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Study on Terrestrial BB-PPDR Spectrum Options – Assessment of BB-PPDR responses to ComReg Document 19/59R

A report from LS Telecom UK Ltd

Consultant Report

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Final Report



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1 Introduction

1.1 General

LS telcom prepared a report for the Commission for Communications Regulation (ComReg) entitled “Study on Terrestrial BB-PPDR Spectrum Options” which was published as ComReg Document 19/59e alongside ComReg’s consultation on its proposed multi band spectrum award including the 700 MHz band (ComReg Document 19/59R).

This document sets out LS telcom’s assessment of responses to ComReg Document 19/59R which are relevant to the LS telcom report.

Four respondents commented on spectrum related issues for the provision of BB-PPDR services in Ireland:

- Eir
- Vodafone
- Three
- Motorola

1.2 Structure of this document

This document is structured as follows:

- Section 2 extracts (verbatim) responses to ComReg Document 19/59R relating to the LS telcom report;
- Section 3 sets out our assessment of these responses, including whether any material has been provided that would materially change the findings of our report.

2 Extract of BB-PPDR-related responses to ComReg Document 19/59R

2.1 Introduction

We provide, in the following sub-sections, the verbatim responses of each of the above respondents relevant to the LS telcom report. As will be seen below, the responses received from the three MNO's were broadly supportive of ComReg's proposals with respect to BB-PPDR and would not require any amendment to the LS telcom report. Only Motorola submitted detailed comments which in our view requires further assessment (in Section 3 below).

2.2 Eir response

Spectrum for Broadband Public Protection and Disaster Relief (BB-PPDR)

eir agrees with ComReg's summary view (see 2.36 to 2.37) to include the full 2x30MHz of the 700MHz Duplex in the proposed award as spectrum requirements for BB-PPDR can be addressed separately, including use of commercial services as is the case in a number of Member States.

2.3 Vodafone response

BB-PPDR Spectrum Management considerations (Section 2.3 of ComReg Document 19/59)

We note the comprehensive analysis carried out by ComReg of BB_PPDR proposals spectrum management considerations, and agree strongly that solutions should be sought for these requirements outside the 700MHz FDD bands.

2.4 Three response

In Document 19/59, ComReg provides some analysis of the requirement to provide spectrum for Public Protection and Disaster Relief (PPDR), and considers whether is necessary or desirable to reserve some of the 700MHz FDD spectrum for PPDR. LS Telcom has examined and reported on this matter for ComReg. The study is quite comprehensive, and we have no reason to disagree with the conclusions.

The LS Telecom study found that "2x6 MHz would be sufficient to support PPDR usage in Ireland", and that there are several options to provide that. Six options are provided in Table 2 of ComReg's document. Three agrees that any of Options A, B, or C are preferable to options D, E, or F. This is because the latter three all reduce the spectrum that might be available for commercial services. There are other spectrum options available to meet the requirement for PPDR, including the 400 MHz band (2x3MHz); Band 28B (2x3 MHz), and Band 68 (2x5 MHz). There may also be options for PPDR deployment in the 410-430 MHz and the 450-470 MHz bands. In addition to these dedicated spectrum options, the requirement may be met by using hybrids of dedicated and commercial networks.

On this basis, it would not be efficient or justifiable to disadvantage commercial networks by limiting the amount of 700MHz FDD spectrum in the award.

2.5 Motorola response

Proposals for the 700 MHz band (p. 11)

MSI agree (7) with ComReg, that the total of 2x30 MHz shall be allocated to the Mobile Service after the shut-down of the DTT Services in 2020.

MSI take the view, that, if parts of this 5G pioneer band is foreseen to deliver BB-PPDR services in the future, then a 2x10 MHz slot shall be identified for these vital services ahead of an eventual award, and, if awarded, special provisions in the license agreement could be considered to prevent a spectrum re-sell, which might bring ownership of the Irish BB-PPDR spectrum in the hands of a potential adversary. In other words, the government shall be in full control of its emergency services spectrum, and as soon as an award is completed, this control may be lost forever.

By the same token, MSI suggests that a coverage obligation “precautionary-plus” shall be assigned to the identified BB-PPDR spectrum slot in accordance with requirements set forth by the national police forces.

Recognizing the 700 MHz band as a 5G “Pioneer” band, it should not be forgotten to mandate the BEM for LTE/5G NR in all segments of the 700 MHz band.

BB-PPDR spectrum management considerations (p. 26 [of ComReg Document 19/59R])

As mentioned above, the market for PPDR in general and BB-PPDR in particular is a niche market in the “sea” of Mobile Services and Equipment. It is therefore the driving reason for MSI to take the position that without prejudice to the special requirements set forth by the PPDR community the choice of spectrum and standards should be positioned as close as possible to the commercial mass market in order to drive down CAPEX of the more expensive niche market BB-PPDR networks.

Regarding spectrum, this means the identification of parts of the “MFCN identified spectrum” for BB-PPDR, as only “MFCN identified spectrum” is harmonized in EU. From this follow, that all BB-PPDR network elements (e-NodeB + UE) might apply all RF chip-sets and higher layer circuits from the low cost mass market. In studying ITU-R RESOLUTION 646 (Rev.WRC-15), resolves 2:...to encourage administrations to consider parts of the frequency range 694-894 MHz, as described in the most recent version of Recommendation ITU-R M.2015, when undertaking their national planning for their PPDR applications, in particular broadband, in order to achieve harmonization, taking into account.....

We notice, that the 700 MHz band is positioned within the specified tuning range in this ITU-R Resolution and relevant recommendation and that therefore the duplex MFCN part (2x30 MHz) can fulfil the requirements for BB-PPDR.

MSI therefore recommends ComReg to focus on BB-PPDR implementations based on Option 3 or Option 2 and 3 of Table 1.

2.15 bullet number one: WBB and BB-PPDR services in the 700 MHz Duplex (MFCN). Furthermore, MSI take the view that spectrum aggregation in products for a niche market (a piece in UHF, a piece in 700 MHz) in order to achieve a calculated total of spectrum demand (ECC Report 199) is a somewhat counterproductive idea, (2.17) as it makes the market niche even deeper and more difficult to access (product availability) and RF deployment complexity.

2.22 (p. 28) MSI agrees fully with the statement, in particular if it says:

.....and the wider European and international context.

2.23 (bullet one) : MSI fully agrees

2.23 (bullet two, p. 29): In general MSI does not adhere to speculation, such as: ...

“i.e. reduced capital and operational costs which otherwise are likely to be substantial”

2.23 (bullet three): The most significant information is hidden in the statement:

“...noting that there are other non-monetary considerations to also be considered.”

However, this is unfortunately not spelled out. MSI thinks that this incorporates the upgrading of a commercial grade network to the PPDR dependability and trust requirements all the way from power back-up of base stations and eNodeB to cryptotransparency etc. All very expensive upgrades, which hardly can be incorporated in the business plan of a commercial network.

2.23 (bullet six, p. 29): MSI fully agrees with this decision. MSI is of the understanding that

Sweden considers that awarding the BB-PPDR spectrum to an emergency communications operator is a “Zero-sum-Game”, as the award proceeds later will be charged back to the government for Police and Emergency network subscriptions. As far as we understand: Emergency/PPDR spectrum should remain a state asset.

2.23 (bullet 7): MSI thinks that this will lead to further fragmentation of the BB-PPDR niche market.

2.25 (bullet 1): MSI recognizes, that any data calculation is likely to be overtaken by applications in the near future and that even if the theoretical LEWP model demand calculation resulted in 2x6 MHz of spectrum, it would be more effective to implement in a single band vs. splitting spectrum across bands and aggregating them.

2.25 (bullet 2, p. 30): MSI agrees with the 700 MHz part of it.

2.26 (p. 31): MSI view is that should the government decision be to allocate 2x5 or 2x10MHz (option 3 in Table 1) in 700 MHz for BB-PPDR, the remaining blocks can be awarded on 2x5 MHz blocks basis to operators without restricting anyone from acquiring adequate 2x (2x5 MHz). In addition, a combination based on Option 2 and Option 3 (Table 1 under 2.25) enables an effective 2x5 in the MFCN + 2x3 in the gap (3GPP Band 28B) contiguous block (i.e. 738-736 / 783-791 MHz). While EU Decision 2017/899 considers the 700 MHz a key band for 5G coverage, MSI view is that 5G capacity is likely to be fulfilled in higher bands including 2.5-2.69 GHz and 3.4-3.8 GHz and other mmWave bands for enhanced mobile broadband (eMBB) experience. 700 MHz offers at best what is achievable with LTE in 800 MHz. The historical band 900 MHz is also expected to be refarmed from 2G/3G to allow for 5G coverage in near future.

Further comments to the observations regarding the LS Telcom Report

2.30 (p. 32): Care should be taken (1st sub-bullet) comparing coverage characteristics of UHF TETRA and possible BB-PPDR in the UHF band based on the most recent AAS and MIMO LTE technology and standards. In regard to the 410-430 MHz band option for BBPPDR for LTE/BB-PPDR, currently there is no ecosystem supporting this band and that new 3GPP specifications for LTE bands in this range have been just completed. Typically, commercialization of bands and development of ecosystem for bands when driven by niche market such as PPDR is relatively slower than for those in harmonized MFCN arrangements for the provision of ECS (Electronic Communication Services) .

2.31 (p. 33): *MSI is of the opinion, that identification of 700 MHz duplex for LTE & 5G NR is an advantage for eventual BB-PPDR implementations, which will benefit from state-of-the art technology under the MFCN umbrella but notes that such benefit is dependent on timing and finally the decision on which spectrum option for 700 MHz BB-PPDR is adopted as commercialization of LTE or NR in parts of the band is yet to happen.*

2.32: *Furthermore, having served the DTT sector for many years with excellent rural coverage and indoor penetration is a further advantage for possible new BB-PPDR implementations in 700 MHz Duplex.*

3 Assessment of BB-PPDR-related responses to ComReg Document 19/59R

3.1 Impact from received responses

In this section we assess in detail the respondents' views in respect of ComReg Document 19/59R and the LS telcom report (ComReg Document19/59e).

Comment number	Comment	Heading
No number	<i>Eir, Vodafone, Three and Motorola responses on the quantum of 700 MHz Duplex spectrum to include in the proposed award</i>	<i>Quantum of 700 MHz Duplex in the Proposed Award</i>
1	<i>We notice, that the 700 MHz band is positioned within the specified tuning range in this ITU-R Resolution and relevant recommendation and that therefore the duplex MFCN part (2x30 MHz) can fulfil the requirements for BB-PPDR. MSI therefore recommends ComReg to focus on BB-PPDR implementations based on Option 3 or Option 2 and 3 of Table 1</i>	<i>Dedicating spectrum in the 700 MHz Band for BB-PPDR</i>
2	<i>MSI take the view that spectrum aggregation in products for a niche market (a piece in UHF, a piece in 700 MHz) in order to achieve a calculated total of spectrum demand (ECC Report 199) is a somewhat counterproductive idea, (2.17) as it makes the market niche even deeper and more difficult to access (product availability) and RF deployment complexity.</i>	<i>The 400 MHz Band and the market for BB-PPDR</i>
3	<i>2.23 (bullet two, p. 29): In general MSI does not adhere to speculation, such as: ... "i.e. reduced capital and operational costs which otherwise are likely to be substantial"</i>	<i>Other comments</i>
4	<i>2.23 (bullet three): The most significant information is hidden in the statement: "...noting that there are other non-monetary considerations to also be considered."</i>	<i>Other comments</i>
5	<i>2.23 (bullet six, p. 29): MSI fully agrees with this decision. MSI is of the understanding that Sweden considers that awarding the BB-PPDR spectrum to an emergency communications operator is a "Zero-sum-Game", as the award proceeds later will be charged back to the government for Police and Emergency network</i>	<i>Other comments</i>

	<i>subscriptions. As far as we understand: Emergency/PPDR spectrum should remain a state asset.</i>	
6	<i>2.23 (bullet 7): MSI thinks that this will lead to further fragmentation of the BB-PPDR niche market.</i>	<i>The 400 MHz Band and the Market for BB-PPDR</i>
7	<i>2.25 (bullet 1): MSI recognizes, that any data calculation is likely to be overtaken by applications in the near future and that even if the theoretical LEWP model demand calculation resulted in 2x6 MHz of spectrum, it would be more effective to implement in a single band vs. splitting spectrum across bands and aggregating them.</i>	<i>Other comments</i>
8	<i>2.26 (p. 31): MSI view is that should the government decision be to allocate 2x5 or 2x10MHz (option 3 in Table 1) in 700 MHz for BB-PPDR, the remaining blocks can be awarded on 2x5 MHz blocks basis to operators without restricting anyone from acquiring adequate 2x (2x5 MHz). In addition, a combination based on Option 2 and Option 3 (Table 1 under 2.25) enables an effective 2x5 in the MFCN + 2x3 in the gap (3GPP Band 28B) contiguous block (i.e. 738-736 / 783-791 MHz). While EU Decision 2017/899 considers the 700 MHz a key band for 5G coverage, MSI view is that 5G capacity is likely to be fulfilled in higher bands including 2.5-2.69 GHz and 3.4-3.8 GHz and other mmWave bands for enhanced mobile broadband (eMBB) experience. 700 MHz offers at best what is achievable with LTE in 800 MHz. The historical band 900 MHz is also expected to be refarmed from 2G/3G to allow for 5G coverage in near future.</i>	<i>Dedicating spectrum in the 700 MHz Band for BB-PPDR</i>
9	<i>2.32 (p. 32): Care should be taken (1st sub-bullet) comparing coverage characteristics of UHF TETRA and possible BB-PPDR in the UHF band based on the most recent AAS and MIMO LTE technology and standards. In regard to the 410-430 MHz band option for BBPPDR for LTE/BB-PPDR, currently there is no ecosystem supporting this band and that new 3GPP specifications for LTE bands in this range have been just completed. Typically, commercialization of bands and development of ecosystem for bands when driven by niche market such as PPDR is relatively slower than for those in harmonized MFCN arrangements for the provision of ECS (Electronic Communication Services)</i>	<i>The 400 MHz Band and the Market for BB-PPDR</i>
10	<i>2.31 (p. 33): MSI is of the opinion, that identification of 700 MHz duplex for LTE & 5G NR is an advantage for eventual BB-PPDR implementations, which will benefit from state-of-</i>	<i>Dedicating spectrum in the 700 MHz Band for BB-PPDR</i>

	<i>the art technology under the MFCN umbrella but notes that such benefit is dependent on timing and finally the decision on which spectrum option for 700 MHz BB-PPDR is adopted as commercialization of LTE or NR in parts of the band is yet to happen.</i>	
11	<i>2.32: Furthermore, having served the DTT sector for many years with excellent rural coverage and indoor penetration is a further advantage for possible new BB-PPDR implementations in 700 MHz Duplex.</i>	<i>Dedicating spectrum in the 700 MHz Band for BB-PPDR</i>

Table 1: Summary table of responses to ComReg Document 19/59R and LS telcom report 19/59e

We have grouped and assessed together Motorola’s response under the following (self-explanatory headings):

- Quantum of 700 MHz Duplex in the proposed award
- Dedicating spectrum in the 700 MHz Band for BB-PPDR
- The 400 MHz Band and the market for BB-PPDR
- Other comments

We review the specific comments and assess whether further action is necessary.

3.1.1 Quantum of 700 MHz Duplex in the proposed award

We note that respondents generally agree with ComReg’s proposal to include 2 x 30 MHz of 700 MHz Duplex spectrum in the Proposed Award, which is also the view set out in the conclusions section of our report:

“Given the option of dedicating some spectrum for PPDR in the 700 MHz duplex band, or making available the whole of the band to wireless broadband services, it is the latter option (i.e. making available 2 x 30 MHz for the provision of wireless broadband services in Ireland) that would appear to be the optimal use of the 700 MHz duplex given the availability of alternative spectrum options for PPDR” (Source: Section 5.3 of ComReg Document 19/59e)

3.1.2 Dedicating spectrum in 700 MHz Band for BB-PPDR – (1, 8, 10, 11)

Noting the responses under this heading (comments 1, 8, 10 and 11), we observe that the matters raised by MSI have been comprehensively considered in our report as outlined below and are thus of the view that no update of our report is required.

- In Section 4.3.3 of our report we note that the 700 MHz Options 2 and 3 (2 x 5 MHz/10 MHz, Band 28) are both attractive options for BB-PPDR, particularly given the harmonised status of the 700 MHz band and the extensive device ecosystem.
- In Section 4.4 of our report, we discussed in detail that there would be significant opportunity costs associated with allocating a portion of the 700 MHz Duplex (Option 3) for BB-PPDR. In that section, we considered whether:
 - (i) the 700 MHz band would be required in order to provide 5G services (Section 4.4.2.2). Among other things we observed that “5G roll-out will also eventually take place in existing bands such as 800 MHz, 1800 MHz, and 2.1 GHz. However, an operator

- without 700 MHz or reduced 700 MHz spectrum would likely need to re-farm other sub-1 GHz bands to support 5G services over wider areas in the nearer term.”; and*
- (ii) the 700 MHz band would be needed to improve rural connectivity (Section 4.4.3.2). Among other things we observed that *“Spectrum in the 700 MHz band is particularly important for providing rural coverage and on major terrestrial routes because it balances a number of attractive features:*

- *For a given power, it provides wider area coverage and better in-building penetration than higher frequency spectrum; and*
- *Compared to higher frequency spectrum, its propagation is less affected by obstacles such as walls, trees, and weather related obstacles (such as rain and fog).*

“Further, in combination with other licensed bands (i.e. 800 and 900 MHz) the 700 MHz band can provide extended coverage, higher speeds and reduce network costs.”

- We summarised our conclusions on the spectrum options for 700 MHz in Section 4.5 which outlines the following:

5G rollout:

- (i) The use of the 700 MHz band is important to provide for **timely and efficient rollout of 5G** in line with the 5G Action Plan.
- (ii) There are **no alternative sub 1 GHz bands likely to become available in the next decade** that could provide near-term 5G services over wide areas. Whilst operators could refarm existing sub 1 GHz holdings, the transition to 5G will take time to ensure that existing services on these bands are not disrupted.

Rural connectivity:

- (i) According to a variety of measures, Ireland has one of the most widely distributed and rural populations in Europe. Ensuring the fullest use of **the 700 MHz duplex for wireless broadband services would help deliver rural connectivity** and is particularly important in Ireland.
- (ii) The use of the 700 MHz band is important to allow operators to provide higher speed services in **rural areas and along major transport routes**.

Reduced spectrum outcomes:

- (i) Not making the full 700 MHz duplex available may restrict one (or more) operators' ability to provide a full range of services, as a reduced assignment of the 700 MHz duplex would likely increase the network costs of providing wide-area coverage.
- We summarised the viable options (Section 4.6) and considered that, while Option 3 would be beneficial in the event of a dedicated BB-PPDR network, this has significant alternative use impediments as the 700 MHz duplex band is important for future mobile broadband services, in particular delivering 5G and services to Ireland's rural communities.

3.1.3 The 400 MHz band and the market for BB-PPDR– (2, 6, 9)

Considering the responses under this heading (comments 2, 6 and 9), we note that the matters raised by MSI are already addressed in our report and no further update is necessary.

- The report considers the deployment and spectrum options for BB-PPDR including use in the 400 MHz band from an international, European and national perspective using a wide range of

information including harmonisation status, spectrum availability, ecosystem development and deployment approaches in other countries.

- In Section 3 of our report, we analyse the international situation and observed that, on account of varying national circumstances, there is no one approach to the provision of spectrum for BB-PPDR. Many European states are exploring various spectrum and deployment options to meet their respective needs.
- In relation to the spectrum in the 400 MHz band (410-430 MHz and 450-470 MHz), we noted in various sections of our report (see Section 2.3, Section 3 and Section 4.3 of the report) that:
 - With the amendments to ECC Decision (16)02, both the 410-430 MHz band and the 450-470 MHz band are now harmonised spectrum options for BB-PPDR; and
 - A number of countries are considering dedicating spectrum in these bands for BB-PPDR. For the 410-430 MHz this was under consideration by three other European countries (Czech Republic, Hungary and Slovenia). For the 450-470 MHz band, this was under consideration by 5 other European countries (France, Germany, Hungary, Slovenia and Sweden).
- Nordic Telecom, an operator in the Czech Republic, announced that it was developing an LTE network for critical communications in the 410-430 MHz band.
- No decision has yet been made regarding future BB-PPDR deployment in Ireland and the proposal by ComReg to set aside 2 x 3 MHz in the 410-430 MHz range for potential future BB-PPDR allows for flexibility in that decision process.

3.1.4 Other comments – (3, 4, 5, 7)

The remaining comments were quite varied in nature and we have grouped them together in this section for assessment.

Comment 3 – The text “*reduced capital and operational costs which otherwise are likely to be substantial*” in our report is informed by among other things the costing studies in a number of countries, - Denmark, Norway and Sweden – which show that the economic costs of deploying PPDR services on a commercial network are significantly lower than the costs of building a dedicated network. (See Section 3 of our report).

Comment 4 – MSI’s comment relates to the considerations associated with the use of a commercial network for BB-PPDR and specifically refers to the upgrading of a commercial grade network to PPDR dependability and trust requirements. Such monetary and non-monetary considerations associated with the commercial deployment model are considered in our report (see for example Figure 3 in Section 2.2.2) which among other things notes that:

- “*some additional capital investment costs may be needed to ‘harden’ the network in certain strategic locations where resilience and availability is paramount e.g. stadiums, metro systems, airports.*”;

Comment 5 – In Section 3.3.13 of our report we outlined the developments for BB-PPDR spectrum in Sweden.

Comment 7 – Carrier aggregation, or the use of a single band versus splitting spectrum across multiple bands, was not discussed in our report as among other things there is limited information available on the use of carrier aggregation for the delivery of BB-PPDR services. Notwithstanding this, we note that:

- Our conclusion that Options A to F (see table below) are technically-viable spectrum options remains valid.

• Option	Amount of Spectrum	410 – 430 MHz	700 MHz Option 1	700 MHz Option 2	700 MHz Option 3
A	2 x 6 MHz	2 x 3 MHz		2 x 3 MHz	
B	2 x 8 MHz	2 x 3 MHz	2 x 5 MHz		
C	2 x 8 MHz		2 x 5 MHz	2 x 3 MHz	
D	2 x 8 MHz	2 x 3 MHz			2 x 5 MHz
E	2 x 8 MHz			2 x 3 MHz	2 x 5 MHz
F	2 x 10 MHz				2 x 10 MHz

Table 2: Technically viable spectrum options to meet the identified requirement

- In relation to Options D, E, F, we note that the use of carrier aggregation does not change our observation that these options have significant alternative use impediments as the 700 MHz duplex band is important for future mobile broadband services and in particular delivering 5G and services to Ireland’s rural communities.
- In relation to Options A, B, C, we note that for a dedicated network these options appear to be the options which are being most closely considered by those countries examined in our international analysis (see Section 3 of our report). In our international analysis we noted that there is no one approach to the delivery of BB-PPDR services, and that many European states are exploring various spectrum and deployment options to meet their respective needs including the use of multiple spectrum bands.
- While carrier aggregation has not yet been standardised between the 410-430 MHz and 700 MHz bands (see for example the 3GPP portal for [specification 3GPP TS 36.101](#)), future developments could see carrier aggregation possibilities for this band.

3.2 Overall assessment

Having considered the BB-PPDR-related responses to ComReg Documents 19/59R and 19/59e, including each of Motorola's specific comments, it is our view that there is no materially new information that would necessitate changes to the findings of our report and no update of that report is therefore required.

Consequently, our conclusions regarding the BB-PPDR spectrum options remain as set out in section 5 of our report on "Study on Terrestrial Broadband Public Protection and Disaster Relief (BB-PPDR) Spectrum Options" (ComReg Document 19/59e).