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TECHNICAL MONOGRAPH

The Future of the FM Broadcast Band 100 to 108 MHz

Review of FM Broadcasting and Aeronautical Service Coordination Issues

**Licensing Unit
Radio Spectrum Management Group**

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1 Introduction

- 1.1 This document discusses the coordination aspects between proposed FM broadcast service (FMBC) assignments in the 100 to 108 MHz band and existing aeronautical radio navigation services.
- 1.2 The proposed FMBC services were identified in the document, "[Future of the FM Band](#)", dated August 2001, recently released by the Radio Spectrum and Broadcasting Policy Group to seek feedback from interested parties.
- 1.3 The new broadcasting band is adjacent to the 108 to 112 MHz band which is used for critical aeronautical navigational services at major airports. Emissions from those broadcasting services can cause harmful interference to the navigational services, which can endanger air travel safety if appropriate coordination is not undertaken.
- 1.4 The aeronautical navigation services in the band 108 to 112 MHz are Instrument Landing Systems (ILS) and the VHF Omnidirectional Range (VOR) systems. The ILS services provide accurate landing approach information at key airports, allowing aircraft to fly in line with runway centrelines and to within 200m vertically and some 1200m horizontally of runway thresholds. The VOR services provide bearing and distance information for aircraft to navigate between widely separated airports, particularly in low visibility. Thus ILS is critical to aircraft when landing and VOR is critical to aircraft to avoid straying from flight paths between airports.

2 FMBC Planning Issues

- 2.1 The planned allocations of FMBC services in the 100 to 108MHz band noted in the discussion document "[Future of the FM Band](#)" are:
 - public broadcasting services in the band 100 to 106.6 MHz;
 - low power broadcasting services in the band 106.6 to 107.4 MHz; and,
 - a [General User Radio Licence \(GURL\) for Short Range Devices](#) (low power) in the band 107.4 to 108 MHz.
- 2.2 FMBC frequency allocations are made on the basis of a 100 kHz channel plan, with assignments for co-sited stations spaced 800 kHz apart and other stations separated both physically and in frequency to minimise mutual interference and maximise coverage. FMBC assignments are recorded in Area Block and Group Plans.
- 2.3 Transmit power levels used by commercial FMBC stations are normally higher than most other radio services and often 1000 times those used in adjacent areas of spectrum. Such high power signals can cause blocking and desensing in the receivers on frequencies close to that of the transmitters (adjacent channels) and also drive those receivers into non linearity causing intermodulation.
- 2.4 Past experience with the introduction of medium and high power FMBC stations located in the central city areas has identified that harmful interference was experienced by many mobile users in the A band (81 to 88MHz). That interference problem was resolved by limiting the FMBC transmitter powers and by moving users to A band channels not experiencing interference or to new bands elsewhere in the spectrum. Such disruption would not be acceptable by aeronautical navigation services the 108 to 112 MHz band because of safety of life issues.
- 2.5 Existing FMBC and ILS/VOR services have been developed with sufficient frequency spacing between them to allow the frequencies for each to be selected relatively independently and with minimal coordination requirements. The use of the

100 to 108MHz band for FMBC stations means that the spacing is no longer sufficient to avoid detailed coordination processes.

- 2.6 In regard to low power and [GURL FMBC](#) stations, experience has indicated that occasionally operators have raised transmit power levels above the licensed limit. Where such cases have been discovered, appropriate compliance action has been taken. However, such illegal action in or near ILS/VOR Designated Operational Coverage (DOC) areas can lead to a reduction in the safety margins of the ILS/VOR services before regulatory action can be taken and may allow possibly dangerous situations develop. Other actions are therefore needed to ensure that operators in those low power bands clearly understand their responsibilities and associated consequences.

3 Aeronautical Services Planning Issues

- 3.1 The band 108 to 117 MHz is one of a number internationally designated for use by ILS and VOR aeronautical services throughout the world. New Zealand, in complying with its responsibilities as a signatory to the Conventions of the International Telecommunications Union Radio Regulations, will adhere to those designations.
- 3.2 Historically, the assignment of ILS and VOR frequencies has been made by the Civil Aviation Authority (CAA) and licensed by RSM. The assignments have been and will continue to be made on the basis of rules noted in "Aeronautical Telecommunications, Annex 10 to the Convention on International Civil Aviation" (ICAO). The assignment frequencies are documented in international aeronautical navigation publications.
- 3.3 ILS and VOR services in New Zealand use only eight 25 kHz allocations in the 108 to 112 MHz aeronautical band and 19 in the 112 to 117 MHz band. This results in a bandwidth spectrum utilisation of 7.5% which, in comparison with the almost 100% utilisation achieved in many areas, e.g., the 88 to 100 MHz FMBC band, is very low.
- 3.4 CAA has advised that current ILS/VOR services are expected to remain in service until 2010 and more likely until 2015, and that growth in those services is expected to be minimal. The services are likely to be replaced by global navigation satellite services, possibly Ground Based Augmentation Systems (GBAS).
- 3.5 The advent of GBAS systems will still require access to the 108 to 117 MHz band for use with calibration beacons. The coordination aspects between the FMBC and the GBAS beacons are now under study and early indications show a greater degree of compatibility than exists with the current systems. CAA proposes to use the higher frequencies in the 112 to 117.95 MHz band for GBAS calibration beacons initially and this will reduce coordination issues for FMBC.
- 3.6 The ILS and VOR receivers currently used in New Zealand include those that comply with the Montreal receiver standard and the newer, better performing ICAO Annex 10 1998 receiver standard. New Zealand is one of only a few countries that have not mandated on the use of the ICAO 1998 receiver type for all aircraft. CAA have "filed a difference" to that effect in accordance with the provisions of ICAO.
- 3.7 A comparison of some aspects of the performance of the Montreal and ICAO 1998 receiver types can be seen in the graphs in Attachment A2.
- 3.8 Coordination of FMBC and ILS/VOR services is normally undertaken on a per FMBC licence basis using a coordination distance defined as the minimum distance between an airport DOC area and an FMBC station.

- 3.9 DOC areas generally conform to ICAO standards. However, where these cannot be implemented due to local conditions, CAA can adjust the DOC area to ensure air safety is maintained. Wellington airport ILS DOC area is considerably non-standard and the CAA through ICAO has promulgated its details.
- 3.10 In areas remote from airports VOR services can be compromised by potential and real harmful interference from FMBC services, e.g., near major transmitter sites accommodating several high power FMBC services. Such interference needs to be taken into account, particularly for FMBC stations operating in the upper end of the 100 to 108 MHz band.
- 3.11 While it is theoretically possible to identify Minimum Separation Distances for air traffic using VOR facilities near large FMBC stations, discussions with CAA would be required before FMBC proposals can be finalised.

4 FMBC and ILS/VOR Frequency Selection

- 4.1 The coordination issues for medium and high power FMBC stations close to the ILS/VOR services band can be eased by the appropriate selection of FMBC, ILS and VOR frequency assignments, that is;
- by separating FMBC and ILS/VOR frequencies to the extent possible by moving ILS/VOR assignments to the upper part of the 108 to 112 MHz band;
 - by ensuring all VOR assignments are above 112 MHz; and,
 - by ensuring that FMBC, ILS and VOR intermodulation (IM) products in ILS/VOR receivers do not coincide with wanted ILS or VOR frequencies. For example, if FMBC assignments near ILS installations are made on even 100 kHz allocations (e.g., 98.2, 99.4, 106.2 MHz) their IM products would fall at even 100kHz frequencies. To minimise interference to ILS services, the ILS allocations could be made on odd 100kHz spaced frequencies (e.g., 110.1, 110.3 MHz). (IM can occur in the presence of high level signals and is discussed in [Attachment 1](#) to this report.)

5 Coordination Processes

- 5.1 Until the recent availability of the 100 to 108 MHz band for FMBC stations, FMBC - ILS/VOR coordination requirements were relatively simple because of the wide frequency separation between the bands. The planned use of frequencies above 100 MHz requires a more comprehensive coordination methodology. That methodology is to be based on the use of ITU-R SM. 1009-1 (1009) methods.
- 5.2 The methodology is dependent on the knowledge of the characteristics of all the services close in frequency and distance to the aeronautical DOC areas for both ILS and VOR services, and in particular;
- Transmitter powers of all local FMBC, ILS and VOR services;
 - The distances from the point of coordination (any aircraft ILS/VOR receiver in a DOC area) to each of the transmitters for those services;
 - The frequencies of each of the services, their associated bandwidths and the separation of the FMBC frequencies from the ILS/VOR frequencies;
 - The characteristics of the aeronautical receivers, particularly receiver selectivity, sensitivity and IM, and antennas; and,
 - The received signal levels required by the aeronautical services throughout the DOC areas, as designated by ICAO.

- 5.3 The large number of possible combinations of these parameters ensures that coordination outcomes are unique for each point of coordination and that the formulation of an entirely automatic coordination process would be costly.
- 5.3 The recommendation 1009 identifies four types of interference that need to be considered for aeronautical navigational service receivers. These are:
- **Type A1**, i.e., unwanted emissions generated remotely from an ILS/VOR receiver. These are generally IM products that are minimised by the use of effective construction practices at transmitter sites. Normal levels of unwanted emissions separated by more than 200 kHz from any ILS/VOR frequency are not considered significant. High levels of co-channel emissions require individual investigation and eradication.
 - **Type A2**, i.e., spurious emissions that may be due to FMBC or other transmissions close to 108 MHz. Since these emissions are normally low level more than 200 kHz from an FMBC frequency and the lowest ILS/VOR frequency used in New Zealand is more than 300 kHz above 108 MHz, these emissions need not normally be considered.
 - **Type B1**, i.e., IM products generated within the aeronautical receivers due to high levels of FMBC signals. The use of appropriate frequency plans for aeronautical and FMBC services can minimise the possibility of these IM products. To achieve this new FMBC stations must be planned by the appropriate choice of frequencies and power levels to avoid interference. Generally only third order IM products are considered ($2f_1-f_2$ and $f_1+f_2-f_3$). This type of interference is potentially the most likely cause of FMBC interference to ILS/VOR services but can be avoided by the selection of FMBC and VOR frequencies that can produce IM products that do not coincide with the ILS/VOR frequencies. In practice there are other factors behind the choice of frequencies that may preclude the possibility of adjusting them to minimise interference. If type B1 interference is avoided, type B2 becomes the significant potential interference source.
 - **Type B2**, i.e., desensitisation of the aeronautical receiver front end due to high levels of FMBC signals. Desensitisation can be a key issue for aeronautical receivers in ILS DOC areas close to major FMBC sites and careful consideration is required before allowing new high power FMBC stations at these sites.
- 5.4 Recommendation 1009 identifies formulae for the determining radio interference margins (effectively operating safety margins) for both Montreal and 1998 ICAO aeronautical navigation receiver types. Those for the Montreal receiver are the more conservative and are currently used in New Zealand for determining A1, A2 and B1 interference potential. For B2 interference, calculations should be completed for both receiver types and the lower permissible broadcast signal level used.
- 5.5 The 1009 coordination method involves the comparison of actual FMBC and ILS/VOR signal levels at the nearest point of a DOC area to an FMBC station. In New Zealand actual test point ILS signal levels can be obtained from Airways Corporation who undertake testing on the DOC areas on a regular basis. Alternatively, an estimate based on transmitter power and antenna radiation pattern data can be used. (Use of the latter method must take account that eirp levels for emissions 10° and 35° off ILS antenna azimuths are 0.6 and 6.2dB below transmitter maximum eirp (licence) level, respectively, for typical civilian installations. The minimum usable receive signal levels required are $32\mu\text{V/m}$ for ILS and $39\mu\text{V/m}$ for VOR receivers.)

- 5.6 As noted above, coordination of FMBC and ILS/VOR services is normally undertaken on a per FMBC basis and at the point of an airport DOC area closest to the proposed FMBC station. Coordination on this basis does not necessarily encompass the worst interference situation for a proposed new FMBC station and interference margins for the whole of the DOC area must be determined taking into account all FMBC and ILS/VOR transmitters that have line of sight to the DOC volume. This process will be time consuming and difficult to automate. It is currently planned to implement a shorter process that requires the maintenance of records of the calculations (spreadsheets) completed as FMBC stations are introduced. As each new FMBC station is proposed, its the impact of the interference margins of existing FMBC stations in the area will need to be recalculated. To facilitate this process a new spreadsheet is being developed.
- 5.7 The 1009 calculations produce interference margins for individual interferers. To ensure accurate coordination the summation of the individual margins is required. (1009 Annex 3 refers).
- 5.8 The 1009 recommendation is based on practical measurements and provides formulae to determine coordination margins. It provides generally conservative solutions.

6 General Coordination Issues for FMBC Use of the 100 to 108 MHz Band

- 6.1 The assignment of new FMBC services in the 100 to 108 MHz band will require consideration of:
- policy requirements and market demand;
 - existing FMBC block and group allocation plans, sites, transmit power levels and RCL MPIS levels;
 - existing co-siting arrangements and limitations;
 - licence and physical details of local ILS and VOR assignments, and associated coordination requirements; and,
 - whether FMBC - ILS/VOR interference margins are acceptable, and if not, can contractual arrangements that can be made to change existing FMBC and aeronautical services arrangements.
- 6.2 As a general guide to the sensitivities of ILS/VOR receiver interference margins graphs have been determined using 1009 methods. These graphs are included below as Attachments A2-1, A2-1 and A2-3
- 6.3 Interpretation of those attachments can show that, for example:
- from [Attachment A2-1](#), a 106 MHz FMBC transmitter, with an eirp of 47dBW, needs to be more than 120km from an aircraft Montreal receiver to avoid contributing to B1 IM products in that receiver;
 - from [Attachment A2-2](#), the same FMBC transmitter needs to be more than 28km from a Montreal ILS/VOR receiver to avoid triggering B1 IM in that receiver; and,
 - from [Attachment A2-3](#), the same FMBC station needs to be only 0.6 km from an aircraft receiver to avoid causing B2 interference in that receiver. Note that this indicates that the Desensing interference (B2) potential is likely to be much less of a coordination issue than B1 IM interference.

(With regard to B1 IM interference, harmful interference will occur only if part of the IM product frequency band is in the wanted ILS frequency band.)

- 6.4 The current proposal to allocate the 106 to 107.5 MHz band for low power FMBC stations and a GURL band between 107.4 and 108 MHz will significantly assist with the maintenance of coordination margins for ILS/VOR services in most cities and towns remote from major airports. However, there will be a need to ensure that all significant FMBC sites housing new higher powered FMBC stations above 100 MHz are identified to and discussed with the CAA with regard to the possible need for Minimum Separation Distances for ILS/VOR equipped aeroplanes.
- 6.5 In addition, there are a number of domestic airports serving provincial cities that utilise VOR services for approach guidance during landing. These services will need to be considered when new FMBC stations above 100 MHz are being proposed. Discussions on coordination margins will need to be reviewed with CAA if changes from the current margins are significant.
- 6.6 Experience overseas suggests that the appropriate allocation of ILS, VOR and FMBC frequencies will allow reasonably high powered FMBC stations to operate within the standard ILS/VOR DOC areas without compromising air traffic safety.
- 6.7 Particular coordination issues for RSM include:
- the training of Licensing staff in the FMBC/Aeronautical coordination requirements;
 - the need for discussions with FMBC clients on coordination matters for those wishing to make use of the 100 to 108 MHz band;
 - the need of discussions with CAA regarding possible changes to ILS and VOR assignments; and,
 - the need of discussions with CAA regarding the continued use of Montreal receivers.

7 Coordination Issues at Auckland

- 7.1 There are two major airports in Auckland, Whenuapai and Auckland (Mangere), for which FMBC and ILS/VOR coordination is required. The ILS DOC areas requiring significant coordination are:
- the eastern approach for Auckland (Mangere) airport, which is aligned between Manurewa and Papatoetoe; and,
 - the eastern approach to Whenuapai airport, which is aligned over Northshore.
- 7.2 Central Auckland has 16 medium and high power FMBC stations located at Skytower use frequencies spaced 800 kHz. Skytower is some 3km from the nearest point of the Whenuapai eastern approach ILS DOC area. The most recent FMBC assignment at Skytower (on 104.6 MHz) was restricted in transmitter power to 39dBW eirp to meet coordination requirements for the Whenuapai ILS DOC area.
- 7.3 There are also currently 5 other low and medium power FMBC sites within line of sight of Skytower that need to be included in FMBC/ILS/VOR coordination for the local airports. These are Waiatarua, Eden House, Waiheke, Albany and the Te Runanga O Ngati Whatua site at Shakespeare Regional Park.
- 7.4 The new public FMBC stations proposed in the document "Future of the FM Band" will probably include assignments in central Auckland, possibly at or close to Skytower. Available frequency assignments for these in the current Skytower Block and Group plan are 100.6, 101.4, 102.2, 103, 103.8, 104.6, 105.4 and 106.2 MHz. However, due to the close proximity of the Whenuapai airport landing approach the transmitter power associated with the use of these frequencies will be limited to lower levels than may have been expected.

- 7.5 The location of new medium and high power FMBC services in the 100 to 108 MHz band anywhere in the Auckland area will require careful coordination to optimise use of the band and the maintenance of airport landing safety margins.

8 Coordination Issues at Wellington

- 8.1 The one airport in the Wellington area that is equipped with ILS/VOR services is located at Kilbirnie. The airport has a southern approach over the sea and a northern approach that is close to and over several FMBC transmitter sites, i.e., Kaukau, Towai, Fitzherbert, Haywards, Tinakori Hill, Porirua and Baxters Knob.
- 8.2 The airport ILS DOC area, as noted earlier in this report, is not standard. A plan of that DOC area is held by the RSM group.
- 8.3 The main FMBC transmitter site, Kaukau, is particularly close to the ILS DOC area (i.e., less than 3km which means within the DOC area under 1009 analysis rules) and any additional assignments there above 100 MHz are likely to require intensive engineering and power restrictions.
- 8.4 The situation in Wellington is complicated by the need for FMBC repeater stations so there is little room to change frequencies. Supplementary coverage of Towai will also need stringent engineering. There may also be a need to reduce the transmitter powers on Mt Kaukau and Towai and increase the power at Baxter's Knob and Forest Heights to maintain coverage.

9 Coordination Issues at Christchurch

- 9.1 There are two airports in the Christchurch area, Wigram and Christchurch International. Only Christchurch International is equipped with ILS/VOR services and is located 12km west of the city. The airport has a north-eastern approach over the Belfast area and a south-western approach over the Rolleston area, both are serviced by ILS. Neither of these approaches are close to the main FMBC site at Sugarloaf.
- 9.2 The airport ILS DOC area is a standard configuration as per ICAO Annex 10.
- 9.3 There are currently no ILS/VOR - FMBC coordination issues as the frequency and distance separation are adequate. However, the introduction of new FMBC stations in the 100 to 106 MHz band will significantly alter that situation and care will be required to ensure harmful interference to ILS services does not occur. IM projections based on the proposed Sugarloaf FMBC frequency plan and the current ILS/VOR frequencies suggest that restrictions will be needed on new FMBC transmitter levels.

10 Coordination Issues at Dunedin

- 10.1 There is one airport near Dunedin equipped with ILS/VOR services. This is located some 25km south-west of the city and remote from major FMBC sites. The airport has a southern approach over the Milton area and a northern approach west of the Mosgiel area. Neither of these approaches is close to the main FMBC site at Mt Cargill. Both are serviced by ILS with standard DOC area configurations.
- 10.2 While the geography of Dunedin makes the coordination requirements less stringent than the other centres, care will be needed in the setting of the power levels for the frequencies above about 104 MHz.

11 Conclusions and Recommendations

- 11.1 The coordination of ILS/VOR and FMBC services is a major safety issue for CAA, RSM, air traffic and FMBC operators, and must be properly determined prior to the expansion of new FMBC services.
- 11.2 The avoidance of interference into ILS/VOR receivers in the DOC areas and the determination of minimum safe distances around major FMBC stations requires careful coordination and agreement from CAA and the principal FMBC station owners. That coordination is to be facilitated by RSM.
- 11.3 It is likely to be beneficial to all parties involved for RSM to arrange open forums in which coordination issues can be discussed and implementation plans made to optimise the use of the 100 to 108 MHz band.
- 11.4 Such forums should discuss the possibility of re-assigning ILS/VOR frequencies, the associated costs and the allocation of responsibility for those costs. The forum should also discuss the need to standardise on the use of 1998 ICAO Annex ILS/VOR receivers.
- 11.5 Experience overseas suggests that the appropriate allocation of ILS, VOR and FMBC frequencies will allow some reasonably high powered FMBC stations to operate within the standard ILS/VOR DOC areas without compromising air traffic safety.
- 11.6 There are particular coordination issues with the establishment of new FMBC stations above 100 MHz at Auckland and Wellington, and their establishment in other areas of New Zealand will also require care.
- 11.7 To facilitate more efficient coordination processes, new procedures will be required for FMBC licence assignment engineering.
- 11.8 In spite of the years of study by ITU member countries there are concerns that the coordination process 1009 is not adequate and may be too conservative. A more complete study of overseas coordination methods may be appropriate, to determine whether they can allow high power FMBC in ILS DOC areas when the 1009 process indicates otherwise.

Attachment A1

Intermodulation (IM)

A1-1 IM occurs when two or more signals mix together to form new signals of different frequencies.

A1-2 IM products can occur in a receiver when a high level receive signal, i.e., a level above the 'trigger' level, overloads the receiver's input to the extent that the receiver becomes non-linear. A receiver operating in its non-linear zone will cause 2, 3 or more received signals to mix together to form new frequency components that can interfere with the wanted signal.

A1-3 Theoretical IM analysis identifies that the bandwidths of third order IM products should be the addition of the individual components, e.g., the bandwidth for $2f_1-f_2$ and $f_1+f_2-f_3$ IM products of FMBC signals should be 768 kHz. This suggests that because co-located FMBC services are spaced 800 kHz apart, and if all available FMBC assignments are being utilised, there will be no gaps in the IM spectrum in the 108 to 112 band. In practice, test results indicate that the bandwidths of FMBC IM products are likely to be up to twice the bandwidth of a typical FMBC signal and that there are clear gaps between the individual IM products into which the narrow bandwidth ILS/VOR assignments can be made.

A1-4 Further consideration suggests that IM products resulting from intermodulation between FMBC and local ILS/VOR signals will reduce the gaps in the IM spectrum if the ILS/VOR assignments are chosen without care. Specifically, the VOR frequency must be above the ILS frequency to ensure that ILS IM products do not include the VOR signal.

Attachment A2

Graphs Illustrating Coordination Challenges

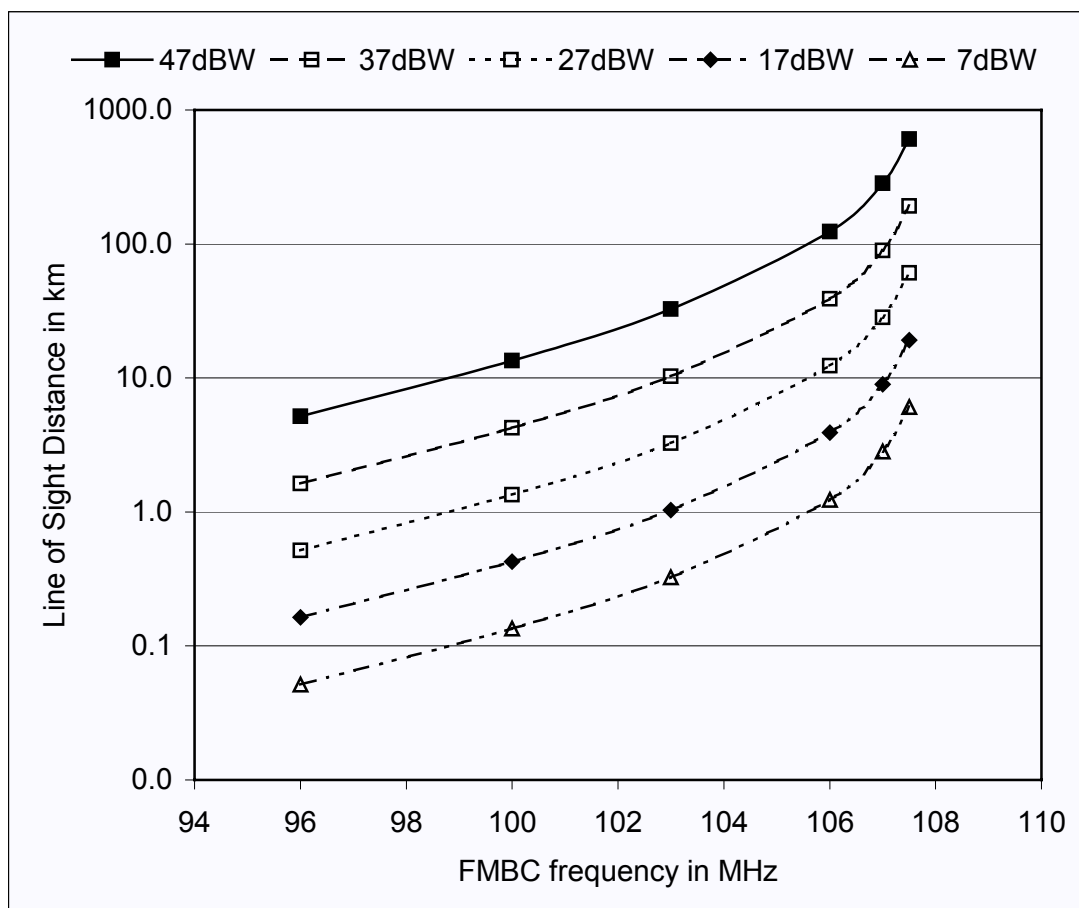
These graphs are included to illustrate the separation distances required between typical FMBC transmitters and ILS/VOR DOC areas. They are based on ITU-R SM.1009-1 recommendation (1009) methods. Detailed calculations are needed for particular FMBC and ILS/VOR DOC areas.

Graph A2-1

Graph indicating the minimum distance from a single FMBC station to an aircraft for the FMBC signal to be less than the IM cut-off level of the aircraft ILS receiver, for various FMBC frequencies and transmitter powers (eirp).

These B1 type interference contributory Cut-off levels are the same for all ILS frequencies in both Montreal and 1998 ICAO aircraft receivers.

The graph indicates that even low powered FMBC stations close to ILS/VOR DOC areas can contribute to IM interference in aeronautical receivers.

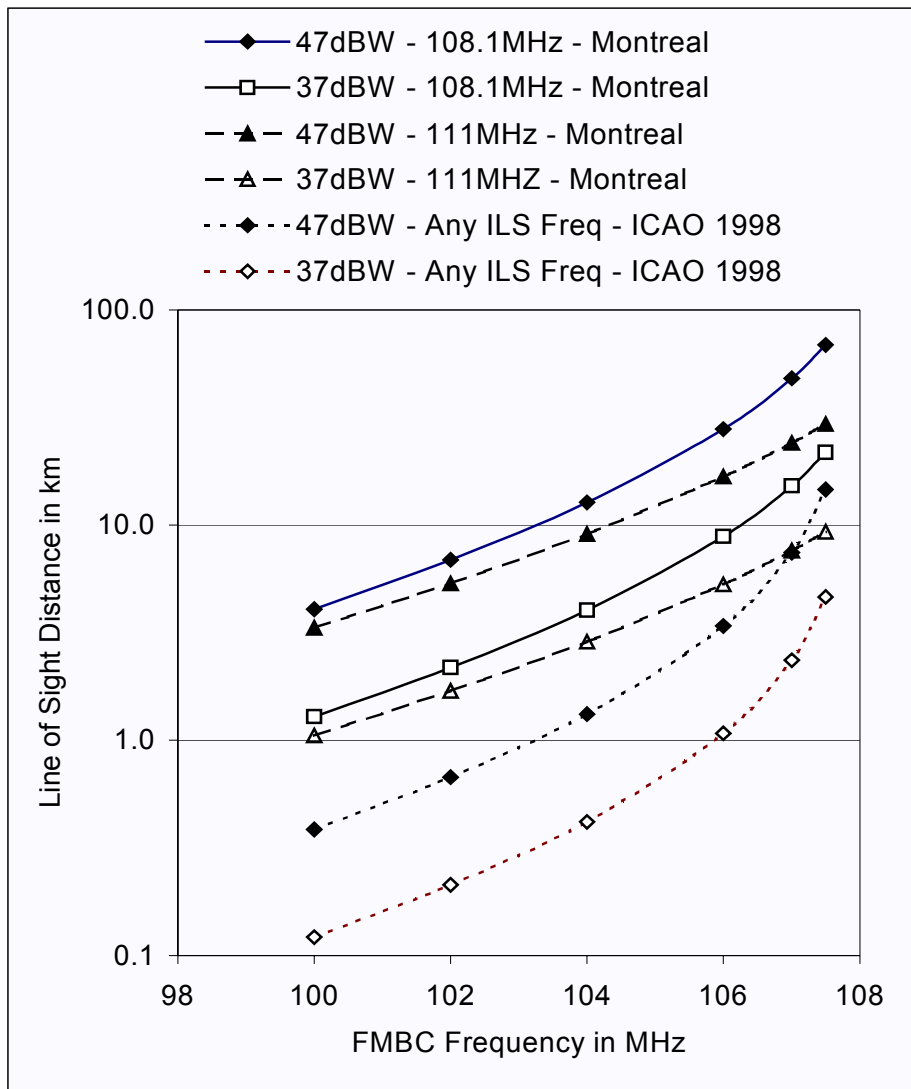


Graph A2-2

Graph indicates the minimum distance from a single FMBC station to an aircraft for the FMBC signal to be less than the IM Trigger level of both Montreal and 1998 ICAO aircraft receiver types, for various FMBC frequencies and transmitter powers (eirp), and ILS frequencies of 108.1 and 111 MHz; i.e., B1 interference Trigger level.

The graph indicates that medium powered FMBC stations above 102 and within 10km of ILS/VOR DOC areas have the potential to cause harmful IM interference in aeronautical receivers

The graphs also indicate that Montreal receivers are significantly more susceptible to B1 IM harmful interference than the 1998 ICAO type.

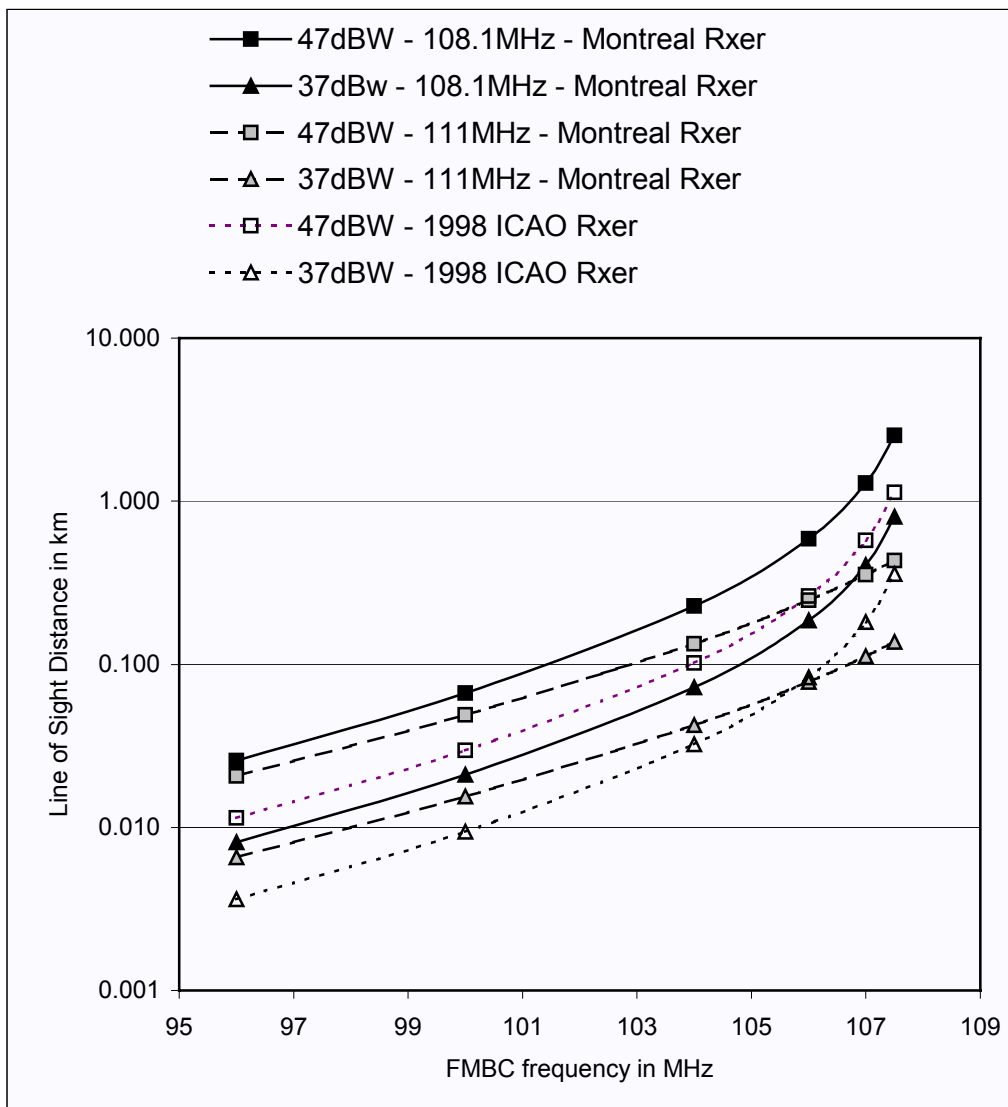


Graph A2-3

Graph indicates the minimum distance from a single FMBC station to an aircraft for the FMBC signal to be less than the Desensing interference level (B2) of both Montreal and 1998 ICAO aircraft receiver types, for various FMBC frequencies and transmitter powers (eirp), and ILS frequencies of 108.1 and 111 MHz.

The graph indicates that aeronautical receivers are significantly less sensitive to Desensing interference than to B1 interference.

The graphs also indicate that Montreal receivers are more susceptible to Desensing interference than the 1998 ICAO type, except for FMBC transmissions above 106 MHz.



Attachment A3

Coordination Process

- 1 The aeronautical services/FMBC coordination process required is in three parts. These are:
 - i. the determination of the coordination margins at the point of the local ILS or VOR DOC area nearest to proposed new FMBC transmitter for existing services in the 88 to 117 MHz band;
 - ii. the determination of the coordination margins at the point of the local ILS or VOR DOC area nearest to proposed new FMBC transmitter, taking into account both the proposed new FMBC services and the existing services in the 88 to 117 MHz band; and,
 - iii. the determination of the coordination margins for each existing FMBC transmitter at points of the DOC area nearest to each of those existing FMBC transmitter taking into account both the proposed new and existing service in the 88 to 117 MHz band.
- 2 The first part requires the identification of the coordination point for the proposed new FMBC transmitter and of all radio licences in the band 88 to 117 MHz within line-of-sight of that coordination point. Once this is obtained the General Assessment Method (GAM) described in 1009 is used to identify the coordination margins that exist for each interference type.
- 3 The second part is to add the proposed new FMBC service to the GAM calculations completed in the first part.
- 4 The third part is to use the GAM to identify changes to the coordination margins at other points in the DOC. This requires either an intuitive approach in which the likely worst case for coordination is identified, perhaps based on the coordination point for the nearest high powered FMBC close to or under the DOC and using the GAM to re-assess the coordination margins at that point.
- 5 The alternative third part is to use a computer programme to calculate coordination margins at all test points as identified in 1009. Such a programme has yet to be identified.
- 6 Note that the above three-step process does not take into account the possibilities that may exist for varying DOC areas or ILS/VOR frequencies.
- 7 Further work is currently underway to produce a step by step process to automate some of the calculations required as part of the GAM.
- 8 This process needs to be part of and use similar methodologies to those that are already part of FMBC and other broadcast licensing coordination activities.
- 9 Should the addition of the new FMBC station reduce the coordination margin at any point in a DOC area to a level that is unacceptable, either the proposed FMBC transmit power must be reduced to a level where the margin is acceptable or if this cannot be achieved, the licence application declined.

Attachment A4**Existing ILS and VOR Assignments**

Location	Reference	Frequency MHz	Power (dBW eirp)
WHENUAPAI	R11, 560894	108.8	14.0
OHAKEA AIRBASE	S23, 123091	109.0	14.0
AUCKLAND TAXIWAY ILS(2)	R11, 675636	109.5	17.0
WELLINGTON(ILS)	R27, 613862	109.9	17.0
CHRISTCHURCH ILS(1)	M35, 739485	109.9	17.0
AUCKLAND ILS(2)	R11, 675633	109.9	17.0
DUNEDIN(ILS)	I44, 917711	109.9	17.0
AUCKLAND TAXIWAY ILS(1)	R11, 711648	110.1	17.0
WELLINGTON(ILS)	R27, 612841	110.3	17.0
CHRISTCHURCH(ILS)2	M35, 711451	110.3	17.0
AUCKLAND INTL AIRPORT	R11, 713646	110.3	17.0
DUNEDIN(ILS2)	I44, 934724	110.3	17.0
WHENUAPAI	R11, 560894	110.7	17.0
OHAKEA AIRBASE	S23, 123091	110.7	18.0
WHENUAPAI	R11, 568894	111.1	17.0
OHAKEA AIRBASE	S23, 123091	111.1	18.0
ROTORUA	U16, 007385	112.1	17.0
PALMER HEAD	R27, 621839	112.3	20.0
MT MARY(LOW)	I38, 925712	112.5	17.0
SWAMPY SUMMIT NDB	I44, 137870	112.7	20.0
WAITAANGA	R18, 669625	113.0	17.0
PALMERSTON NORTH	T24, 321953	113.4	17.0
SLOPE HILL	F41, 774718	113.6	17.0
NAPIER(DVOR)	V21, 428873	113.8	20.0
HAMILTON	S15, 153687	114.0	17.0
GISBORNE AIRPORT MID RUNAWAY	Y18, 428703	114.2	17.0
NEW PLYMOUTH	Q19, 122437	114.4	17.0
NARAWHIA	Q27, 242014	114.6	20.0
AUCKLAND AIRPORT	R11, 678634	114.8	17.0
CHRISTCHURCH AIRPORT	M35, 707446	115.3	22.0
WOODBOURNE AIRPORT	P28, 820649	115.6	20.0
NELSON	N27, 212902	116.4	17.0
EYREWELL	M35, 602563	116.6	17.0
INVERCARGILL AIRPORT(DME)	E46, 501115	116.8	17.0

Attachment A5

Acronyms and Definitions

1009	ITU-R SM.1009-1 recommendation; one of a significant number of telecommunications performance recommendations agreed by the members of the International Telecommunication Union. This recommendation specifies how the coordination of FMBC services and aeronautical radio services such as ILS and VOR should be completed. New Zealand adheres to the recommendations.
CAA	Civil Aviation Authority
DOC	Designated Operational Coverage areas; areas designated as requiring specified radio coverage for ILS, VOR and aeronautical radio services.
eirp	Equivalent isotropic radiated power; indicates power levels transmitted from an equivalent reference antenna.
FMBC	Frequency modulated broadcast service; normally in 88 to 108 MHz band.
GBAS	Ground Based Augmentation System; associated with GPS services
GPS	Global Positioning System; a satellite based radio location service
GURL	General User Radio Licence; a general licence available to users without the need for a licence application and for which equipment must be operated in accordance with the requirements in a Gazette Notice.
ICAO	Convention on International Civil Aviation
ILS	Instrument Landing System; an aeronautical navigation system operating in the 108 to 112 MHz band
IM	Intermodulation; see attachment for explanation
MED	Ministry of Economic Development
MPIS	Maximum Permitted Interfering Signal level
RCL	Receive Coverage Location; a location designated in spectrum licence to be used for measurement of wanted and unwanted signal levels, particularly for FMBC services.
RSM	Radio Spectrum Management Group.
VOR	VHF Omnidirectional Range System; an aeronautical navigation system normally operating in the 112 to 117 MHz band