and dust (no fans);
- Police vehicles may be subject to high impact forces;
- Broad temperature operating range; and
- Able to co-exist with other emergency systems (i.e. lights, sirens, radars, medical devices).

Where feasible, the communications hub solution needs to be able to cover all frequency bands and technologies in use by the agency. It is expected that the solution is able to utilise multiple carrier network providers seamlessly while working anywhere in the agreed coverage areas. It is desirable to limit the number of devices required, offering increased operational flexibility.

4.1.7.1 Vehicle Solution

Agencies will have a large range of operational vehicles of various makes and models (which in this context could be road, air, or water-based). Space in an Emergency Services vehicle is limited and is also required for operational purposes (bags, safety equipment, operational equipment etc). Effort shall be made to reduce the equipment footprint, and weight of any additional hardware. This also applies to the roof of the vehicle for antenna placement. Special consideration shall be made regarding helicopters, which are unique across the country and may require a tailored solution depending on the current build and operating firm. Emergency Services vehicles are often leased or at least rotated this is therefore a need for a modular solution, refer Section 4.2.1.1.

Agency vehicles may have operational equipment that shall not be obstructed or may impact optimal operation of a communication system, such as a light bar, ladders or may not have a suitable ground plane (fibreglass roof). The height of the vehicle and typical locations the vehicle will need to access needs to be considered when planning roof equipment placement. For example, sally ports (stations and corrections facilities), tunnels/bridges, roadside and driveway vegetation, and parking garages.

Agencies will require emergency warning signals (lights, sirens etc.) and communication systems to continue to operate in the absence of the vehicle running. It is therefore important that consideration is taken regarding the power management for the ongoing operation of a vehicle. Features such as low voltage disconnect, charging methods and other such power management capability will need to be investigated so that the vehicle is able to continue operating when required. This may require an additional battery to be added to the vehicle to support agency requirements. For example, as part of Police vehicle requirements (not PSN) a Police vehicle must be able to restart the engine after eight hours of continuous operation of all emergency equipment while the engine is off.

Additional interfacing requirements include, but aren't limited to:

- Agency specific hardware services. This could be hardware such as Fire and Emergency messaging hardware or vehicle steering wheel controls; and
- A safety helmet (motorbike), standards-based headset (helicopter) or audio integration platforms (avionics, specialised vehicles).

Consideration for minimising antenna cable loss should be made to realise the full data capability offered on modern cellular services. Location of hub equipment close to the antenna locations or use of remote modems are ways of addressing this.

Installation of multiple external cellular antennas may also be required (to access multiple antenna technology) where consistent high data rates are required – particularly for high data use vehicles where multiple users or devices can be expected to use rich data applications at the same time.

4.1.7.2 Portable (Suitcase)

In a number of cases a coverage solution may be in the form of a portable deployable solution. Typically, a deployable solution will be required for a temporary event in locations where coverage is limited and/or a vehicle is not appropriate. Such locations may be within a building/event centre or of significant distance from a road (i.e. forward operating station, Search and Rescue (SAR) operation in the bush).

Examples of cases where the device shall be fit-for-purpose include working in and around water (Fire and Emergency high-pressure hose) or mud, biohazardous/hazardous environments, running/jumping with a high probability of dropping, and potential situations where an intrinsically safe (or equivalent) device may be required.

Devices shall have the capability to operate for an agency's working shift, and typically this will be no less than 12 hours operating at full capacity. The device needs to operate independently of an external battery with the capability to add additional power source(s) as required. Agencies will specify minimum operational time on internal power.

4.1.7.3 In-Building Access

A communications hub installed in a building situation would be of benefit to agencies to provide enhanced capability and features or may extend coverage into a building that would otherwise be problematic. In these cases, the modular functionality of the communications hub would be of benefit.

Building communication hubs may utilise the multi-bearer capability to provide enhanced capability within an agency building, such as building telemetry (power supply, secure key cabinet) and Fire and Emergency turnout systems as shown in Figure 3.

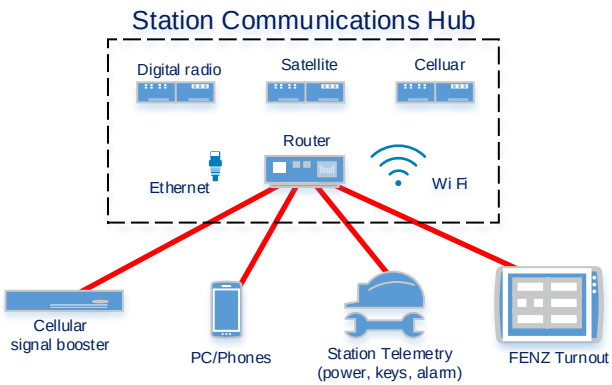

Figure 3: Station Communications Hub

Coverage in buildings can be problematic because either the coverage penetration into the building is insufficient, or there is a lack of coverage in the general area.

An in-building communications hub for agency and/or allied party buildings may be utilised to enhance capability within the building (Figure 4) for cellular or LMR by operating as a coverage extension solution (image on left) or by providing coverage operating via the agencies IP network (image on right).

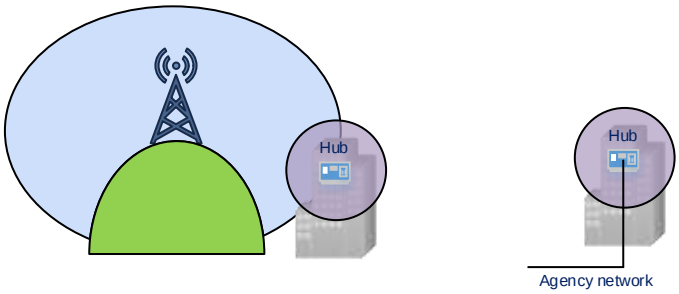

Figure 4. Communications Hub in a building concept

Situations where this solution will benefit agencies may include small agency buildings in remote locations on the edge of service coverage to allow the solution to provide improved in-building capability, provided to third-party supporting agency locations, or locations that are isolated from the wider network (e.g. underground/basement).

Options available should include both open speaker (programmable) and privacy capability (i.e. headset or mute) reflecting that these devices could be located at shared desks, open common areas, or other supervisory or administrative locations. In some cases, functionality may need to be limited to listen/read only access.

4.2 Architectural Principles

The technical architecture for the vehicle communications hub will be defined by the service provider delivering the service, however there are some principles anticipated to ensure the service delivers appropriately to Emergency Services agencies. Figure 5 below shows an overview of key elements, and the remainder of this section discusses the key principles defined to the minimum extent to indicate the intent.

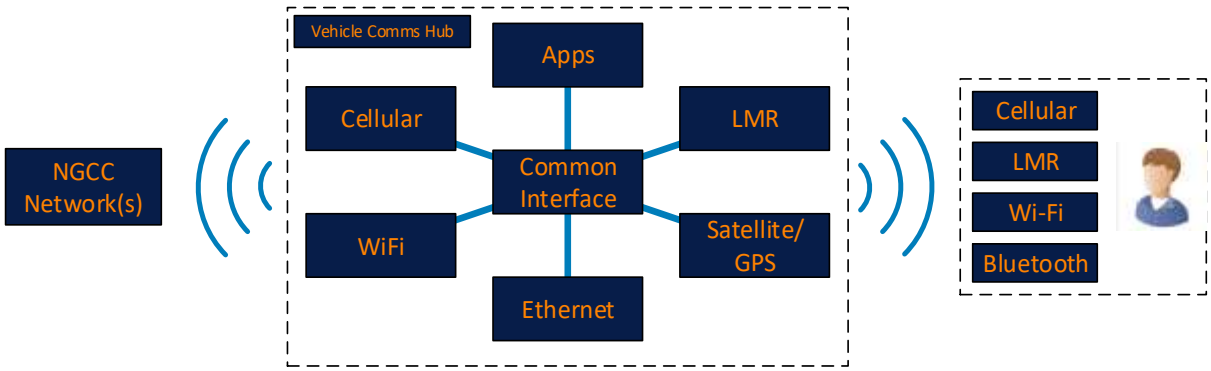

Figure 5: Overview of potential conceptual architecture

4.2.1 Underlying Solution Flexibility

LMR and cellular are expected to be the primary technologies used for the backhaul capability of the communications hub and these services will be in line with the respective services guidelines. However, the solution shall be flexible regarding this backhaul as agencies may wish to utilise supplementary services such as satellite or Wi-Fi, or in the event the solution is desktop-based, ethernet.

Where possible, the backhaul service should be transparent to the end-user (notwithstanding the ability to manually switch), including automatic switching while retaining sessions including voice with sub-second failover.

4.2.1.1 Modular Solution

Modular solutions will be an advantage to ease the transition of evolving technologies where one part of a vehicle hub can be changed without changing the entire vehicle sub-system. Emergency vehicles may be leased or rotated to different areas requiring different operational needs. For instance, cellular modem modules connected to a router via ethernet allows newer cellular capability to simply and cost-effectively be added to access the latest high order 4G modulation or 5G modes. Another example is adding satellite connection capability where required (may not be across the entire fleet).

4.2.2 Application Programming Interface (API)

It is expected that the Communications Hub will involve an application portal type device fixed within the vehicle (i.e. a tablet/PC to provide user access to the various communication functionalities as well as any admin function systems). Functionality may include, but is not limited to, service availability, currently connected devices, user definable functions/configurations (typically via a federated/agency login).

The API view of network status in real-time so any interruptions to the service are understood and operational procedures can be adjusted accordingly. This will include visibility of planned work and associated service impacts. See *Appendix 4.5 Services Guidelines Transparent Network Management* and *Appendix 4.4 Services Guidelines: Device and Application Management.*

4.2.3 Configuration Management

Provisioning and management of communication hubs on the relevant networks, as well as the management of the device configurations, are all requisite components of the PSN capability. Local and remote management of devices shall work in conjunction so that any changes made locally are reflected in the remote management system, and vice versa. Unless otherwise specified all devices that form part of the communications hub shall have identical management functions as per their respective technology guidelines (LMR and PTT cellular).

For additional guidance refer the document *Appendix 4.4 Services Guidelines Device and Application Management.*

4.2.4 Access Management

Access management services to the communications hub functionality and/or application APIs shall have a form of federated identity and access to provide common access policies to any system for simple and straightforward authentication for the agency users so it is secure and useable.

For example, basic critical functionality may operate independent of a login (i.e. LMR or MCPTT functions) but any enterprise functions, patient or personal data shall be via secure login in line with an agency's standard operating procedures.

The access management shall be such that changes to existing, adding new or removing exiting users is easily manageable internally by the agency via a portal.

4.2.5 Compatibility

The communications hub component devices shall work in harmony as a system, which is that any device in the solution shall not impact on the operation of any other operational device. In the case of a vehicle installation this includes the vehicle as well as any other equipment that forms part of the vehicle (e.g. GPS, lights, medical equipment, fire pump controller). This is typically relating to the impacts of radio frequency interference (RFI) but may also be related to power or software-based interactions.

Exceptions to this may be granted on a case-by-case basis by the agency pending impact assessment and the devices/services impacted.

Multiple communications hubs may be in operation while in proximity to another, and agency users need the ability to combine the hubs to form a linear and/or mesh network where operations require or continue to allow the hubs to operate independently. Where multiple communications hubs are in use, they shall not interfere with the operation of any other communication hub in a nearby vehicle or building.

4.2.6 Compliance

Where required, the communications hub design, system and all its components shall conform to all relevant New Zealand standards and regulations including, but not limited to, those outlined under the Radio Communications Act (1989) and the Radio Communications Regulations (2001). This includes but is not limited to the frequencies used and licensing, interference, and standards compliant terminals.

Where applicable, devices shall be compliant for their respective install. For example, Civil Aviation Authority (CAA) for aircraft, NZ Transport Agency (NZTA) for vehicles and Maritime NZ for marine.

4.2.7 Resilience/Redundancy

A public safety communications system needs to be highly resilient to faults and as such shall have multiple layers of redundancy and the ability to continue to operate in reduced modes of functionality.

The communications hub solution shall be such that in the event of a failure of one communication method the system can automatically and seamlessly switch to another available service. Service access devices that form part of the hub shall operate independently of the solution in the event of a system failure (i.e. the LMR device will continue to operate with its own PTT function).

Multiple user interfaces (UI) may be retained to allow continued operation of the vehicle in the event one of the UI parts fails. This may be via built-in UI or use of a portable device inside the vehicle.

The fault and the switch should be notified to both the user (so that they are able to assess and modify operational processes) as well as a centralised reporting system for follow-up for assessment and necessary resolution.

4.2.8 End-to-End Encryption

End-to-end encryption is required for all communications traffic. Whilst this is fairly self-explanatory over an IP network, there are architectural considerations when the network paths traverse networks of different security postures, and more explicitly which endpoints are capable of decrypting the traffic. Examples include end-clients on trusted agency networks, end-clients on public networks, recording interfaces, servers and gateways. Each of these

endpoints must be capable of encrypting and decrypting the traffic. Wherever possible, agencies should maintain control over access to communication.

Devices within the vehicle communications hub shall be considered as an end-client, where applicable, as communication must be usable within the vehicle. Communications between vehicle and user shall be considered as a network path and therefore encrypted. Where communications cross platforms (i.e. LMR to cellular), every effort shall be made to minimise transmission of 'clear' data and voice.

4.2.9 Loose Coupling

There are multiple integration points including connections between varying technologies within the vehicle and the underlying networks. The ability to separately maintain the lifecycle management of all these systems is essential for maintainability and upgradeability. This also extends to administration and provisioning/incident management processes and system interconnections. See document *Appendix 5.4 Functional Guidelines Integration Target State.*

It is expected that the solution will take into consideration existing vehicle builds and, where possible, any new or additional equipment reuses the existing infrastructure.

4.2.10 Continuous Development

Continued development to maintain currency, supportability and provide access to modern features will be inherent within the communications hub. As per the previous principle, loose coupling is required to ensure that ongoing application lifecycle development does not impact on the other systems wherever possible. The extensive eco-system of devices and accessories must continue to be supported, but this is not expected to be a static environment, and ongoing development is to be inherent in the service delivery design.

Also important is that equipment and service lives for particular functions of the communications hub service are sufficiently long (e.g. the life of the vehicle), to manage adverse impacts on users and agencies consuming the service. For example, onerous training requirements, vehicles out of service for equipment changes, new vehicle models, excessive costs due to short lifecycles and having to source sub-optimal devices last-minute due to unplanned loss of support for in-service units. It is expected that regular dialogue is held between agencies, the PSN programme and service providers on the development of the service to allow timely planning and budgeting for future developments.