

## **1 Scope**

These are the comments of Pacomm Consulting Group Ltd. on Canada Gazette Notices DGSO-001-10 and SMSE-013-10, regarding Part B of “Decisions on the Transition to the Broadband Radio Service (BRS) in the Band 2500-2690 MHz and Consultation on Changes Related to the Band Plan” (the Consultation Document).

These comments are presented in the same order as the specific questions asked in the Consultation Document, and should be read in conjunction with the associated submission prepared by Dr. Martyn F. Roetter.

## **2 Frequency Band Plan**

### **Question 1. Should Industry Canada adopt the Option 2 band plan?**

Answer: Yes, for the reasons stated in the associated submission of Dr. Roetter.

### **Question 2. Should operation of the TDD systems be permitted in the FDD portion of the band plan and, if so, under what conditions?**

Answer: Yes, TDD use of FDD spectrum should not be prohibited but left to the licensee to decide under specified rules, for the reasons stated below.

***It Should be Permitted.*** – The principal reason the Department should allow TDD use of FDD spectrum is efficient use of the spectrum. The proportion of mobile traffic that is data (including video and multimedia) is rising at a significant rate. The majority of such data traffic is strongly asymmetric and the downlink direction will continue to dominate. The allocation of time-slots to the downlink and uplink in TDD systems can be arranged accordingly to make the most efficient use of the radio channel. In contrast, in FDD systems the downlink and uplink spectrum resources are tied together, so the uplink is not efficiently used in FDD.

Data traffic is growing at a significantly large rate, as pointed out in Dr. Roetter’s submission. Inefficient use of FDD uplinks will grow with growing traffic asymmetry, which will be reflected in excess user costs.

There are some TDD applications that may well be able to co-exist with FDD in the same spectrum (e.g., indoor underlays). In other cases, however, there is inefficiency in using FDD spectrum for TDD because TDD guard bands have to be provided within the FDD spectrum as discussed below. The operator’s challenge will be to get a

combination of large channel widths and large asymmetry such that the net efficiency increases above what FDD alone would provide. It would be short-sighted not to allow the licencees the choice of doing so by using TDD in place of or in addition to FDD in their FDD licenced bands.

***Conditions That Should Apply.*** -- Within its licenced spectrum, we can expect that a licensee wanting to use TDD in FDD spectrum can and will manage its own FDD/TDD co-existence. Between operators, the Department should apply the Band Edge Masks (BEMs) and Power Flux Density (PFD) limits of the Annex to European Commission (EC) Decision 2008/477/EC in the way discussed below.

The EC decision invokes and is based upon CEPT Report 19, which proposed<sup>1</sup> a two-part regime of (a) EIRP Band Edge Masks (BEMs) that limit radiation at spectrum boundaries and (b) power flux density (PFD) limits at the geographic edges between licenced territories. Both documents are attached. We think the CEPT approach to BEMs and PFDs has merit because it allows better use of the spectrum than the other proposals being discussed, and international equipment vendors are complying with it. So we commend it and the EC's BEM and PFD rules to the Department for the Canadian 2500-2690 MHz band.

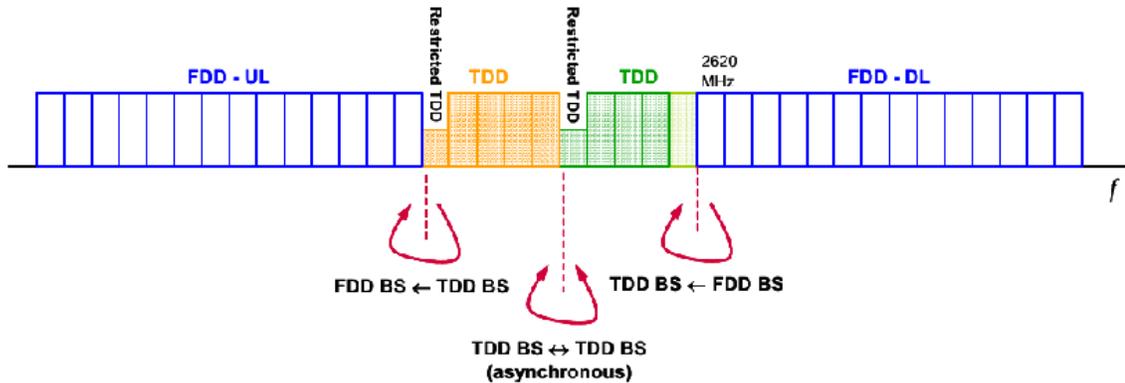
We now discuss the rules that we suggest should apply where operators are on adjacent channels in the same geographical area, and then we discuss the co-channel case of operators in different geographical areas.

***Adjacent-Channel Rules.*** – In the adjacent-channel environment, CEPT Report 19 addresses a similar situation in their Figure 9, which is reproduced below as our Figure 1. The individual spectrum blocks are 5 MHz, the same as the Option 2 Band Plan. There is 50 MHz of unpaired spectrum in the figure, like the Option 2 Band Plan. The upper edge of the unpaired spectrum is 2620 MHz in both cases.

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<sup>1</sup> CEPT Report 19 subsection 5.4.6 and Annex 4. Please note that this band is called "2.6 GHz" in Europe.

Figure 1 – CEPT Illustration of the Band Edge Mask Boundaries



Source: CEPT Report 19 Figure 9

Figure 1 above illustrates the three dominant adjacent-channel interference cases that will be found in a common geographical area when a plan like Option 2 of the Consultation Document is applied. Allowing TDD use of the FDD bands adds more such cases and we think the answer is to treat them similarly in a controlled way. The three cases in the figure are:

- Case 1 -- FDD base station (BS) transmitters into TDD BS receivers.
- Case 2 -- Interference between unsynchronized TDD BSs of different operators (unsynchronized operation probably represents the typical case).
- Case 3 -- TDD BS transmitters into FDD BSs receivers.

In Case 1, CEPT, Industry Canada and others agree this requires a 5-MHz guard band, which CEPT recognizes as part of the unpaired band, and is placed at 2615-2620 MHz in CEPT Report 19 and the Option 2 Band Plan of the Consultation Document.

CEPT considers that the other two interference cases are not so severe because they can be ameliorated by lower EIRPs and attention to siting and coupling losses. Therefore the CEPT report has identified that the 5-MHz blocks immediately above the lower edge of each TDD allocation as “Restricted” spectrum blocks belonging to the licensee on the high side of the Restricted spectrum. We commend the idea of Restricted unpaired spectrum blocks rather than guard bands on the lower edge of TDD allocations, because it allows at least some use of this otherwise-unused spectrum to be made in a controlled manner.

Thus 2615-2620 MHz should be a guard band and 2570-2575 MHz should be Restricted unpaired spectrum as just described.

We think an FDD licensee wishing to use TDD instead of or in addition to FDD would first do it in the FDD uplink band because that will be the least utilized due to traffic asymmetry, but we realise it could happen in the downlink band as well.

In the FDD uplink band, the FDD licensee using TDD should be required to obey the same BEMs at its band edges and should also obey the Restricted unpaired spectrum rule in the lower edge of its uplink spectrum.

In the FDD downlink band, the FDD licensee using TDD should provide 5 MHz guard bands at the top and bottom of its allocation.

***Co-Channel Rules.*** – In co-channel cases, Canadian use of the FDD spectrum for TDD will not be the only case that needs to be addressed, but also in U.S. border areas due to band plan differences between the U.S. and Canada as discussed by Dr. Roetter. The existing border co-ordination regime in this band is based on PFDs, and we think PFDs as defined by CEPT Report 19 should be the basis for co-channel co-ordination between TDD and FDD in the 2.5 GHz band within Canada.

***Onus on the TDD Proposer.*** – Licensees that use the unpaired band for unpaired applications such as TDD, and licensees that use the FDD bands for FDD should be treated as co-equal and each bear their own costs in ameliorating interference. However, an FDD licensee proposing to use its FDD spectrum for TDD should bear all such costs since they are causing those costs by departing from the default band plan.

**Question 3. Should the guard band blocks 2570-2575 MHz and 2615-2620 MHz be held in reserve by Industry Canada or should they form part of the unpaired block (TDD)?**

Answer: The upper guard band is mandatory and should be held in reserve for this purpose by Industry Canada but considered part of the unpaired block. We note that CEPT Report 19 takes the same view that it should be considered part of the unpaired block.

The lower guard band should be designated Restricted as described in our answer to Question 2 and the BEM and PFD limits of CEPT Report 19 should apply. It should be assigned to the same licensee that is awarded the next higher block (e.g., 2575-2580

MHz in the case of 5-MHz blocks) in order not to create further restricted blocks higher in frequency.

**Question 4. If the guard bands are to be held in reserve, should they be considered for future use by licence-exempt wireless systems?**

Answer: No, this only adds unwanted uncertainty to the interference equation and there are other allocations for this purpose.

**3 Mapping of Incumbents into Option 2 Band Plan**

**Question 5. Should 20 MHz of the MDS spectrum held by Industry Canada be exchanged for 20 MHz of the MCS spectrum licenced to the MCS incumbent as indicated in Figure 5?**

Answer: Yes, with two changes. The exchange should be implemented because the alternatives of Figures 3 and 4 of the Consultation Document are untenable due to FDD pairing constraints. The proposed changes are the following.

- a. In Figure 5 of the Consultation Document, the allocations to licencees should be multiples of 5 MHz for consistency with international standards and to avoid wasted spectrum, so change “2596” to “2595” in the figure and related text here and in every other relevant case in the Consultation Document.
- b. Also in Figure 5, shift the MCS paired spectrum to the top of the FDD uplink and downlink bands, to facilitate co-existence between the MCS FDD uplink and MCS unpaired bands and possible elimination of the lower TDD guard or Restricted band as discussed later below in our answer to Question 7.

**Question 6. Whether government intervention is required where there are different MCS and MDS incumbents in the same geographic areas?**

Answer: With a few exceptions, the MCS and MDS incumbents are the same where both types of licence were issued.<sup>2</sup> About half the Canadian population is covered by Inukshuk as an MCS and MDS incumbent,<sup>3</sup>

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<sup>2</sup> Taking into account the sale to Inukshuk of Look and Craig MDS and BRS properties.

<sup>3</sup> The transfer of MDS licences from Look to Inukshuk affects 46% of the Canadian population, and the Craig transfers will be in addition

So we think a generalized solution should be organized to collect the MCS and MDS spectrum together to expose the fewest inter-licencee adjacent channel interference cases where the MCS and MDS incumbents are the same. Further, this spectrum should be placed in a way that is consistent with our answer to Question 5.

Thus in Figure 7 of the Consultation Document:

- a. Change “2596” to “2595” for the reasons stated in our answer to Question 5.
- b. Shift the MCS paired spectrum to the top of the FDD uplink and downlink bands as stated in our answer to Question 5.
- c. Shift the MDS paired spectrum to be immediately below the MCS paired spectrum.

Shifting spectrum in this way requires government intervention that in fairness should apply to all incumbents. Shifting should not be mandatory, however, until there is an actual need for an incumbent or a new licensee auction to use spectrum that is currently not placed according to this plan.

**Question 7. Should Industry Canada rely on market forces or should it develop specific technical rules to facilitate coexistence between two or more operators and alignment with the Option 2 Band Plan?**

Answer: Industry Canada should apply technical rules and specifically those that are in CEPT Report 19 and the Annex to EC Decision 2008/477/EC.

***Better, in Balance, to Set Some Rules.*** –In this case it is not clear if total reliance on market forces is advisable. Among other factors, there is an MCS/MDS incumbent in many cases that has an established and in many cases dominant market position in 2.5 GHz and whose owners have at least 155 MHz of other wireless spectrum as well as wired and wireless services across Canada. In contrast, the relative strengths and weakness of the other possible player(s) are unknown. Rules reduce risk by giving certainty to everyone. So, on balance, it is better to set some rules.

***Consider Adopting The EC/CEPT Rules.*** – For co-existence between operators, the Department should consider adopting the rules of the Annex to EC Decision 2008/477/EC and CEPT Report 19, as described in our answer to Question 2, because they are applicable to the Option 2 Band Plan, were carefully analyzed and broadly reviewed, and are being followed by equipment manufacturers whose products conforming to this Band Plan are already in commercial service in Scandinavia.

Thus the CEPT BEM limits should apply in adjacent-channel cases between different licencees and the PFD limits in co-channel cases. In addition, there should be a 5-MHz guard band at the upper edge of the unpaired block, and a 5-MHz Restricted band at the bottom of each unpaired licencee's block.

*Adjust the Plan of Figure 8.*—The text associated with Figure 8 in the Consultation Document postulates two unpaired licencees with about 15 MHz of usable spectrum. This seems non-optimal in two ways. First, 15 MHz is not likely to be a really attractive bandwidth commercially in the light of increasing user bit rate expectations; 20 MHz or more would be better. Second, 20 of the 50 unpaired MHz are unusable, which seems a bit wasteful. However it may be possible to do better in the following way.

With current WMAX technology, at least 30 MHz plus guard and Restricted bands is necessary to support one operator seeking to respond to the significantly high growth rate of data using a 3-cell system with 10-MHz carriers. Such prospective operators would be unlikely to find 15 MHz or even 20 MHz interesting. The 5-MHz slivers postulated in the band plan are likely to seem of little commercial usefulness with any platform in the context of high and increasing bandwidths. However stand-alone deployments of current WiMAX technology that don't need to be part of a frequency re-use pattern may be commercially practical in 10 MHz plus guard and Restricted spectrum.

TDD-LTE can use these 5 and 10 MHz slivers with a frequency re-use factor of unity, and 15 MHz is a standard channel width as well, but spectral efficiency falls significantly as bandwidth decreases below 20 MHz so it would be best to provide 20 MHz plus guard and restricted spectrum if it can be arranged.

Consideration should be given to achieving 20 MHz for two unpaired licencees in the following way.

- a) Move the MCS incumbent FDD uplink band to be 2530-2570 MHz (40 MHz) (and make a corresponding change in the FDD downlink band), as described in our answer to Question 5, and the MDS incumbent FDD bands to be immediately below as described in our answer to Question 6.
- b) Move the MCS incumbent TDD band to be immediately adjacent at 2570-2590 MHz (20 MHz). Of this, designate 2570-2575 MHz as Restricted, but do not apply the restriction while the same or affiliated parties hold spectrum immediately adjacent on either side of the 2570 MHz, with the expectation that the licencee will optimise the use of both their unpaired and paired spectrum

through internal arrangements. If the spectrum on either side of 2570 MHz is subsequently sold on to different parties, require the sale to protect and continue the co-ordination arrangements that existed at the time of sale.

- c) Allocate a second TDD band 2595-2615 MHz (20 MHz) to the MDS incumbent where it exists or new licensee otherwise. Attach to it a Restricted unpaired band 2590-2595 MHz. Do not apply the restriction while the same licensee holds spectrum on either side of 2590 MHz
- d) Allocate an upper unpaired guard band 2615-2620 MHz to be held by Industry Canada.

***Set a Foundation for Divestment.*** – We do not know if, in the future, the MCS/MDS incumbent (Inukshuk) may decide or be required to divide its spectrum between Rogers and Bell, or sell some or all of its incumbency spectrum to third parties<sup>4</sup>, thus creating more inter-company adjacent-channel and co-channel interference cases. The same is true in principle for other incumbents and indeed new licensees. It seems reasonable to prepare for such eventualities now, using the principles outlined above.

Thus, when incumbency or auctioned spectrum is divided:

- a. Apply the BEM and PFD limits at the adjacent-channel and co-channel edges thus created.
- b. Maintain the guard band 2615-2620 MHz.
- b. If unpaired spectrum is divided, also apply the Restricted unpaired limits to the lowest 5 MHz of each piece of spectrum thus divided.

**Question 8. Should 20 MHz of the MDS spectrum be exchanged for 20 MHz of the MCS spectrum as indicated in Figure 10?**

Answer: Same answer as our answers to Questions 5, 6 and 7 above.

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<sup>4</sup> Among other aspects, industry Canada may wish to consider whether the fees set for incumbency spectrum at 2.5 GHz will or should create arbitrage opportunities for selling part or all of such spectrum at below-auction prices.

**Question 9. Comment on the timing aspects related to the physical migration of the existing network facilities to the new band plan, including the timing required for the completion of all transactions regarding spectrum exchanges.**

Answer: We have no comments.

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