Appendix two – Trunked public safety radio networks

Trunked public safety radio networks

Unlike conventional radio networks, the enhanced Public Safety Network is a 'trunked' radio network. Instead of having defined channels for different users, trunked radio networks have defined groups of users that are automatically allocated to any channel that is available at the time a user wants to transmit a call.

Managing talkgroups

Most radio calls made on a trunked radio network are between the members of a pre-defined group of radio users. These are called talkgroups or callgroups.

Talkgroups typically comprise users who perform certain functions (for example, 'Operations', 'Emergency Response', 'Fleet', 'Training' etc), are in the same geographic area ('Metro East', 'Central Coast' etc). These can also be combined: such as, 'Metro East – Operations'.

Each time a user in a talkgroup keys their radio (presses a button) to speak, the following process happens:

- the radio will send a data message over a dedicated 'control channel' asking the computerised network controller to find and allocate a channel for the call
- the network controller will search for an available channel from the pool of channels
- if the network controller finds an available channel, it allocates that channel to the requesting radio
- the network controller then switches each radio in that talkgroup to that channel
- the talkgroup is then established on a channel for the call to be transmitted by the user who initially keyed their radio.

When the initiating user commences talking, all members of the talkgroup will hear the transmission and that channel cannot be used by another user for the duration of the call.

The process of requesting, allocating, and switching all radios to an allocated channel happens instantaneously to ensure that operational communications achieve mission-critical performance.

When the initiating user releases their talk button, the channel is also released immediately (or within a few seconds)[11] back into the pool of available channels. The process would then repeat if another member of the talkgroup replies, hence the talkgroup can change channels every time a microphone is keyed.

Accordingly, a trunked radio network removes the need for a user to find an available channel, relieving the user of a task that can become complex and confusing if the network is congested.

Managing channels

In addition to removing the burden on the user, a trunked radio network increases how efficiently channels are used.

Under a conventional radio network, channels are usually reserved for specific purposes, and therefore may remain underused during times when other channels are experiencing congestion. In contrast, in a trunked radio network each requested call is allocated to the next available channel and therefore channels are not left idle when other parts of the network are busy.

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[11] In some circumstances, the channel may be reserved for a few seconds to provide for an immediate reply from another member of the talkgroup.

This benefit of trunked radio networks is usually described with reference to queue theory. Instead of individual users being confined to the pace of an individual queue, users in the queue have access to the next available channel - much like a queuing for an airline check-in.

Exhibit 10 below illustrates how the management of channels differs between conventional and trunked radio networks. In the first illustration, each group of users has a dedicated channel for their communications. At different times, some channels will approach or even exceed their call capacity, while other channels may have unused capacity. This can result in some channels becoming congested, while others are underused. This is an inefficient use of the channels.

In the second illustration below, because calls are allocated to the next available channel, no channels are left underused during busy times. By maximising the use of all channels and allowing for more calls to be made, trunked radio networks are more efficient than conventional radio networks when there are a large number of users.

Exhibit 10: Simple illustration of conventional versus trunked radio network
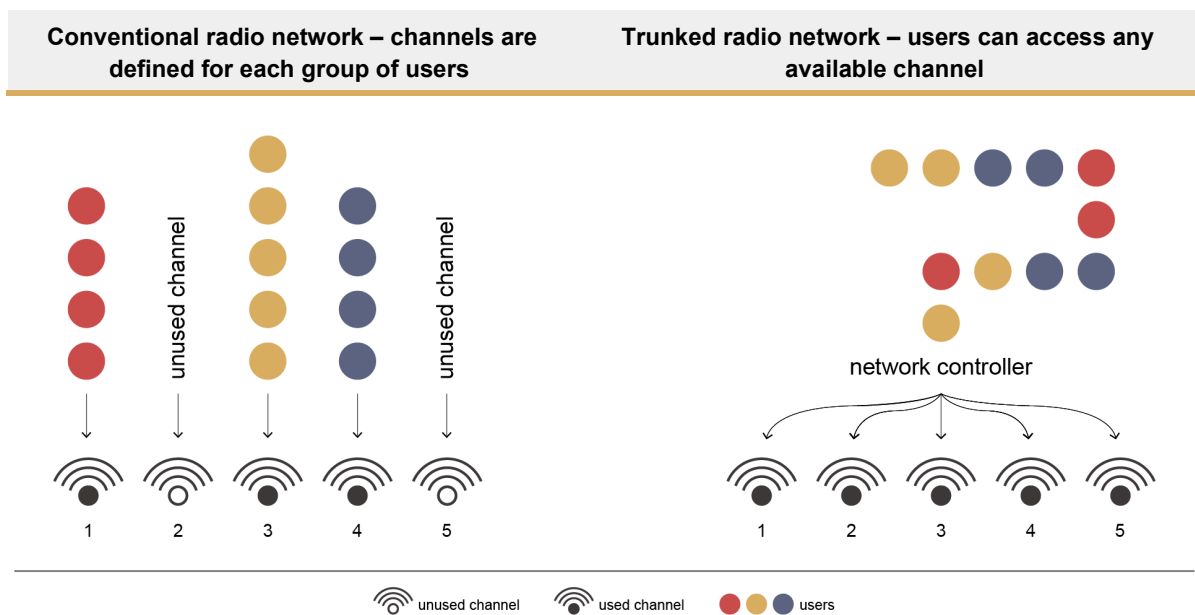
Reference: Audit Office of New South Wales based on: Cast, C. (2018) 'Radio communications' presentation to Marjory Stoneman Douglas High School Public Safety Commission; Mississippi Emergency Management Agency (2018) 'Unit 5: Frequency Regulations and Usage'; Stephan, K.D. (2006) 'We've got to talk; Emergency communication and engineering ethics' in IEEE Technology and Society Magazine, July.

Other types of calls available on a trunked radio network

While the majority of calls made on a trunked public safety radio network are usually within one or more talkgroups, P25 digital technology, as used for the Public Safety Network, allows for other forms of communication, including (subject to the capabilities of the terminal being used):

- system messages, whereby the system administrator communicates to all users
- duress calls, where a user in distress or in need of urgent assistance can press a button on the radio to allow priority alerts to the network – this can also activate location tracking and open a 'hot mic' whereby the user's microphone is turned on without any action from them
- user-to-user messaging, including where the radios are outside coverage of the network and are effectively communicating directly on a line-of-sight basis as 'walkie talkies'
- roaming voice calls on 4G or satellite when the user is outside of radio network coverage
- calls to mobile phone numbers over the trunked radio network when outside mobile coverage.