MARKET REPORT: Summary of Findings

Request for Information about the Next Generation Critical Communications Programme

Version 1.0 FINAL

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1. Introduction

This document summarises the findings from a Request for Information (RFI) for the Next Generation Critical Communications (NGCC) Programme. It is written for all potential suppliers of NGCC services in the market.

We used information from the RFI to understand what the market's capability is to deliver modern, critical communications (including potential commercial models, operating models, service descriptions and high-level technical solutions) to the emergency services; and to gather indicative pricing information for our detailed business case.

The emergency services[1] sector would like to thank the RFI respondents for their effort and commitment during the RFI process.

1.1. Request for Information Process

The NGCC RFI was released in May 2018 and generated considerable interest from the market. Nearly 100 market representatives attended a briefing on the RFI, and we received 16 responses.

The RFI responses were evaluated against pre-defined criteria that assessed the respondents' ability to contribute to our detailed business case. Next, between July and September 2018, the NGCC programme team (representatives from emergency services) invited the highest-rated respondents to one or more technical and solution workshops, depending on the breadth of services they had proposed. The other respondents were invited to attend a 'quick-fire' session during which the respondents presented information to the programme team and mutual question and answer sessions were held. Most respondents took up these opportunities.

After the workshops, the respondents involved were invited to refine and resubmit their RFI responses. The respondents who'd attended a solution workshop were then invited to a commercial workshop, after which they had a final opportunity to refine their responses, especially the commercial elements.

[1] The emergency services are New Zealand Police, Fire and Emergency New Zealand (FENZ), St John Ambulance Service and Wellington Free Ambulance.

After respondents had submitted their final responses, the programme team asked some to give further clarifications.

2. What is the Context of the investment?

The NGCC programme has been established to deliver a modern communications capability for the emergency services. It is a joint initiative of NZ Police, Fire and Emergency NZ (FENZ), St John Ambulance Service and Wellington Free Ambulance.

The existing voice-centric radio networks used by the emergency services need replacing: they are 20 to 30 years old; capable only of providing voice-only, or voice and narrowband data communications; and can't meet future operational needs. Instead, the emergency services sector wants to use broadband data services to improve its services to the public, e.g. through the use of maps, pictures and analytical and clinical information.

Emergency services rely heavily on voice and mobile data to coordinate, manage and direct their geographically-dispersed staff and resources to respond to communities' needs. They are committed to developing their response capability to keep up with the government's and public's increasing needs. To do this, they need to use digital mobility so that their workforces can deliver services more effectively to communities. Modern, reliable communications are essential to keeping staff safe; and improving productivity and effectiveness of emergency response, law enforcement, and life and property protection. We will achieve these benefits by creating innovative ways to better serve New Zealanders using voice, video, messaging and broadband data services.

Emergency service agencies have previously built or leased nationwide radio networks to provide their critical voice, messaging and paging communications. They want to move away from owning and operating communications networks to using commercial services. This will avoid the agencies having to make periodic capital investments and allow them to concentrate on delivering their primary services. Moving to a common commercial capability will enable the emergency services to leverage commercial investment, move from proprietary to consumer technologies, and adopt innovative services and solutions.

The NGCC programme team envisages that the capability created by the NGCC programme could be expanded to other government agencies in future.

3. What Capability do the Emergency Services Need?

Together, the emergency services and the market defined the sector's critical communications needs.

3.1. Services

The emergency services need the following critical communications services:

- mission-critical voice – Push to Talk (PTT) and telephony
- mission-critical messaging
- mission-critical data
- mission-critical video – conferencing and Push to Video (PTV).

These critical communications services will have evolution built in so their capability can continue to grow, they remain current and will be sustainable.

Emergency services also need location-based services, integration, deployable coverage and real-time network status information. They need to be able to deploy and manage applications; introduce and manage devices; and secure their critical-communications capability. This is likely to need an app store and mobile-device management capability.

3.2. Capability Roadmaps

Rural and remote locations need a minimum of mission-critical voice and messaging services. To improve the resilience of communications, emergency services also need a roadmap for having all mission-critical services available nationwide. Users need to be able to access communications through their portable device, a vehicle hub, or some other means.

Cities, towns and state highways need to have all mission-critical services. While initially voice and messaging services are the minimum level needed as backup and in rural areas, emergency services also need a roadmap for having all mission-critical services available. Users need to be able to access communications through their portable device when they are on foot, in buildings, or in vehicles.

In-building coverage will be achieved through a mixture of macro-cell coverage, vehicle repeaters, and high-power user equipment. We are not considering in-building Wi-Fi and distributed antenna systems for this investment, but we have not ruled out adding this capability for specific scenarios.

3.3. Technology

The critical-communications services need a minimum of the following technology:

- digital radio
- cellular 4G and beyond, and Internet of Things (IOT)-oriented networks
- Low Earth Orbiting (LEO) or similar high-performance, low-latency satellite capability. By 2023 to 2025, this is expected to allow a broadband-like performance with a minimal cost premium over other mobile broadband technologies.

The technology must have the following features:

- priority access to the network (over other users)
- rights to access resources if required (even at the expense of other users)
- end-to-end quality of service over multiple types of network.

3.4. Operations

The critical-communications services and enabling technology will need the following types of operational support:

- reactive and proactive service delivery
- dedicated support to operate and evolve the services and technology
- differentiated levels of service that are appropriate to different applications, scenarios, priority and risk levels.

3.5. Governance

A governance structure will be needed that ensures:

- services are governable by the emergency services and the critical-communications provider
- critical communications evolve and keep pace with technology
- critical-communications investment delivers value for money for the Government.

3.6. Commercial Arrangements

The commercial arrangements will need the following features:

- emergency service agencies have a common catalogue of services
- emergency service agencies can select the services they need
- the critical-communications provider can easily introduce new capability
- commercial and government partners will have mutual benefits

3.7. Specialist Equipment and Applications

Emergency services will need an open arrangement for providing devices, equipment and applications, which isn't constrained to one vendor or supplier.

4. What did we Learn from the RFI?

4.1. Concept

We used the RFI to validate and refine our understanding of how next-generation critical communications can best be provided to the emergency services in New Zealand.

The RFI was informed by a process conducted in 2014 that suggested the emergency services should aggregate their communications services through a specialist aggregation-services provider or a prime contractor. This RFI shows that, while the market was willing to support an aggregator approach, it presented distinct product sets (cellular, Land-Mobile Radio (LMR) or satellite) rather than integrated capability. The RFI respondents' strengths are delivering a full range of services on their own networks, so they would need to build capacity to manage other providers' networks. There was no strong independent respondent with aggregation capability in New Zealand. While there may be suitable, interested organisations who didn't respond to the RFI, we concluded that a prime contractor model for major components was preferable to a specialist aggregator or lead provider. (We describe these approaches in section 4.5).

Some respondents used complex approaches, based on what appeared to be conservative risk perspectives. In future procurements, we would like respondents to demonstrate simpler solutions that achieve the outcomes we're seeking, focus on transparency and use an agreed approach to managing risk.

The market agreed with the direction that the emergency services propose to take for their critical communications. It supported the Government's sector-wide approach to aligning their communication needs, and confirmed that this presents an attractive opportunity. The market stressed that maintaining operational delivery relationships directly with individual agencies would be important to ensuring quality outcomes.

The market acknowledged that the emergency services need mission-critical communications capability nationwide. It ratified the approach of establishing a hybrid network, dedicated support team and specialist devices. The market raised the following points for us to consider:

- Migration from traditional radio-voice services, to PTT over cellular, should be approached cautiously, as this area of network capability, devices, and accessories is still maturing.
- Mission-critical communication services over cellular Long-Term Evolution (LTE) technology are likely to take two or three years to reach maturity.
- Broadband services that use LEO satellites to meet the emergency services' need for on-the-move, low-latency communications are unlikely be available and affordable in New Zealand for another five or more years.
- Specialist device-to-device communication using LTE (when there is no network access) is immature and won't be delivered until 2023, if at all.
- Existing commercial LMR networks need more investment in their features, coverage, capacity and resilience before they will be suited to mission-critical-grade communications.
- A dedicated LTE core for emergency services that mirrors the approach being taken in larger jurisdictions internationally would add cost and complexity, and is unnecessary for the size of the

country and sector (New Zealand has only four emergency services agencies while the UK has over a hundred and the US more than ten thousand). The market's view was the capability requirements should be right-sized for New Zealand; however, we could re-consider the requirements if the market could adequately address the cost and complexity challenges.

4.2. Technology

We used the RFI to validate and refine our understanding of what technology was available and necessary to provide next-generation critical communications to the emergency services in New Zealand.

Having integrated mission-critical services, and delivering them seamlessly, is essential to the emergency services. In future procurements we would like respondents to demonstrate how they can achieve the full outcomes we need by using multiple technologies to complement each other's coverage and resilience capabilities.

The market confirmed there are three main communications technologies we should consider:

- LTE cellular services built on 4G standards and beyond, and associated technologies including IOT networks built on LTE
- LMR services
- satellite services based on next-generation LEO constellations.

The specific considerations for each technology are explained below, but the market recommended a hybrid approach using all three technologies was the best approach.

Using vehicle-based multi-bearer capability, end-user devices can use any of these communications technologies in a way that's 'transparent' or unseen by the user. A vehicle can also extend the LTE coverage of a handheld device. We provide more information on vehicle-based communications, handheld devices, messaging and security later.

4.2.1. LTE

The recommended approach to delivering mission-critical voice, video, messaging and data is commercial LTE cellular networks based on 3GPP standards. To be suitable for mission-critical communications, these networks must have priority access and quality-of-service features. They also need better resilience and coverage before they will they meet emergency services' needs. Coverage in fringe areas can be improved by using vehicle-based repeaters; however, it's impractical to use LTE alone to deliver coverage everywhere it's needed. Satellite or LMR needs to supplement LTE to achieve complete coverage and ensure communications are resilient to an LTE outage.

The market gave us the following advice about LTE.

Mission-critical Features

The 3rd Generation Partnership Project (3GPP) has defined a range of mission-critical features for LTE. The market confirmed it could provide these features. Many of them, such as Quality of Service (QoS), are needed for commercial voice-over LTE (VoLTE) and media streaming services.

The lessons from the market about these features are:

- PTT over LTE should ideally be integrated with the telephone network. This controls how services behave (such as using business rules to re-direct incoming phone calls) when PTT is active
- proximity services (services that allow devices to talk directly with each other for PTT, and to daisy-chain off each other for network access) are problematic and may not work effectively for another five years or more. In the short-term, dedicated radio or multimode devices are the answer for device-to-device communication
- multicast services are important when there are several users on a cell site (a single data stream for each talk-group), such as multiple responders to an incident. If the audio is synchronised, it will not be confusing for users who are in the same area and can communication from multiple devices at the same time. Mobile operators are already considering investing in multicast technology for uses such as streaming live sports events
- priority access and QoS features are already deployed in networks and could be configured relatively easily to meet emergency services' needs
- mission-critical services are complex to deploy across multiple LTE networks. It is easier to deploy them on one network only, and use best efforts to deploy them on other networks (if used).

Network Expansion and Hardening

LTE coverage for all mobile operators in New Zealand is currently being expanded by Crown Infrastructure Partners (CIP) and the Rural Connectivity Group (RCG), which represents the three mobile operators. Any further investment in LTE coverage by the NGCC programme should target creating uninterrupted access on state highways and access in specific locations of interest; other technologies should be used to provide access outside the LTE coverage area.

Vehicle-based repeaters can enhance LTE coverage. They improve the effective coverage of LTE devices in fringe areas, including inside buildings if the vehicle is parked outside. Most of the emergency services' rural-coverage requirements are on roads, as staff need to drive vehicles to reach those locations. Therefore, road coverage is the priority for LTE coverage outside urban areas. How far handheld LTE devices can operate from vehicles still needs to be tested.

Respondents to the RFI told us they have invested heavily in producing resilient core components for their LTE networks. Most outages are now isolated to individual cell sites or groups of cell sites. They usually result from localised power failures or backhaul failures, so investing in resilient backhaul and batteries or generators would reduce the risk of outages. However, the emergency services need to be sure that any investment it makes targets its needs directly; that it finances only the proportion of the investment that directly relates to its requirements; and that operators who will benefit from the investment contribute fairly to the total cost.

Cell sites are either for coverage or capacity. Hardening coverage cell sites in urban areas would deliver the best return on investment, while supplementary technologies (LMR or satellite) would provide better resilience in rural areas.

Multiple Operator or Single Operator

Respondents to the RFI confirmed that, in principle, they were prepared to work together and provide emergency services with access to multiple networks, but they preferred that one operator took the lead. Outside cities, operators share a lot of infrastructure, so single failures can cause an outage for multiple networks. Where operators don't share sites, there is better resilience.

LTE Core Network

All LTE networks are controlled by a core that has security and identity capability, controls policy and provides other functions across the network. To deliver mission-critical services over LTE, the core needs to be enhanced. This could be done by creating a dedicated (duplicate) core, or by enhancing an existing (shared) core. Respondents made the case for each approach, but the cost and complexity of managing a dedicated core for the scale of New Zealand's emergency services doesn't seem justified. This could be reconsidered if the market could adequately address the cost and complexity challenges posed by having a dedicated core.

Network slicing in 5G may 'virtualise' the core's functions to the point that, in future, they can be achieved through virtual shared infrastructure. This could be a better time to invest in this approach.

4.2.2. LMR

Currently all emergency services agencies use LMR networks. Police owns and operates networks used by itself, FENZ (outside Auckland) and Wellington Free Ambulance (Wellington). St John Ambulance Service and FENZ (in Auckland) use a commercially-provided LMR service. The market proposed combining Police's existing network infrastructure with existing commercial capability to establish a digital mission-critical LMR service for all emergency services. This commercially-delivered digital LMR service could then be used as a primary voice and messaging service and to extend coverage and ensure resilience.

4.2.3. Satellite

Satellite technology has typically been expensive, worked poorly on the move, and had limited coverage. Satellites are geo-stationary above the equator. This makes them low in the sky from New Zealand's perspective, and therefore ineffective in gullies, near hills, between buildings, and in large areas of southern New Zealand. Geo-stationary satellites are positioned at high altitudes, which delays data transfer, causing problems for delay-sensitive applications like PTT.

The satellite industry is investing significantly in LEO satellites that should lower costs, improve coverage in New Zealand, offer high-data rates, and reduce delays in data transfer. However, next generation commercial services haven't been launched and the costs are uncertain – especially for genuine broadband capacity. Phased-array flat-panel antennas have been developed that enable effective communication on the move. They are very expensive, but the price is expected to drop significantly over the next few years. LEO and antenna technology advances provide a bright future for using satellite to augment terrestrial networks and to improve coverage and resilience.

Vehicles are the most appropriate platforms to house satellite antenna. In future, satellite antenna are expected to be as small as 40cm by 40cm, which means they could fit on the roof of any emergency services vehicle. They can provide backhaul of communications while staff use the same device to access services on other networks. This 'transparency' would give emergency services' staff a seamless experience.

Most respondents to the RFI demonstrated they knew about new capabilities and roadmaps for service delivery, but they knew less about what the future commercial offerings for satellite may be. This is an area of value and interest to us. In future procurements, we would like to see how providers are planning to use LEO satellites in New Zealand.

4.2.4. Vehicle-based Communications

Vehicle-based communications are important for most emergency services personnel. The market advised us we could achieve the capability we need in all vehicles from vehicle communication hubs that can access LTE, satellite and LMR. However, the solutions need to be sophisticated enough to support PTT voice-only communications if LMR backhaul is used.

Multiple vendors offer technology for various purposes: in-car telemetry, safety, security, navigation, entertainment and in autonomous vehicles. Consumer demand for similar solutions will help drive down price.

Respondents to the RFI hadn't tested this technology. So far, we don't know if switching between networks will be seamless (undetectable by the user), result in any loss of service, or require an action by the user such as pushing a button on the vehicle console. The risk that the equipment may significantly change the vehicle's power consumption may influence the equipment we choose to use.

Traditional solutions, such as UHF or VHF cross-banding, may still be used for situations where emergency services personnel move further from their vehicles (for example police dog-handlers).

4.2.5. Devices

While the ecosystem for LMR end-user devices is mature, it is still developing for LTE. Manufacturers have different opinions about whether multi-mode devices (devices that support LMR and LTE) are useful, or whether carrying separate devices for LMR and LTE is better. Incident-ground-control and armed-offender squads are likely to prefer using separate devices. Other users are likely to prefer a single device with appropriate accessories, especially if their vehicles have communications hubs that can access multiple networks.

While dedicated satellite devices exist, our primary use for satellites would be mounting the antenna on vehicles and accessing them via LTE or Wi-Fi. Vehicle-based technology can help us use multiple networks in the back end, independent of the user device.

Using accessories that enhance the usability of consumer-grade LTE devices in mission-critical communications will improve the experience for emergency services personnel. The battery life of a device is an important consideration when using PTT services and accessories. The UK has commissioned a major supplier to customise a consumer device with a replaceable battery. The RFI respondents recommended that we minimise this type of customisation and use accessories instead. This approach would reduce the cost and allow us to keep the technology up to date.

4.2.6. Messaging

The market suggested three communications technologies that could replace the paging service that St John Ambulance Service, Wellington Free Ambulance and FENZ currently use for dispatch and to turn out volunteers:

- LTE using cellular devices for messaging (such as text or an app)
- IOT networks that use the cellular network
- narrowband data that uses a digital LMR network to deliver short messages.

Specific devices are already being developed for all these technologies, and some hybrid devices (devices that can receive messages over a traditional paging network but allow a cellular response when there's network coverage) are available.

We will need technology that can respond and attach a GPS tag so the communications centre knows how far away the responder is. Any of the three suggested technologies are capable of this.

CAT-M1 is an IOT standard that uses LTE networks (expanding their effective coverage) and can potentially even carry voice traffic. This is a strong candidate for a future messaging solution for us.

4.2.7. Security

Security was a common theme discussed during the RFI workshops. The main lessons that emerged from these workshops were:

- getting the right balance between the usability of a device and the level of security it provides (for example, officers logging into their devices at the start of shifts only, or every time they use their devices). We can use mobile-device management and user-access control tools to implement policy settings, as these tools can quickly disable a device if it is lost
- protecting against denial-of-service attacks is critical to a highly-available service
- establishing a common set of security requirements and certification across emergency services should reduce the cost of security compliance
- needing to have security gateways between networks in LTE environments
- needing to have the right level of security for each type of technology (accessories and IOT need a strong security posture; NB-IOT has better built-in controls than LoraWAN and Sigfox)
- using a dedicated app store will help ensure applications with weak security controls aren't used in a mission-critical environment.

4.2.8. Interworking

The market unanimously recommended interworking – using gateways between LMR networks, satellite networks and LTE PTT services. Interworking reduces the risk of communication service outages during transition between networks. It also allows users to interact seamlessly between different networks. This means that we can use different approaches to improve coverage and resilience without restricting emergency services personnel's use of the services.

3GPP standards define interworking between all these networks, but only focus on the LTE side of the gateway. This leaves it up to the gateway vendor to define the radio and satellite interfaces (and what features they support). The service provider would need to own this risk so it can ensure emergency services' users have a seamless experience.

We expect future service providers to work together to ensure the interworking is effective.

4.3. Services

We used the RFI to validate and refine our understanding of how to define the services we need for next-generation critical communications to the emergency services in New Zealand.

In future procurements, emergency services would like respondents to offer creative models to manage service outcomes for devices and vehicle communication hubs, and ways to deliver services across multiple technologies.

The market confirmed that a service catalogue approach was appropriate for the emergency services. It confirmed the services we'd proposed in the indicative architecture, and it helped us differentiate between mission-critical features and the actual services that would be listed in a catalogue.

Mission-critical features (such as priority access) are needed for mission-critical services (PTT voice, video, data and messaging), but they are unlikely to be purchased without those services. When costs are similar, having multiple options for similar services is unnecessary. However, when costs differ significantly, it would be commercially sensible to have variations. For example, if an access connection for a tablet or mobile data terminal (MDT) doesn't need PTT (the licensing for PTT is expensive), we need to be able to buy a mission-critical data only option.

The market proposed persona-based services as a way to group services, devices and accessories. We see frontline staff versus back office workers as one clear variation; another variation is on-call personnel (requiring turnout) versus rostered on-shift personnel; a third variation is users who need multiple devices (such as an LMR radio and LTE device).

Communications technologies for vehicles and deployables (these are cell sites on wheels that deliver temporary, portable coverage) can be delivered as a service, but we will need variations to the different technologies as they can have different costs.

Deployables can be configured in many ways, from self-contained trailers or pallets through to units transported in backpacks. The emergency services should hold deployables that they can easily set up themselves for ad hoc and emergency response (the first few hours), while the service provider should hold deployables for planned events, long-term emergency response and recovery (after the first few hours). Deployables could still be delivered as a service, even if they are held by emergency service agencies.

The market recommended we use an app store to standardise users' access to data through applications the emergency services have agreed to use. This approach would provide clear guidance to application developers on our performance and security requirements before they develop applications specifically for emergency services. This approach is used by other jurisdictions like FirstNet in the US.

Variations in radio frequency performance in different environments make it difficult to guarantee data throughput, and the minimum specified requirement for cell-edge performance is important to measure usability. This is one area where minimum performance requirements must be defined so service levels can be set.

Video streaming from multiple cameras on an individual or vehicle could cause network congestion if it's done constantly. We would need to consider 'cache locally' and 'upload later' approaches to reduce this problem, and only stream in real time when it's necessary.

4.4. Operations

We used the RFI to validate and refine our understanding of the operating model and conceptual service levels we need for next-generation critical communications to the emergency services in New Zealand.

The market gave a mixed response to this part of the RFI, which suggested it had limited understanding of outcomes-based service levels.

Respondents had thought about integrating Network Operations Centres (NOCs) to facilitate faster responses to incidents, and to enable them to proactively share network-state and change information with emergency services operations.

We would like respondents to focus on outcome-based service levels that measure user experience across multiple technologies, and to develop ways of sharing status information between their technology partners.

Our discussion with the market focused on service levels, especially availability and coverage. The main lessons that emerged from this discussion were:

- outcome (service-oriented) service-level agreements (SLAs) that incorporate users' experience (such as whether they can access services) are important alongside traditional network-element monitoring measures. If one network is available while another is down, but the user can still communicate, the SLA requirements to restore the faulty network could be lower than if two networks were down
- NOCs and Security Operations Centres (SOCs) should be linked to the different providers and to emergency services' service desks to achieve transparent and effective service management outcomes
- telemetry information can be obtained from all devices (crowdsourcing) to identify coverage problems and measure against performance and coverage outcomes in SLAs
- investments in coverage and hardening are the best ways to improve call drop, accessibility and retainability measures, which are not currently as good as we need for mission-critical services.

While the market was reluctant to commit to outcomes-based service levels, it accepted that these were essential to measuring user experience. The market will need to build its capability to define and meet these types of service levels. The approaches that overseas jurisdictions take will provide a useful insight into what New Zealand needs.

4.5. Commercial Arrangements

We used the RFI to validate and refine our understanding of the commercial approach that would best deliver next-generation critical communications to the emergency services in New Zealand.

The market gave a mixed response to this part of the RFI. Some respondents stated a clear position and rationale, while others did not. In future procurements, the emergency services would like respondents to demonstrate the value of up-front investments, and to give us models of how they will deliver 'as a service' to ensure their services and technology continue to evolve. Proposals also need enough cost transparency for us to assess value for money.

In our workshops we explored three distinct approaches with the market:

- Lead provider: one provider delivers most services, aggregates other providers' services (essentially representing them as their own) and is accountable for integrating all elements of the solution (including those provided by third parties, some of which may have been selected by emergency services and have a contractual relationship directly with the emergency services rather than with the Lead provider).
- Prime contractor: one or more providers deliver services directly to the emergency services, and all parties are responsible for integrating the solution. The prime contractor is responsible for selecting any subcontractors, holding the commercial relationship with those subcontractors, and managing the performance of the subcontractors.
- Specialist aggregator: an independent organisation manages other providers' services on behalf of the emergency services and is responsible for integrating all elements of the solution.

4.5.1. Sourcing

The market recommended we use a prime contractor, and most respondents indicated that they would form consortia as needed to provide the full scope of services. While they were willing to aggregate each other's services and provide LTE and LMR devices, the respondents presented LTE, LMR and satellite connectivity as different products rather than an integrated capability. We need to refine the preferred procurement approach to resolve this problem, and our current view is that the prime contractor model for each of the main technology components is appropriate.

The next-generation LEO satellite market is not well established, so satellite isn't expected to form a primary component of the initial services. The emergency services would work with a prime contractor to set targets for introducing satellite services when certain criteria (such as affordability, latency and bandwidth) are met.

If the LTE network needs to be expanded to achieve the desired coverage, the market recommended that this work should be done by CIP rather than one of the NGCC programme providers.

4.5.2. Funding and Governance

Most respondents expected the Crown and the successful provider(s) to provide some funding for infrastructure. The Crown would need transparent information about the full costs before it could make any investment decisions.

The amount of Crown investment is likely to be based on the proportion of infrastructure that would be dedicated to emergency services' use versus the providers' entire network; the direct costs of building capability; and the configuration costs.

Any crown investment would need to recognise the service providers' investment beyond their existing capability. The level of commitment will need mutual consideration and oversight to ensure the benefits and costs are understood.

4.5.3. Contracting

The market confirmed it would prefer to use a master services agreement with one or more prime contractors. This agreement would establish the main common-platform elements and allow emergency services agencies to buy services from a catalogue depending on their individual needs.

We expect to appoint a prime contractor for each specialist network (radio and cellular). Each emergency services agency, and parties that join later, would have a direct relationship with the prime contractor(s) known as a subscription agreement. The prime contractors' incentives for contract performance should be mainly driven by at-risk bonus payments for achieving targets, with penalty payments reserved for critical events.

4.5.4. Risk Management

The market agreed that financial risk should be shared between prime contractors and the emergency services. Prime contractors would be responsible for risks related to operations, service availability, technology and performance.

Risks related to individual emergency services agencies transitioning from current to new technology sit best with the agencies themselves.

Risks related to acquiring sites for cell towers, radio towers or other network equipment need to be investigated: the emergency services may be better placed than prime contractors to manage these risks.

4.5.5. Market

The existing critical-communications market that services the emergency services, disaster response, utilities, councils, airports, railways and maritime sectors and government departments is fragmented. It contains a range of service providers and a mixture of own and operate, lease and managed-service arrangements. If service providers establish their capability in next-generation critical communications, they can offer these services to other sectors and government departments that will follow the emergency services lead.

The Government's strategy states that agencies need to adopt new ways of working with the enabling capability provided by digital communications. Operating radio and communication networks are not core government business, and transitioning agencies' communication services to commercial providers is an objective of the NGCC Programme. The essential-service nature of many government departments is expected to drive growth in critical communication services worth more than $60 million per annum before 2030.

4.6. Transition

We used the RFI to understand how to transition emergency services agencies to next-generation critical communications services.

The market responded conceptually to this part of the RFI. Most respondents offered a high-level response and didn't define the dependencies well. We encourage respondents to research international best practice for establishing and transitioning to next-generation critical communications services, and reflect these lessons in any future response. They should also demonstrate their technical capability in this area, offer well-defined projects to build this capability, and provide low-risk processes for the transition.

The market's approaches were to transition service-by-service, region-by-region, and agency-by-agency. A clear theme of protecting mission-critical voice communications emerged. This suggested

that mission-critical voice should only be migrated to next-generation services once the foundations (such as mission-critical data services) are in place and demonstrating that agencies have the coverage and availability they need.

The specific areas we need to consider in our transition planning are:

- user experience, which is critical to a successful outcome and mustn't be compromised in the pursuit of higher-level outcomes. User experience needs to be considered as part of business change management: even if the technology is ready, the agencies must be ready to manage the change
- business readiness risk, which should sit with emergency services agencies and not service providers, to avoid a risk premium being added to the costs
- interworking existing and new communications services
- additional LTE coverage, which could be a long process if it is needed. The RCG is already committed to building Rural Broadband Initiative phase two (RBI-2) and Mobile Black Spot Fund (MBSF) Initiatives up to 2023, so any additional building for the emergency services is unlikely to start until after then. However, hardening may be possible in parallel.

5. What are our key messages to the market?

As a result of what we've learnt from this RFI, we have several key messages for the market:

1. The critical communications services we need are mission-critical data, voice, messaging and video. Technologies that don't deliver all these services (such as digital radio) are unlikely to be part of the long-term solution, but they may be useful in the short term for resilience and coverage.
2. The market is already investing in the capabilities it needs to provide mission-critical features on LTE networks (such as on-demand and live-streaming entertainment services). The main technology enablers within the cellular networks will provide most features that the emergency services need, so passing on these costs is unnecessary. Potential suppliers are encouraged to clearly understand the cost of establishing their capability, and to explain which of these costs are dedicated to emergency services.
3. Service-uplift costs (based on tangible, dedicated functions; operating resources; and toolsets) should demonstrate direct value to the emergency services.
4. Most of the emergency services' coverage requirements will be met by the RBI-2 and MBSF initiatives. We believe that minimal additional investment will be needed to create uninterrupted coverage for the majority of state highways, if coverage is enhanced by using vehicle-based cellular extension capability. However, if service providers wish to offer further expansion of coverage as part of their business-as-usual investment plans, we would value this.
5. LMR services will remain the primary service for rural and remote areas until satellite is proven, affordable, and operationally fit-for-purpose. Having minimum nationwide LMR capability will help ensure our LTE communication services (expected to cover 75 percent of the country using a

vehicle-based solution) are resilient. This reflects the publicly-stated coverage numbers from CIP[2] plus improvements we expect from using vehicle-based booster technology. We know that the effective area for full broadband capability will be less, which supports the need to use multiple complementary technologies.

6. Next-generation broadband satellite services are strategically relevant for emergency services, and we anticipate the market will deliver affordable, fit-for-purpose capability by 2023 that can replace LMR services by 2025. Satellite will provide a growth opportunity for commercial providers and deliver on the nationwide critical-communications capability objectives for the emergency services.
7. The market didn't demonstrate an end-to-end capability with the core competencies of a specialist aggregator. The lack of options for this role will influence our procurement strategy.
8. We prefer to procure services in an 'as-a-service' manner. Potential suppliers that need to invest upfront in this area must transparently justify these costs during any future procurement process.
9. There is clear justification to transition to an evolving state (rather than to a specific target state) where fit-for-purpose, sustainable capability is delivered and the costs of continuing to evolve the capability are built into the services.
10. We need a sophisticated device-management approach and appropriate commercial model that means devices can be operationally managed and regularly refreshed. Agencies need to be able to replace their devices and change the types of devices they use over time.
11. The market needs to have an approach to measuring service availability that underpins the services, capability and investment it provides. We required committed service levels that include what actions will be taken in a force majeure situation. We prefer a mutual approach to delivering outcomes over a penalty-driven 'punishment' approach.
12. The interactive procurement processes we used in the RFI are likely to be the basis of any future approach.
13. There is an opportunity for service providers to develop a new critical-communications market, and leverage their investments for a high-value market segment.

[2] Crown Investment Partners (n.d.) *What is the Mobile Black Spots Fund (MBSF)?* Retrieved 22 February 2019 from https://www.crowninfrastructure.govt.nz/blackspots/what/