CODE OF PRACTICE FOR THE PAIRING OF VHF AERONAUTICAL STATIONS TO VHF OR UHF LAND MOBILE RADIOS

'Best practice' recommendations for interconnection of services between VHF Airband (AB) and Land Mobile Radio (LMR) systems

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Code of Practice for the pairing of VHF Aeronautical radios to VHF or UHF Land Mobile Radios.

This code of practice has been developed by the Australian Radio Communications Industry Association (ARCIA), both the Australian Communications and Media Authority (ACMA) and Air Services Australia (ASA) were consulted during the development of the code. The code is designed to provide information for regulators, airlines and communication industry members on a standard interface format for interconnection of radios.

Guiding Principles

VHF Aeronautical (AB) frequencies and networks are a critical part of aviation networks in Australia. Protection of these networks in particular from interference is paramount for the safe operations of Aeronautical networks. This code of conduct is intended to maintain the expected protection of VHF Aeronautical frequencies and networks in Australia.

All Radio Frequency (RF) equipment has the potential to cause interference and this Code of Conduct serves to highlight suitable standards for all RF equipment used in airports.

The Code of Conduct does ***NOT*** permit (under normal operational circumstances) equipment to be connected in this format for other than provision of 'Ground service facilities' at any airport, it must not be used for any form of Flight Operations.

1. Purpose.

The aim of this document is to give a guideline for the interconnection of a VHF Airband radio service to a Land Mobile Radio service, either VHF or UHF. In several locations this type of service is used to extend the availability of 'Ground to Air' communications for management personnel located within airport terminals where radio coverage on AB is poor, or locations where an airport is not permanently manned but contact needs to be available for support services.

The potential for impact on aviation services caused by interconnection to VHF AB services is greater at high demand locations. Similarly the potential for interference is greater in locations with a higher density of RF transmitters. The parties to this paper believe that all locations should have a similar standard of engineering for all RF systems in order to protect the integrity of the aviation network.

This code of practice has been prepared in accordance with the general guidelines set by others, to differentiate locations as either Tier 1 or Tier 2 as follows –

Tier 1 locations – Adelaide, Alice Springs, Avalon, Ayers Rock, Brisbane, Broome, Cairns, Canberra, Coolangatta, Darwin, Hamilton Island, Hobart, Karratha, Launceston, Mackay, Melbourne, Perth, Port Headland, Rockhampton, Sunshine Coast, Sydney, Townsville, Newman, Gladstone & Coffs Harbour.

Tier 2 locations - all other airports or locations outside of the Tier 1 terminal areas as mentioned above.

From a security of communications perspective there are two areas to be addressed, personnel who may access the system (who need to be appropriately trained and authorised) as well as the electronic protection to ensure no improper communications are transmitted on the Aeronautical system. This is achieved by limiting the access to the interconnection by transmitter coding or using dedicated frequencies for the LMR service. The LMR service must also be designed in such a way that inadvertent access is not possible, fault conditions cannot cause the VHF Airband radio to transmit and the system must be capable of easy disconnection in the event of a fault condition.

Consideration must be given to the antenna systems with proper cabling and antenna mounting methods employed, as well as suitable filtering in the antenna circuits to ensure that neither the Airband or LMR receivers are degraded in performance, plus other nearby services neither suffer from interference or any degradation of receiver performance. The system design of the interconnect configuration should include transmit time-out-timers (TOT) for both services as well as ensuring that no external factors can operate the system.

Under this Code NO access to AB systems from external services without control measures in place or connection to 'common use' frequencies such as UHF CB or Amateur Radio networks is allowed. In addition CASA Regulations determine the requirements for permission to transmit on an Aeronautical frequency. The systems shall NOT be used for any form of flight operations, only for legitimate 'Ground-to-air' communications.

2. Interconnect principles

The following principles should be complied with for installations at Tier 1 locations, for Tier 2 locations the principles may be varied dependent on local conditions, however, it is good practice to maintain the standards at all locations if possible.

- Any connection to an AB system must include a "bridge" device (Omnitronics 619DSRI for example) or similar device that provides an isolated audio connection between the AB equipment and LMR or similar equipment.
- The bridge would ideally be mounted in the same location as the AB equipment such that in the event the connection needs to be disabled a suitably qualified technician can identify and disable the physical connection between the bridge and the AB equipment.
- The AB equipment or the bridge device must contain a Time out Timer (TOT) mechanism, set to 60 seconds, such that regardless of any PTT instruction received from third party LMR equipment or fault condition the AB radio will have its transmitter disabled after 60 seconds.
- The operation of the interconnection is to provide important Ground to Air communications, not for general LMR radio traffic. The bridge or interconnection device should be installed in such a fashion to prevent unwanted traffic on AB channels.

3. Engineering practices for the interconnection installation.

1) Interface system

a) Any connection to an AB system must include an isolation device (for example: audio bridge) to provide isolated audio connections between the AB radio and LMR equipment.
b) The interconnect system must be appropriately labelled for easy identification.
c) The isolation device would ideally be mounted in the same location as the AB equipment such that in the event the connection could be disabled by a suitably qualified technician.
d) The AB equipment or the bridge device must contain a Time out Timer (TOT) mechanism, set to 60 seconds, such that regardless of any PTT instruction received from third party LMR equipment or fault condition the AB radio will have its transmitter disabled after 60 seconds.
e) The operation of the interconnection is to provide important Ground to Air communications, not for general LMR radio traffic. The bridge or interconnection device should be installed in such a fashion to prevent unwanted traffic on AB channels.

2) Land mobile radio (LMR) system.

(a) The LMR system must be capable of being easily and simply disconnected from the interface device. Options for connection format to the bridge include-
- Connection to a dedicated LMR repeater
- Connection to a trigger radio or RF Control radio used to connect to an LMR conventional or trunked radio network

(b) Suitable bandpass filtering should be inserted into the relevant transmit and receive circuits to ensure that there is no impact on the sensitivity of the AB receiver. Diplexers and/or band-pass cavity filters should be used to provide proper protection of signals and on duplex systems transmit isolators are highly recommended.
(c) The interface to the LMR system must be done in such a manner to ensure that even under fault conditions the interconnection cannot lock the AB radio on transmit.
(d) LMR systems must take note of ACMA special licence conditions that include limits on out of band transmissions.
(e) The LMR radio system must be configured in order to prevent any form of 'in-band' signalling or audible tones to be passed to the AB radio for transmission. This is possible through the programming of most audio bridge devices.
(f) The interconnection of audio shall have minimal delays in order to minimise any risk of message confusion by missing words or syllables at the commencement of transmitted audio. This is possible through the programming of most audio bridge devices.
(g) The antenna system should be installed in such a way to ensure adequate radio coverage and not present any danger to personnel operating in the general area.
(h) The antennas should be installed in such a way to provide appropriate isolation from other antennas to minimise the potential interference through RF coupling. Antenna cables should be correctly terminated and all exposed connectors sealed with self-amalgamating tape, cables should be fixed in place as per manufacturers' guidelines and cable access points must be made weatherproof as required and designed to minimise any possibility of cables being damaged over time.

3) VHF Aeronautical radio (AB) system –

(a) The radio unit should be mounted in the same enclosure as the LMR radio with all wiring protected.

(b) Consideration should be given to the use of ferrite beads on external wiring connecting to the AB radio to minimise the risk of interference. Amplitude Modulated (AM) radios can generate audio and RF interference without special consideration of the unique issues involved.

(c) Suitable filtering should be inserted into the antenna circuit to ensure no impact on the sensitivity of the LMR receiver system. The standard requirements listed on the VHF Airband licence is - . Condition 6 "*Cavity filter - Transceiver/antenna*" notes that "*An efficient cavity filter must be fitted between the transceiver and the antenna*." Use of a Band-pass cavity filter is preferable.

(d) Antenna mounting requirements are as per paragraph 3.2 (h) above, plus consideration must be given to the location of the antenna with respect to other equipment and antennae on the site. If a new antenna is not being fitted, a close inspection of the existing antenna and cabling must be undertaken and any evidence of deterioration through ageing must be reported to the equipment owner with a recommendation that it be upgraded. Failure of any of the antenna components could cause interference to other services close by, especially other aeronautical services.

4) Common equipment requirements –

(a) Attention must be given to the antenna mounting locations as this can be a cause of degradation of performance of both the VHF AB radio as well as the LMR radio. Where both antennas are to be mounted on a single mast, there should be a minimum of two metres vertical space between the antennas. Where antennas are to be mounted in the same horizontal plane, either on a mounting rail on the roof of a building or on separate mounts attached to the building at the same level, it is preferable that there should be at least five metres and preferably ten metres between the antennas.

(b) Consideration must also be given to antenna mounting with regard to minimising any form of interference to other radio services at the location.

(c) It is preferable that all radio equipment be housed within one single enclosure.

(d) As the equipment is likely to be in an area not generally accessible to the public, or not under regular visibility, the equipment should be powered by –

- A protected power source as part of site 'no-fail' mains power network, or
- Be supplied with a battery back-up system capable of running the system for an extended period of time. The amount of time should be relative to the usage of the system and it is suggested a minimum of eight hours at locations which are manned during all business hours, or a minimum of twenty-four hours in other locations. There should be some form of monitoring system in place to identify to LMR users that the system is operating on back-up power.

(e) Documentation with clear instructions on system disconnection is required with the equipment.

(f) The enclosure should be clearly labelled on the front panel with details on the functionality of the equipment and the enclosure should be locked to prevent unauthorised access. If the equipment is located in a locked communications room or similar, then the requirement to lock the enclosure can be disregarded.

4. Security of communications.

1) Personnel security access

(a) Only authorised personnel shall be permitted to communicate via any of the paired radios outlined in this document for communications with an aircraft.

(b) It should be noted that a person may operate an aeronautical station only if they are qualified to operate the station in accordance with the Civil Aviation Regulations and the relevant Civil Aviation Orders made under the Civil Aviation Act 1988 or any subsequent determinations.

(c) Access controls should be in a place such that only authorised maintenance personnel have access to the system to prevent unauthorised system changes and unauthorised frequency changes.

2) Security access at an equipment level –

Special note – It is essential that any LMR equipment connected to VHF AB radios shall contain provision to prevent unintended or unauthorised operation.

(a) The physical connection between the Aeronautical (AB) and VHF/UHF Land Mobile Radios (LMR) radios should include some form of coding prior to the radios being connected, this could include one or more of the following options –

- A digital or tone-squelch code within the LMR radio that is NOT common to other radios on that LMR frequency,
- A defined 'talk-group' code within any trunked radio network, where incoming communications from the AB communications network are broadcast on a suitable code over the LMR network, but only on selection of a dedicated code will the connection from the LMR to AB radios be activated
- A selective-call coded signal that requires operation of specific key tones to activate the interconnect

Note – the interconnection of the audio circuits to the AB transmitter shall only remain active for as long at the LMR unit is receiving, closure of the mute on the LMR unit shall immediately release the Press-To-Talk (PTT) function of the AB radio

(b) The wiring for the interconnection facility shall be enclosed within either the LMR unit or an associated housing which is neither easily accessible to un-skilled personnel and also has no open wiring connections.

(c) The interconnect wiring must be capable of being un-plugged to disconnect the interface and any open connections associated with the AB radio must not be capable of easily initiating the AB radio PTT function.

(d) It is preferable that both the LMR system and the AB radio interface have Transmit limit timers (TOT), with a maximum time limit of no greater than sixty (60) seconds. These requirements are to ensure that the LMR radio cannot inadvertently lock the AB radio on transmit.

(e) All radio units shall be licenced under the relevant ACMA licencing systems. Under **NO** circumstances shall the LMR radio be any form of radio that operates on 'common access' frequencies such as UHF CB, VHF Marine radio channels or any other services which operate under ACMA Class Licence or Spectrum Authorisation categories.

5. Licence conditions.

At present all licences for VHF Airband ground-based services have the following condition - as a prerequisite for endorsement Accredited Persons been directed by ASA to include Special Condition 6 on all such licenses. Condition 6 "*Cavity filter - Transceiver/antenna*" - "*An efficient cavity filter must be fitted between the transceiver and the antenna*."

The following should also be considered -

a) It is essential that both services involved are correctly licenced and that the licences contain all of the relevant information applicable to the services.
b) As indicated above, it is expressly forbidden for the LMR radio to be operating on either a 'Class Licence' or 'Spectrum Authorisation' format, the radio must be part of a fully licenced VHF/UHF service.
c) The relevant licence AB documentation should carry an annotation that the service is part of a 'Paired connection' with licence number xxxx (where the xxxx indicates the actual licence number of the other service involved).
d) Where a dedicated LMR frequency is being utilised for the service it would also be preferable that the relevant licence is annotated similarly. This is not possible with LMR trunked radio systems.

Document history			
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