Response from Bob Vernall to MSP proposed certification rules

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1.0 Background

Some years back Bob Vernall was hired by Teamtalk (or the Araneo subsidiary) on a part-time basis to craft MSP licences in various TLA districts. Bob was later hired by THEPACIFIC.NET on a part-time basis for crafting MSP licences in the Marlborough TLA. Bob has since moved further towards retirement and is unlikely to accept further engagement with MSP licensing. In preparing this response a draft was supplied to Teamtalk for them to consider in preparing their own submission. Because I have not been active with MSP matters for some two years I'm not sure of the thrust behind consultation material or why MSP activities should not continue in a self-managed manner.

2.0 Responses to each of the seven RSM proposals

Bullet point proposals are numbered for the purposes of presenting responses.

Proposal 1

PIB 39 should provide a **default MPIS value of 34 dBµV/m** for receivers with isotropic antennas, and should indicate how to adjust that for systems with antenna gain and feeder loss.

Response

Disagree. This is meddling with the established definition of MPIS, which is: "The MPIS level is defined at a point in front of the receive antenna on the boresight, and is expressed as the field strength spectral density". MSP applications use antennas with significant net gain, as do almost any point-to-multipoint fixed system. 16 dBµV/m is a popular "MPIS default value" with registered MSP licences and seems to have been arrived at by using a published MPIS formula. For the MSP band, 16 dBµV/m on boresight for an 18 dBi net gain antenna gives parity with 34 dBµV/m and an isotropic antenna, so the methods are parallel working but there is nothing to be gained from referencing MPIS to an isotropic antenna. The question is: why deviate from the established MPIS definition with a variation for MSP situations?

In any case an MPIS value based on unwanted signal that raises the thermal noise floor by 1 dB is most likely too low for MSP practical spectrum sharing. It would be better to rank the unwanted signal limit based on actual wanted signal and a desired protection ratio. This is best discussed between affected rightholders for optimising spectrum sharing, where wanted to unwanted signal ratio is the "bottom line" rather than an absolute level of unwanted signal.

Proposal 2
AREs should be required to observe a **minimum receive signal level of -89 dBm** at the input of the receiver to define the edge of coverage. It is anticipated that this would prevent unreasonably low MPIS values being set that inhibit spectrum sharing. Where more accurate information is available from the manufacturer, such information could be used instead of -89 dBm.

Response
Disagree. The actual limit of useful service is a commercial decision for a rightholder, who could select a higher gain antenna or other higher performance hardware for a subscriber with otherwise challenging circumstances, as a way to produce a viable result. This is basically a business decision.

MSP service has receivers at base stations as well as at customer premises. Some cases of service optimisation involve different signal levels at each end of a path.

There is dimensional inequality in units used. MPIS values are in field strength (equipment independent) whereas terminated signal in dBm depends on antenna net gain.

Spectrum sharing is best resolved by discussion between respective rightholders and most likely the solution is to apply wanted to unwanted signal ratios rather than prescriptive regulatory rules with set limits for transmission parameters.

Proposal 3
AREs should be required to observe a **minimum field strength of 40 dBµV/m** for determining the edge of coverage. This figure allows for a receiver with a nominal +17 dBi antenna gain

Response
Disagree. The proposal is excessively prescriptive as to where customers could have an engineered solution and what antenna a rightholder could allocate to a given customer.

When a rightholder has multiple base stations there are multiple edges of coverage and it is up to the rightholder to decide transmission parameters and customer loading per base station.

Proposal 4
AREs should be required to limit the **maximum radiated power of base stations to +10 dBW eirp**. It is anticipated that this would avoid unnecessarily high overspill into neighbouring area.

Response
Disagree. 10 dBW is too low for a power cap for an MSP base station where the TLA boundary and customer distribution is a long distance away, such as for rural coverage and where trees are present.

Control of overspill to an adjacent TLA is a tension for both rightholders aspiring to have customers that happen to live near a TLA boundary. As covered in counter proposals, co-channel sharing either side of a TLA boundary is unlikely to work, but using adjacent channels would work. So one solution is to split bandwidth between rightholders rather than cap radiated power or MPIS for sharing that is basically impractical or would lead to patchy or substandard service quality for both rightholders.

Proposal 5
AREs should include on the licence, detailed information about transmitter and receiver equipment configurations, including receiver antenna details, and actual frequencies or channels to be used. It is anticipated that this would enable good co-ordination with subsequent systems and hence increase the efficiency of spectrum use in the MSP.

Response
Disagree. Such rules would require amendment of a licence each and every time there is a change in delivery plan or when an antenna is replaced with a different type or a change in sector angle. Minimum but sufficient is to have an omnidirectional full bandwidth licence and leave sharing outcomes and updating plans to liaison between rightholders.

Proposal 6
When using antennas with gain, the corresponding beam width should be clearly identified on licences and should be used for co-ordination.

Response
Disagree. Co-ordination is best carried out by liaison between rightholders. In any case, beamwidth is not the key information, it is the full specification of radiation pattern envelope (RPE) and it may even need cross-polar and down tilt information. It is a waste of resource to compulsorily require this to be part of a licence when it can easily be exchanged between rightholders. In the case of when antennas are changed to a different type a rightholder would be open to receiving an infringement notice unless the change was made on the day a prior filed Form 8 specified a date for when the modification was to apply (and it could transpire there was a bad storm that day).

If rightholders are not willing to co-operate then the Crown manager could act as an administrative pivot for exchange of relevant information between parties.

Proposal 7
AREs should not use a single licence for all of the sectors of a base station when individual sectors or sets of sectors use separate frequency sub bands. Each sub band should have a separate licence showing the frequency range and aggregate HRP of the set of sectors. It is anticipated that this will identify the antenna nulls in each sub band to facilitate efficient spectrum use through better technical co-ordination with subsequent systems

Response
Disagree. A single licence per base station is minimum but sufficient for legal purposes. Co-ordination is best carried out by liaison between rightholders, including when sector and frequency planning evolves with customer growth.

3.0 Further comments

3.1 Rightholders and relationship to AREs
In my opinion the RSM MSP discussion under-emphasises the role of rightholder and over-emphasises the role of approved radio engineer (ARE). The rightholder is the party who funds the commercial operation, manages the overall operation of services and negotiates with one or more rightholders in adjacent TLA districts to develop suitable deployment plans.

3.2 It takes two to tango
Registering a spectrum licence is basically a **singular function** initiated by a prospective rightholder. Optimisation of MSP coverage must involve liaison between affected rightholders, with **mutual agreement** as to deployment that suits both parties. In some cases there are more than two rightholders involved (like up to two in each TLA) but the basic point is unchanged that all affected parties need to engage in how to share MSP bandwidth. Trying to achieve sharing via licensing documentation is cumbersome and incapable of taking heed of new ideas by another rightholder, or a new party deciding to apply for an MSP licence that they consider would co-ordinate with existing MSP licences.

In a network where a rightholder has multiple base stations they would be “sharing with themselves” and optimising the network for service delivery. In general service quality within a given network is set by wanted to unwanted signal ratios and not thermal noise floor, and MPIS is ignored as having less relevance to meeting wanted to unwanted signal ratio at base stations as well as customers.

3.3 Site selection considerations
Site selection is the key to setting coverage and reach of interference. In some cases site selection seems to be higher than needed to cover a TLA and be line of sight for hundreds of kilometres to

other TLAs. One such site is Wharite (915 m asl) which was selected for the Tararua TLA but is line of sight on the west side of the divide for a good fraction of the lower North Island. It seems MSP licences were cancelled in August 2014 so Wharite is no longer a current example of a very high MSP site Another example is Mt Campbell (1330 m asl) but it seems MSP licences were cancelled in February 2014 so is no longer a current example of a very high MSP site.

Further investigation on high sites with influence on a mixture of rightholders was intended to be included in this response, but the data extract function in SMART was unavailable during the time available for preparing a response.

There should be some way of assessing potential for out of TLA interference potential before the Crown manager accepts an MSP proposal.

3.4 TLA boundaries can be a poor match to natural UHF coverage

The way MSP areas are allocated by TLA leads to artificial difference between administrative boundaries and limits of practical UHF coverage. Some TLAs have jagged boundary lines and there is no choice for an MSP rightholder to echo a similar jagged line just inside the TLA boundary, and that is called a protection area (different to coverage contours). Any rightholder aspires to maximise their service market and it applies to rightholders each side of a TLA boundary. So in general some signal "over-spill" is an unavoidable reality, especially when a TLA boundary is on fairly flat land.

Where TLA boundaries are on populated flat land then allocation of rights by TLA district is an administrative setup that guarantees sharing difficulties either side of that boundary.

4.0 Some counter proposals

It would not go unnoticed that I disagreed with all proposals in the RSM discussion. This is because I see that heading towards an overly prescriptive format for spectrum licensing could involve needless burdon to maintain licence details when respective MSP networks develop and have planned changes to transmission, and alone does little to resolve co-channel spectrum sharing between rightholders in adjacent TLAs. Rather than be a naysayer to RSM proposals and leave it at that, I decided to contribute some counter proposals.

The Goodwin consultation is good background as to the range of constraints for sharing between different networks near a TLA boundary. The key difference with opinions is that the Goodwin report does not come out with a result that co-channel sharing either side of a TLA boundary is generally impractical, because wanted to unwanted signal ratios are insufficient in both networks. It is application of radio physics that seals the fate and no amount of tinkering with rules will change the underlying radio physics and avoid equally unhappy rightholders wanting to achieve some coverage near TLA boundaries where they have customer aspirations. These counter submissions have a preliminary stance that co-channel sharing near a TLA boundary is impractical and the initial path forward should be for affected rightholders to each be allocated half the net bandwidth, so they can each proceed with "normal" transmission parameters while they explore and negotiate possible increased sharing.

TDD with asynchronous transmission between different networks has a significant limitation of unwanted signal from a Network A base station transmission to a Network B base station receiver, and vice versa. There are also sharing modes involving customer premises terminals but these are generally easier to satisfy than base to base unwanted signal. The following table has been copied from the Goodwin report and the column of interest is the right hand side, being the minimum ratio of wanted to unwanted signal as the criteria for interference threshold. That is the "bottom line" criteria for radio performance (not absolute MPIS).

Base Station Type	Equivalent Modulation Order	User Terminal Type	Minimum receive signal level for BER 10^{-6} (dBm)	Minimum field strength for isotropic antennas (dB(μV/m))	S:I for 1 dB threshold degradation (dB)
FDMA	2	FDMA	-89	56.5	24
	3	FDMA	-86	59.5	27
	4	FDMA	-82	63.5	30
TDMA	2	2Mbit/s	-88	57.5	23
		4Mbit/s	-85	60.5	23
	4	8Mbit/s	-79	66.5	23
TDMA/ OFDM	2	Any	-88.5	57.0	23
	4	Any	-80.5	65.0	30
	6	Any	-74.5	71.0	37
OFDMA/ TDD	2	OFDMA/ TDD	-91	54.5	17

As well, wanted signal should be taken as faded, whereas unwanted signal is taken as unfaded, which effectively increases the threshold protection ratio by a system fade margin.

The path between base stations either side of a TLA boundary is likely clear line of sight and path length only an octave or so longer than the distance to each set of customers. Free space signal has a 6 dB per octave reduction with distance. For base station sectors "facing each other" the only useful protection factors are differential down tilt and polarisation discrimination. VRP (vertical radiation pattern) difference from declination to the furthest customer to declination or inclination to the other base station is unlikely to be more than a few dB. Polarisation discrimination is limited by scatter or foreground reflections from slanted surfaces despite base station antennas having high specification for polarisation purity and being installed with spirit level accuracy for mechanical setting.

For the above reasoning, it can be appreciated that the default situation for MSP base stations with line of sight paths across a TLA boundary should assume that co-channel operation is impractical. Adjacent channel operation between different networks is generally possible as there is typically of the order of 30 dB interference reduction factor between co-channel and adjacent channel operation.

Liaison between rightholders is the way to develop deployment plans for affected rightholders. Rightholders can employ appropriate technical staff to carry out sharing assessments and work out what sub-areas of each planned network could operate with co-channel sharing and identify the sub-areas that would be interference limited if services were co-channel. In the interference limited sub-areas there can be agreement on splitting bandwidth and what sectors to apply this to. Alternatively they could agree to some exclusive bandwidth and some shared bandwidth, or choosing fully synchronous operation, it is up to them to reach a mutually acceptable (including affordability) way to develop. Ongoing liaison between rightholders is needed to cater for maturing networks.

MPIS applies only to co-channel scenarios, so agreement to apportion bandwidth and deploy adjacent channels does not violate a stated MPIS limit on a licence, and there won't be any complaints of co-channel interference between networks that use agreed adjacent channels.

While splitting the bandwidth is a loss in delivery potential for either network, so would be an ongoing struggle with co-channel sharing and persistent interference issues. So approaching sharing from initial splitting of bandwidth is considered to be a "cleaner" way for each to have good startup service, pending exploring details of where each has coverage aspirations and where overspill could be.

In a few cases there could be adjacent channel limitations within a same area where different rightholders co-locate or are near sited. A 5 MHz guard band may be a suitable way to cater for the combination of transmitter unwanted emissions and receiver adjacent channel selectivity limitations. 5 MHz guard band leads to offset channels but is of no consequence as each rightholder can easily manage coverage within their network.

I believe there is no need for "chapter and verse" contents included in a spectrum licence. Minimum but sufficient is a "legal umbrella" licence showing net bandwidth available and omnidirectional radiation pattern, and leaves all coverage, antenna and deployment details to agreements between affected rightholders, and develops over time.

5.0 Suggestions for Crown manager intervention

The existing process for applying for a new MSP licence includes "send an interference risk notice to the affected licensee" and I have yet to know of a case where that has happened.

The term "interference risk notice" should be changed to "frequency sharing impact report" as that is more neutral and universal regarding conclusions. Rather than leave judgement and action to a prospective applicant, it would be better for every application to be accompanied by a "frequency sharing impact report" for the Crown manager to distribute to to all existing MSP rightholders so they can assess the situations described by the applicant. The Crown manager to consider responses from rightholders before accepting or declining the high altitude base station proposal.

The present method of only AREs having access to planned licences is too restrictive. It would be improved coverage of applications if the Crown manager emailed all material on proposals to all existing MSP rightholders. As well, SMART could be modified allow MSP rightholders to access MSP planned licences.

As high altitude base stations have potential to cause interference at long distances and limit MSP utilisation in other TLAs, then there should be an early process to subject a high altitude siting proposal to scrutiny of potentially affected rightholders in surrounding districts. The proposer of a high altitude MSP base station should prepare a written "frequency sharing impact report" for distribution by the Crown manager, for distribution to rightholders from all surrounding districts with line of sight to some part of a TLA where they hold MSP licences. The Crown manager to consider responses from rightholders before accepting or declining the high altitude base station proposal.

Similarly for an MSP base station proposal close to a TLA boundary, the proposer to prepare a written report and the Crown manager seek responses before accepting or declining a proposed siting.

New MSP licences should be issued with a starting bandwidth of 10 MHz selected by the Crown manager, pending development of sharing agreements with other MSP rightholders, including those in other TLAs. Modification of licences to full bandwidth can follow the lodging of sharing agreements of affected parties, including those in another TLA.

Sharing agreements need to be updated as networks mature. The Crown manager should have a process to contact ech MSP rightholder at an interval not exceeding 12 months to get confirmation of updated sharing agreement, within a TLA and for adjacent TLA.