QUEENSLAND FIRE AND RESCUE SERVICE

CERTIFICATE III IN FIRE COMMUNICATIONS OPERATIONS

TELECOMMUNICATIONS

REFERENCE MANUAL

QFCRAD 1A - OPERATE RADIO COMMUNICATIONS EQUIPMENT
QFC RAA 1A - RECEIVE REQUESTS FOR ASSISTANCE

Version Five: January 2009

CONTENTS

INTRODUCTION

Communication is the act of conversing or conveying information and for communication to be successful it must involve the transfer not only of information but also of understanding from one person to another. Communication can not be considered complete until the information has been received and understood as intended by the originator
Communication can be face to face, verbal or non-verbal.

Telecommunication is the action of communicating from or over a distance (from the Greek word tele meaning far) using the science and technology of telephony, radio or television. This manual will look at the electronic means used to communicate (tele-communicate) information by QFRS Communications Officers (CO's).

The Communications Centre - Firecom - is the centre of the communications network for the region. Personnel working in a Firecom Centre have the responsibility of operating and maintaining the equipment used to communicate. This equipment includes telephones (standard, mobile and satellite), paging systems, fax and radio. Corporate computer systems for E-mail and map info are also used in the centres. Communications Officers must be able to use all of this equipment efficiently and with minimum recourse to reference material.

Maintaining good communications is vital; the nature of the QFRS work is such that at times lives are saved by the receiving and passing on of information, via the communications network. The fact that many times the people at both ends of the medium are under stress makes it vitally important that equipment is working at its optimum and that the persons using the equipment do so in the most efficient manner. Understanding the equipment and how it works makes it possible for the Communications Officer to ensure that the best possible results are obtained at all times.
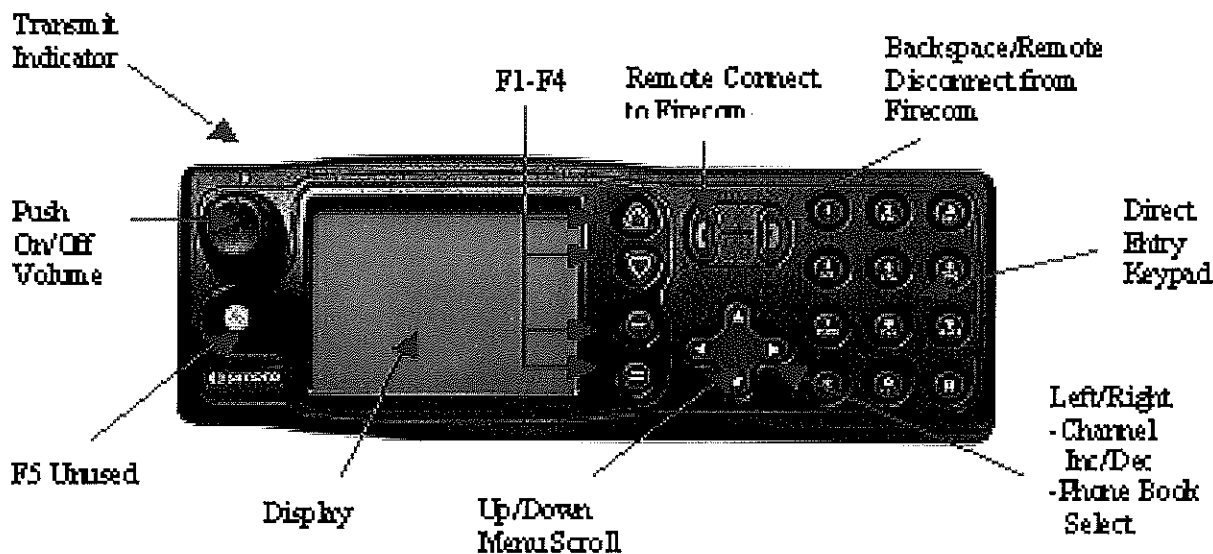
Telephone

The Communications Officer is the front line for communication with the general public and will be asked for information and assistance relating to the QFRS.

Firecom has an extensive E-Info database of information at its disposal that lists contact names and numbers for personnel, departments and premises. These details can be used to ensure that enquiries from the public are given the appropriate advice, however security limitations for contact details for personnel apply. Consider taking a message and passing on the callers details to the Officer, who can return the call at a convenient time. Calls requesting or giving information are documented according to Firecom Centre Reference Manual (FCRM).

Most calls for emergency assistance will be received via the telephone. There are dedicated lines for 000 calls and these will often have different ringing tones, flashing lights and will always be answered as priority calls. In some Regions requests for assistance by other Emergency Services will be received on internal telephone lines, these calls will also, generally, be identified by a different ringing tone.

All telephone services will, at some time, fail. The CO must know the appropriate procedures for establishing backup telephone communications and the reporting system for re-establishing the primary system.   These procedures will be detailed in the State-wide Integrated Operational Planning Process (SIOPP) manual and the Equipment manuals.

Mobile Telephones

In recent years technology has advanced at a rapid rate. Mobile telephones are in common use and the coverage area is becoming greater. There are currently six types of PMTS (Public Mobile Telephone Services) used, these being Next G, 3G (third generation), the GSM (Global System for Mobiles) digital systems, satellite phones and radiophones.

Mobile telephones – GSM:

Provides coverage to more than 96% of the Australian population. Mobile phone usage can sometimes be restricted or even impossible inside certain buildings, structures and some locations, notably within capital cities. Mobile GSM networks have an extensive range of base stations inside selected buildings and structures to help provide coverage within some of these difficult areas.

GSM network users can also take advantage of mobile online access. With a compatible mobile phone it is possible to link to the mobile internet, send and receive emails, get sports updates and more

Mobile telephones – Next G:

The Telstra Next G system in Australia combines the benefits of digital operation (privacy, security, voice clarity, video calling, SMS & MMS messaging, high speed internet, tv and other data services) with coverage which is greater than the former CDMA (Code Division Multiple Access) system that closed in 2008. The CDMA system replaced the analogue service. The towers previously used for the analogue service were used for CDMA coverage and vice versa with Next G.

Mobile telephones – 3 G:

Similar to the Telstra Next G system, 3 G is operated by other network carriers (Optus, Vodafone, 3 Three & Hutchison). Prior to the introduction of their own Next G system, Telstra sold phones in Australia connected to a 3 G network that was operated by Hutchison – used by DES for paging network system. 3 G system in Australia combines the benefits of digital operation (privacy, security, voice clarity, video calling, SMS & MMS messaging, high speed internet, tv and other data services). 3 G phones will operate effectively inside buildings.

Mobile telephones – satellite

The telephone services described so far are land-based, with handsets sending and receiving radio signals from mobile phone towers and base stations on the ground. Satellite-based mobile phone services link terminals and handsets with satellites orbiting the earth, providing coverage in *most outdoor locations*, even in remote parts of Australia.   The limiting factor for Satellite phones is the obscuring of the line of vision to satellite by high buildings or overhead structures, density of vegetation & speed of vehicle. Some of these units are multimode, which means that the telephone can be used as an ordinary digital phone or linked to the aerial as a *sat-phone*. Being digital, the *sat-phone* allows for fax & data transmission from a laptop, PC or standard fax machine.

Closed User Group – CUG

Optus Singtel in collaboration with Police and DES propose to establish Closed User Group (CUG) operational channels using enhanced satellite phones. This project seeks to provide remote area communications to operational groups in areas where black spots exist and where conventional communications network infrastructure has not been provided. Users can be assigned access to a CUG on request to the CUG controller, this allows for inter-agency communications when needed. The current sat-phones are vehicle-based units only and require a dome antenna for QFRS vehicle arrangements. This may limit the operational advantages for field operations. QFRS has arranged for trials of modified sat-phones that will be interfaced to the vehicle communications equipment. CUG enabled satellite phones will work as a normal sat-phone, but when on the CUG they work like a 2 way radio without the need to dial numbers for every contact. DES closed this system from use in 2008, however some handsets will still have the non-functional mic attached.

Radio Phone

Radiotelephones are a communications system using technology which combines long-range radio and the telephone system. Calls are made from Firecom via an operator who makes the connection to the radiophone. These calls are like a simplex radio communication as transmission & reception cannot occur simultaneously. Some systems require a button to be pushed to talk (*) but this varies. Radiophones have been replaced in most instances in QFRS by satellite phones.

Telecommunications for the Deaf

A text based communication system is used by people who have acute hearing disabilities as it allows them to get assistance in an emergency (It may also be used by people with speech impediments). .

People who use a TTY (teletypewriter) or a computer with modem to access the telephone network can call emergency services via the National Relay Service which operates 24 hours seven days. The number used to access this service is 106 and has immediate access to 000. The telephone number and address of the caller are displayed to the 106 operator and can not be blocked, even if there is a line or call block in place. A 000 operator relays the information verbally, directly to the appropriate emergency service. Normal response procedures apply to these calls, additional

information relating to the caller's disability should be relayed to the fire-fighters by the comms officer.

USING THE TELEPHONE

The Code of Conduct states that personnel shall '*Treat clients (including other QFRS personnel) with courtesy'* and *'Represent the QFRS with pride, honesty, integrity and dignity'* and these statements describe how the telephone manner of the Communications Officer should be conducted. When answering general business lines calls, staff of the Queensland Fire & Rescue Service are required to state the name of the Department, their rank and name. e.g. -*Queensland Fire & Rescue Communications Officer Smith* or *Firecom, Sue speaking.* For Emergency Call Taking, refer to FCCD Q-1.1 Emergency Call Management.

It should also be remembered that, because the communication is voice only (not body language as well) officers need to convey a pleasant and welcoming attitude in their tone for general lines and a calm controlled attitude for emergency calls.

Complaints

Any person wishing to register a complaint against the QFRS or personnel employed by the QFRS should be referred to a senior officer. Communications Officers should not engage in any discussion in this situation or offer any opinions.

Telephone Interrogation

The first indication that the CO usually has of an emergency is the ringing of the 000 telephone and flashing light. Obtaining all the relevant information is not necessarily as easy as asking the questions. Questioning techniques may need to be varied for different callers; the phrase 'telephone interrogation' should not be taken as 'giving the 3rd degree' but rather as 'questioning closely'.

When answering an emergency call from the Telstra operator, the Communications Officer must reassure the caller immediately that they have reached the correct emergency service. FCCD Q-1.1 Emergency Call Management advises of the correct Communications Officer response 'Queensland Fire and Rescue, What is the location of the emergency?

This gives the caller an immediate identification that they have reached the Queensland Fire and Rescue Service and that they have been asked a direct and open question to provide details of the exact location of the emergency.

Terms such as 'Fire Brigade & Fire and Rescue' have been used in the past, however they do not identify the QFRS correctly to the caller and do not follow on with any line of questioning.

The CO must be in control of the conversation but must not add to the stress or distress of the caller. Information necessary to ensure the appropriate dispatch should be sought first and any other information obtained, if available, afterwards.
The minimum basic information considered necessary to enable appropriate and efficient dispatch of appliances and crews is:

- Suburb or Town or Premise
- Street road/name including number
- Cross street and/or landmark – directions if required

- Details of the emergency – what is happening?
- Further questioning as per problem type
- Are there persons involved/injured/trapped
- Caller details CLI including call back number

The CO should repeat the information back to the caller to ensure that the details are fully correct. Usually direct questioning will result in the essential details being obtained, however there will be situations where the caller is panicking, in shock or has physical disabilities which handicap their ability to respond. Adjust your questioning to suit the caller (e.g. if caller advises they are blind, asking them if they can smell smoke is more helpful than asking can you see fire – a genuine error).

Managing these situations is a skill which communications officers must acquire very early in their training. It may be that a person from a non-English speaking background or with speech impediments will not be able to make themself clear when distressed but is able to respond to simple, direct questions. In this situation the officer can ask 'are you at Smith Street in Townsville' (from the CLI) and 'is the house on fire' to which the caller can give simple answers.

Other information relevant to the call, which should be obtained if possible, includes

Structural	-	any persons in the building
Grass fires	-	any life, structures/property threatened
Motor Vehicles		how many persons trapped
		Is there any sign of fire?
		How many vehicles are involved?
		What type of load (heavy vehicle incident?)
Train		What is the direction of travel?
		Distance from nearest station
		What type of train is it – passenger/freight/diesel/electric?
		What freight is being carried?
Aircraft		How many persons on board
		Do you know how many persons injured?
		What type of aircraft – commercial, cessna, military, helicopter
		Best access to scene

When the information has been obtained and the caller has confirmed that it is correct, the officer should assure/re-assure the caller that help is on the way. In the event of a large or highly visible incident, multiple calls will be received at the Firecom Centre and some of the secondary information can be obtained from subsequent callers.

Calls for assistance are also received from other emergency services. It must be remembered that, although the officer calling has his/her own priorities, Firecom cannot work efficiently without the same information that would be obtained direct from the persons involved in the incident. Professional questioning by both parties will lead to an appropriate response.

Prioritisation:

Once enough information has been received to give a picture of the emergency, the CO needs to prioritise the response required for that incident, taking into account resources available and other emergency commitments. ESCAD already has the QFRS problem types loaded with State FCCD's including any Regional variations, which will determine a priority response incident level from 1 to 5 where 1 is the highest priority once the ECT window is completed.

The order of priority levels is simple:

<p align="center">**<u>Life, Property then the Environment</u>**</p>

Life is referred to as humans and animals. This is of the highest priority. Property is referred to as structures, commercial buildings, houses, sheds etc. Environment is referred to as land, vegetation and atmospheric conditions etc.

Dispatch:

When the appropriate response has been determined, (using the FCDS's) clear and precise information must be relayed to the responding crews. The correct use of the radio (including voice) codes and terminology are vital for a successful result.

Coordination:

The CO has a complete picture of the resources of the region and is able to ensure that the most appropriate crews are responded and that backup is available as required.
Support resources including other emergency services, hazardous material information and power companies are accessed by the CO using the facilities of Firecom.

Recording:

Telephone calls received into the Communications Centre are recorded. These tapes form part of the official records of the Centre and may be used as evidence in a Court of Law. Immediate playback of telephone calls (and radio) is available by use of the Quicklog on the console (this is in addition to the Voice Logger and is not a permanent record). The unit stores approximately 36 minutes of recorded conversation and can record new data while being used to play back previous recordings.

Some Fire Communication Centres use computer software platforms to record radio and telephone calls. This provides for instant retrieval of all communications from that console. This equipment will be studied more closely in the *Console & Ancillary Equipment* unit.
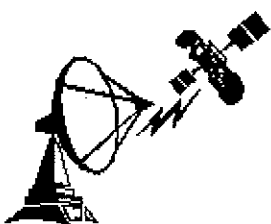
CALL LINE IDENTIFICATION (CLI)

Call Line Identification information is forwarded by the telephone carrier network. When a 000 call is received this information relating to the originating telephone is displayed on a computer screen. This screen will show the callers registered address and telephone number and further details relating to the Telstra job number, the time that the call was made to 000 and the mobile phone tower the caller was switched through (if applicable). The information is printed in hardcopy, however, when the information has gone from the screen, the scroll buttons on the side of the screen will allow the CO to check back through previous calls.
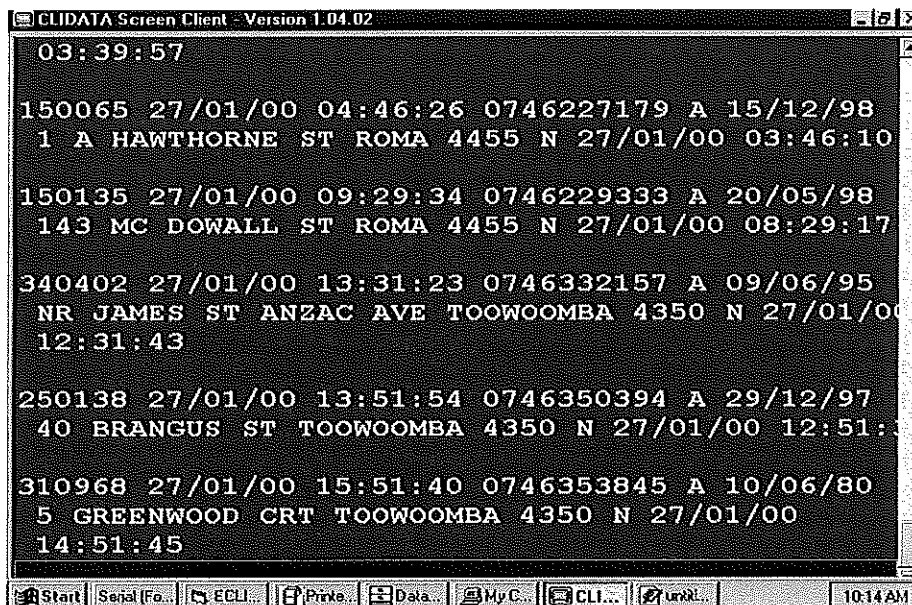
The CLI allows the CO to confirm that the address given by the caller is correct and in cases where the caller is distressed or has hung up, the CO is still able to dispatch units to assist. When the call has been placed from a subscriber with an unlisted phone number the address will not be displayed although the phone number is. If the call is from a mobile phone the registered address of the owner may or may not be displayed, depending on the options selected. Because of these anomalies the CO should not rely solely on the CLI for the address to dispatch to. Default mobile numbers may be displayed where the caller has removed the sim car and is using the emergency S.O.S. feature of their mobile.

CLI Printout

CLI details can be imported directly into ESCAD from the ANI/ALI Screen for address geo-verification, creating time efficiency for CO's. Should a CLI error by identified, CO's are to complete and submit a CLI error discrepancy form to the Telstra 000 Supervisor Sydney advising of the correct details. Refer to FCRM.

PAGERS

A pager is a portable message receiver and can receive either tone only or alphanumeric messages. This unit can only be used for one-way communication; there is no facility for response.

The tone only pager alerts the user that a response is required from them and they will either respond to a nominated meeting site (i.e. the fire station) or will telephone a nominated message centre (i.e. Firecom).

The alphanumeric pager displays a firecall message from ESCAD or a message that has been typed in by the operator using the Mtel paging interface giving details to the user of the response required. The advantage of the alpha-numeric pager is that the user has immediate information available and is able to prioritise his/her response.

Pagers are activated by either software integration with ESCAD, radio signal via telephone line or direct radio signal (selcall), or by network provider (Hutchison). Messages received via selcall activation are 'set' messages and usually relate to an alarm activation or power failure.

Manual Paging

When a pager is activated by a telephone system (commercial carrier - Hutchison) the operator is able to transmit details relating to the call. The most basic method is to ring the Hutchison number 1300 555 555 and quote the operator the number of the pager and the message to be sent. This is not the quickest method of paging and pagers will not activate if they are outside the networks geographic coverage areas.

Pico cell Paging

A commonly used system in QFRS is the Pico-cell paging system developed by Mtel (pico means small cell). This system is used where the fire stations are outside commercial networks (n.b. can be used to access the commercial carrier or combination of both). An antennae and transmitter are installed at the station (or nearby tower) and the message is transmitted via an IDSN/PSTN telephone line to the transmitter and then to the pagers with-in a radius of approximately five kilometres (depending on terrain and weather) This program is quickly accessed through an interface with the ESCAD system and has the facility to have numbers and standard messages programmed so that dispatch can be very fast.

Pagers are used throughout the service to maintain contact for administrative purposes as well as for emergency contact with both firefighters and senior officers. In many areas pagers are used as the primary turnout notification for emergency calls. This has evolved as communities are less willing to accept the noise levels and disturbances related to siren activation. The paging system has the advantage of allowing firefighters to be contactable outside of town areas where they are out of hearing of the telephone or siren.

Automatic ESCAD Paging

The ESCAD computer system now in use throughout the QFRS Fire Communications Centres has an inbuilt facility to automatically page fire fighters when their appliance is assigned and committed to an emergency incident. This feature can respond crews more quickly to an incident as it improves the efficiency of the CO to dispatch, given that its one less thing to do on turnout. Similarly, Senior Officers vehicles can be automatically paged through ESCAD when committed to an incident.

This system uses Mtel software interfaces in a Brisbane and will dial back out to the required Fire Station Pico and/or Hutchison network, transmitting firecall details from the ECT screen. Details that will be received are similar to the following:

FIRECALL: Warwick 321Aux turnout FCA 32114-01. 3Warwick Hospital , 56 Locke ST , WARWICK , WAZ1N11

FIRECALL: Rosewood 673A turnout Car vs Tree, Rosewood Warrill View Rd , ROSEWOOD , UBD 210 B19

Note that the ESCAD system identifies the appliance committed to the incident, FCA number & premise name with Regional identifier, incident details, address location and UBD map reference. An additional application for this facility could be to automatically page a SOC with firecall details when their on-call response car is committed to the incident.

ESCAD ECT Window

It is imperative that Fire Communications Officers input and complete all relevant details and mandatory blue fields (picture below) into the ESCAD ECT window whilst call taking. This will ensure that if Crews/Senior Officers are being automatically paged, that they receive complete firecall details (e.g. leaving the *Details* field blank will not provide any incident particulars, therefore page recipients will only receive the address fields.)

Facsimile (Fax)

Fax machines use the telephone system to transfer text and graphics electronically. Whole documents can be transferred electronically almost instantaneously, and this is a great advantage to the Communications Officer. The use of fax is taken for granted in our modern age, where we are able to transfer a complete Chemdata document from Firecom to the Hazchem vehicle on site at an incident, and in fact this is part of our FCCD's. (where this equipment has been installed). '

Fire reports are often transmitted to Fire Stations or Senior Officers via fax for administrative purposes. Fax is also used to receive information into Firecom from such entities as the Bureau of Meteorology and other emergency services.

RADIO COMMUNICATION

Without electromagnetic radiation, modern society would become nearly blind, deaf and dumb. Radiated power levels and the upper frequency limit of radio frequency utilisation are continuously increasing, due to advances in technology, providing advantages to society. The Emergency Services use radio communications to assist in the provision of safe and efficient services to the community.

Radio propagation

Radio propagation, or how radio energy travels in space, is a complex subject. A basic understanding is needed to appreciate the communications range capabilities and limitations of radio equipment.

Radio frequency spectrum

Sound, being a form of energy, travels in waves. When speech is converted into an electric current within the transmitter, the current is then broadcast via the aerial into the air as radio waves. The waves radiate away from the aerial in much the same way as ripples spread in water when a stone is thrown in.

Discussion about radio waves revolves around their 'frequency' which is the number of waves per second passing a given point. Radio frequencies are described by a unit of measurement called a hertz (which equals one cycle per second).

The radio spectrum is divided into eight bands, two of which are used by the QFRS; They are Very High Frequency (VHF) and Ultra High Frequence (UHF) authorised by the 'Australian Communications Authority' under the authority of the Commonwealth Radio Communications Act.

Influences on radio waves

Radio waves travel in a straight line but are influenced by objects and the media in which they travel. The degree of influence often depends upon the frequency. Signals can be reflected, refracted and diffracted, altering their paths and absorbing them, reducing the distances over which they may travel.

Reflection

Reflection of light is an every day occurrence. As mirrors, windows and shiny surfaces reflect light, radio waves are similarly reflected by many surfaces. When a signal is reflected, there is normally some loss of the signal, either through absorption, or as a result of some of the signal passing into the medium.

For relatively short range communications, many buildings, especially those with metallic surfaces provide excellent reflectors of radio energy. As a result of this, signals travelling to and from VHF/UHF radios (and mobile phones) often travel via a variety of paths. Wet areas provide good reflection of radio signals.

Refraction

The concept of light waves being refracted is very familiar, especially as it can be easily demonstrated by placing a part of a stick or pole in water and leaving the remaining section in air. It is possible to see the apparent change or bend as the stick enters the water. Mirages also

demonstrate refraction and a very similar effect can be noticed on hot days when a shimmering effect can be seen when looking along a straight road. Radio waves are affected in the same way

Diffraction

When radio signals encounter an obstacle they tend to travel around them. This may mean that a signal may be received from a transmitter even though it may be "shaded" by a large object between them. Even though there will be a shadow zone immediately behind the obstacle, the signal will diffract around the obstacle and start to fill the void. It is found that diffraction is more pronounced when the obstacle becomes sharper and more like a 'knife edge'.

Line-of-Sight (LOS)

The LOS distance is the straight-line distance from the antenna to the horizon (optical horizon). The radio horizon extends slightly beyond the optical horizon. (For average conditions the radio horizon is approximately 4/3 of the optical horizon.).

Interference/Influences

There are many variables that affect the propagation of radio energy including the time of day or night. The seasons and the natural phenomena of solar flares also affect the behaviour of radio waves. There have also been instances when radio reception has been effected by smoke during heavy bushfire periods. Other sources of electrical energy (i.e. power lines) and high energy output areas (densely populated areas) and people using frequencies close to those allocated to the QFRS all have an effect.

Radio waves can travel over different paths from transmitter to receiver – A signal arriving by two or more paths may cancel each other out. Moving the receiver a short distance in any direction may alleviate this problem

Radio Black Spots/shadows:

Areas recognised as having severely degraded or no radio RX/TX consistently are referred to as 'radio black spots' and this can be caused by either terrain, tall buildings, tunnels, steel cladding, or other power sources etc. Other areas, where reception is intermittent or weak are referred to as being in a 'shadow'. These areas need to be identified within each region so that staff will be aware of potential loss of communication with mobiles.

QFRS BAND PLAN

The band plan is a plan (or map) assigning numbers (Channels) to the frequencies allocated to QFRS., a channel number will have both a receive and transmit frequency assigned. The channel numbering system is arranged to facilitate compatibility of portable and mobile equipment, and radios within a QFRS region will have frequencies assigned to a common number
Tables cross-referencing allocated channel numbers to base/repeater/voting groups and transmit (TX) and receive (RX) frequencies are filed at each Firecom. These may need to be referred to if frequencies are requested by other agencies, as the channel numbers may not correspond between agencies. (e.g.: when tasking an aircraft)

QFRS UHF Portable Radio Band plan

Chan No	Allocation	Area	Reg.	Transmit	Receive
1	Fireground Simplex	All	All	465.525	465.525
2	Fireground Repeater	All	All	456.025	465.525
16	R6 Mt Mahomet Repeater		1,4,6	457.100	466.600
61	R3 Picnic Point Repeater	Toowoomba	2,3,5,7	456.650	466.160

The same channel numbers may also be allocated to both UHF and VHF plans.

QFRS VHF Band plan

Chan No	Allocation	Area	Reg	Transmit	Receive
1	QFRS VHF Fireground 1	All	All	72.5125	72.5125
2	QFRS VHF Fireground 2	All	All	72.5875	72.5875
16	Repeater Mt Barmoya	Yeppoon	2	73.9000	71.4000
61	Rural CH11 Brigade Fireground	Rural band plan	2	79.8750	79.8750
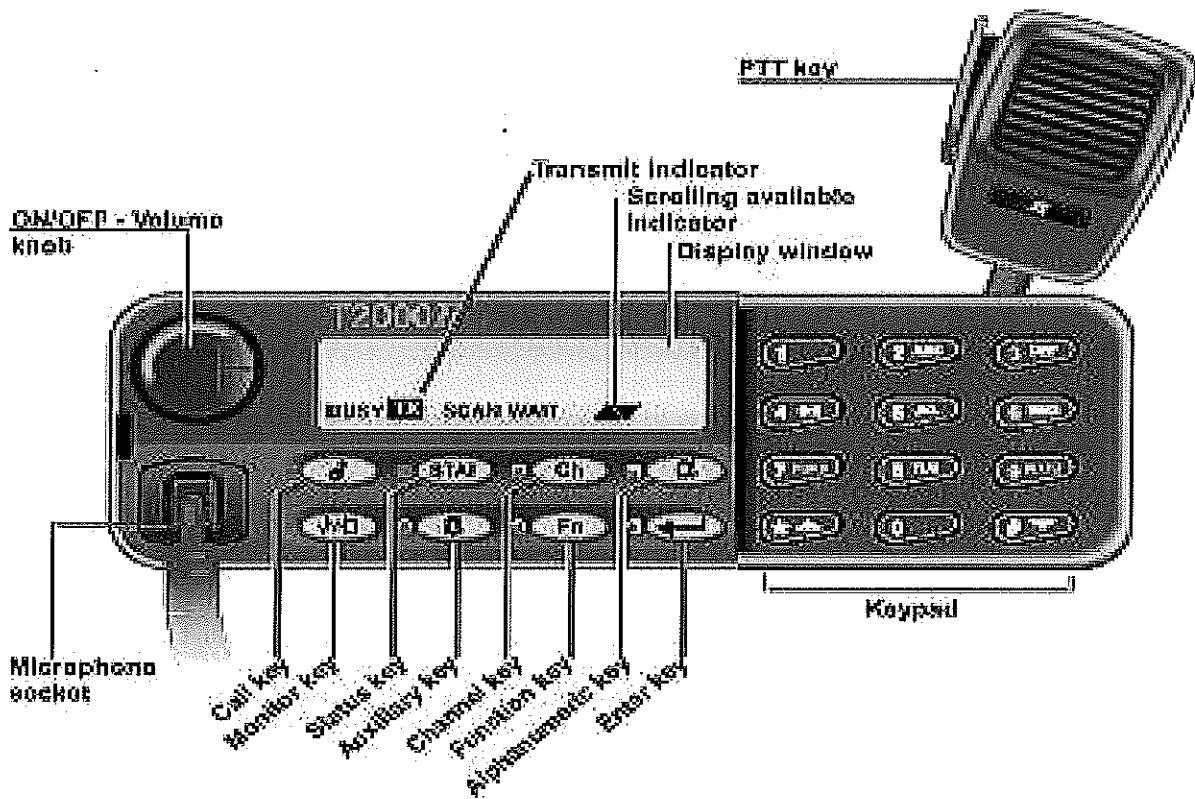
METHODS OF TRANSMISSION

Single frequency Simplex.

Simplex is communication between two parties using a single radio frequency, without using a relay or repeater.
This is where both the base station and the mobiles transmit (TX) and receive (RX) on the same frequency and all radios in a system can hear transmissions from all the other radios.

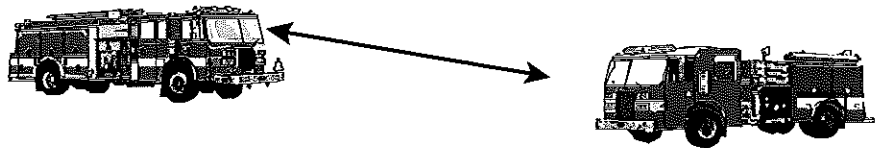A Simplex system is useful when radios need to be able to talk directly to each other however two mobiles transmitting at the same time will cause mutual interference and two mobiles can engage the whole system and make it difficult for control

Simplex radio communication is suitable for incidents in a single area, (i.e. mobiles involved in the same incident) and is usually reserved for portables or fireground operations.

Semi-Duplex (two frequency simplex)

Duplex refers to the operation of an intermediate piece of equipment called a 'Talk Through Repeater' - TTR – which receives on one frequency and re-transmits simultaneously on a different frequency. Communication between mobiles is not possible without the repeater because of the different transmit & receive frequencies. The base-station transmits on one frequency and the mobiles transmit on an adjacent frequency.

Base transmits on frequency A and receives on frequency B
Mobiles transmit on frequency B and receive on frequency A

Control of a large number of mobiles over an extended geographical area is much easier using this system as every-one can hear all transmissions.
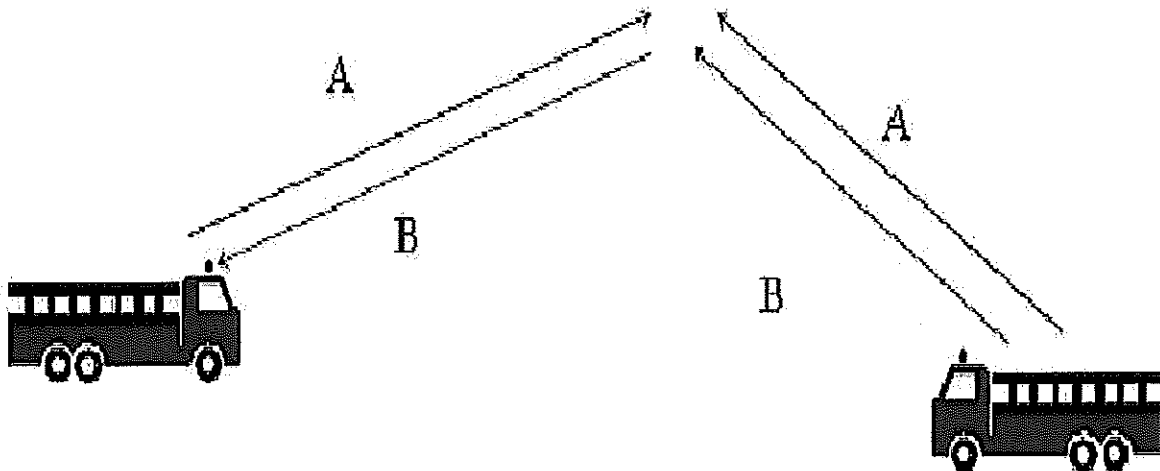
Talkthrough – enables the base station to re-transmit everything that it receives, enables mobiles to hear all transmissions, and for mobiles to communicate with each other.

Duplex - Two-frequency duplex - two frequencies used. Both transmitter and receiver can operate simultaneously (like a telephone). Used in cellular telephone.

Sub-audio tone - an inaudible tone (unique to each system) which is transmitted simultaneously with any speech. The radio will open up and switch on its speaker when it receives this tone. Radio reverts to closed down state when it ceases to receive the sub-audio tone.

Transmitter range

Radio has limited range; radio waves travel in straight lines, although they can be reflected off some of the layers of the upper atmosphere, or off some buildings. The range is also relative to the power of the transmitter, i.e. the more powerful the transmitter the further the range - within the limits of 'line of sight'.
Radio reception is always best from a high, unobstructed location
If a mobile cannot receive (hear) Firecom (which usually has a higher powered transmitter and better aerial siting than mobiles) then it is unlikely that Firecom will be able to receive the mobile.
If radio reception is poor, e.g. at the limit of the range or in a radio black spot, the mobile should move to a more favourable location (usually higher up or on the opposite side of a hill/building) before attempting to transmit.

Scanning:

Radios have the facility to be programmed to monitor several frequencies. When the radio detects a signal on one of the set frequencies, it locks onto the frequency and receives and transmits on that frequency until nothing is heard (approx 30 secs). At that stage it resumes scanning. Within the nominated band of frequencies to be scanned, one will be the primary frequency and this will override any other signal received at the same time.

BASE RADIO

Base Radio Systems

There are three base radio systems and any one, or a combination of several, may be used depending on the location of the communications centre.

- Local & remote control –the base radio and aerial are at a single location. The radio has both a speaker and a microphone and there may be remote control units in other parts of the building for other operators to use.
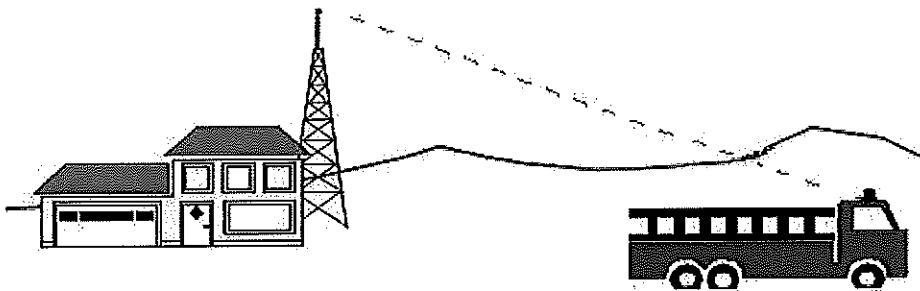
- Remote Control via landline – used when the communications centre is in a poor radio reception area. The base radio may be located in a better position (on a nearby hill) and a landline is used to connect the base radio to the remote control unit in the Communications Centre.
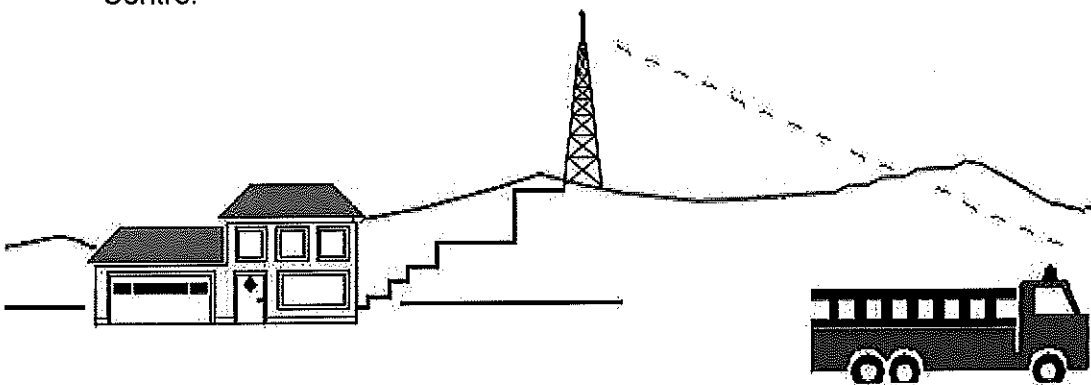
- Remote Control via radio link - used when the other two systems are not suitable. The base radio can be placed at an elevated site away from the Remote Control unit. A radio signal links the RCU at the Communications Centre to the base radio.
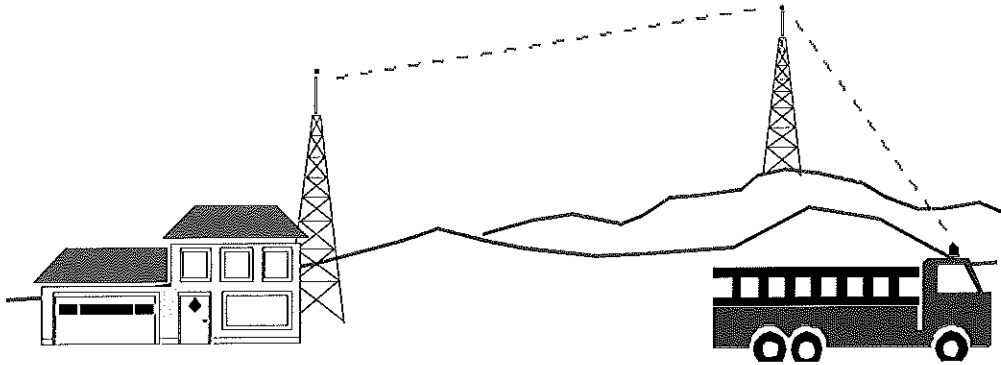
Repeaters:

Where the distance between two transmitting radios is too great for radio signals to be effectively sent & received, a repeater may be established. A fixed station is mounted on a tall building, tower, high point or mountain. This then allows the automatic re-transmission of radio communications received from any radio within range of the repeater. (In the figure transmission is sent on one frequency (A) and the repeater then transmits on another adjacent frequency (B)
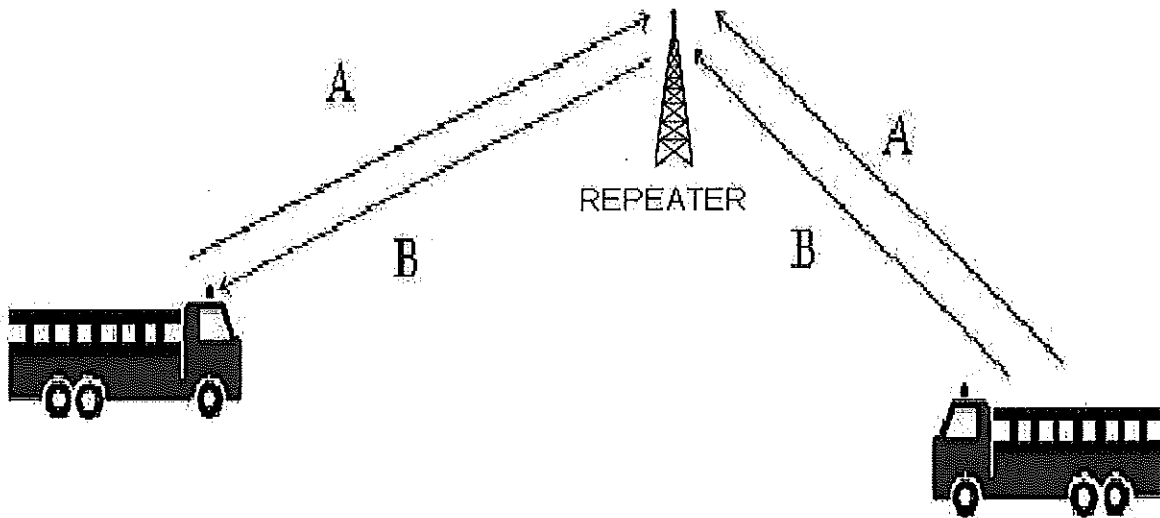
Repeaters are usually associated with remote sites that are suitable for wide area coverage. To achieve a wider coverage than is possible with a single repeater, a number of channels may be cross-patched into a group to appear to the Communications Officer as a single channel. Mobile radios need to have a channel selected appropriate to their geographic location, and Communications Officers need to know the location of the repeaters and the associated channels to advise the mobile.)

V22

V14

FIRECOM

V20

V16

🔺 Talk through   🔴 Link Control   🟡 Talk Through Link
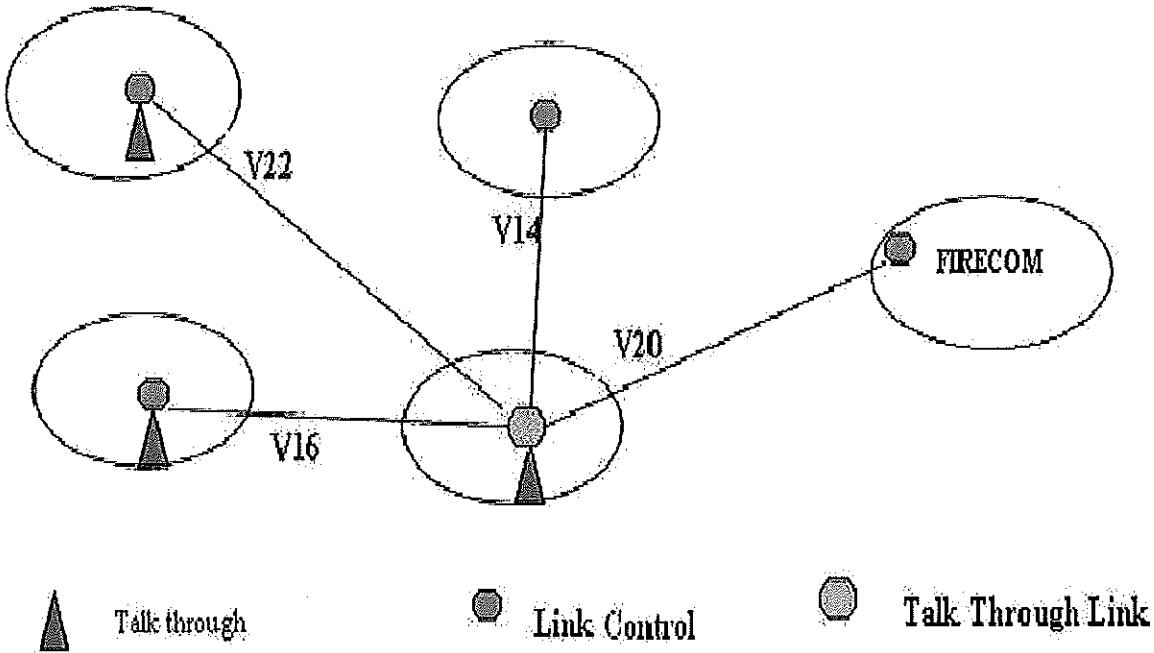
Indicators of repeater failure could be mobile radio transmission failure; power problems or storm weather activity and Communications Officers can predict this by being aware of the repeater sites and related channels. A selcall code may also be automatically transmitted to the Communications Officer on the console, reporting a power failure at the repeater site. Regular testing of repeaters using a mobile or portable is part of Firecom procedures.

RADIO CONTROLS

The appearance of radios will vary however the basic features and controls remain the same. Controls found on radios include: -

On/Off switch	Controls electrical power to the radio
Volume Control	Controls output of sound from the receiver
Mute/Squelch	Diminish unwanted background noise/limits sensitivity of receiver
Channel Selector	Allows channels on network to be selected
Channel Display	Indicates channel radio is operating on
Transmit button(PTT)	Fitted to mobile radio microphone or on the side of portable radio.(*Press to talk – transmits when button depressed - in receive mode when not*)
TX/RX Indicator	Indicates transmitting (TX) or receiving(RX)

Mobiles

Mobile radios are usually mounted in vehicles and the distance of transmission depends on the position of the vehicle at the time. In addition to the controls described for the base radio, mobiles will usually have:

Scan on or off button	Used to monitor a number of channels
Scan edit button	Scans activity on programmed list of channels
Priority scanner	Select priority channel
Trunking mode switch	Select radio channel for communication between designated radio users
External speaker	Allows personnel outside vehicle to hear messages

Portable Radios

Portable radios are hand held, are totally self contained, have their own aerial and power source (battery). These radios are normally used for portable to mobile or other portables, they are not designed primarily for use to communicate with Firecom.

Motorola GP 339   MTX 838

Backlight button

Push-to-Talk button

Rotary channel
selection knob   Antenna

Talkaround Button

On / Off / Volume

LED Indicator
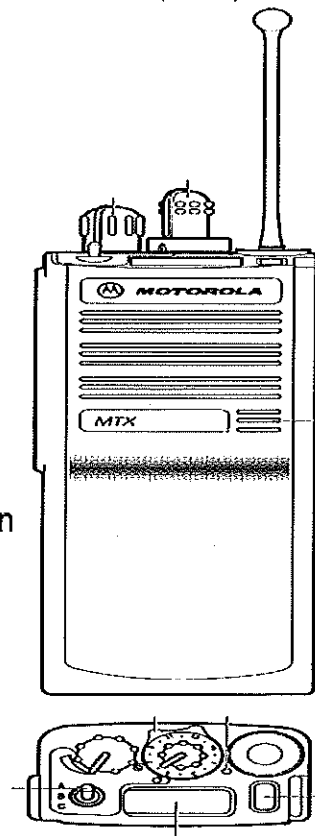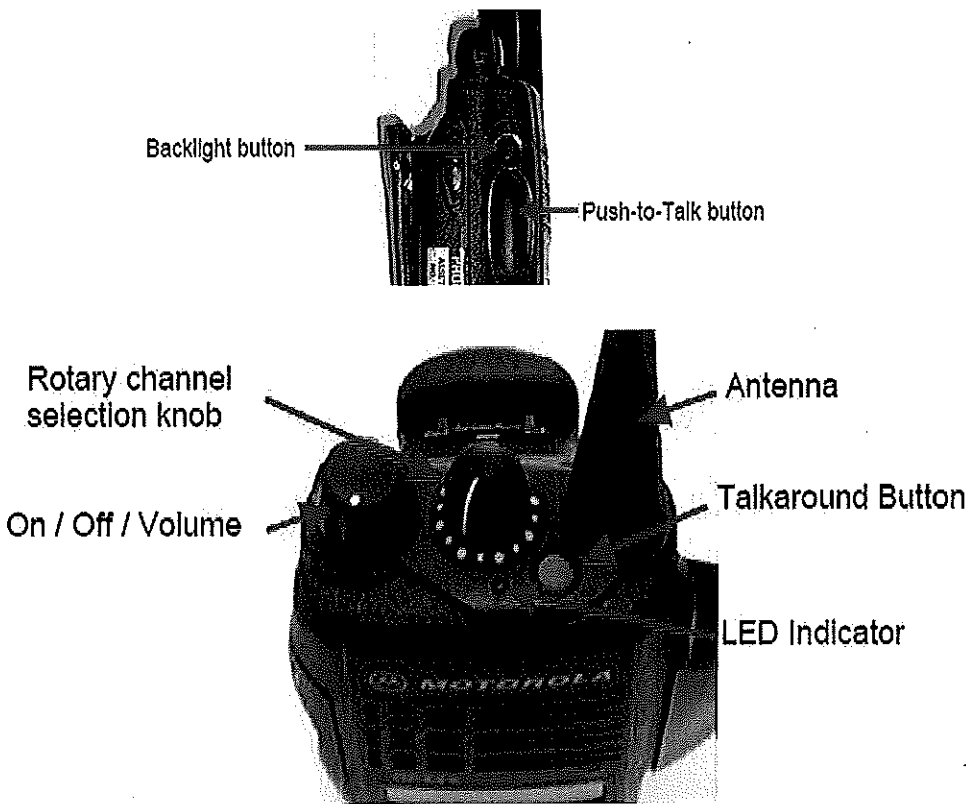
Intrinsically safe portables do not give off any electrical discharge. This becomes vital when crews are operating in a volatile environment as even a slight electrical discharge could precipitate a reaction. Intrinsically safe portable radios are identified by a blue dot on the bottom of both the transceiver and also the battery which must be used together.

Cross Channel Linking

The Cross-channel Linking facility provides the console with the ability to automatically rebroadcast incoming traffic. It is used because:
-       artificially broadens the communications area
-       enables mobiles to vote correctly to the optimum channel
-       Reduce/eliminate "doubling" (2 mobile operators trying to talk over each other) as all traffic in the group will be heard by all mobiles using that group.
-       allows the operator to split the network in times of heavy traffic (if there is an operator available to man the second console)

Cross Patch Radio

- has the ability to 'cross patch' – 'link' UHF & VHF frequencies
- can act as a repeater, to improve strength of signal
- Can be transported (in an ordinary vehicle i.e. sedan or wagon) to a remote location to act as a repeater for large incidents, or when a repeater fails or is damaged

Voting

In a voting system, the signal from a radio is sent to all repeaters. The radio automatically selects (votes) the repeater with the first signal that meets the required preset signal standards. The radio then transmits the signal via the selected repeater to its destination. (Mobile telephones also work on this principle)
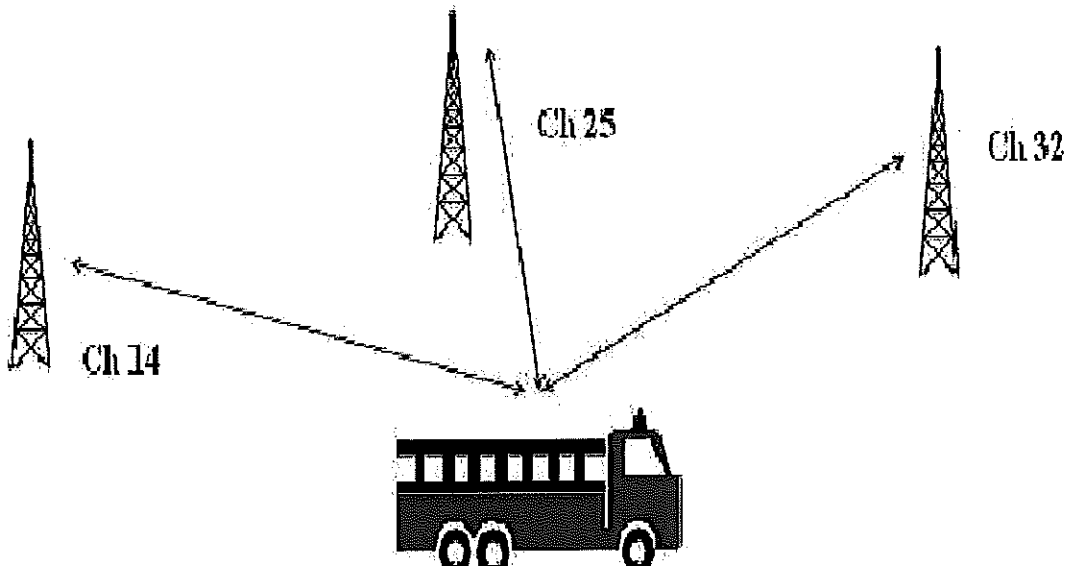
Voting Groups

Nominating a new channel that will scan a normal set of channels within a region creates a voting group. The mobile radio transmits a 'voting pulse' (which is non-audible) and from this selects the strongest channel depending on the answer received and automatically changes the mobile radio transmit channel. This enables a mobile to move throughout the region without the radio operator having to physically change channels to maintain communication.

TRANSMITTING MESSAGES – RSVP

The operator can ensure that the transmission of radio messages is successful by using a number of strategies, including adjusting the microphone distance from the mouth to suit the individual's normal speaking level.

> **Rhythm** – ordinary conversation has a natural rhythm, which should be preserved when transmitting radio messages. Messages should be transmitted in short complete phrases that make sense in themselves.

> **Speed** – speak slightly slower than in normal conversation and ensure precise and correct pronunciation of words. Pause between phrases to give the receiver time to copy the message.

> **Volume** – speak *slightly* louder than in normal conversation. Adjust microphone distance to suit speaking level and avoid shouting or speaking loudly, this may distort pronunciations and will disrupt other activities in the communications centre.

> **Pitch** – Use a normal or slightly higher pitched voice for best transmission.

STANDARD RADIO PROCEDURES

The use of correct procedures will ensure that radio messages are successful. The 'R*adio Procedure Handbook 2005*' describes the correct procedures and codes to be used. Always pause after pressing the 'press to talk' switch and before speaking as some transmitters/repeaters may take a second to activate and the first part of the message or call sign may be missed, requiring a repeat of the message. Firecom will acknowledge all radio messages and will close transmissions with a statement of the time (in 24-hour time).

SELCALL

This function allows Firecom to transmit a numerical code via the Firecom radio network that will activate a piece of radio hardware that is listening within the system. This numerical code is unique to the radio which is fitted to appliances, vehicles, station sirens, pagers & turnout systems. When appliances are selcalled, the radio will emit a ringing tone which then activates the horn. This will continue until someone presses the push to talk (PTT) button on the radio handset, acknowledging the firecom transmission.

TESTING

Regular radio checks are necessary to determine the operational readiness of equipment and ensure overall system integrity. User awareness of the performance to be expected as a result of normal operation will result in early identification of any performance degradation. Attention may then be given to rectification of such deterioration before complete failure occurs.

The focus of routine checks should be:
- User required functions
- Selcall alerting and number identification systems
- Voice clarity and volume
- Range or geographic distance over which communications takes place.

During the process of routine checks, reference may need to be made to operators' manuals or user guides supplied by manufacturers, specific equipment training notes and FCRM's.

EQUIPMENT FAILURE

In the event of equipment failure Communications Officers should be able to determine the area of failure, i.e. console, headset, radio, telephone, repeater etc by a process of elimination.
An outage report must be sent (usually emailed) to Systems Support Services as soon as possible. Refer to the priority definitions matrix for response and include full details of the occurrence. This will allow the technicians to problem solve before they attend on site. Outage Reports are numbered and a copy filed in the Firecom Centre for future reference.

CONDITIONS OF LICENSING

Every radio telephone system must be licensed by the Australian Government; the process is managed by 'Australian Communications Authority' under the authority of the Radio Communications Act. When a license is issued to the organisation, all staff are bound by the conditions of the license. The license indicates the frequencies that will be used. The radio communications act requires a radio service to be controlled by competent operators.

Privacy of Communication.

Under International Radio Regulations, an operator (and any other person) who becomes acquainted with the contents of a radio transmission is placed under an obligation to preserve the secrecy of such transmission. Secrecy restrictions do not apply to distress; urgency or safety messages, however confidentiality after the event must be maintained.

Use of Station.

Transmissions must be related to the operation of the organisation as described in the license and should be kept as brief as possible.

Call Signs

Call signs are allocated to each transmitting radio station and must be used as a means of identification at the initiation of transmission. QFRS call signs are allocated as described in the *Radio Procedures handbook 2005.*

Radio procedures as described in the QFRS *Radio Procedures Handbook 2005,* (a copy of which is included with this manual) must be used at all times. Correct radio procedures are not only necessary to comply with the licensing requirements but also to ensure the best operational use of airtime. The Phonetic Alphabet and pro words are included in this document.

Emergency Services Liaison Radio

Firecom Centres have an emergency services liaison radio which, in the event of a disaster or other major incident, can be used to pass information directly to the other emergency services – e.g. police or ambulance. This radio should be tested with both police and ambulance on a regular basis as it is used very rarely 'in anger'.

A SUMMARY FROM THE QFRS SYSTEMS SUPPORT SERVICES

Questions you may be asked:

Radio communications can be an invaluable tool for emergency services. To get the best radio communications, familiarisation is required, not only of the equipment, but with the basic terms and system concepts employed. To be unprepared in this area of knowledge in an emergency situation means that lives could be put at risk, as the natural reaction of an untrained person would be to discard or discredit the communication medium or the equipment, and use alternate means to handle the situation. Understanding the limitations of radio communications can help sensible decisions to be made in difficult situations. The following consists of some questions and answers that should be understood by, or issues that may be raised by, emergency personnel using two-way radio equipment in the field.

What makes radio communications work?

To achieve satisfactory radio communications, there are many factors that need to be taken into consideration. These factors include overall requirements, system design, equipment choice, and of no less importance, operator understanding and manner of use. To support the operations of the Queensland Fire & Rescue Service (QFRS), many base and repeater stations have been strategically located to provide coverage over a wide area. These networks have been designed to provide reliable communications for mobile units in primary response areas, and are linked to regional communications centres.

Which is the best frequency band to use?

Each frequency band has advantages and disadvantages, and the final choice will always be a compromise. The Very High Frequency (VHF) band suffers more from noise and interference than the Ultra High Frequency (UHF) band, which works better in high rise and underground locations. Depending on the frequency band used, radio waves may travel more or less in a straight line, similar to light waves. They may be reflected by some surfaces, or undergo refraction depending upon atmospheric temperature and humidity. The radio antenna size is an indication of the frequency band being used.

What is a radio channel?

A radio channel is the assigned frequency or frequencies for transmission and reception

What is the channel number on a radio?

This number is purely arbitrary. It is a reference number that is used to refer to the programmed band plan, listing assigned radio frequencies. Ideally the same channel number on two radios should indicate that their frequencies are the same, permitting communications to take place. This must not be assumed, unless it is known in advance, that radios are programmed to the same band plan.

What does the term simplex mean?

Commonly, simplex means that direct communication takes place between two talking parties, using a single radio frequency, with no intermediate relay or repeater station. This limits the range of communication, and so this mode is usually reserved for localised incident or fireground operations. Hand held portable radios are intended primarily for simplex use.

What does the term duplex mean?

Duplex communication describes the situation where transmission and reception occur at the same time, and cellular telephones are a good example of this. Commonly, duplex refers to the operation of an intermediate piece of equipment called a 'Talk Through Repeater' or TTR, which receives on one frequency and transmits simultaneously on a different frequency. Communications between mobile radios on such a 'duplex channel is therefore not possible without a repeater, because of the different receive and transmit frequencies. The QFRS uses such a method for mobile communications that is more correctly called half-duplex, or semi-duplex. This is because a mobile radio transmits when the 'Press to Talk' (PTT) switch on the microphone is depressed, and receives when it is released.

What is mobile voting?

In an area wide radio system, base stations at different locations transmit the same information, simultaneously, on different frequencies. When a 'voting' channel is selected on a mobile radio, it scans and votes for the base station with the strongest signal, then ensures communication takes place through that base station, until the mobile radio detects that another base station has a better signal. This ensures that the mobile unit is always operating on the best available channel, unless a non-voting channel is selected.

What is a voting channel?

A voting channel or group is a collection of normal channels between which the radio automatically passes and votes for the best on which to communicate. This allows the mobile units to roam over a larger area than usual, without having to manually change channels. There are different voting groups for different areas and regions.

How can cellular phones work where two-way radio does not?

Mobile units attempting to communicate may have selected the incorrect channel for the area or region. There also may not be any supporting two way infrastructures in the vicinity, whereas there may be a cellular telephone station quite close. As cellular telephone networks are commercially operated, there is usually a large number of low power base stations in densely populated areas, but the cost to provide a similar network for mobile two way radio would be prohibitive. However, for the less densely populated areas, the reverse situation sometimes applies when the QFRS networks will work but the cellular network will not. The QFRS works on different frequency bands from that chosen to suit the cellular telephone networks.

What can I do if I am told that my transmission is 'breaking up'?

Assuming that the radio, including antenna and battery is fully serviceable, try moving position. Moving a distance of only half a metre to several metres can improve the signal strength. This applies to vehicle mounted and hand held radios.

It is important not to shout or scream into the radio's microphone. Speaking in a normal voice with the microphone around 100 mm from the mouth is a good guide. This distance should be adjusted depending on the normal speaking level of the operator. A good technique is to usually hold the microphone with your thumb against your cheek and speak across the microphone. In a noisy environment, the microphone can then be angled around and spoken straight into, reducing background noise.

What can I do if I cannot talk to another unit within sight?

Assuming that the radios are identically programmed and fully serviceable, check that the radios both have the same simplex channel selected, then communication should be possible. Choosing a duplex channel within close range can cause communication difficulties, particularly when the repeater is a fair distance away. (as a guide, greater than 10km.)

What can I do if my hand held radio cannot get through to the communications centre?

Use the vehicle-mounted radio, as this has greater transmission capability. Hand held radios should be confined to communications at or around an incident scene, using a simplex channel.

What can I do to improve hand held radio coverage in a high rise building?

Try moving close to a window or a stair well, as concrete and steel structures absorb radio waves. If a duplex channel is being used, try using a simplex channel. If a simplex channel is being used and a repeater station is close by (as a guide, less than 3 km.), choose the duplex channel to access that repeater, then this should improve communications.

Familiarisation with the standard radio band plan should help in choosing the most appropriate channel for the coverage area required. If you are transferred to another station or area, re-familiarisation is then required.

If I had a voice operated switch (VOX) attachment; this would give me hands free operation.

This is true, but there are other considerations. VOX attachments work best in a very quiet environment, where there is no noise to cause VOX to operate when it should not. If a VOX unit 'locks up', which is very common on firegrounds, the radio channel then becomes unusable. There are special manually operated 'mushroom button' type press to talk switches which can be easily operated with gloved hands, and are preferable to the use of VOX.

PHONETIC ALPHABET

When using radio or telephonic means to pass information there are times when radio conditions can make the reception of simple words difficult to understand. Certain words such as chemical names and acronyms may prove difficult to pronounce or the sender may need to ensure the correct spelling is received. The International Phonetic Alphabet listed below is used when the normal method of spelling is unsuccessful or unsuitable.

Alpha		November
Bravo		Oscar
Charlie	Papa	
Delta		Quebec
Echo		Romeo
Foxtrot	Sierra	
Golf		Tango
Hotel		Uniform
India		Victor
Juliett		Whiskey
Kilo		Xray
Lima		Yankee
Mike		Zulu

TWENTY FOUR HOUR CLOCK

The Twenty-Four Hour Clock system is used to automatically differentiate between AM and PM.

Examples of the Twenty-Four Hour Clock are:

Time	24 – Hour Clock	Transmission
12.08am	0008 Hours	Zero Zero Zero Eight
09.00am	0900 Hours	Zero Nine Hundred
10.30am	1030 Hours	Ten Thirty
12.08pm	1208 Hours	Twelve Zero Eight
09.00pm	2100 Hours	Twenty One Hundred
10.30pm	2230 Hours	Twenty Two Thirty

QFRS staff use the system for all phone and radio transmissions of time to reduce the risk of error. Fire Communications Officers also use the Twenty-Four Clock time to end radio transmissions.

GLOSSARY

Aerial	WIRE WHIP OR ROD CONNECTED TO A RADIO TO TRANSMIT OR RECEIVE RADIO WAVES
AFcom	Ambulance & Fire Communications Centre (Brisbane)
Antenna	A device used on a vehicle or building to radiate a transmitted signal and to receive a signal
Base Radio	High powered radio used in communications centre
CAD	Computer Aided Dispatch
Call Sign	Name allocated to all two-way radios
Channel	An identifier of the radio frequency/frequencies assigned for transmission and reception
CO	Communications Officer in the Firecom Centre
Duplex	Communication through an intermediate piece of equipment (TTR) which receives on one frequency and transmits simultaneously on a different frequency. (*more correctly called semi-duplex*)
Encoder/decoder	encode (or decode) a series of audio tones which may be used to activate a pager on the radio system
ERS7	Emergency Reporting System (Telstra system)
Facsimile	Device, which scans and transforms data into coded signals, which are, transmitted electronically (via telephone/radio system) to a similar device, which decodes and prints.
FAX	Facsimile
Firecom	Fire Communications Centre
FIX	Fire fighters intercept telephones (in ERS)
HF	High Frequency (radio frequency)
Interference	Any unwanted signal at the output of a radio receiver.
Mobile Radio	Vehicle-mounted two way radio
Pager	Compact pocket or belt carried radio receiver, provides one way communication
Phonetic Alphabet	System of spelling clearly, internationally recognised word for each letter of the alphabet
Pico-cell	Trade name – pico = small . Indicates small transmission radius.
Portable Radio	Completely self contained radio, easily carried from one position to another
Pro-word	Standard communication words which have an accepted meaning(see Standard Radio Procedures Guide)
Radio Frequency	The number of cycles per second, unit of measurement is Hertz(Hz)
Radio Network	Two or more radios working on the same frequency in order to communicate with each other
RCU	Remote Control Unit
Repeater	A fixed station which receives and resends radio communications automatically
RX	Receive/Reception
Simplex	Direct communication between two parties using a single radio frequency; no intermediate relay or repeater.
Selcall	Unique numerical code transmitted to radio hardware.
Squelch	A system for removing unwanted background noise from the speaker
Transceiver	Radio with both transmitter and receiver (known as a two –way radio)
Transmit	To send a message via a two way radio
TTR	Talk through repeater. Receives on one frequency & transmits simultaneously on different frequency.
Two-way Radio	Radio which is able to transmit and receive

TX	Transmit/Transmission
UHF	Ultra High Frequency (radio frequency)
VHF	Very High Frequency (radio frequency)
Voting	Radio selects and uses the strongest signal available at the time