Compatibility analysis of SDL operating in 1452-1492 MHz with Fixed Links operating above 1492 MHz in the UK

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Table of Contents

1. Executive summary ... 6

2. Background to the study ... 9

3. Analysis of existing Fixed Links ... 10

3.1 FLs overview ... 10

3.2 FLs distribution per Carrier Spacing ... 10

3.3 FLs distribution per geotype ... 11

3.4 FLs in urban areas ... 11

3.5 FLs in main metropolitan areas ... 12

3.6 FL distribution per link length ... 12

4. Criteria for compatibilty studies between users in adjacent bands ... 13

4.1 Net Filter Discrimination (NFD) ... 13

4.2 Extended Net Filter Discrimination (Extended NFD) ... 14

4.3 LTE OOBE and FL selectivity ... 15

5. Minimum Coupling Loss (MCL) analysis ... 18

5.1 SDL Transmitters ... 18

5.1.1 SDL Out-of-Band EIRP ... 18

5.2 FL Receivers ... 20

5.2.1 FL Rx selectivity ... 20

5.3 MCL modelling ... 26

5.3.1 Interference geometry ... 26

5.3.2 Propagation model and path loss ... 28

5.3.3 Antenna configurations pathloss ... 29

5.3.4 Current licence OOBE limits ... 31

5.4 MCL study results ... 33

5.4.1 FL 25 kHz ... 36

5.4.2 FL 75 KHz ... 41

5.4.3 FL 250 kHz ... 48

5.4.4 FL 500 KHz ... 54

5.4.5 FL 1 MHz ... 60
5.4.6 FL 2 MHz ... 66
5.4.7 FL 3.5 MHz ... 72
5.5 MCL analysis conclusion ... 76
6. Full network simulation for the London area ... 80
6.1 London area ... 80
6.2 Assumptions and methodology ... 80
6.3 Simulation results ... 82
6.4 Consideration of assumptions, propagation model and worst case analysis ... 83
6.4.1 Location of LTE SDL BSs ... 83
6.4.2 Propagation model ... 84
6.5 Conclusion for London and other urban areas ... 84
7. Rural area analysis ... 86
7.1 Critical use case - Fixed Link 787 ... 86
7.1.1 Planning – antenna downtilt ... 88
7.1.2 Filtering in specific cases ... 89
7.2 Typical use case - Fixed Link 148 ... 90
7.3 Conclusion of the rural analysis ... 92
8. Assignment and compatibilty of future FLs ... 93
8.1 Analysis assumptions ... 93
8.1.1 Propagation assumptions ... 93
8.1.2 Coexistence distance ... 93
8.1.3 FL Rx interference level ... 93
8.2 Optimal frequency range for deployment without coordination ... 93
8.2.1 Identification of optimal frequency range ... 93
8.2.2 FL channels available in 1498.5 – 1517 MHz ... 95
8.2.3 Analysis of current deployment vs 1498.5 MHz ... 95
8.2.4 Conclusion on the border above which coordination is not required ... 99
8.3 Filtering requirements for SDL BS and FL Rx ... 100
8.3.1 SDL BS filtering requirement ... 100
8.3.2 FL Rx filtering requirement ... 101
8.4 Minimum coexistence distance and FL antenna gain ... 102
8.4.1 Coexistence/clearance distance for all antennas ... 102

8.4.2 Coexistence/clearance distance in the side lobe ... 103
8.5 Conclusion for compatibility with future FLs ... 103
8.5.1 Frequency range for new FL deployment without coordination ... 103
8.5.2 SDL OOBE mask ... 104
8.5.3 Future FLs filtering requirement ... 104
8.5.4 Coexistence/clearance distance ... 105
9. Conclusion ... 106
10. References ... 108
11. Acronyms ... 109
12. Annex 1: Varied license SDL technical conditions ... 110
12.1 Max EIRP ... 110
12.2 Block Edge Mask ... 110
12.3 Maximum Out-of-Band EIRP ... 110
12.4 Band plan ... 110
13. Annex 2: SDL Out-Of-Band EIRP ... 111
14. Annex 3: SDL antenna model ... 117
15. Annex 4: FL antenna model ... 119
15.1 FL antenna model for the MCL analysis ... 119
15.2 FL antenna MCL sensitivity analysis ... 119
15.3 FL antenna model for the London analysis ... 122
16. Annex 5: Rx Preselect filters for existing FLs ... 124
16.1 Feasibility and performance ... 124
16.2 Practicalities of installation ... 127
17. Annex 6: Rx Preselect filters for future FLs ... 130
17.1 Filter requirements ... 130
17.1.1 FL radio configuration: single filter and Rx/Tx duplexers ... 130
17.1.2 FL channels ... 130
17.1.3 SDL rejection (FL Preselect filter) ... 131
17.1.4 FL Transmit filter requirements (for FLs duplexers) ... 131
17.2 Filter specifications ... 132
17.3 Filters and duplexers performance, cost and size ... 133
17.3.1 Filter cost ... 134
17.3.2 Rx/Tx duplexer cost ... 135

17.3.3 Size ... 137
18. Annex 7: SDL Tx filter ... 138
19. Annex 8: FL Rx channel filter model ... 145
20. Annex 9: Sensivity analysis of London full network simulation to propagation model ... 149
21. Annex 10: Reference tables for Extended NFD ... 151
21.1 LTE EIRP = 74 dBm/20MHz ... 151
21.1.1 FL CS 3.5 MHz ... 151
21.1.2 FL CS 2 MHz ... 151
21.1.3 FL CS 1 MHz ... 152
21.1.4 FL CS 500 KHz ... 152
21.1.5 FL CS 250 KHz ... 153
21.1.6 FL CS 75 KHz ... 155
21.1.7 FL CS 25 KHz ... 161
21.2 LTE EIRP = 68 dBm/20MHz ... 178
21.2.1 FL CS 3.5 MHz ... 178
21.2.2 FL CS 2 MHz ... 179
21.2.3 FL CS 1 MHz ... 179
21.2.4 FL CS 500 KHz ... 180
21.2.5 FL CS 250 KHz ... 181
21.2.6 FL CS 75 KHz ... 182
21.2.7 FL CS 25 KHz ... 188
21.3 LTE EIRP = 65 dBm/20 MHz ... 206
21.3.1 FL CS 3.5 MHz ... 206
21.3.2 FL CS 2 MHz ... 206
21.3.3 FL CS 1 MHz ... 206
21.3.4 FL CS 250 KHz ... 207
21.3.5 FL CS 250 KHz ... 208
21.3.6 FL CS 75 kHz ... 210
21.3.7 FL CS 25 kHz ... 216
22. Annex 11: FL noise floor ... 234
23. Annex 12: Classification of FLs per geotype around FL Rx ... 235

1. EXECUTIVE SUMMARY

On 8th November 2013, the European Conference of Postal and Telecommunications Administrations (CEPT) approved ECC Decision (13)03 on “the harmonised use of the frequency band 1452-1492 MHz for Mobile/Fixed Communications Networks Supplemental Downlink” [3]. On 22nd November, Qualcomm sought a variation by Ofcom to its Licence for the 1452-1492 MHz spectrum band to modify some of the technical conditions contained in the Licence to ensure that Supplemental Downlink (SDL) can be deployed in the United Kingdom (UK) in accordance with the European harmonised technical rules as defined in the ECC Decision. Specifically, Qualcomm requested changes to the out-of-band emission limits, the in-band power limits and to the limit on the maximum number of SDL Base Stations (BSs).

In the UK, Fixed Links (FLs) operate in the 1492.5-1517 MHz spectrum band which is adjacent to 1452-1492 MHz. The ECC considered the co-existence between SDL and FLs and concluded, in its Decision, that it would be adequately managed through relevant coordination procedures which may include additional technical and operational conditions such as frequency-territorial planning depending on national circumstances. Qualcomm has undertaken this study to assess any interference issue into FLs which may arise from the use of 1452-1492 MHz for SDL in the UK based on the varied licence technical terms and to determine the solutions which ensure compatibility between SDL deployment in 1452-1492 MHz and existing and future FLs above 1492.5 MHz. The conclusion of the study is that we are confident that SDL deployment in 1452 – 1492 MHz (with the revised technical conditions summarised in Annex 1) is compatible with FL deployment above 1492.5 MHz, when implementing sound and standard network planning and engineering practices.

Our work started by scrutinizing the 851 FLs referenced in the Ofcom’s database to determine their technical characteristics, their distribution per Carrier Spacing (CS) and their distribution in urban, suburban and rural environments. We also talked with FLs equipment vendors and analysed available literature. We studied FLs assignment criteria as defined by Ofcom in OfW446 [1] with the aim to develop solutions and recommendations that are consistent with the current assignment procedures. A coherent set of interference criteria for the compatibility between SDL and FLs in adjacent bands based on Extended Net Filter Discrimination (Extended NFD) were determined.

We then carried out a Minimum Coupling Loss (MCL) analysis between SDL BS operating in 1472-1492 MHz and FLs deployed above 1492.5 MHz. An MCL analysis is a commonly used methodology which allows for determining any potential interference issue and appropriate mitigation solutions. In our MCL analysis, we have considered all type of FLs CSs (25 KHz, 75 KHz, 250 KHz, 1 MHz, 2 MHz and 3.5 MHz), a representative set of FLs channels within 1492.5-1517 MHz, all kind of geotypes (urban, suburban and rural) and all interference geometries (main-beam to main-beam and main-beam to side-lobes). We have regularly made sure to use conservative assumptions in the analysis in order not to underestimate any interference risk. The MCL analysis showed that the interference levels are heavily dependent on the scenarios under consideration and the assumptions used. In some cases, the interference from SDL into FLs would not exceed an I/N of -12 dB. In some other cases, the level of interference would exceed this limit. However, the MCL analysis further demonstrated that even under worst cases, standard network planning practices and filtering at the SDL transmitter and/or the FL receiver decreases the interference to levels that are well below an I/N of -12 dB and adequately mitigate any interference issue which may arise in real life deployment. We have then worked with two filter vendors to design filters that meet the requirements while being feasible, available and also practical to install. The MCL analysis allowed us to conclude that the compatibility between SDL deployment in 1452-1492 MHz and FLs operating above 1492.5 MHz can be achieved in all environments, for all FL channels and for all FLs carrier spacing based on sound engineering practices and through available and well proven mitigation techniques such as filtering.

The next phase of our work consisted in determining the interference levels and the scale of implementation of the identified mitigation solutions using simulations methods that reflect more closely real life SDL deployment both in urban and rural areas.

The Atoll Wireless Network Engineering Software has been used to simulate a typical LTE SDL network in the London area, where the density of FLs is the highest with 23 FLs currently in operation. The location of the SDL BSs, their transmit power as well as their antenna pointing closely mirror a typical SDL network. More than 2600 fully loaded SDL BSs have been modelled. The exact location, antenna height and antenna azimuth of all 23 FLs have also been used. The simulation showed that the interference levels into all 23 FLs is well below the noise floor; only 3 FLs, out of 23 FLs, would require special attention from the SDL operator when engineering its network as those FLs would experience an interference within 12 dB below the noise floor. For those 3 FLs, adding Tx filtering, if required in real life deployment, in the few key base stations surrounding these 3 FLs would be sufficient to ensure that the interference remains below an I/N of -12 dB. The detailed modelling of the London area leads to the conclusion that an SDL operator can engineer and deploy a fully loaded SDL network in 1452-1492 MHz in full compatibility with all FLs currently in operation above 1492.5 MHz in urban areas based on standard and sound engineering practices and using if required in some limited cases filtering.

We have then carried out a second analysis to look at how an SDL operator can plan its network in 1452-1492 MHz and roll it out in full compatibility with the FLs deployed in rural areas taking into account the FLs referenced in Ofcom's database. Two use cases based on actual and operational FLs have been selected to illustrate such an approach. The former corresponded to a challenging scenario where the FL operates at a low number channel (channel 2) and is located near and in parallel to a motorway (M74) which may require coverage from an SDL BS. The latter is a typical use case where the FL is deployed about 50km west of Middlesborough. The conclusion of this analysis is that for the vast majority of FL channels, the geographical area where an SDL operator would have to assess interference risks before deploying BSs are so small, that they would have a negligible impact on network planning and deployment. For the few extremely challenging cases, the zones where the SDL operator should pay special attention may be large. However, simple and standard techniques such as antenna downtilt can by themselves solve most interference issues. Should antenna downtilt not be sufficient, filtering provides a solution that solves in practice all potential interference problems.

The last phase of our work then consisted in determining the conditions to ensure compatibility between SDL BSs deployed in 1452-1492 MHz and future FLs to be deployed above 1492.5 MHz taking into account that FLs assignment process by Ofcom within 1492.5-1517 MHz is automated and FL users' current planning methods are based on ensuring Line of Sight (LOS) clearance between the FL transmitter and receiver. The conclusions of this analysis were that compatibility between SDL and future FLs can be ensured without coordination if Ofcom were to assign new FLs within the 1498.5 – 1517 MHz range, the SDL OOBE mask introduces a 42.5 dB of additional SDL filtering above 1498.5 MHz, new FLs receivers meet appropriate Rx filtering and new FLs users ensure LOS clearance between the transmitter and receiver when installing a new FL.

This extensive compatibility study shows that SDL deployment in 1452-1492 MHz is fully compatible with existing and future FLs deployment above 1492.5 MHz, when adopting the varied SDL technical conditions summarized in Annex 1 and implementing sound and standard network planning and engineering practices.

2. BACKGROUND TO THE STUDY

In November 2013, Qualcomm sought a variation to its spectrum Licence number 0309189, to modify the technical conditions contained in the Licence to enable SDL deployment in the UK in the band 1452-1492 MHz in accordance with the European harmonised technical rules as defined in ECC Decision (13)03. Qualcomm requested changes to the out-of-band emission limits, to the in-band power limits and to the limit on the maximum number of SDL BSs.

In the UK, 851 FLs operate in the 1492.5-1517 MHz spectrum band which is adjacent to 1452-1492 MHz. Furthermore, a need for additional future FLs in the band, especially in rural areas, has been identified.

This study aims to assess any interference issues into existing and future FLs which may arise from the use of 1452-1492 MHz for SDL according to the varied technical conditions and to determine the solutions which can ensure the compatibility between SDL deployment in 1452-1492 MHz and existing and future FLs above 1492.5 MHz.

3. ANALYSIS OF EXISTING FIXED LINKS

Fixed Links are deployed in the UK as duplex links with one link direction operating in 1350-1375 MHz and the other link direction operating in 1492.5 – 1517 MHz. As the study focuses on coexistence between systems at the 1492-1492.5 MHz frequency border, the analysis of the database focuses on the duplex direction with FL reception in 1492.5-1517 MHz. As such, all the Fixed Links in the Ofcom's database have been analysed and classified according to the position of the Fixed Link station receiving in 1492.5-1517 MHz.

3.1 FLs overview

The positions of all 851 FLs operating in the band have been identified. The location of FLs in Northern Scotland and south west England is shown in Figure 1 for illustration purposes. Red markers indicate FL station receiving in 1492.5-1517 MHz. Blue markers indicate FL station transmitting in 1492.5-1517 MHz.

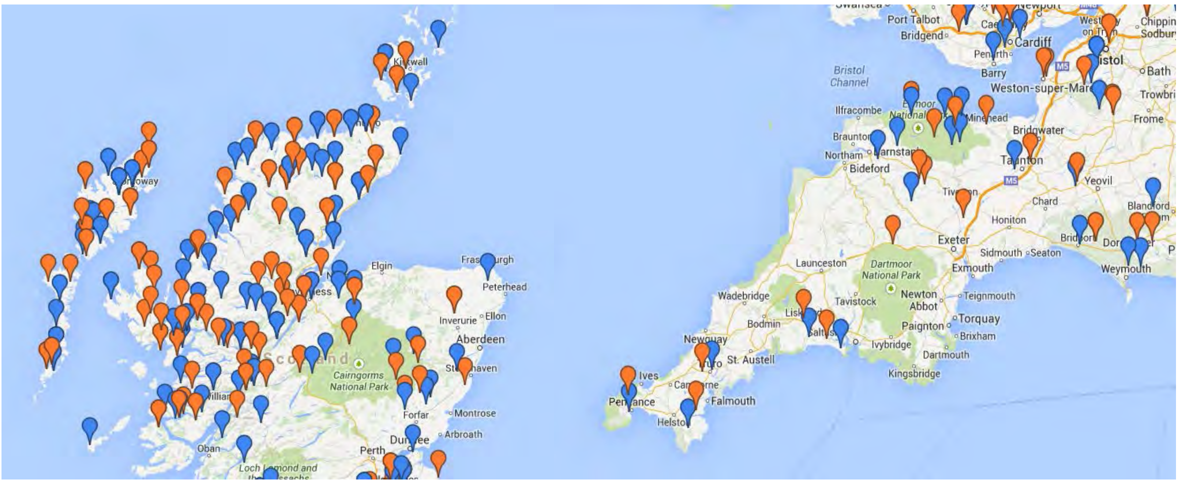


Figure 1: Location of FLs, throughout UK in Northern Scotland and south west England, shown for illustration purposes

3.2 FLs distribution per Carrier Spacing

The distribution of FLs per Carrier Spacing (CS) is as follows:

Carrier Spacing (MHz)	Number of FLs	Number of FLs on channel 1[1]
All	851	95
0.025	None	None
0.075	21	6
0.25	177	28
0.5	323	30
1	41	2
2	286	28
3.5	3	1

Table 1: FL distribution per Carrier Spacing

[1] The first FL channel above 1492.5 MHz as defined in OfW446

3.3 FLs distribution per geotype

It is further possible to classify the FLs according to the location of the FL receiving (Rx) station. The number of FL links for which the Rx station is in Urban, Suburban or Rural environment was estimated by visual inspection of the surrounding of the FL Rx station. FL Rx stations located more than 1 km from a significant continuous habitat zone was considered rural. FL Rx stations located within surrounding exclusively urban were considered urban, while all other stations were considered suburban. Some FLs were found to be located at sea, most likely on off-shore platforms. These FLs are not considered relevant for the study. The resulting classification proposed for the 851 links is provided in Section 23.

Geotype	Number of FLs
Urban	53
Suburban	273
Rural	467
Sea	58

Table 2: FL distribution per geotype

3.4 FLs in urban areas

There are 53 FLs deployed in urban areas. They are shown for illustration purposes in Figure 2. 23 of these FLs are in the London metropolitan area.

Figure 2: Location of 53 FLs deployed in urban areas, shown for illustration purposes

3.5 FLs in main metropolitan areas

In addition to the FLs in urban areas, some suburban FLs are also deployed in the suburbs of the UK main metropolitan areas. The table below provides an overview of the number of FLs deployed in a given metropolitan area.

London	23 FLs in total, with 16 FL Rx sites (See Section 6).
Manchester	0
West Midlands (Birmingham)	3 FLs (26, 210, 495)
New Yorkshire (Leeds)	6 FLs (187, 191, 246, 706, 757, 829).
Liverpool	2 FLs (512, 617)
South Hampshire (Southampton)	8 FLs in 2 FL Rx locations (FL 100 on its own, 393, 568, 569, 614, 615, 616, 622 share single location)
Tyneside (Newcastle)	9 FLs in 6 FL Rx locations (92, 418, 374, 856, 857 on their own, 245, 353, 567 and 587 share single location)
Nottingham	1 FL (FL 608)
Sheffield	2 FLs (717, 838)
Bristol	1 FL (112)
Leicester	1 FL (673)
Brighton	2 FLs (45, 788)
Bournemouth	1 FL (FL 515)
Cardiff	4 FLs in 3 FL Rx locations (152, 436 on their own, 27 and 433 share single location)
Glasgow	5 FLs (817, 818, 819, 820 and 821)817).
Edinburgh	4 FLs in 2 FL Rx locations (390 on its own, 462, 654, 655 share single location)
Belfast	5 FLs (116, 221, 224,451, 505)

Table 3: FLs in metropolitan areas

3.6 FL distribution per link length

Taking into account its good propagation characteristics, the 1.5 GHz is mostly suitable for Fixed Links with very long range. However, the analysis of the FL database shows that, although some FLs operate over large distances, the majority of FLs currently deployed in the 1.4 GHz band operate over short distances.

FL distance	Number of FLs	Remarks
Link Distance < 10km	385	
10 km < Link Distance < 15 km	125	
15 km < Link Distance < 20 km	102	
20 km < Link Distance < 25 km	87	
25 km < Link Distance < 30 km	39	
30 km < Link Distance	113	13 FLs at sea, 86 in rural area.

Table 4: FL distribution per link lengths

4. CRITERIA FOR COMPATIBILTY STUDIES BETWEEN USERS IN ADJACENT BANDS

4.1 Net Filter Discrimination (NFD)

Ofcom uses Net Filter Discrimination (NFD) when performing Fixed Link frequency assignment, as described in OfW446 [1]. NFD provides the combined filtering resulting from the transmitting (Tx) mask and the receiving (Rx) mask of the interference generated by the Tx to the Rx in adjacent channels/band. NFD considers the receiver mask and the transmitter mask over the in-band and out-of-band domain of the systems, i.e. within [fc - 250% CS, fc + 250% CS] where fc is the centre frequency and CS is the carrier spacing of the systems.

Illustration of such typical masks in the in-band and out-of-band domain for LTE 20 MHz Tx centred on 1482 MHz and a Fixed Link with 2 MHz Carrier Spacing (CS) on channel 4 is provided in Figure 3.

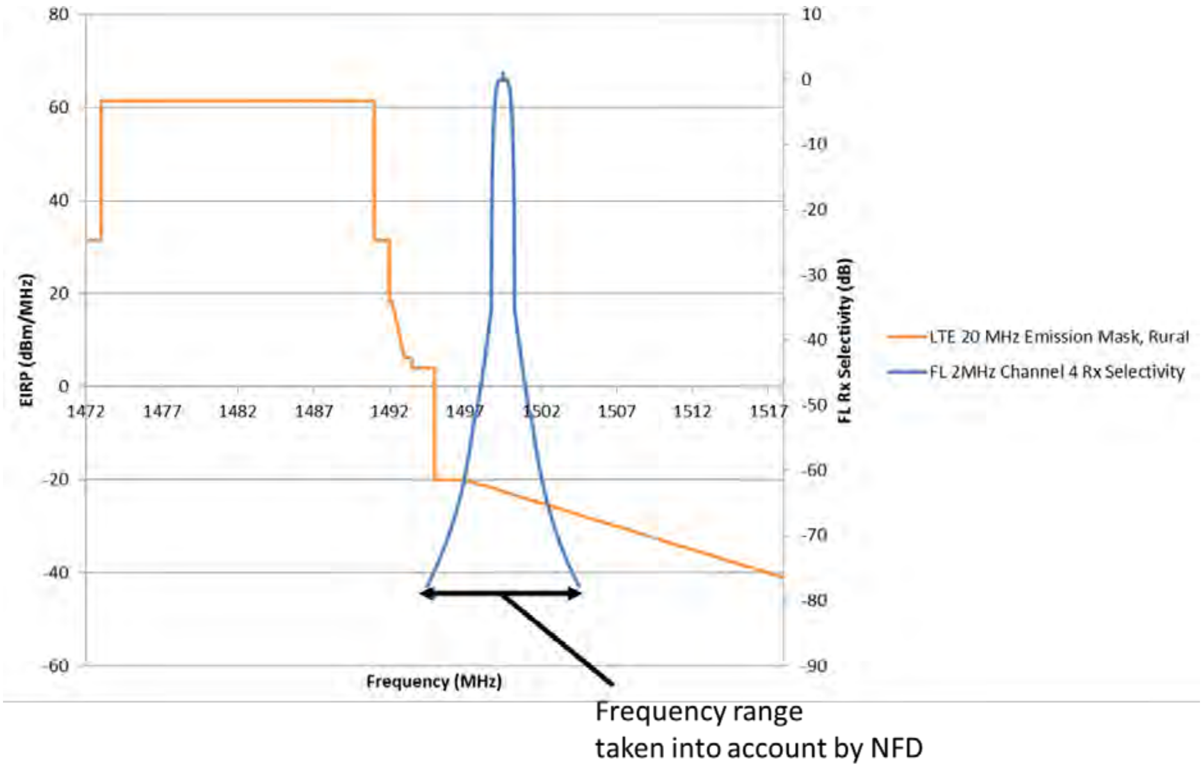


Figure 3: Illustration of LTE Tx and FL Rx masks and frequency range taken into account by NFD

Note that the out-of-band domain of LTE 20 MHz systems with 1482 MHz centre frequency extends up to 1532 MHz, i.e. above 1518 MHz. Therefore, the frequency range relevant for NFD derivation is always determined as the in-band and out-of-band domain of the Fixed Link considered.

While NFD is most appropriate for Fixed Link frequency assignment in-band, it has two drawbacks in the scope of studies related to compatibility between users in adjacent band and any required interference mitigation techniques:

- NFD only considers the in-band and out-of-band domain of the systems considered. In the context of the study, this is particularly critical for the FL Rx mask. Considering the FL Rx mask only over the in-band and out-of-band domain is equivalent to considering that the FL Rx has infinite selectivity over the spurious domain, i.e. completely rejects signals in the spurious domain. In the interference scenarios considered in this document, the FL Rx spurious domain intersects the LTE 20 in-band domain and potential interference over this frequency range should be taken into account[2].

- NFD provides the combined filtering resulting from the Tx mask and the Rx mask. Should the existing NFD prove insufficient to mitigate interference, NFD does not provide indication on whether additional filtering should be implemented at transmitter's end or at receiver's end. As such, NFD would not be an appropriate tool for the identification of interference cause and remedies in the context of SDL network/Fixed Link planning by operators.

4.2 Extended Net Filter Discrimination (Extended NFD)

One of the major shortcomings of NFD, in the context of compatibility studies between users in adjacent bands, is that it does not consider the spurious domain of the systems. In the interference scenarios considered in this study, it is relevant to extend the NFD to an 'Extended NFD' which is derived as the NFD but takes into account the LTE in-band frequency range.

Illustration of the frequency range considered by the Extended NFD for LTE 20 MHz Tx centred on 1482 MHz and a Fixed Link with 2 MHz Carrier Spacing on channel 4 is provided in Figure 4.

[2] In-band and out-of-band domain are within the 250% CS, while the spurious domain is >250% CS

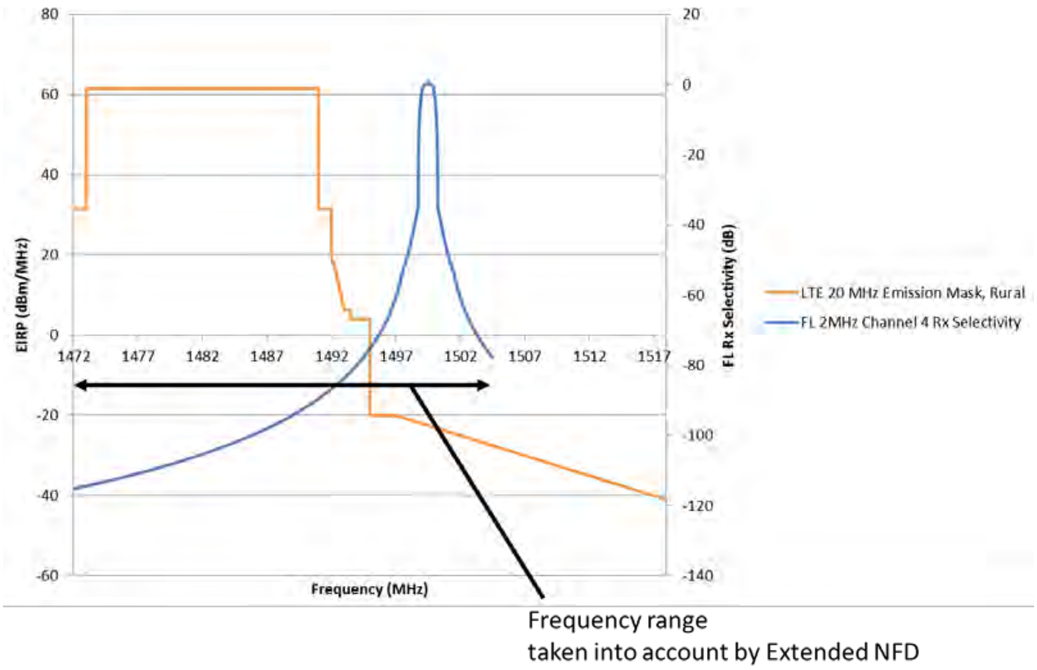


Figure 4: Illustration of LTE Tx and FL Rx masks and frequency range taken into account by Extended NFD

Extended NFD addresses the shortcomings of NFD for Fixed Link frequency assignment, in-band, in the presence of SDL interferers in adjacent band, as it provides an accurate assessment of the combined filtering from LTE Tx and FL Rx.

However, just like NFD, in interference situations, Extended NFD does not provide indication on whether the filtering should be improved at transmitter's end or at receiver's end as it only provides an aggregate interference criterion. In order to provide such insight, 4 different Extended NFDs would need to be considered:

- Extended NFD, Generic (Generic Preselect at FL Rx and generic LTE Tx emission),
- Extended NFD, Hi-Perf Rx (Hi-Perf Preselect at FL Rx and generic LTE Tx emission),
- Extended NFD, Hi-Perf Tx (Generic Preselect at FL Rx and Hi-Perf SDL Tx Filter),
- Extended NFD, Hi-Perf Tx and Rx (Hi-Perf Preselect at FL Rx and Hi-Perf SDL Tx Filter)

Extended NFD will not be applied in the MCL analysis as the aim of the MCL analysis is to identify any interference issue, its source and the appropriate mitigation techniques. Extended NFD will be applied in Section 6 for the "full network simulation for the London Area" to determine the overall interference received by the 23 FLs deployed in London from more than 2600 SDL BSs, in Section 7 for the rural analysis and in Section 8 for the proposed method for Ofcom to assign future FLs. Reference tables for Extended NFD are provided in Section 21.

4.3 LTE OOBE and FL selectivity

The total interference from the LTE to the FL is composed essentially of two components:

- FL Selectivity, i.e. the interference due to the LTE in-band signal attenuated by the FL Rx selectivity,
- LTE OOBE, i.e. the interference due to LTE Out-of-Band Emissions (OOBE) and received in band of the FL Rx.

Illustration of the frequency ranges considered by FL Selectivity and LTE OOBE for LTE 20 MHz Tx centred on 1482 MHz and a Fixed Link with 2 MHz Carrier Spacing (CS) on channel 4 is provided in Figure 5.

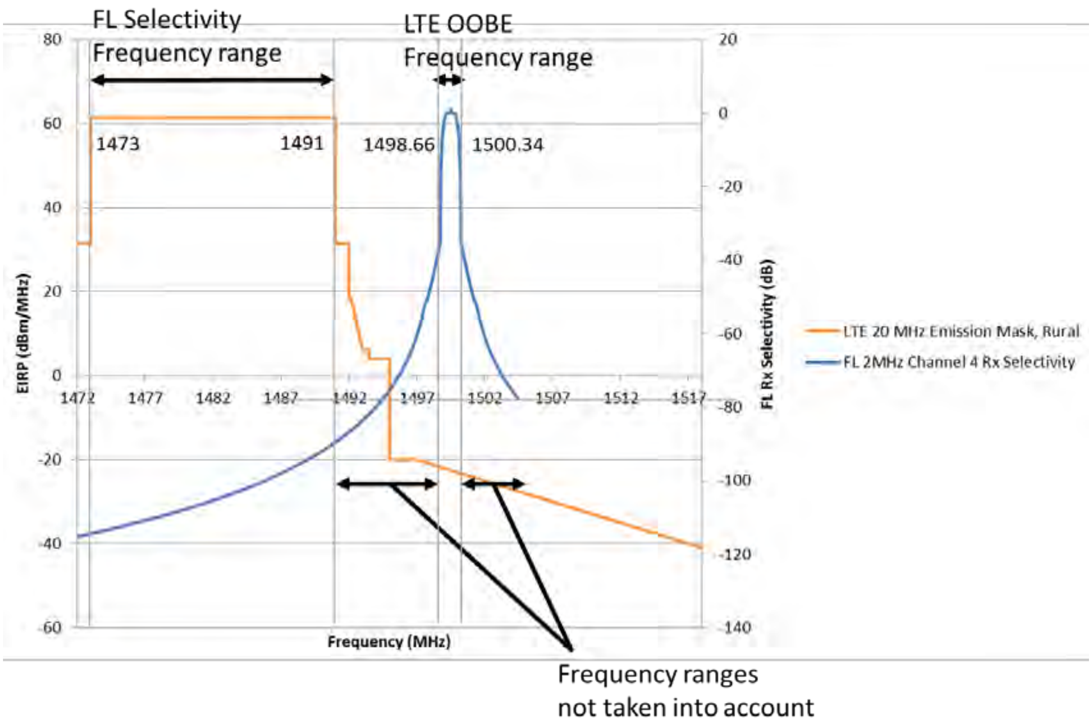


Figure 5: Illustration of LTE Tx and FL Rx masks and frequency range taken into account by LTE OOBE and FL Selectivity

The interference component (frequency range) taken neither by LTE OOBE nor by FL Selectivity into account corresponds to a frequency range where both LTE Tx and FL Rx provide significant filtering, as opposed to LTE OOBE domain where the FL Rx only proposes limited filtering (includes in-band of FL) and FL Selectivity where the LTE Tx proposes close to no filtering (mainly the LTE in-band). The interference component not taken into account is therefore negligible compared to LTE OOBE and FL Selectivity. Figure 5 provides a clear illustration of this aspect. The total theoretical interference received by an FL Rx with 0 dBi antenna in the absence of channel pathloss can therefore be expressed as:

$$I = \text{LTE Total EIRP} - \text{Extended NFD} \approx \text{LTE OOBE} + \text{FL Selectivity}$$

The table below illustrates for one example, how closely the values of I, LTE OOBE, FL Selectivity and LTE OOBE + FL Selectivity are related. The table presents I, LTE OOBE, FL Selectivity and LTE OOBE + FL Selectivity all expressed in dBm for LTE 20 MHz transmitting at 74dBm, centred on 1482 MHz, Fixed Link, 2 MHz CS, channel 4 and generic assumptions. For full details on assumptions see Section 5.

I = LTE EIRP – Extended NFD (dBm)	LTE OOBE (dBm)	FL Selectivity (dBm)	LTE OOBE + FL Selectivity (dBm)
-20.5	-22.4	-24.9	-20.5

Table 5: Illustration of relationship between Extended NFD, LTE OOBE and FL Selectivity

In the scope of the MCL interference analysis, considering separately LTE OOBE and FL Selectivity provides direct insight on whether the LTE Tx filtering, the FL Rx filtering, or both Tx and Rx filtering should be improved.

On the other hand, using LTE OOBE and FL Selectivity requires considering two separate criteria to assess a single interference situation, which would be cumbersome for direct estimation of interference potential. LTE OOBE and FL Selectivity are therefore applied in Section 5 for MCL studies.

5. MINIMUM COUPLING LOSS (MCL) ANALYSIS

5.1 SDL Transmitters

Typical values for SDL Base Stations characteristics have been developed for the purpose of this study based on actual mobile network deployments. They have been determined based on inputs from Qualcomm Engineering Services Group which contributed to the design of commercial LTE800 and UMTS900 networks in the UK and other European countries.

The values are determined for three different geotypes 1) dense urban/urban, 2) sub-urban and 3) rural. This classification in three categories reflects mobile operators' network planning practices.

	Urban	Suburban	Rural
Antenna height	30 m	20 m	20 m
EIRP	59 dBm/5 MHz 65 dBm/20 MHz	62 dBm/5 MHz 68 dBm/20 MHz	68 dBm/5 MHz 74 dBm/20 MHz
Technology	LTE	LTE	LTE
Bandwidth	20 MHz	20 MHz	20 MHz
Antenna gain	17 dBi	17 dBi	17 dBi
Antenna diagram	Section 14	Section 14	Section 14
Antenna tilt	-9	-4	-3
Cell radius	0.5 km	1 km	4 km
Cell density	0.4 cells / km2	0.1 cells / km2	0.00625 cells / km2
Inter-cell distance	1.5 km	3 km	12 km
OOBE	Section 5.1.1	Section 5.1.1	Section 5.1.1

Table 6: SDL Base Stations characteristics

NOTES:

- SDL Base Stations highest EIRP value is 68 dBm/5 MHz. Such high value is used for rural deployment. This value is also aligned with ECC Decision (13)03. In its License variation request, Qualcomm proposed a maximum EIRP value of 72 dBm/5 MHz (6 kW per 1.7 MHz) as this was the value specified by Ofcom for a low-power, high-density licence in the L-Band auction information memorandum. Qualcomm suggests now to specify in its varied licence a maximum EIRP limit of 68 dBm/5 MHz as this value would be in line with the planned SDL deployment and would ease compatibility with fixed links in adjacent band;

- SDL deployment is assumed to be LTE with 20 MHz bandwidth. Any multiple of 5 MHz is possible for an SDL deployment but 20 MHz is the most likely taking into account that an SDL of 20 MHz at 1.5 GHz provides the best technical and economic efficiency;

- Typical antenna tilts have been determined for each geotype. Mobile networks' BS antennas are typically significantly down-tilted in urban areas to optimise coverage and self-interference.

5.1.1 SDL Out-of-Band EIRP

The Out-of-Band Emissions (OOBEs) from an SDL transmitter operating in the 1452-1492 MHz band is subject to the requirements from [2] and [3]. First the OOBEs must comply with the 3GPP standard requirements, as specified in 3GPP TS 37.104, paragraph 6.6.2 "Operating Band Unwanted Emissions". Second are regulatory requirements defined in the

ECC Decision (13)03 for SDL use in this band. The relevant requirements from each are shown in the tables below:

Frequency offset of measurement filter -3dB point, Δf	Frequency offset of measurement filter centre frequency, f_offset	Minimum requirement (Note 1, Note 2)	Measurement bandwidth (Note 4)
0 MHz ≤ Δf < 0.2 MHz	0.015MHz ≤ f_offset < 0.215MHz	-14 dBm	30 kHz
0.2 MHz ≤ Δf < 1 MHz	0.215MHz ≤ f_offset < 1.015MHz	$-14dBm-15\cdot\left(\frac{f\_offset}{MHz}-0.215\right)dB$	30 kHz
(Note 3)	1.015MHz ≤ f_offset < 1.5 MHz	-26 dBm	30 kHz
1 MHz ≤ Δf ≤ min(Δf_{max}, 10 MHz)	1.5 MHz ≤ f_offset < min(f_offset_{max}, 10.5 MHz)	-13 dBm	1 MHz
10 MHz ≤ Δf ≤ Δf_{max}	10.5 MHz ≤ f_offset < f_offset_{max}	-15 dBm (Note 5)	1 MHz
NOTE 1: For MSR BS supporting non-contiguous spectrum operation within any operating band the minimum requirement within sub-block gaps is calculated as a cumulative sum of contributions from adjacent sub-blocks on each side of the sub-block gap. Exception is Δf ≥ 10MHz from both adjacent sub-blocks on each side of the sub-block gap, where the minimum requirement within sub-block gaps shall be -15dBm/MHz. NOTE2: For MSR BS supporting multi-band operation with inter RF bandwidth gap < 20MHz the minimum requirement within the inter RF bandwidth gaps is calculated as a cumulative sum of contributions from adjacent sub-blocks on each side of the inter RF bandwidth gap.			

Table 7: OOBE Requirements from 3GPP TS 37.104

Frequency range of out-of-band emissions	Maximum mean out-of-band e.i.r.p. [dBm]	Measurement Bandwidth [MHz]
Below 1449 MHz	-20 dBm	1 MHz
1449-1452 MHz	14 dBm	3 MHz
1492-1495 MHz	14 dBm	3 MHz
Above 1495 MHz	-20 dBm	1 MHz

Table 8 : OOBE Requirements from ECC Decision (13)03

The OOBE model used in this MCL study is therefore composed of three elements:

1. 3GPP 37.104 emission mask for the 3 MHz adjacent to the band edge (1492.0-1495.0 MHz).
2. ECC Decision from 1495.0 MHz to 1497.0 MHz.
3. Decay of 1.0 dB/MHz beyond 1497.0 MHz.

The reasoning for adopting the 3GPP 37.104 emission mask below 1495 MHz is that the ECC Decision integrated the power specified in 3GPP 37.104 in the entire first 3 MHz of the band. 3GPP 37.104's requirement is in alignment with the ECC Decision, but provides better resolution which is important when studying FLs with smaller bandwidths near the lower band edge. Beyond 1497.0 MHz, emissions naturally decay. Analysis of the actual LTE OOBE of commercial base station indicate that such decay can be large (much larger than 1 dB/MHz), but that it is difficult to identify a single value as representative. The selection of 1 dB/MHz provides two benefits:

- It is conservative, and therefore corresponds to 'worst case assumption' for this analysis,
- It is aligned with the assumption adopted by Ofcom in previous studies[3].

Actual LTE OOBEs are typically better than the above model and some measurements are provided in Section 13.

[3] See Section 13

The OOBE mask used in the MCL study is depicted in the figure below:

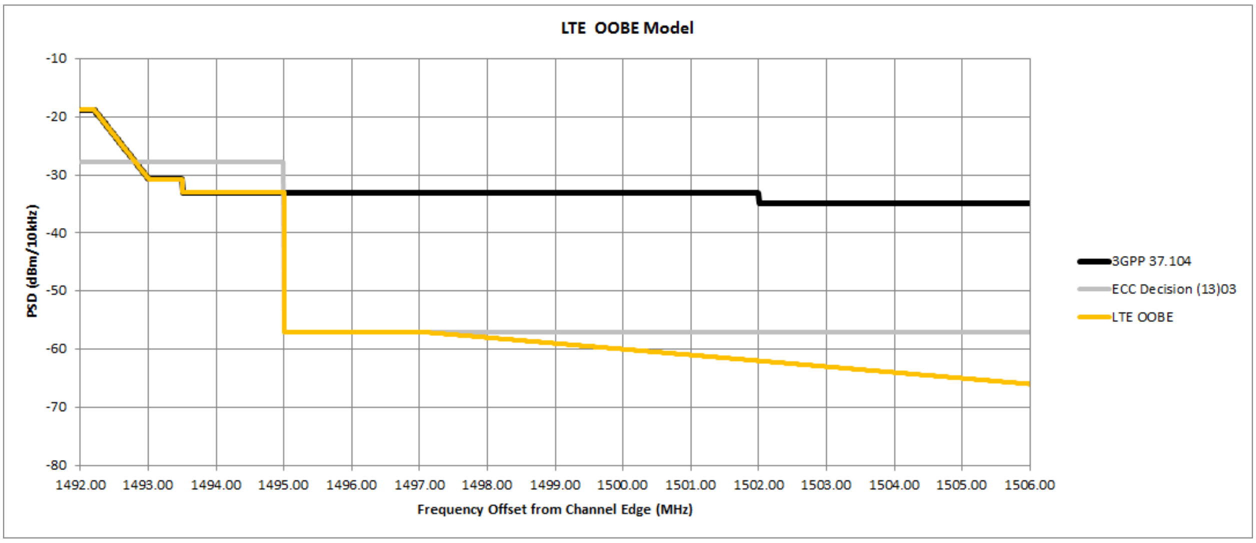


Figure 6: SDL OOBE mask for the MCL study

5.2 FL Receivers

FL characteristics have been determined based on the FL database analysis which was carried out in Section 3.

	Urban	Suburban	Rural
Antenna height	30 m	20 m	19 m
Carrier Spacing	0.025, 0.075, 0.25, 0.5, 1, 2, 3.5 MHz	0.025, 0.075, 0.25, 0.5, 1, 2, 3.5 MHz	0.025, 0.075, 0.25, 0.5, 1, 2, 3.5 MHz
Antenna gain	17 dBi	17 dBi	17 dBi
Antenna diagram	Section 15	Section 15	Section 15
Antenna tilt	0	0	0
Noise Floor	Section 22 (based on OfW446)	Section 22 (based on OfW446)	Section 22 (based on OfW446)
Selectivity	Section 5.2	Section 5.2	Section 5.2

Table 9: FL characteristics

NOTES:

- The average FL Rx antenna tilt was determined for each geotype, according to the information in Ofcom’s FL Database . The analysis of the database confirms that the FL is mostly not tilted with average tilts of 0.03, 0.03 and -0.002° in urban, suburban and rural areas respectively.

5.2.1 FL Rx selectivity

Selectivity is the ability of the receiver to receive the desired signal in the presence of a strong unwanted signal, typically close in frequency. Sources of interference from insufficient selectivity can be due to either linear or non-linear mechanisms. This interference is created within the receiver itself. The linear mechanism is due to insufficient filtering of the unwanted signal. In this case energy of an unwanted signal reaches receiver's detector, thus interfering with the desired signal. Non-linear mechanisms cause the nearby signal to be spread or mixed into the desired signal's channel. Non-linear mechanisms include Third-Order Intermodulation (IM3), Second-Order Intermodulation (IM2), mixing products and Cross-Modulation products.

Models to predict interference due to selectivity are typically linear in nature. Non-linear modelling requires detailed knowledge of the components in the receiver chain. This information is not publicly available; hence non-linear modelling is not typically used other than by the equipment manufacturer. Linear modelling can provide accuracy when used at or near the threshold of interference.

The selectivity model used in this study consists of two elements. First is the receiver's channel filter, and second is the receiver's Preselect filter. These two elements are shown in the figure below (note this figure is a simplified abstraction of a receiver which does not include fundamental functions such a gain and frequency conversion).

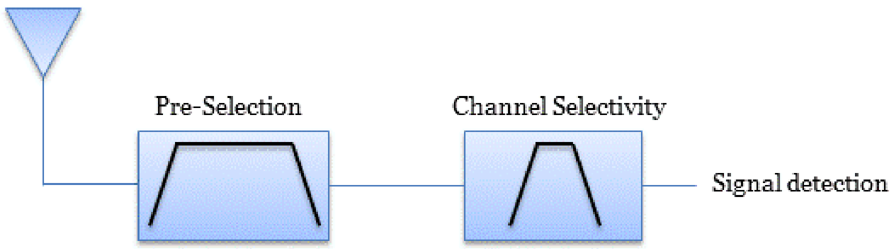


Figure 7: Receiver Selectivity Model

5.2.1.1 Receiver channel filter model

The channel selectivity model used in this study is defined in ETSI TR 101 854, Annex F. A model familiar and accepted by the industry was desired.

In the "Hitless Space Diversity" paper, Moseley Associates Inc. validates this model for their Starlink receiver products, shown in the figure below:

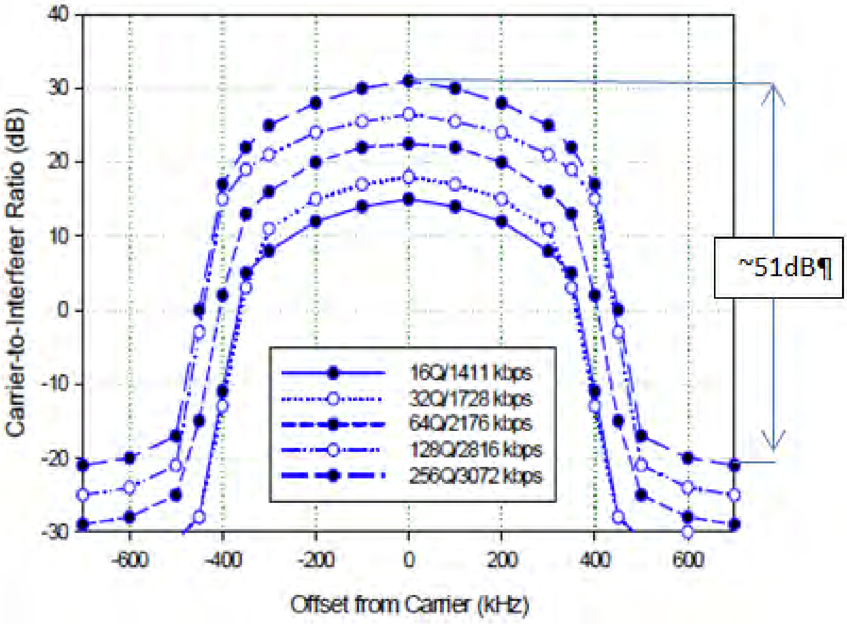


Figure 8: Starlink receiver carrier to interference in 500 kHz channels

The resultant channel selectivity masks for all FL bandwidths, using in ETSI TR 101 854, Annex F, are shown in Section 19.

5.2.1.2 Generic Preselect filter

Preselect filter rejection requirements are tailored to a specific site and the surrounding conditions and spectrum usage. Once the rejection requirements are determined, the filter can be incorporated into the FL radio (by working with the manufacturer), or an external Preselect filter can be installed (by the site commissioning team). All FL receivers utilize Pre-Selection to protect against strong signals. Examples of strong signals are broadcast, public service and other transmitters' signals. Since the Preselect filter requirements are site specific, and since the Preselect filter maybe installed during site installation (without the FL radio manufacturer's knowledge), FL radio manufacturers do not publish the characteristics of the internal Preselect filter.

In order to proceed with this study, two Preselect filter types were considered. The first is generic Preselect, commonly used in the industry. This configuration was based on discussions and published articles from FL radio manufacturers. This filter is assumed to be a 5th order Chebyschev cavity-resonator filter. These filters are common and available from numerous manufacturers. Since the adjacent band 1452-1479.5 MHz has been harmonised for T-DAB operation, it is assumed that the Preselect filter was designed to provide sufficient rejection of a T-DAB transmitter. Although the actual Preselect filters deployed in the field are unknown, this approach follows reasonable engineering practice. A reasonable example for this study is a T-DAB transmitter at 1478.640 MHz (Block LP). Per the Maastricht Agreement, a power of 71.5 dBm EIRP/1.536 MHz is allowed. Assuming a FL receiver is located 1km from the T-DAB transmitter, and the T-DAB transmitter is within the main beam of the FL receiver, we get the following:

T-DAB Tx Power	+71.5 dBm	(EIRP/1.536 MHz)
Pathloss	-95.3 dB	per ITU-R-P.452-4, urban @ 1 km
FL Antenna Gain	+17 dBi	
FL Channel Selectivity	-51 dB	per ETSI TR 101 854, Annex F
Filtered Blocker Level	-57.8 dBm	Residual energy @ Receiver Detector (interference)

Table 10: Derivation of residual energy at receiver detector

Taking a 1 MHz FL channel and assuming a noise figure of 2 dB, a receiver noise floor -112 dBm[4] and a maximum acceptable interference at the receiver noise floor, the Preselect filter must provide ~54 dB of rejection of the T-DAB signal at 1479.5 MHz:

Assumptions		
T-DAB Tx Power	+71.5 dBm	(EIRP/1.536 MHz)
Pathloss	-95.3 dB	per ITU-R-P.452-4, urban @ 1 km
FL Antenna Gain	+17 dBi	
FL Channel Selectivity	-51 dB	per ETSI TR 101 854, Annex F
Filter Blocker Level	-112.0 dBm	Residual energy @ Receiver Detector (interference)
Conclusion		
Preselect Rejection	-54.2 dB	Rejection required to FL Noise floor

Table 11: Derivation of Preselect filter rejection

For the purpose of this study, a Preselect filter with the following characteristics (generic Preselect) is assumed:

Type	Chebyschev
Ripple	0.1 dB
Order	5
Center Frequency	1495.0 MHz
Bandwidth	3.8 MHz

Table 12: Generic Preselect filter characteristics

[4] According to OfW 446, FL's noise floors vary between -119.6 and -100.5 dBm, depending on the systems considered (see Section 19)

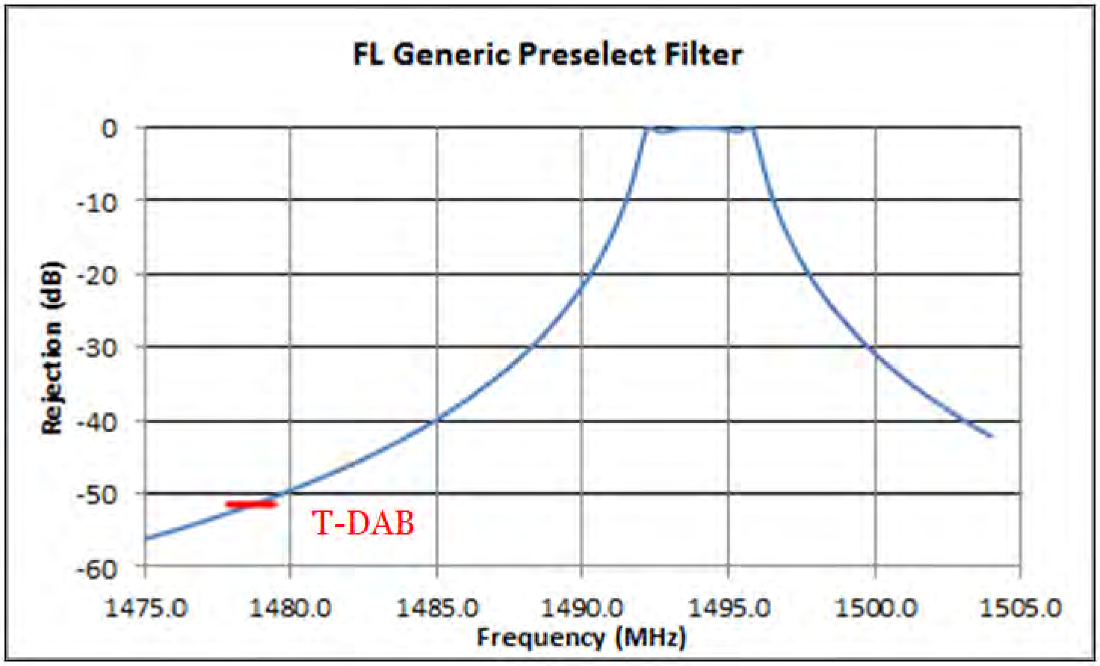


Figure 9: Rejection of T-DAB at 1478.640 MHz

An example composite response of the channel filter cascaded with the Preselect filter is shown below. A 2.0 MHz FL channel is shown in the example. The channel filter based on ETSI TR 101 854, Annex F model is considered up to 2.5 times the FL channel bandwidth:

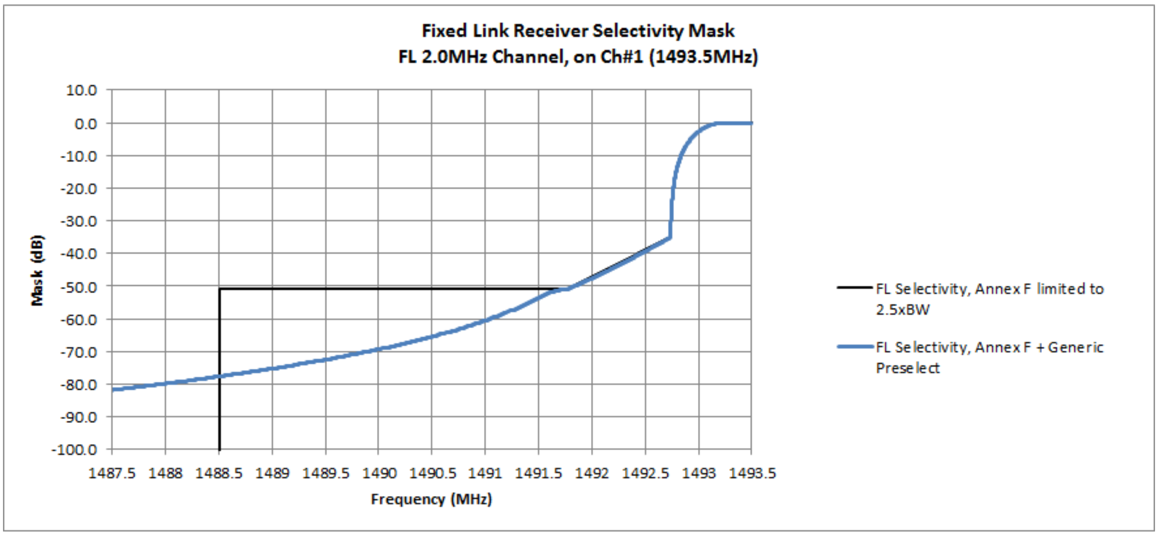


Figure 10: Assumed generic Preselect filter

5.2.1.3 High performance Preselect filter

The High-Performance (Hi-Perf) Preselect filter consists of dielectric loaded cavity bandpass filters. Because of the extreme high quality factor, the passband can be reduced while achieving reasonable insertion loss. The filter topology cross-couples the resonators, resulting in "transmission zeros" located close to the passband for steep rejection skirts. Two filter specifications were created and distributed to filter manufacturers. 80-H8706-1 is optimized for FL channel bandwidths of 25 kHz to 2.0 MHz, and 80-H8706-2 was optimized for FL channel bandwidths of 3.5 MHz. The filters are intended for the low channels (channel close in frequency to 1492.5 MHz), i.e. the FL channels located within the passband of the Hi-Perf Preselect filter. For FL channels above the filters' passband, additional filters could be specified, with relaxed rejection requirements. The responses of the Hi-Perf Preselect filters 80-H8706-1 and 80-H8706-2 are depicted in the figures below. Additional information on those Preselect filters, their performance and the practicalities of their installation into existing FLs radios is provided in Section 16.

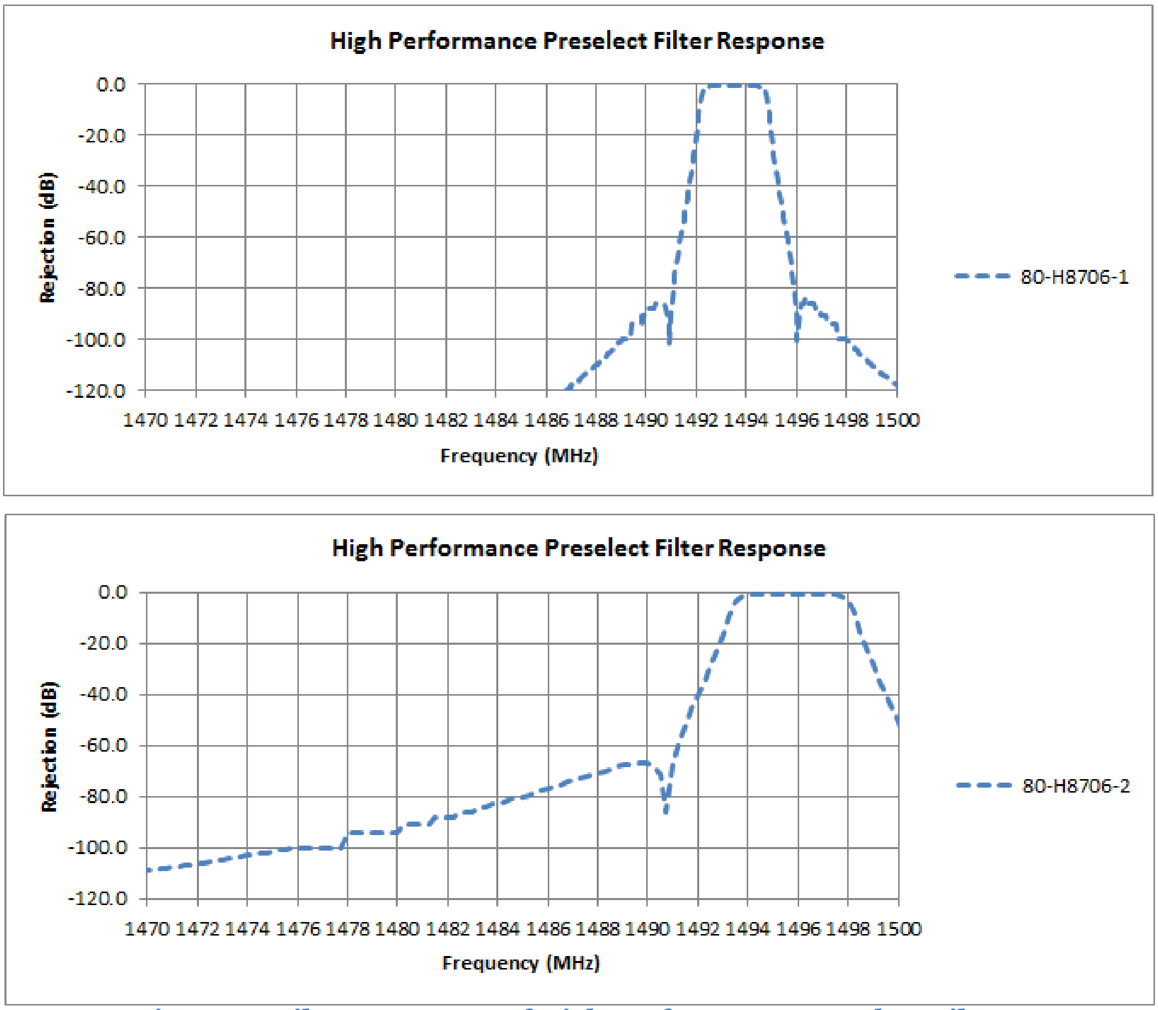
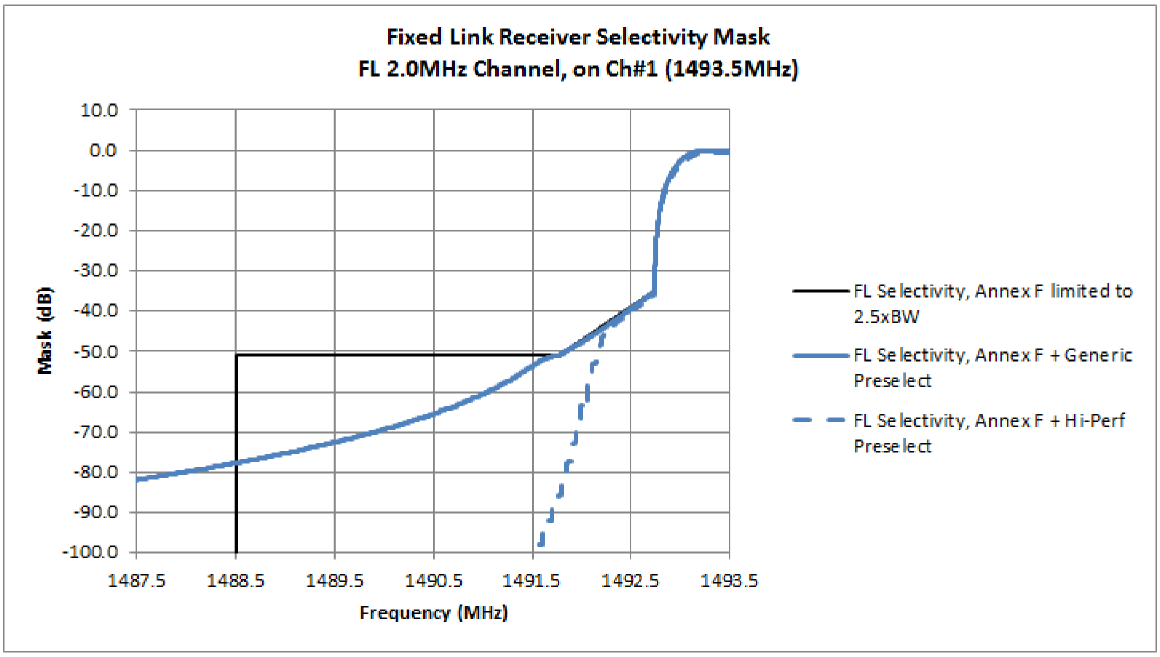


Figure 11: Filter responses of High Performance Preselect Filters

The composite responses of the channel filter cascaded with the generic Preselect filter and channel filter cascaded with the Hi-Perf Preselect filter are provided for 500 kHz and 2 MHz FLs:



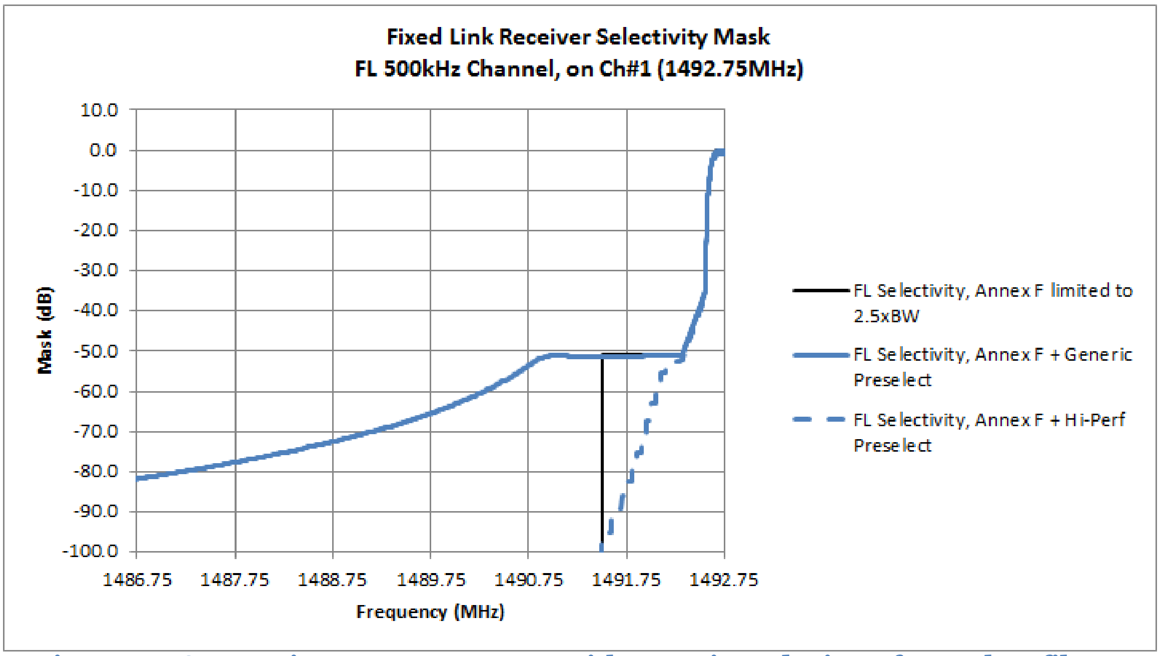


Figure 12: Composite FL Rx responses with generic and Hi-Perf Preselect filters

5.3 MCL modelling

5.3.1 Interference geometry

For each geotype and FL channel bandwidth, two interference MCL interference geometries have been modelled. Case 1 corresponds to the worst case SDL mainbeam to FL mainbeam interference scenario and case 2 to the case of SDL mainbeam to FL sidelobes scenario.

Channel interference power at FLs receiver input port (dBm/FL Channel) has been calculated as a function of the separation distance (d, in km) between the SDL Base Station and the FL receiver.

5.3.1.1 Case 1 - main beam to main beam

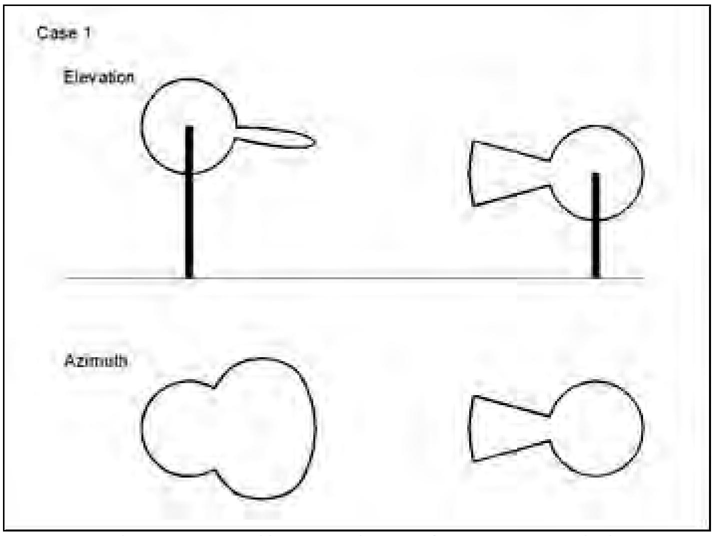


Figure 13: Illustration of case 1 model

Case 1 geometry and modelling are assumed as follows:

- SDL BS is placed at average height (h1) per geotype
- FL is placed at average height (h2) per geotype
- SDL BS downtilt (t1) is determined as per geotype
- FL Rx downtilt/uptilt (t2) is determined as per geotype
- SDL BS are assumed to be tri-sectorial
- In the horizontal plane, FL mainbeam points toward SDL mainbeam
- In the vertical plane, antennas discrimination will be calculated based on d, h1, h2, t1 and t2.

5.3.1.2 Case 2 – main-beam to side-lobes

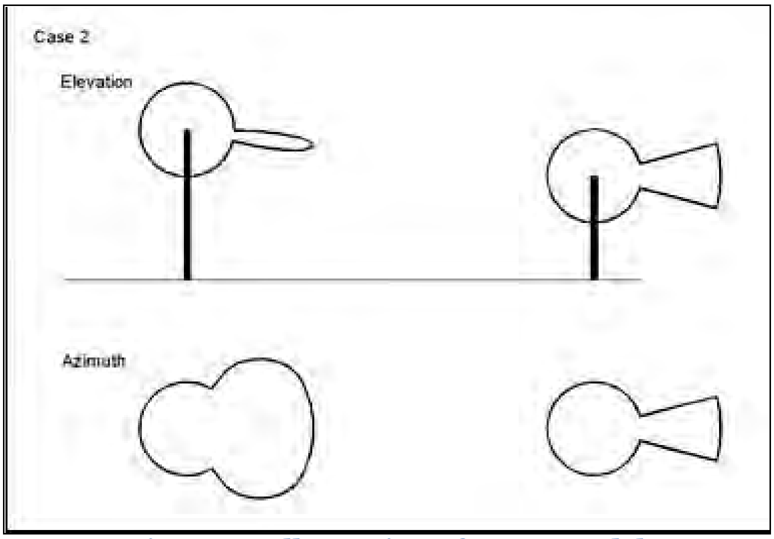


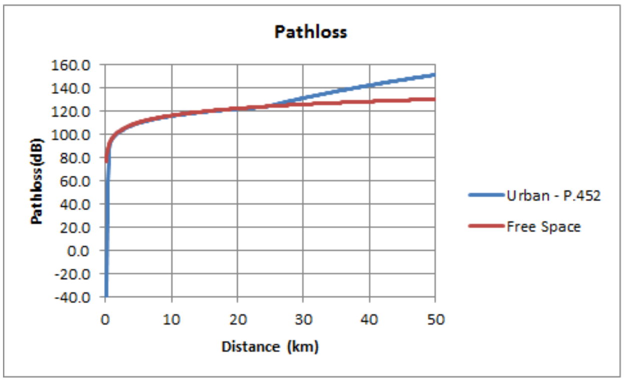
Figure 14: Illustration of case 2 model

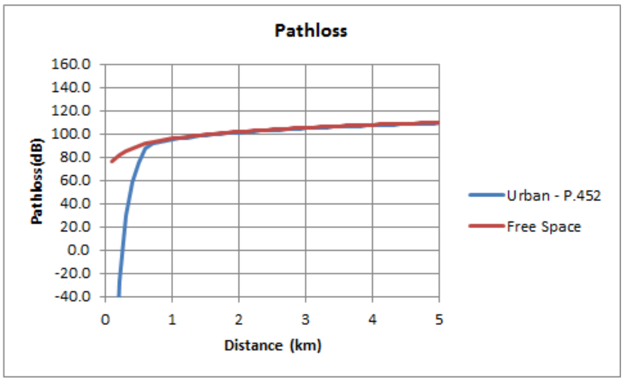
Case 2 geometry and modelling are assumed as follows:

- SDL BS is placed at average height (h1) per geotype
- FL is placed at average height (h2) per geotype
- SDL BS downtilt (t1) is determined as per geotype
- FL Rx downtilt/uptilt (t2) is determined as per geotype
- SDL BSs are assumed to be tri-sectorial
- In the horizontal plane, FL side-lobes points toward SDL mainbeam
- In the vertical plane, antennas discrimination will be calculated based on d, h1, h2 and t1.

5.3.2 Propagation model and path loss

Pathloss calculations are based on ITU-R-P.452-14 [8]. This methodology is optimized for propagation above the surface of the earth, for distances that are typical of fixed links and other similar radio services. At short distances (i.e. <1 km), this method provided questionable results.





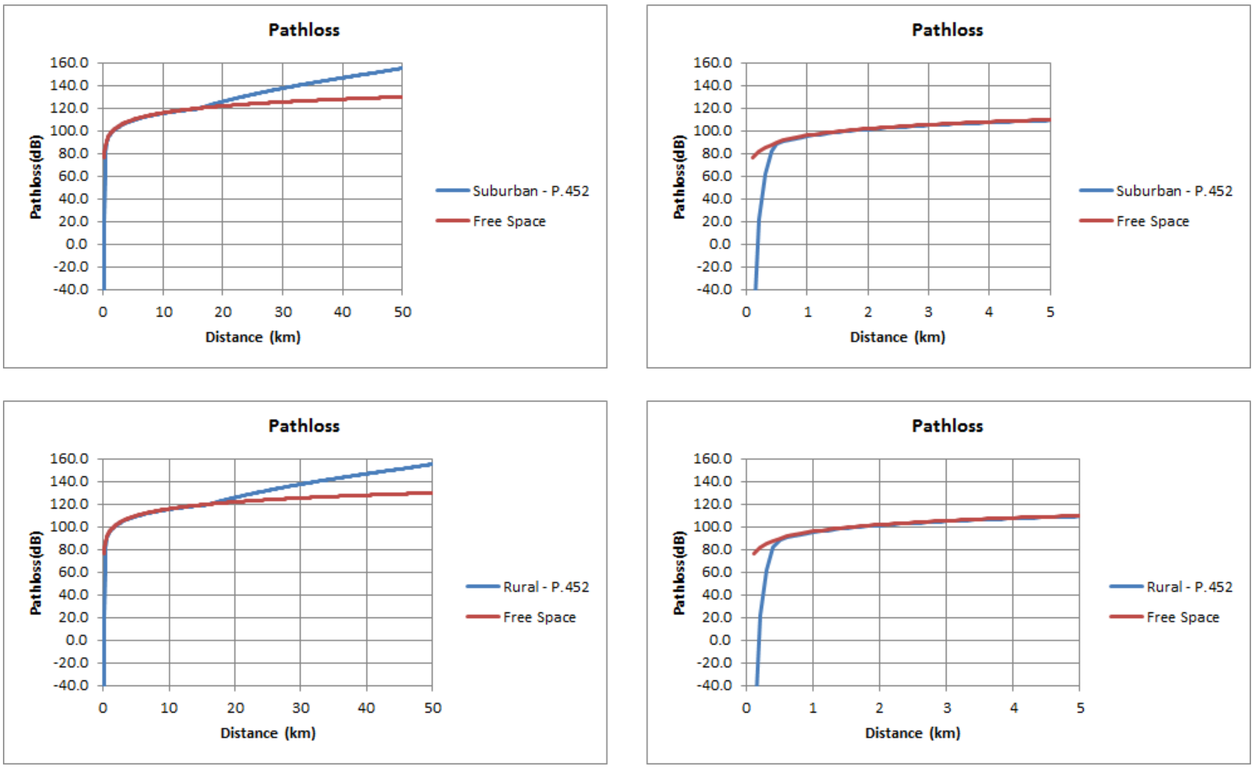


Figure 15: Comparative plots of channel pathloss according to ITU-R-P.452-14 and Free Space model.

Therefore, in this study, ITU-R-P.452-14 will be used at distances equal to and above 1 km, and the freespace model below 1 km.

5.3.3 Antenna configurations pathloss

Given the antenna configurations for the specific geotypes, the distances for which FL antenna is within the half power beamwidth of the SDL transmitter is calculated. The FL antenna has a broader beamwidth, so that the SDL Tx is within its half power beamwidth until very short distances. A FL antenna with a wide beamwidth (e.g. 30 degrees) is more likely to have a SDL transmitter within its main beam (in close proximity). In comparison, a large parabolic or grid antenna with a narrow beamwidth (e.g. 3.6 degree) would have a much smaller probability of having the SDL transmitter within its main beam at short distances.

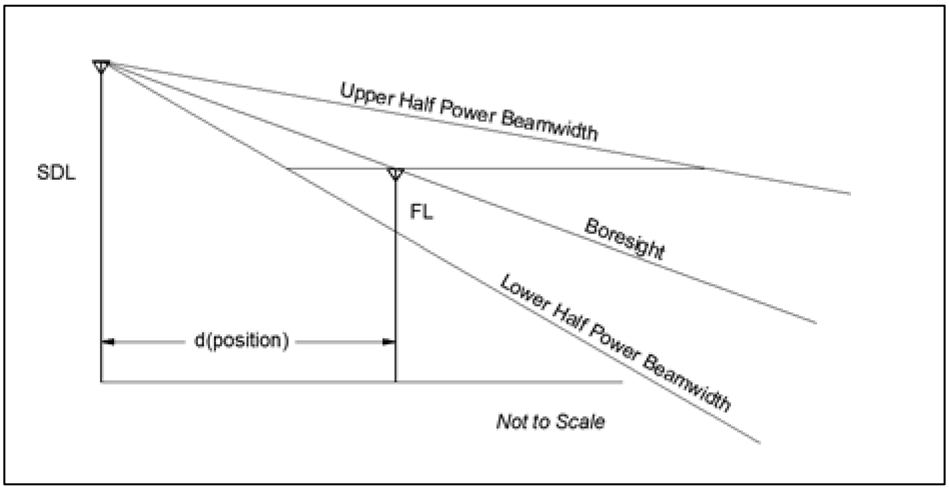


Figure 16: Illustration of antenna configuration

Geotype	d (Lower HPBW) (m)	d (Boresight) (m)	d (Upper HPBW) (m)
Urban	23.5	31.6	47.6
Suburban	16.3	28.8	114.8
Rural	19.0	38.2	∞

Table 13: Distances corresponding to antenna configurations

The effect of the antenna vertical orientation with respect to the FL antenna is included in the calculations. The resultant pathloss (including SDL Relative gain vs SDL BS/FL separation) is shown in the figures below.

For the Urban case, due to the significant SDL antenna downtilt, the FL antenna is always outside the SDL antenna's main beam for separations of interest.

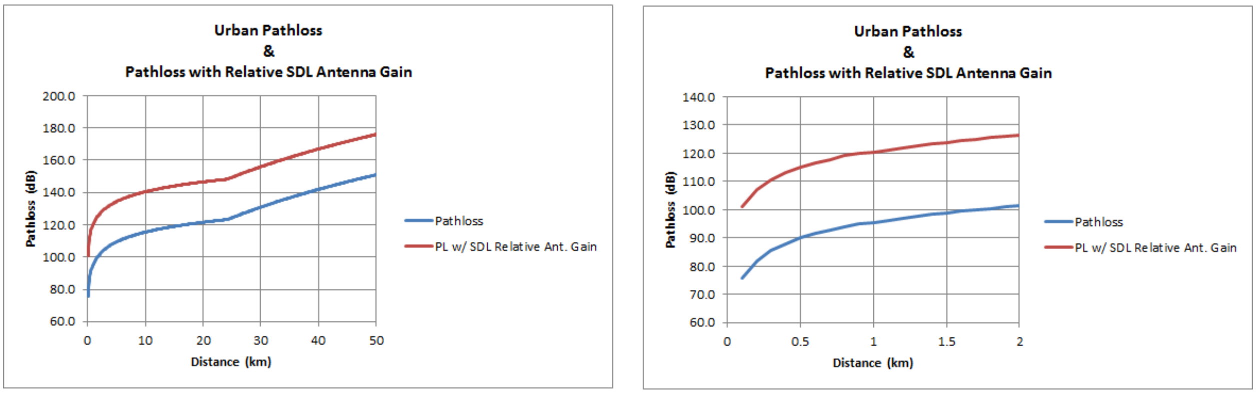


Figure 17: Pathloss in urban geotype

For the suburban case, the FL antenna is in the SDL's main beam only at short distances.

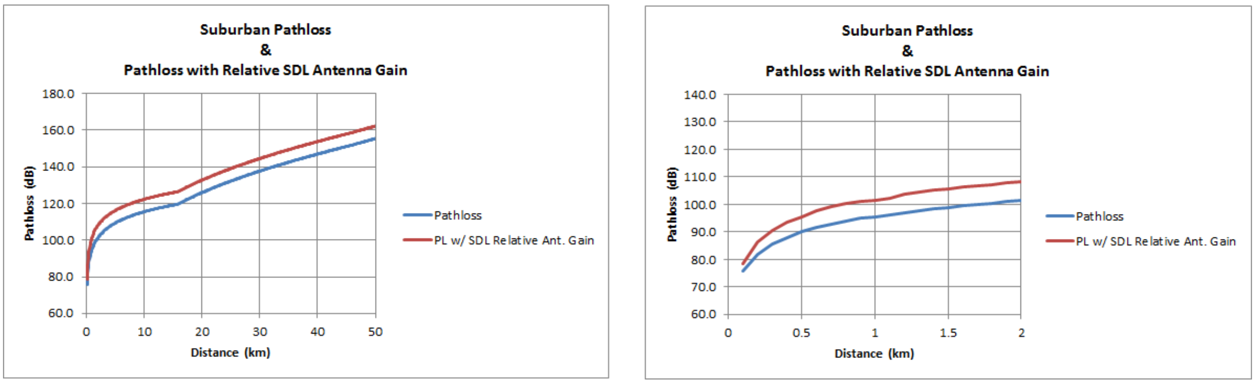


Figure 18: Pathloss in suburban geotype

For the rural case, the FL antenna is in the SDL antenna's main beam at all distances.

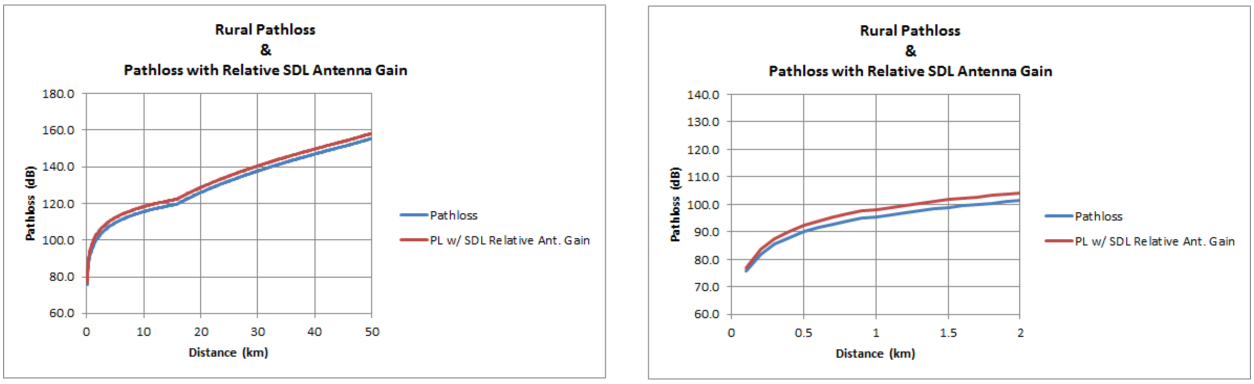


Figure 19: Pathloss in rural geotype

5.3.4 Current licence OOBE limits

The existing license for 1452-1492 MHz (Schedule 1 for 1452-1479.5 and Schedule 2 for 1479.5-1492 MHz) specifies maximum allowed emissions in adjacent bands. These requirements are specified as a Power Flux Density (PFD) at a height of 1.5 m above ground level, not to be exceeded at 95% of the coverage area. The requirements (from the License, Schedule 2) are shown in the table below:

Offset from block edge ΔF	Maximum aggregate PFD At a receive antenna height of 1.5 m above ground level (dBW/m²/MHz)
6.250 to 6.000 MHz	-121
6.000 to 5.400 MHz	-120
5.400 to 5.000 MHz	-119
5.000 to 4.600 MHz	-118
4.600 to 4.200 MHz	-117
4.200 to 3.800 MHz	-116
3.800 to 3.400 MHz	-115
3.400 to 3.000 MHz	-114
3.000 to 2.800 MHz	-113
2.800 to 2.600 MHz	-112
2.600 to 2.200 MHz	-111
2.200 to 2.000 MHz	-110
2.000 to 1.800 MHz	-109
1.800 to 1.600 MHz	-108
1.600 to 1.400 MHz	-107
1.400 to 1.200 MHz	-106
1.200 to 1.000 MHz	-105
1.000 to 0.800 MHz	-104
0.800 to 0.600 MHz	-102
0.600 to 0.400 MHz	-101
0.400 to 0.200 MHz	-99
0.200 to 0.000 MHz	-97

Table 14: Current licence's OOBE limits

To evaluate how these existing OOB Emissions apply to existing Fixed Links, the PFD values need to be converted to conducted values at the Fixed Link antenna height. This process consists in:

- Converting PFD (dBW/m²/MHz) to Conducted Power Density (dBm/Hz), using the effective aperture of the receiving antenna. This section assumes a 0 dBi antenna, the appropriate antenna gain is applied in each analysis scenario.

- Applying an antenna height correction factor between 1.5 m (per Licence) to the appropriate FL antenna height. This study uses the ITU-R P.1546-4 propagation model as required by the existing Licence.

The resultant power density can be converted to interference power by applying the appropriate antenna gain and integrating over the FL channel bandwidth at the channel offset of interest.
The antenna height correction factors using ITU-R P.1546-4 [9] are shown in the table below. The distance of 1km was chosen because it is reasonable for this study. Distance of 2 km and 5 km were spot checked, and the results were within 0.1 dB. The values in the table indicate the change in pathloss between antenna located at 1.5 m to the FL antenna height. This means the PFD or conducted power is stronger at the FL antenna by 31.3 dB, 27.9 dB and 25.2 dB for Urban, Suburban and Rural respectively.

Geotype	ΔPathloss$_{1.5m\ to\ FL\ Antenna\ Height}$ (dB)
Urban	-31.3
Suburban	-27.9
Rural	-25.2

Table 15: Change in pathloss from 1.5 m to FL antenna height

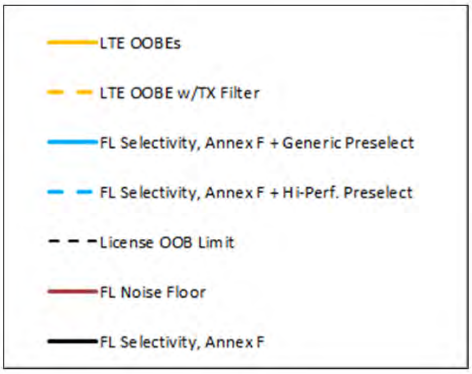
Using the above methodology and correction factors, the predicted power densities are shown in the table below:

Offset frequency from 1492 MHz Band edge (MHz)	Maximum PFD @ 1.5 m above ground level (dBW/m²/MHz)	Power Density, 0dBi antenna(1), 1.5 m above ground level (dBm/Hz)	Urban, Power Density,0dBi antenna @ 30 m above ground level (dBm/Hz)	Suburban, Power Density, 0dBi antenna @ 20 m above ground level (dBm/Hz)	Rural, Power Density, 0dBi antenna @ 19 m above ground level (dBm/Hz)
0.000 – 0.200	-97	-151.97	-120.67	-124.07	-126.77
0.200 – 0.400	-99	-153.97	-122.67	-126.07	-128.77
0.400 – 0.600	-101	-155.97	-124.67	-128.07	-130.77
0.600 – 0.800	-102	-156.97	-125.67	-129.07	-131.77
0.800 – 1.000	-104	-158.97	-127.67	-131.07	-133.77
1.000 – 1.200	-105	-159.97	-128.67	-132.07	-134.77
1.200 – 1.400	-106	-160.97	-129.67	-133.07	-135.77
1.400 – 1.600	-107	-161.97	-130.67	-134.07	-136.77
1.600 – 1.800	-108	-162.97	-131.67	-135.07	-137.77
1.800 – 2.000	-109	-163.97	-132.67	-136.07	-138.77
2.000 – 2.200	-110	-164.97	-133.67	-137.07	-139.77
2.200 – 2.600	-111	-165.97	-134.67	-138.07	-140.77
2.600 – 2.800	-112	-166.97	-135.67	-139.07	-141.77
2.800 – 3.000	-113	-167.97	-136.67	-140.07	-142.77
3.000 – 3.400	-114	-168.97	-137.67	-141.07	-143.77
3.400 – 3.800	-115	-169.97	-138.67	-142.07	-144.77
3.800 – 4.200	-116	-170.97	-139.67	-143.07	-145.77
4.200 – 4.600	-117	-171.97	-140.67	-144.07	-146.77
4.600 – 5.000	-118	-172.97	-141.67	-145.07	-147.77
5.000 – 5.400	-119	-173.97	-142.67	-146.07	-148.77
5.400 – 6.000	-120	-174.97	-143.67	-147.07	-149.77
6.000 – 6.250	-121	-175.97	-144.67	-148.07	-150.77
Notes; (1)- 0dBi antenna has an Effective Aperture of 0.0032 m² (-24.97 dB).					

Table 16: PFD @ 1.5m & PFD @ Fixed Link antenna height

5.4 MCL study results

The results for the Minimum Coupling Loss (MCL) analysis is a set of charts showing the OOBE and Selectivity interference levels for the conditions in the chart's legend and described below:



- **LTE OOBE** – This is the Out-of-Band Emissions, falling into the Fixed Link Receiver's channels;

- **LTE OOBE w/TX Filter** – This is the same emission mask as for 'LTE OOBE' but applying the high performance Tx filter as defined in Section 18;

- **FL Selectivity, Annex F + Generic Preselect** – This is the interference level due to the FL Receiver selectivity, assuming the Annex F + Generic Preselect filter as previously specified;

- **FL Selectivity, Annex F + Hi-Perf. Preselect** – This is the interference level due to the FL Receiver selectivity, assuming the Annex F + High Performance Preselect filter as previously specified;

- **License OOB Limit** – This is the emission level allowed in the current license, at (i.e. translated to) the FL Receiver Input. Note that limits only apply to ~6.25 MHz offset from 1492.0 MHz;

- **FL Noise Floor** – This is the noise floor of the FL Receiver, using the levels defined in Annex E of OfW 446;

- **FL Selectivity, Annex F** – This is the selectivity model defined on Annex F of ETSI TR 101 854. This model is defined to 2.5 x the FL receiver channel spacing, so beyond infinity selectivity is assumed.

The charts provide the analysis results for the following conditions:

- FL Channels – For each channel bandwidth, three channels are selected within the first ~5 MHz. Channel #1, a mid channel and a channel ~5 MHz (~1497.5 MHz). Also the furthest channel is included. For the 3.5 MHz channel, only three channels are defined;

- Antenna orientation – Case 1 and case 2 are included, as previously defined;

- Geotype – Results are provided for urban, suburban and rural as previously defined.

The results are shown in graphical form. The X-Axis is the separation distance (km) between the two system's antennas, and the Y-Axis is the interference level (dBm/FL Channel). The results for each case/condition is provided in two charts, one with distance from 100 m to 50 km, and the other with the distance zoom into 100 m to 4 km. The Y-Axis range is set to 0 to -160 dBm/FL Channel. All traces are plotted on each chart, however in many cases the interference trace falls below the lower limit (i.e. -160 dBm/FL Channel) and therefore does not appear on the chart.

5.4.1 FL 25 kHz

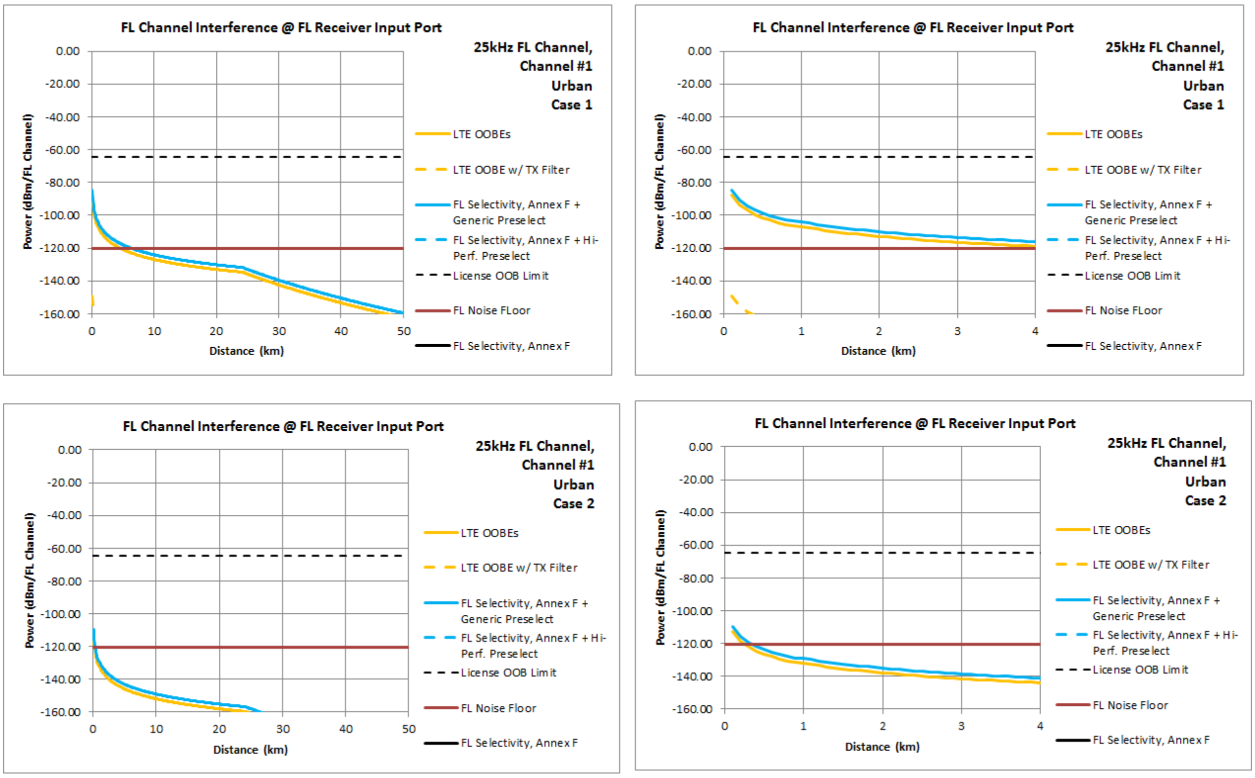


Figure 20: MCL results, FL CS 25 kHz, channel 1, urban, case 1 and case 2

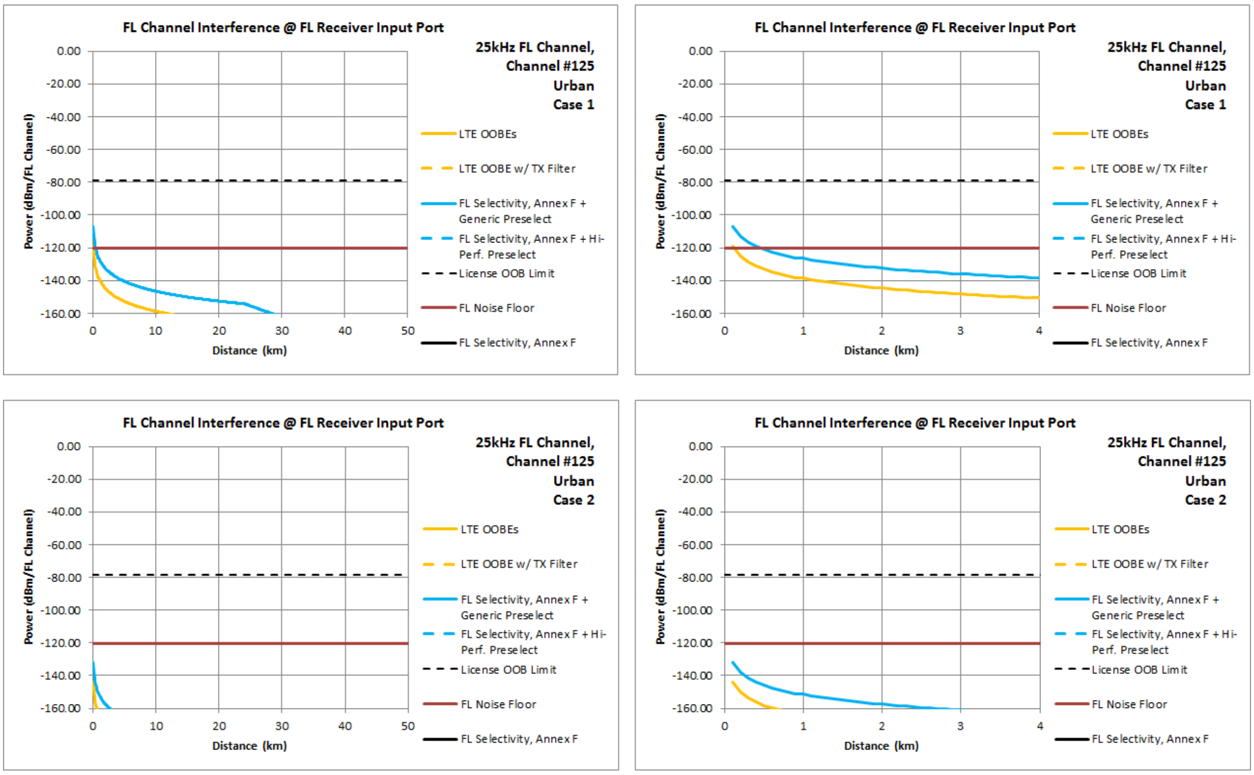


Figure 21: MCL results, FL CS 25 kHz, channel 125, urban, case 1 and case 2

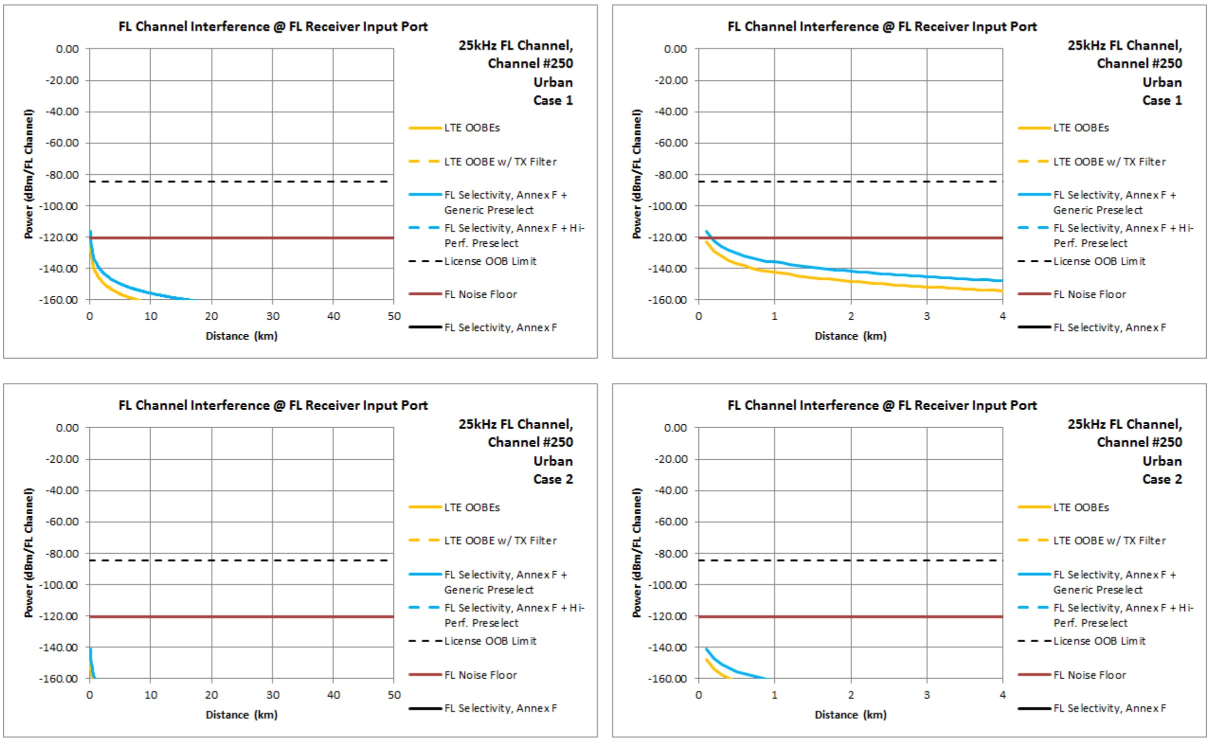


Figure 22: MCL results, FL CS 25 kHz, channel 250, urban, case 1 and case 2

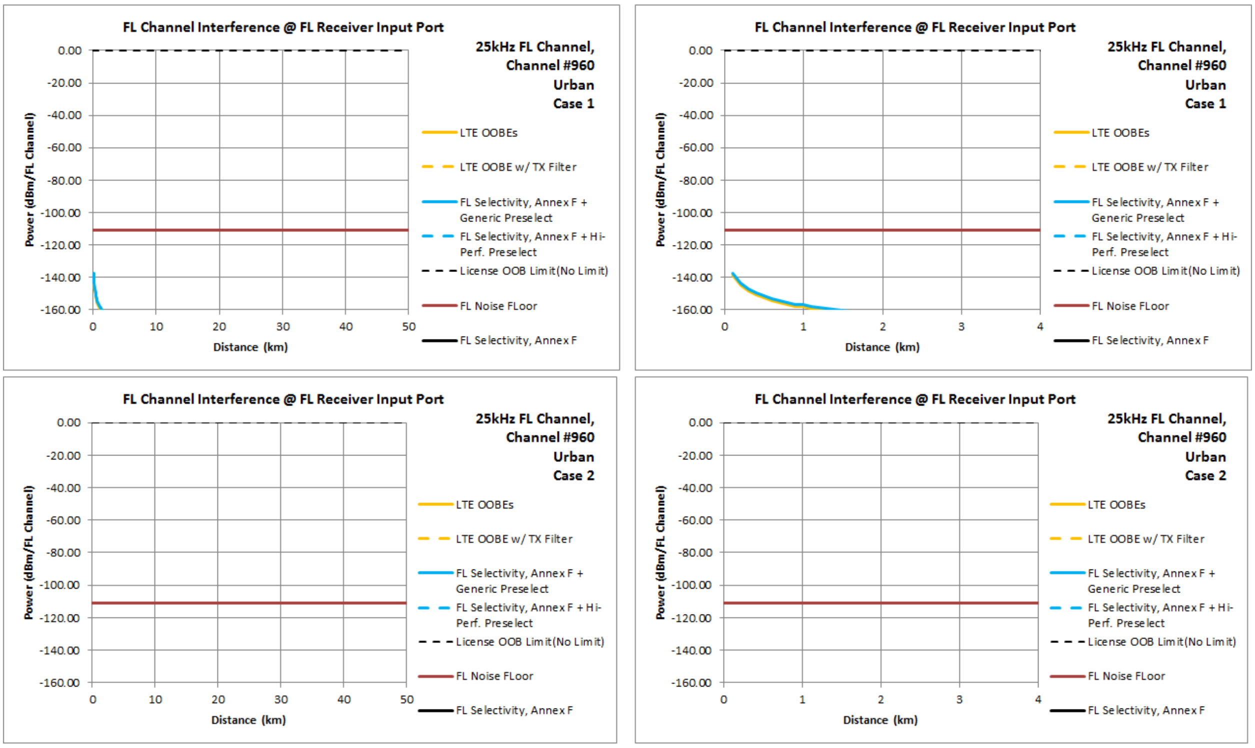


Figure 23: MCL results, FL CS 25 kHz, channel 960, urban, case 1 and case 2

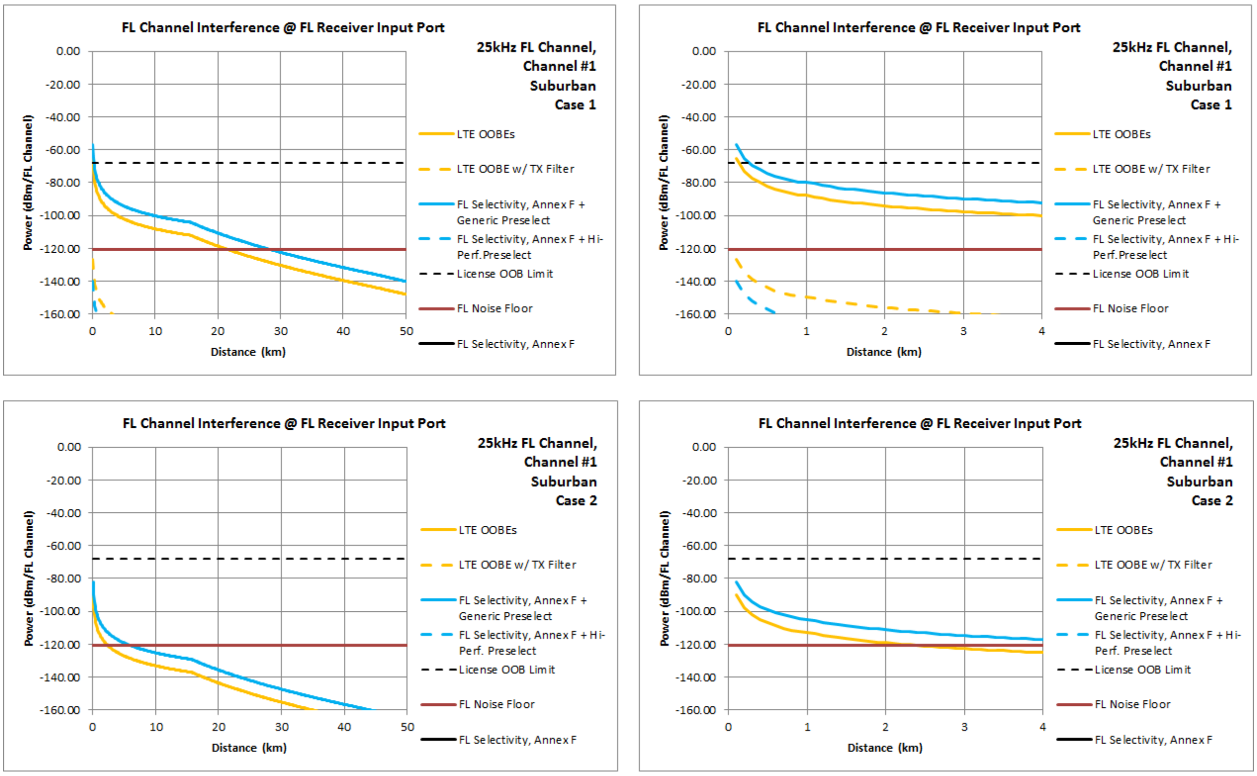


Figure 24: MCL results, FL CS 25 kHz, channel 1, suburban, case 1 and case 2

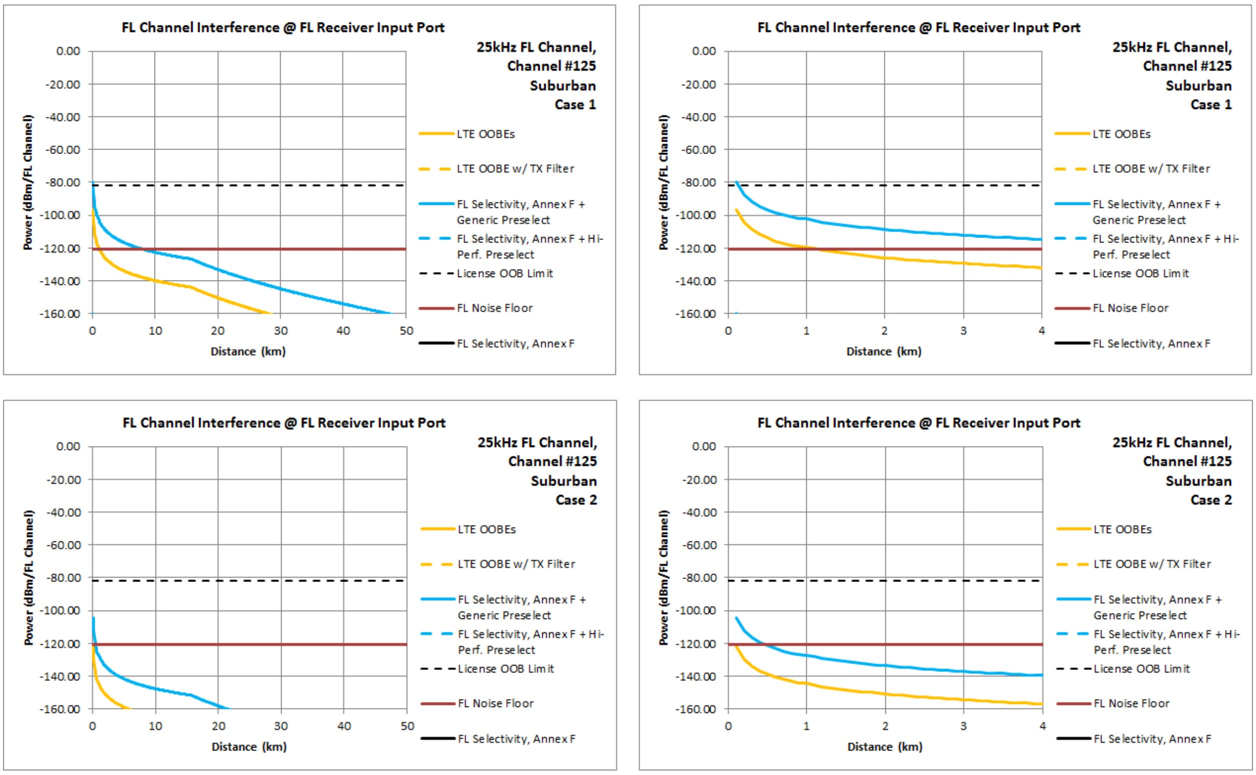


Figure 25: MCL results, FL CS 25 kHz, channel 125, suburban, case 1 and case 2

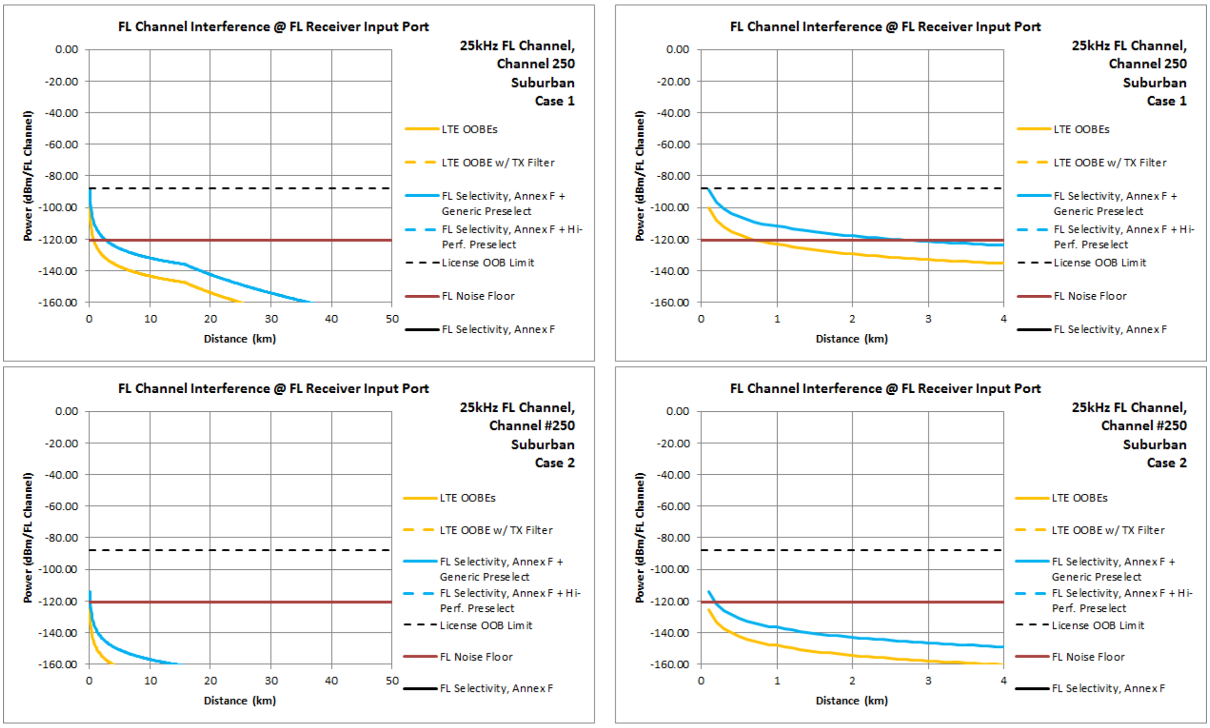


Figure 26: MCL results, FL CS 25 kHz, channel 250, suburban, case 1 and case 2

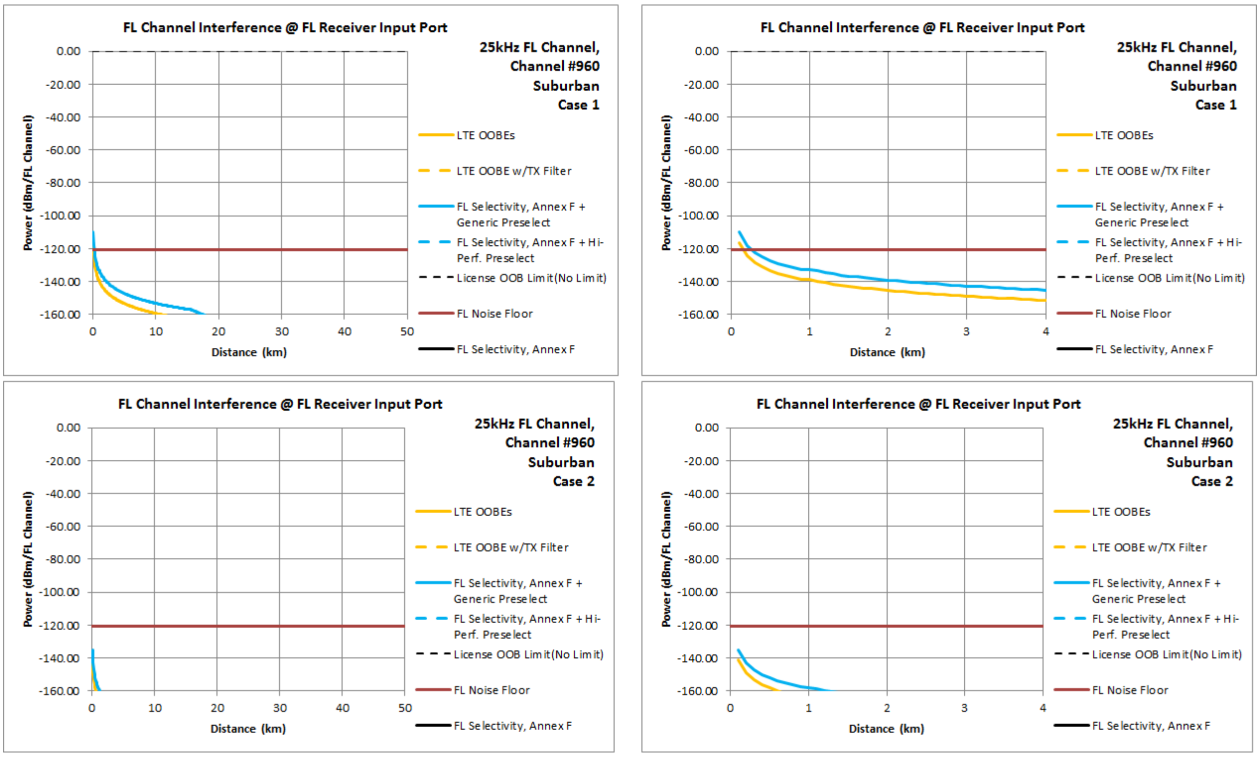


Figure 27: MCL results, FL CS 25 kHz, channel 960, suburban, case 1 and case 2

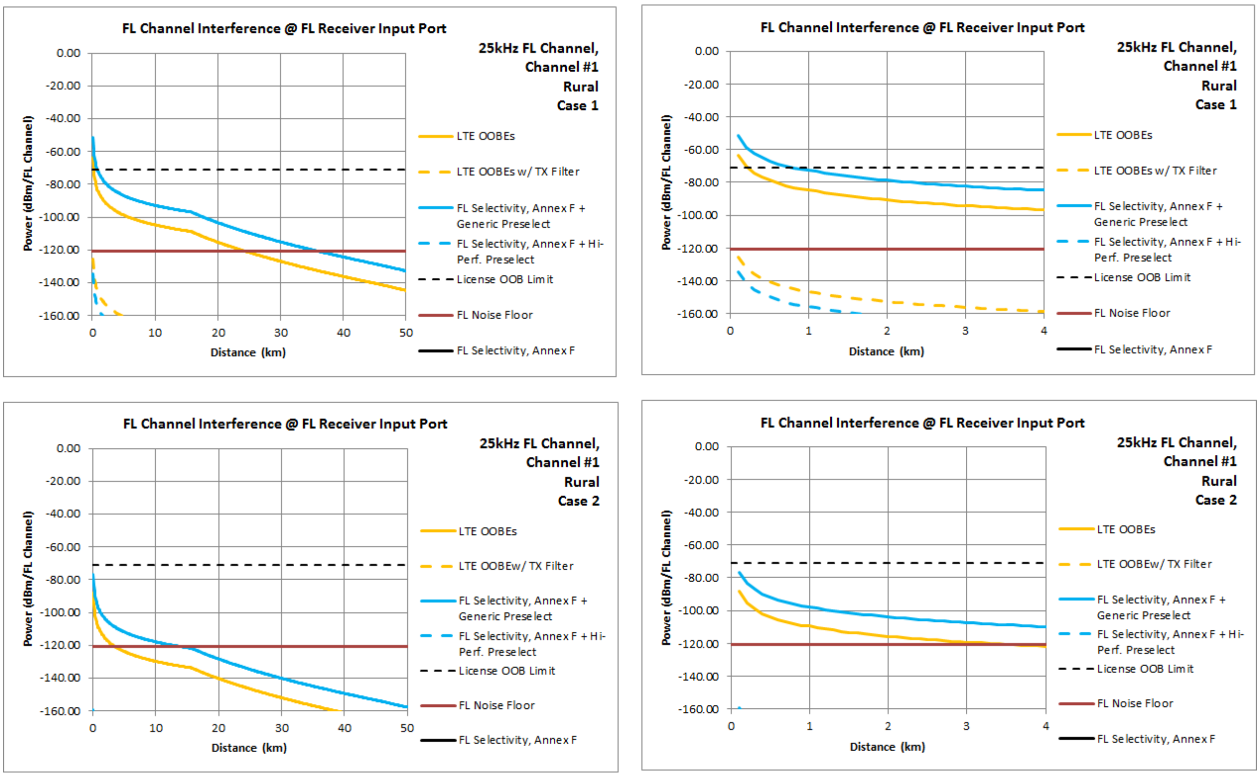


Figure 28: MCL results, FL CS 25 kHz, channel 1, rural, case 1 and case 2

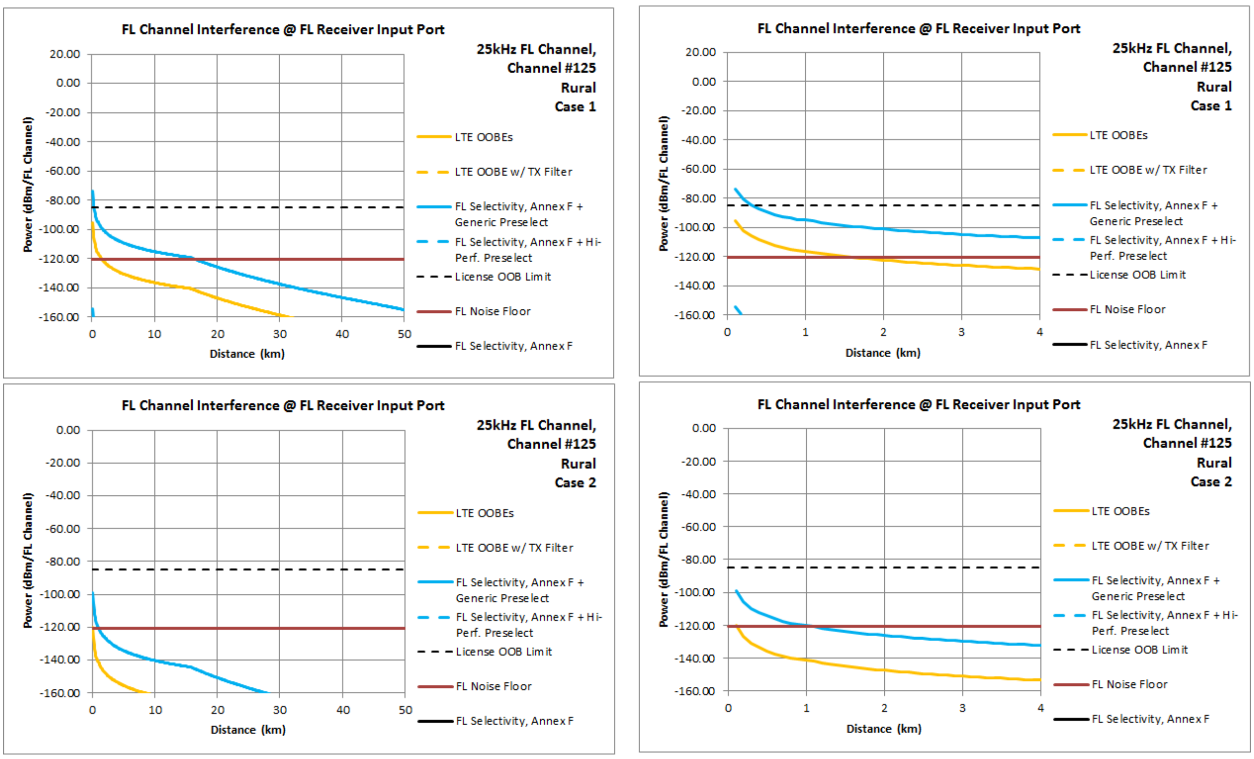


Figure 29: MCL results, FL CS 25 kHz, channel 125, rural, case 1 and case 2

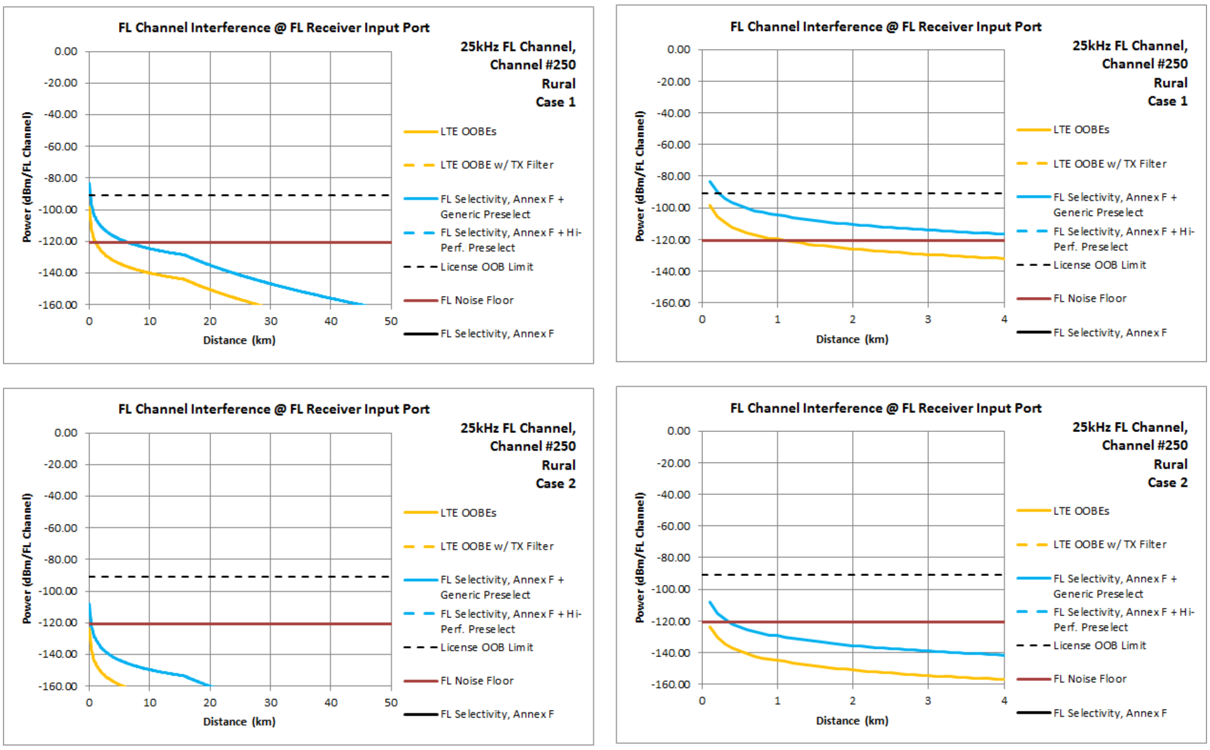


Figure 30: MCL results, FL CS 25 kHz, channel 250, rural, case 1 and case 2

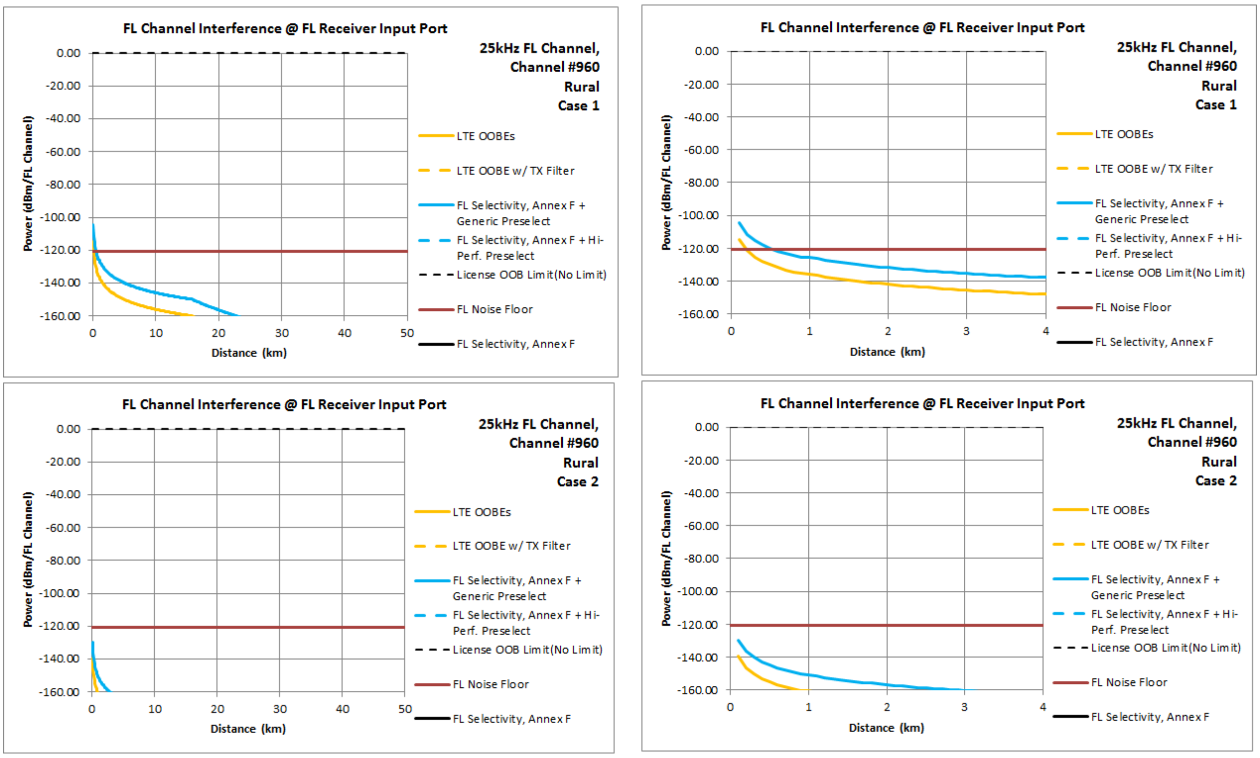


Figure 31: MCL results, FL CS 25 kHz, channel 960, rural, case 1 and case 2

5.4.2 FL 75 KHz

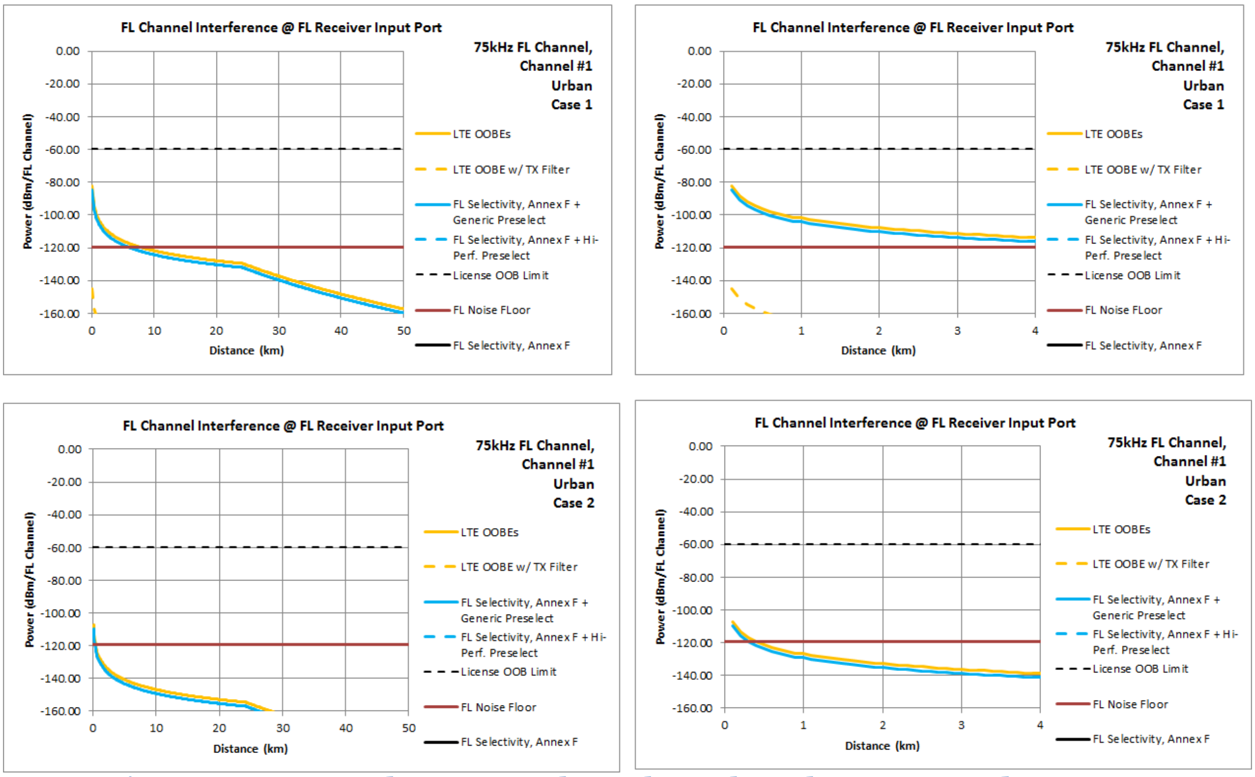


Figure 32: MCL results, FL CS 75 kHz, channel 1, urban, case 1 and case 2

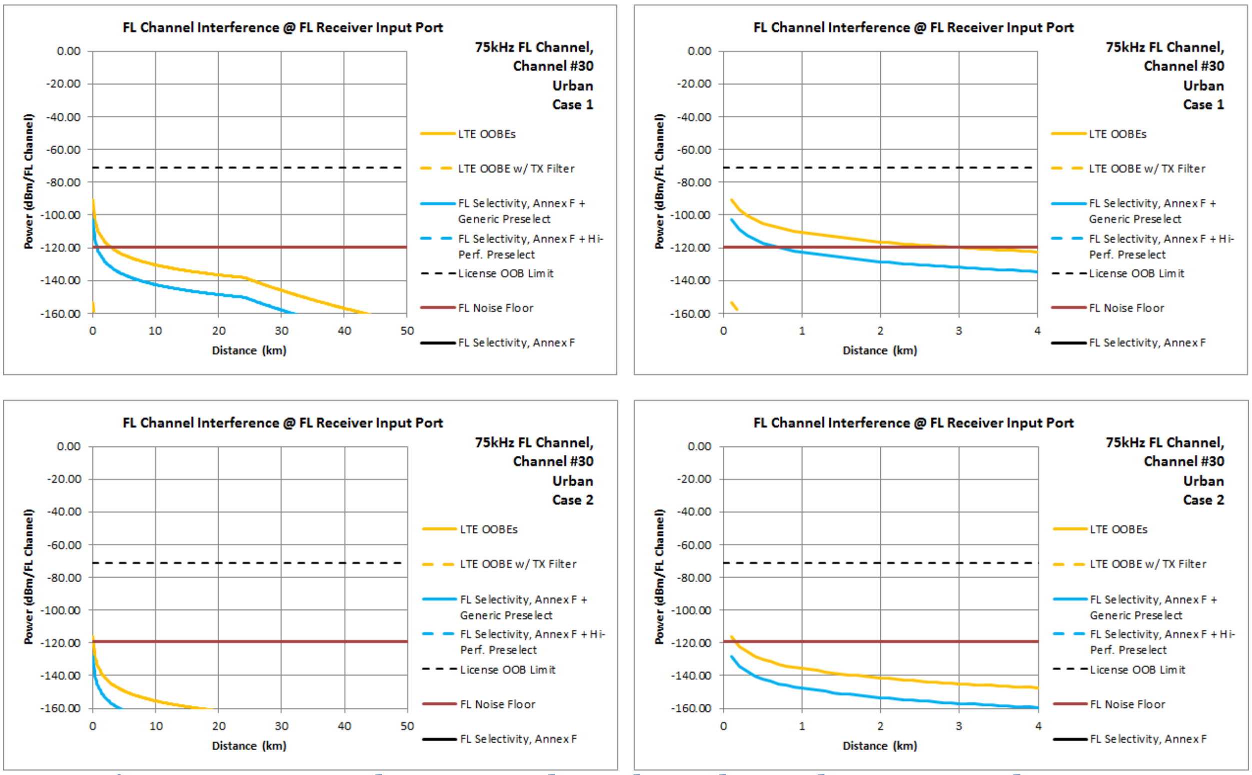


Figure 33: MCL results, FL CS 75 kHz, channel 30, urban, case 1 and case 2

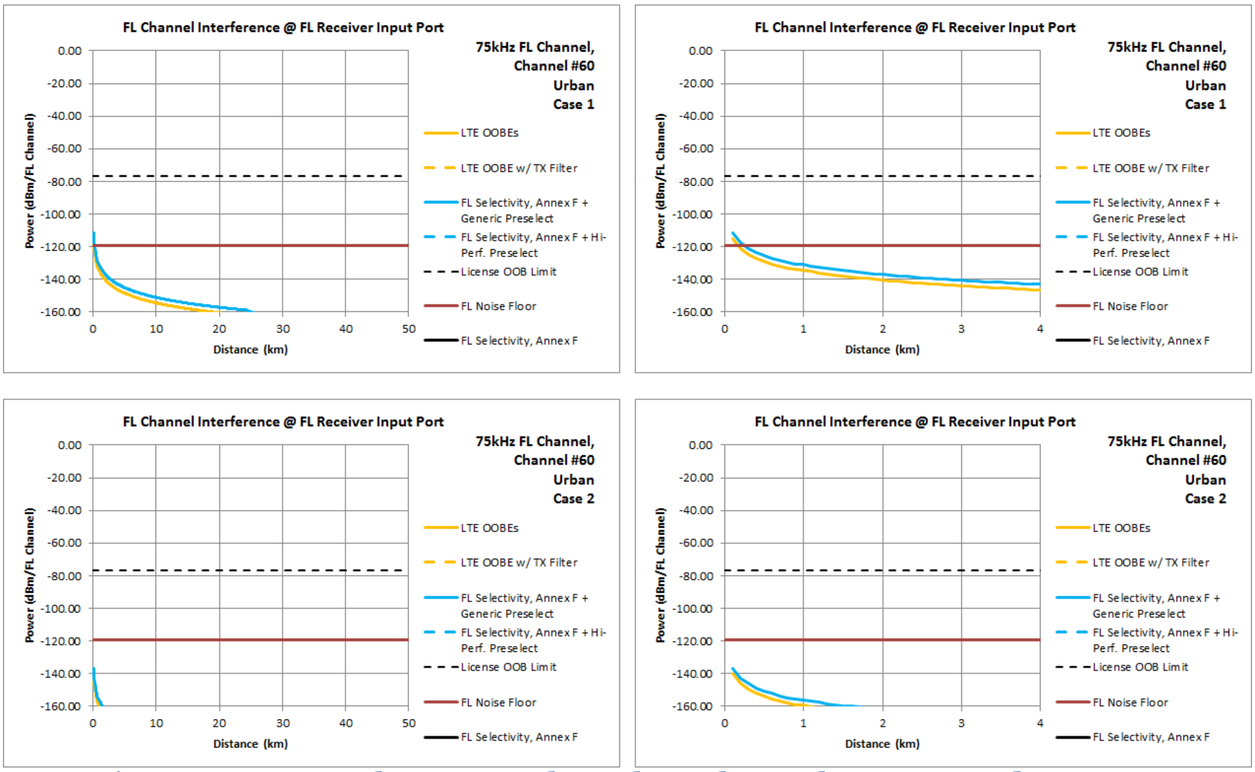


Figure 34: MCL results, FL CS 75 kHz, channel 60, urban, case 1 and case 2

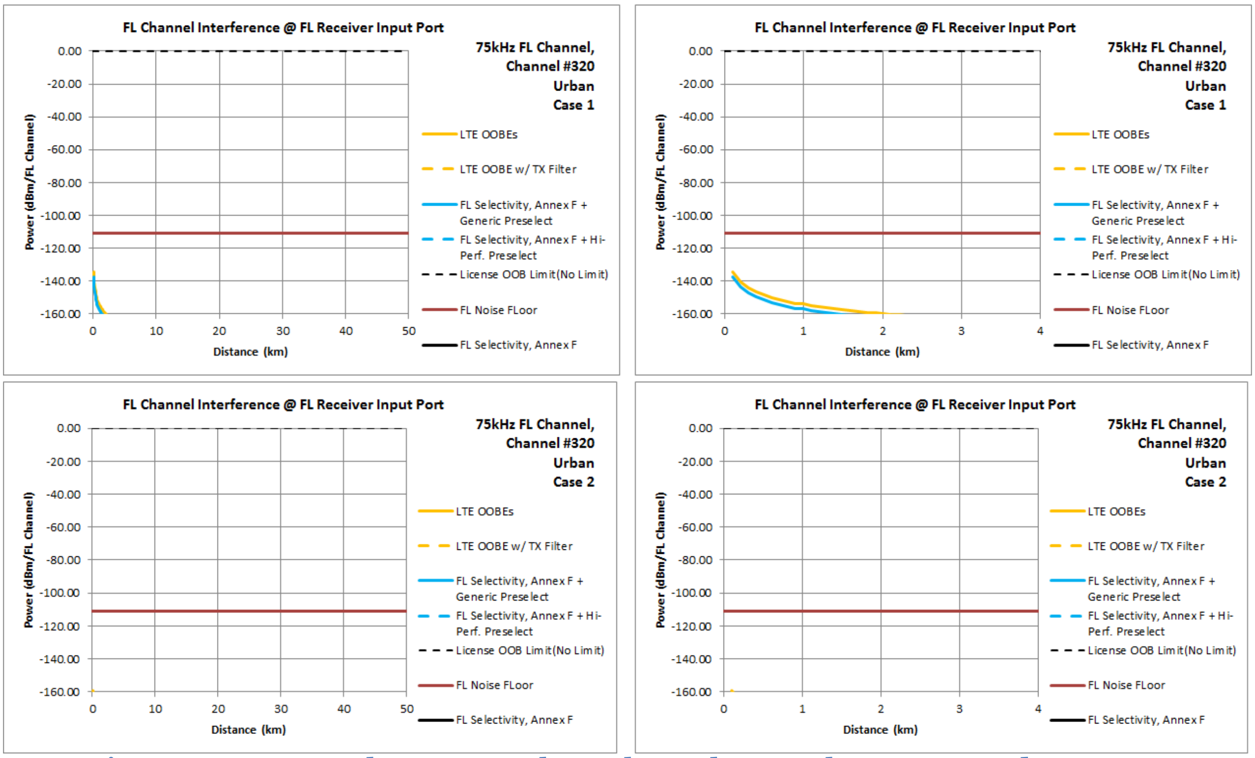


Figure 35: MCL results, FL CS 75 kHz, channel 320, urban, case 1 and case 2

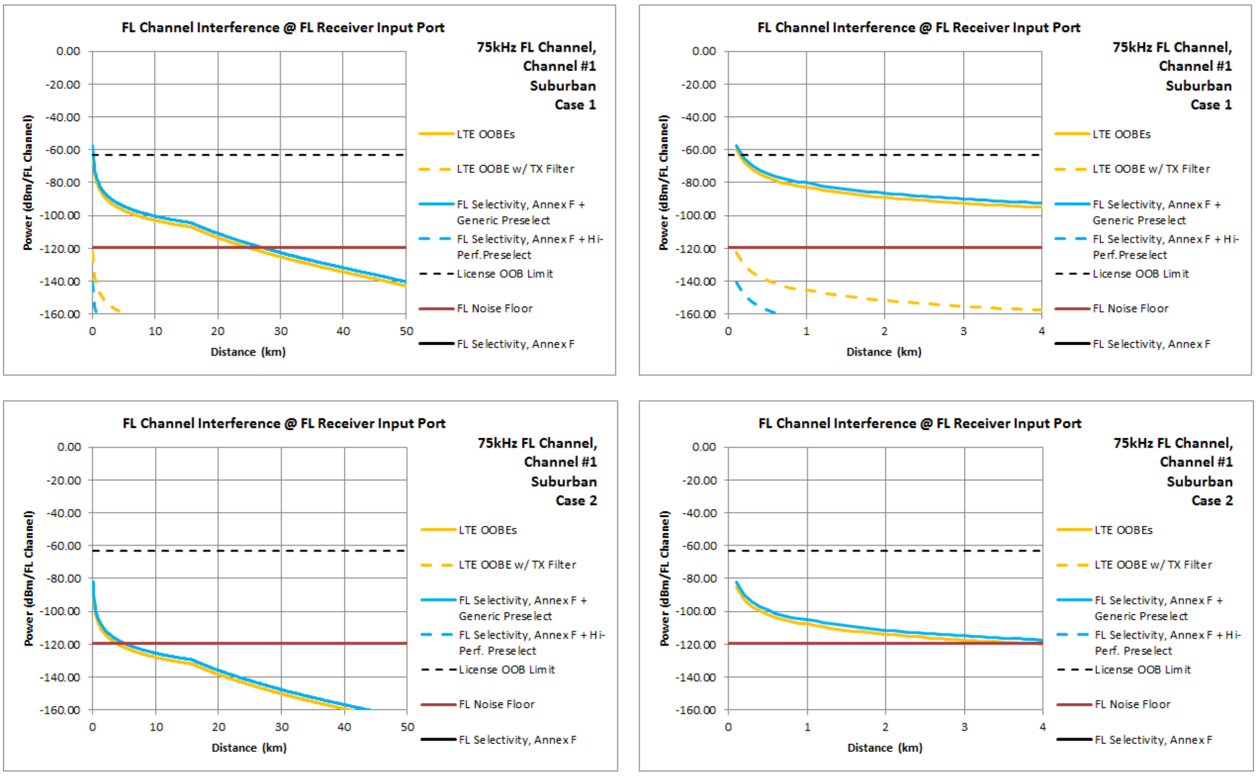


Figure 36: MCL results, FL CS 75 kHz, channel 1, suburban, case 1 and case 2

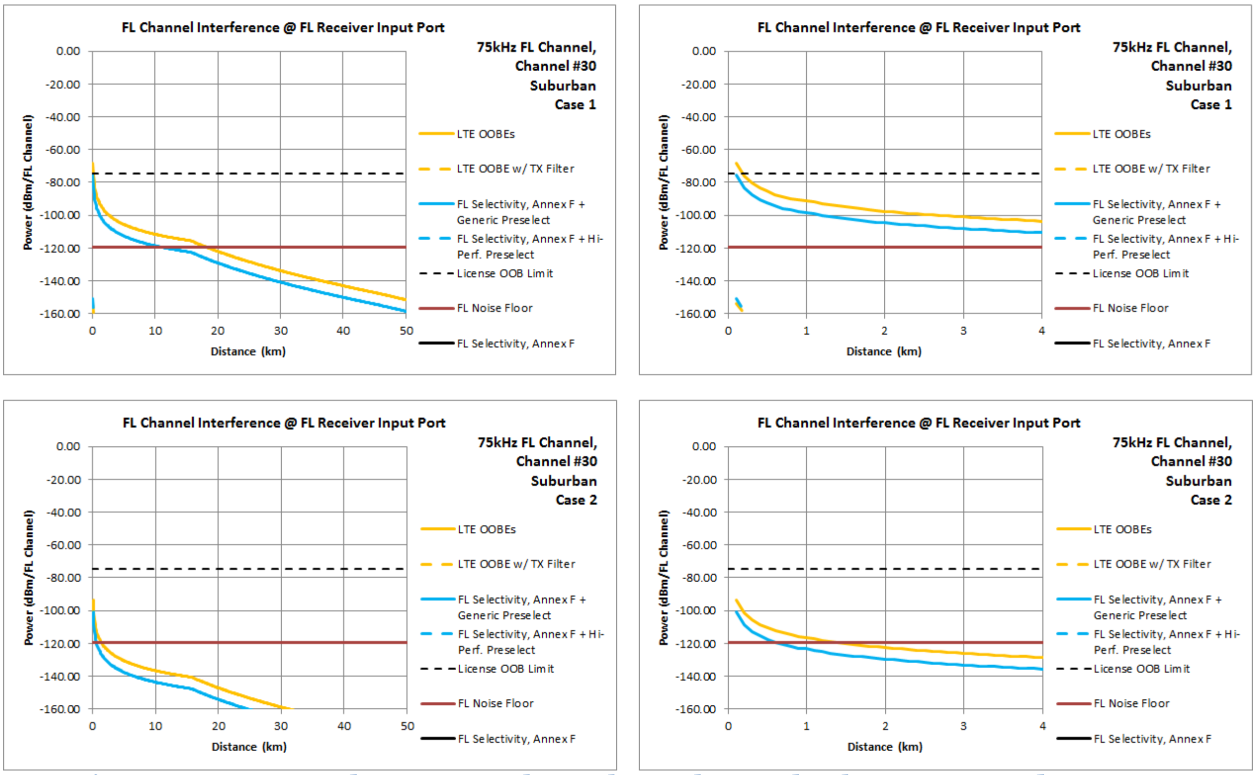


Figure 37: MCL results, FL CS 75 kHz, channel 30, suburban, case 1 and case 2

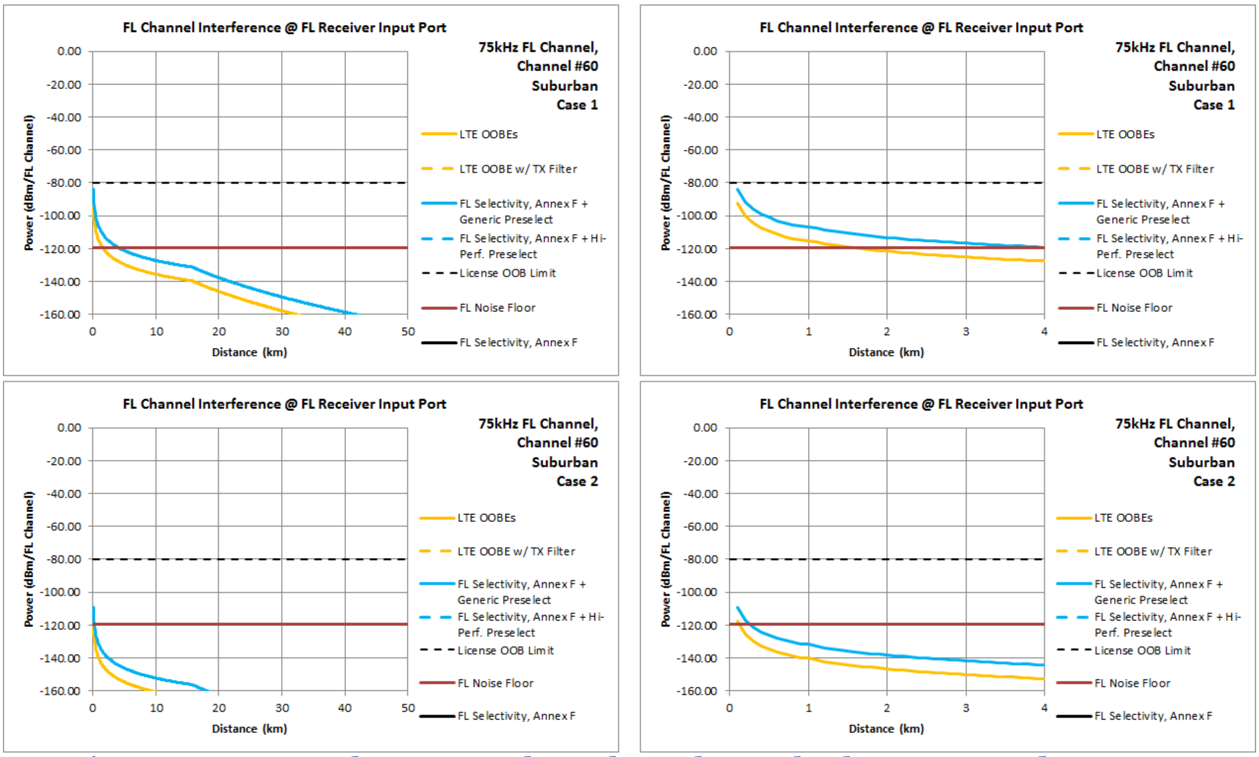


Figure 38: MCL results, FL CS 75 kHz, channel 60, suburban, case 1 and case 2

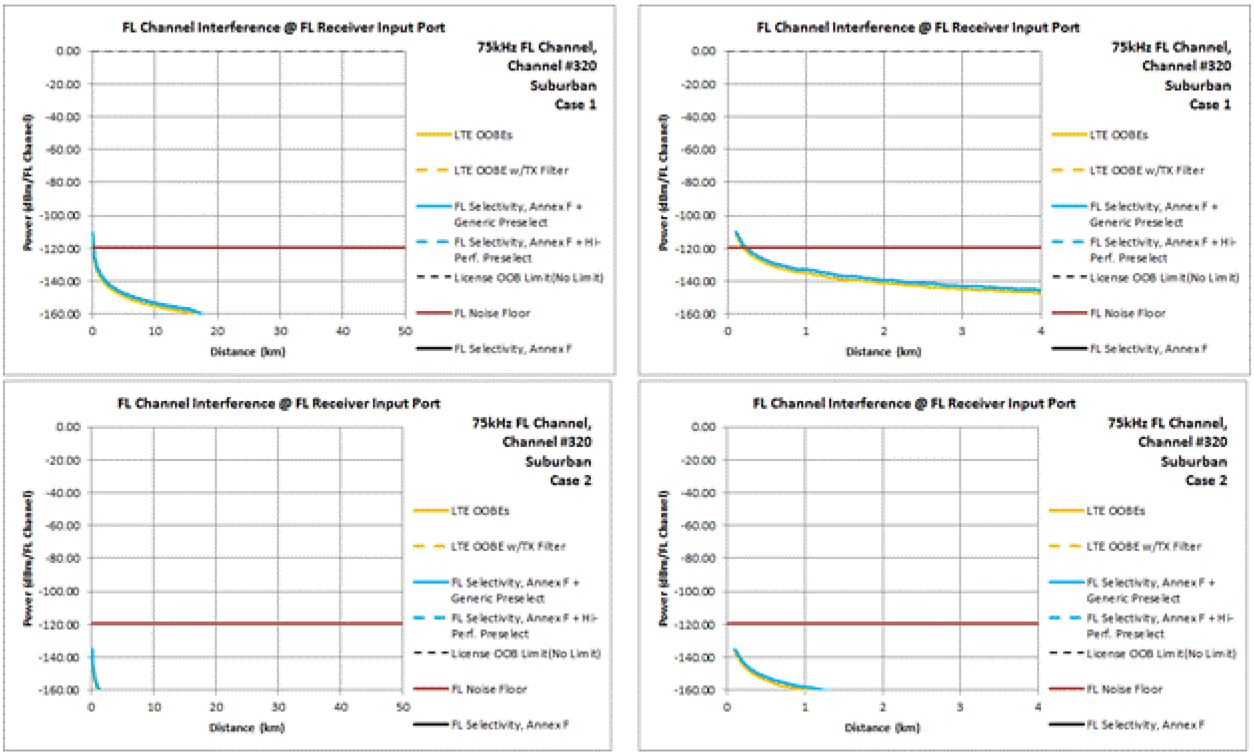


Figure 39: MCL results, FL CS 75 kHz, channel 320, suburban, case 1 and case 2

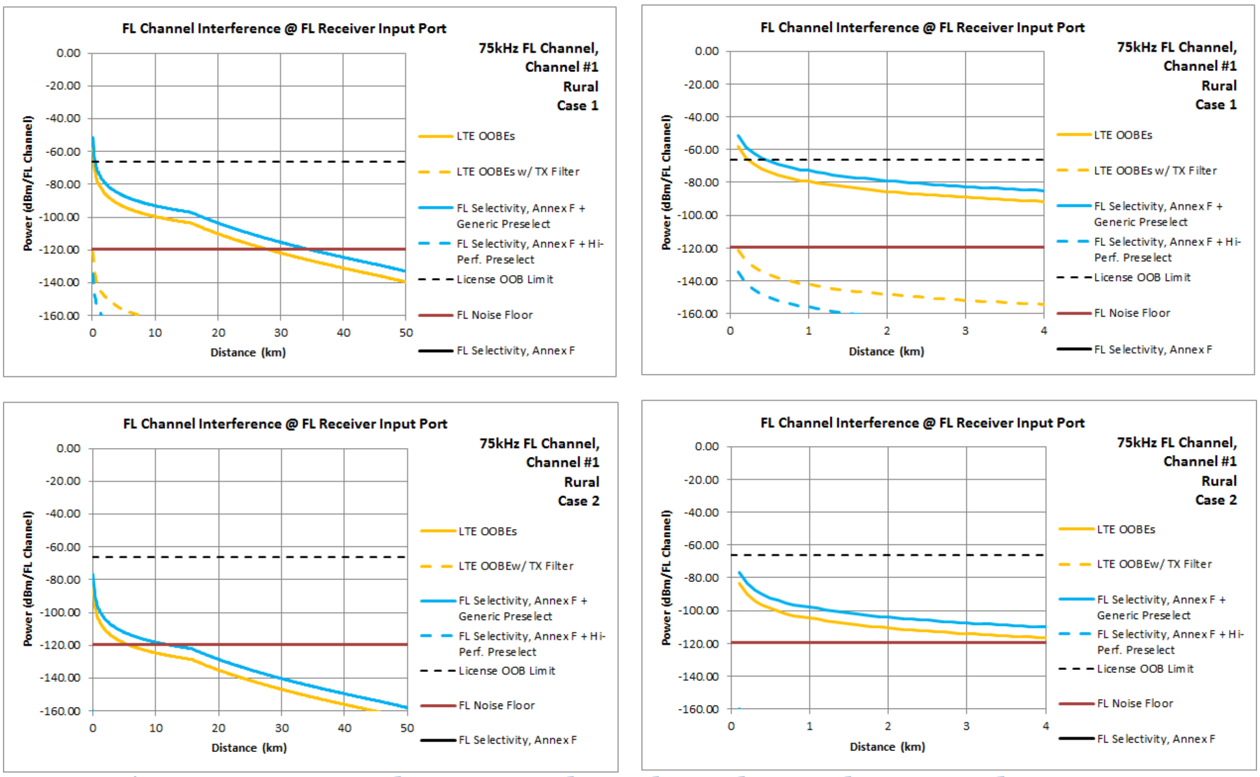


Figure 40: MCL results, FL CS 75 kHz, channel 1, rural, case 1 and case 2

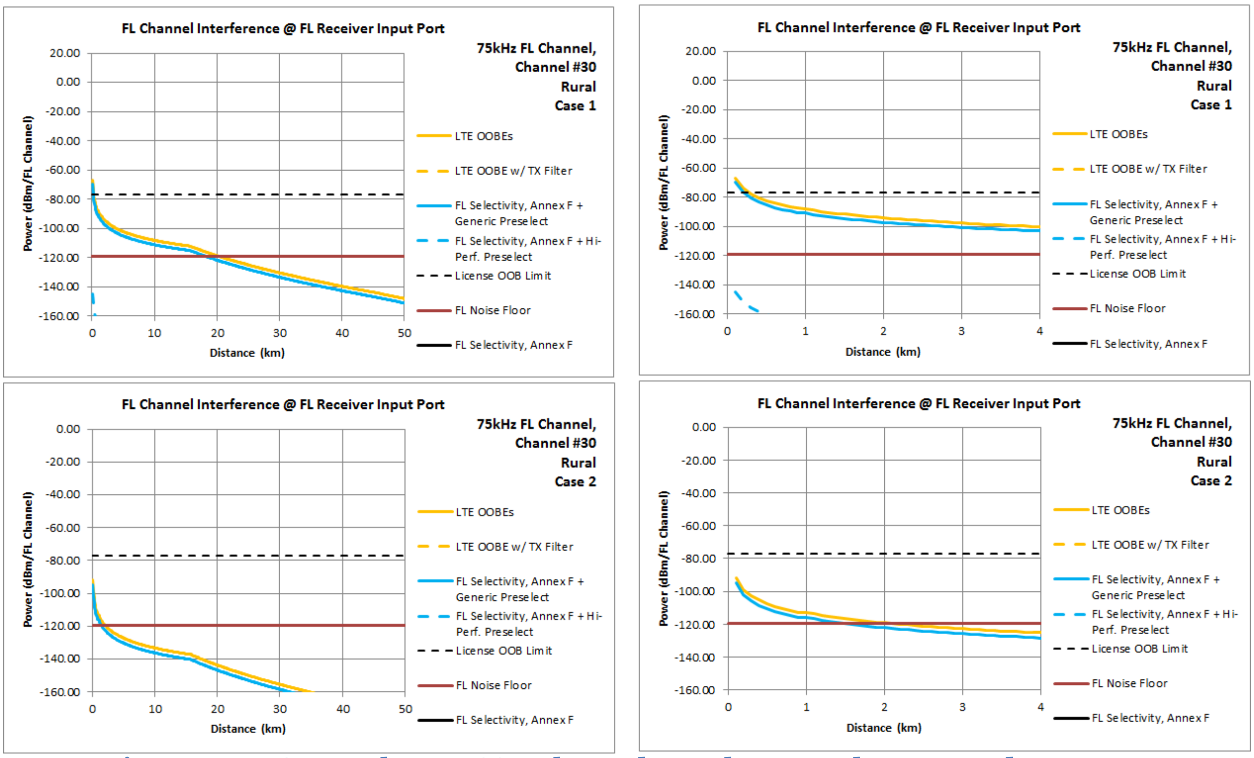


Figure 41: MCL results, FL CS 75 kHz, channel 30, rural, case 1 and case 2

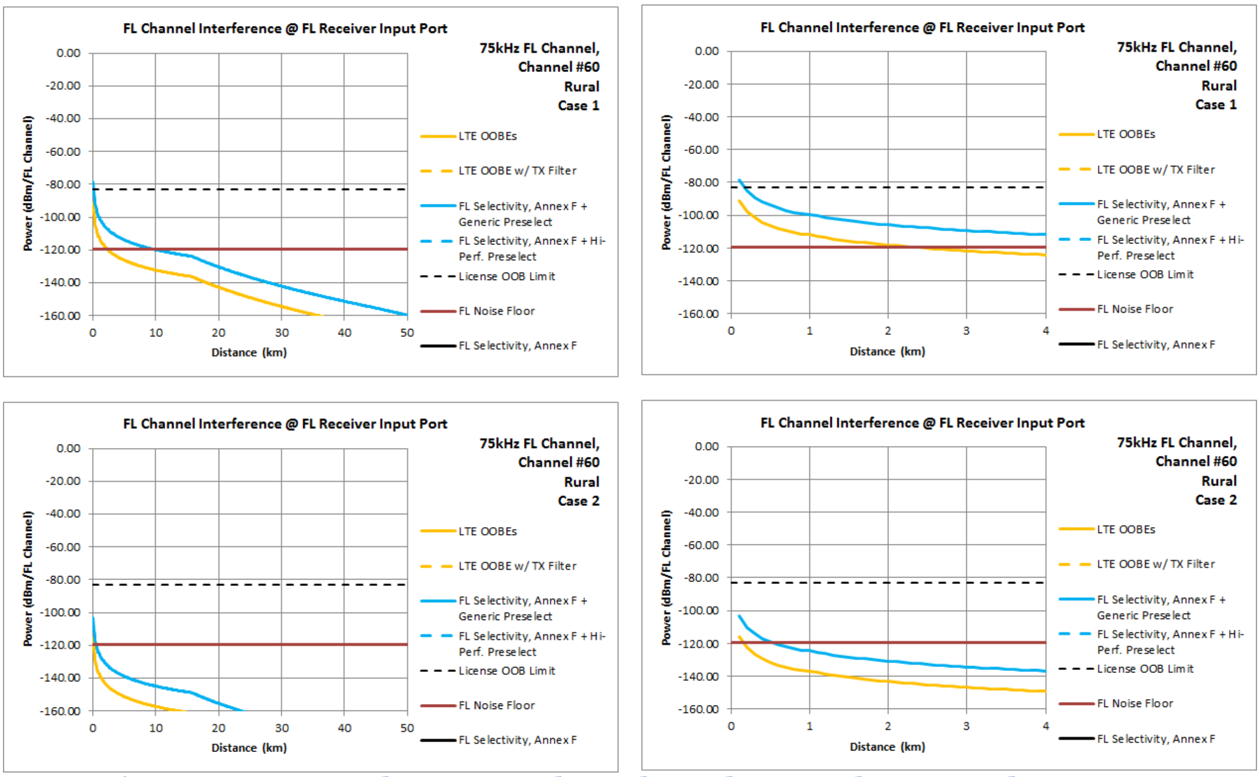


Figure 42: MCL results, FL CS 75 kHz, channel 60, rural, case 1 and case 2

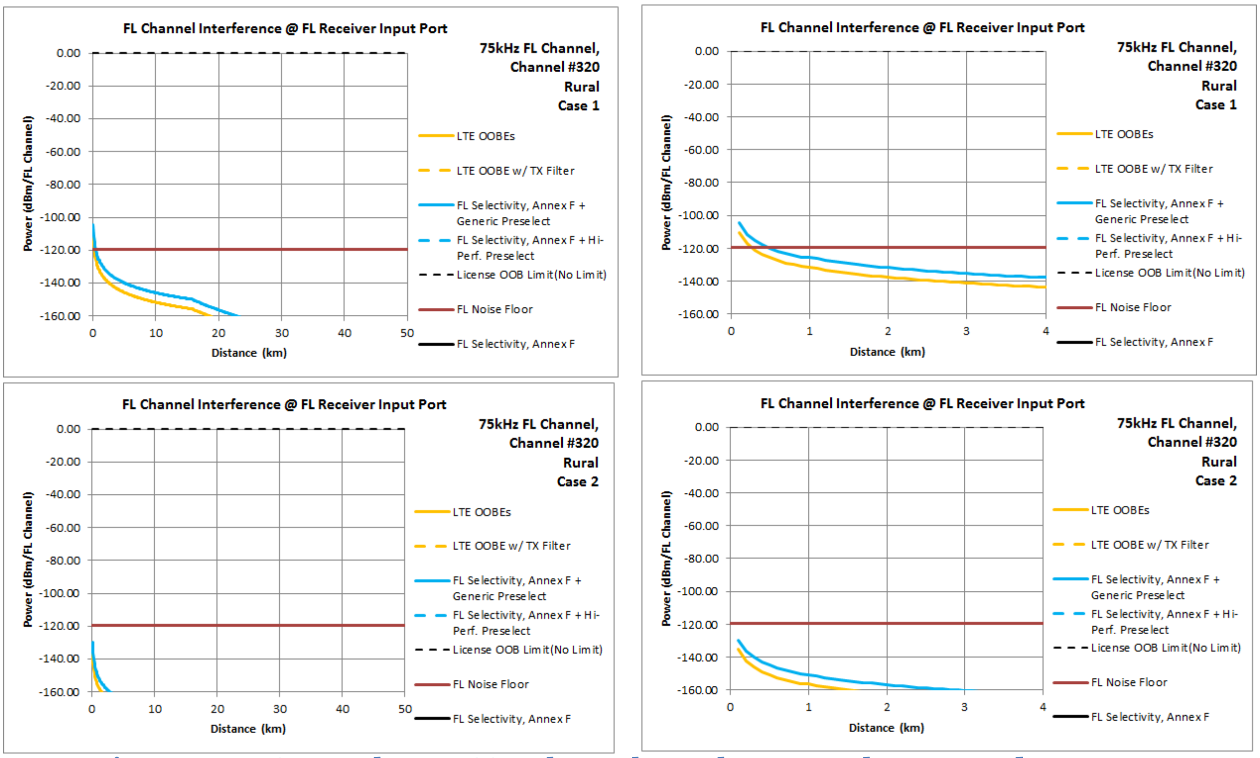


Figure 43: MCL results, FL CS 75 kHz, channel 320, rural, case 1 and case 2

5.4.3 FL 250 kHz

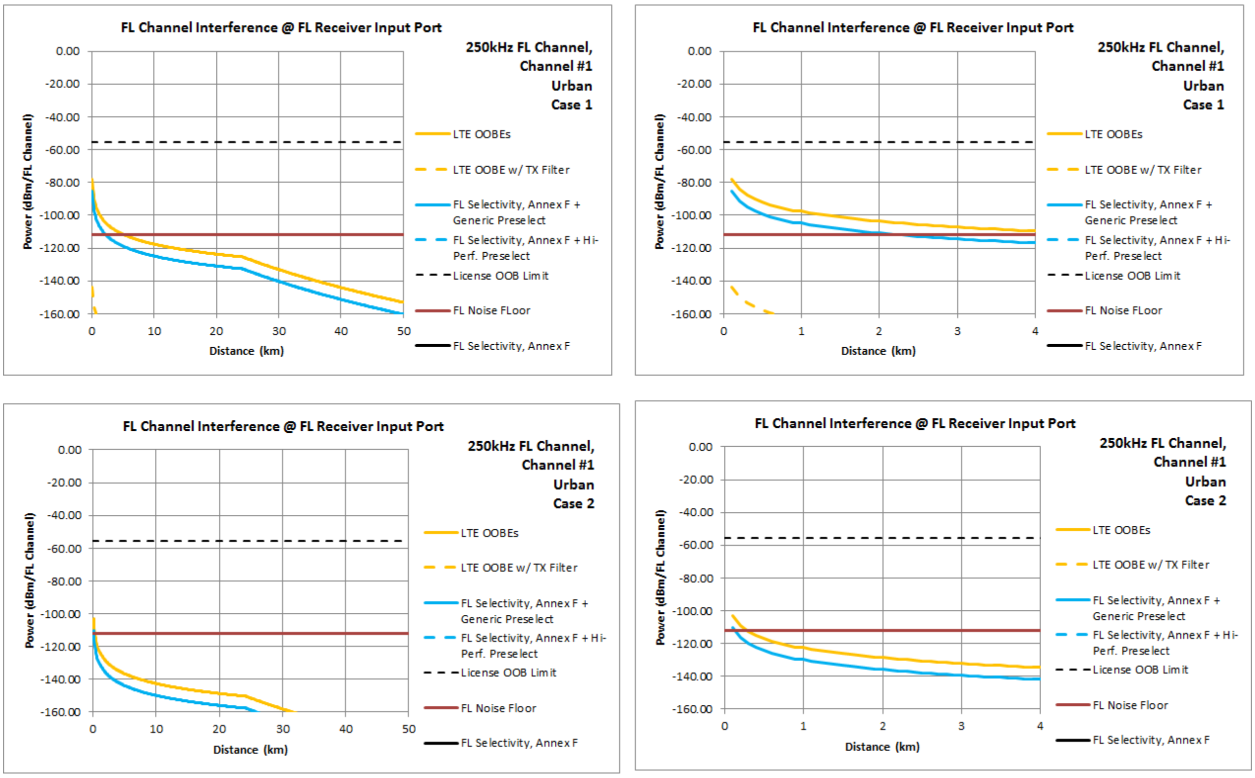


Figure 44: MCL results, FL CS 250 kHz, channel 1, urban, case 1 and case 2

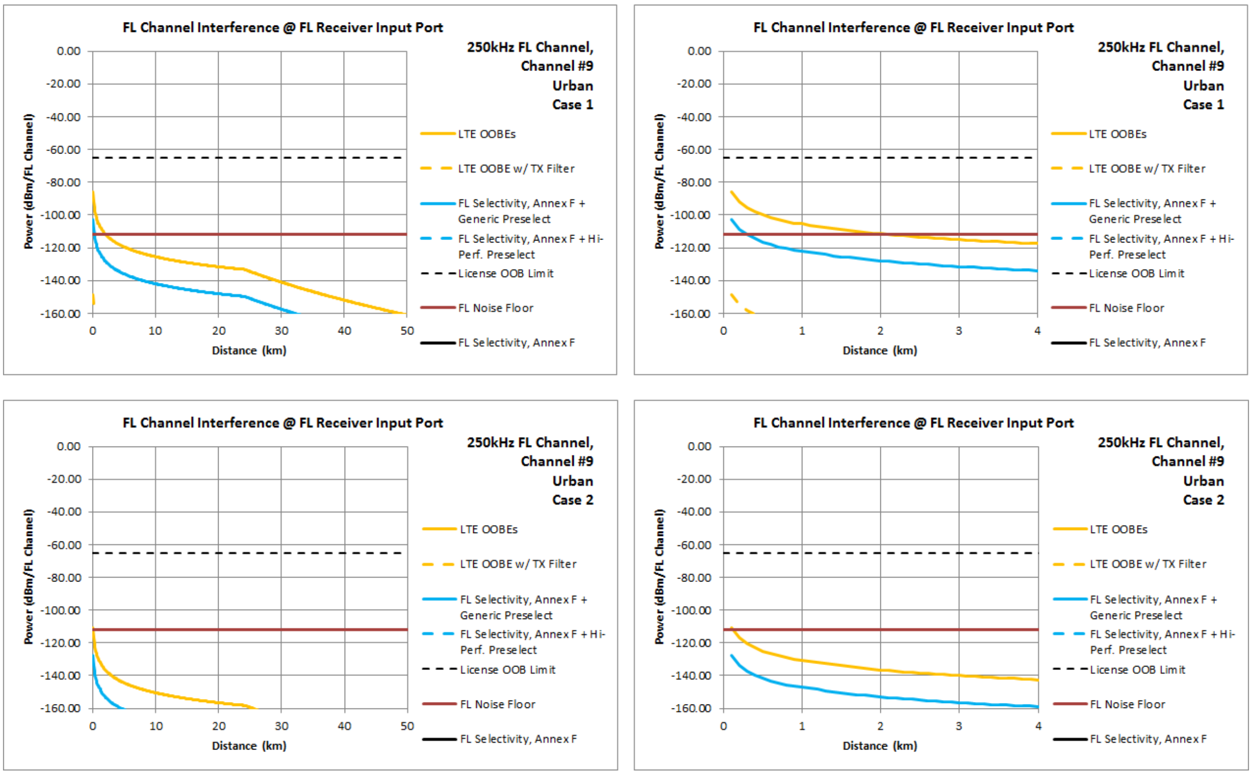


Figure 45: MCL results, FL CS 250 kHz, channel 9, urban, case 1 and case 2

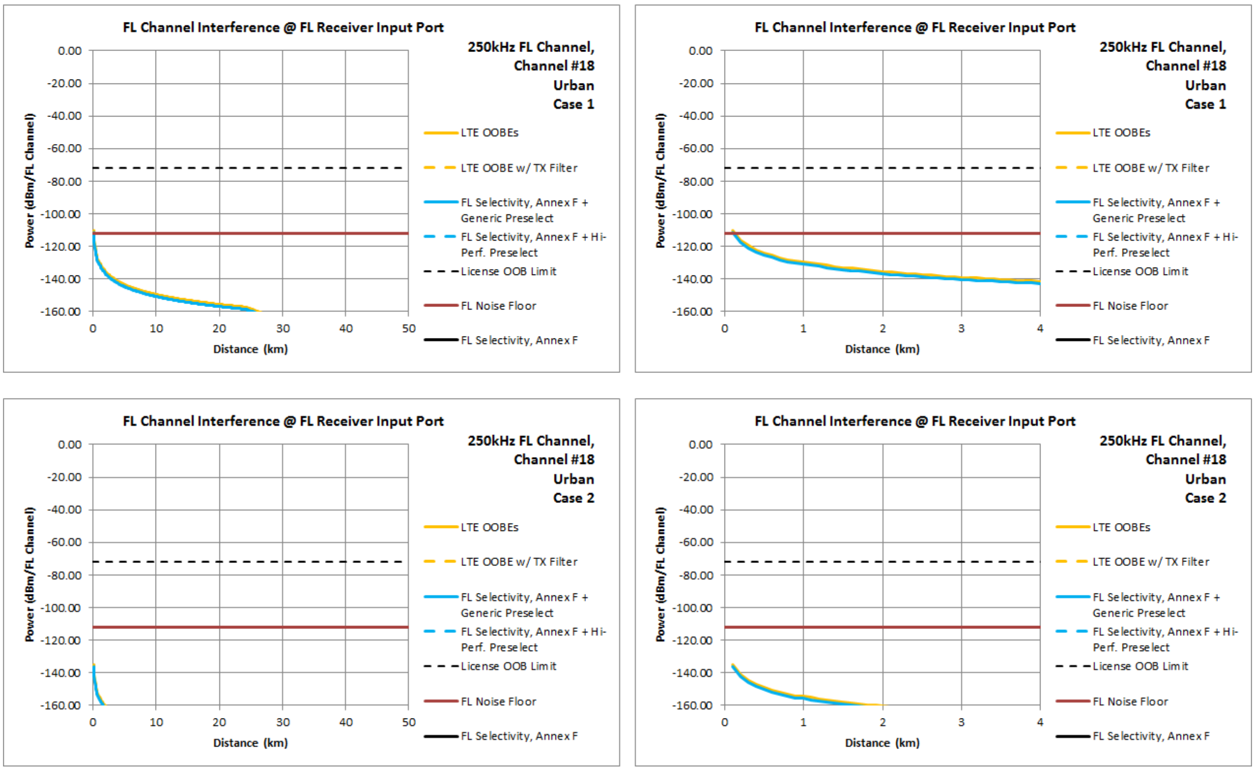


Figure 46: MCL results, FL CS 250 kHz, channel 18, urban, case 1 and case 2

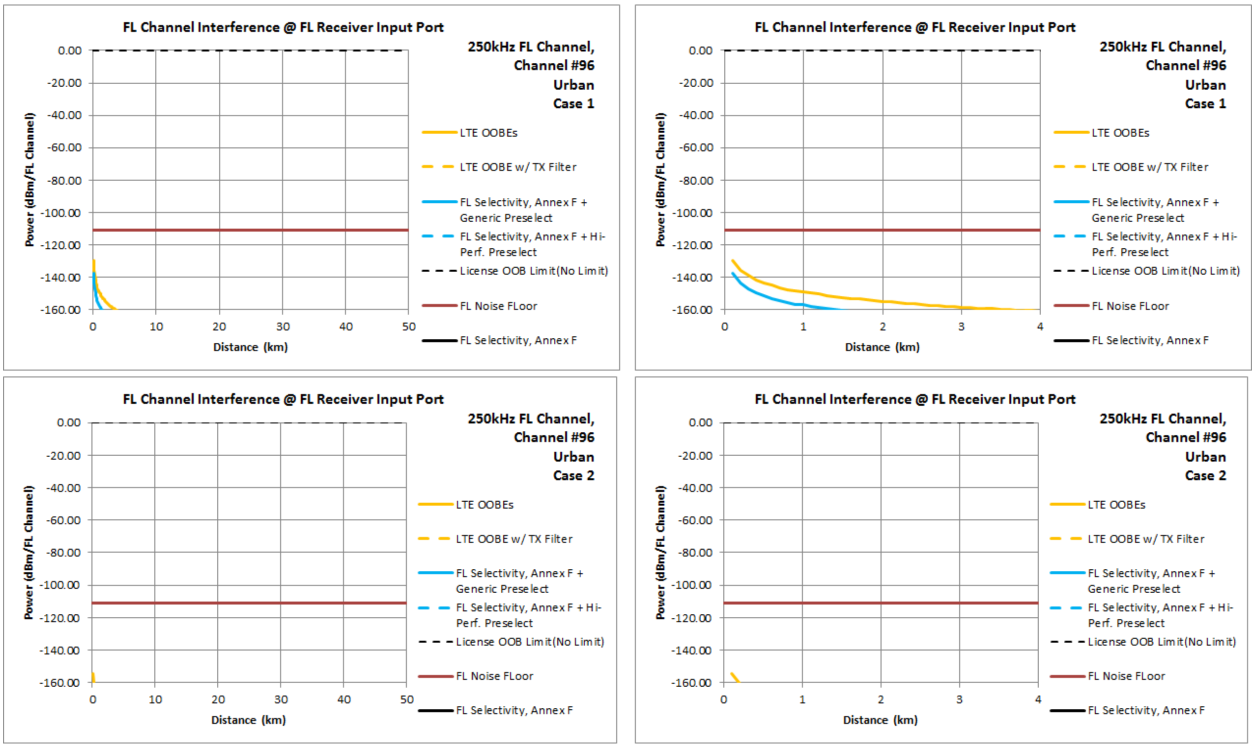


Figure 47: MCL results, FL CS 250 kHz, channel 96, urban, case 1 and case 2

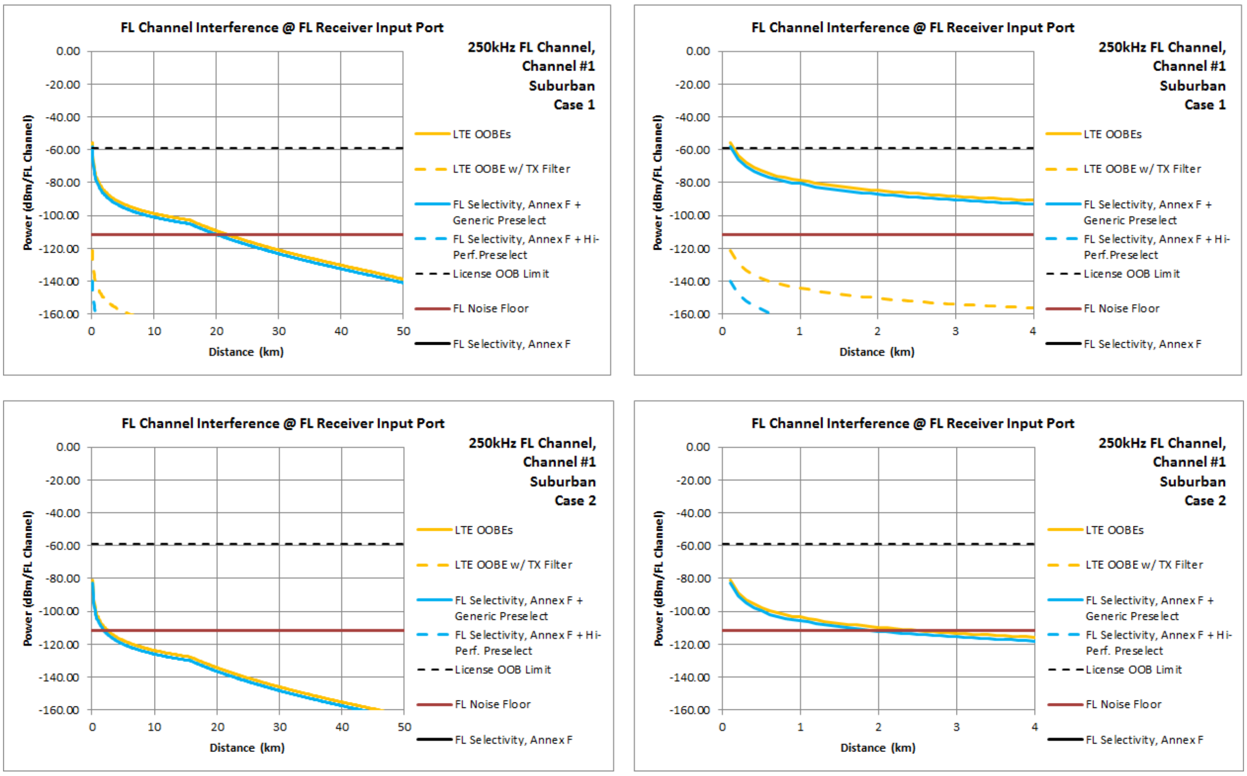


Figure 48: MCL results, FL CS 250 kHz, channel 1, suburban, case 1 and case 2

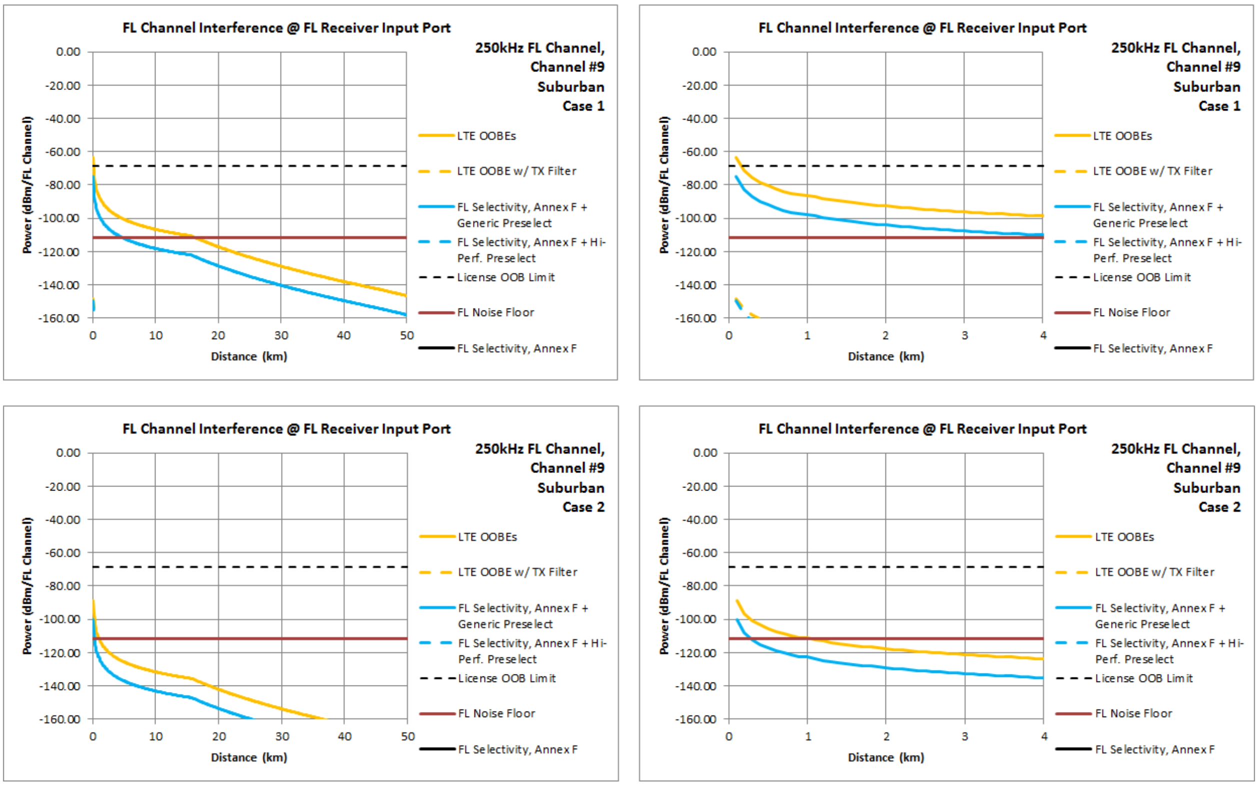


Figure 49: MCL results, FL CS 250 kHz, channel 9, suburban, case 1 and case 2

Qualcomm

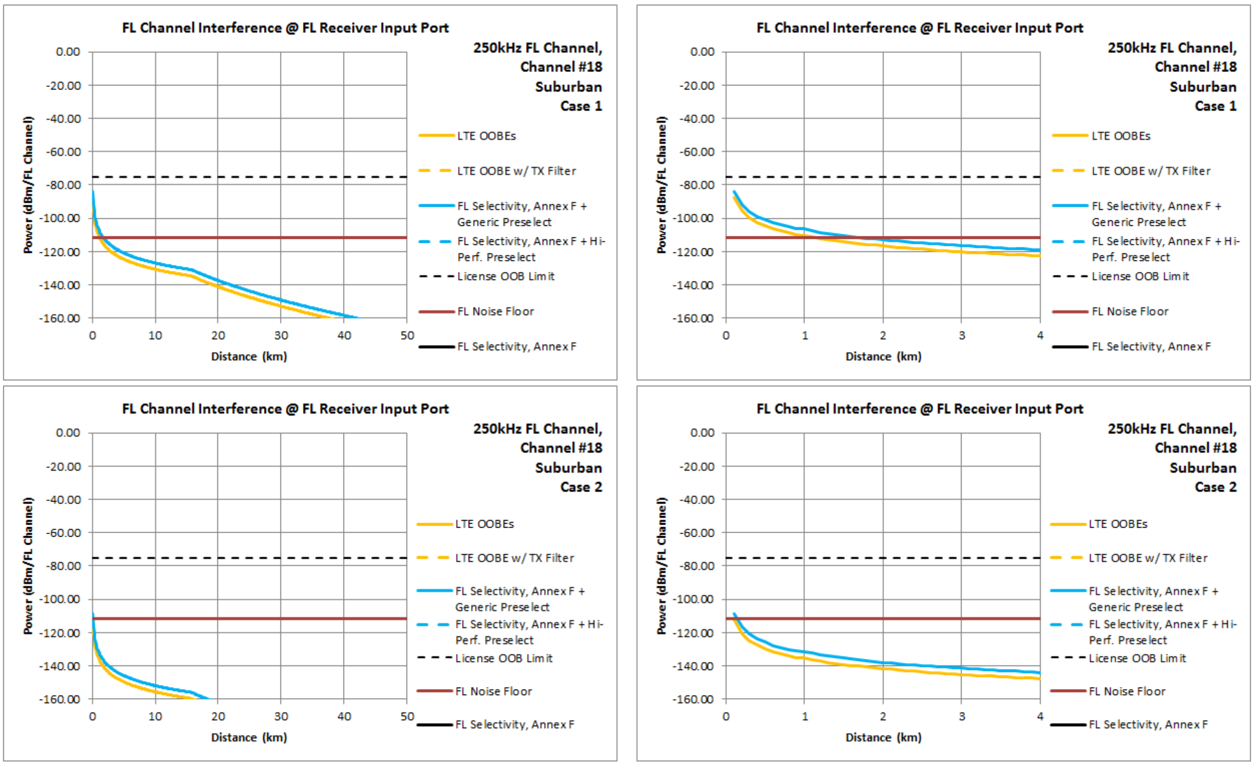


Figure 50: MCL results, FL CS 250 kHz, channel 18, suburban, case 1 and case 2

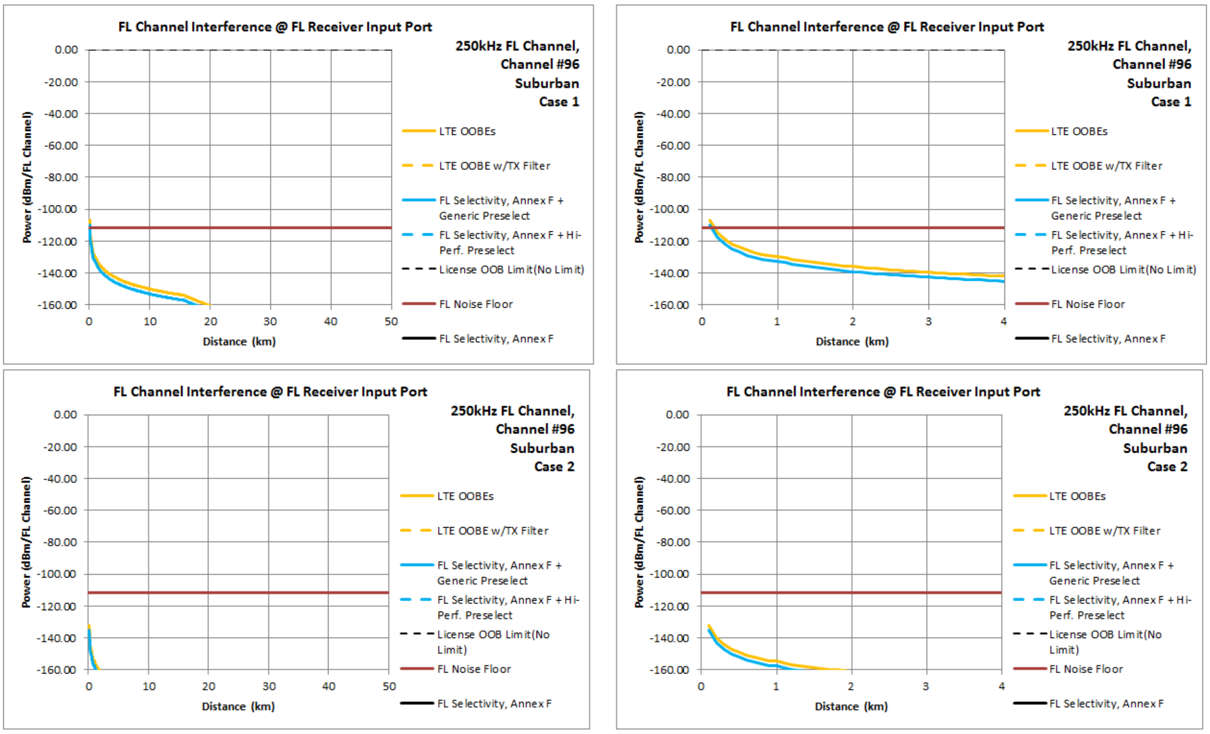


Figure 51: MCL results, FL CS 250 kHz, channel 96, suburban, case 1 and case 2

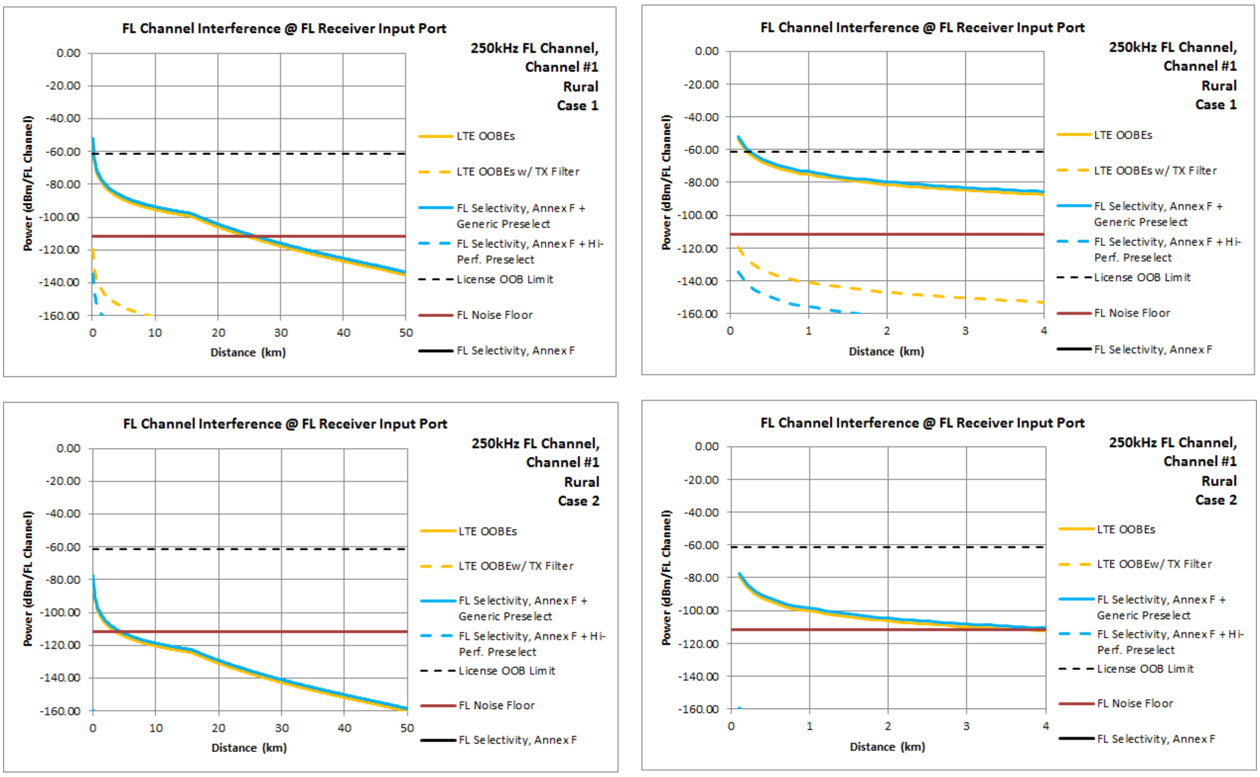


Figure 52: MCL results, FL CS 250 kHz, channel 1, rural, case 1 and case 2

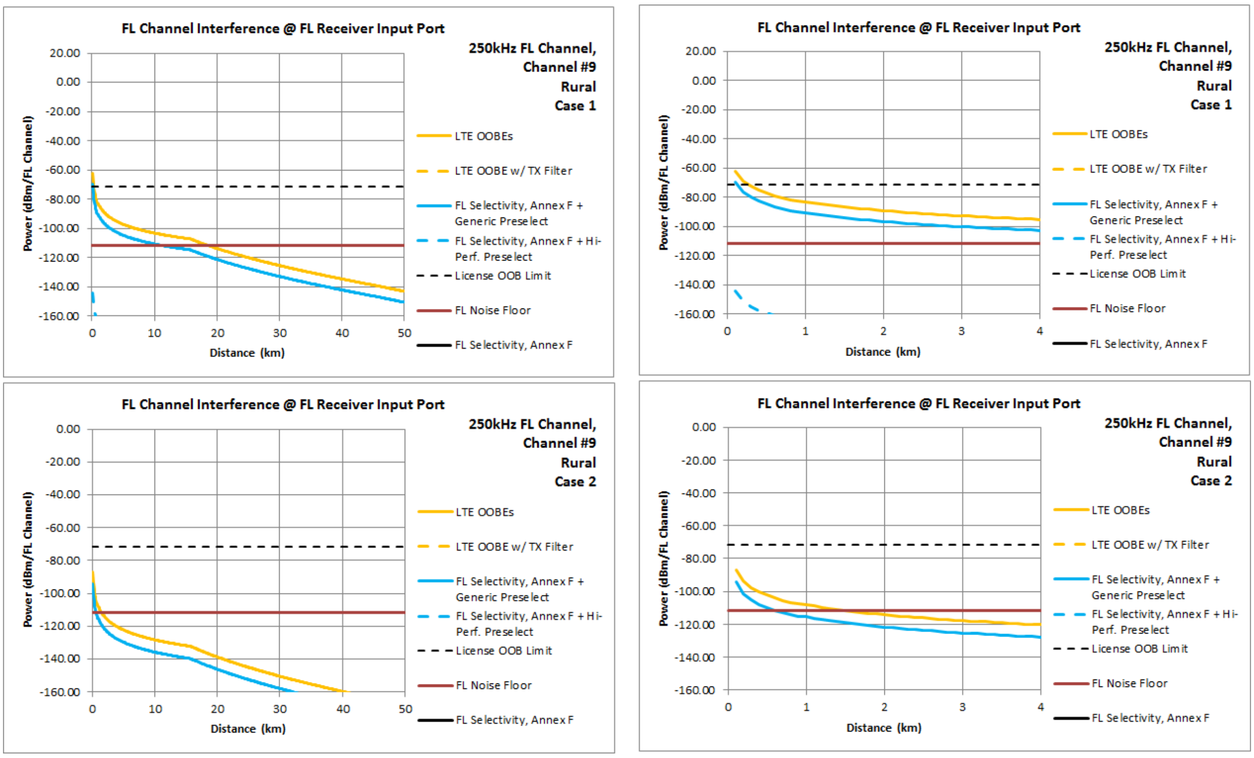


Figure 53: MCL results, FL CS 250 kHz, channel 9, rural, case 1 and case 2

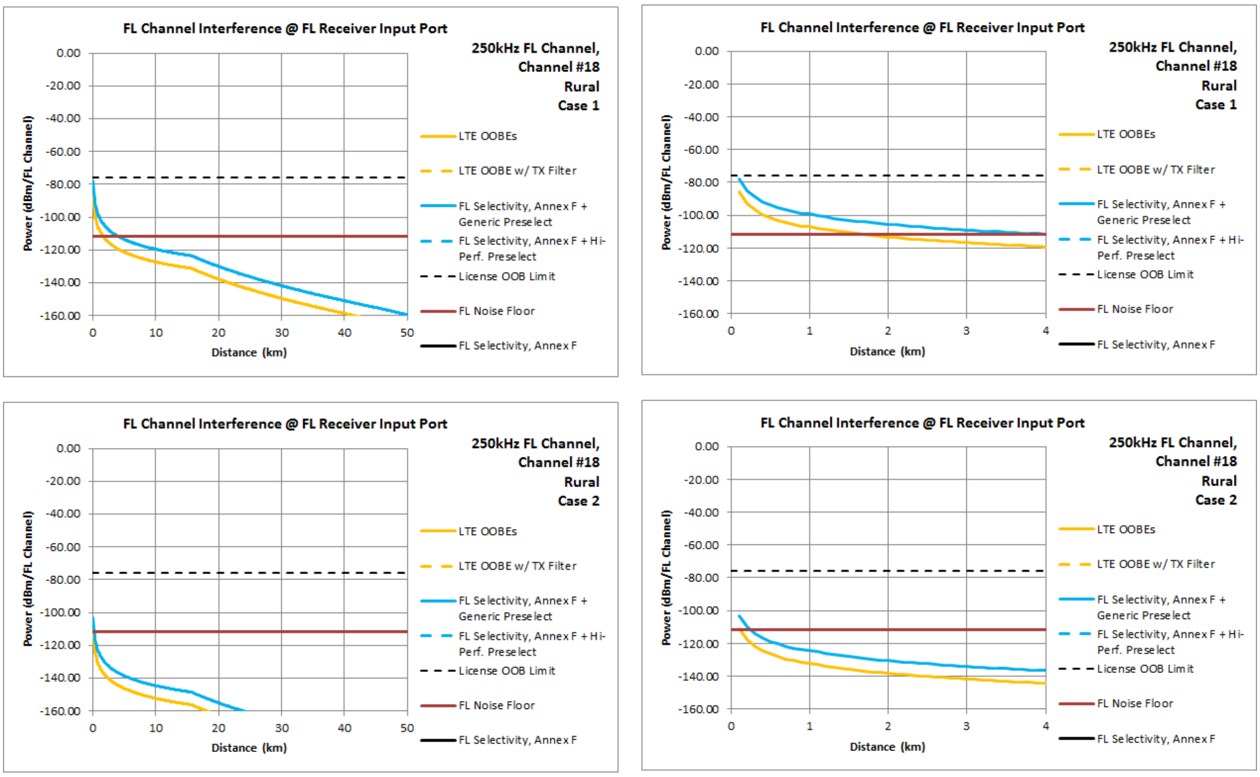


Figure 54: MCL results, FL CS 250 kHz, channel 18, rural, case 1 and case 2

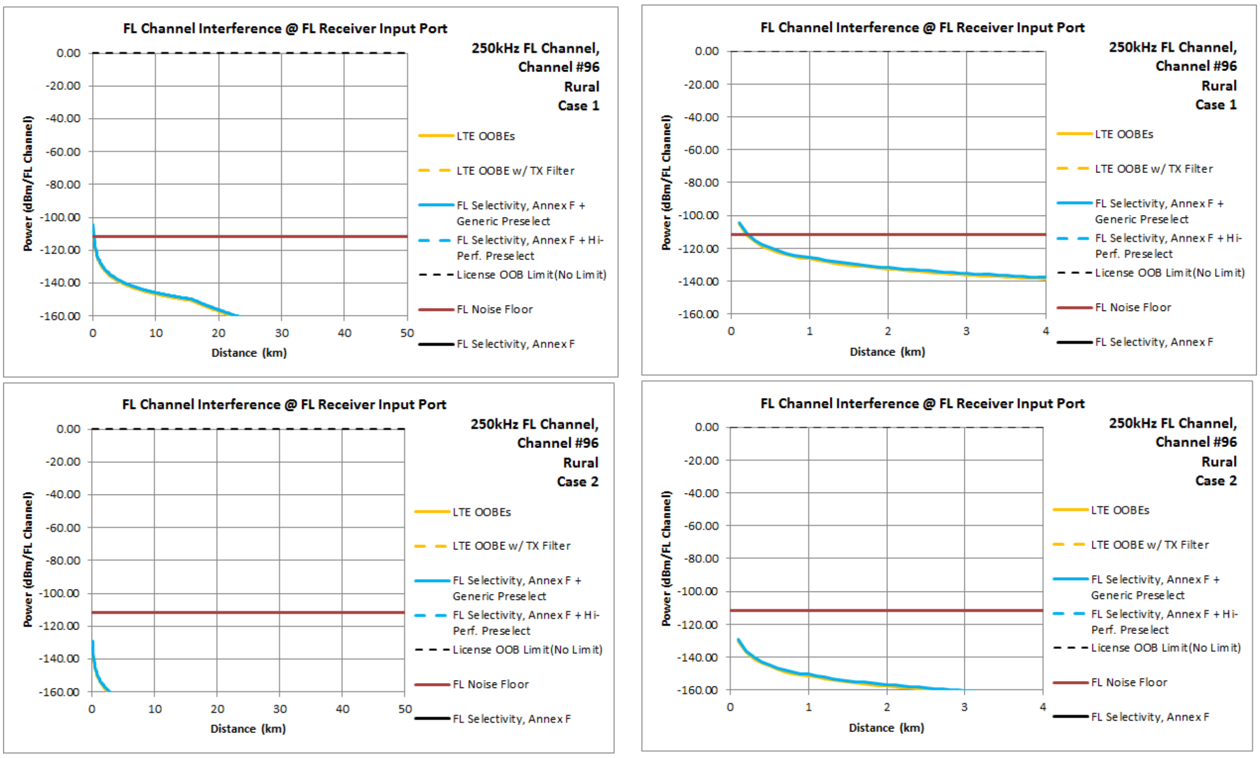


Figure 55: MCL results, FL CS 250 kHz, channel 96, rural, case 1 and case 2

5.4.4 FL 500 KHz

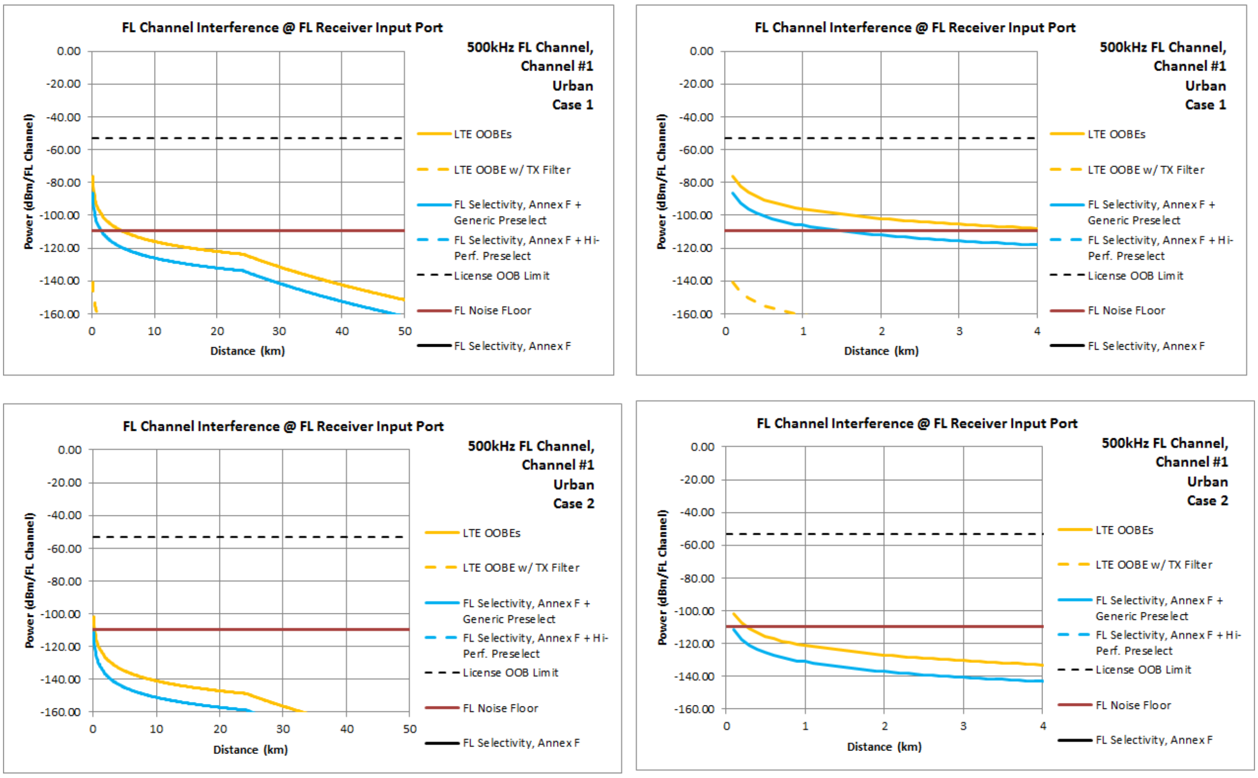


Figure 56: MCL results, FL CS 500 kHz, channel 1, urban, case 1 and case 2

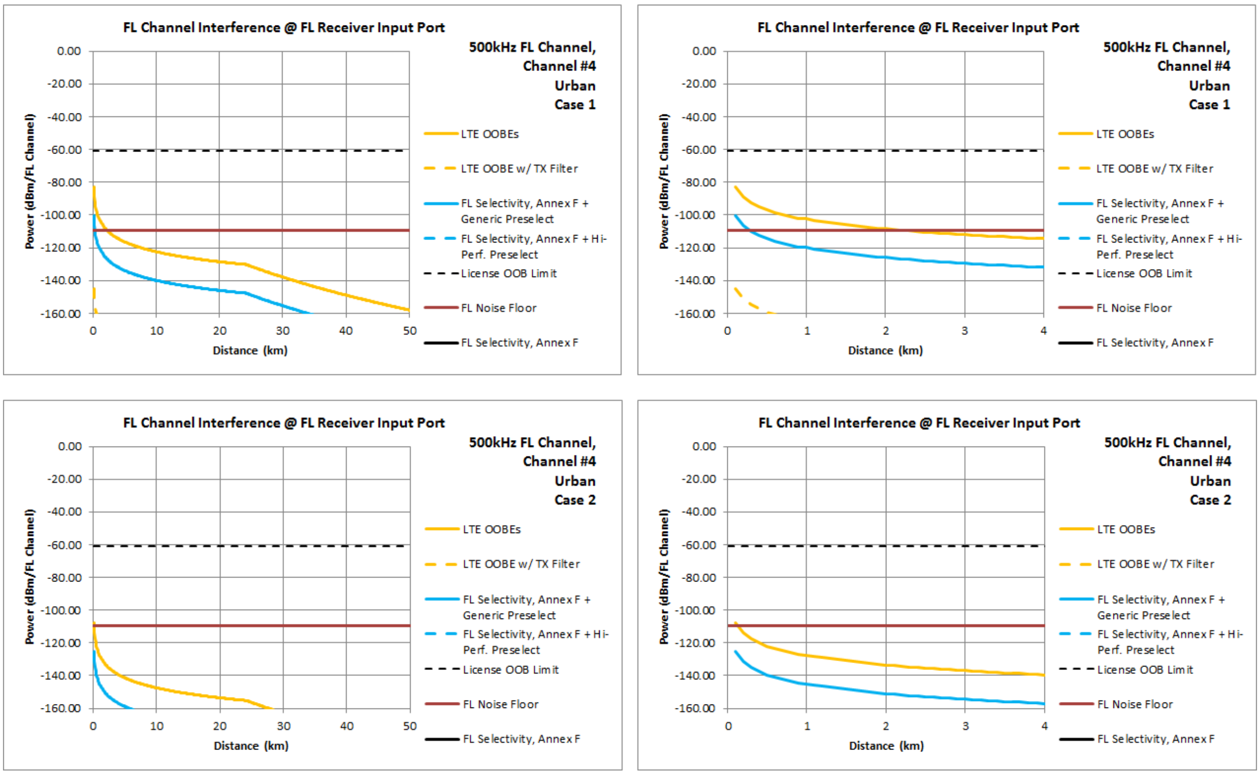


Figure 57: MCL results, FL CS 500 kHz, channel 4, urban, case 1 and case 2

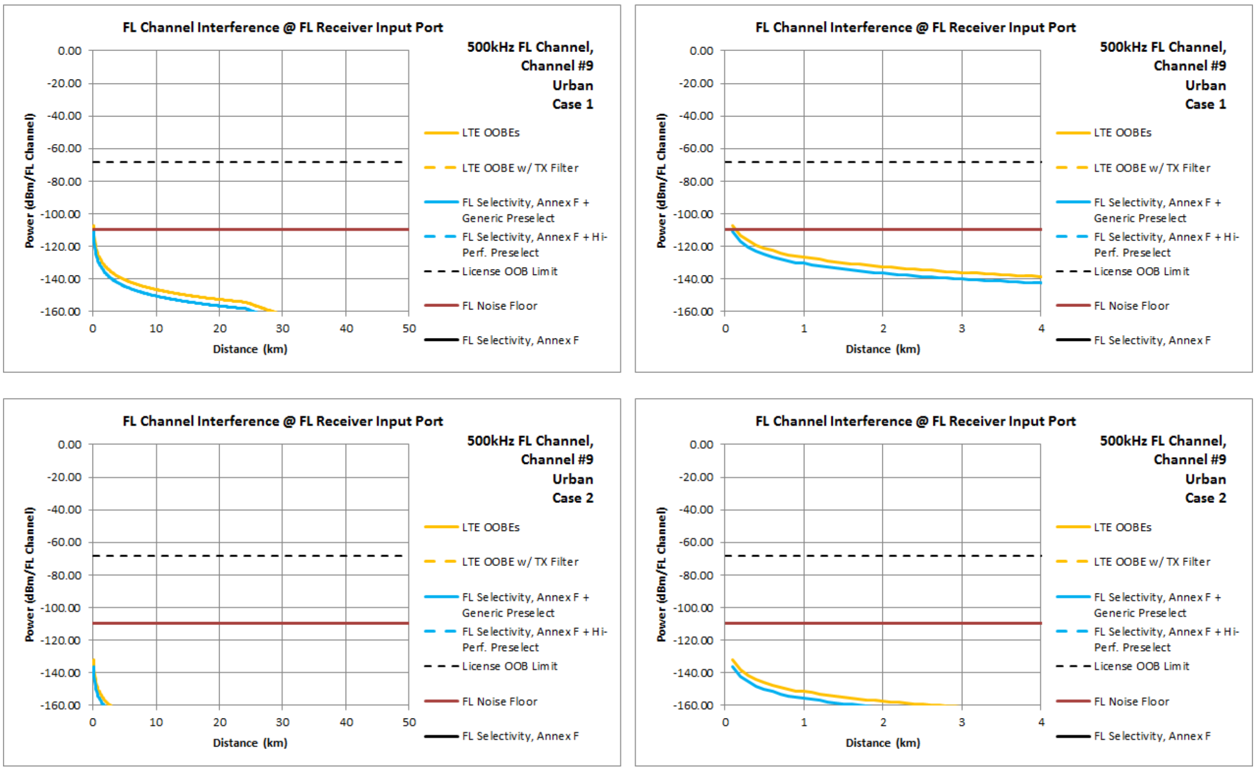


Figure 58: MCL results, FL CS 500 kHz, channel 9, urban, case 1 and case 2

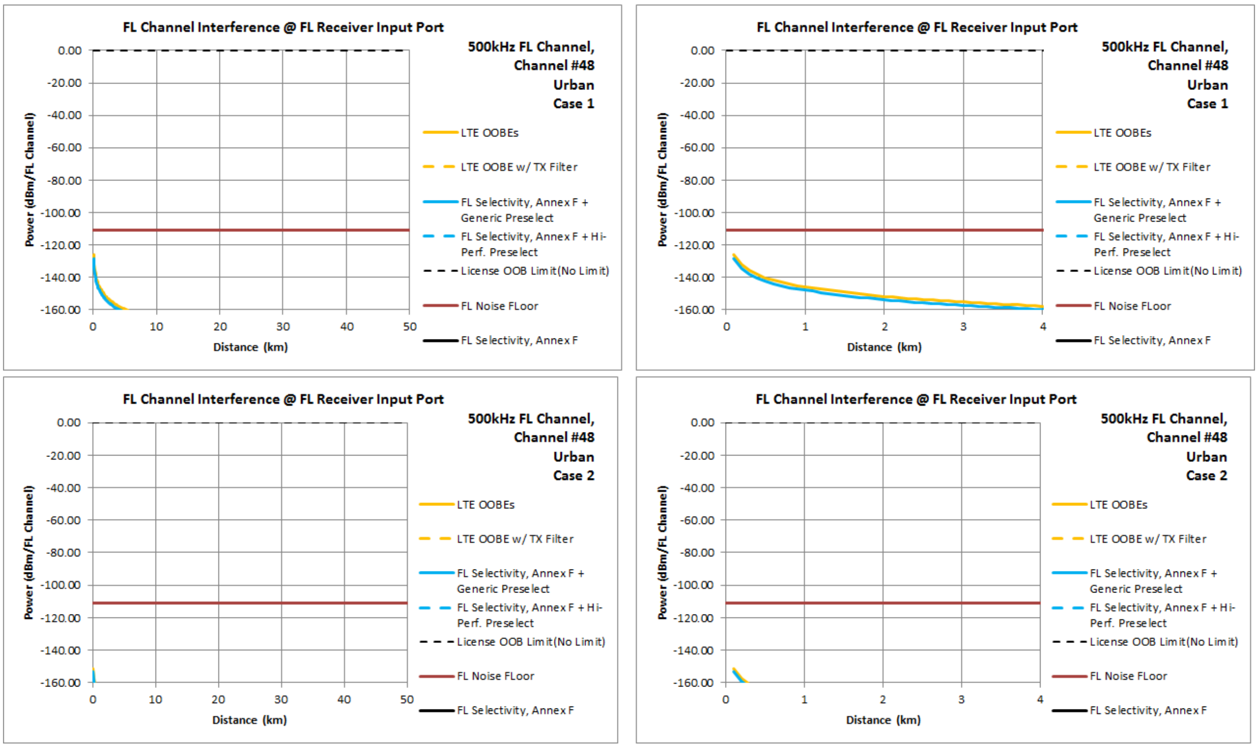


Figure 59: MCL results, FL CS 500 kHz, channel 48, urban, case 1 and case 2

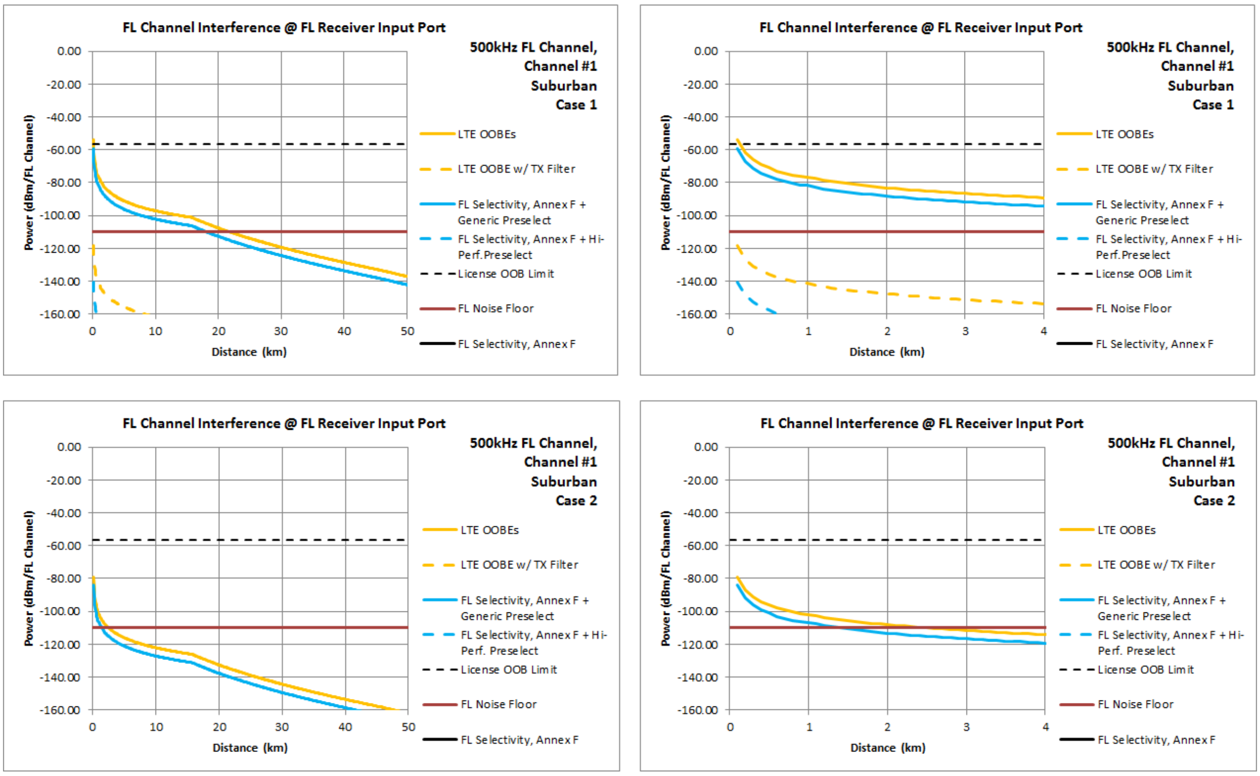


Figure 60: MCL results, FL CS 500 kHz, channel 1, suburban, case 1 and case 2

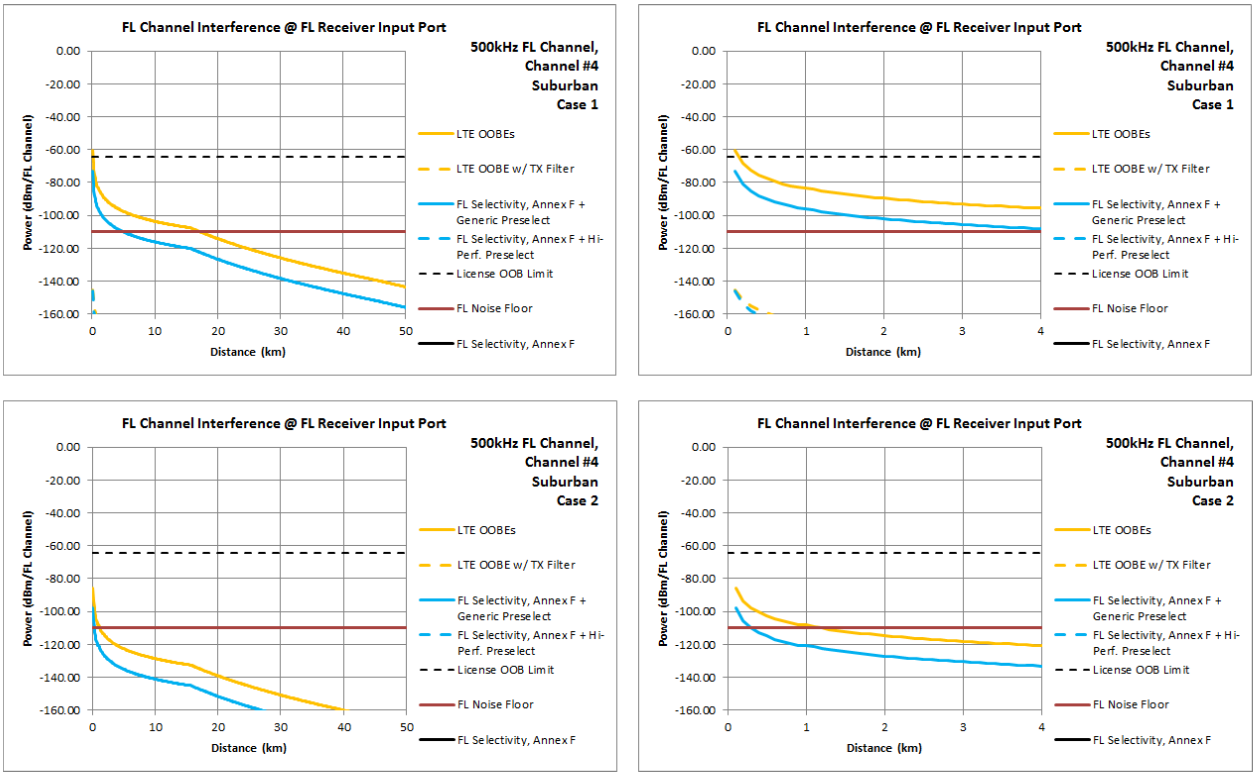


Figure 61: MCL results, FL CS 500 kHz, channel 4, suburban, case 1 and case 2

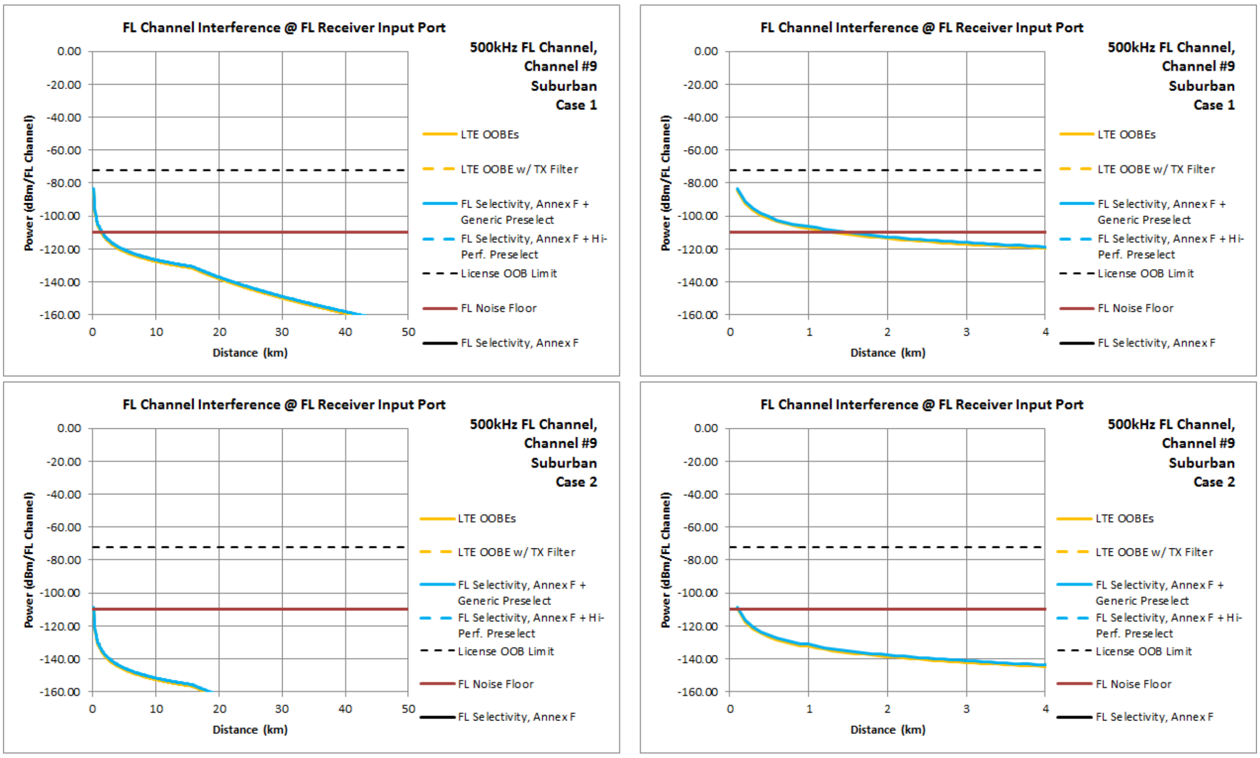


Figure 62: MCL results, FL CS 500 kHz, channel 9, suburban, case 1 and case 2

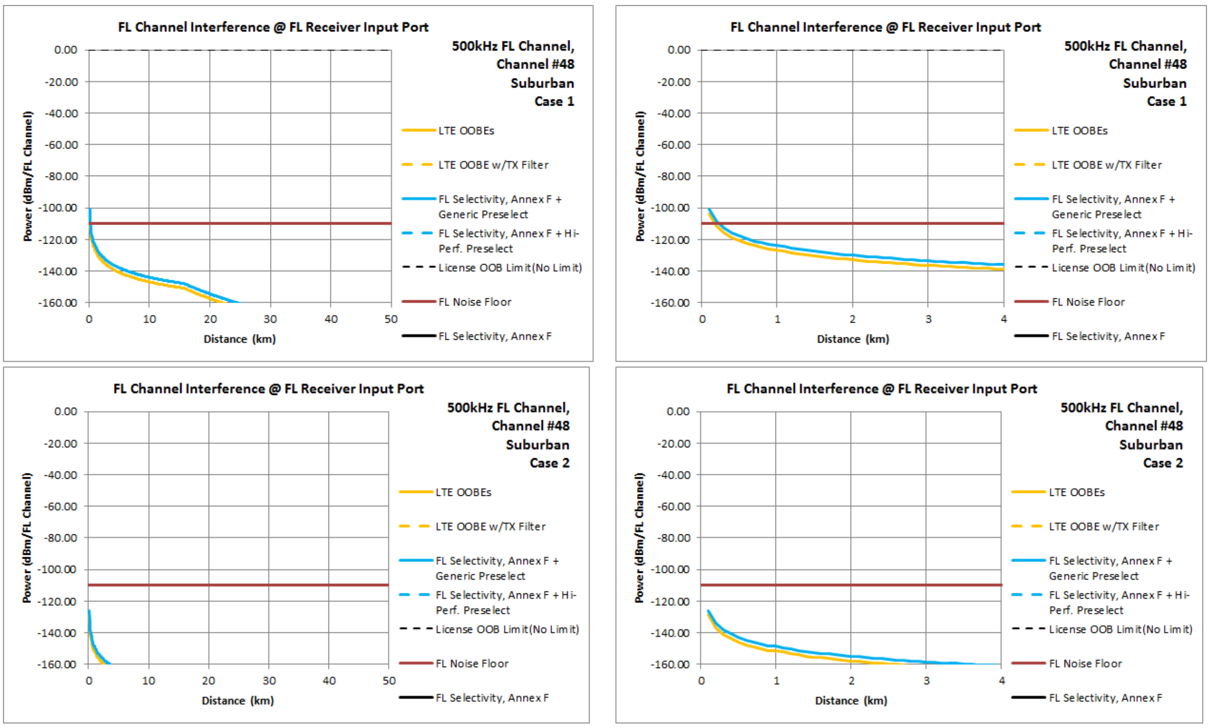


Figure 63: MCL results, FL CS 500 kHz, channel 48, suburban, case 1 and case 2

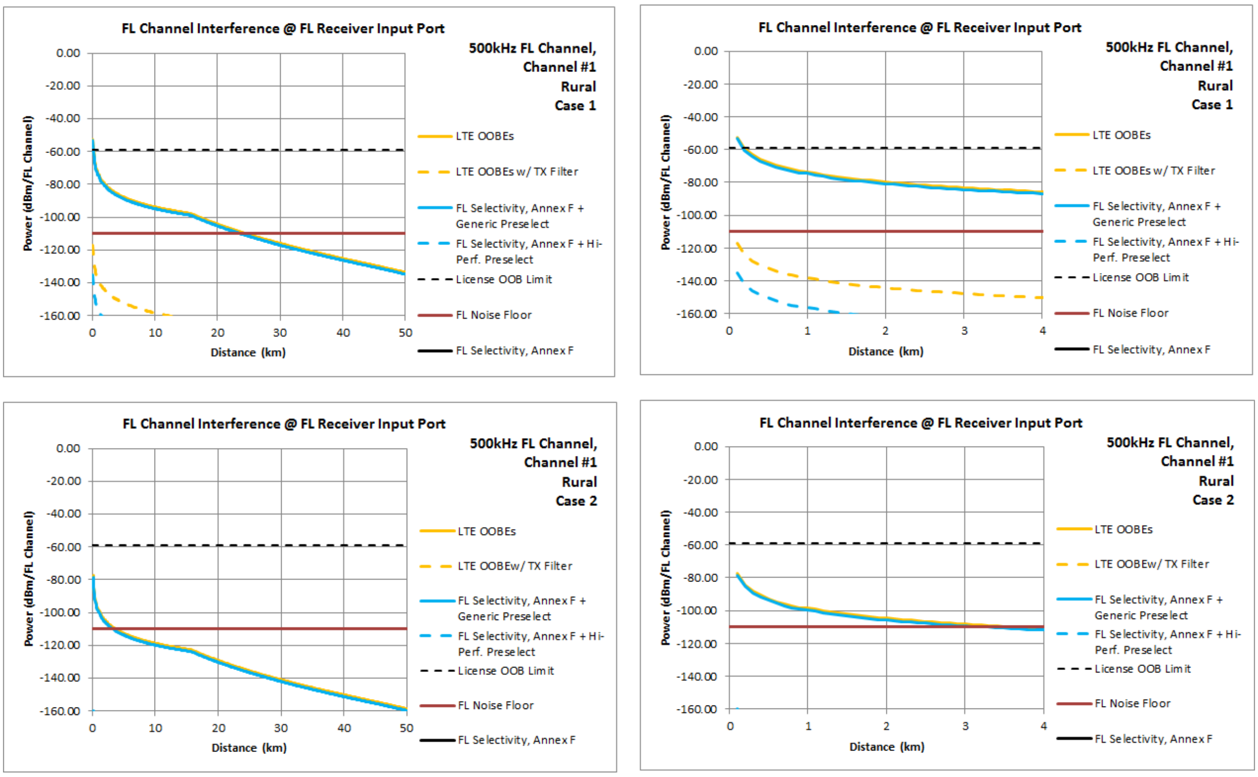


Figure 64: MCL results, FL CS 500 kHz, channel 1, rural, case 1 and case 2

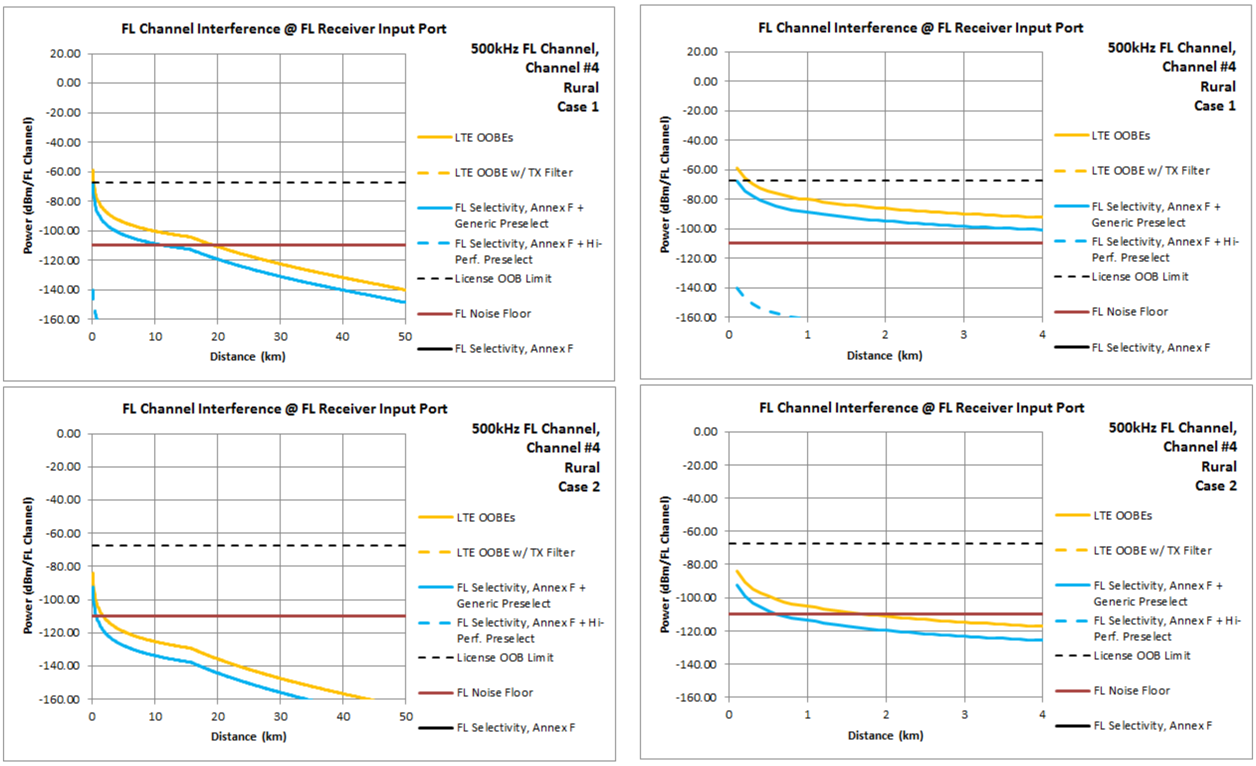


Figure 65: MCL results, FL CS 500 kHz, channel 4, rural, case 1 and case 2

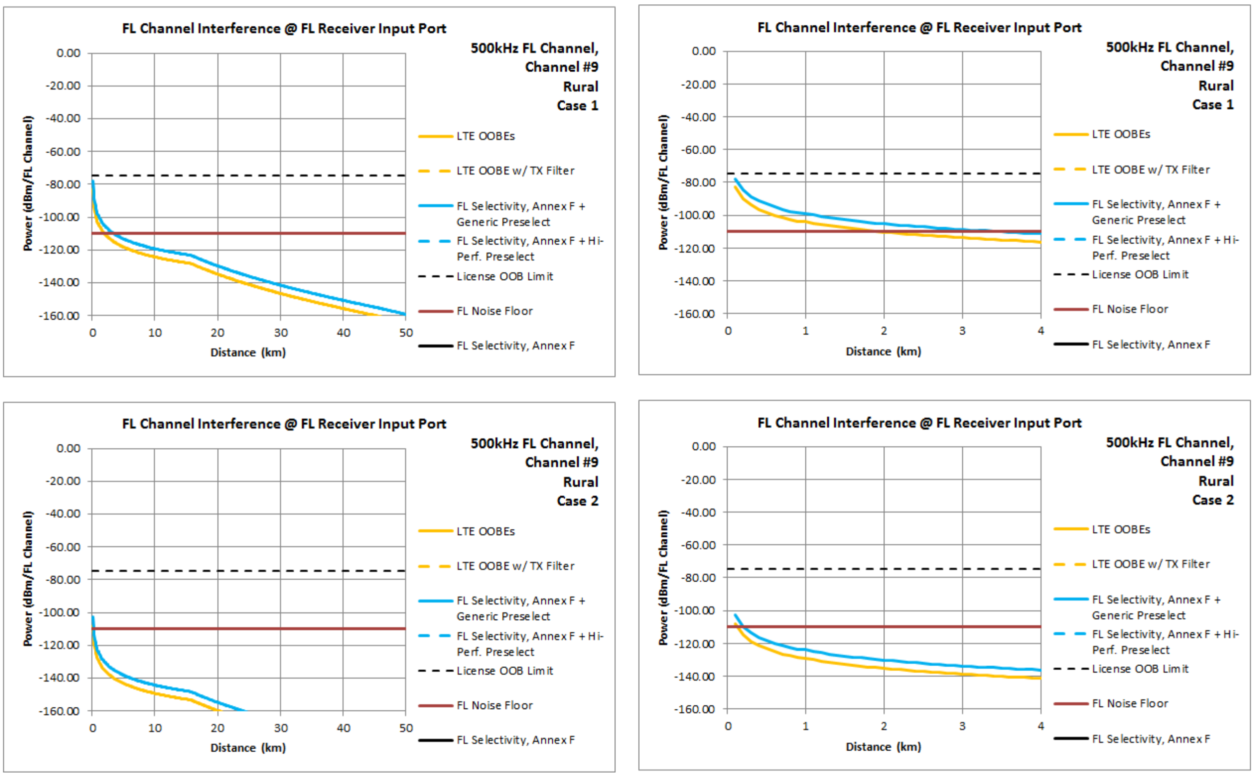


Figure 66: MCL results, FL CS 500 kHz, channel 9, rural, case 1 and case 2

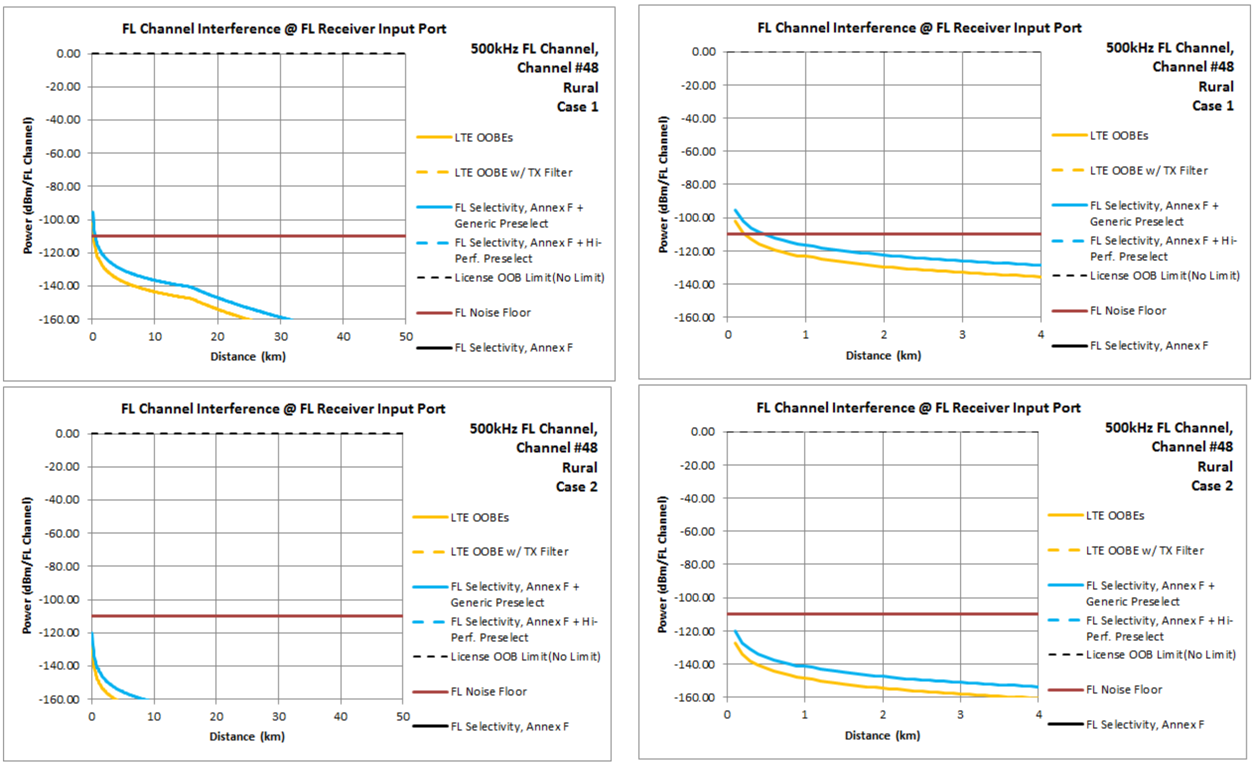


Figure 67: MCL results, FL CS 500 kHz, channel 48, rural, case 1 and case 2

5.4.5 FL 1 MHz

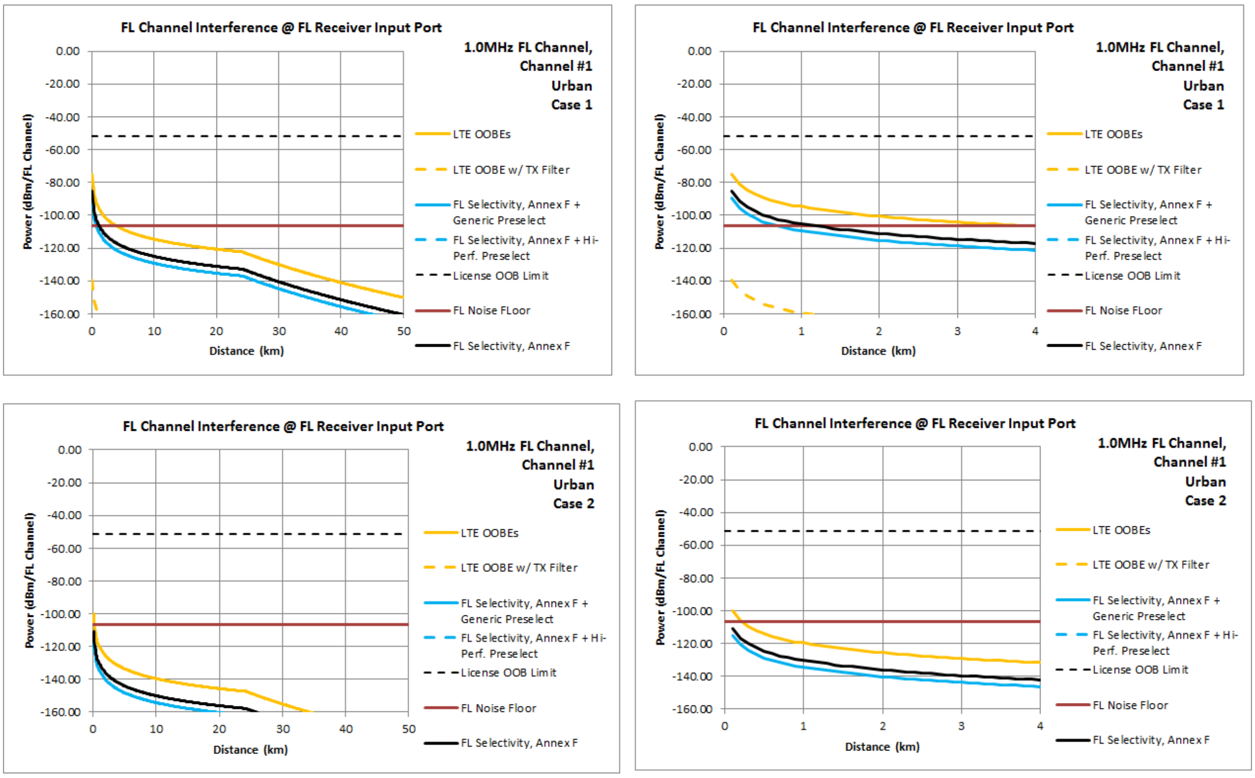


Figure 68: MCL results, FL CS 1 MHz, channel 1, urban, case 1 and case 2

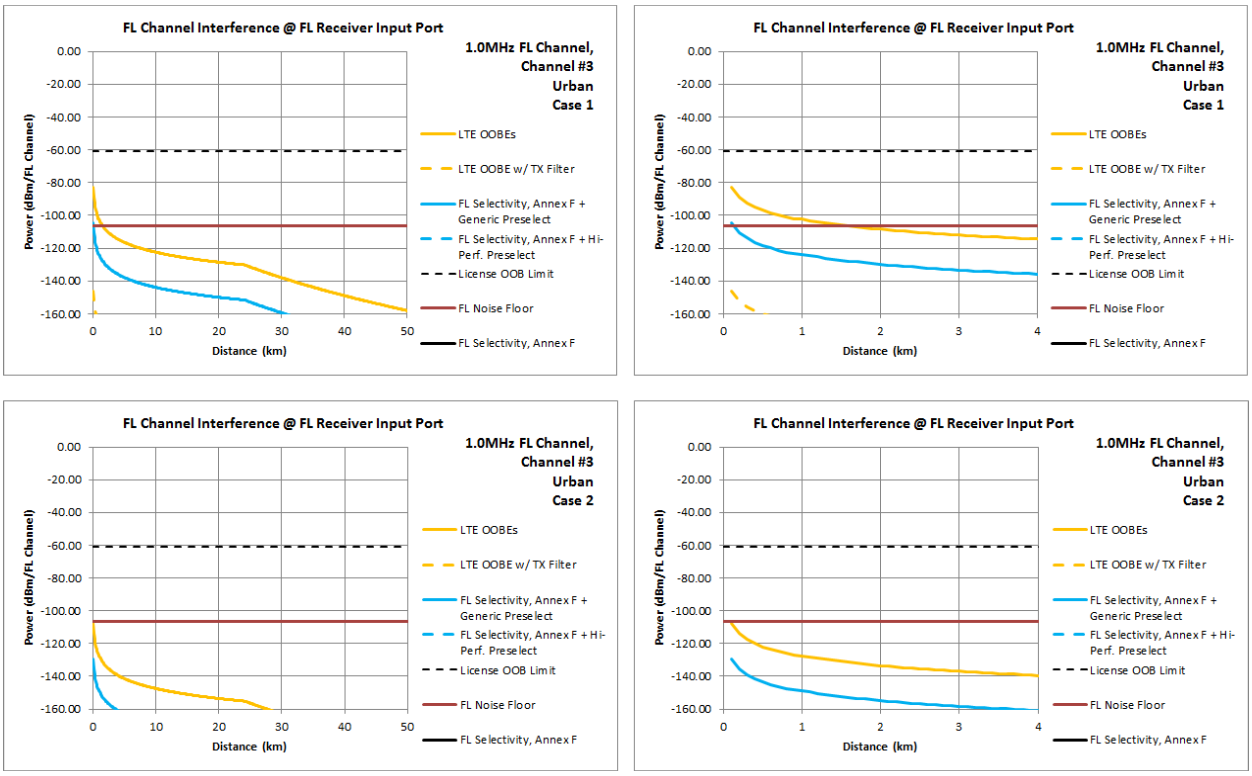


Figure 69: MCL results, FL CS 1 MHz, channel 3, urban, case 1 and case 2

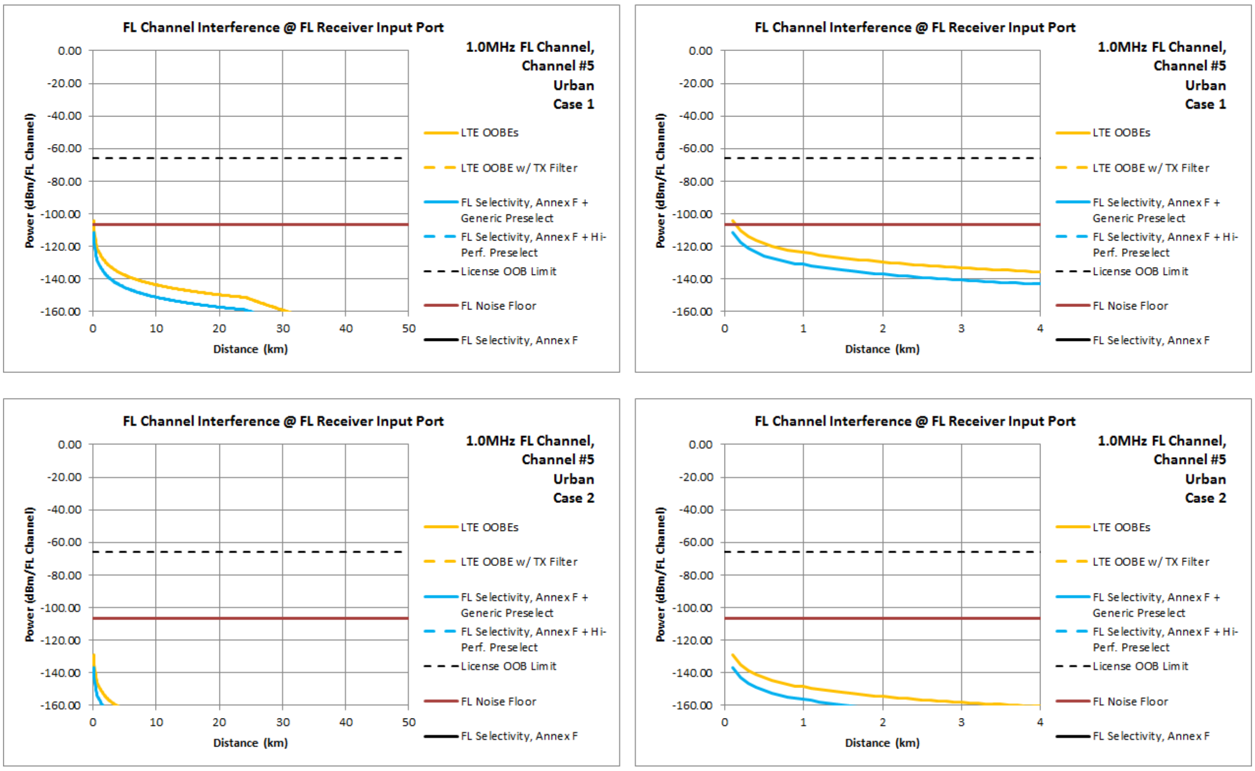


Figure 70: MCL results, FL CS 1 MHz, channel 5, urban, case 1 and case 2

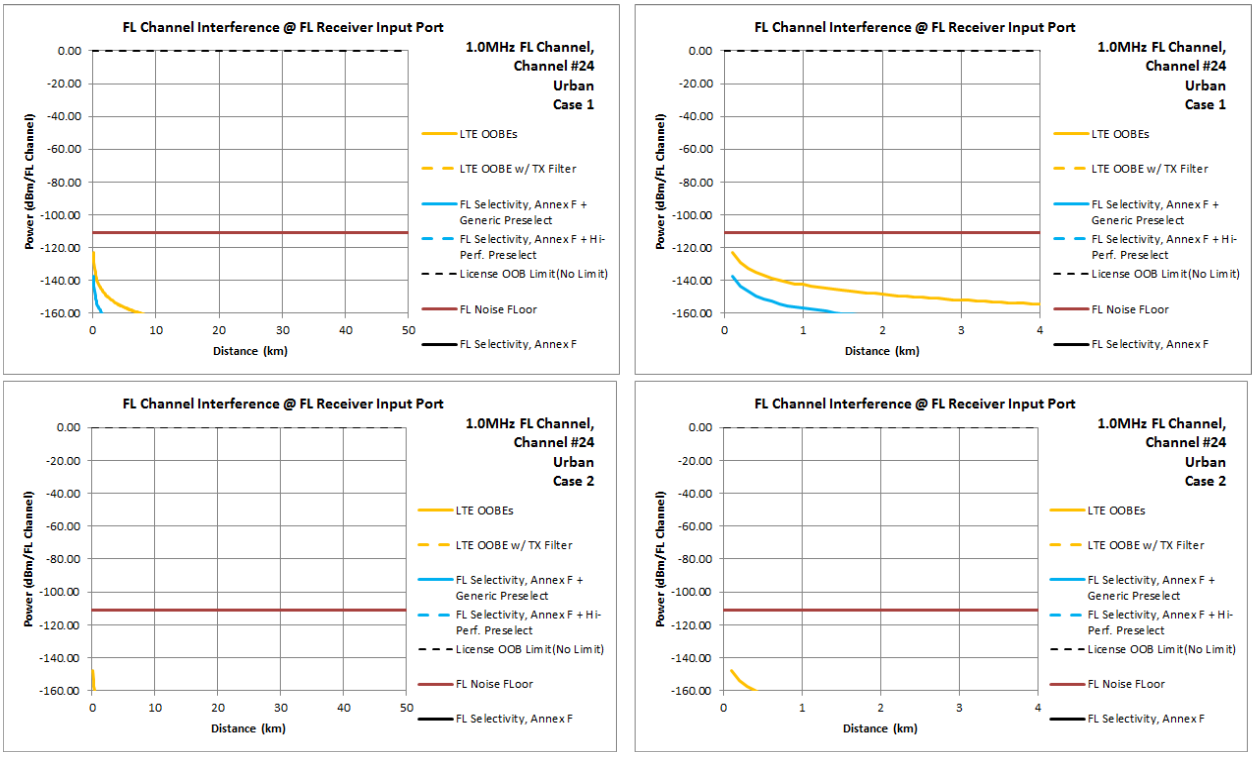


Figure 71: MCL results, FL CS 1 MHz, channel 24, urban, case 1 and case 2

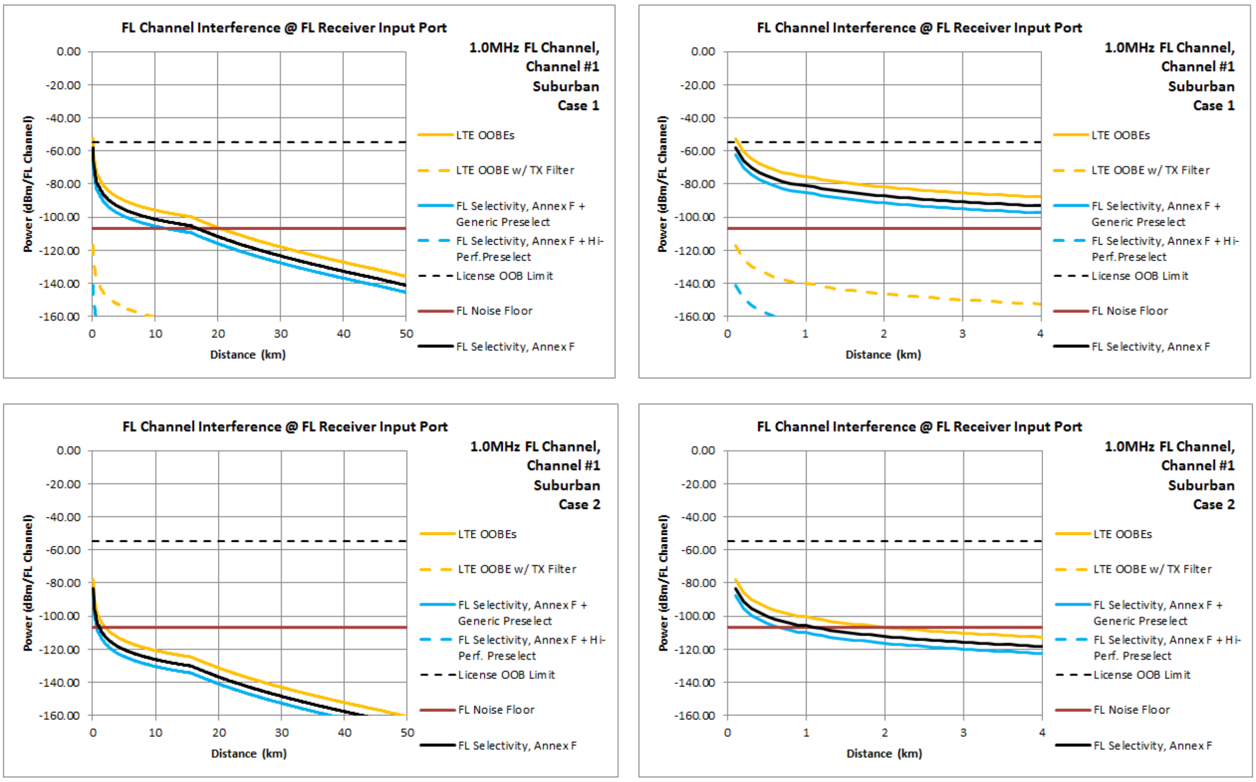


Figure 72: MCL results, FL CS 1 MHz, channel 1, suburban, case 1 and case 2

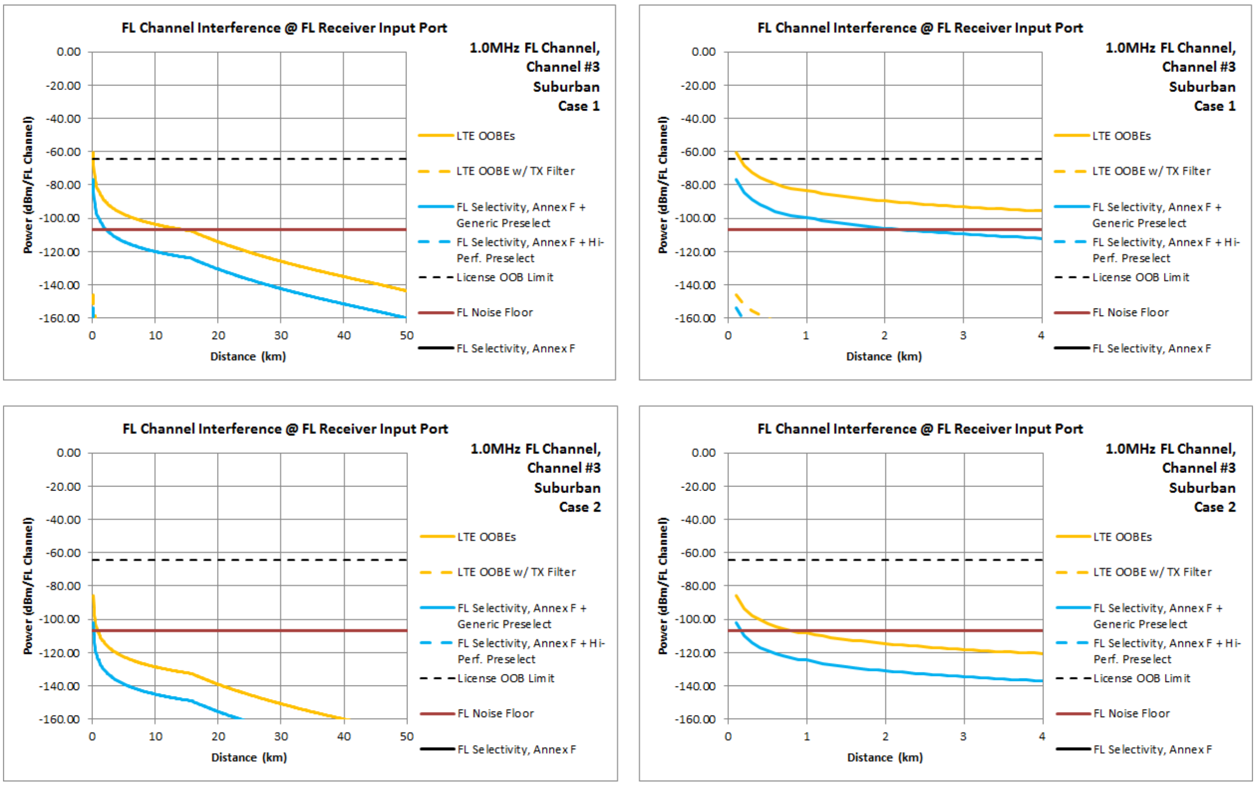


Figure 73: MCL results, FL CS 1 MHz, channel 3, suburban, case 1 and case 2

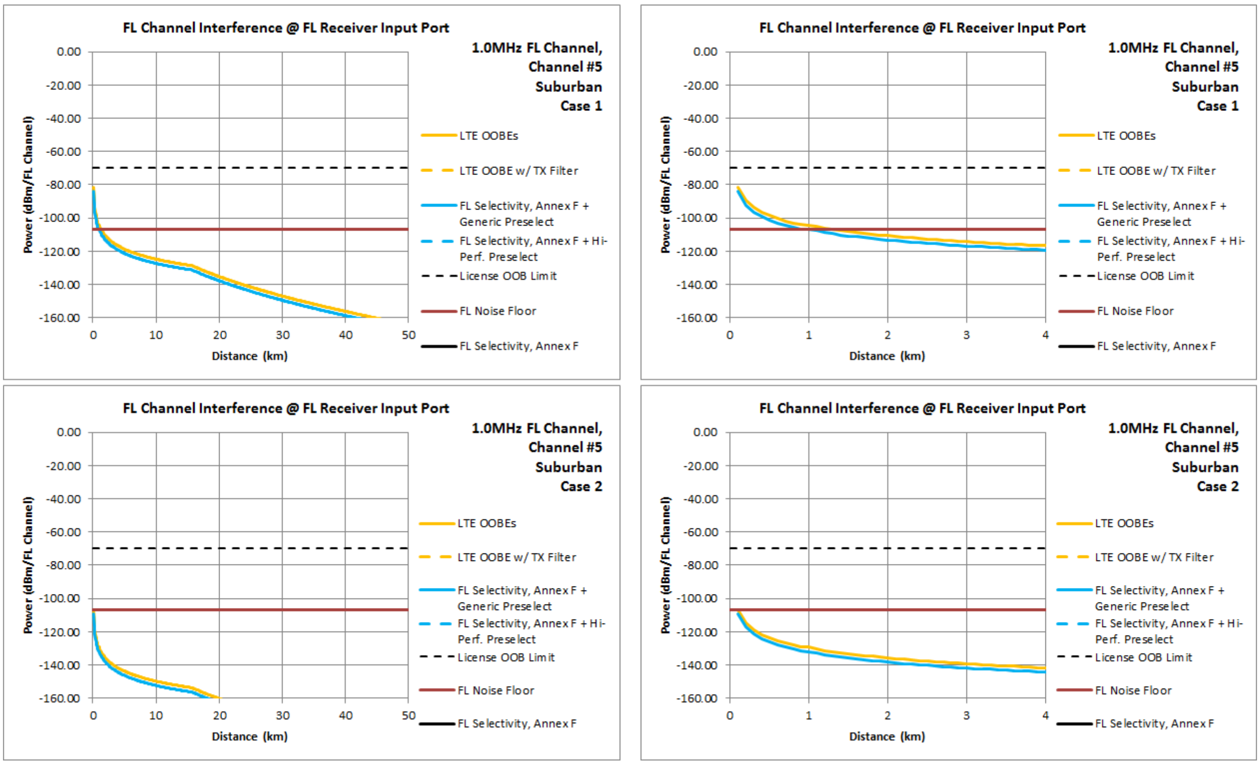


Figure 74: MCL results, FL CS 1 MHz, channel 5, suburban, case 1 and case 2

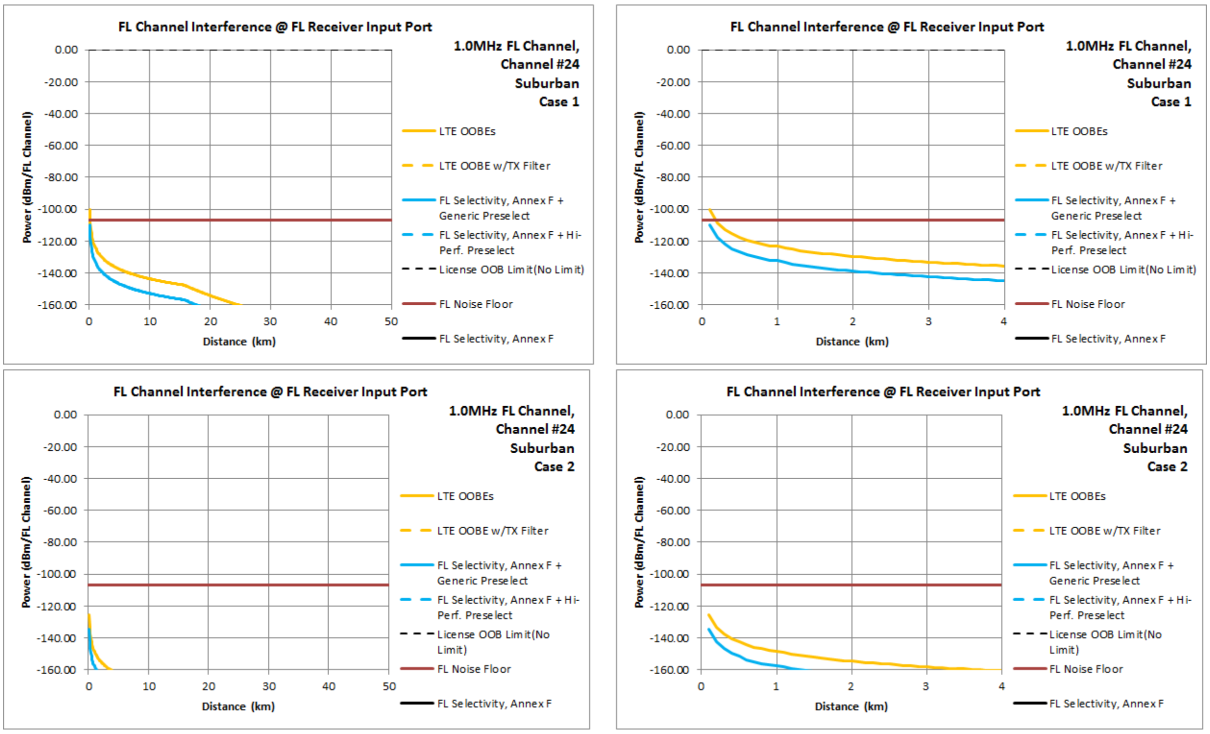


Figure 75: MCL results, FL CS 1 MHz, channel 24, suburban, case 1 and case 2

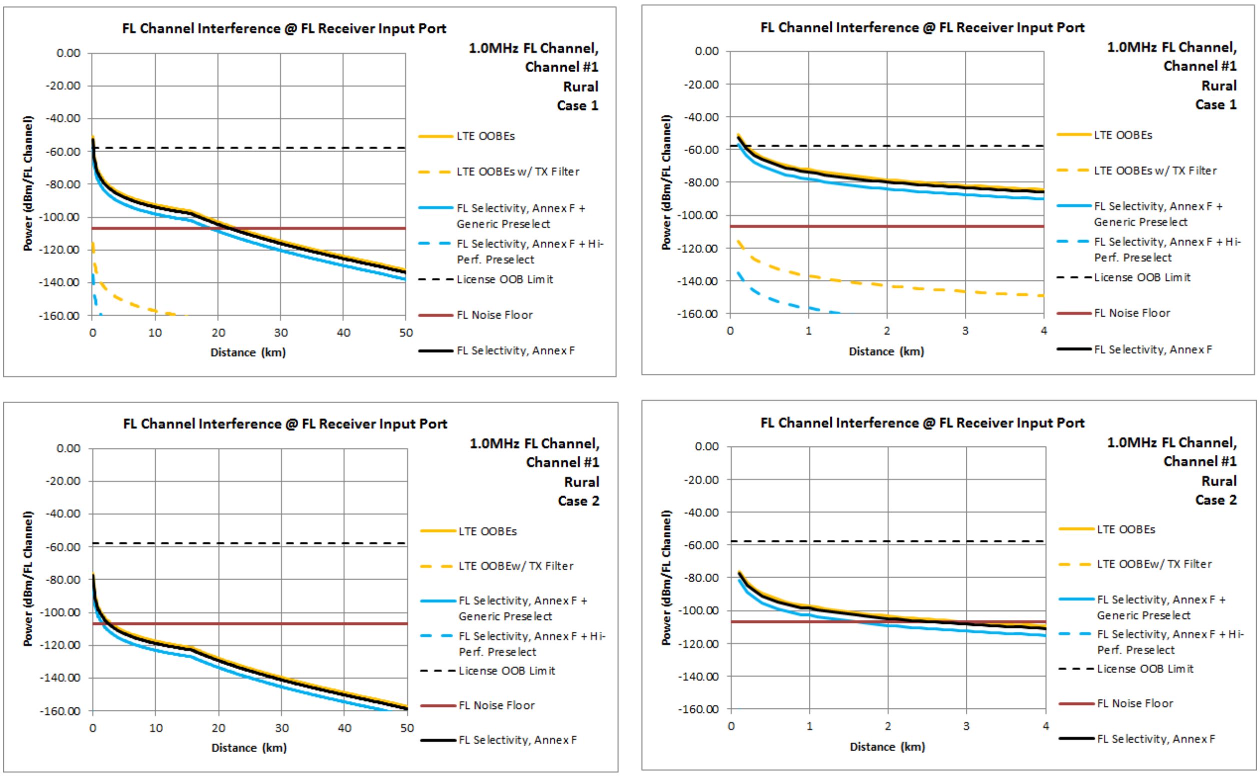


Figure 76: MCL results, FL CS 1 MHz, channel 1, rural, case 1 and case 2

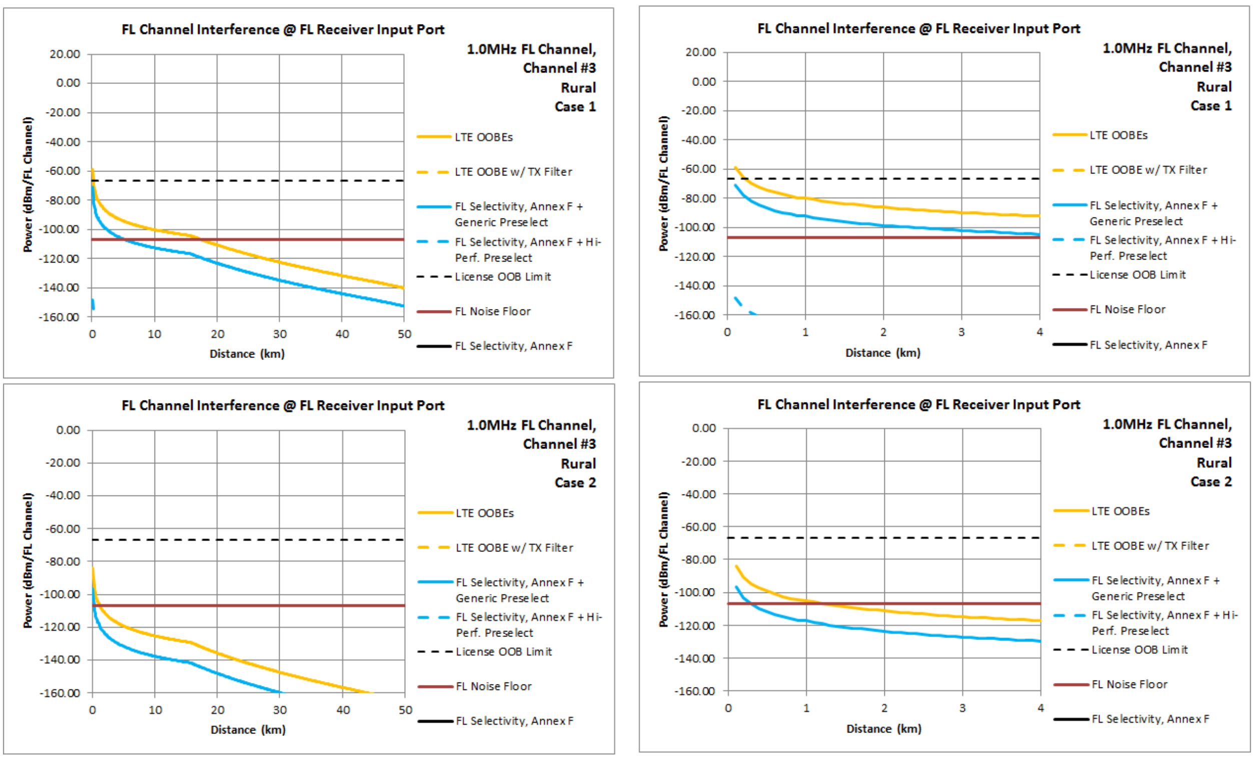


Figure 77: MCL results, FL CS 1 MHz, channel 3, rural, case 1 and case 2

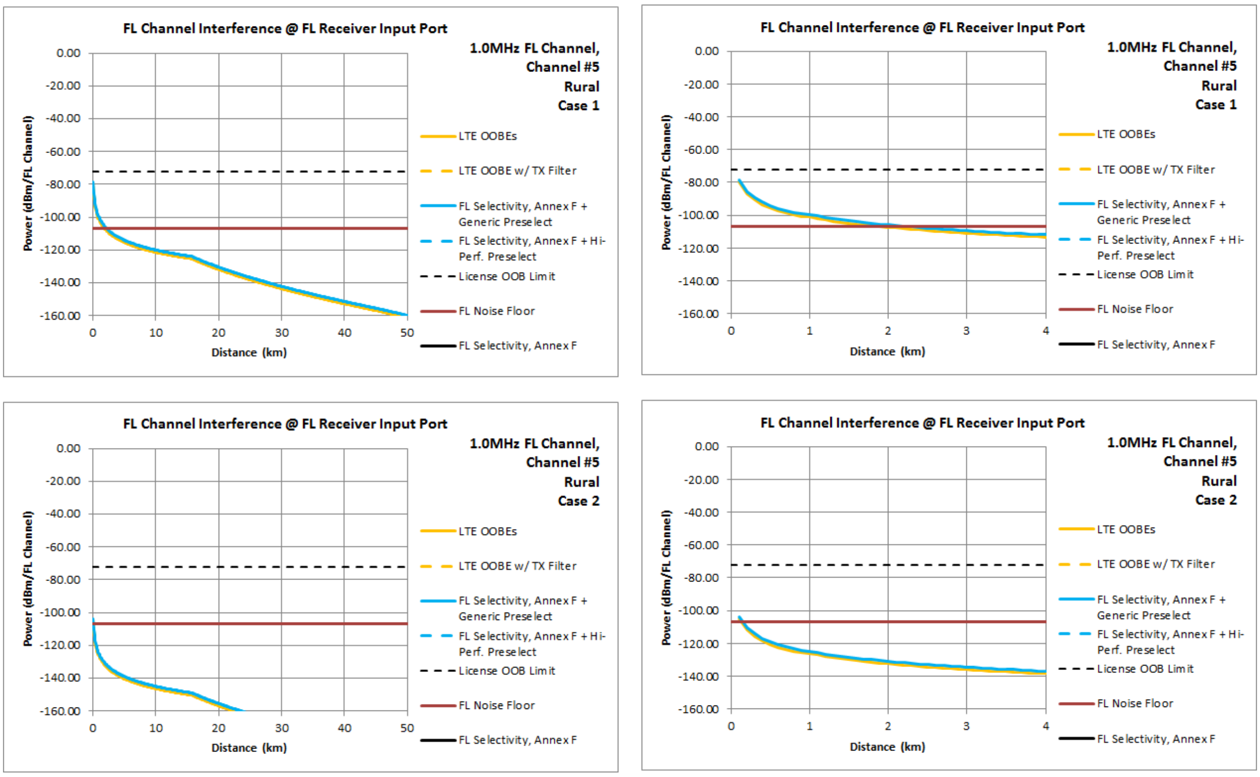


Figure 78: MCL results, FL CS 1 MHz, channel 5, rural, case 1 and case 2

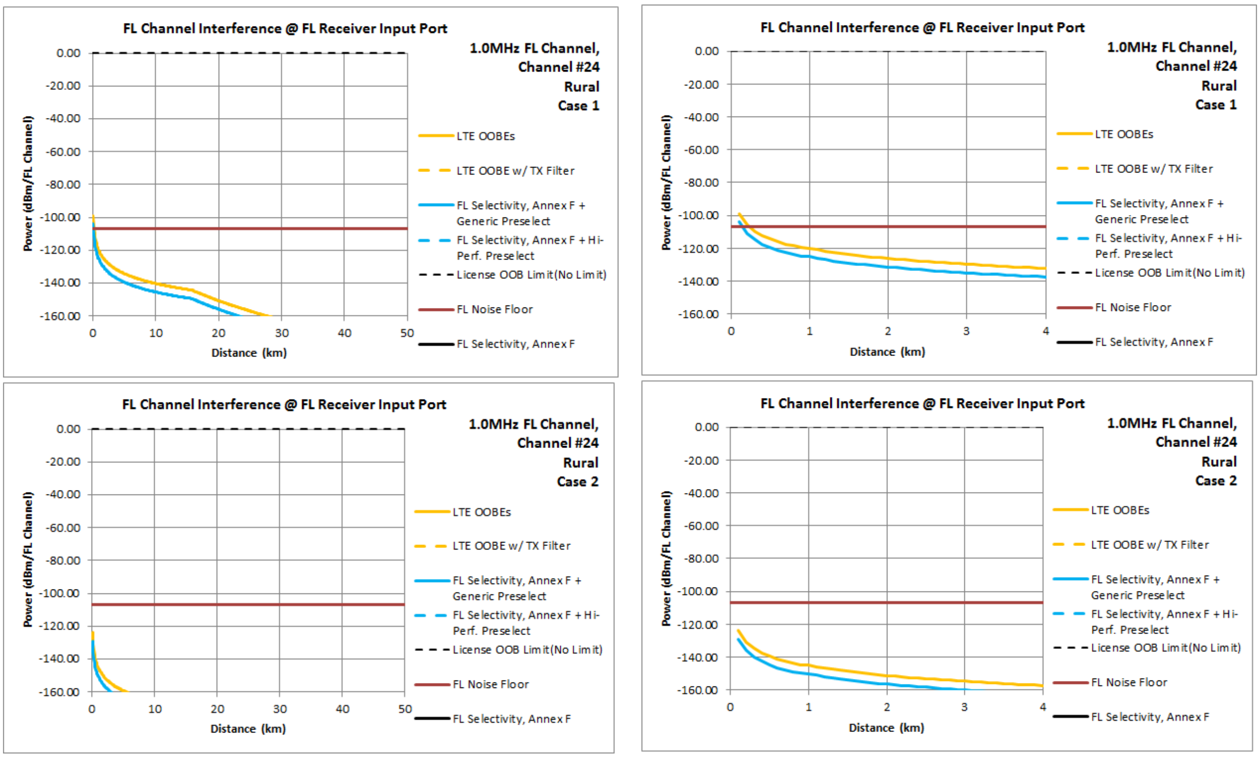


Figure 79: MCL results, FL CS 1 MHz, channel 24, rural, case 1 and case 2

5.4.6 FL 2 MHz

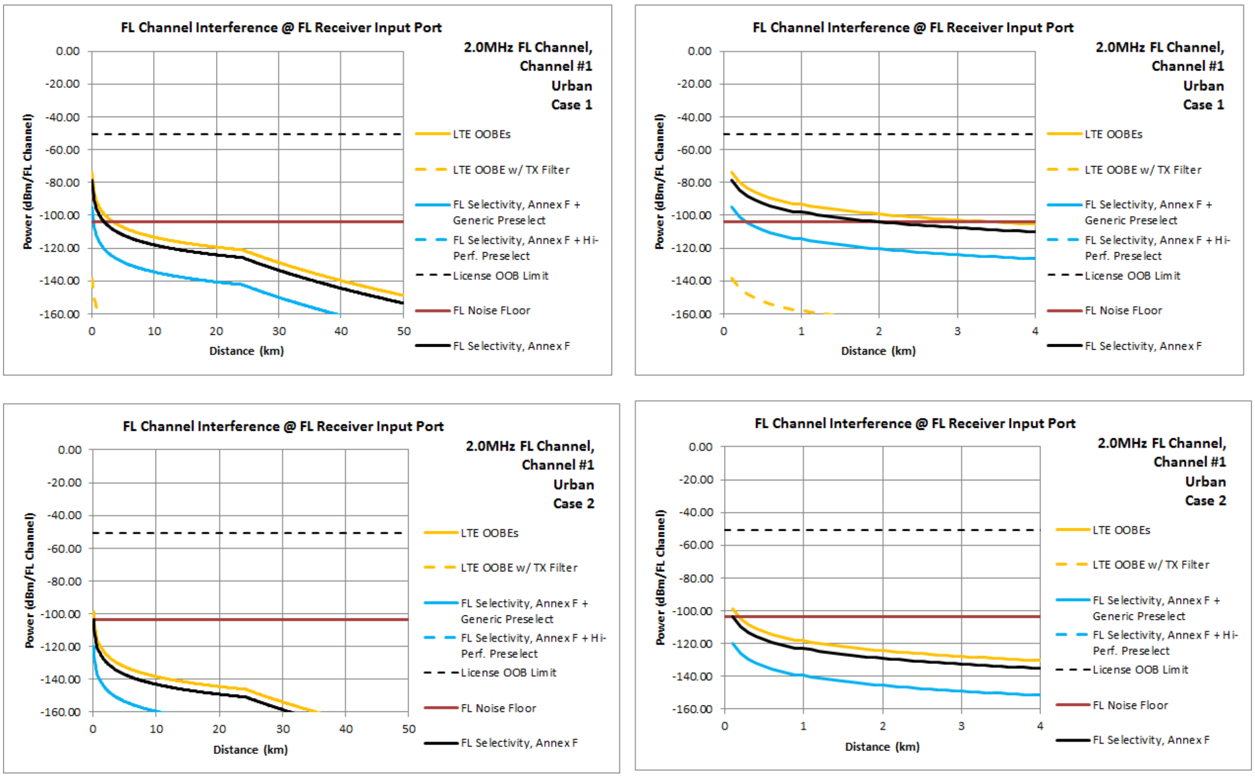


Figure 80: MCL results, FL CS 2 MHz, channel 1, urban, case 1 and case 2

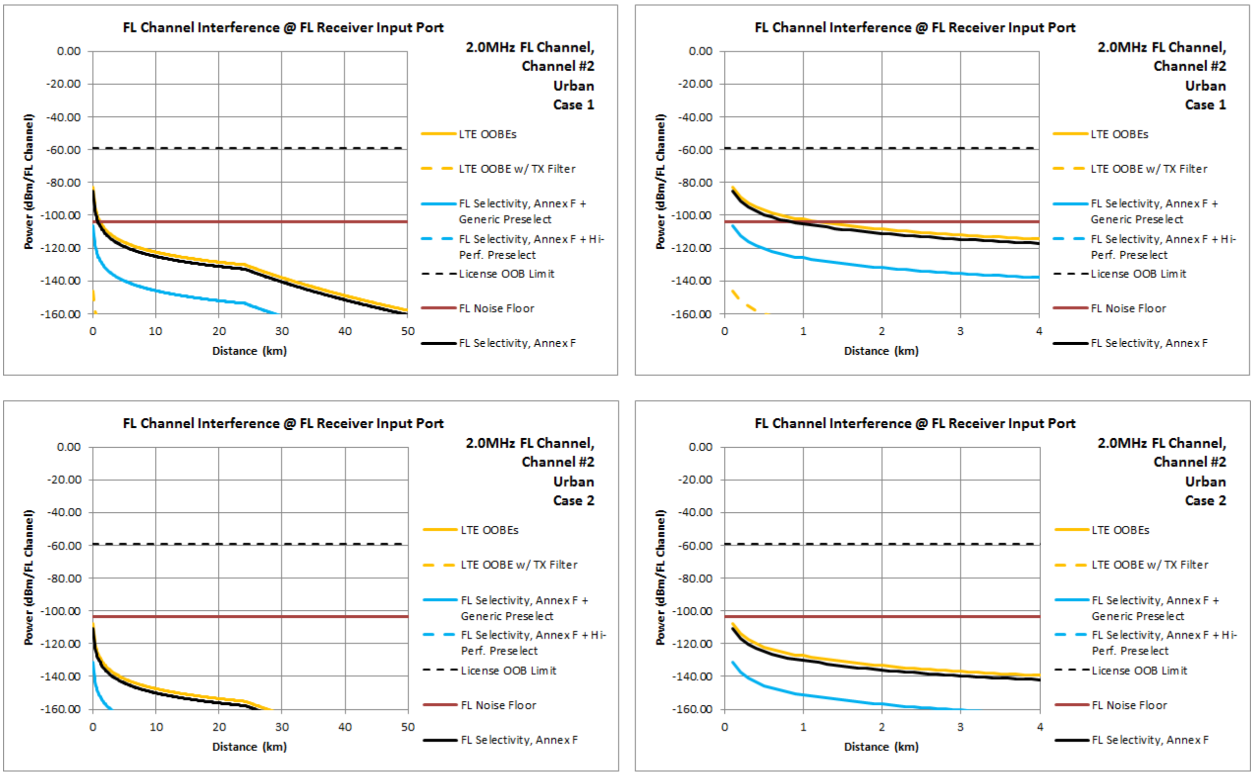


Figure 81: MCL results, FL CS 2 MHz, channel 2, urban, case 1 and case 2

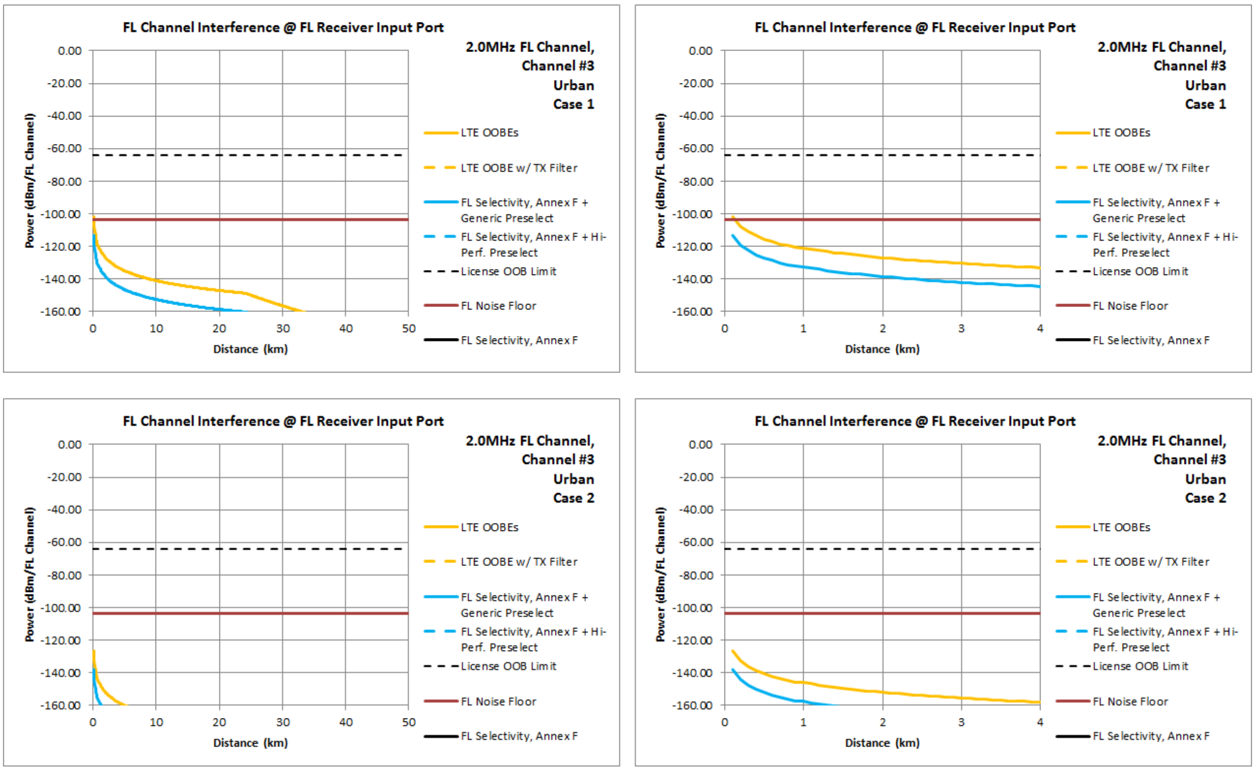


Figure 82: MCL results, FL CS 2 MHz, channel 3, urban, case 1 and case 2

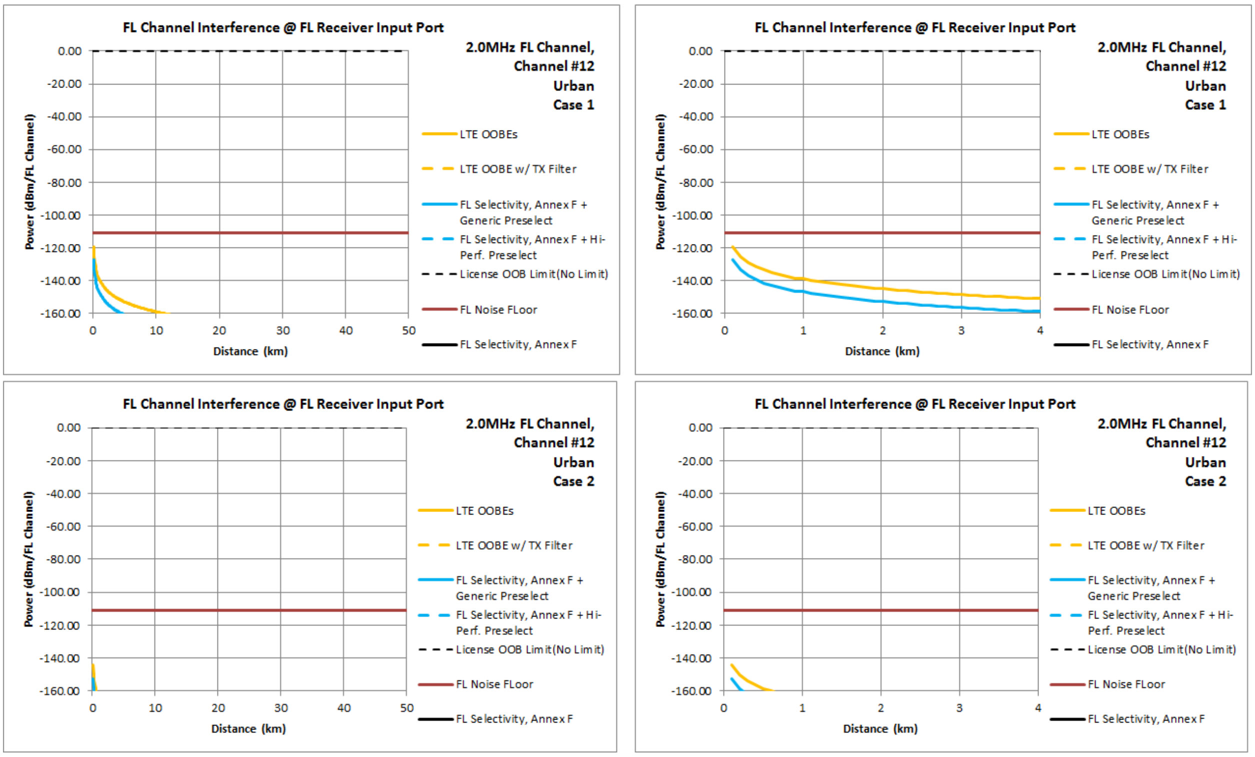


Figure 83: MCL results, FL CS 2 MHz, channel 12, urban, case 1 and case 2

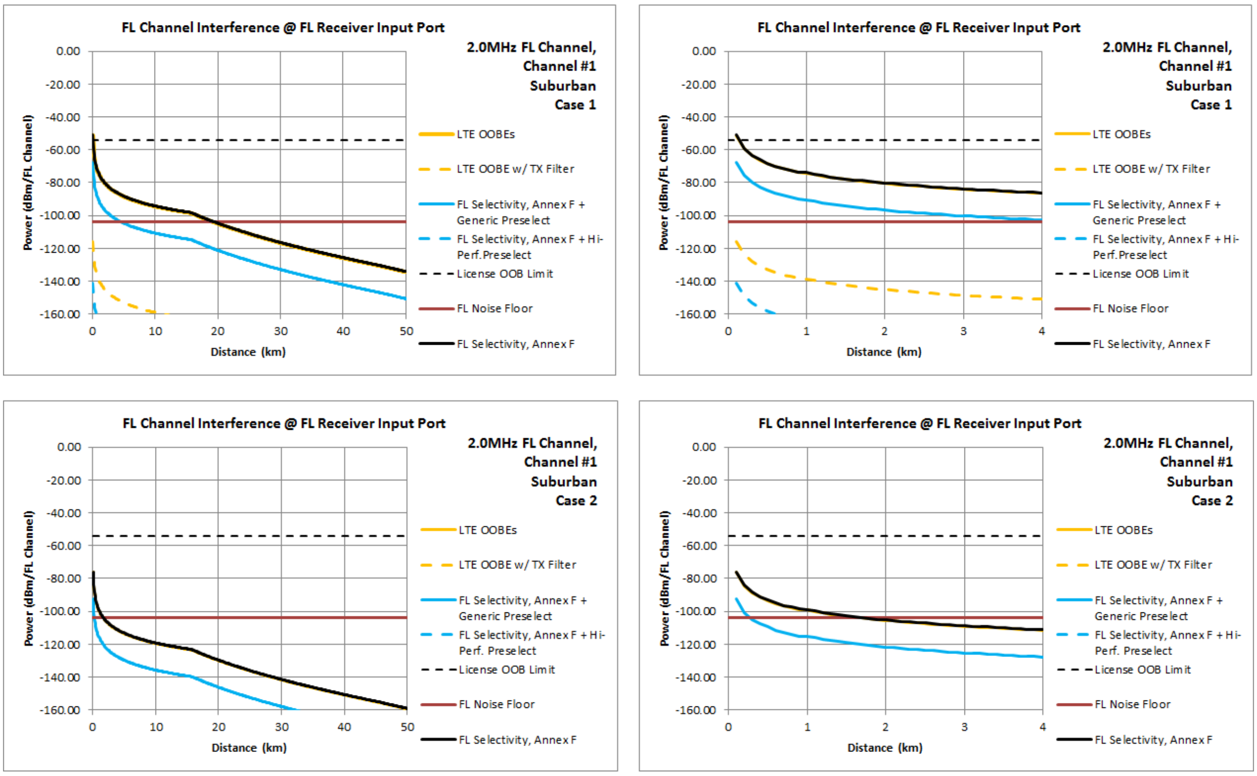


Figure 84: MCL results, FL CS 2 MHz, channel 1, suburban, case 1 and case 2

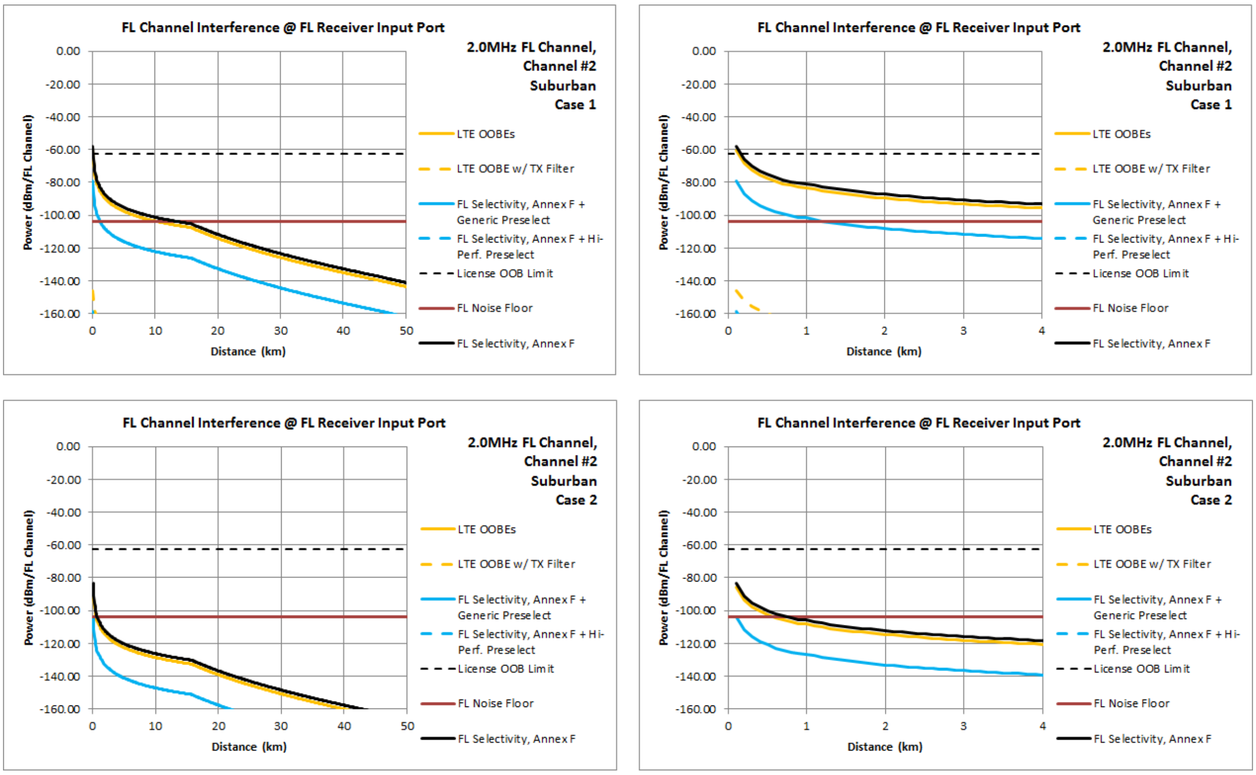


Figure 85: MCL results, FL CS 2 MHz, channel 2, suburban, case 1 and case 2

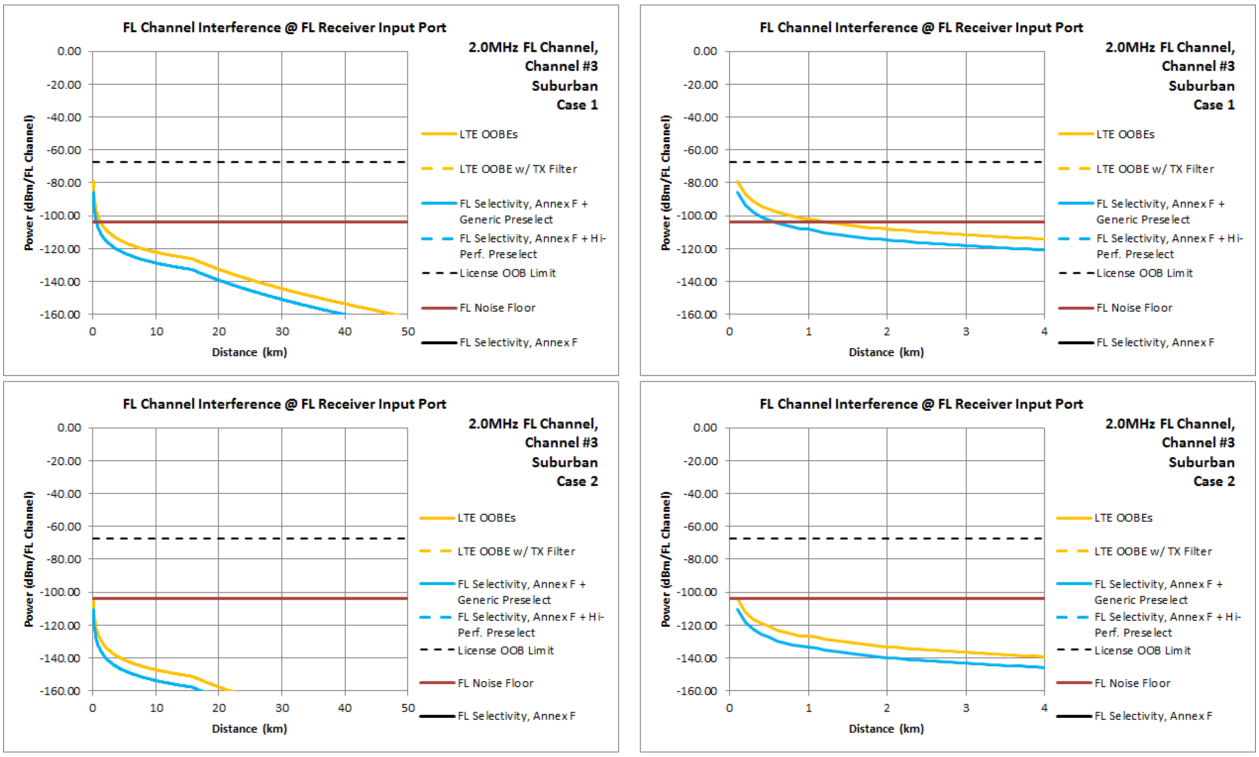


Figure 86: MCL results, FL CS 2 MHz, channel 3, suburban, case 1 and case 2

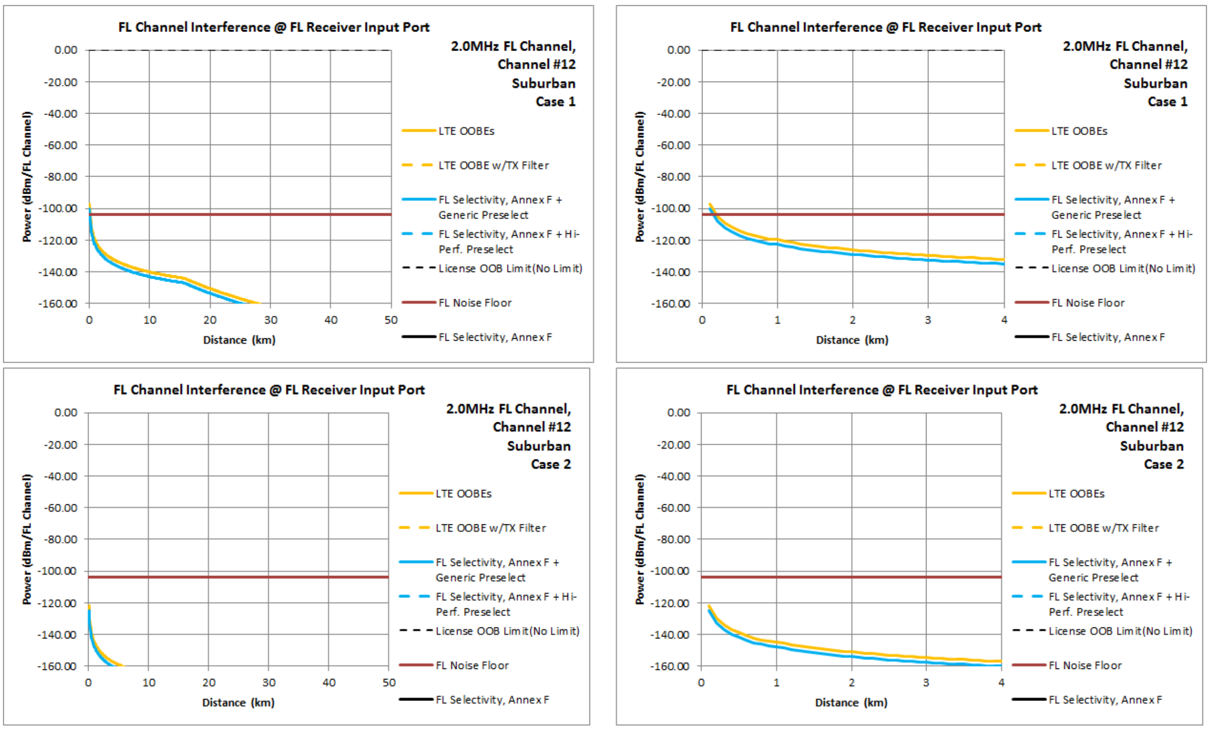


Figure 87: MCL results, FL CS 2 MHz, channel 12, suburban, case 1 and case 2

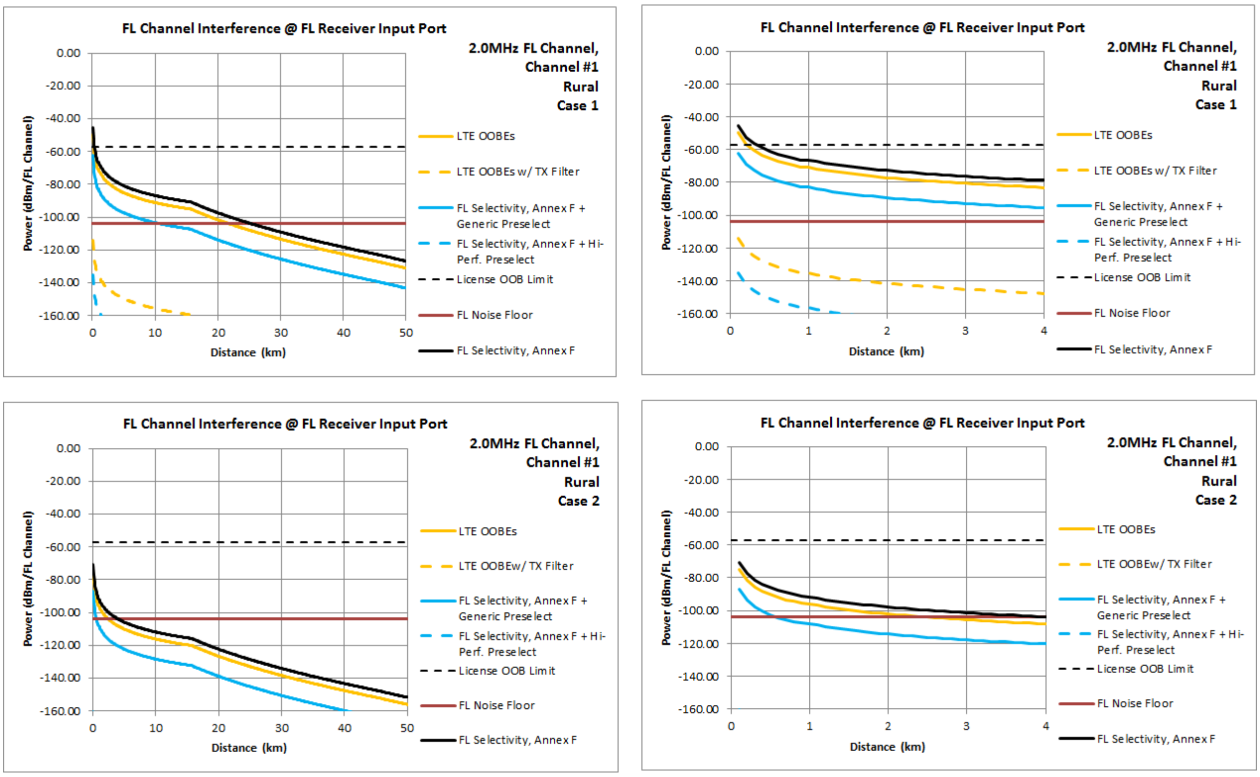


Figure 88: MCL results, FL CS 2 MHz, channel 1, rural, case 1 and case 2

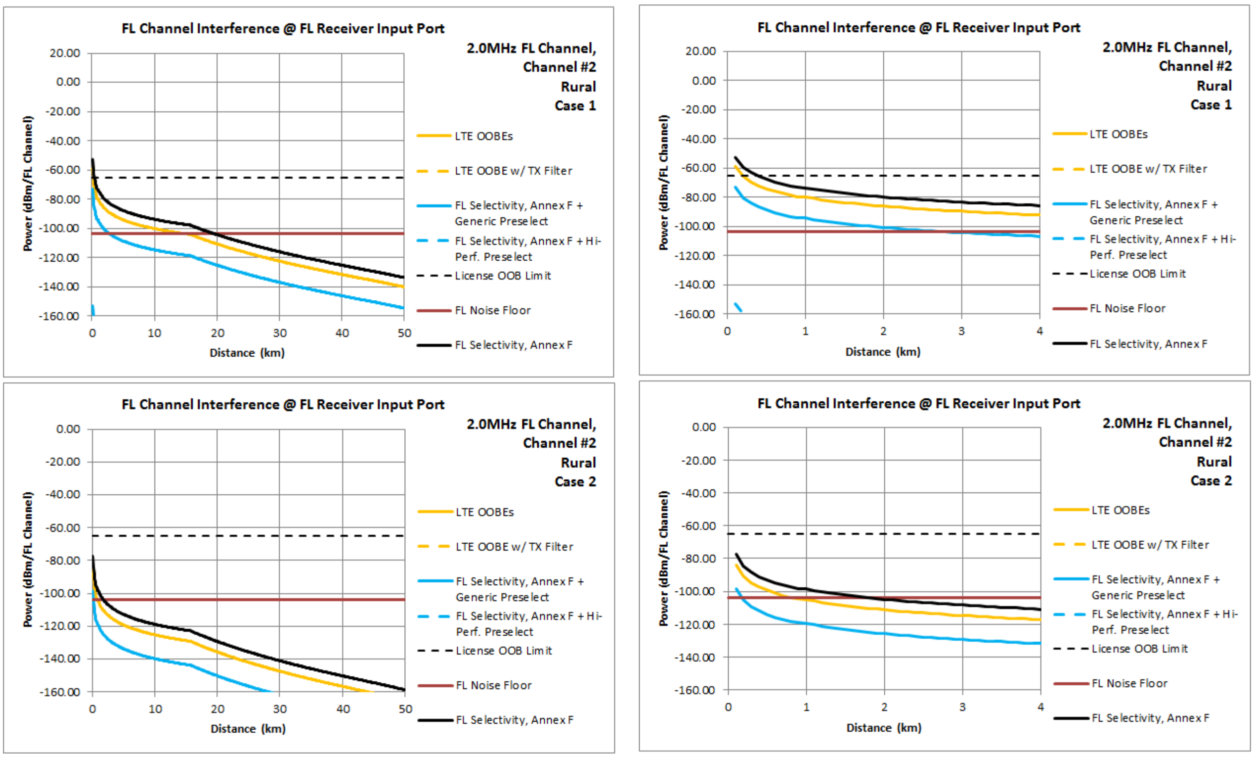


Figure 89: MCL results, FL CS 2 MHz, channel 2, rural, case 1 and case 2

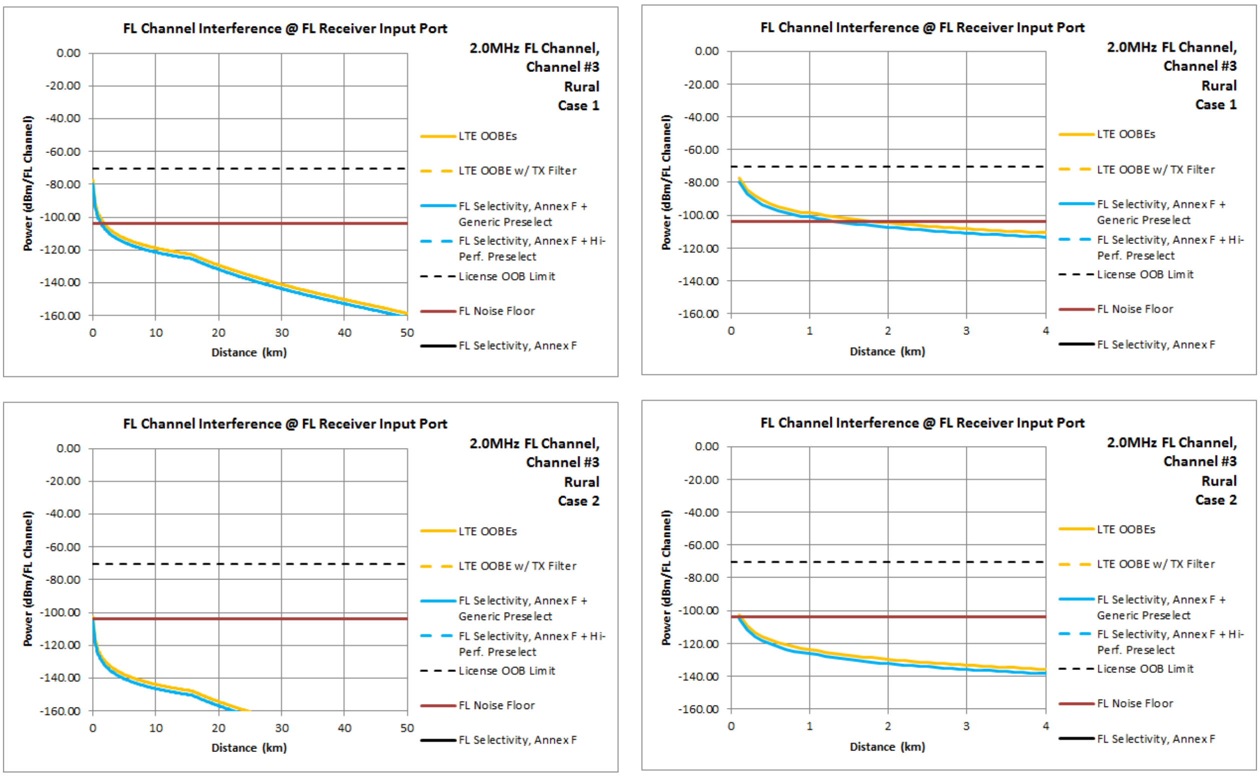


Figure 90: MCL results, FL CS 2 MHz, channel 3, rural, case 1 and case 2

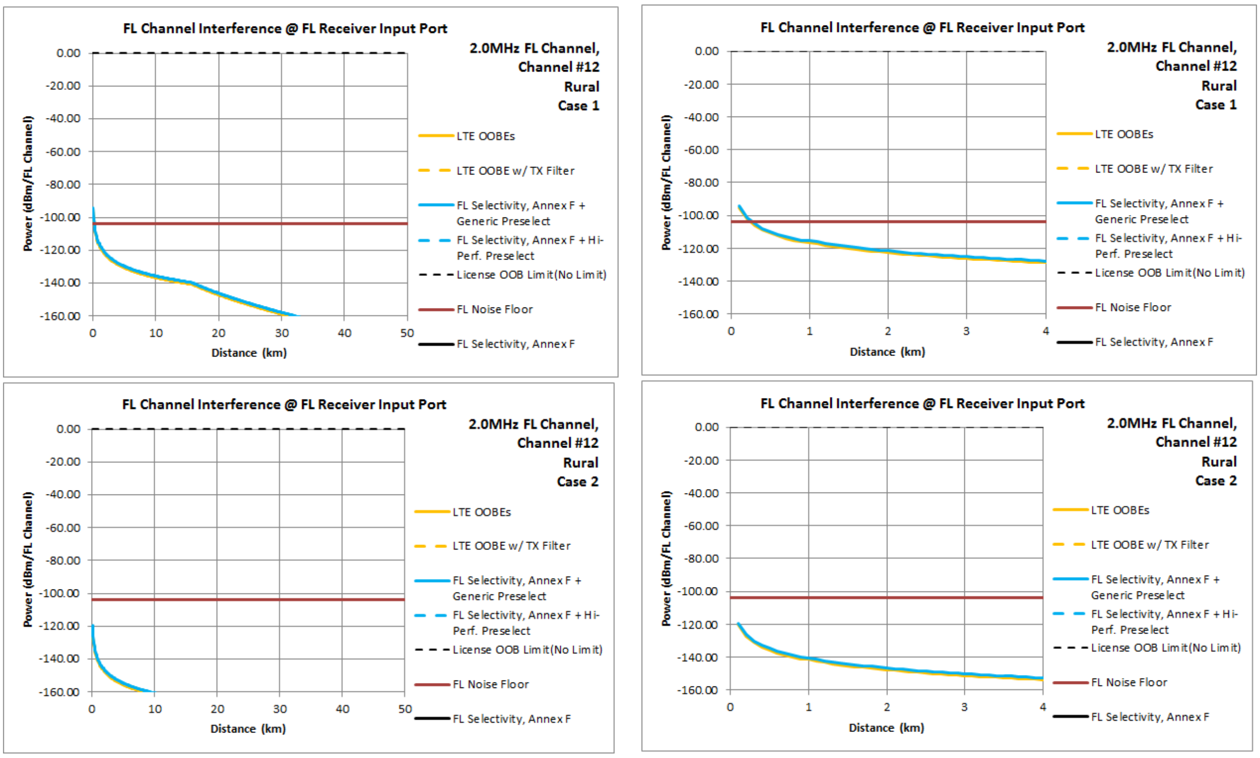


Figure 91: MCL results, FL CS 2 MHz, channel 12, rural, case 1 and case 2

5.4.7 FL 3.5 MHz

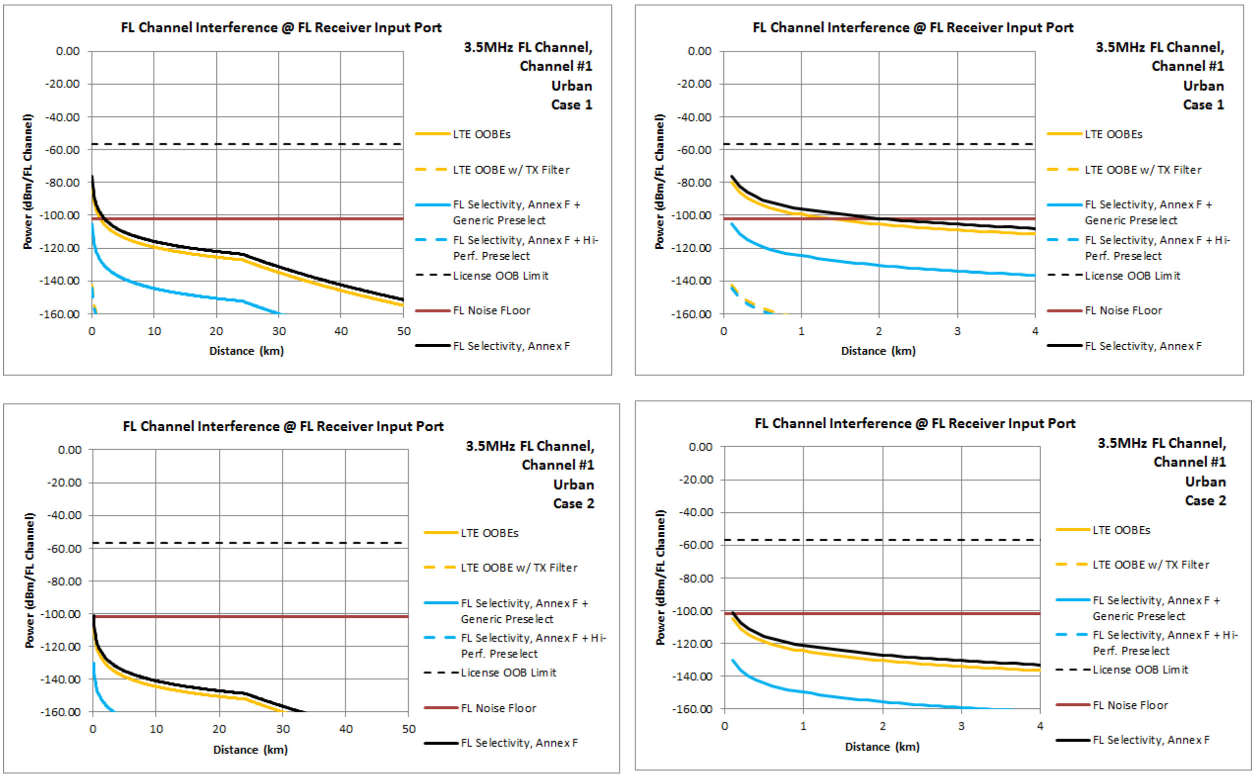


Figure 92: MCL results, FL CS 3.5 MHz, channel 1, urban, case 1 and case 2

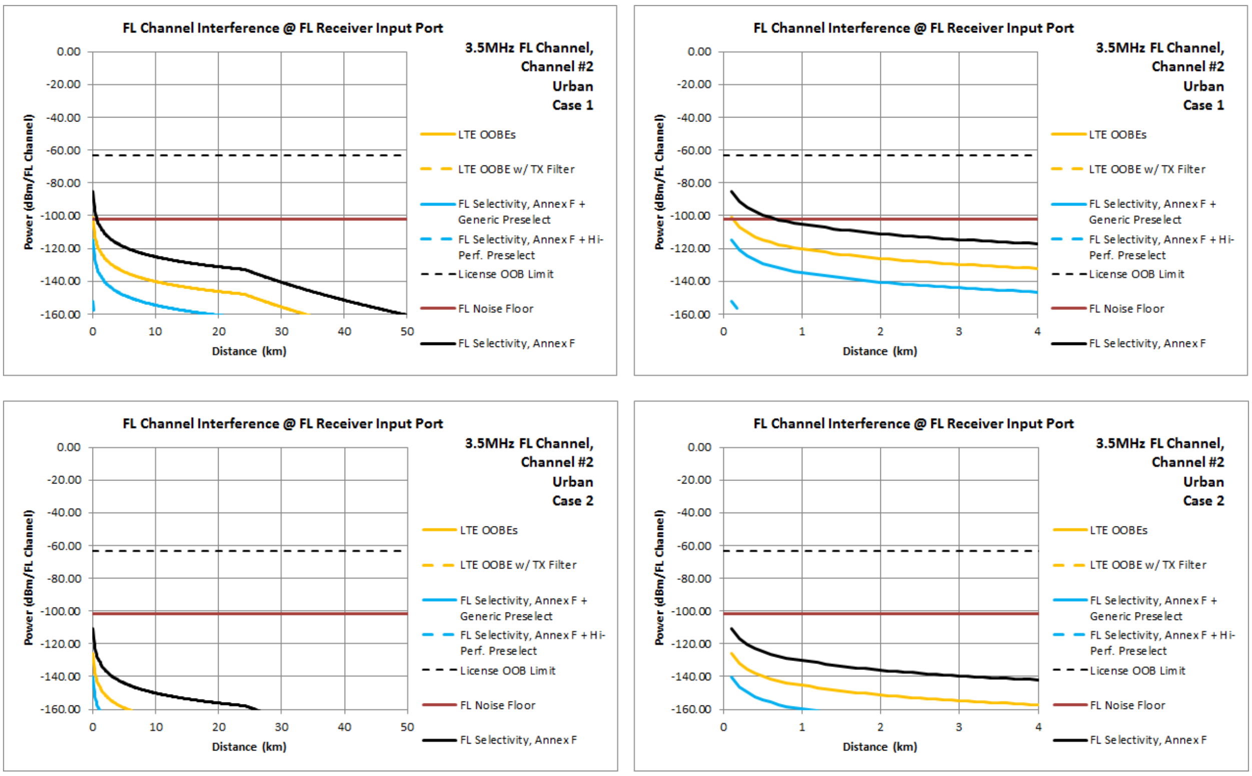


Figure 93: MCL results, FL CS 3.5 MHz, channel 2, urban, case 1 and case 2

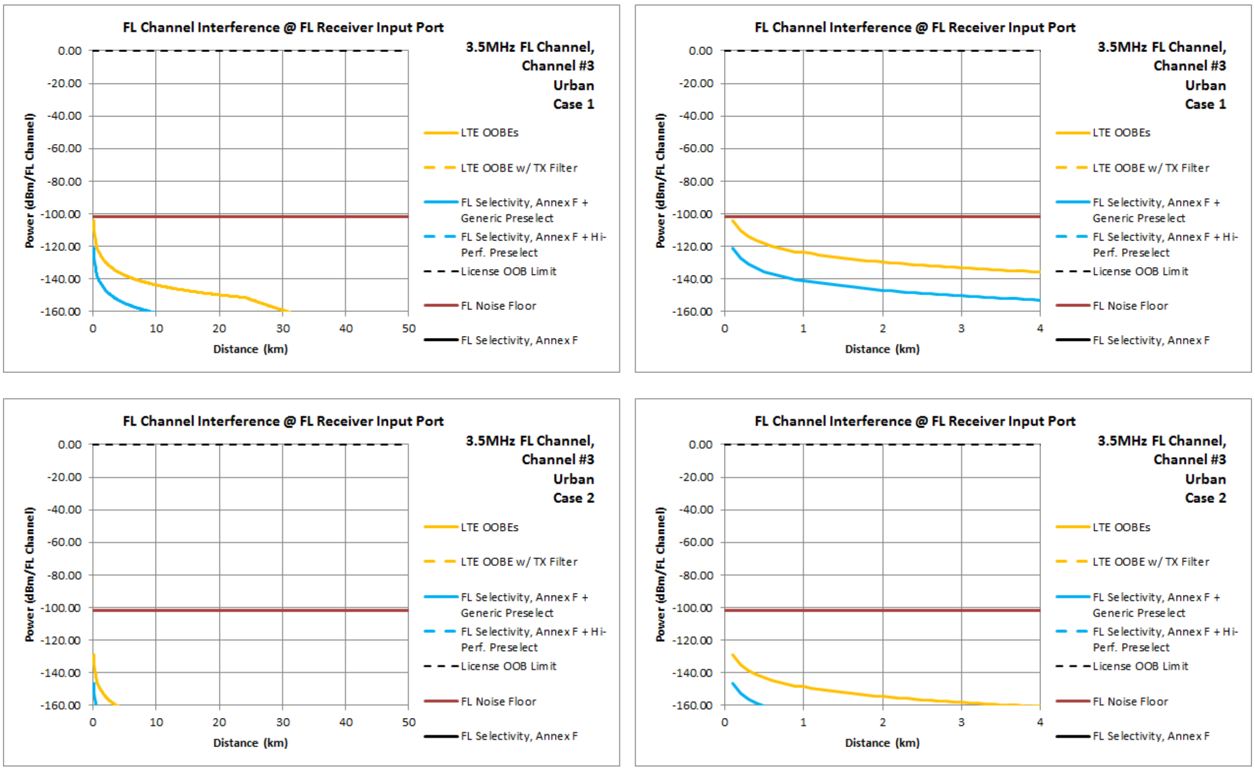


Figure 94: MCL results, FL CS 3.5 MHz, channel 3, urban, case 1 and case 2

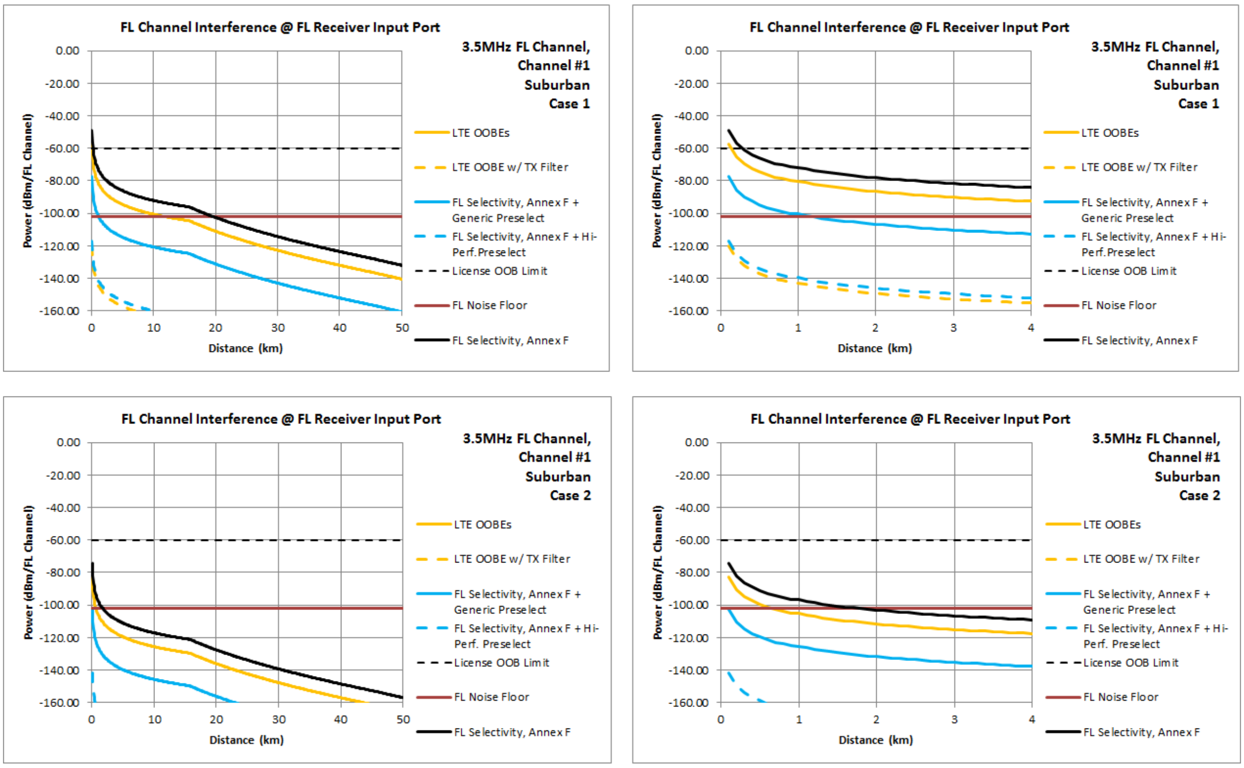


Figure 95: MCL results, FL CS 3.5 MHz, channel 1, suburban, case 1 and case 2

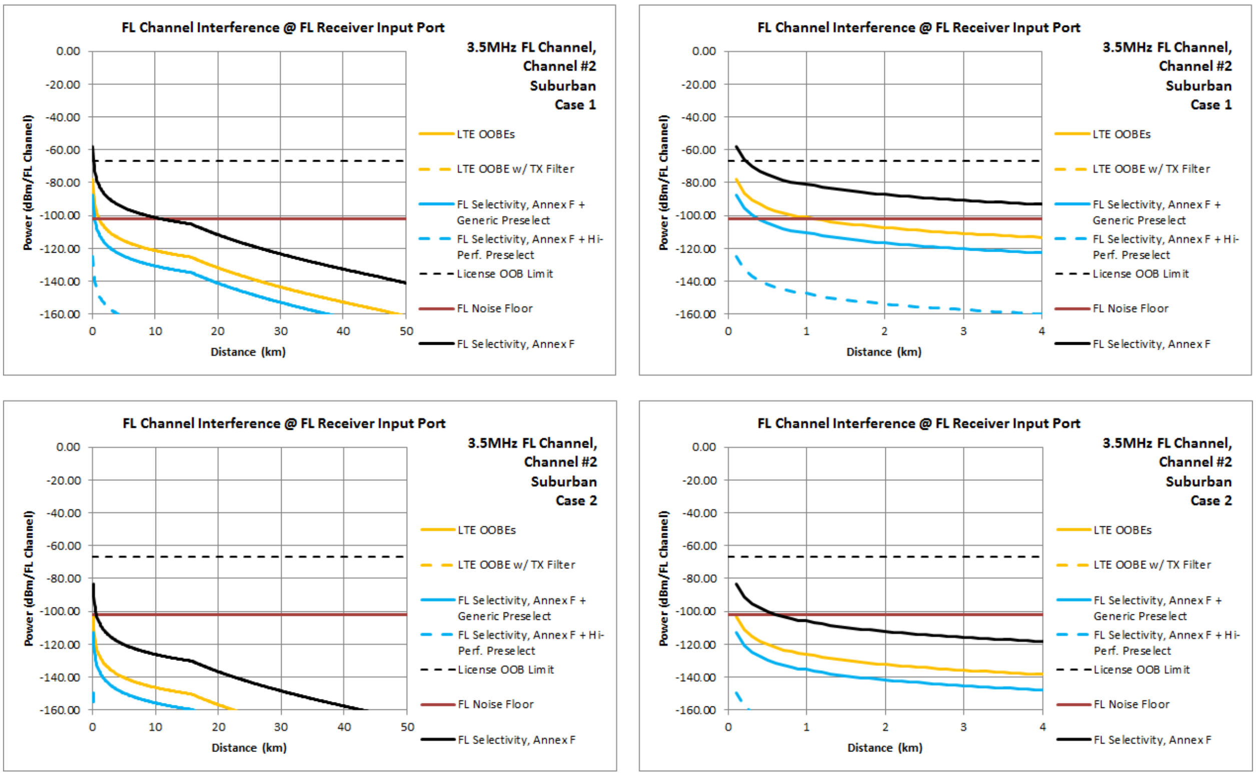


Figure 96: MCL results, FL CS 3.5 MHz, channel 2, suburban, case 1 and case 2

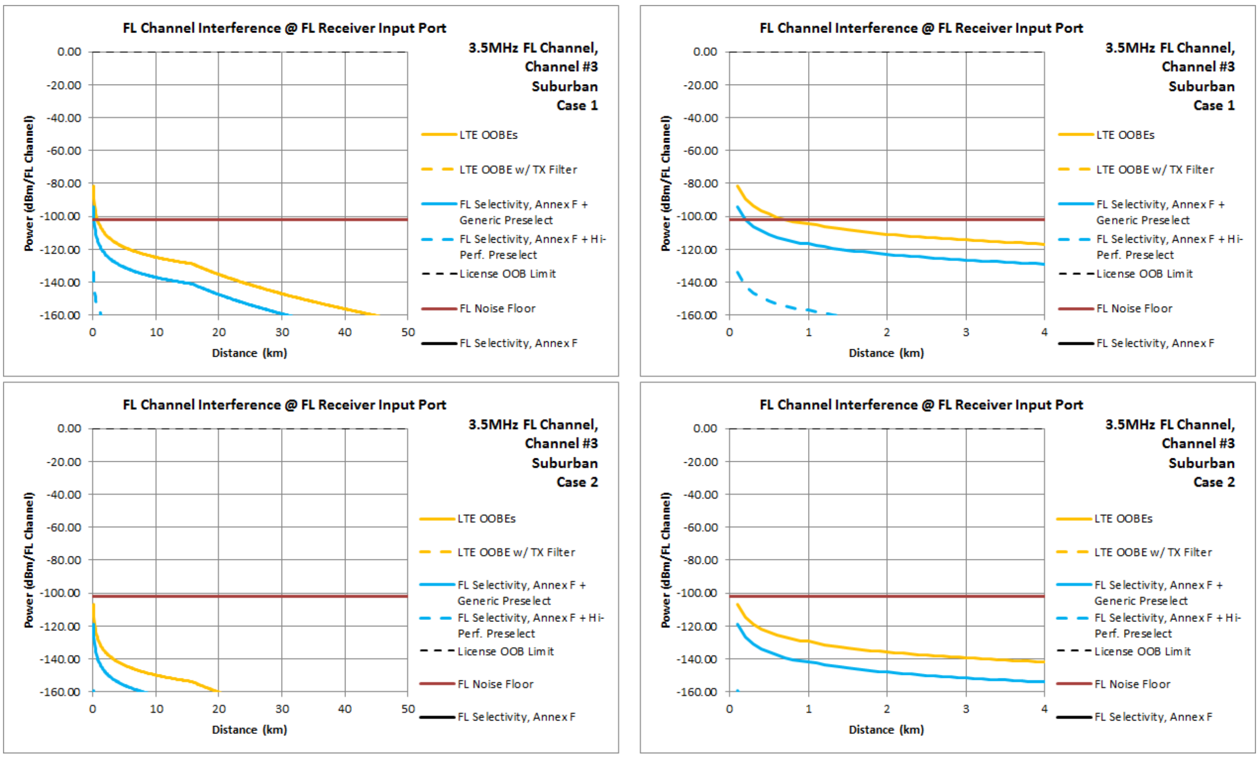


Figure 97: MCL results, FL CS 3.5 MHz, channel 3, suburban, case 1 and case 2

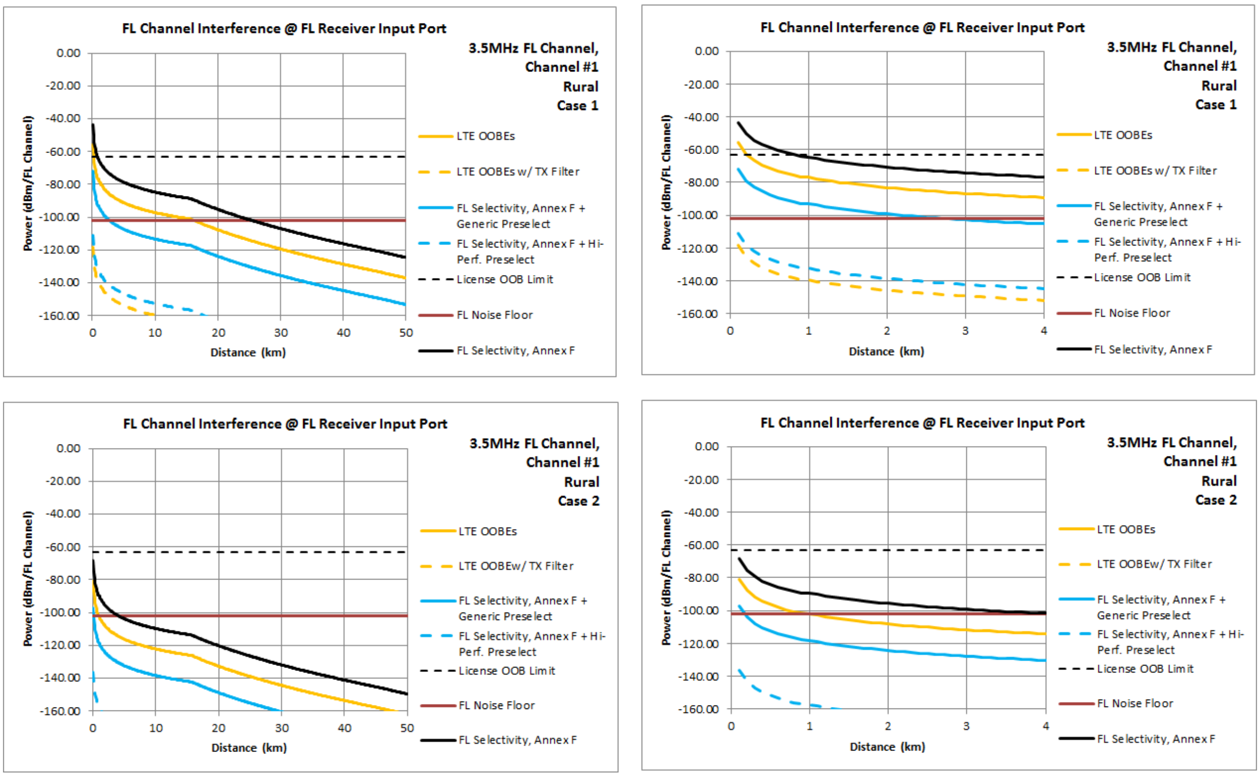


Figure 98: MCL results, FL CS 3.5 MHz, channel 1, rural, case 1 and case 2

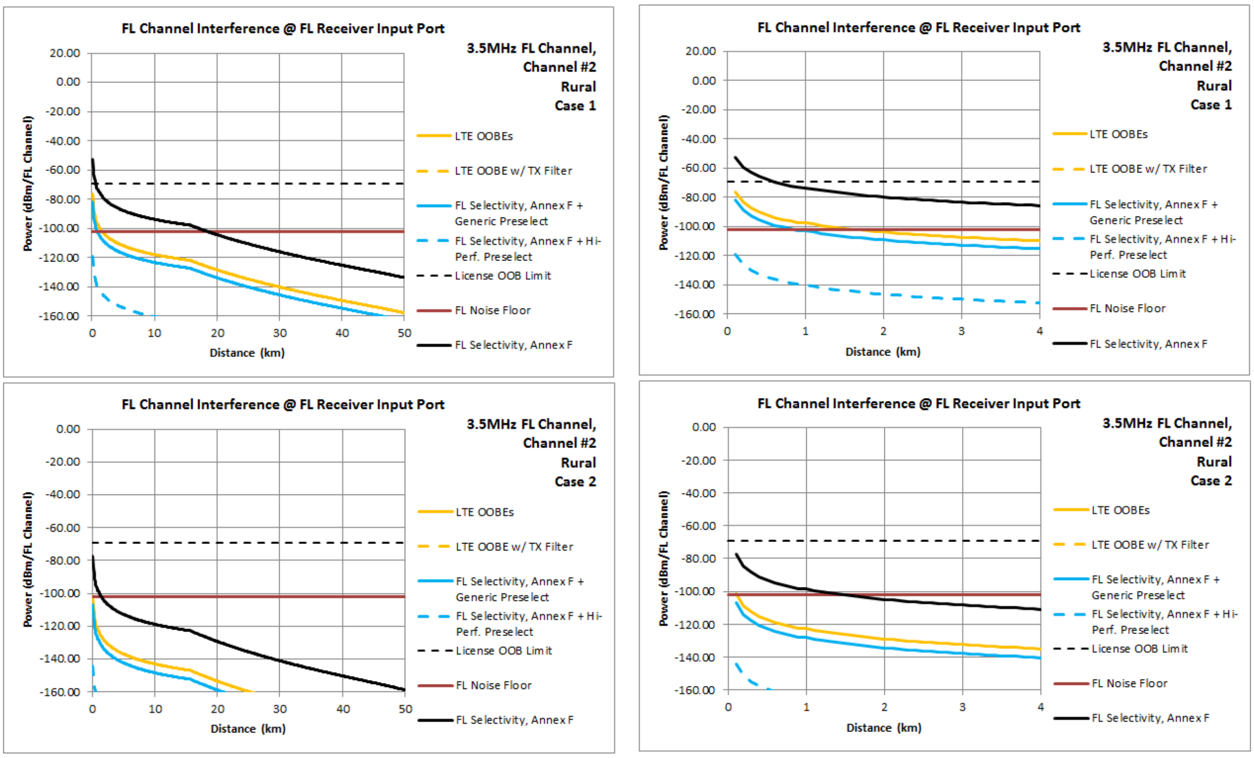


Figure 99: MCL results, FL CS 3.5 MHz, channel 2, rural, case 1 and case 2

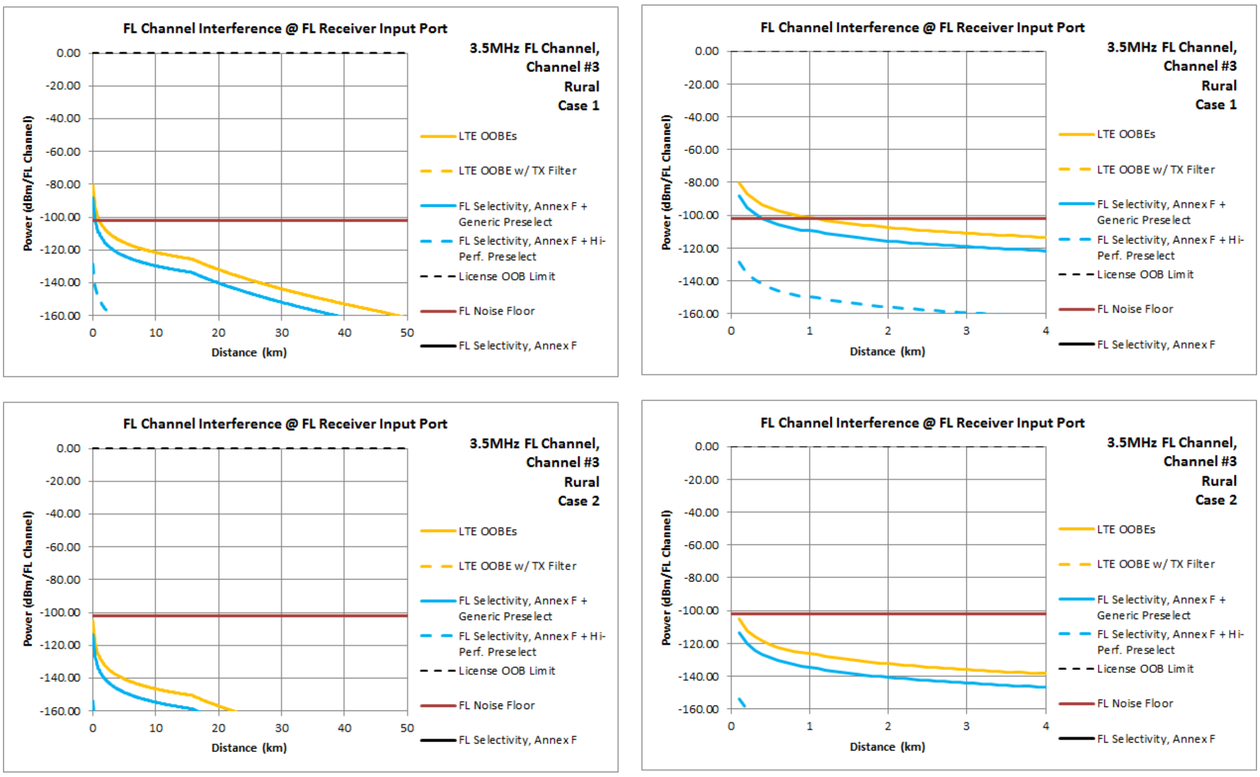


Figure 100: MCL results, FL CS 3.5 MHz, channel 3, rural, case 1 and case 2

5.5 MCL analysis conclusion

The MCL analysis provides the theoretical interference levels which would be generated by a single SDL transmitter into a FL with a specific carrier spacing (25 kHz, 75 kHz, 250 kHz, 1 MHz, 2 MHz and 3.5 MHz), at a certain distance from the SDL transmitter, operating at a low, mid or high-numbered channel within 1492.5-1517 MHz, in a specific environment (urban, suburban and rural) and subject to specific interference geometry (Case 1 SDL main-beam to FL main-beam and case 2 SDL main-beam to FL side-lobes).

The MCL analysis shows that the interference levels are heavily dependent on the scenarios under consideration and the assumptions used. In some cases, the interference from SDL into FLs would not exceed an I/N of -12 dB. In some other cases, this level would exceed this limit. The noise floor values vary with the type of FL equipment and we have used the lowest noise floor for each FL CS for a worst case analysis. However, the MCL analysis demonstrates that even under worst cases, filtering at the SDL Tx and/or FLs Rx will decrease the interference to levels that are well below an I/N of -12 dB and adequately mitigate any interference issue which may arise in real life deployment. In many instances, the high-performance filters which were specified for the very worst cases provide excessive rejection reducing the interference level to 40 dB below the noise floor. Less performing and therefore less expensive and smaller filters are a better choice to appropriately address many of the interference cases.

In the tables below, a detailed assessment is provided per geotype (urban, suburban and rural) and per case (Case 1, SDL main-beam/FL main-beam and case 2, SDL main-beam/FL side-lobes):

<table>
<tr><td colspan="2">Urban: case 1 and case 2 scenarios may occur. SDL transmit EIRP is lower than in other scenarios (suburban and rural) and SDL antennas are characterised by a significant downtilt. SDL antennas height is higher than in the two other scenarios.</td></tr>
<tr><td>Case 1</td><td>Generic filtering:

- Interference would exceed I/N of -12 dB for FLs operating on the first FL channel, for distances below 18-25 km for CSs of 25, 75, 250, 500 kHz, and distances below 5-14 km for CSs of 1, 2, 3.5 MHz.

- Interference would exceed I/N of -12 dB for FLs operating on mid numbered FL Channels, for distances below 2.5-12 km for CSs of 25, 75, 250, 500 kHz, and distances below 400 m-5 km for CSs of 1, 2, 3.5 MHz.

- Interference would exceed I/N of –12 dB for all FLs operating on a high-numbered FL Channel, for distances below 250-900 m.

High-Performance Tx and Rx filtering:

High-Performance filtering can be used to reduce the interference well below I/N of -12 dB in all interference cases identified above i.e. for:

- all FLs operating on the first FL channel at any distance;
- all FLs operating on the mid numbered channels at any distance;
- all FLs operating on the high numbered channel at any distance.</td></tr>
<tr><td>Case 2</td><td>Generic filtering:

- Interference would exceed I/N of -12 dB at short distances below 400 m-1.5 km for FLs operating on the first FL channel, for all CSs;

- Interference would be below I/N of -12 dB at short distances below 600 m for FLs operating on mid numbered channels.

- Interference would be below I/N of -12 dB for FLs operating at a high-numbered FL channel, for all CSs at any distance.

High-Performance filtering:

High-Performance filtering can be used to reduce the interference well below I/N of -12 dB in the interference cases identified above i.e. for all FL operating on the first FL channel and mid-numbered channels at short distances from the SDL Base Station.</td></tr>
</table>

<table>
<tr><td colspan="2">Suburban: case 1 and case 2 scenarios may occur. SDL EIRP power is lower than in the rural scenario but higher than in urban. SDL antennas height is lower than in an urban deployment and antennas downtilt is lower.</td></tr>
<tr><td>Case 1</td><td>Generic filtering:

- Interference would exceed I/N of -12 dB for FL operating on the first FL Channel, for distances below 30-40 km for CSs of 25, 75, 250, 500 kHz, and distances below 20-28 km for CSs of 1, 2, 3.5 MHz

- Interference would exceed I/N of -12 dB for FL operating on mid numbered FL Channels for distanced below 18-27 km for CSs of 25, 75, 250, 500 kHz and 1, 2 MHz, and distances below 4 km for CS of 3.5 MHz.

- Interference would exceed I/N of -12 dB for FL operating on high number</td></tr>
</table>

	Channels for distances below 5-15 km for CSs of 25, 75, 250, 500 kHz, and distances below 4 km for CSs of 1, 2, 3.5 MHz. **High-Performance Tx and Rx filtering:** High-Performance filtering can be used to reduce the interference well below I/N of -12 dB in all interference cases identified above i.e. for: - all FL operating on the first FL channel for distances above 250m for all CSs; - all FLs operating on the mid numbered channels at any distance; - all FLs operating on the high numbered channel at any distance.
Case 2	**Generic filtering:** - Interference would exceed I/N of -12 dB for FL operating on the first channel at distances below 7-16 km for CSs of 25, 75, 250, 500 kHz and 1, 2 MHz, and distances below 400 m-7 km for CS of 3.5 MHz. - Interference would exceed I/N of -12 dB for FLs operating on mid number Channels at distances below 1.5-5 kM for CSs of 25, 75, 250, 500 kHz, and for distances below 300 m-3.5 km for CSs of 1, 2, 3.5 MHz. - Interference would exceed I/N of -12 dB for FLs operating on high numbered Channels for distances below 500-1000 m for CSs of 25, 75, 250, 500 kHz, and for distances below 200-400 m for CSs of 1, 2, 3.5 MHz. **High-Performance Filtering:** High-Performance filtering can be used to reduce the interference well below I/N of -12 dB in all interference cases identified above i.e. for: - all FLs operating on the first FL Channel at any distance; - all FLs operating on the mid numbered Channels at any distance; - all FLs operating on the high numbered Channel at any distance.

Rural: rural scenario is expected to be a mainly case 2 due to higher gain FL antennas/small beamwidth and low SDL transmitters' density. The cell size is larger than urban and suburban scenarios. On the other hand, a higher SDL transmit power is usually used.	
Case 1	**Generic filtering:** - Interference would exceed I/N of -12 dB for FL operating on the first FL channel, for distances below 24-50 km for all CSs. - Interference would exceed I/N of -12 dB for FL operating on mid number channels at distances below 22-30 km for CSs of 25, 75, 250, 500 kHz and 1, 2 MHz, and for distances below 6 km for CS of 3.5 MHz. - Interference would exceed I/N of -12 dB for FL operating on high number Channels at distance below 7-20 km for CSs of 25, 75, 250, 500 kHz and 1, 2 MHz, and for distance below 200 m for CSs 3.5 MHz. **High-Performance Tx and Rx filtering:** High-Performance filtering can be used to reduce the interference well below I/N of -12 dB for: - all FL operating on the first FL channel at distances above 100-300 m; - all FLs operating on the mid numbered channels at any distance;

	- all FLs operating on the high numbered channel at any distance.
Case 2	**Generic Filtering :** - Interference would exceed I/N of -12 dB for FL operating on the first channel for distances below 9-22 km for CSs of 25, 75, 250, 500 kHz and 1, 2 MHz, and distances below 3.6 km for CS of 3.5 MHz. - Interference would exceed I/N of -12 dB for FLs operating on mid number channels for distances below 3.5-8 km for CSs of 25, 75, 250, 500 kHz and 1, 2 MHz, and for distances below 300 m for CS of 3.5 MHz. - Interference would be below I/N of -12 dB for FLs operating on high number channels for distance below 700 m-2 km for CSs of 25, 75, 250, 500 kHz, and for distances below 300-500 m for CSs of 1, 2, 3.5 MHz. **High-Performance Tx and Rx Filtering:** High-Performance filtering can be used to reduce the interference well below I/N of -12 dB in all interference cases identified above i.e. for: - all FLs operating on the first FL Channel at any distance; - all FLs operating on the mid numbered Channels at any distance; - all FLs operating on the high numbered Channel at any distance.

The MCL study shows that compatibility between SDL deployment in 1452-1492 MHz and FLs operating above 1492.5 MHz can be achieved based on standard and sound engineering practices and through available and well proven mitigation techniques which include:

- Optimization of SDL planning (e.g. avoidance of main-beam to main-beam);
- Installation of FL Preselect filters to eliminate interference when needed;
- Installation of SDL Tx preselect filter to eliminate interference when needed.

The MCL study also shows that beyond a certain FL channel, the interference from SDL into FLs, under generic assumption (no high performance Tx or Rx filter), falls below the noise floor in all geotypes, for all FLs carrier spacing and in all interference geometries (main-beam to main-beam and main-beam to side-lobes) at short distance.

Any loss due to off axis polarization has not been taken into account in the analysis which assumed that the FL antenna was oriented at the same polarization angle as the SDL antenna. Any loss due to polarization would provide additional margin in the analysis.

Furthermore, the MCL study shows that any interference levels which would be generated from SDL into FLs using the varied License technical terms remain within the limits of interference allowed as per the current License conditions.

6. FULL NETWORK SIMULATION FOR THE LONDON AREA

The London area, as the only major metropolitan area in the UK with a significant number of FLs, provides the best location to analyse in detail the interference generated by a typical LTE SDL network operating in 1452-1492 MHz on the FL operating above 1492 MHz.

6.1 London area

For the purpose of the identification of the Fixed Links potentially impacted, the London metropolitan area is defined as the geographical area located between 51.25° and 51.6667° Latitude and -0.5° and 0.25° Longitude.

There are 23 Fixed Links altogether deployed in the London area, spread around 16 FL Rx locations.

The location of those links is illustrated in Figure 101.

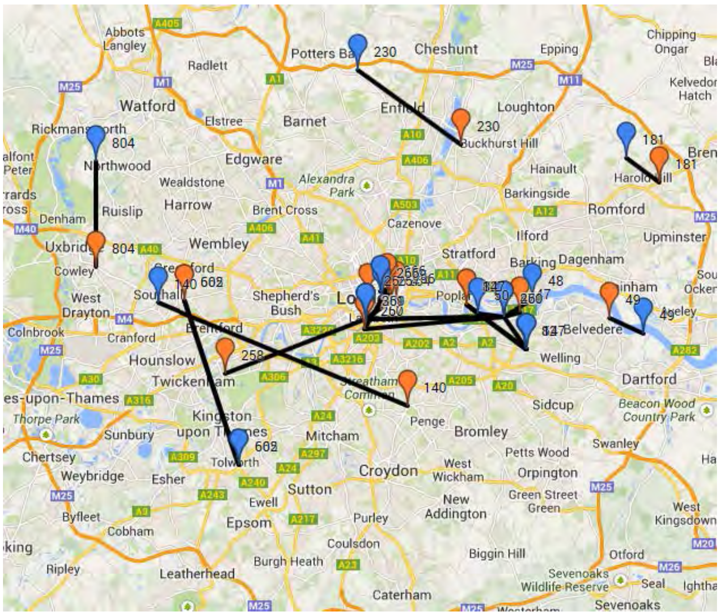


Figure 101: Location of Fixed Links in the London Area

In the following section, the interference created by a typical LTE SDL network deployment across the London areas on the 23 FL Rx deployed in London is simulated.

6.2 Assumptions and methodology

The Atoll Wireless Network Engineering Software is used to simulate a typical LTE SDL network covering the London area. The location of the BSs, their transmit power as well as their antenna pointing closely mirrors typical network configuration of the LTE 800/HSPA 900 networks. More than 2600 SDL BSs have been modelled. The exact location, antenna height and antenna azimuth of all 23 Fixed Links deployed in the London area are included in Atoll. A simulation area much larger than the area where Fixed Links are deployed is taken into account in order to ensure that the area where the statistics are derived (focus area) receives representative signals from the LTE SDL network, as illustrated in Figure 102.

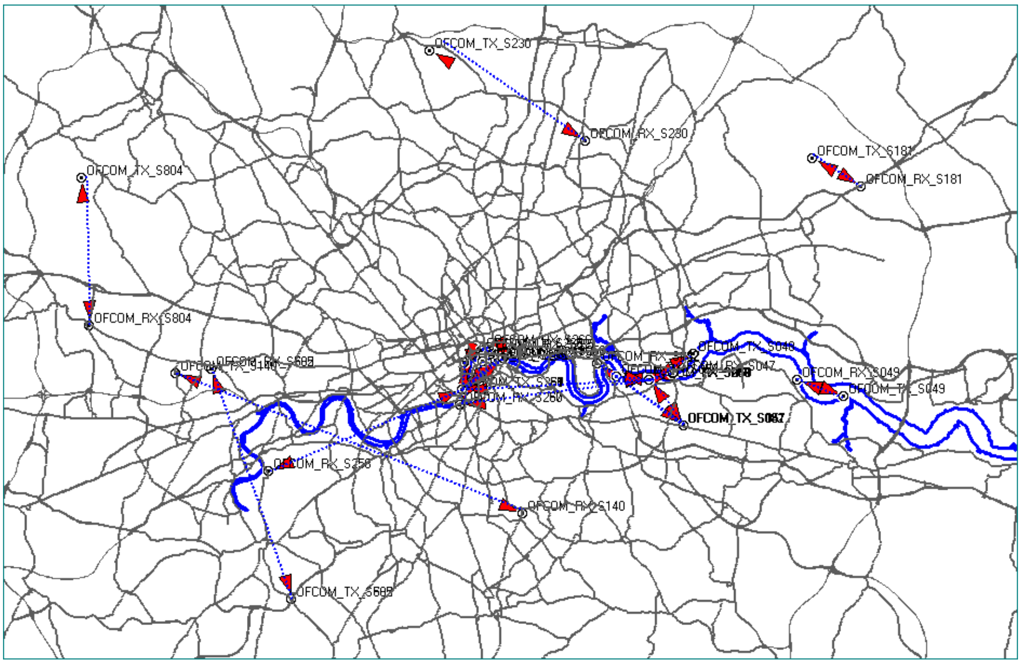


Figure 102: Atoll representation of all 23 Fixed Links in the London area

The Atoll Wireless Network Engineering Software is a professional planning tool for the design of mobile broadband wireless networks. As such, it is designed to model the level of the signal received in specific location through complex simulations. In order to derive the interference created from the LTE SDL network to FL receivers in adjacent band, the methodology is described below:

Step 1: LTE SDL base stations are positioned and configured throughout the simulation zone, assuming LTE 20 MHz centred on 1482 MHz. The LTE BS in band EIRP is 65 dBm/20 MHz, in line with assumptions in Section 5.1

Step 2: The simulated network is setup as a fully loaded network by assigning the full transmitted power on all cells, with power equally distributed across the whole bandwidth.

Step 3: The FL Rxs are modelled as terminals receiving the signal, but adopting the exact FL Rx position, elevation and antenna characteristics including antenna pointing (azimuth, elevation).

Step 4: The propagation model selected is the Standard Propagation Model (SPM) in default mode. More considerations on propagation models are provided in Section 6.4.2.

Step 5: The Received Signal Strength Indicator (RSSI) for each of the FL Rxs is provided by the simulation. The RSSI is the signal strength generated by a fully loaded 20 MHz LTE SDL network in 1472-1492 MHz at the location of each FL Rx, measured at the FL Rx antenna port. The RSSI is the total in band power received, i.e. the sum of the power of the signal received by the FL from each SDL BS. The RSSI is estimated over the full 20 MHz bandwidth; with all SDL BS transmitting with full power (e.g. the network is fully loaded).

Step 5: The total interference as seen by the FL Rx is deduced by adding the Extended Net Filter Discrimination (see Section 4.2) to the RSSI. The full table of Extended NFDs is provided in Section 21.

Step 6: The total interference is compared to the FL noise floor provided by the OfW 446 (See Table below and Section 22).

Link ID	Channel Spacing (kHz)	Equipment Reference	Equipment Bit Rate (bps)	N (OfW446) (dBm)
47	500	E/01/DE/99/038/WA	704	-105.5
48	500	E/01/DE/99/038/WA	704	-105.5
49	500	E/01/DE/99/038/WA	704	-105.5
50	500	E/01/DE/99/038/WA	704	-105.5
51	500	E/01/DE/99/038/WA	704	-105.5
82	500	E/01/DE/99/038/WA	704	-105.5
140	250	E/01/EM/99/037/WA	256	-111.5
147	500	E/01/DE/99/038/WA	704	-105.5
181	500	E/01/DE/99/038/WA	704	-105.5
230	500	E/01/DE/99/038/WA	704	-105.5
254	500	E/01/DE/99/038/WA	704	-105.5
255	500	E/01/DE/99/038/WA	704	-105.5
256	500	E/01/DE/99/038/WA	704	-105.5
257	500	E/01/DE/99/038/WA	704	-105.5
258	500	E/01/DE/99/038/WA	704	-105.5
259	500	E/01/DE/99/038/WA	704	-105.5
260	500	E/01/DE/99/038/WA	704	-105.5
265	250	E/01/EM/99/037/WA	256	-111.5
266	250	E/01/EM/99/037/WA	256	-111.5
361	500	E/01/DE/99/038/WA	704	-105.5
565	500	E/01/DE/99/038/WA	704	-105.5
602	2000	E/01/EG/05/050/WA	4096	-101.6
804	250	E/01/EM/99/037/WA	256	-111.5

Table 17: Noise floor of FL deployed in London Area

6.3 Simulation results

The results are provided in the Table below:

Link ID	Channel Spacing (kHz)	Channel	RSSI (dBm)	Extended NFD (dB)	I (dBm)	N (OfW446) (dBm)	I/N (dB)
47	500	13	-65	91.4	-156.5	-105.5	-51.0
48	500	8	-48	87.6	-135.8	-105.5	-30.3
49	500	8	-67	87.6	-154.7	-105.5	-49.2
50	500	5	-57	66.8	-123.5	-105.5	-18.0
51	500	3	-46	66.6	-112.6	-105.5	-7.1
82	500	20	-68	95.5	-163.2	-105.5	-57.7
140	250	21	-66	91.5	-158.0	-111.5	-46.5
147	500	6	-68	85.1	-153.0	-105.5	-47.5
181	500	1	-63	60.0	-122.8	-105.5	-17.3
230	500	43	-69	107.1	-176.5	-105.5	-71.0

254	500	15	-52	92.6	-144.5	-105.5	-39.0
255	500	1	-64	60.0	-123.8	-105.5	-18.3
256	500	46	-44	108.6	-152.9	-105.5	-47.4
257	500	47	-61	109.1	-170.5	-105.5	-65.0
258	500	36	-65	103.7	-168.3	-105.5	-62.8
259	500	19	-66	94.9	-161.2	-105.5	-55.7
260	500	16	-59	93.2	-152.1	-105.5	-46.6
265	250	3	-50	66.4	-116.2	-111.5	-4.7
266	250	7	-52	69.5	-121.2	-111.5	-9.7
361	500	9	-67	88.4	-155.0	-105.5	-49.5
565	500	12	-58	90.7	-148.7	-105.5	-43.2
602	2000	8	-60	95.3	-155.7	-101.6	-54.1
804	250	4	-72	66.9	-138.8	-111.5	-27.3

Table 18: I/N at each 23 FLs in London area

The simulations show that the interference level received from an SDL network into FL Rxs currently deployed in London ranges from -112.6 to -176.5 dBm. This corresponds to an I/N ranging from -4.7 to -71 dB for all 23 FLs. The interference into 20 of the FLs is well below an I/N of – 12 dB. The interference into 3 FLs 51, 265 and 266 is below the noise floor, but within 12 dB of the noise floor.

The analysis indicates that an operator can deploy an SDL network in 1472-1492 MHz (and therefore de facto in 1452-1472 MHz) without interfering into the FLs currently operating above 1492.5 MHz in the London area. The operator would need to pay special attention to the FLs 51, 265 and 266 when engineering its network. Just by equipping the few BSs generating most interference to these 3 FLs with high performance Tx filters, the interference would then fall 12 dB below the noise floor:

- For FL 51, the Extended NFD would be improved to 78.2 dB with Tx filtering, i.e. a 11.6 dB improvement,
- For FL 265, the Extended NFD would be improved to 72.5 dB with Tx filtering, i.e. a 6.1 dB improvement,
- For FL 266, the Extended NFD would be improved to 80.7 dB with Tx filtering, i.e. a 11.2 dB improvement.

We note additionally that Qualcomm has used in its study emission levels that exceed those of 'real life' SDL OOBE[5] and that even the three limited circumstances requiring special attention may not do so when base stations are operating at the lower SDL OOBE levels.

6.4 Consideration of assumptions, propagation model and worst case analysis

6.4.1 Location of LTE SDL BSs

The full network simulation of the London area is based on a number of assumptions, in particular on specific base station locations. The simulated network is representative of a typical SDL network in the band of interest. Due to the discrete position of the Fixed Links, it may occur that the selection of alternative LTE BS locations would lead to extreme situations where a SDL base station and an FL Rx station are directly pointing at each other in close proximity, which may lead to situations analysed in Section 5. However, what the full network simulation shows is that such cases would be specific and dealt with through sound

[5] See Section 13

engineering practices and that a typical situation is that FLs deployed in London would not be interfered by a typical fully loaded SDL network.

6.4.2 Propagation model

Atoll simulates propagation according to the Standard Propagation Model (SPM) which considers shadowing and diffraction (empirical cellular model based on extensions of the Okamura-Hata model) and is fully applicable for 1.5 GHz. The simulation results are based on Atoll running the SPM in so called 'default mode', i.e. without customization of the propagation model.

For real deployment, mobile operators are calibrating the SPM based on measurement data to obtain not the typical propagation model but the exact propagation throughout the coverage zone. Therefore, a real network planning campaign would rely on the SPM running in 'calibrated mode' instead of 'default mode'. Such calibrated mode would provide improved accuracy of the field strength generated by the overall network on specific locations.

Although the propagation prediction and specifically the SPM model used takes the actual morphology and clutter into consideration, exact building shapes are not considered. Especially in a dense urban environment, the shadowing provided by building considering a specific pair of SDL base station and FL Rx antenna, might be much higher than the statistical shadowing impact considered in the SPM used model, leading in specific cases to significant lower RSSI values than predicted.

In the absence of measurement data, the SPM in 'default mode' is the best approximation in Atoll to real life propagation. However, in some specific propagation cases, the SPM in 'default mode' may lead to underestimation of the RSSI from the LTE network at some Rx locations. A sensitivity analysis of the impact of the propagation model on the simulation results is provided in Section 20. The sensitivity analysis indicates that the pathloss delta between the LOS and SPM model would not exceed 15 dB within 500 m separation distance. Even under such worst case propagation conditions (i.e. LOS), the simulations indicate that SDL deployment in 1452-1492 MHz is compatible with FLs operating above 1492.5 MHz in the London area with the interference into 20 of the 23 FLs remaining well below the noise floor. An SDL operator would be able to focus on a very low number of FLs, namely FLs 51, 265 and 266 when planning and engineering its network, notwithstanding the fact that real life SDL OOBE will be better than the conservative emission levels used in the simulation[6] reducing further any risk of interference.

6.5 Conclusion for London and other urban areas

The detailed modelling of the London area indicates that a typical fully loaded SDL network can be deployed in 1452-1492 MHz while being compatible with the FLs currently operating in that area above 1492.5 MHz. Taking into account the density of FLs in the London area, this analysis shows that SDL deployment in 1452-1492 MHz in urban areas is compatible with FLs above 1492.5 MHz.

3 FLs (out of 23) in London would command special attention from the SDL operator when engineering its network as those FLs are the most sensitive to interference. Implementing

[6] See Section 13

mitigation techniques (e.g. additional filtering in the few key base stations surrounding these 3 FLs) would be sufficient to ensure that the interference remains -12 dB below the FLs noise floor level.

The full network simulation relies on assumptions about the network modelling (location of BSs) and propagation, in the absence of exact propagation measurement. Therefore, it cannot be excluded that interference levels in real life could be higher than the simulation results with different BS location or in some extreme propagation cases. However, it was shown in the MCL analysis that sound engineering practices and additional mitigation techniques such as additional filtering in particular at Tx side will solve any interference issue that may arise due to those limited extreme situations in real life deployment.

7. RURAL AREA ANALYSIS

This section analyses how an SDL operator can plan its network in 1472-1492 MHz and roll it out in full compatibility with the FLs deployed in rural areas above 1492.5 MHz. Two use cases based on actual and operational FLs have been selected to illustrate such an approach. The former corresponds to a challenging scenario where the FL operates at a low number channel (channel 2) and is located near and in parallel to a motorway (M74) which would require coverage from an SDL BS. The latter is the a typical use case where the chosen FLs is deployed about 50 km west of Middlesborough,

Taking into account the low density of SDL base stations in rural areas, it will be straightforward for an operator when planning its network to identify if an SDL BS would impact an FL receiver currently in operation and referenced in the database. It is equally straightforward for the operator to take the appropriate measures to solve any interference issue when engineering its network.

7.1 Critical use case - Fixed Link 787

Fixed Link 787 operates on a 500 kHz Carrier Spacing, on channel 2. FL 787 is deployed about 40 km south east of Glasgow, as shown in Figure 103. FL 787 is a Fixed Link type E/01/DE/99/038/WA (datarate 704 bps, bandwidth 500 kHz) with a noise floor of -105.5 dBm (See Section 22).

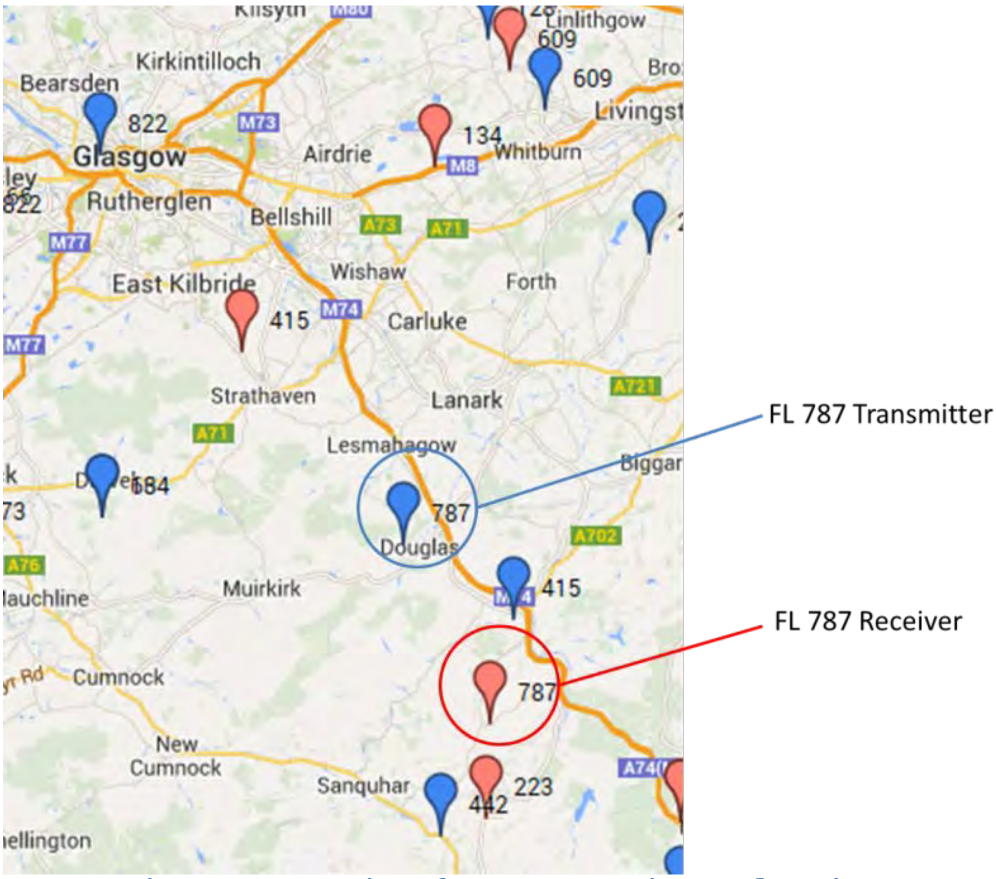


Figure 103: Location of FL 787 transmitter and receiver

From the noise floor of the FL (Annex 22), the expected EIRP in rural environment and antenna gain (Section 5), as well as the Extended NFD (Annex 21), the required pathloss between the FL receiver antenna and the SDL BS antenna can be easily derived, both for the main beam to main beam (case 1) and main beam to side lobe (case 2) geometries, as shown in Table 19. Assuming free-space pathloss, this also provides a worst case required separation distance.

	FL CS (kHz)	N (dBm)	SDL EIRP (dBm)	FL Channel	Extended NFD (dB)	FL Rx Ant Gain (dBi)	Required Pathloss (dB)	Required Distance (km)
Case 1	500	-105.5	74	2	70.7	17	125.8	31.3
Case 2	500	-105.5	74	2	70.7	-8	100.8	1.7

Table 19: Required separation distance, in rural, assuming free-space path loss

The geographical area within which an SDL rural base station would impact with the FL Rx, assuming free space LOS propagation is illustrated in Figure 104.

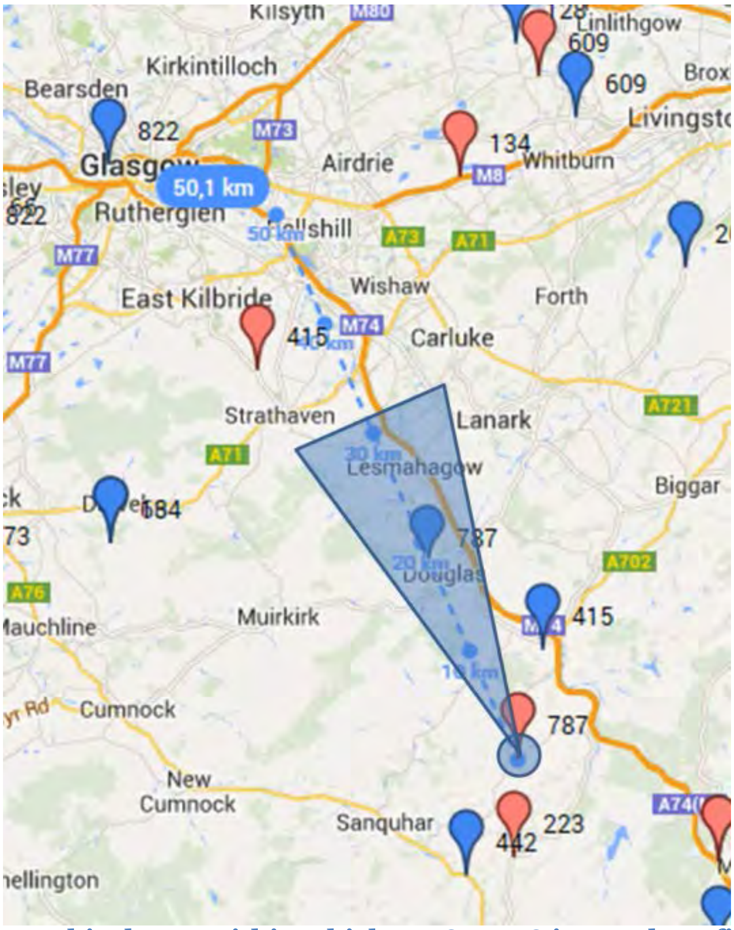


Figure 104: Geographical area within which, an SDL BS in rural configuration would exceed FL 787 Rx's noise floor (free space – LOS propagation)

The large geographical zone shows why this use case has been selected to represent a critical scenario.

The SDL operator will have a number of engineering options when planning and deploying its network to eliminate any interference risk from its network into FL 787. The impact of two of those mitigation techniques, namely antenna downtilt and filtering have been analysed hereafter.

7.1.1 Planning – antenna downtilt

It is of interest to analyse what the protection zone looks like when considering that the SDL antennas are downtilted to avoid having their main beam transmitting towards the horizon. As indicated in Section 14, such downtilt provides a 25 dB reduction of the EIRP and the corresponding separation distance is derived in Table 20.

FL CS (kHz)	N (dBm)	SDL EIRP (dBm)	FL Channel	Extended NFD (dB)	FL Rx Ant Gain (dBi)	Required Pathloss (dB)	Required Distance (km)
500	-105.5	49	2	70.7	17	100.8	1.7

Table 20: Required separation distance, in the main beam, assuming SDL BS downtilted antenna

Figure 105 illustrates that ensuring that SDL BS in the FL Rx main beam are using downtilted antenna would solve in itself the vast majority of interference cases.

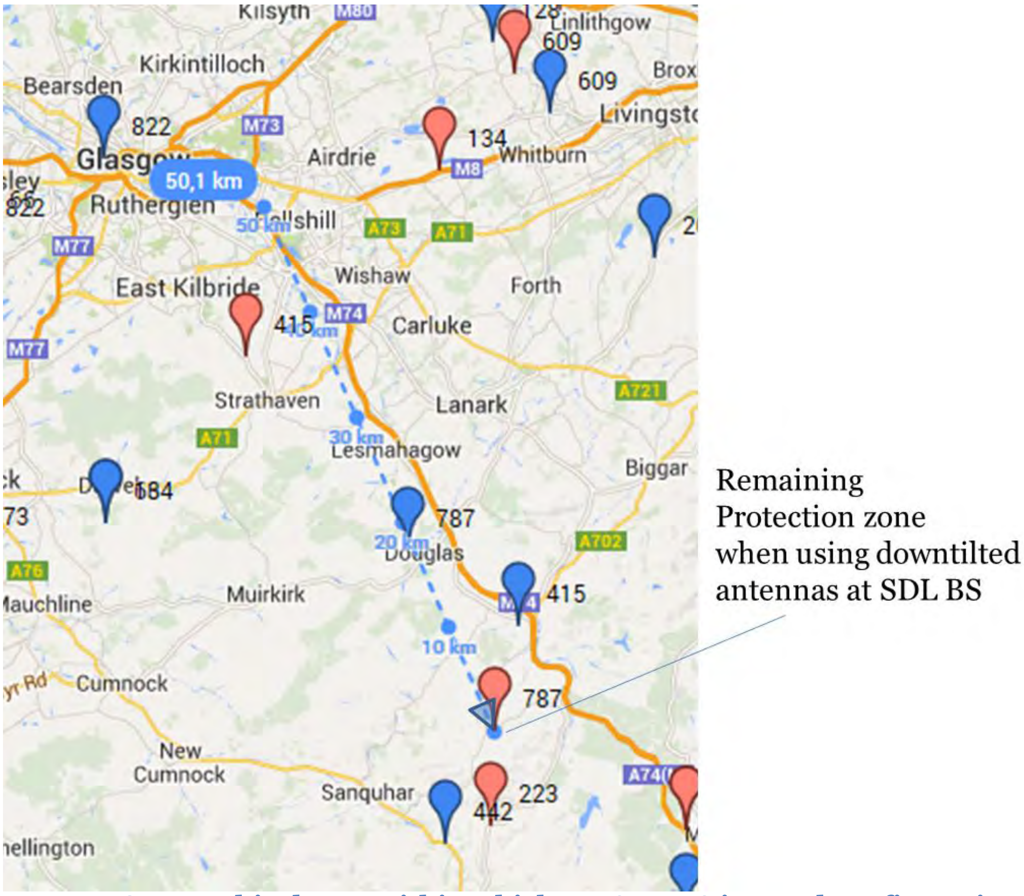


Figure 105: Geographical area within which, an SDL BS in rural configuration with donwtilted antenna (main lobe does not intersect horizon) would exceed FL 787 Rx's noise floor.

7.1.2 Filtering in specific cases

In some specific critical cases, it may be beneficial for the SDL operator to use SDL BSs that are not downtilted. For example in Figure 106, it is assumed that an SDL BS, represented by a red star, would be deployed to cover the M74, therefore purposely targeting the horizon in the direction of FL 787. The latter corresponds to a worst case assumption as this geometry can be further optimised in real life deployment.

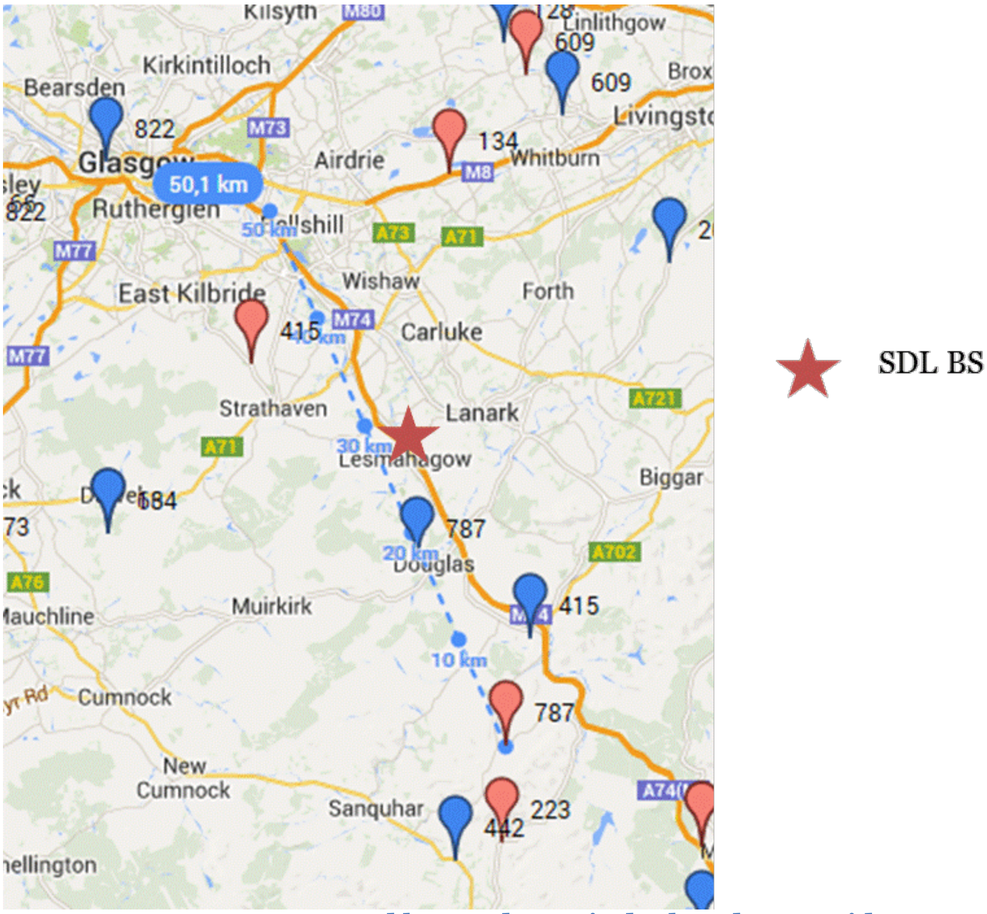


Figure 106: An SDL BS, represented by a red star, is deployed to provide coverage along the M74 motorway

In such a case, it may be more appropriate to consider using additional filtering, in order to eliminate the protection zone. Table 21 provides the required separation distances for several filtering options.

Extra filtering?	FL CS (kHz)	N (dBm)	SDL EIRP (dBm)	Extended NFD (dB)	FL Rx Ant Gain (dBi)	Required Pathloss (dB)	Required Distance (km)
No	500	-105.5	74	70.7	17	125.8	31.3
At LTE Tx	500	-105.5	74	73.8	17	122.7	21.9
At LTE Tx and FL Rx	500	-105.5	74	125.3	17	71.2	0.06

Table 21: Required separation distance, in the main beam, assuming SDL BS downtilted antenna

The corresponding geographical protection zones are illustrated in Figure 107.

Figure 107: Impact of filtering on the protection zone

The protection zone when applying for filtering at both Tx and Rx ends is so small that it is not visible on the Figure. In the case considered, the MNO will apply additional filtering at Tx side and optimize its SDL antenna geometry, which will prevent interference without requiring additional intervention at the FL Rx side.

7.2 Typical use case - Fixed Link 148

Fixed Link 148 operates on a 500 kHz Carrier Spacing, on channel 9. FL 148 is deployed about 50km west of Middlesborough, as shown in the Figure 108. FL 148 is a Fixed Link type E/01/DE/99/038/WA (datarate 704 bps, bandwidth 500 kHz) with a noise floor of -105.5 dBm (See Section 22).

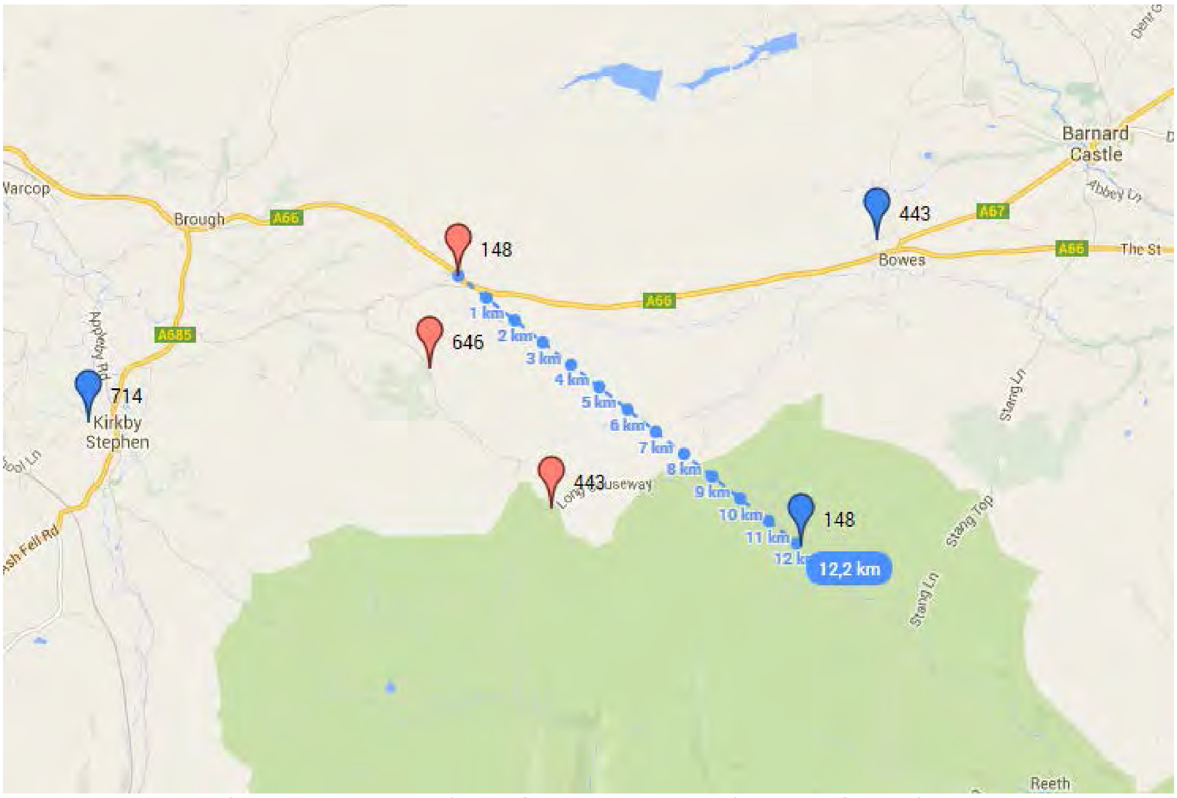


Figure 108: Location of FL 148 transmitter and receiver

From the noise floor of the FL (See Section 22), the expected EIRP in rural environment and antenna gain (See Section 5), as well as the Extended NFD (See Section 21), it is straightforward to derive the required pathloss between the FL receiver antenna and the SDL BS antenna, both for the main beam and the side lobe, as shown in the Table 22 below. Assuming free-space pathloss, this also provides a worst case required separation distance.

	FL CS (kHz)	N (dBm)	SDL EIRP (dBm)	FL Channel	Extended NFD (dB)	FL Rx Ant Gain (dBi)	Required Pathloss (dB)	Required Distance (km)
Case 1	500	-105.5	74	9	91.3	17	105.2	2.9
Case 2	500	-105.5	74	9	91.3	-8	80.2	0.2

Table 22: Required separation distance, in rural environment, assuming free-space path loss

Figure 109 illustrates the corresponding protection zone but also how unlikely it is for an SDL operator to have the absolute need to deploy a Base Station within the protection zone.

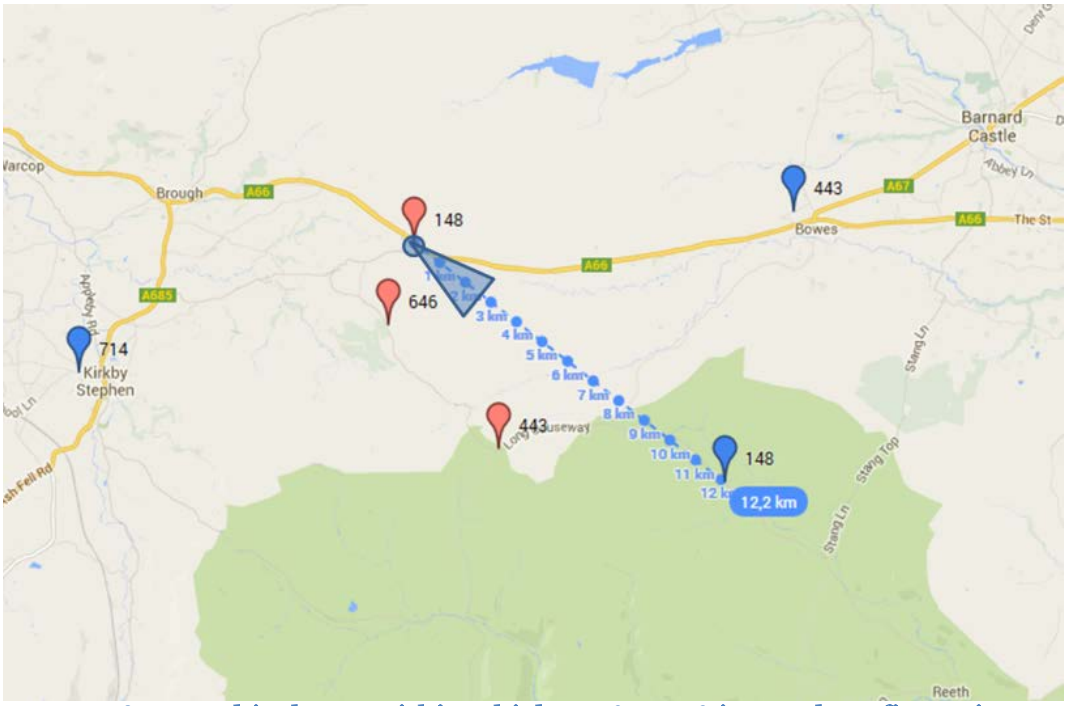


Figure 109: Geographical area within which, an SDL BS in rural configuration would exceed FL 148 Rx's noise floor.

7.3 Conclusion of the rural analysis

Depending on the location of the FL receiver, it is straightforward to determine whether a planned SDL BS deployment may cause interference to a FL or not.

For the vast majority of FL channels, the geographical area where an SDL operator would have to assess interference risks before deploying base stations are so small, that they would have a negligible impact on network deployment.

For the few extremely challenging FL channels, the protection zones where the SDL operator should pay special attention may be large. However, simple techniques such as antenna downtilt could by themselves solve most interference challenges. Should antenna downtilt not be appropriate, filtering provides a solution that would solve practically all interference issues.

8. ASSIGNMENT AND COMPATIBILTY OF FUTURE FLS

FLs assignment process within 1492.5-1517 MHz is automated and FL users' current planning methods ensure LOS / Fresnel zone clearance between the FL Tx and Rx. It is proposed to adopt 1498.5 – 1517 MHz for assignment of new FLs without coordination. This frequency range ensures that, for each FL CS, at least 75% of all channels are available for deployment without coordination. It is important to note that there is significant FL current operation below 1498.5 MHz which will be protected from interference through SDL network planning and engineering. The 1492-1498.5 MHz will therefore remain efficiently used and is not to be considered as guard band. Additional technical conditions for SDL and FLs would be required and are defined in this section.

8.1 Analysis assumptions

8.1.1 Propagation assumptions

It is proposed to assume free-space propagation between SDL BS and FL Rx, as a worst case assumption.

8.1.2 Coexistence distance

It is proposed to adopt an approach based on site clearance where the FL user will be required to check that there is no BS within a certain coexistence distance in the main beam of the FL Rx when installing a new FL. This is consistent with the current FL deployment approach where FL users check LOS / Fresnel zone clearance when installing a new FL.

The coexistence distance between the SDL BS and the FL Rx and the FL Rx antenna gain are directly related. It is proposed to adopt as 'guiding assumptions' a FL Rx antenna gain of 17 dBi and a clearance distance in the FL Rx main beam of 100m which is consistent with FL current deployment approach to check LOS/Fresnel zone clearance. This corresponds to 75.9 dB free space propagation pathloss. The coexistence in the side lobe will be ensured unless the FL is deployed in very immediate proximity of (a few meters away from) of the SDL BS.

8.1.3 FL Rx interference level

It is proposed to adopt an interference criteria for FL operation of I/N=-6 dB, with apportionment of interference between 4 individual interferers ($I_{Single\_interferer}$/N=-12 dB) and apportionment between the interference due to OOBE and the interference due to FL Rx selectivity of 3 dB. This leads to an I_{SDL_OOBE} /N=-15 dB and $I_{FL\_Selectivity}$ /N=-15 dB

8.2 Optimal frequency range for deployment without coordination

In the following section, a frequency limit is proposed for FL deployment without coordination with SDL BS operating below 1492 MHz based on considerations about existing deployment and FL channel plan. A further analysis of the channel availability based on the proposed limit is provided.

8.2.1 Identification of optimal frequency range

The selection of the optimal frequency range should be based on the two opposing considerations:

- the lower the frequency range entry point, the larger the number of FL channels available without coordination,

- the lower the frequency range the more stringent (costly) the filtering requirements for both the SDL BS and the FL Rx.

8.2.1.1 Filtering requirements and 2/3 of FL channels available

Fulfilling the requirement to achieve the coexistence criteria selected for deployment without coordination will require significant filtering through RF filters for both the SDL BS and the FL Rx. Cost-efficient RF filters require some MHz to provide significant rejection, pointing to a frequency separation between 5 and 10 MHz above 1492 MHz. A frequency range of 1500-1517 MHz would correspond to 69% of the FL frequency range available for deployment without coordination.

1500 MHz provides a sufficient frequency separation to ensure the availability of cost effective RF filters while ensuring that more than 2/3rd of the FL frequency range would be available for FL deployment without coordination. 1500 MHz would therefore be a good candidate for further analysis.

8.2.1.2 FL CS and optimal frequency limit

The selection of the frequency limit will have a larger impact of the FL with larger CS, since the total number of channel available within 1492-1517 MHz is much smaller for larger CS. The number of channels available above 1500 MHz for the larger CS as well as the frequency limit to protect on additional FL channel are listed in the Table below:

FL CS	Total number of channels	Number of channels above 1500 MHz	Limit to protect one more channel[7] (MHz)
500	48	33	1499.54
1000	24	17	1499.58
2000	12	8	1498.66
3500	3[8]	1[8]	1497.75

Table 23: Number of channels above 1500 MHz for each FL CS

8.2.1.3 Most relevant FL Carrier Spacing

The number of FLs currently deployed in the band, grouped by Carrier Spacing (CS), is provided in the Table below:

FL CS	Total number of existing links
25	0
75	21
250	177
500	323
1000	41

[7] The protection limit is set to channel centre frequency taking into account the System Bandwidth (BW). The BW for a specific Carrier Spacing is provided in Annex A.3.2 of [11] (See also Section 19).
[8] Note that Recommendation T/R 13-01 E defines 6 channels for FL CS 3.5 MHz, including 4 above 1500 MHz. In the UK, only the 3 lowest channels are available in the band.

2000	286
3500	3

Table 24: Number of existing FLs for each FL CS

FL CS of 250, 500 and 2000 kHz are most widely used, while FL with other CSs are used sparingly. In particular, there is hardly any FL with 3.5 MHz CS in the band.

8.2.1.4 Proposed optimal frequency range

Since:

- filtering requirement requires a frequency separation of approximately 5 to 10 MHz, pointing to a frequency limit of 1497 to 1502 MHz,
- a frequency limit of 1500 MHz would ensure that 69% of the full FL frequency range would be available for deployment without coordination,
- FL CS of 250, 500 and 2000 kHz are the most used in this band,
- the larger the CS, the highest the impact the selection of the frequency limit will be on the percentage of FL channels available,

It is proposed to select 1498.5 – 1517 MHz as the frequency range for FL deployment without coordination with SDL BS operating below 1492 MHz.

8.2.2 FL channels available in 1498.5 – 1517 MHz

The total number of channels available in 1492-1517 MHz and the number of channels available in 1498.5 – 1517 MHz are provided in the table below.

FL CS (kHz)	Total number of channels	Number of channels above 1498.5 MHz	% of channels available for deployment without coordination
25	960	720	75
75	320	240	75
250	96	72	75
500	48	36	75
1000	24	18	75
2000	12	9	75
3500	3[8]	1[8]	33

Table 25: Number and % of channels available above 1498.5 MHz, per CS

Adopting a frequency limit of 1498.5 MHz would ensure that 75% of the FL channels for all FL CS except CS 3.5 MHz are available for deployment without coordination.

8.2.3 Analysis of current deployment vs 1498.5 MHz

The numbers of FLs currently deployed per MHz in 1492 - 1495 MHz are the highest, lower to significantly lower numbers of FLs currently deployed per MHz occur in 1495-1517 MHz, as illustrated in the Figure below:

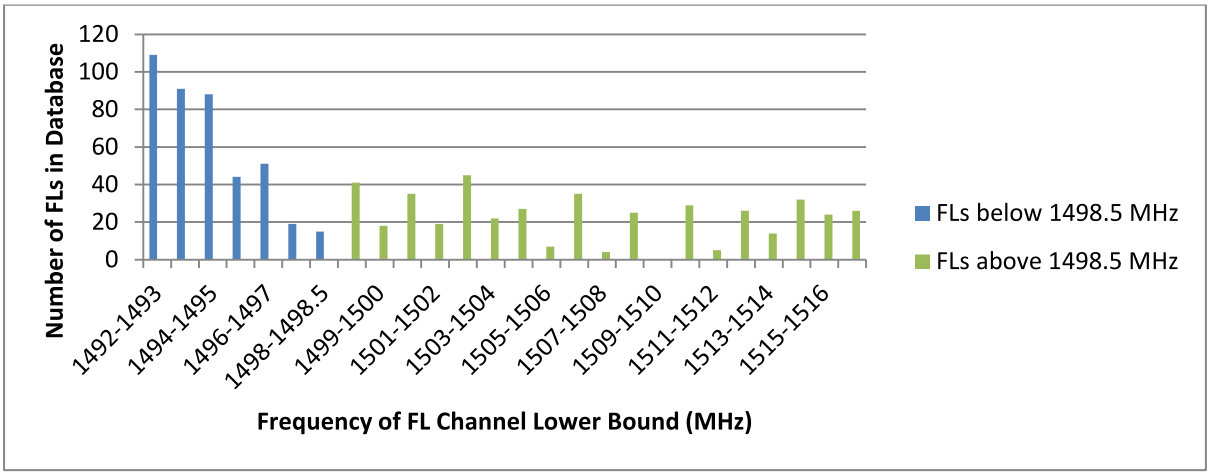


Figure 110: Number of FLs deployed in each frequency range.

A detailed analysis is provided in the Table below for each FL CS.

FL CS	Total number of existing links	Number of existing links below 1498.5 MHz	Density below 1498.5 MHz	Density above 1498.5 MHz
25	0	0	0 FL/Ch	0 FL/Ch
75	21	16	0.2 FL/Ch	0.02 FL/Ch
250	177	135	5.6 FL/Ch	0.6 FL/Ch
500	323	169	14 FL/Ch	4.3 FL/Ch
1000	41	14	2.3 FL/Ch	1.5 FL/Ch
2000	286	81	27 FL/Ch	22.8 FL/Ch
3500	3	2	1.0 FL/Ch	0.25 FL/Ch
Total	851	417	69.5 FL/MHz	24.1 FL/MHz

Table 26: Density of FLs deployed below and above 1498.5 MHz, per CS

An illustration of the FL density per channel, per CS, is provided in the following Figures:

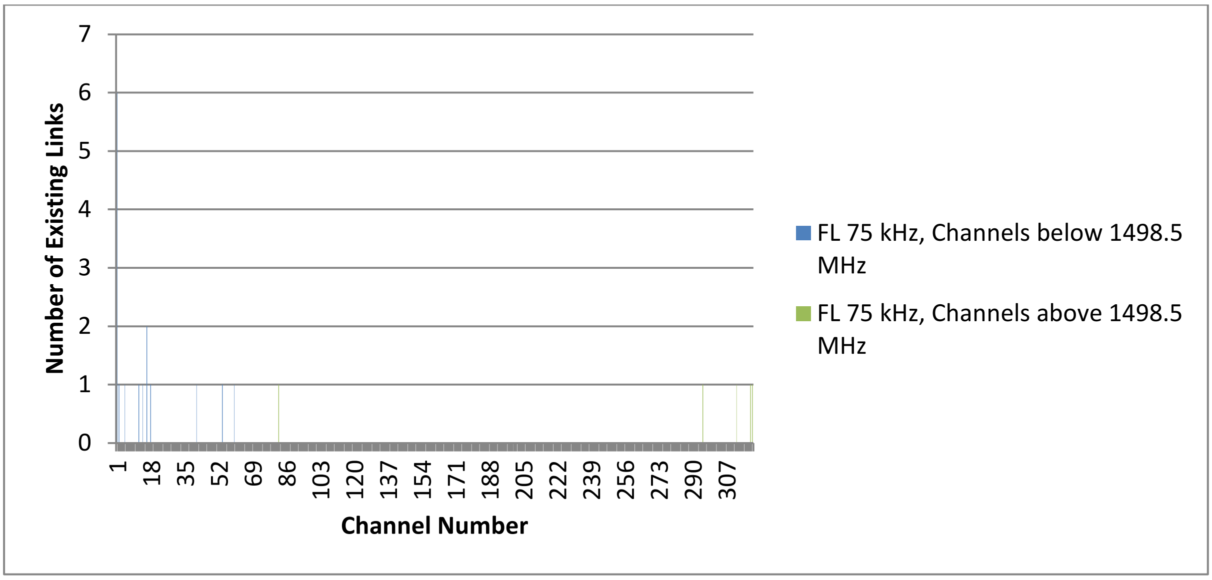


Figure 111: Number of existing FLs below and above 1498.5 MHz, CS 75 kHz

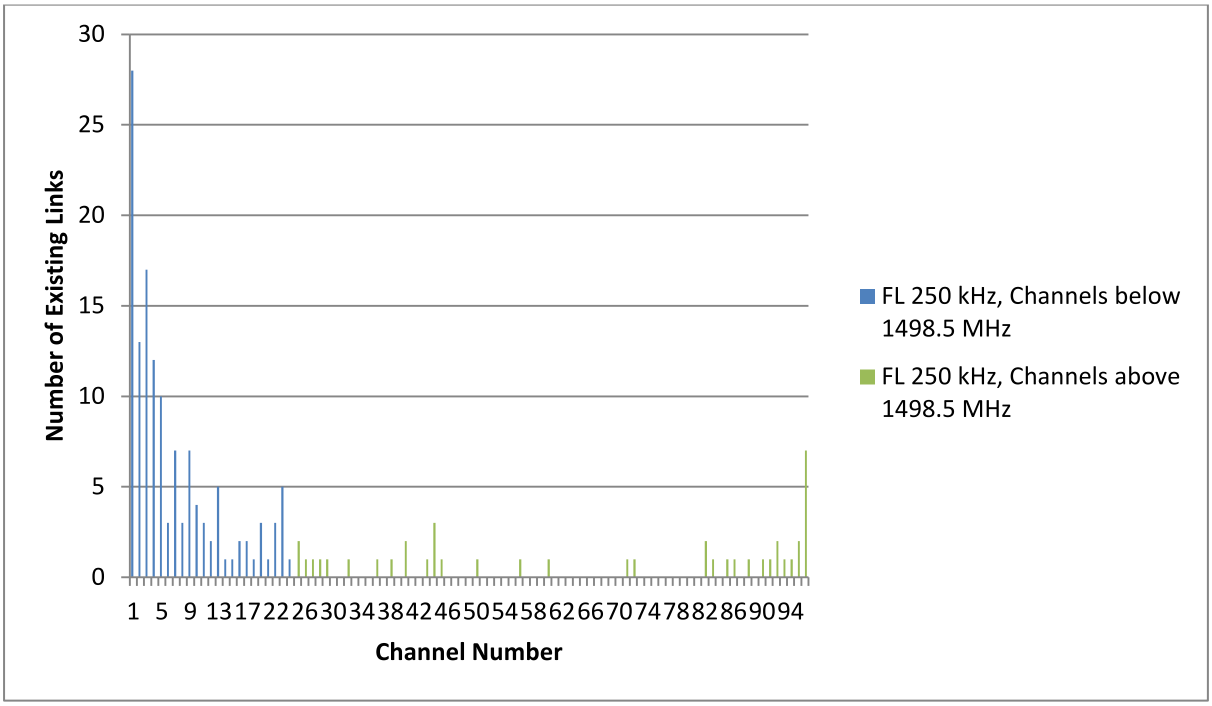


Figure 112: Number of existing FLs below and above 1498.5 MHz, CS 250 kHz

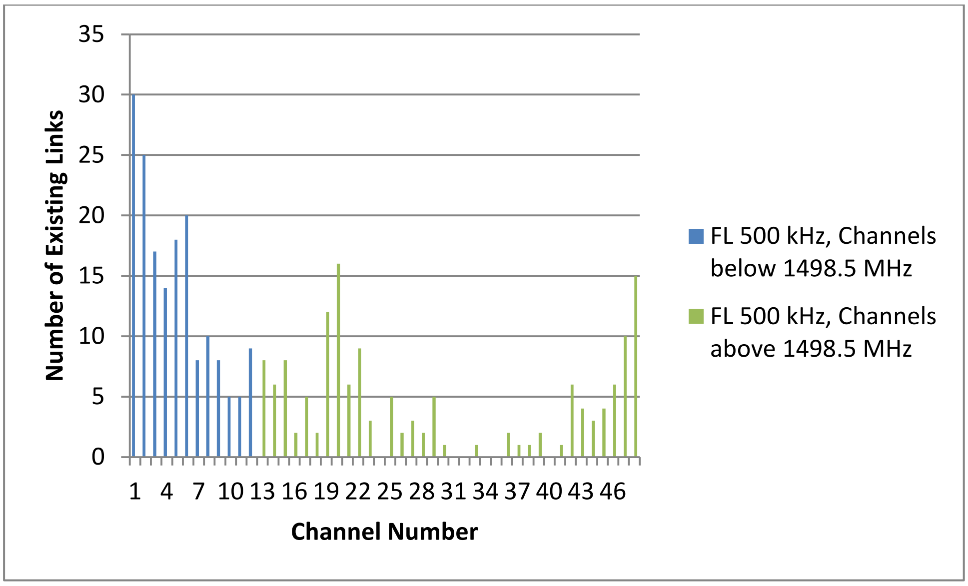


Figure 113: Number of existing FLs below and above 1498.5MHz, CS 500 kHz

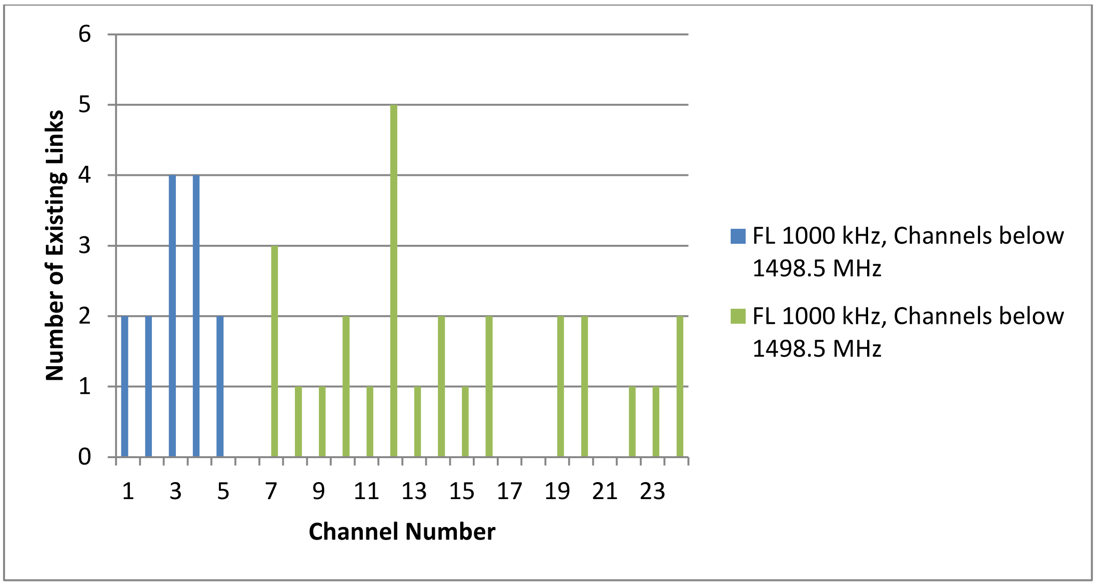


Figure 114: Number of existing FLs below and above 1498.5 MHz, CS 1000 kHz

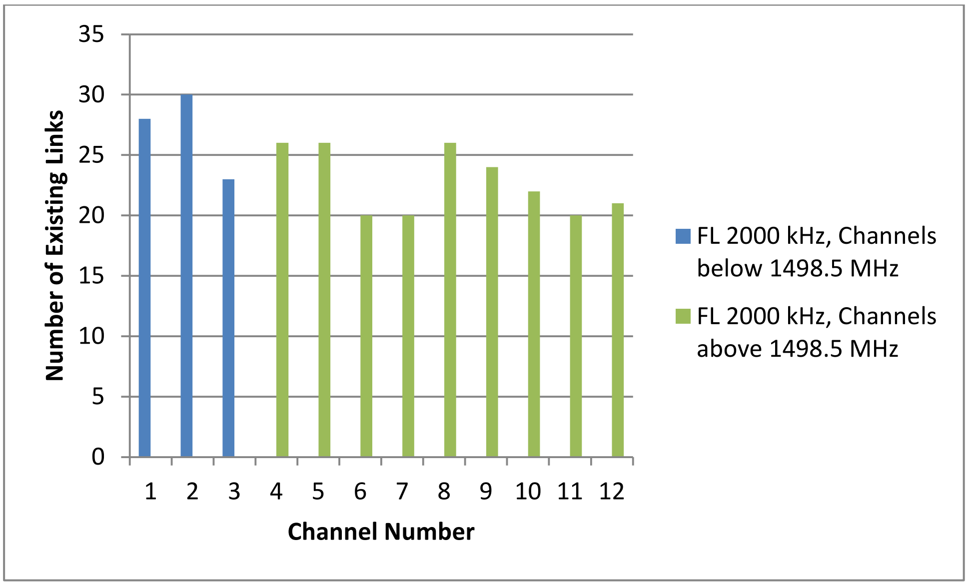


Figure 115: Number of existing FLs below and above 1498.5 MHz, CS 2000 kHz

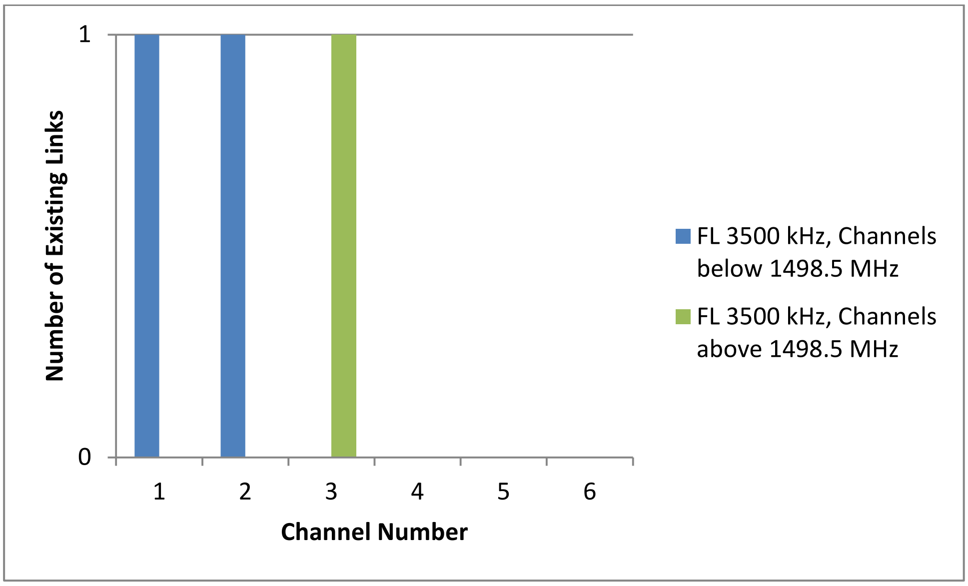


Figure 116: Number of existing FLs below and above 1498.5 MHz, CS 3500 kHz

8.2.4 Conclusion on the border above which coordination is not required

It is proposed to adopt 1498.5 – 1517 MHz as the frequency range for deployment of FL without coordination beyond site clearance with SDL BS operating below 1492 MHz. The frequency range ensures that, for each FL CS, at least 75% of all channels are available for deployment without coordination.

The frequency range 1492-1498.5 MHz is currently by far the more densely used portion of the band, which ensures that:

- Channels above 1498.5 MHz are the most available,
- Significant FL operation will be maintained below 1498.5 MHz even without coordination (since SDL BS will protect existing FLs).

8.3 Filtering requirements for SDL BS and FL Rx

The filtering requirements are derived to satisfy the coexistence criteria set in Section 8.1.

8.3.1 SDL BS filtering requirement

8.3.1.1 Interference criteria for SDL BS emission in FL Rx band

The noise levels for all FL types, as provided in OfW 446, and the corresponding interference levels, are provided in the Table below.

Radio System Type (kbit/s in kHz)	System BW[9] (MHz)	N (dBW)	N (dBm/MHz)	$I_{Single\_interferer}$ (dBm/MHz)	$I_{Single\_interferer – LTE\_OOBE}$ (dBm/MHz)
32 in 25	0.024	-147.5	-101.3	-113.3	-116.3
64 in 25	0.024	-149.6	-103.4	-115.4	-118.4
96 in 75	0.072	-136.5	-95.1	-107.1	-110.1
192 in 75	0.072	-145.6	-104.2	-116.2	-119.2
256 in 250	0.22	-141.5	-104.9	-116.9	-120.0
512 in 250	0.22	-139.6	-103.0	-115.0	-118.1
512 in 500	0.42	-139.5	-105.7	-117.8	-120.8
704 in 500	0.42	-135.5	-101.7	-113.8	-116.8
1024 in 500	0.42	-137.6	-103.8	-115.9	-118.9
2048 in 500	0.42	-134.6	-100.8	-112.9	-115.9
1024 in 1000	0.84	-136.5	-105.7	-117.8	-120.8
2048 in 1000	0.84	-134.6	-103.8	-115.9	-118.9
2048 in 2000	1.68	-133.5	-105.8	-117.8	-120.8
4096 in 2000	1.68	-131.6	-103.9	-115.9	-118.9
4500 in 3500	3	-130.5	-105.3	-117.3	-120.3
9100 in 3500	3	-131.6	-106.4	-118.4	-121.4

Table 27: Interference criteria for each FL Radio System Type

In the study, the target interference level for in band interference from a single interferer will be the minimum over all systems (worst case assumption) corresponding to

$$I_{Single\_interferer – LTE\_OOBE} = -121.4 \text{ dBm/MHz}$$

8.3.1.2 SDL BS maximum EIRP in FL Rx band

[9] System Bandwidth for a specific Channel Spacing is provided in Annex A.3.2 of [11] (See also Section 19).

The maximum EIRP from an SDL BS in the FL Rx band is derived according to the equation below:

$$EIRP_{BS-above\ 1498.5} = I_{Single\_interferer-LTE\_OOBE} - \text{Reference FL Rx Antenna Gain} + \text{Pathloss}$$
$$= -121.4 - 17 + 75.9$$
$$= -62.5\ \text{dBm/MHz}$$

8.3.1.3 SDL BS OOBE mask

The SDL BS OOBE mask is provided by the OOBE mask of ECC Decision ECC DEC/13)03 with an additional step at 1498.5 MHz which will require an additional 42.5 dB filtering.

Frequency range of out-of-band emissions	Maximum mean out-of-band e.i.r.p. (dBm)	Measurement bandwidth (MHz)
1492 - 1495 MHz	14	3
1495 – 1498.5 MHz	-20	1
1498.5 – 1517 MHz	-62.5	1

Table 28: Proposed SDL BS OOBE mask

8.3.2 FL Rx filtering requirement

FL candidate for deployment without coordination with SDL BS will need to adopt sufficient selectivity in the Rx to ensure that blocking does not become the dominant interference mechanism.

8.3.2.1 Interference criteria for FL Rx filtering SDL BS in band

The noise levels for all FL types, as provided in OfW 446, and the corresponding interference levels, are provided in the Table below.

Radio System Type (kbit/s in kHz)	N (dBW)	N (dBm)	$I_{Single\_interferer-FL\ selectivity}$ (dBm)
32 in 25	-147.5	-117.5	-132.5
64 in 25	-149.6	-119.6	-134.6
96 in 75	-136.5	-106.5	-121.5
192 in 75	-145.6	-115.6	-130.6
256 in 250	-141.5	-111.5	-126.5
512 in 250	-139.6	-109.6	-124.6
512 in 500	-139.5	-109.5	-124.5
704 in 500	-135.5	-105.5	-120.5
1024 in 500	-137.6	-107.6	-122.6
2048 in 500	-134.6	-104.6	-119.6
1024 in 1000	-136.5	-106.5	-121.5
2048 in 1000	-134.6	-104.6	-119.6
2048 in 2000	-133.5	-103.5	-118.5
4096 in 2000	-131.6	-101.6	-116.6
4500 in 3500	-130.5	-100.5	-115.5
9100 in 3500	-131.6	-101.6	-116.6

Table 29: Maximum interference level for each FL Radio System Type

8.3.2.2 FL Rx filtering requirement

QUALCOMM

The SDL BS in band EIRP is set to 68 dBm/5 MHz, corresponding to 77 dBm/40 MHz.

The total interference due to SDL BS in band power in 1452-1492 MHz should remain below $I_{Single\_interferer-\ FL\ Selectivity}$ threshold provided in the previous section. The equation below provides the relationship between filtering requirement, SDL BS in band EIRP, FL Rx Antenna Gain and Pathloss:

$$\text{FL Rx Filtering} = \text{SDL EIRP} - I_{Single\_interferer-\ FL\_Selectivity} + \text{Reference FL Rx Antenna Gain} - \text{Pathloss}$$

$$= 77 + 17 - 75.9 - I_{Single\_interferer-\ FL\_Selectivity}$$
$$= 18.1 - I_{Single\_interferer-\ FL\_Selectiviy}\ (\text{dB})$$

The FL Rx filtering requirement is provided in the table below.

Radio System Type (kbit/s in kHz)	$I_{Single\_interferer-\ FL\ selectivity}$ (dBm)	FL Rx filtering requirement over 1452 - 1492 MHz (dB)
32 in 25	-132.5	150.6
64 in 25	-134.6	152.7
96 in 75	-121.5	139.6
192 in 75	-130.6	148.7
256 in 250	-126.5	144.6
512 in 250	-124.6	142.7
512 in 500	-124.5	142.6
704 in 500	-120.5	138.6
1024 in 500	-122.6	140.7
2048 in 500	-119.6	137.7
1024 in 1000	-121.5	139.6
2048 in 1000	-119.6	137.7
2048 in 2000	-118.5	136.6
4096 in 2000	-116.6	134.7
4500 in 3500	-115.5	133.6
9100 in 3500	-116.6	134.7

Table 30: Future FL filtering requirement for each for each FL Radio System Type

8.4 Minimum coexistence distance and FL antenna gain

The FL user will be required to check that there is LOS clearance with no BS within a coexistence distance (m) in the main beam of an FL Rx when installing a new FL. This is consistent with the current FL deployment approach when FL users check LOS / Fresnel zone clearance. This coexistence distance corresponds to 100 m reference distance for a 17 dBi FL antenna. The coexistence distance between an FL Rx antenna in the main beam and an SDL BS antenna can determined according to the equation below:

$$D_{Separation} = 1000\text{*SQRT(}10\text{\^{}((}G_{FL\_Rx}-37)/10))$$

8.4.1 Coexistence/clearance distance for all antennas

The coexistence/clearance distance for the all FL antennas can be determined as follows:

Antenna type	Antenna gain	Coexistence/clearance
A/01/O/06/005/JB	14	71
A/01/O/95/030/EU	14.3	74
A/01/H/00/095/SK	16	90
A/01/O/96/046/JB	16	90
A/01/O/97/034/JB	16	90
A/01/O/97/059/EU	16.6	96
A/01/O/97/035/JB	16.7	97
A/01/O/97/058/EU	17	100
A/1G5/O/83/009/JB	17	100
Reference Antenna	**17**	**100**
A/01/S/04/001/RF	17.3	104
A/01/O/08/021/GA	19	126
A/01/H/05/011/RF	20	142
A/01/S/04/043/RF	20	142
A/01/H/11/030/GR	22.1	180
A/01/H/97/032/AA	22.3	184
A/01/H/05/007/RF	22.5	189
A/01/H/10/002/GA	22.6	191
A/01/H/98/001/AA	22.9	198
A/01/H/06/070/RF	23.7	217
A/01/S/05/014/MR	25.1	254
A/01/H/09/014/RF	25.7	272
A/01/H/97/033/AA	25.8	276
A/01/H/98/002/DT	26.2	289
A/01/H/96/051/AA	28.7	385

Table 31: Coexistence/clearance distance for each antenna type

8.4.2 Coexistence/clearance distance in the side lobe

Equation (1) is also valid to derive the coexistence/clearance distance required for the side lobe of an FL Rx antenna.

For illustration purposes, the reference antenna in the studies had a 17 dBi gain in the main beam and a -8 dBi gain in the side lobe, see Figure 126.

Following (1), an FL with a -8 dBi antenna gain will coexist with an SDL BS located more than 6 m away. An antenna gain of 0 dBi would correspond to a required separation distance of 15m.

As a conclusion, it is clear that coexistence in the side lobe will be ensured unless the FL is deployed in immediate proximity of (a few meters away from) the SDL BS.

8.5 Conclusion for compatibility with future FLs

8.5.1 Frequency range for new FL deployment without coordination

FL Channels within 1498.5-1517 MHz identified in the Table below will be channels where future FLs can be deployed without coordination, beyond site clearance, with SDL BS operating below 1492 MHz.

FL CS (kHz)	Channels for deployment without coordination
25	241-960
75	81-320
250	25-96
500	13-48
1000	7-24
2000	4-12
3500	3-6

Table 32: Channels available for deployment without coordination

8.5.2 SDL OOBE mask

SDL BS deployed in 1452-1492 MHz will be restricted to the following maximum mean out-of-band e.i.r.p. above 1492 MHz

Frequency range of out-of-band emissions	Maximum mean out-of-band e.i.r.p. (dBm)	Measurement Bandwidth (MHz)
1492-1495 MHz	14	3
1495 – 1498.5 MHz	-20	1
1498.5 – 1517 MHz	-62.5	1

Table 33: Proposed SDL OOBE mask

8.5.3 Future FLs filtering requirement

Future FLs deployed in the channels identified in Section 8.5.1 will have to provide the following minimum Rx filtering of signals in 1452-1492 MHz. The corresponding filtering requirements are:

Radio System Type (kbit/s in kHz)	FL Rx filtering requirement over 1452 - 1492 MHz (dB)
32 in 25	150.6
64 in 25	152.7
96 in 75	139.6
192 in 75	148.7
256 in 250	144.6
512 in 250	142.7
512 in 500	142.6
704 in 500	138.6
1024 in 500	140.7
2048 in 500	137.7
1024 in 1000	139.6
2048 in 1000	137.7
2048 in 2000	136.6
4096 in 2000	134.7
4500 in 3500	133.6
9100 in 3500	134.7

Table 34: Future FL filtering requirement for each for each FL Radio System Type

8.5.4 Coexistence/clearance distance

FL users will be required to ensure that there is no BS within $D_{clearance}$ in the main beam of the FL Rx when installing a new FL. This is consistent with the current FL deployment approach when FL users check LOS / Fresnel zone clearance between the FL Tx and Rx. This distance is 100 m for the reference antenna of 17 dBi.

The coexistence/clearance distance between an FL Rx antenna main-beam and an SDL BS antenna can be determined according to the equation below:

$$D_{clearance} = 1000*SQRT(10\text{^}((G_{FL\_Rx}-37)/10))$$

The derived coexistence/clearance distance for the following antennas are:

Antenna Type	Antenna Gain	Coexistence/Clearance distance
A/01/O/06/005/JB	14	71
A/01/O/95/030/EU	14.3	74
A/01/H/00/095/SK	16	90
A/01/O/96/046/JB	16	90
A/01/O/97/034/JB	16	90
A/01/O/97/059/EU	16.6	96
A/01/O/97/035/JB	16.7	97
A/01/O/97/058/EU	17	100
A/1G5/O/83/009/JB	17	100
Reference Antenna	**17**	**100**
A/01/S/04/001/RF	17.3	104
A/01/O/08/021/GA	19	126
A/01/H/05/011/RF	20	142
A/01/S/04/043/RF	20	142
A/01/H/11/030/GR	22.1	180
A/01/H/97/032/AA	22.3	184
A/01/H/05/007/RF	22.5	189
A/01/H/10/002/GA	22.6	191
A/01/H/98/001/AA	22.9	198
A/01/H/06/070/RF	23.7	217
A/01/S/05/014/MR	25.1	254
A/01/H/09/014/RF	25.7	272
A/01/H/97/033/AA	25.8	276
A/01/H/98/002/DT	26.2	289
A/01/H/96/051/AA	28.7	385

Table 35: Coexistence/clearance distance for each antenna type

9. CONCLUSION

In the UK, 851 FLs operate in the 1492.5-1517 MHz spectrum band. A continuing requirement of the 1.4GHz band for future fixed links was indicated in an independent study conducted for Ofcom [10]. This comprehensive study aimed to assess any interference issue into FLs which may arise from the use of 1452-1492 MHz for SDL according to the varied License technical terms and to determine and recommend solutions which can ensure compatibility between SDL and existing and future FLs.

The 851 Fixed Links in the Ofcom's database were scrutinised and their technical characteristics, their distribution per carrier spacing and their distribution in urban, suburban and rural environments were determined.

A Minimum Coupling Loss (MCL) analysis between an SDL LTE BS operating in 1472-1492 MHz and FLs deployed above 1492.5 MHz was carried out; conservative assumptions have been used for both SDL transmitters and FLs receivers in order not to underestimate the risk of interference. In some cases, the MCL analysis showed that the interference from SDL into FLs would not exceed an I/N of -12 dB. In some other cases, the level of interference would exceed this limit. The MCL analysis further demonstrated that even under worst cases, filtering at the SDL transmitter and/or the FL receiver decreases the interference to levels that are well below an I/N of -12 dB and adequately mitigate any interference issue which may arise in real life deployment. Work with two filter vendors showed that such SDL Tx and FLs Rx filters are feasible, available and also practical to install. The conclusion of the MCL analysis was that compatibility between SDL deployment in 1452-1492 MHz and FLs operating above 1492.5 MHz can be achieved in all environments, for all FL channels and for all FLs carrier spacing based on sound engineering practices and through available and well proven filtering techniques.

Simulations that reflect more closely real life SDL deployment both in urban and rural areas were then carried out with the aim to determine more precisely the interference levels and the scale of implementation of any mitigation techniques.

The Atoll Wireless Network Engineering Software was used to simulate a typical LTE SDL network covering the London area, where the density of FLs is the highest with 23 FLs currently in operation. The location of the SDL BSs, their transmit power as well as their antenna pointing closely mirror a typical SDL network. More than 2600 fully loaded SDL BSs were modelled. The exact location, antenna height and antenna azimuth of all 23 FLs were used. This simulation showed that the interference levels do not exceed the noise floor at all 23 FLs; only 3 FLs, out of 23 FLs, would require special attention from the SDL operator when engineering its network as those FLs are the most sensitive with interference levels below the noise floor, but within 12 dB of the noise floor. Implementing, if needed, Tx filtering in the few key base stations surrounding these 3 FLs would be sufficient to ensure that the interference remains below an I/N of -12 dB. The conclusion derived from this simulation is that an SDL operator is able, based on the information available in Ofcom's FL database, to engineer and deploy a fully loaded SDL network in 1452-1492 MHz in full compatibility with all FLs currently in operation above 1492.5 MHz in urban areas using standard and sound engineering practices and if required in some limited cases Tx filtering.

An analysis of how an SDL operator can plan its network in 1452-1492 MHz and roll it out in compatibility with the FLs deployed in rural areas was then performed. Two use cases based on actual and operational FLs were selected to illustrate such an approach. The former corresponded to a challenging scenario where the FL operates at a low number channel (channel 2) and is located near and in parallel to a motorway (M74) which would require coverage from an SDL BS. The latter is a typical use case where the FL is deployed about 50 km west of Middlesborough. The analysis led to the conclusion that for the vast majority of FL channels, the geographical area where an SDL operator would have to assess interference risks before deploying base stations are so small, that they would have a negligible impact on network planning and deployment. For the few extremely challenging cases, the zones where the SDL operator should pay special attention may be large. However, simple techniques such as antenna downtilt could by themselves solve most interference challenges. Should antenna downtilt not be sufficient, filtering provides a solution that solves in practice all potential interference problems.

The last phase of the study consisted in determining the conditions to ensure compatibility between SDL BSs deployed in 1452-1492 MHz and future FLs to be deployed above 1492.5 MHz taking into account that FLs assignment process by Ofcom within 1492.5-1517 MHz is automated and FL users' current planning methods are based on ensuring Line of Sight (LOS) / Fresnel zone clearance between the FL Tx and Rx. The conclusions were that compatibility between SDL and future FLs can be ensured without coordination if Ofcom were to assign new FLs within the 1498.5 – 1517 MHz range, the SDL OOBE mask introduces a 42.5 dB of additional SDL filtering above 1498.5 MHz, new FLs receivers meet appropriate Rx filtering and new FLs users ensure LOS clearance between the transmitter and receiver when installing a new FL.

This extensive compatibility study shows that SDL deployment in 1452-1492 MHz is compatible with existing and future FLs deployment above 1492.5 MHz, when adopting the varied SDL technical conditions summarized in Annex 1 and implementing sound and standard network planning and engineering practices.

10. REFERENCES

[1] Ofcom OfW446, *Technical Frequency Assignment Criteria for Fixed Point-to-Point Radio Services with Digital Modulation*, version 5.1, August 2012.

[2] 3GPP TS 37.104 V11.5.0 (2013-07), "*3rd Generation Partnership Project; Technical Specification Group Radio Access Network; E-UTRA, UTRA and GSM/EDGE; Multi-Standard Radio (MSR) Base Station (BS) radio transmission and reception (Release 11)*"

[3] ECC Decision (13)03, "*The harmonized use of the frequency band 1452-1492MHz for Mobile/Fixed Communications Networks Supplemental Downlink (MFCN SD*L)" Approved 8 November 2013.

[4] ETSI TR 101 854 V.3.1 (2005-01)"*Fixed Radio Systems; Point-to-point equipment; Derivation of receiver interference parameters useful for planning fixed service point-to-point systems operating different equipment classes and/or capacities*"

[5] "*Optimizing Radio Performance for Hostile Environments" Moseley Associates Inc.* http://moseleysb.com/mb/OptPerf1.html

[6] "*Hitless Space Diversity STL Enables IP+Audio in Narrow STL Bands*" presented at the 2005National Association of Broadcasters Annual Convention Broadcast Engineering Conference Sessions "HS Radio™ Technology" April 17, 2005. Moseley Associates Inc. http://www.moseleysb.com/mb/whitepapers/friedenberg.pdf

[7] Ofcom Technical Report, "*Technical analysis of interference from mobile network base stations in the 800 MHz band to digital terrestrial television - Further modelling*", OFCOM Technical Report, 23 February 2012

[8] ITU-R-P.452-14 "*Predicting procedure for the evaluation of interference between stations on the surface of the Earth at frequencies above about 0.1GHz*"

[9] Recommendation ITU-R P.1546-4 (10/2009) "*Method for point-to-area predictions for terrestrial services in the frequency range of 30MHz to 3000MHz*"

[10] "*Frequency Band Review for Fixed Wireless Service*", 2315/FLBR/FRP/3, 29th November 2011, Aegis spectrum engineering, Ovum consulting, DB Spectrum Service Ltd, http://stakeholders.ofcom.org.uk/binaries/consultations/spectrum-review/annexes/report.pdf

[11] "*Fixed Radio Systems; Characteristics and requirements for point-to-point equipment and antennas; Part 2-2: Digital systems operating in frequency bands where frequency co-ordination is applied; Harmonized EN covering the essential requirements of article 3.2 of the R&TTE Directive*", ETSI EN 302 217-2-2.

11. ACRONYMS

BS	Base Station
CEPT	European Conference of Postal and Telecommunications Administrations
CS	Carrier Spacing
ECC	Electronic Communications Committee
EIRP	Equivalent Isotropically Radiated Power
FL	Fixed Link
Hi-Perf	High Performance
IM	Intermodulation
LOS	Line Of Sight
LTE	Long Term Evolution
MCL	Minimum Coupling Loss
NFD	Net Filter Discrimination
OOBE	Out-of-Band Emission
PFD	Power Flux Density
RSSI	Received Signal Strength Indicator
Rx	Receiver
SDL	Supplemental Downlink
SPM	Standard Propagation Model
T-DAB	Terrestrial Digital Audio Broadcasting
Tx	Transmitter
UMTS	Universal Mobile Telecommunications System
UK	United Kingdom

12. ANNEX 1: VARIED LICENSE SDL TECHNICAL CONDITIONS

Based on the compatibility study developed in this Report between SDL in 1452-1492 MHz and existing and future FLs above 1492.5 MHz, the varied license SDL technical conditions would be as follows:

12.1 Max EIRP

The maximum SDL Base Station EIRP in 1452-1492 MHz is 68 dBm/5 MHz.

12.2 Block Edge Mask

The SDL Base Station out-of-block EIRP limits within the band 1452-1492 MHz per antenna are set as follows in line with ECC Decision (13)03:

Frequency range of out-of-block emissions	Maximum mean out-of-band e.i.r.p. (dBm)	Measurement Bandwidth (MHz)
−10 to −5 MHz from lower block edge	11 dBm	5 MHz
−5 to 0 MHz from lower block edge	16.3 dBm	5 MHz
0 to +5 MHz from upper block edge	16.3 dBm	5 MHz
+5 to +10 MHz from upper block edge	11 dBm	5 MHz
Remaining MFCN SDL frequencies	9 dBm	5 MHz

Table 36: SDL Base Station out-of-block EIRP limits within the band 1452-1492 MHz

12.3 Maximum Out-of-Band EIRP

The maximum mean out-of-band EIRP for SDL Base Stations operating in 1452-1492 MHz is restricted to the following limits:

Frequency range of out-of-band emissions	Maximum mean out-of-band e.i.r.p. (dBm)	Measurement Bandwidth (MHz)
Below 1449 MHz	-20	1
1449-1452 MHz	14	3
1492-1495 MHz	14	3
1495 – 1498.5 MHz	-20	1
1498.5 – 1517 MHz	-62.5	1

Table 37: Maximum mean out-of-band EIRP for SDL Base Stations operating in 1452-1492 MHz

12.4 Band plan

The Band Plan for the 1452-1492 MHz is in accordance with the harmonised frequency arrangement of ECC Decision (13)03 with the transmission limited to Base Station (Downlink):

1452 - 1457	1457-1462	1462-1467	1467-1472	1472-1477	1477-1482	1482-1487	1487-1492
Downlink (base station transmit)							
40 MHz (8 blocks of 5 MHz)							

Figure 117: Band plan for the 1452-1492 MHz

13. ANNEX 2: SDL OUT-OF-BAND EIRP

Out-of-Band Emissions (OOBEs) are a potential source of interference. OOBEs are unwanted energy created by all transmitters, falling outside the transmitter's desired channel. The OOBEs of interest are the emissions that fall into a nearby receiver's channel. Since this energy falls into the receiver's channel, the receiver cannot reject this energy with an RF filter. Figure 118 shows the OOBE energy created in the transmitter radiated and received by the receiver. In this study, the scenario of interest is the OOBEs created in the LTE transmitter, falling into the FL receiver.

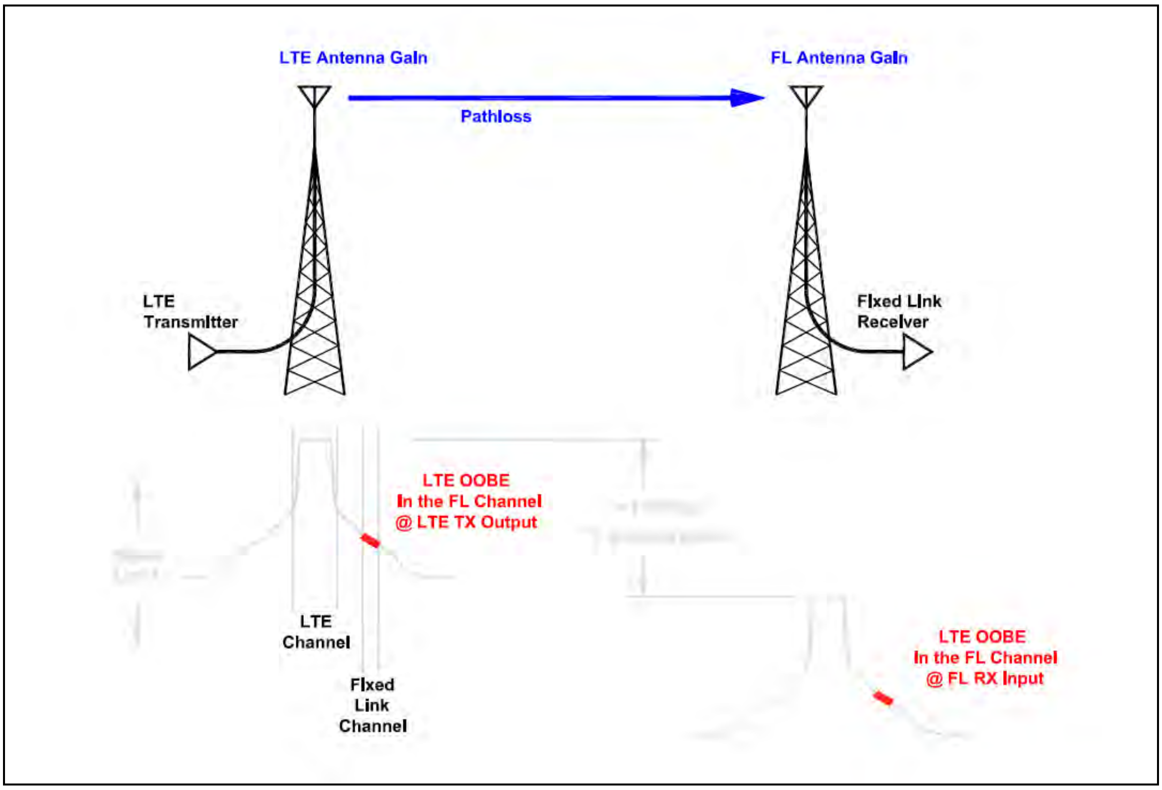


Figure 118 : OOBE Description

Since all transmitters generate OOBEs, maximum levels are defined by standards specifications and regulatory decisions. The OOBEs from a LTE transmitter operating in the 1452-1492 MHz band is subject to the requirements from two references. First the OOBEs must comply with the 3GPP standard requirements, as specified in 3GPP TS 37.104, paragraph 6.6.2 "Operating Band Unwanted Emissions". Second are requirements defined in the ECC Decision (13)03 for SDL use in this band. The relevant requirements from each are shown in the tables below:

Frequency offset of measurement filter -3dB point, Δf	Frequency offset of measurement filter centre frequency, f_offset	Minimum requirement (Note 1, Note 2)	Measurement bandwidth (Note 4)
0 MHz ≤ Δf < 0.2 MHz	0.015MHz ≤ f_offset < 0.215MHz	-14 dBm	30 kHz
0.2 MHz ≤ Δf < 1 MHz	0.215MHz ≤ f_offset < 1.015MHz	$-14dBm-15\cdot\left(\frac{f\_offset}{MHz}-0.215\right)dB$	30 kHz
(Note 3)	1.015MHz ≤ f_offset < 1.5 MHz	-26 dBm	30 kHz
1 MHz ≤ Δf ≤ min(Δf_{max}, 10 MHz)	1.5 MHz ≤ f_offset < min(f_offset_{max}, 10.5 MHz)	-13 dBm	1 MHz
10 MHz ≤ Δf ≤ Δf_{max}	10.5 MHz ≤ f_offset < f_offset_{max}	-15 dBm (Note 5)	1 MHz
NOTE 1: For MSR BS supporting non-contiguous spectrum operation within any operating band the minimum requirement within sub-block gaps is calculated as a cumulative sum of contributions from adjacent sub-blocks on each side of the sub-block gap. Exception is Δf ≥ 10MHz from both adjacent sub-blocks on each side of the sub-block gap, where the minimum requirement within sub-block gaps shall be -15dBm/MHz. NOTE2: For MSR BS supporting multi-band operation with inter RF bandwidth gap < 20MHz the minimum requirement within the inter RF bandwidth gaps is calculated as a cumulative sum of contributions from adjacent sub-blocks on each side of the inter RF bandwidth gap.			

Table 38: OOBE Requirements from 3GPP TS 37.104

Frequency range of out-of-band emissions	Maximum mean out-of-band e.i.r.p. [dBm]	Measurement Bandwidth [MHz]
Below 1449 MHz	-20 dBm	1 MHz
1449-1452 MHz	14 dBm	3 MHz
1492-1495 MHz	14 dBm	3 MHz
Above 1495 MHz	-20 dBm	1 MHz

Table 39 : OOBE Requirements from ECC Decision (13)03

The OOBE model used in this study is composed of three elements;

1-3GPP 37.104 emission mask for the 3 MHz adjacent to the band edge (1492.0-1495.0 MHz).
2-ECC Decision from 1495.0 MHz to 1497.0 MHz.
3-Decay of 1.0 dB/MHz beyond 1497.0 MHz.

The reasoning for this is that the ECC Decision integrated the power in the entire 3 MHz. The 3GPP 37.104 requirement is aligned with the ECC Decision, but provides better resolution which is important when studying FLs with smaller bandwidths. Beyond 1497.0 MHz, emissions naturally decay. Analysis of the actual LTE OOBE of commercial base station indicate that such decay can be large (much larger than 1 dB/MHz), but that it is difficult to identify a single value as representative. The selection of 1 dB/MHz provides two benefits:

- It is conservative, and therefore corresponds to 'worst case assumption' for the analysis,
- It is aligned with the assumption adopted by OFCOM in previous studies[10].

[10] OFCOM has conducted investigations on the LTE OOBE in the context of the studies to investigate the impact of interference from future mobile/fixed communication network (MFCN) base stations (BSs) in the 800 MHz band (791-872 MHz) to digital terrestrial television (DTT) services below 790 MHz. OFCOM states in [7]:

5.21 In practice, the MFCN base station emission levels naturally reduce with increasing frequency separation from the base station carrier. Evidence suggests that a spectral gradient of around 11 dB per 8 MHz is a reasonable model for this spectral roll-off. In the final stages of the SE42 deliberations, Ofcom proposed that such a roll-off be included in the EC Decision block-edge mask.

The OOBE mask used in the analysis is graphically represented in the figure below:

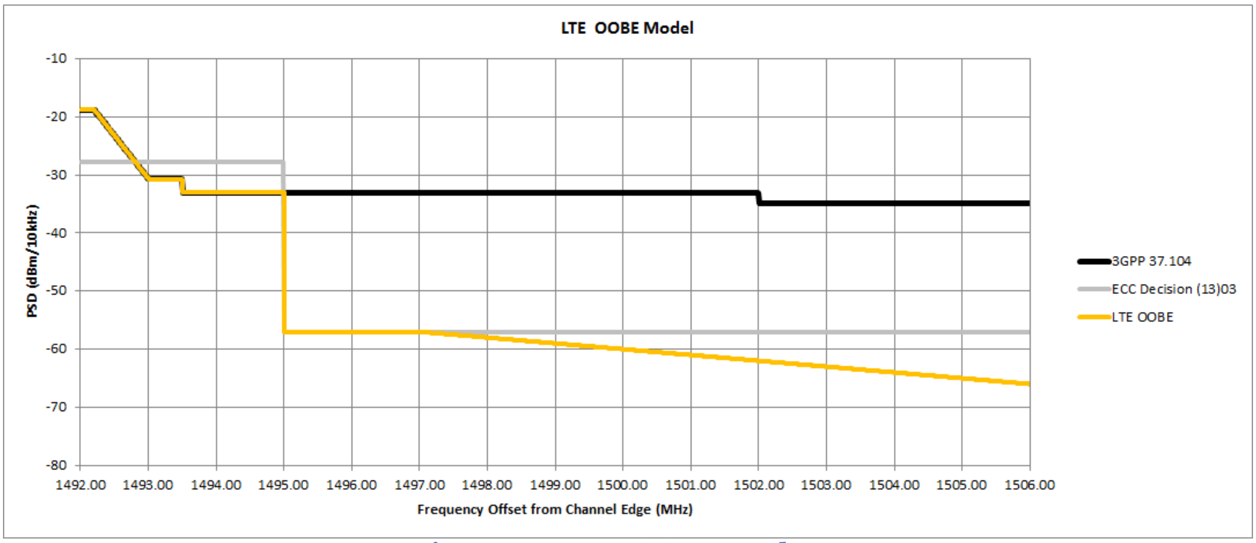


Figure 119: LTE OOBE mask

Note, as mentioned above, that actual OOBEs are typically better than the proposed model. FCC Type Acceptance reports provide data on emissions close to the LTE channel.

The figures below show a 20 MHz LTE carrier and emissions for a 100 W (Ericsson) and a 20 W (Huawei) transmitter operating in the 3GPP Band 1 at 2 GHz. Although the frequency is different, the behaviour will be similar for the 1.5 GHz band. Note that in the figures below, the noise floor is that of the measurement system (not the emissions of the transmitter).

This proposal was considered to be reasonable by the SE42 team, but was ultimately not adopted due to the tight deadlines.

5.22 We have used a roll-off of 10 dB/(8 MHz) in all our previous modeling (first presented to stakeholders in April 2010). Absent evidence to the contrary, we intend to continue using the said roll-off in our further modeling.

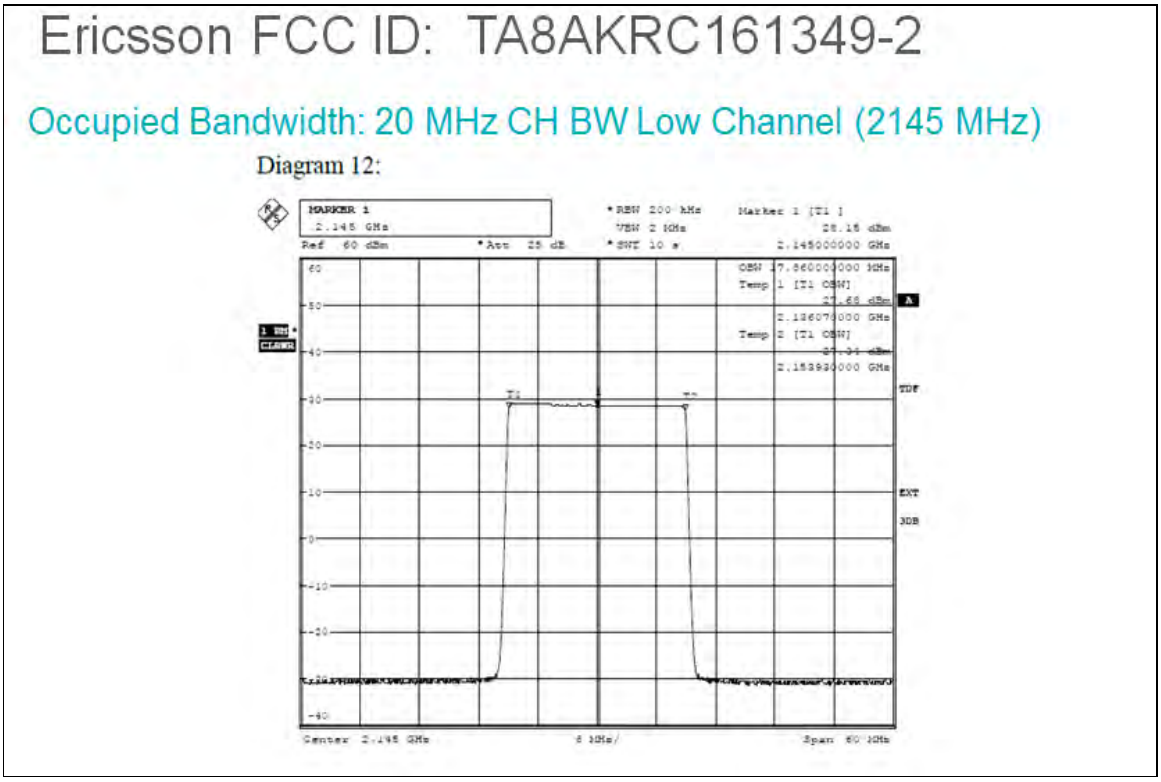


Figure 120: OOBE of 100 W Ericsson transmitter

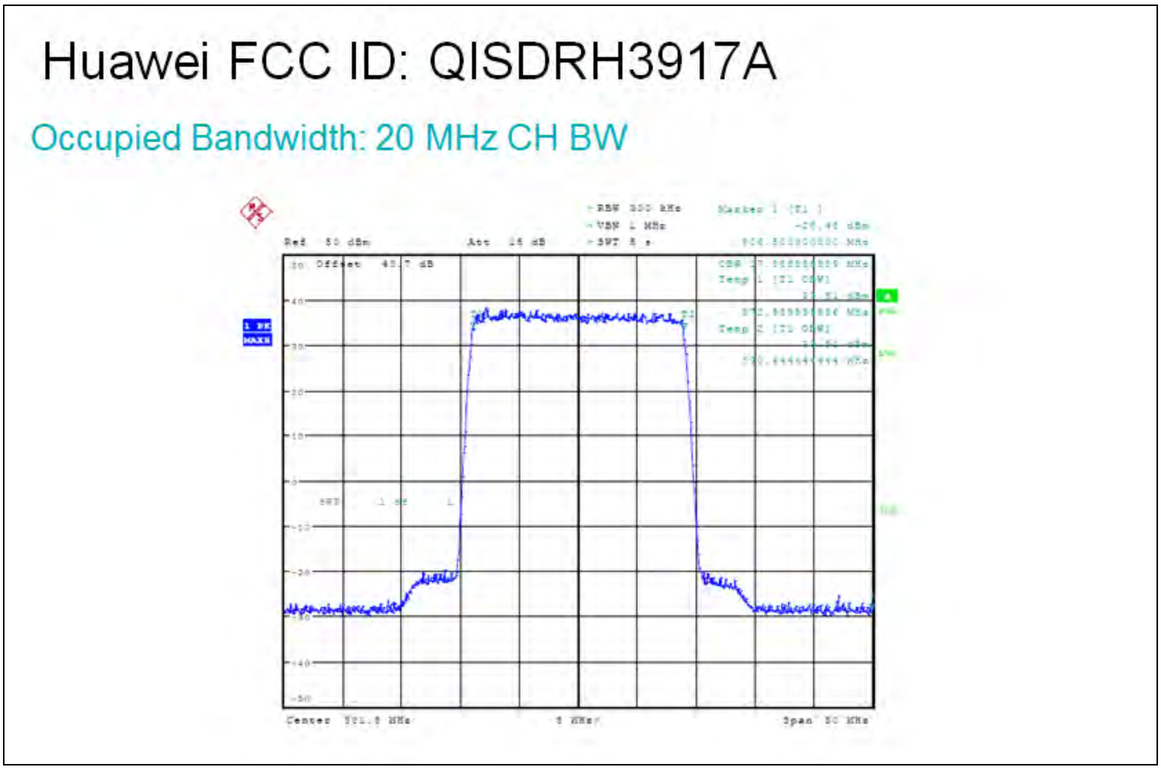


Figure 121: OOBE of 20 W Huawei transmitter

The figure below compares these actual 20 MHz LTE masks to the OOBE model used in the analysis. In this figure, the Power Spectral Density (PSD) of the OOBEs from the Huawei product (Figure 121, RBW of 200kHz) and the Ericsson product (Figure 120, RBW of 200kHz) are converter to dBm/10kHz, to be consistence with the OOBE model used. The absolute carrier powers (provided in the referenced reports) was used to properly set the carrier power (i.e. carrier PSD) to ensure the offset levels of the OOBE were at the correct level.

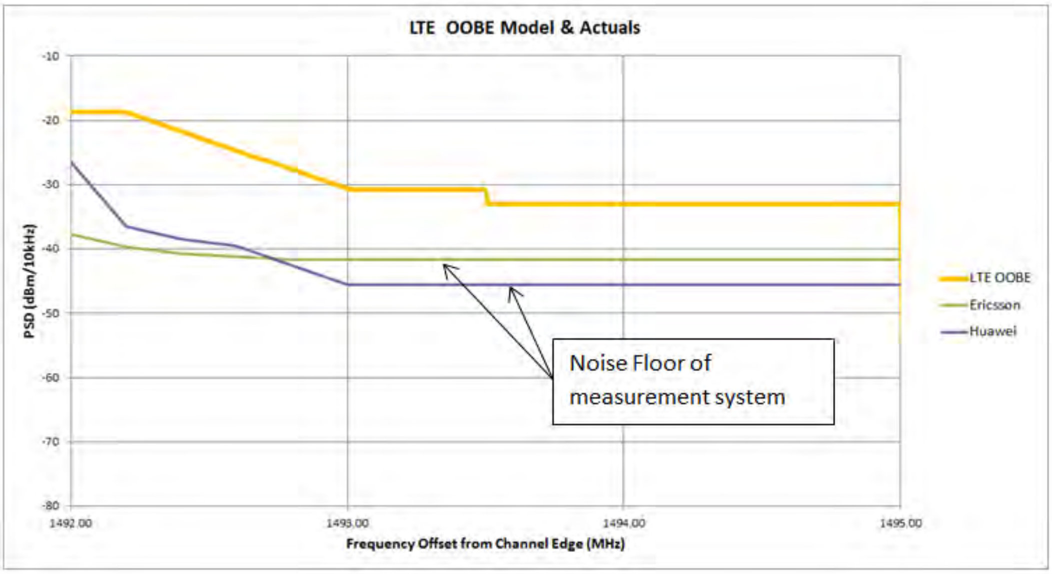


Figure 122: Comparison between actual 20 MHz LTE OOBEs and LTE SDL OOBE model

Details of the actual measurements are provided hereafter.

- Ericsson Product Details
  - Product Name: RRUS 12 B4
  - Product Number: KRC 161 349/2
  - FCC ID: TA8AKRC161349-2
  - Band support evaluated: 3GPP Band 4 (DL=2110 to 2155 MHz)
- Link to test reports:
  - https://apps.fcc.gov/oetcf/eas/reports/ViewExhibitReport.cfm?mode=Exhibits&RequestTimeout=500&calledFromFrame=N&application_id=157969&fcc_id=TA8AKRC161349-2
- Conducted Transmit power for testing: 50.8 dBm (100W)
- Test modes from 3GPP 36.141 used for testing
- Occupied BW and Band edge Test data was from single TX MIMO configuration

- Huawei Product Details
  - Product Name: Distributed Remote Head
  - Product Number: DRH3917A
  - FCC ID: QISDRH3917A
  - Band support evaluated:
    - 3GPP Band 4 (DL=2110 to 2155 MHz): NOTE TEST REPORT SHOWS B5 PLOTS…PLOTS MUST BE FROM A B5 SYSTEM ON ACCIDENT
    - 3Link to test reports:
  - https://apps.fcc.gov/oetcf/eas/reports/ViewExhibitReport.cfm?mode=Exhibits&RequestTimeout=500&calledFromFrame=N&application_id=475795&fcc_id=QISDRH3917A
- Conducted Transmit power for testing: 43 dBm (20W)
- Test modes from 3GPP 36.141 used

14. ANNEX 3: SDL ANTENNA MODEL

SDL antennas gain is 17 dBi, the half-power beam 6° vertical and 70° horizontal. Downtilt will be applied per geotype. The antenna diagram used in the study is provided in Figure 123.

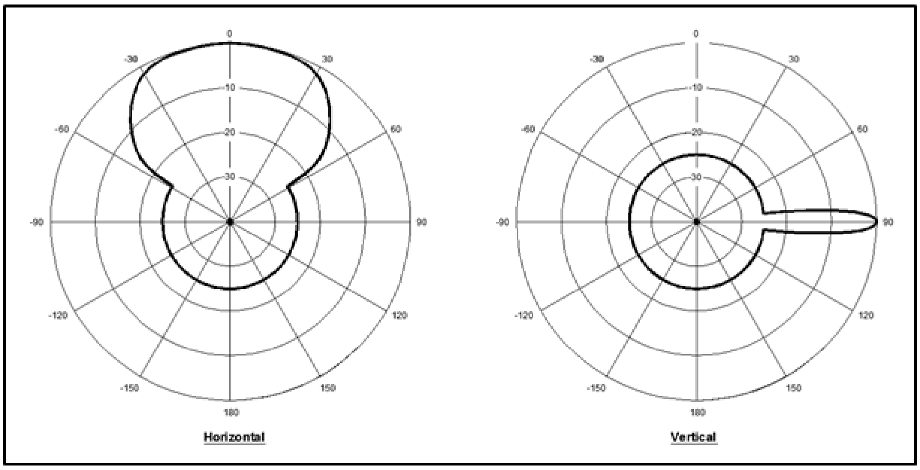


Figure 123: SDL antenna diagram

The SDL antenna model and a real SDL antenna pattern for the Dengyo AAwq7-141WSNDK at 1452-1492 MHz are compared in Figure 124.

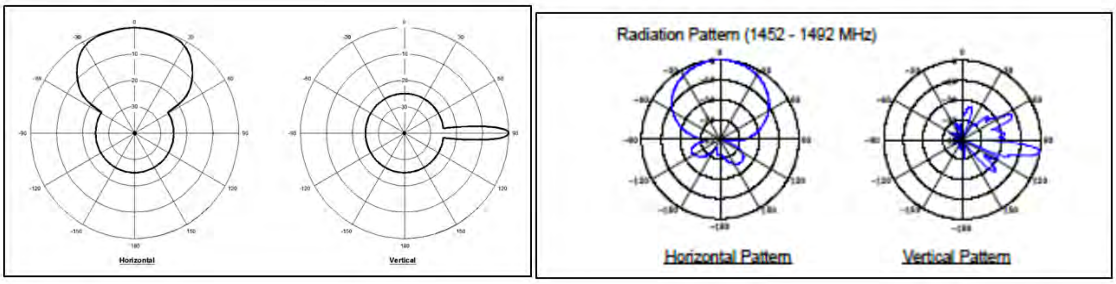


Figure 124: SDL antenna model and real antenna pattern

Figure 125 shows the SDL antenna pattern for the Dengyo AAwq7-141WSNDK at 1452-1492 MHz (Blue trace), overlaid with points from the SDL antenna model used in this study (red markers); the model downtilt was adjusted to match the Dengyo antenna.

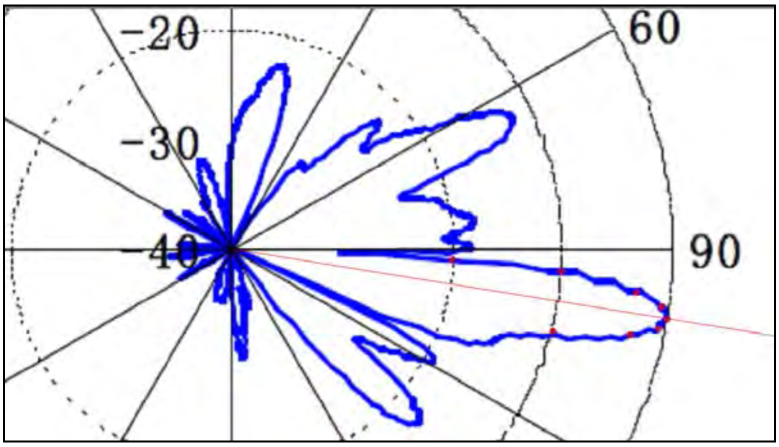


Figure 125: Simulated diagram

15. ANNEX 4: FL ANTENNA MODEL

15.1 FL antenna model for the MCL analysis

FL antenna diagrams, both modelled and real SkyMasts 744.02, are provided in the figures below:

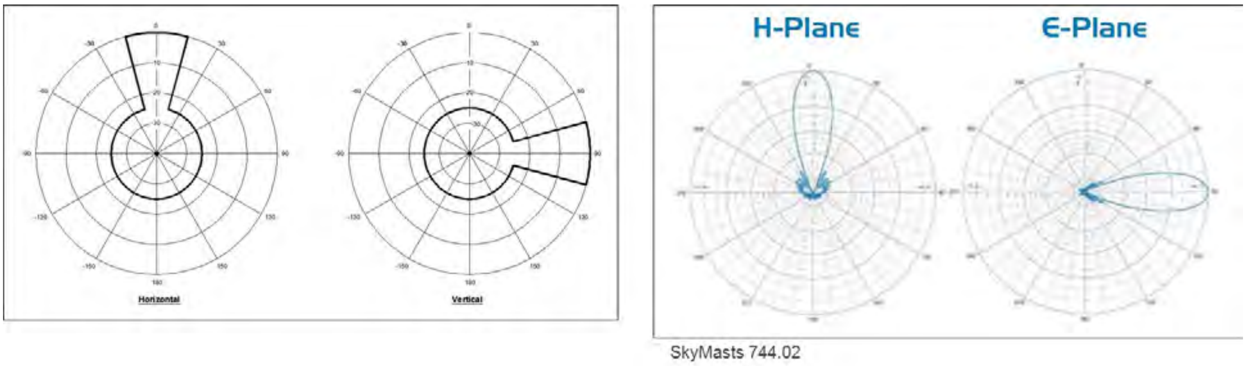


Figure 126: FL antenna pattern

15.2 FL antenna MCL sensitivity analysis

The model we used in the analysis is based on the SkyMast 744.02. Both the SkyMast 744.02 and 726.02 are included in the FL database provided by Ofcom. The table below compares some of the key specifications of the two antennas and the model used in the analysis:

Parameter	SkyMast 726.02	SkyMast 744.02	Model
Forward Gain	13 dBi	17 dBi	17 dBi
3dB Beamwidth E-Plane/H-Plane	23°/26°	23°/26°	30°/30°
Front/Back Ratio	>20 dB	>20 dB	25 dB

Table 40: FL antenna parameters

SkyMast 744.02 was selected since it is better performing than the SkyMast 726.02 and this "better performance" results in higher interference levels, hence a more conservative approach in the context of this compatibility analysis. Indeed, the higher the gain, the worst the interference the FL receiver would experience. If SkyMast 726.02 model were to be used, the calculated interference levels would be reduced by 4 dB for both case 1 and case 2 scenarios.

Both data sheets of SkyMast 744.02 and 726.02 indicate they guarantee the front-to-back ratio to be >20 dB. Actual data from SkyMast for the 744.02 shows a worst case front-to back ratio of 28.44 dB. 25 dB has been used as a fair representation.

A 17 dBi antenna gain based on the SkyMast 744.02 product has been used in the report. This represents the average antenna gain from Ofcom database as highlighted in the table below:

Geotype	Average antenna gain (dBi)	Antenna Gain selected for simulation (dBi)
Urban	16.6	17
Suburban	16.2	17
Rural	16.8	17

Table 41: Antenna gain selected for simulation

A sensitivity analysis was also carried out based on the highest gain antenna in the Ofcom database. This is an Andrews KPR13F-13 with a 4 m diameter and 3.6 degree beamwidth:

Frequency Range	1.35-1.535 GHz
Gain	32.9 dBi
VSWR	≤ 1.30
Nominal Impedance	50 Ω
Cross Polarization	30 dB
Dimension / Diameter	4.0 m / 13 ft
F/B Ratio	35 dB
3dB Beamwidth	3.6
RPE Number(s)	3490

Table 42: Parameters of Andrews KPR13F-13 antenna

The charts below show the MCL results for a FL 75 KHz operating on Channel #1. The first set of charts is the one currently provided in the Report using the SkyMast 17 dBi antenna. The second set of charts is for the Andrews antenna. The overall conclusions of the MCL remain unchanged as follows:

- Interference would exceed I/N of -12 dB in a case 1 scenario. The use of Hi-Perf Preselect filters at FL Rx and SDL Tx reduces the interference well below I/N of – 12 dB and solve any interference issue which may arise;

- Interference would exceed I/N of -12 dB in a case 2 scenario at distances below 2.5 km. The use of Hi-Perf Preselect filters at FL Rx and SDL Tx reduces the interference well below I/N of – 12 dB. In this case, the filters are over specified as they would reduce the interference by 40 dB below the noise floor. Less performant and therefore less expensive and smaller filters can be used to solve any interference issue which may arise in real life deployment;

- Furthermore, taking into account the higher gain and the narrower beamwidth of the Andrews antenna, the probability of a case 1 scenario occurring is considerably lower than in the case of wider beamwidth SkyMast.

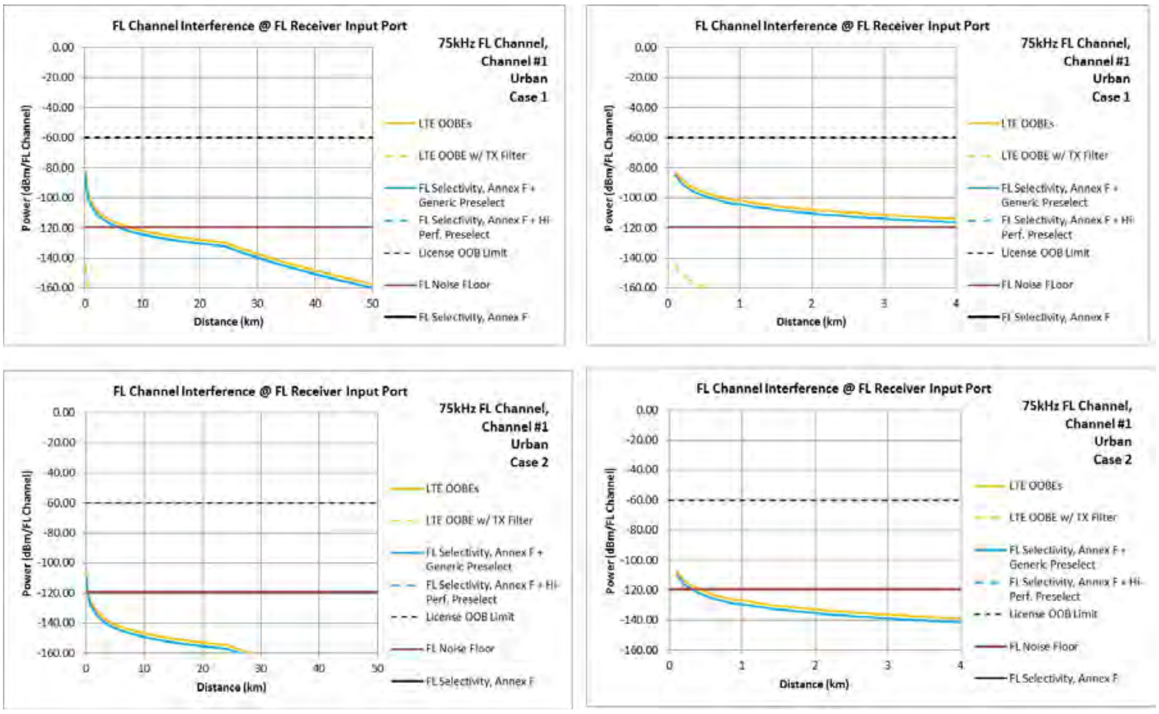


Figure 127: SkyMast 744.02

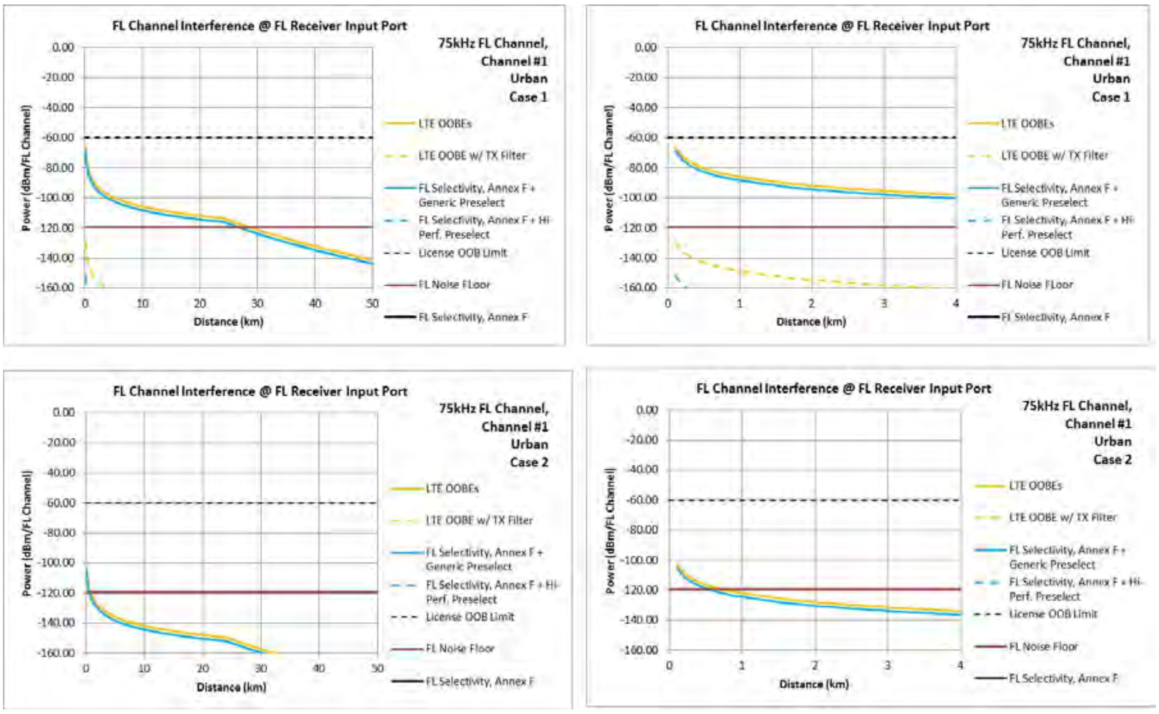


Figure 128: MCL Andrews KPR13F-13

A summary of the antenna types from the database provided by Ofcom are provided in the table below:

Antenna Type	Quantity	Gain Range	Beamwidth Range

		(dBi)	(Degrees)
Flat Panel	53	14-17	12-40
Grid	119 74	17-25 30-33	8-22 3.5-5.3
Parabolic	145 132	20-23 26-29	11-21 6-9
Yagi	60	13-17	31-45

Table 43: Summary of antenna types in OFCOM FL antenna database

15.3 FL antenna model for the London analysis

For the real full network simulation in London, the exact values for FL receivers antenna gains was used in conjunction with the antenna pattern of the Sky Masts 744.02. London FLs' antenna gains and types are provided in the two tables hereafter:

Link ID	Rx antenna gain	'RX_ANT'
47	16.7	A/01/O/97/035/JB
48	16.7	A/01/O/97/035/JB
49	16.7	A/01/O/97/035/JB
50	16.7	A/01/O/97/035/JB
51	16.7	A/01/O/97/035/JB
82	16.7	A/01/O/97/035/JB
140	16.7	A/01/O/97/035/JB
147	16.7	A/01/O/97/035/JB
181	16.7	A/01/O/97/035/JB
230	14.3	A/01/O/95/030/EU
254	16	A/01/O/97/034/JB
255	16	A/01/O/97/034/JB
256	16	A/01/O/97/034/JB
257	16	A/01/O/97/034/JB
258	16	A/01/O/97/034/JB
259	16	A/01/O/97/034/JB
260	16	A/01/O/97/034/JB
265	14.3	A/01/O/95/030/EU
266	14.3	A/01/O/95/030/EU
361	16	A/01/O/97/034/JB
565	14	A/01/O/06/005/JB
602	16.7	A/01/O/97/035/JB
804	14	A/01/O/06/005/JB

Table 44: Antenna type and gain for FLs deployed in London

Antenna ID	Antenna Reference Code	Model	Manufacturer	Description	Gain (dBi)	Beamwidth (o)
23	A/01/O/97/035/JB	7680	JAYBEAM	Panel Antenna 500mm	16.7	12
19	A/01/O/95/030/EU	FPA14	EUROPEAN ANTENNAS	Flat Plane Antenna	14.3	40
22	A/01/O/97/034/JB	5227	JAYBEAM	Shrouded Yagi	16	15
18	A/01/O/06/005/JB	5680 SHF	JAYBEAM	SHF PANEL	14	36

Table 45: Parameters of FL antennas deployed in London

When comparing the actual antenna patterns of the FLs receivers which included various Yagi and panel antennas, SkyMast 744.02 was found to allow performing a reasonable conservative worst case analysis as shown in the Figure below:

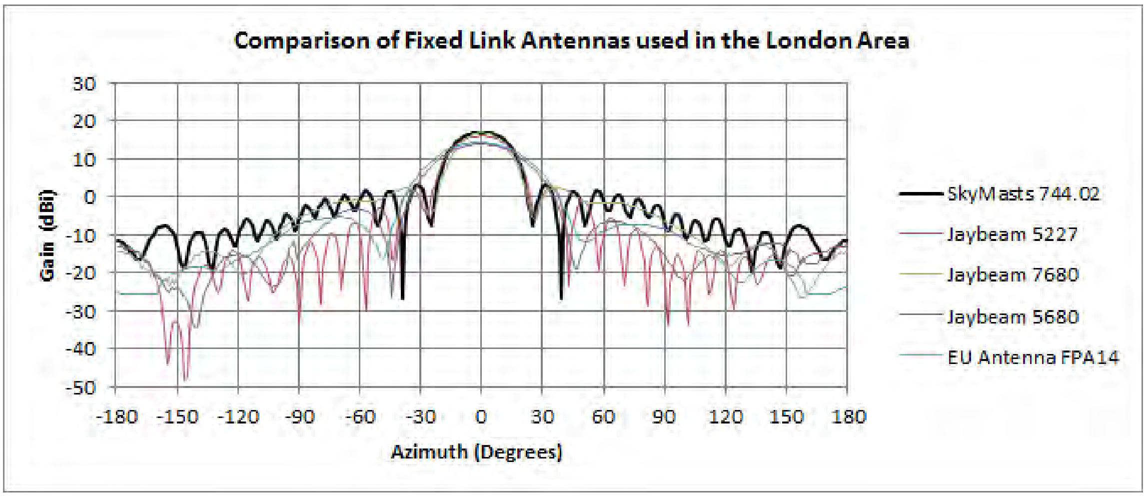


Figure 129: Comparison of London FLs antenna patterns

16. ANNEX 5: RX PRESELECT FILTERS FOR EXISTING FLS

Filtering of the LTE carrier may be required under specific conditions and in limited cases to mitigate FL Rx selectivity interference. The amount of rejection required at the LTE carrier channel is dependent on a number of factors:

- Distance between SDL and FL antennas
- Channel position (frequency separation)
- Antennas orientation
- High power SDL transmitter (e.g. rural)

The worst case for FL Selectivity interference occurs when all four factors align to create the maximum LTE carrier level at the FL receiver, or close proximity, FL operating on a low channel number, in a rural location and both FL and SDL antennas pointing at one another. It is not expected for this alignment to occur often in an actual deployment taking into account engineering best practices, but it is a useful exercise to determine if filtering can be used to mitigate FL Selectivity interference if it does.

16.1 Feasibility and performance

Temperature compensation high dielectric pucks are used with cavity resonator filter structure to realize high performance filters. Cross-coupling of the resonators results in the ability to position transmission zeros at critical frequencies. Comnav Engineering (Portland, Maine, USA, http://comnav-eng.com/index.htm) designed filters as requested by Qualcomm.

Given the channelization of the fixed link band, two FL Preselect filters were specified as shown in the table below. These high performance FL Preselect filters were only specified for the lower FL channels because these are the most challenging cases, and higher numbered channel could utilize simpler filters due to the larger frequency separation of the LTE carrier.

Filter Specification Number	FL Channel Bandwidth	FL Channel Number
80-H8706-1	25 kHz	1-76
	75 kHz	1-25
	250 kHz	1-7
	500 kHz	1-3
	1.0 MHz	1
	2.0 MHz	1
80-H8706-2	3.5 MHz	1

Table 46: FL channel supported by Preselect filter

The figures below show the rejection achieved:

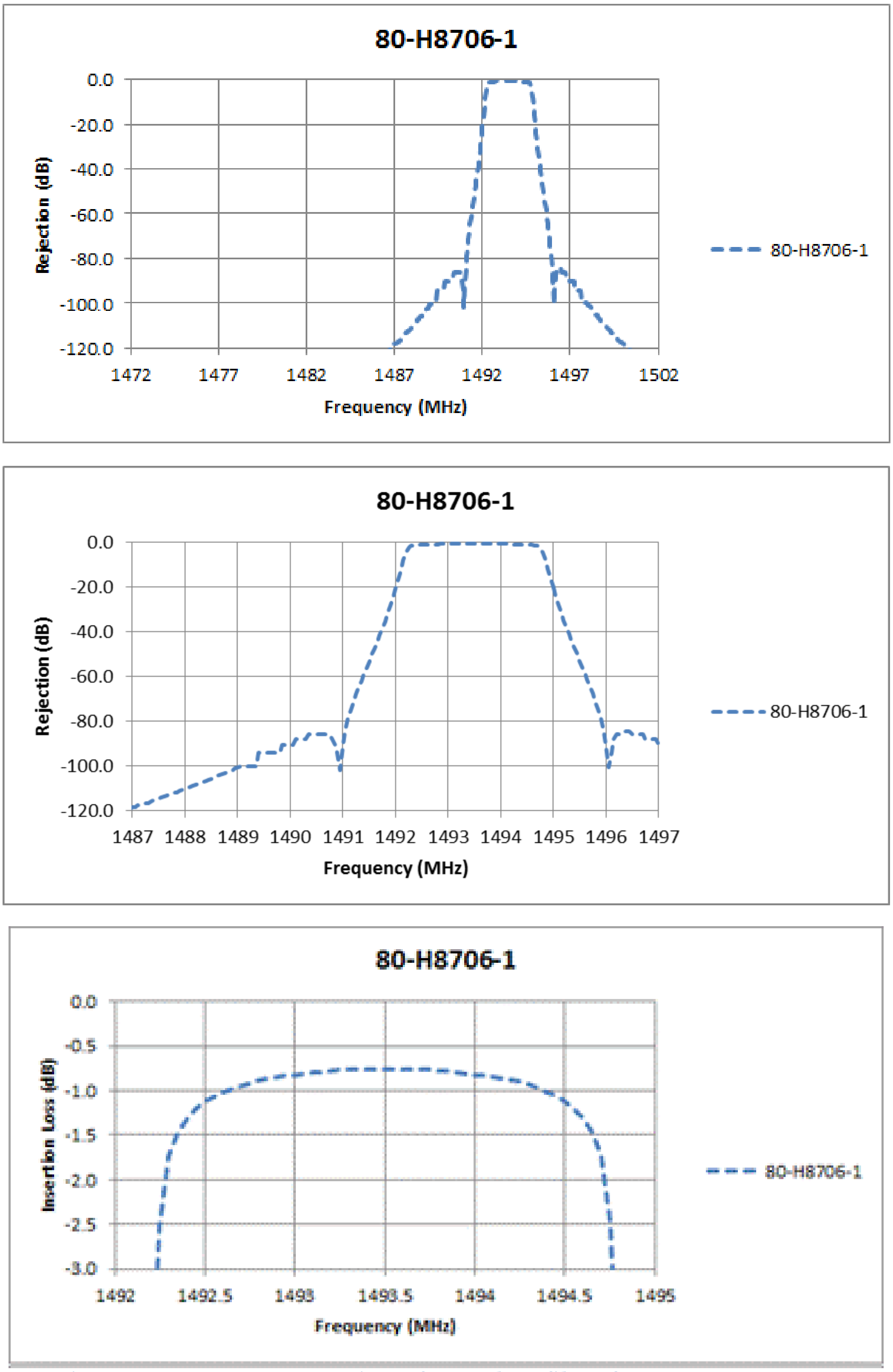
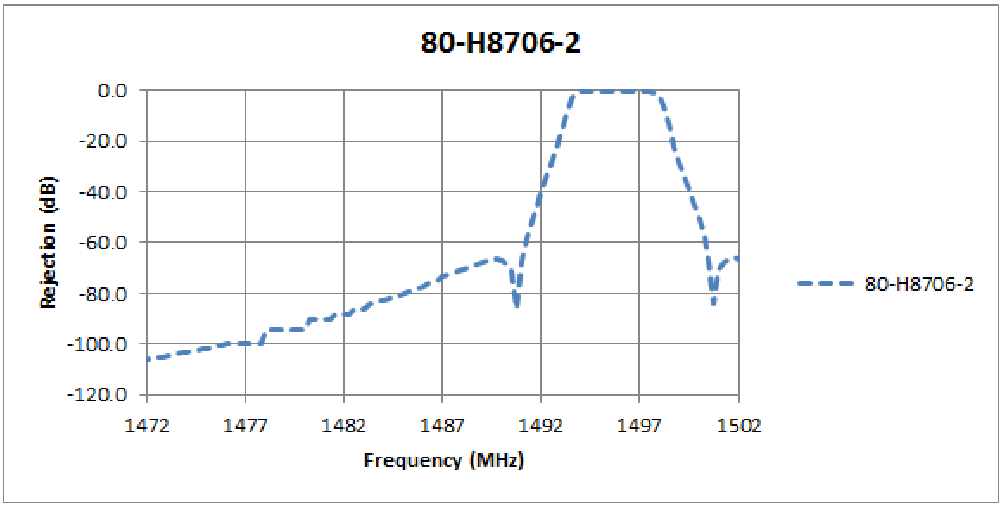
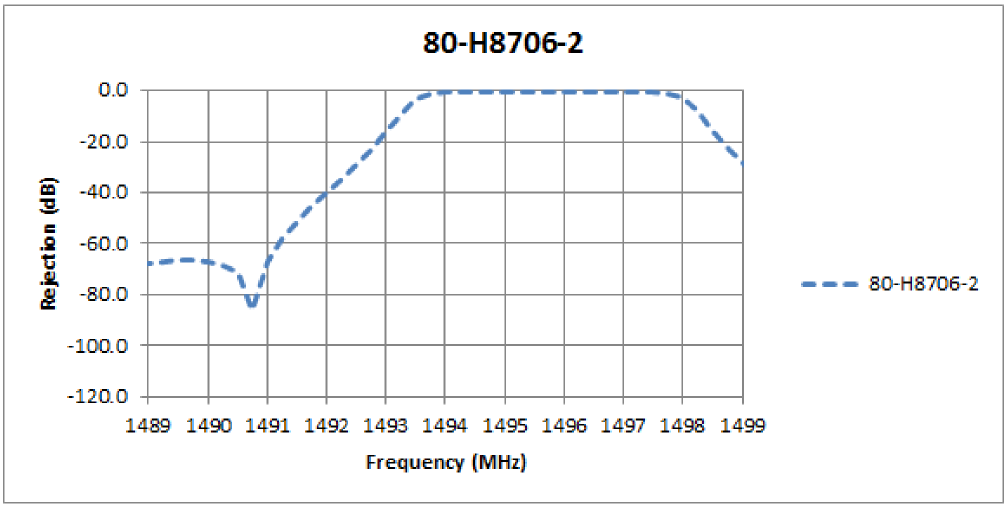


Figure 130: 80-H8706-1 Hi-Perf Preselect filter frequency response





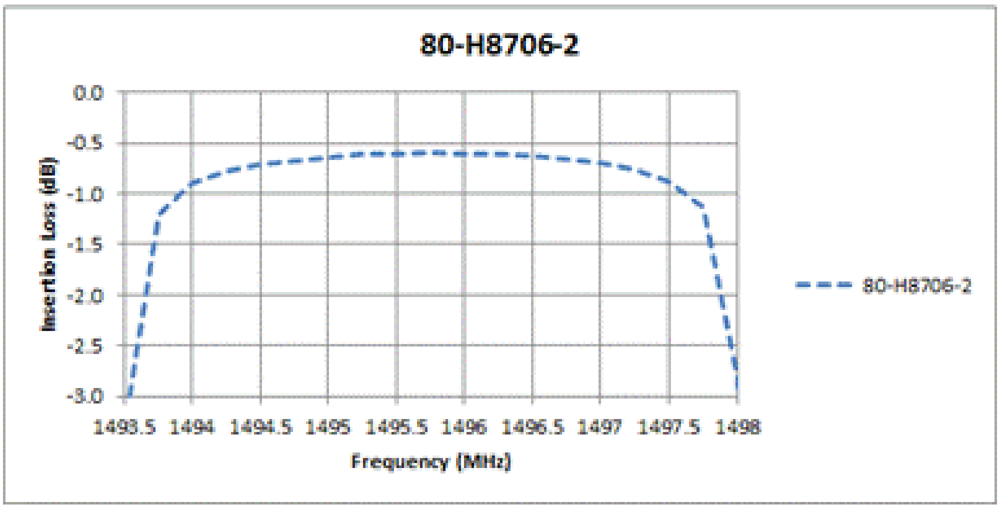


Figure 131: 80-H8706-2 Hi-Perf Preselect filter frequency response

16.2 Practicalities of installation

A small percentage of Fixed Links may require the installation of an additional preselect filter to mitigate interference from the SDL network. It is important that the necessary modifications associated with adding filters to existing FLs radio installations are practical.

A common fixed link radio configuration is designed for installation into a standard 19 inch rack. This configuration would be for an inside installation, or installation in an environmental enclosure. Since remote electronics are becoming popular in the wireless industry, although not common for fixed link radios, this type of installation will be considered as well.

The largest fixed link preselect filter is based on the high-performance preselect filter requirement used in this document. The largest this filter will be is approximately 11 x 7 x 2.5 inches, much smaller than a typical fixed link radio. The Preselect filters are passive devices, meaning they require no power or control interfaces, just two RF connections, input/output (note that outdoor devices typically have a ground terminal).

For inside installation, extra space within the 19" can house the Preselect filter. If this is not an option, the Preselect filter can be mounted in any available space. Wall mounting adjacent to the RF Demarcation panel is common. An example of a Preselect filter provided by Moseley for their Starlink Radio (http://moseleysb.com/mb/accessories.html) is shown below (note this specific product is for a 900MHz radio, so it is physically larger than a 1500 MHz device):

Figure 132: Starlink band pass cavity filter

For remote electronic installations, or installation where mounting the preselect filter outdoors is desirable, a sealed Preselect filter is utilized. Environment sealing of the Preselect filter is achieved using a coating product. Environmental coating is a common practice and an available option at most all manufactuers. Once coated, these filters can be installed in an outdoor enviroment. Typically, locating the Preselect filter near the existing antenna allows the use of the existing coaxial cable without modification. An example of a coated filter (with mounting bracket and ground terminal) is shown below, this example is for a 900 MHz device available from Kaelus (http://www.kaelus.com/Home/):

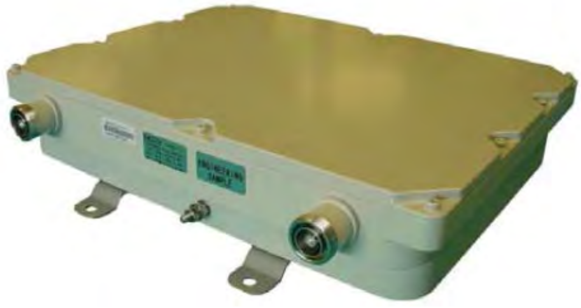


Figure 133: Kaelus coated filter

Of the numerous filter technologies available, microwave cavity filter are commonly used in front of the radio receivers. This is because cavity filters can achieve very low insertion loss. The insertion loss for the high-performance Preselect filters used in this Report is below 1.0dB as shown in Figure 130 and Figure 131.

The use of preselect filters is common – and most of the time necessary - in the FL industry because the selectivity of the fixed link receiver is insufficient in many installations to reject strong signals in adjacent bands. Many installations will require less rejection in the preselect filter. Less rejection means less resonators hence lower insertion loss. Other losses before the receiver include lightning protection and cabling. Common values for these are 0.25dB for the lightning protection device and 3dB for the cabling. Using the noise figures for the FL receiver provided in OfW 446, and the common values, the degradation in noise figure (at the antenna connector) with and without a High-Perf preselect filter is estimated in the following table and it shows the degradation in selectivity due the installation of a High-Perf preselect filter is small when considering the realities of the FL performance and installation:

FL Ch. Spacing (kHz)	Receiver Noise Figure	NF @ Antenna w/out Filter	NF @ Antenna w/ High-Perf preselect Filter	(NFw/ - NFw/out) NFw/out
25	10.6	13.85	14.85	0.0722
75	6.8	10.05	11.05	0.0995
250	9.1	12.35	13.35	0.0810
500	8.3	11.55	12.55	0.0866
1000	8.3	11.55	12.55	0.0866
2000	8.2	11.45	12.45	0.0873
3500	7.6	10.85	11.85	0.0922

Table 47: Assessment of the degradation in FL selectivity due to filtering

If the FL radio is configured with a TX/RX Duplexer (BPF) or Diplexer (LP/HP), a filter inserted between the Radio and antenna will have the additional requirement of passing the FL TX signal. An example of a configuration utilizing a duplexer is shown in the figure below:

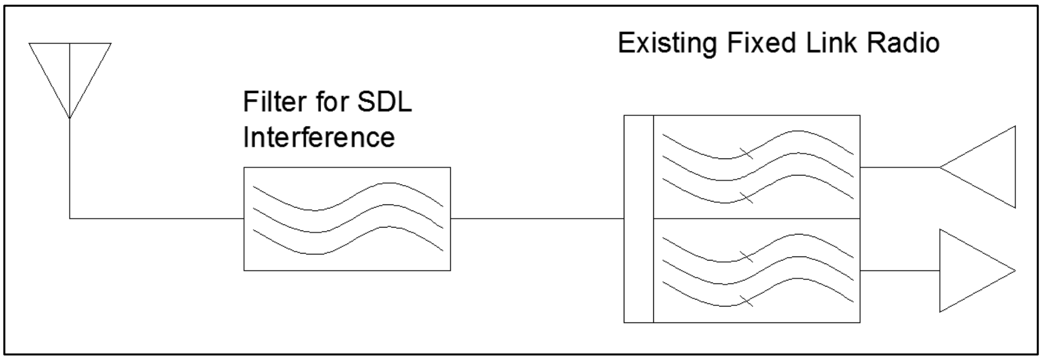


Figure 134: FL duplexer configuration

For this type of configuration, the filter must pass both the FL RX and TX channels while rejecting the SDL band. This differs from the 'un-duplexed' FL radio configuration where the SDL filter only needs to pass the FL RX channels and rejects the SDL band. There are a number of standard configurations that have this capability. Three common configurations are Bandstop Filter, Direction Filter and Dual Bandpass Filter.

17. ANNEX 6: RX PRESELECT FILTERS FOR FUTURE FLS

The study performed in Section 8 concludes that coexistence between future Fixed Links (FLs) in 1498.5-1517.0MHz and SDL in 1452-1492 MHz is feasible without coordination by imposing a more stringent SDL OOBE limit above 1498.5 MHz, requiring new FLs assigned above 1498.5 MHz to implement Rx preselect filters and to ensure LOS clearance between FL Tx and Rx. Under this approach, the interference from SDL into future FLs would not exceed I/N of -12 dB with the OOBE interference component remaining below I/N of -15 dB and the interference component due to insufficient FL Rx selectivity below I/N of -15 dB.

Based on this study, The Rx preselect filters specifications were derived from the required rejections. Both single filters and Rx/Tx duplexers configurations have been considered. Feedback from vendors allowed providing an indication of cost and size of those filters. For low order quantities (i.e. less than 10 filters/duplexers), the price of the single filter option ranged from £ 240 to £ 1200 depending on the required rejection, operating range and vendor. The price of duplexers ranged from £ 260 to £ 1500, also depending on the required rejection, operating range and vendor. Naturally, the bigger the quantity orders the cheaper is the price. The single filter size ranged from 1700 cm^3 to 3000 cm^3 (18 x 26 x 6 cm). The duplexer size ranged from 2200 cm^3 to 3800 cm^3 (23 x 26 x 6 cm). The details of filters/duplexers size and cost, for various ordered quantities, are provided in this Annex.

17.1 Filter requirements

17.1.1 FL radio configuration: single filter and Rx/Tx duplexers

FL configurations requiring both Rx/Tx duplexers as well as single filters may be deployed. An example of a configuration requiring separate filters is when a dual polarized antenna is utilised, each polarization has its own feed (connector). An example of configuration requiring a Rx/Tx duplexer filter is when one RF output port to cover both the Tx and Rx via a single antenna is available.

To address the potential FL radio configurations, both single RX filters and Rx/Tx duplexers configurations have been considered.

17.1.2 FL channels

As stated in Section 8, uncoordinated FL can be assigned in the frequency range of 1498.5 – 1517.0MHz subject to the implementation of FLs preselect filters which would maintain an I/N due to FL receiver imperfect selectivity below -15 dB.

Breaking this frequency range into sub-ranges would result in simpler filters. Using the FL channelization as specified in the OfW 446 [1], the following frequency ranges have therefore been defined to accommodate all FL channels and channel spacing;

Passband (MHz)	BW (MHz)	FL Channel Type (kHz) and Channel #						
		3500	2000	1000	500	250	75	25
1498.5-1504.5	6.0	3	4-6	7-12	13-24	25-48	81-160	241-480
1504.5-1511.5	7.0	4-5	7-9	13-19	25-38	49-76	161-253	481-760
1510.5-1516.5	6.0	6	10-12	19-24	37-48	73-96	241-320	721-960

Table 48: Frequency range and corresponding FL channels for FL Preselect filters

17.1.3 SDL rejection (FL Preselect filter)

The total FL receiver selectivity rejection requirements for the SDL band were calculated in Section 8.3.2. Using the FL Receiver selectivity, Annex F (assuming the selectivity extends beyond the 2.5xChBW limit per), see Section 19, the rejection requirements of the FL preselect filter have been derived. The table below calculates the filter rejection required for each FL Radio system type. Note that the FL channel bandwidth has an impact on the rejection requirement. For instance, the difference between the rejections required by a 25kHz and 3.5MHz FL channel is ~18dB.

FL Radio System Type (kbit/s in KHz)	FL Rx filtering requirement over 1452-1492 MHz (dB)	FL Preselect filter rejection requirements over 1452-1492 MHz (dB)	Filter category and SDL rejection requirement
32 in 25	150.5	99.5	Category A 102 dB
64 in 25	152.7	101.7	
96 in 75	139.6	88.6	
192 in 75	148.7	97.7	
256 in 250	144.6	93.6	Category B 94 dB
512 in 250	142.7	91.7	
512 in 500	142.6	91.6	
704 in 500	138.6	87.6	
1024 in 500	140.7	89.7	
2048 in 500	137.7	86.7	
1024 in 1000	139.6	88.6	Category C 90 dB
2048 in 1000	137.7	86.7	
2048 in 2000	136.6	85.6	
4096 in 2000	134.7	83.7	
4500 in 3500	133.6	82.6	
9100 in 3500	134.7	83.7	

Table 49: FL Preselect filter rejection requirements and filter category, FL Radio System Type

17.1.4 FL Transmit filter requirements (for FLs duplexers)

The requirements of the FL transmit filter are needed to defined the specifications for FLs duplexers. They depend on the characteristics of the FL Radio transmitter. Tx parameters such as Out-of-Band Noise, Harmonics, Spurious and Reverse Intermodulation will dictate the performance of the Tx filter. Since the transmit performance is manufacturer dependent and since the FL transmitter is beyond the scope of this study, a generic set of Tx requirements has been used so that the cost and size of a duplex filter solution can be estimated. The table below include the generic Tx filter requirements to be used.

Parameter	Requirement	Comment
Passband	Rx Passband – 142 MHz	Frequency separation per [2]
Insertion Loss	≤1.0 dB	
Rejection in RX Passband	≥60 dB	This assumes the RX Band noise at the transmitter output is less than -132 dBm/Hz. This does not include any isolation due to dual polarization antennas.
Shape Factor (30 dB)	2:1	The ratio between the

		passband bandwidth and the 30 dB rejection bandwidth.

Table 50: FL Transmit filter requirements

17.2 Filter specifications

The Rx filter and Rx/Tx duplexers specifications for the 3 rejection Categories and 3 FL Rx operating ranges are defined hereafter:

1498.5-1504.5 MHz (FL Rx Band)		
Parameter	Requirement	Comment
RX Filter		
RX Passband	1498.5 – 1504.5 MHz	
Insertion Loss	≤ 1.0 dB	
SDL Rejection Category A Category B Category C	 ≥102 dB ≥94 dB ≥90 dB	SDL Rejection is the rejection integrated from 1452-1492 MHz.
Rejection <1350MHz >1517MHz	 ≥30 dB ≥30 dB	
TX Filter		
TX Passband	1356.5 – 1362.5 MHz	
Insertion Loss	≤ 1.0 dB	
Rejection 1498.5-1504.5MHz	 ≥60 dB	
Shape Factor$_{30dB}$	2:1	

Table 51: Requirements for FL Preselect filter, 1498.5-1504.5 MHz operating range

1504.5-1511.5 MHz (FL Rx Band)		
Parameter	Requirement	Comment
RX Filter		
RX Passband	1504.5 – 1511.5 MHz	
Insertion Loss	≤ 1.0 dB	
SDL Rejection Category A Category B Category C	 ≥102 dB ≥94 dB ≥90 dB	SDL Rejection is the rejection integrated from 1452-1492 MHz.
Rejection <1350 MHz >1517 MHz	 ≥30 dB ≥30 dB	
TX Filter		
TX Passband	1362.5 – 1369.5 MHz	
Insertion Loss	≤ 1.0 dB	
Rejection 1504.5-1511.5 MHz	 ≥60 dB	
Shape Factor$_{30dB}$	2:1	

Table 52: Requirements for FL Preselect filter, 1504.5-1511.5 MHz operating range

1510.5-1516.5 MHz (FL Rx Band)		
Parameter	Requirement	Comment
RX Filter		
RX Passband	1510.5 – 1516.5 MHz	
Insertion Loss	≤ 1.0 dB	
SDL Rejection Category A Category B Category C	 ≥102 dB ≥94 dB ≥90 dB	SDL Rejection is the rejection integrated from 1452-1492 MHz.
Rejection <1350 MHz >1517 MHz	 ≥30 dB ≥30 dB	
TX Filter		
TX Passband	1368.5 – 1374.5 MHz	
Insertion Loss	≤ 1.0 dB	
Rejection 1510.5-1516.5 MHz	 ≥60 dB	
Shape Factor$_{30dB}$	2:1	

Table 53: Requirements for FL Preselect filter, 1510.5-1516.5 MHz operating range

17.3 Filters and duplexers performance, cost and size

The range of performance requirements outlined in Section 3, results in a range of filter/duplexer cost. To assess this, Qualcomm released a set of filter/duplexer specifications and sent these to vendors for quotes.

The figure below shows one example of the filter rejection response for the three sub-bands for a Category A rejection (102 dB). Naturally, the sub-band of 1498.5-1504.5 MHz has the stringent requirement due to the proximity to the 1452-1492 MHz SDL Band.

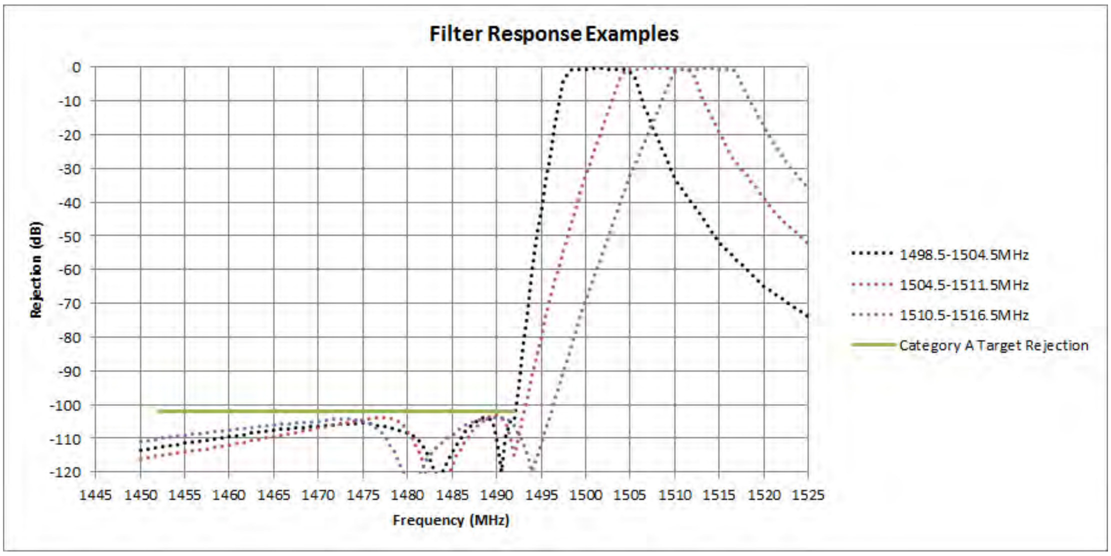


Figure 135: Future FL Preselect filter response examples

An example of a Category A (102 dB) vs. Category C (90 dB) rejection for the same operating range is shown below. For this example the sub-band of 1504.5-1511.5 MHz was selected as operating range.

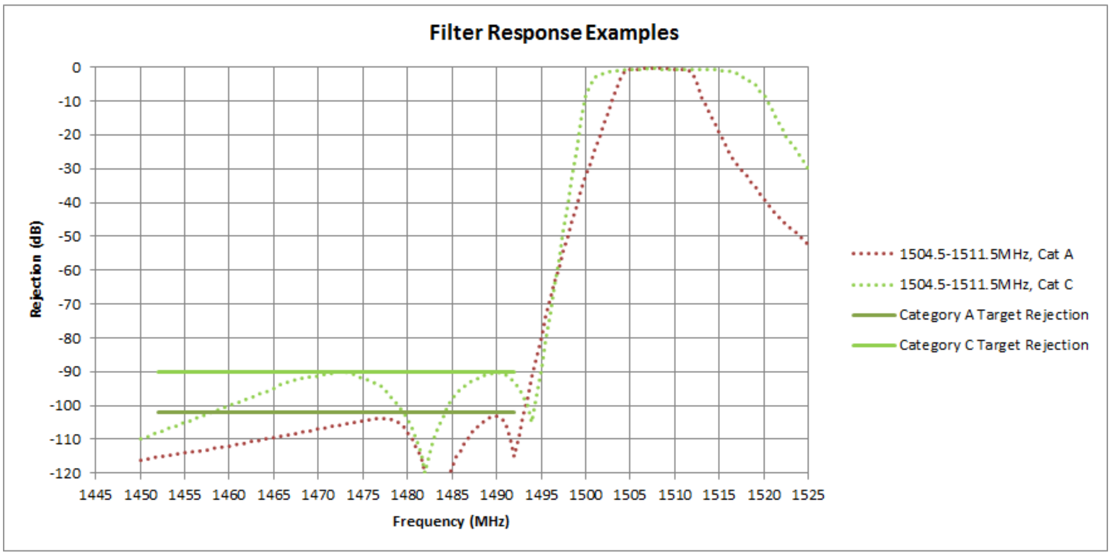


Figure 136: Future FL Preselect filter response examples, comparison between category A and category C

17.3.1 Filter cost

The following figures show the cost range of the single filter option based on the quantities ordered for:

- The 3 rejection categories i.e. Category A (102 dB), Category B (94 dB) and Category C (90 dB);
- The 3 FL operating ranges 1498.1504.5 MHz, 1504.5-1511.5 MHz and 1510.5-1516.5 MHz:

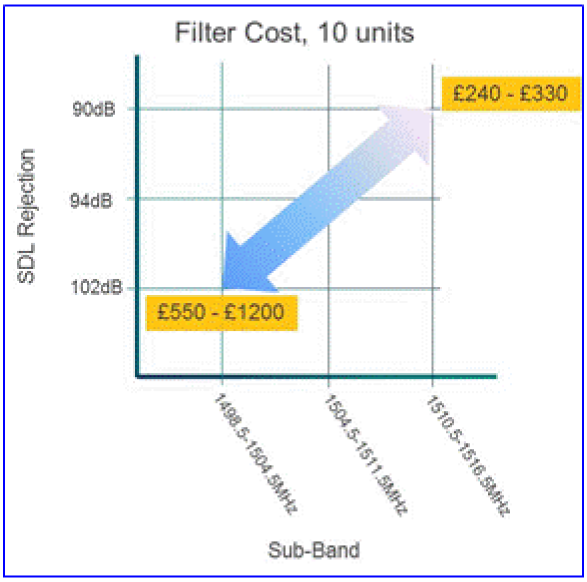


Figure 137: Range of future FL Preselect filter cost per unit, for 10 units

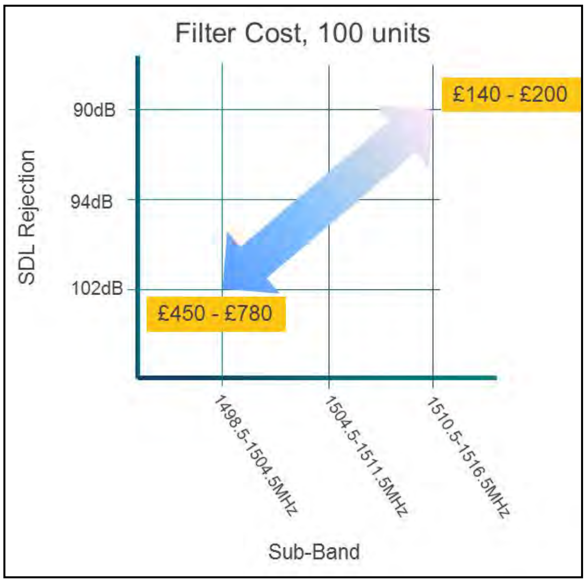


Figure 138: Range of future FL Preselect filter cost per unit, for 100 units

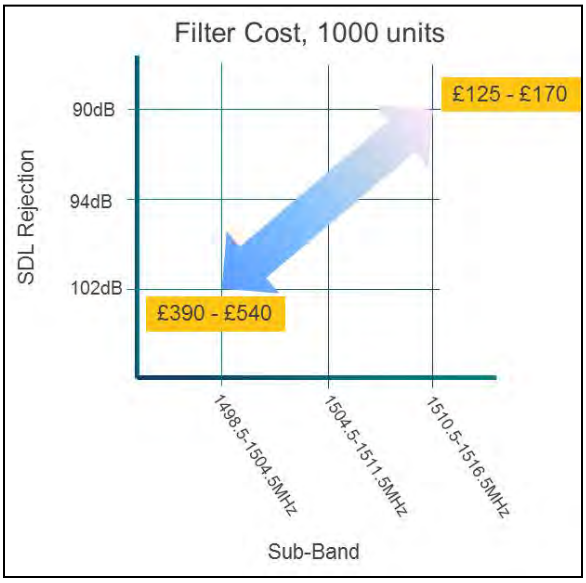


Figure 139: Range of future FL Preselect filter cost per unit, for 1000 units

17.3.2 Rx/Tx duplexer cost

The following figure shows the cost range of the duplexer option based on the quantities ordered for:

- The 3 rejection categories i.e. Category A (102dB), Category B (94 dB) and Category C (90dB);
- The 3 FL operating ranges 1498.1504.5 MHz, 1504.5-1511.5 MHz and 1510.5-1516.5 MHz:

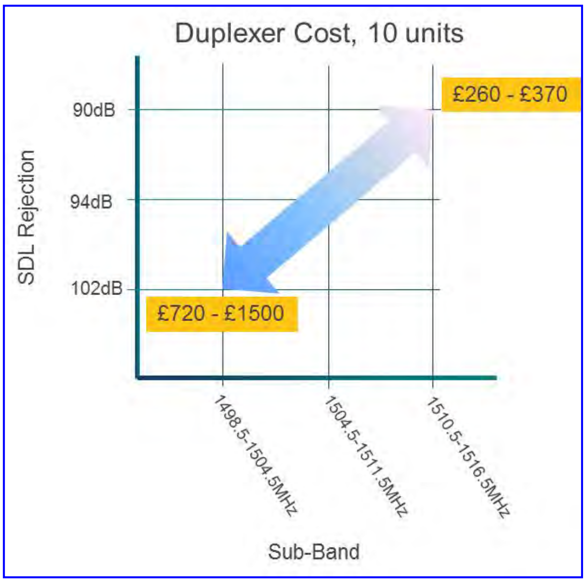


Figure 140: Range of future FL Preselect duplexer cost per unit, for 10 units

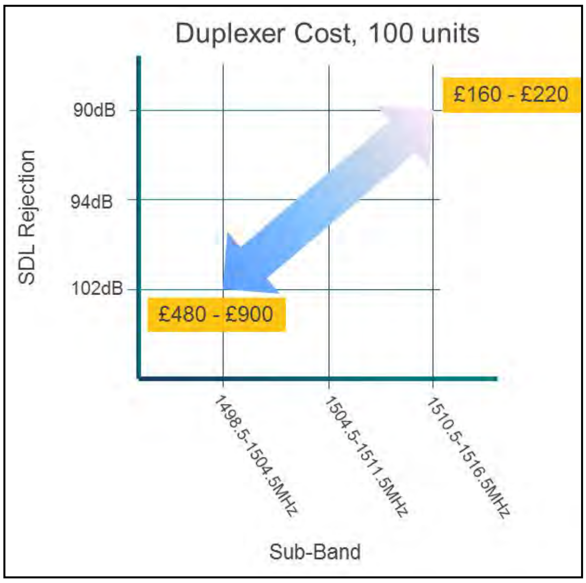


Figure 141: Range of future FL Preselect duplexer cost per unit, for 100 units

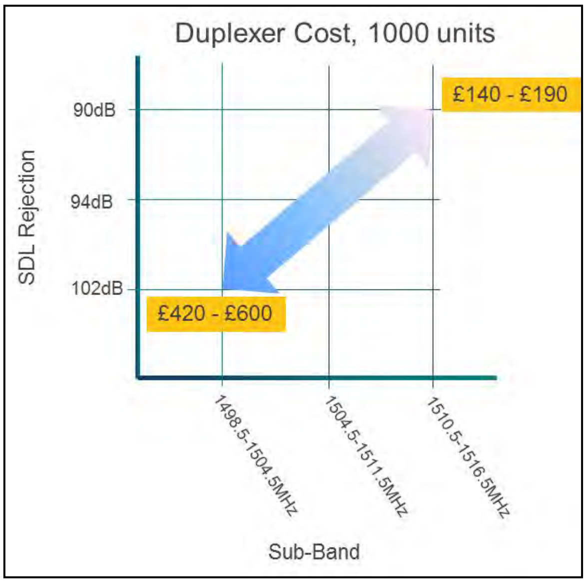


Figure 142: Range of future FL Preselect duplexer cost per unit, for 1000 units

17.3.3 Size

The filter size ranges from 1700 cm^3 to 3000 cm^3 (18 x 26 x 6 cm). The duplexer size ranges from 2200 cm^3 to 3800 cm^3 (23 x 26 x 6 cm).

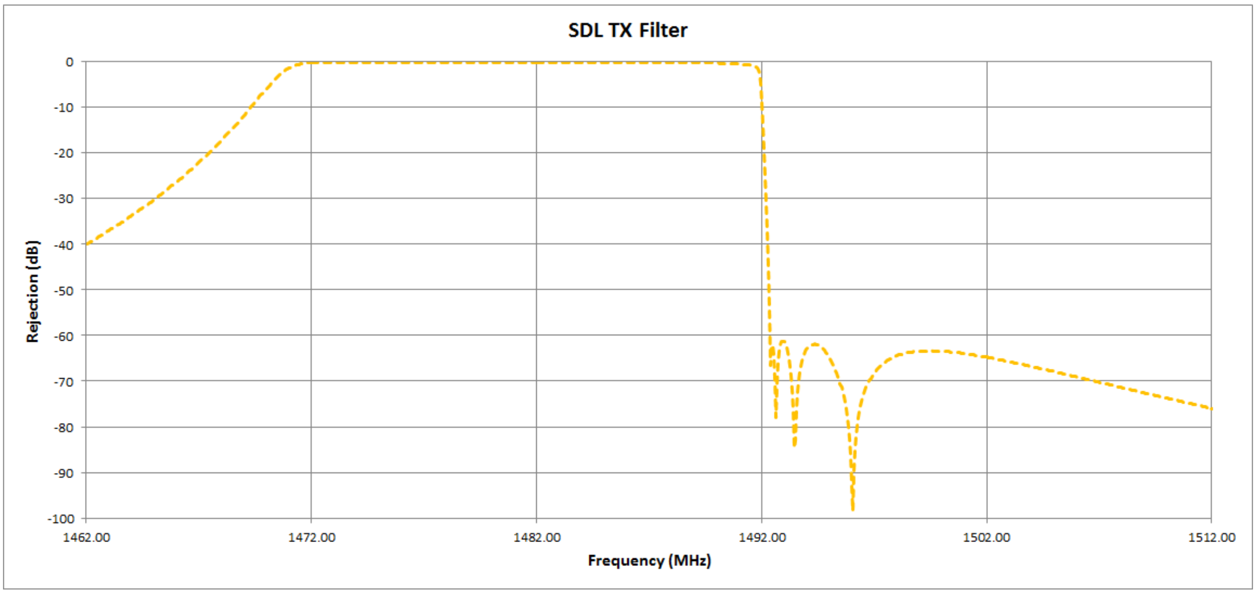
18. ANNEX 7: SDL TX FILTER

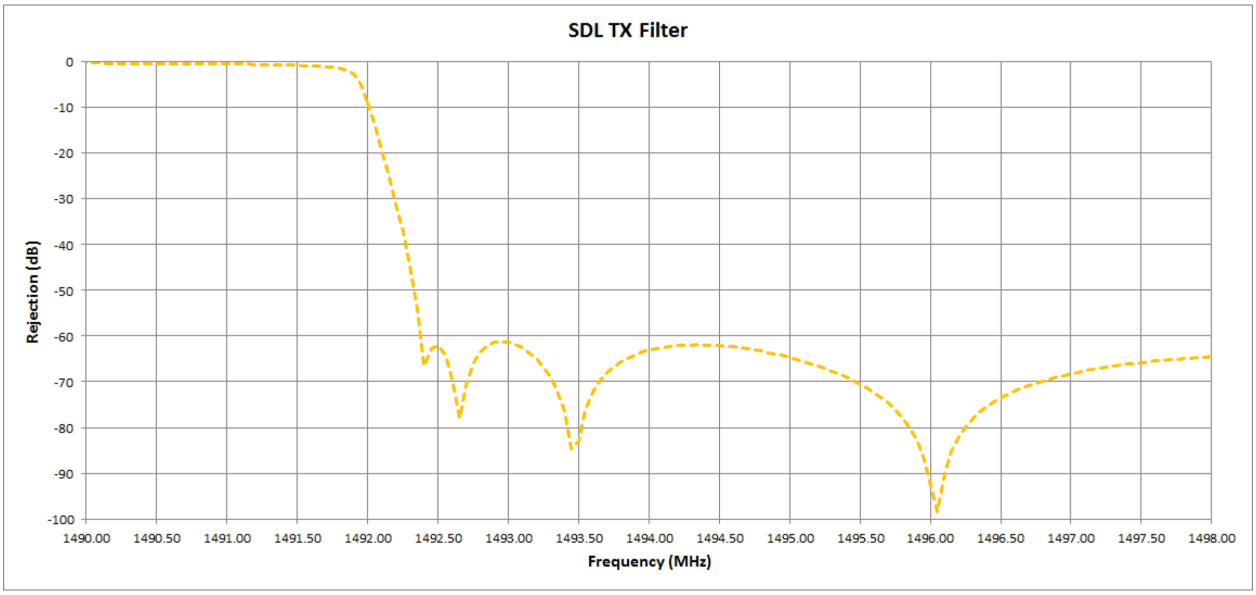
Filter of the LTE OOBE may be required under specific conditions to mitigate interference to the FL Receiver. The amount of rejection required at the FL channel is dependent on a number of factors:

- Distance between SDL and FL antennas.
- Channel position (frequency separation).
- Antenna orientation.
- High Power SDL transmitter (i.e. rural)

The worst case for SDL OOBE interference occurs when all four factors align to create the maximum OOBE level at the FL receiver, or close proximity, Fixed Links operating on a low channel number, in a rural location and both FL and SLD antennas pointing at one another. It is not expected for this alignment to occur often in an actual deployment taking into account engineering best practices, but it is a useful exercise to determine if filtering can be used to mitigate OOBE interference if it does.

Temperature compensation high dielectric pucks are used with cavity resonator filter structure to realize high performance base station filters. Cross-coupling of the resonators results in the ability to position transmission zeros at critical frequencies. API Technologies Corporation (Rancho Cordova, California, USA, http://micro.apitech.com/) designed such a filter as requested by Qualcomm. The figures below show the rejection achieved:





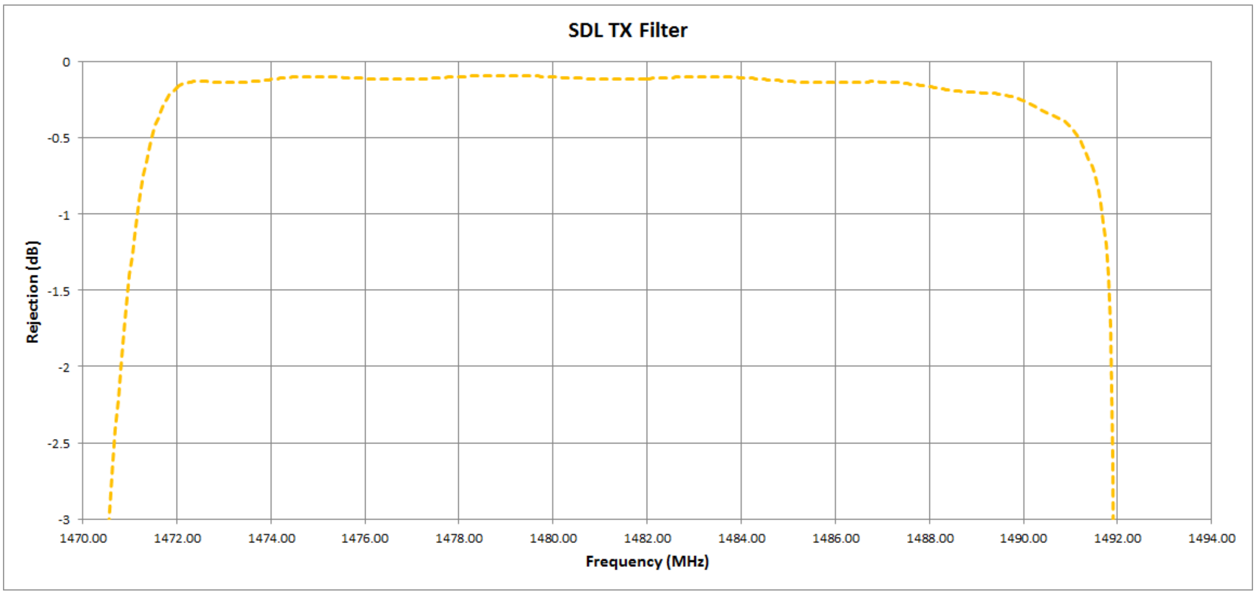
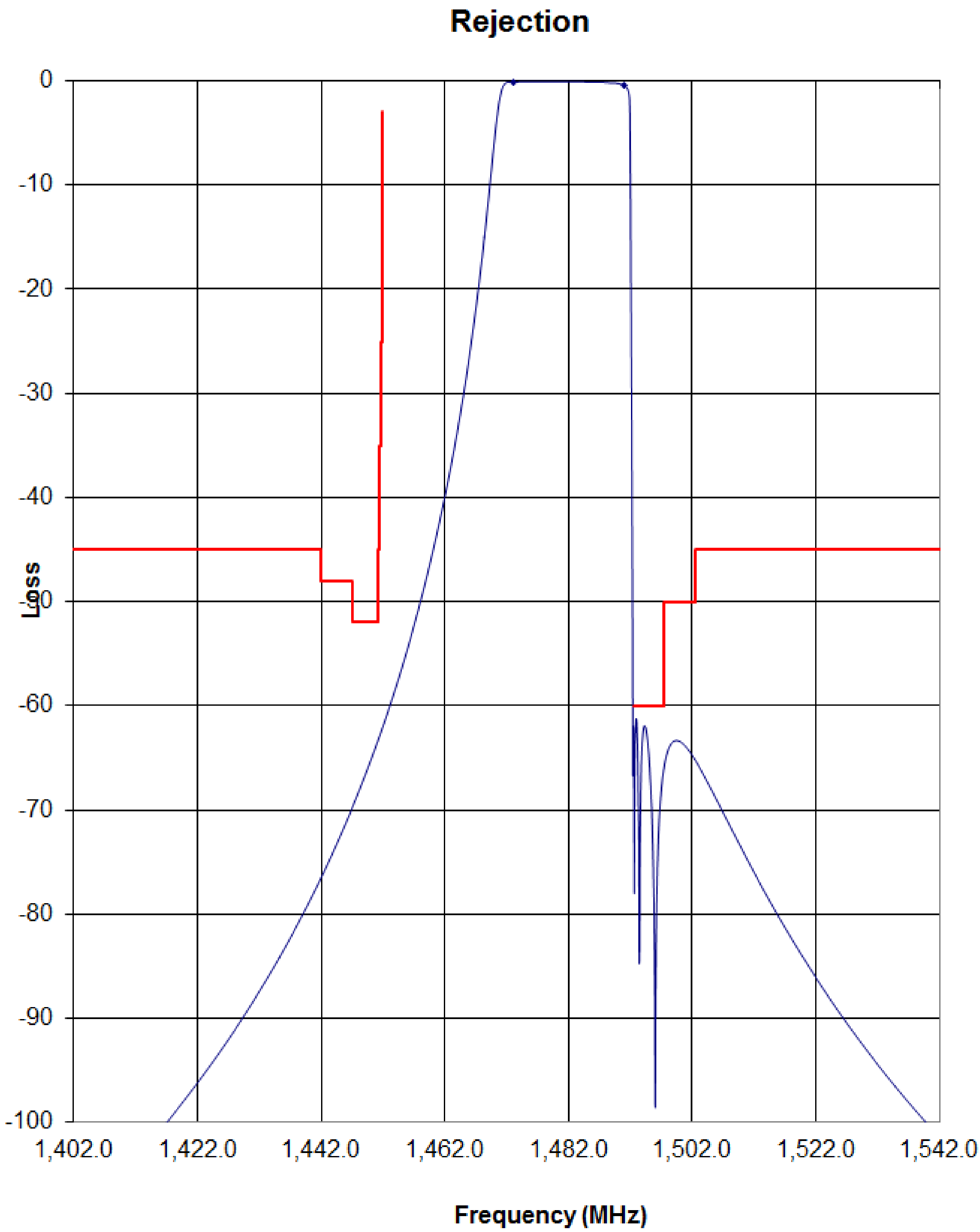
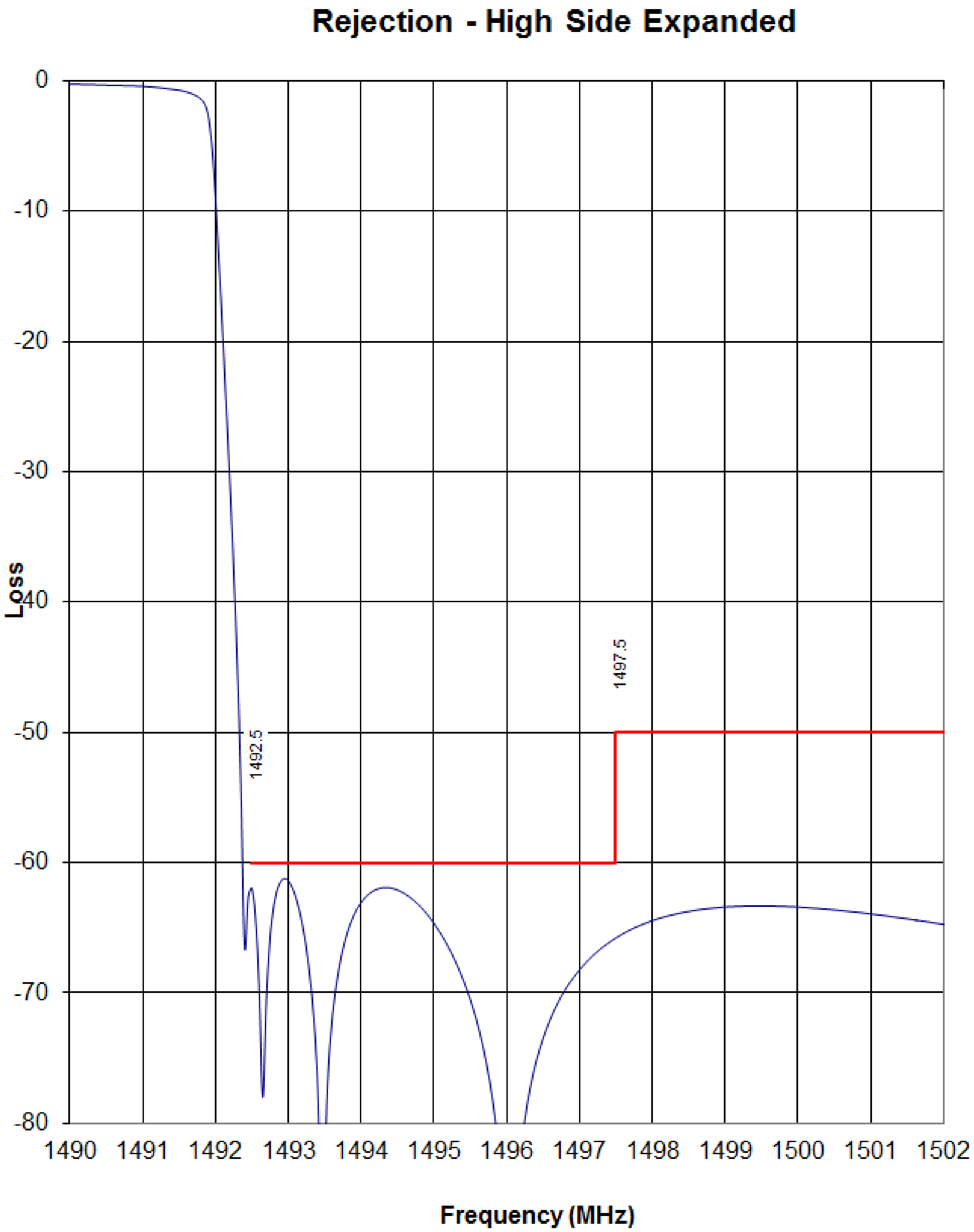
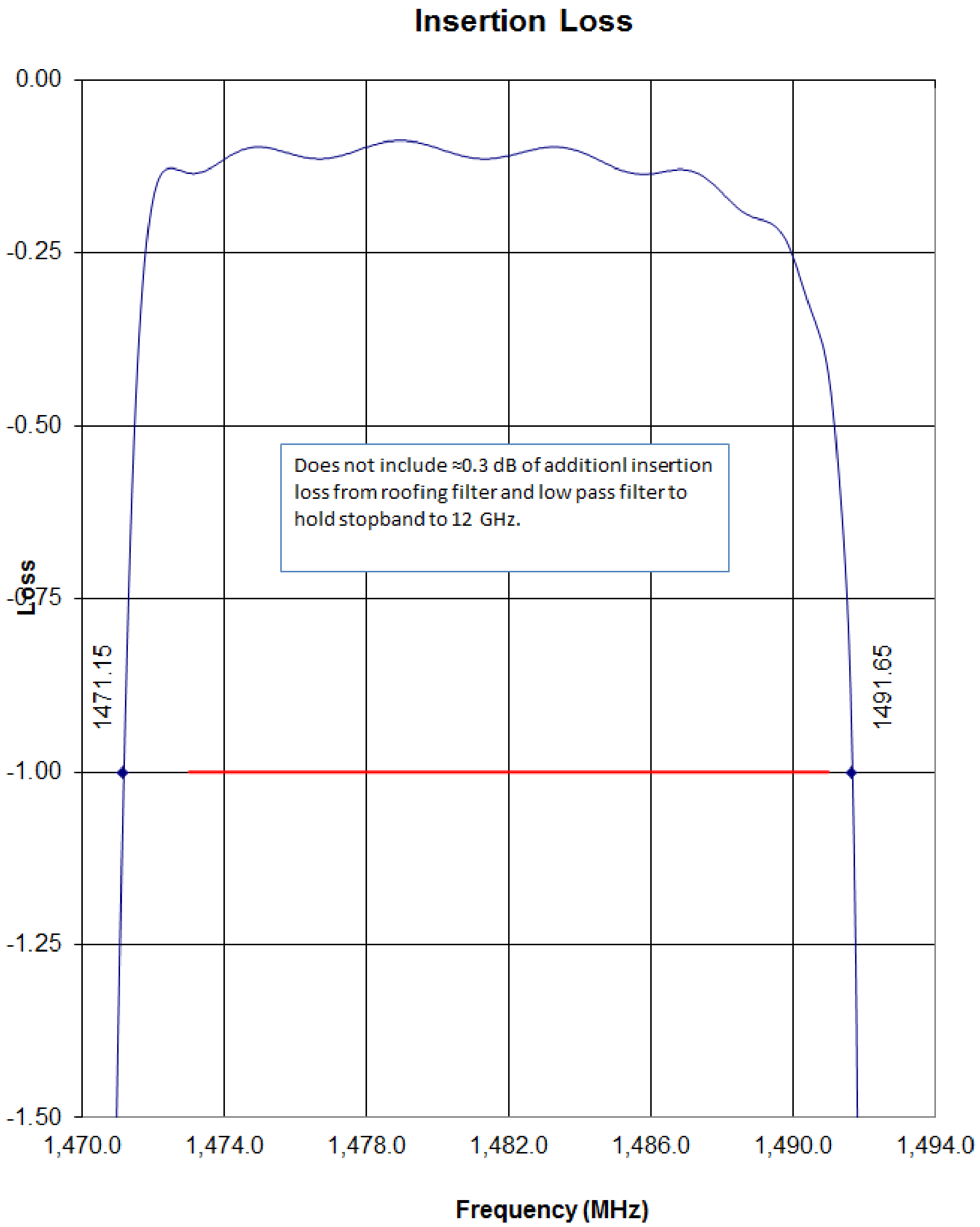


Figure 143: Frequency response of Hi-Perf SDL Tx filter


Rejection
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
Loss
1,402.0
1,422.0
1,442.0
1,462.0
1,482.0
1,502.0
1,522.0
1,542.0
Frequency (MHz)


Rejection - High Side Expanded
0
-10
-20
-30
Loss
-40
-50
-60
-70
-80
1490
1491
1492
1493
1494
1495
1496
1497
1498
1499
1500
1501
1502
1492.5
1497.5
Frequency (MHz)



Insertion Loss
0.00
-0.25
-0.50
-0.75
-1.00
-1.25
-1.50
Loss
1471.15
1491.65
Does not include ≈0.3 dB of additionl insertion loss from roofing filter and low pass filter to hold stopband to 12 GHz.
1,470.0
1,474.0
1,478.0
1,482.0
1,486.0
1,490.0
1,494.0
Frequency (MHz)

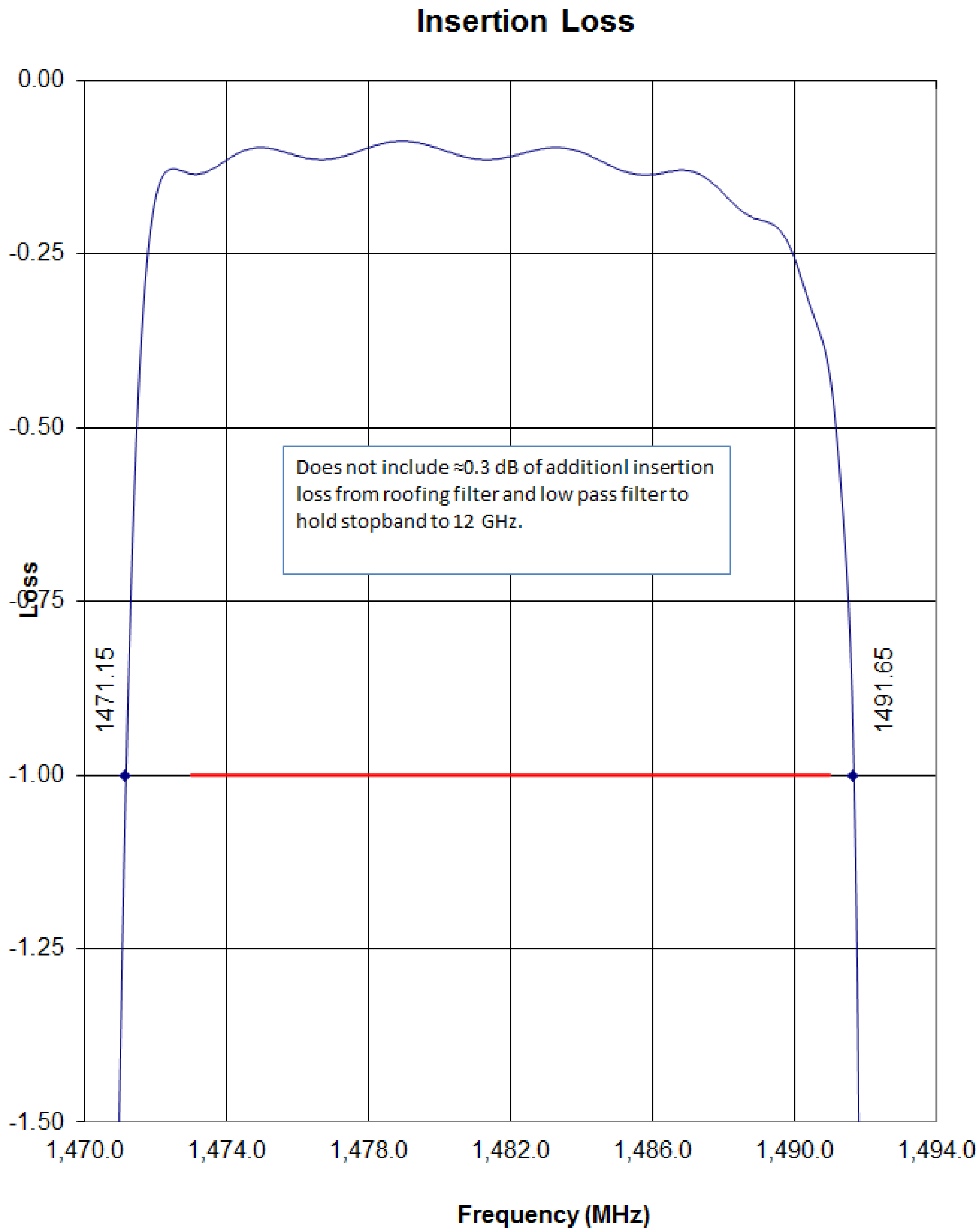


Figure 144: Frequency response of Hi-Perf SDL Tx filter (plots from vendor)

The resulting LTE OOBE mask with the High-Perf SDL Tx filter is provided in the figure below:

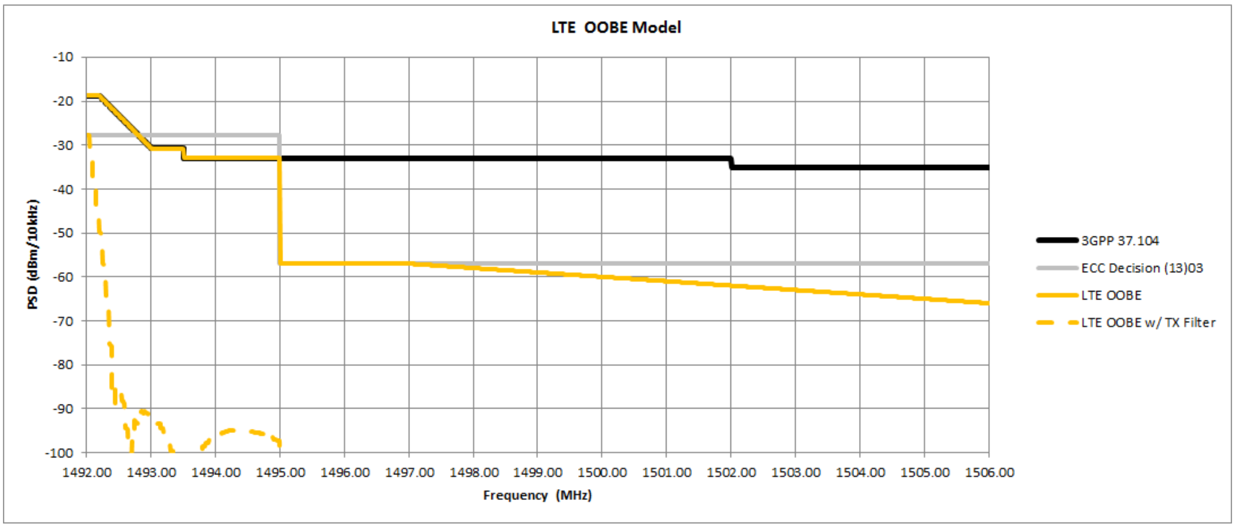


Figure 145: LTE OOBE Mask with High-Perf Tx filter

19. ANNEX 8: FL RX CHANNEL FILTER MODEL

The FL Rx channel filter or selectivity masks, using in ETSI TR 101 854, Annex F model are shown in the following figures for all FLs bandwidths:

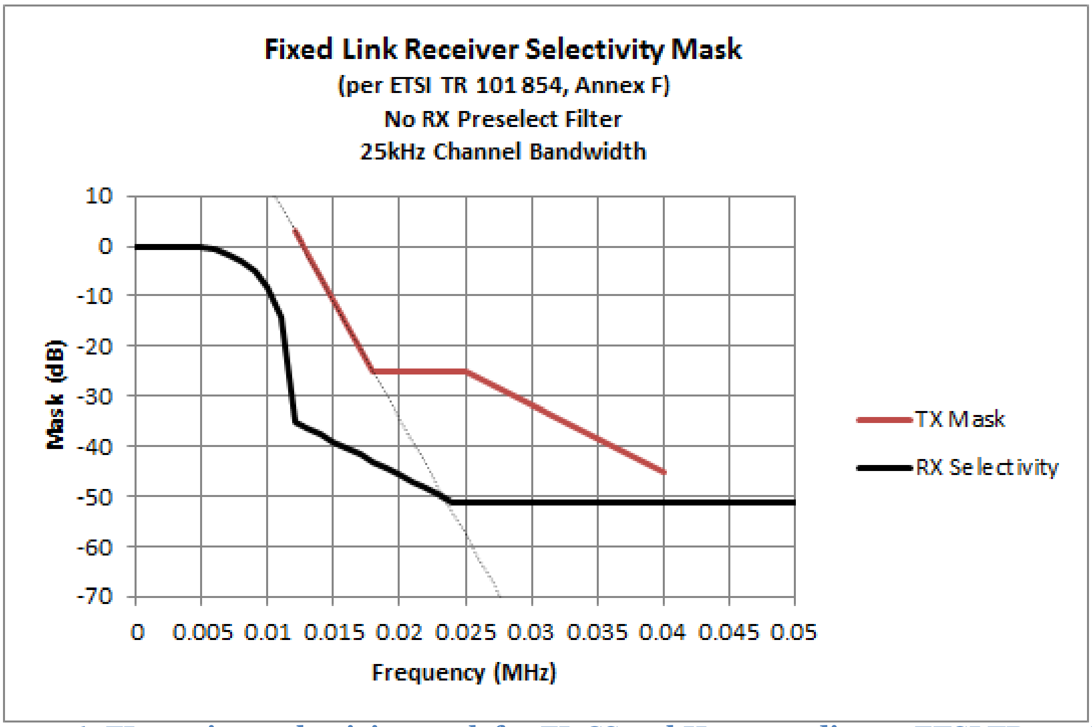


Figure 146: FL receiver selectivity mask for FL CS 25 kHz, according to ETSI TR 101 854, Annex F (no Preselect filter)

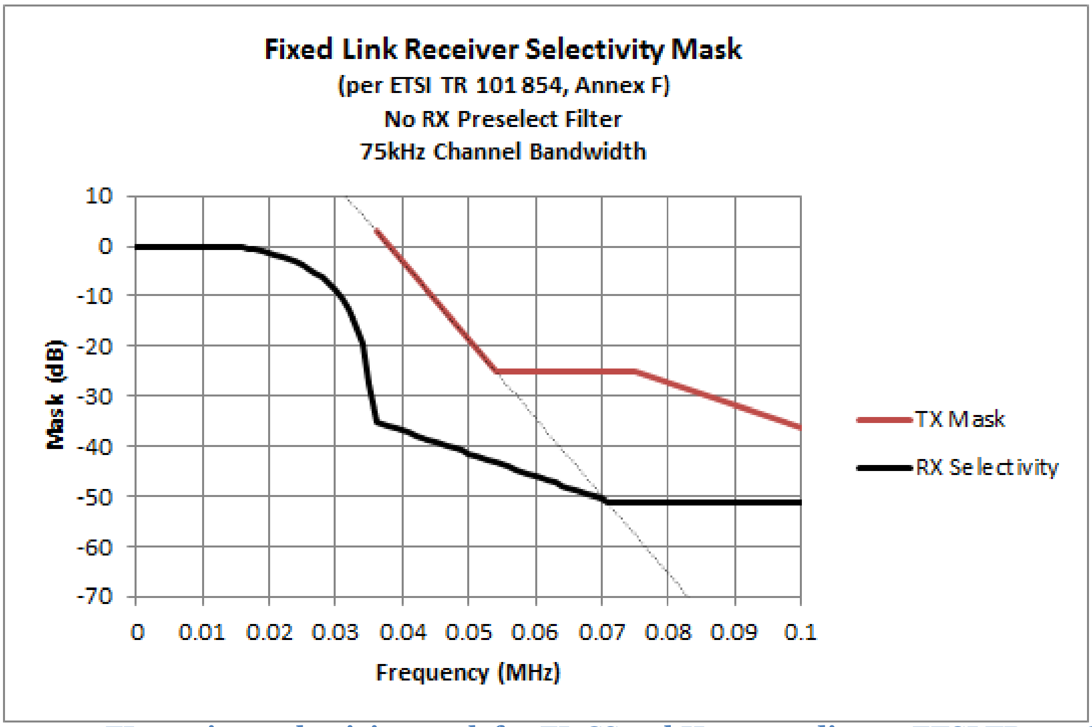


Figure 147: FL receiver selectivity mask for FL CS 75 kHz, according to ETSI TR 101 854, Annex F (no Preselect filter)

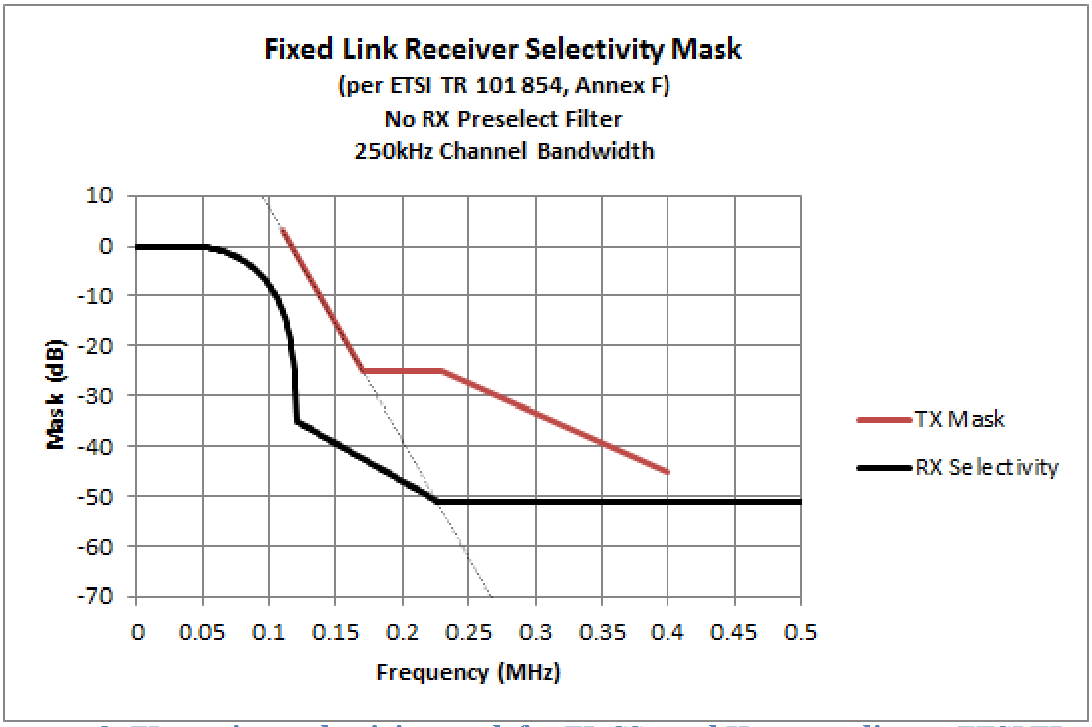


Figure 148: FL receiver selectivity mask for FL CS 250 kHz, according to ETSI TR 101 854, Annex F (no Preselect filter)

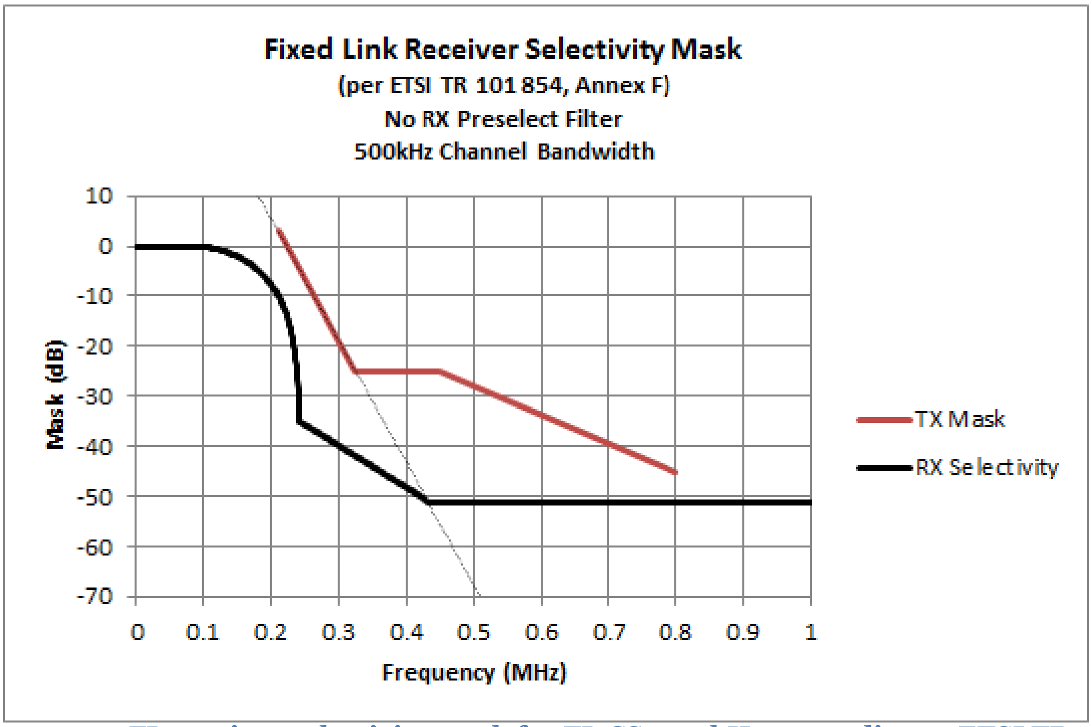


Figure 149: FL receiver selectivity mask for FL CS 500 kHz, according to ETSI TR 101 854, Annex F (no Preselect filter)

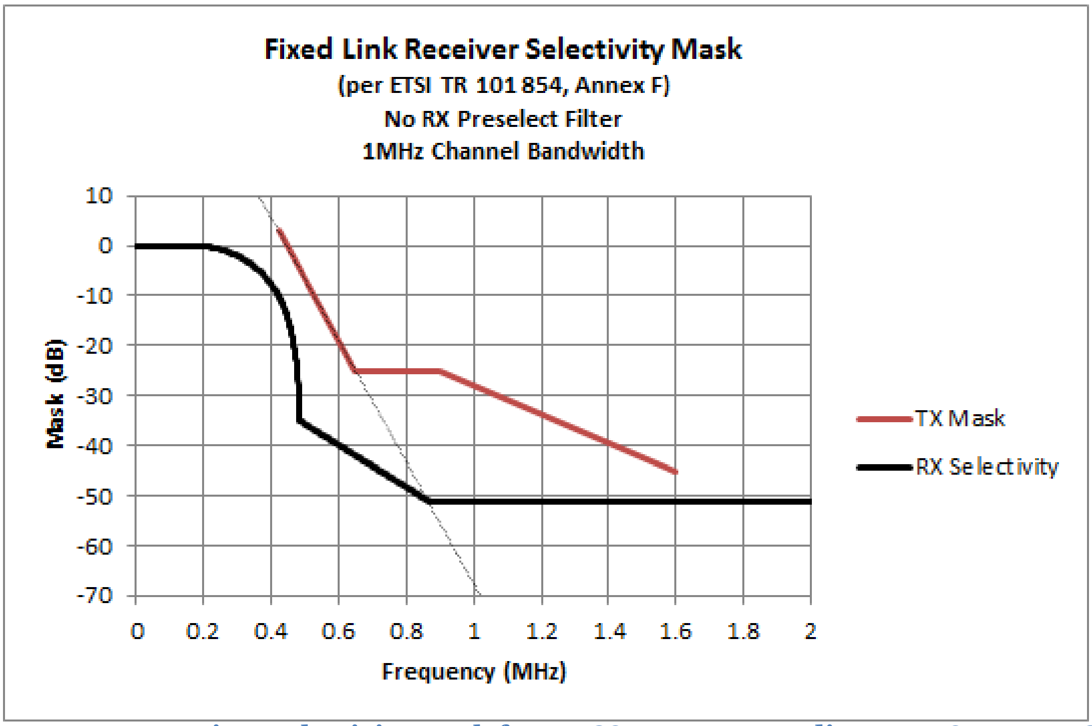


Figure 150: FL receiver selectivity mask for FL CS 1 MHz, according to ETSI TR 101 854, Annex F (no Preselect filter)

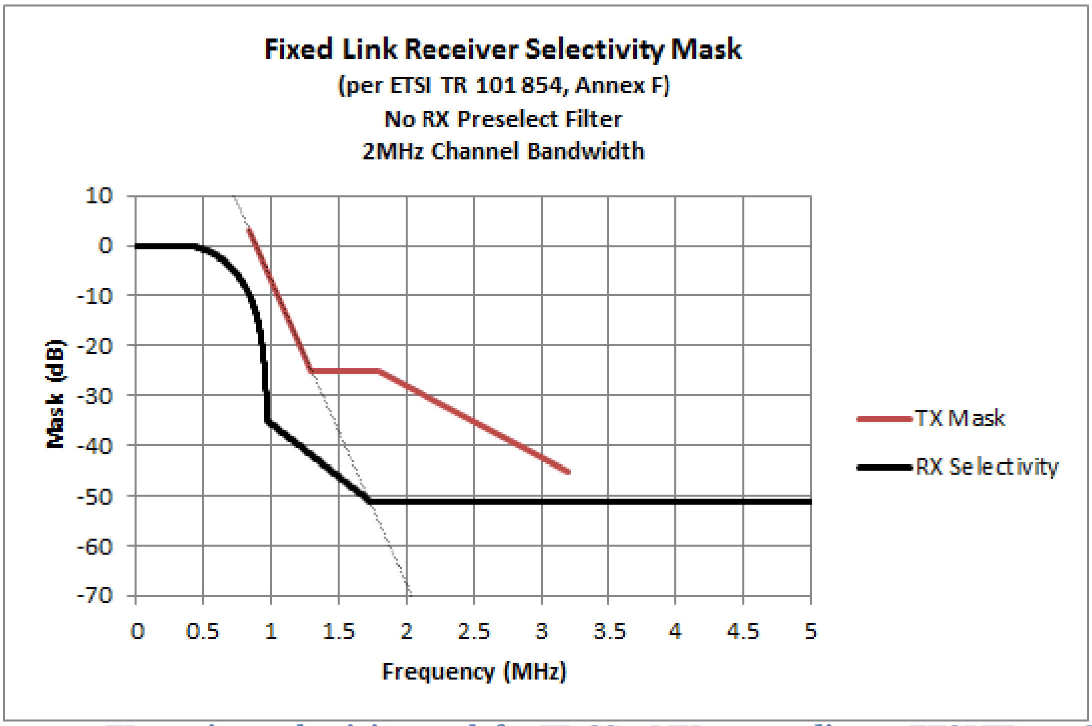


Figure 151: FL receiver selectivity mask for FL CS 2 MHz, according to ETSI TR 101 854, Annex F (no Preselect filter)

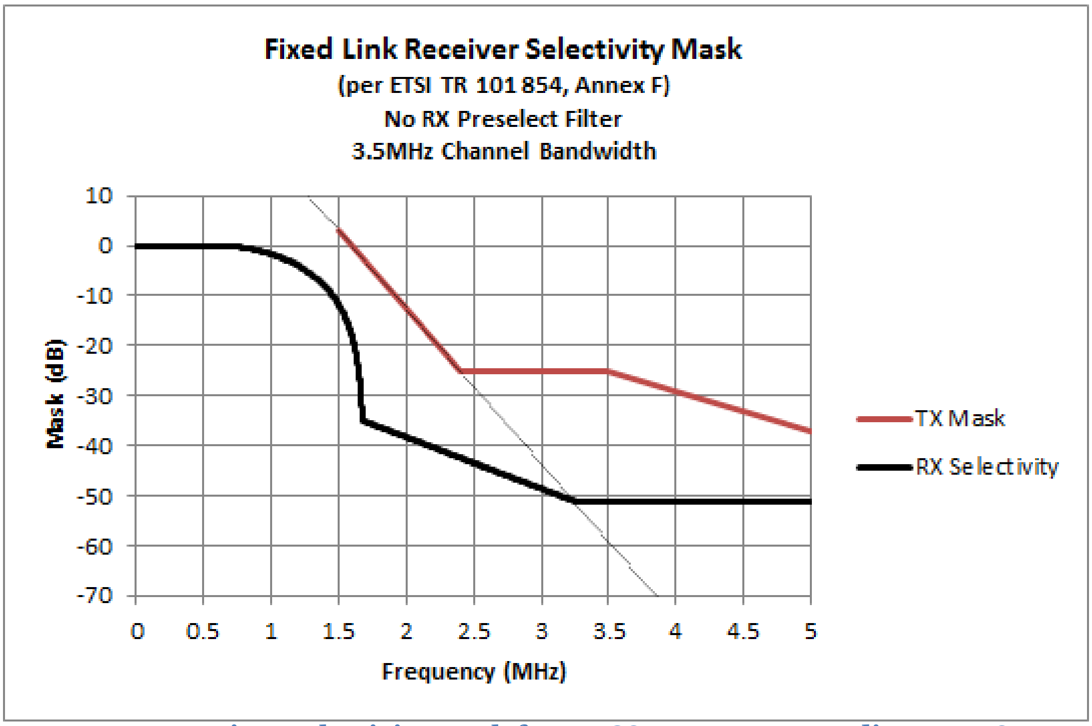


Figure 152: FL receiver selectivity mask for FL CS 3.5 MHz, according to ETSI TR 101 854, Annex F (no Preselect filter)

20. ANNEX 9: SENSIVITY ANALYSIS OF LONDON FULL NETWORK SIMULATION TO PROPAGATION MODEL

In Atoll, in the absence of propagation measurement data, the SPM propagation model in 'default mode' provides the best estimate of the actual propagation environment. In some extreme cases, the SPM may underestimate the RSSI generated by a network at a specific location.

An upper bound on the interference increase that may occur during such extreme case is obtained by comparing the pathloss predicted by the SPM model[11] with free-space LOS pathloss, as illustrated in the Figure 153 below.

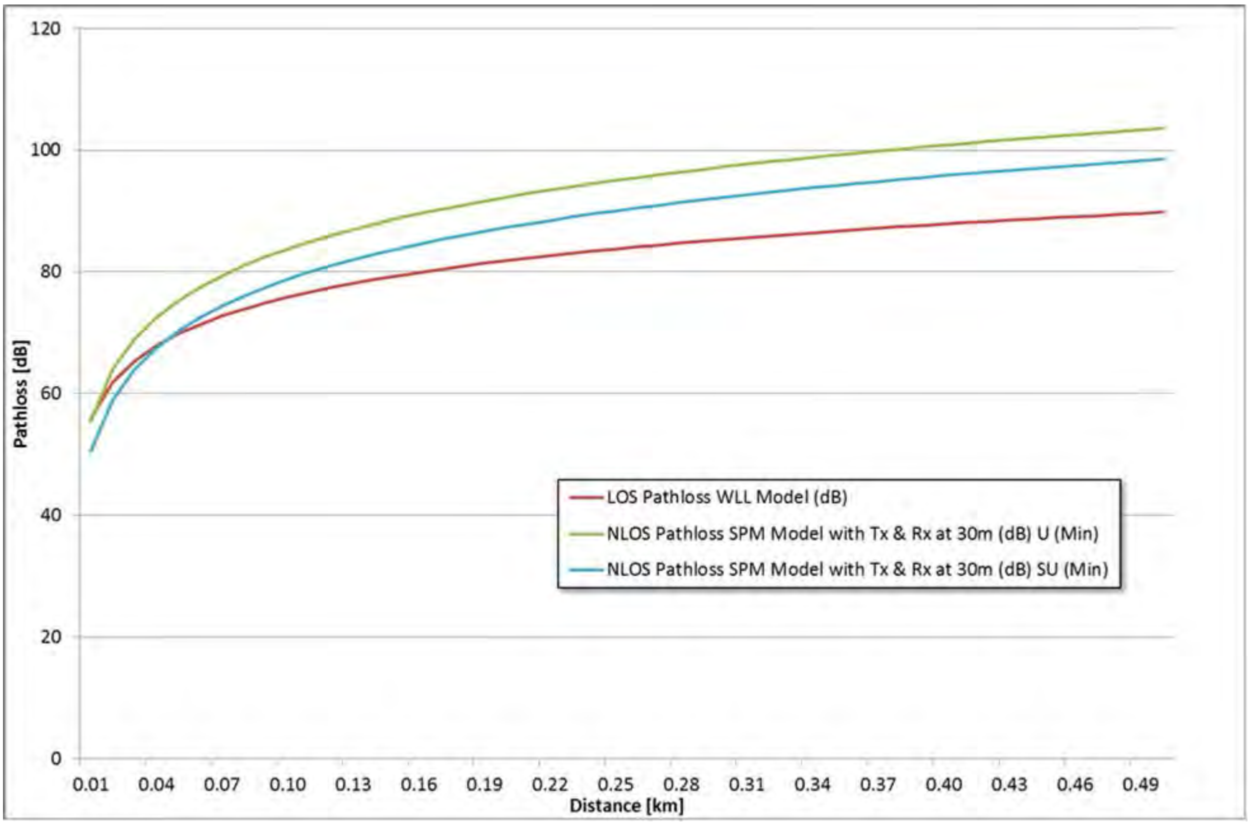


Figure 153: Comparison of free-space LOS (WLL) and SPM pathloss in urban and suburban environments

The pathloss delta between the free space LOS and SPM models would not exceed 15 dB within 500 m separation distance, as illustrated in Figure 154 below.

[11] The simulation from Section 6 use the uncalibrated SPM model with the so called "min" parameters values, which provides the closest prediction to free-space propagation

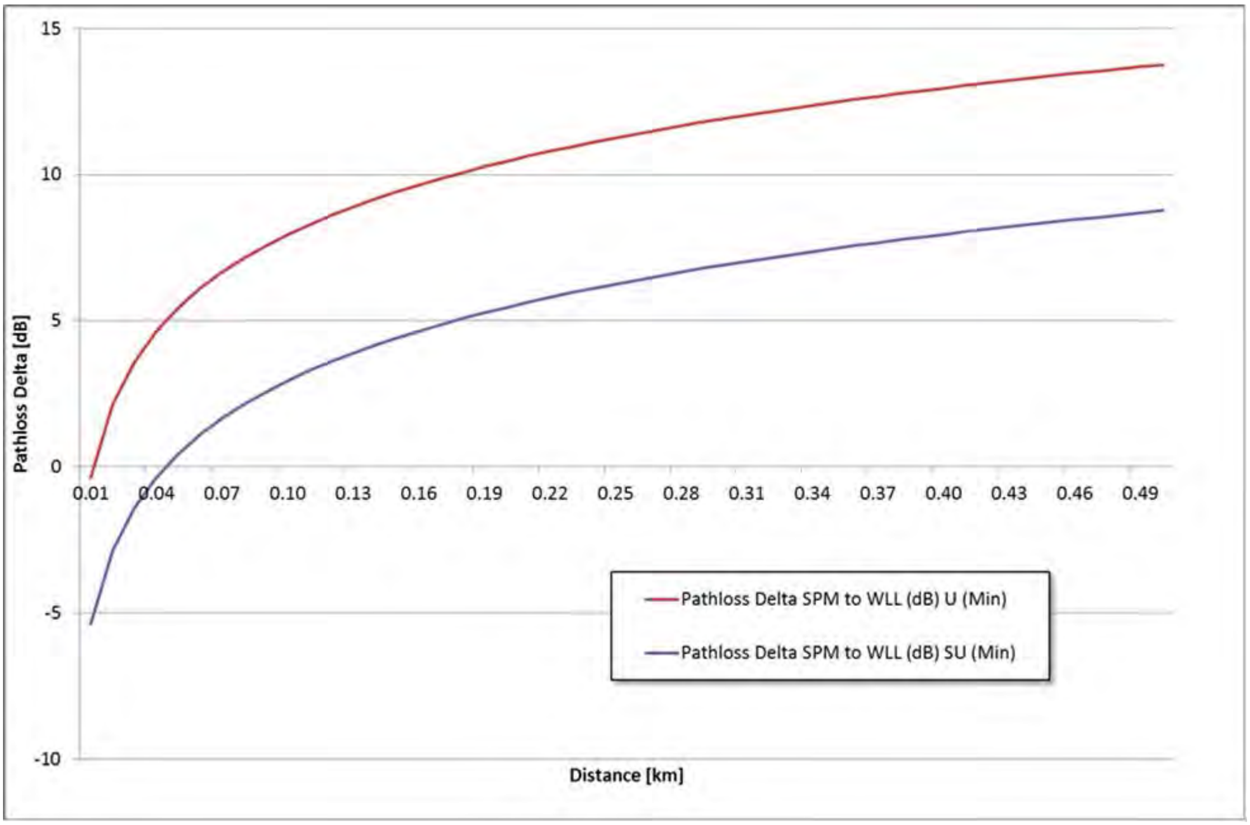


Figure 154: Pathloss difference between free-space LOS and SPM pathloss in urban and suburban environments

The study in Section 6 indicates that, even in extreme propagation cases (15 dB lower pathloss), SDL deployment in 1452-1492 MHz is compatible with FLs operating above 1492.5 MHz in the London area with the interference into 20 out of the 23 FLs being well below the noise floor and that an operator would be able to focus on a very low number of FLs, namely FLs 51, 265 and 266 when planning and engineering its network.

21. ANNEX 10: REFERENCE TABLES FOR EXTENDED NFD

Extended NFD provide a straightforward way to derive the interference level produced by an SDL Base Station to a specific FL Receiver, according to the following equation:

I = EIRP - Extended NFD – Pathloss + FL Rx Antenna Gain

Where EIRP is the transmit in-band power of an SDL base station, pathloss is the pathloss in dB between the SDL Tx antenna and the FL Rx antenna and FL Rx Antenna Gain is the antenna gain of the FL.

It should be noted that Extended NFD would vary depending on the assumption on the EIRP of the LTE base station. Extended NFDs are provided in this Annex for EIRP = 74 dBm/20 MHz, EIRP = 68 dBm/20 MHz and EIRP = 65 dBm/20 MHz, corresponding respectively to SDL EIRP assumptions for rural, suburban and urban scenarios.

As described in Section 4, 4 Extended NFDs are derived in order to provide indication of the impact of additional filtering either at Tx, at Rx or both at Tx and Rx:

- Extended NFD, Generic (Generic Preselect at FL Rx and generic LTE Tx emission),
- Extended NFD, Hi-Perf Rx (Hi-Perf Preselect at FL Rx and generic LTE Tx emission),
- Extended NFD, Hi-Perf Tx (Generic Preselect at FL Rx and Hi-Perf SDL Tx Filter),
- Extended NFD, Hi-Perf Tx and Rx (Hi-Perf Preselect at FL Rx and Hi-Perf SDL Tx Filter).

21.1 LTE EIRP = 74 dBm/20MHz

The Extended NFDs in this section were derived in line with the rural assumptions, i.e. SDL EIRP equal 74 dBm/20MHz.

21.1.1 FL CS 3.5 MHz

FL Channel	Generic (dB)	Hi-Perf Rx (dB)	Hi-Perf Tx (dB)	Hi-Perf Tx and Rx (dB)
1	74.4	74.2	88.5	125.2
2	91.8	92.7	98.4	133.5
3	95.8	96.2	104.7	143.1
4	99.4	99.7	109.3	150.6
5	102.9	103.2	113.0	156.9
6	106.4	106.7	116.1	161.8

Table 54: Extended NFDs, LTE EIRP = 74 dBm/20 MHz, FL CS = 3.5 MHz

21.1.2 FL CS 2 MHz

FL Channel	Generic (dB)	Hi-Perf Rx (dB)	Hi-Perf Tx (dB)	Hi-Perf Tx and Rx (dB)
1	67.9	68.6	76.2	122.7
2	81.4	82.5	87.6	146.8

3	91.3	94.4	94.2	160.2
4	94.5	96.4	98.9	159.7
5	97.0	98.4	102.7	162.6
6	99.3	100.4	105.8	166.4
7	101.4	102.4	108.4	170.5
8	103.5	104.4	110.7	174.3
9	105.5	106.4	112.8	177.6
10	107.5	108.4	114.6	179.9
11	109.4	110.4	116.3	181.2
12	111.3	112.4	117.9	181.8

Table 55: Extended NFDs, LTE EIRP = 74 dBm/20 MHz, FL CS = 2 MHz

21.1.3 FL CS 1 MHz

FL Channel	Generic (dB)	Hi-Perf Rx (dB)	Hi-Perf Tx (dB)	Hi-Perf Tx and Rx (dB)
1	67.1	69.5	71.0	125.1
2	72.1	73.0	79.9	125.5
3	75.4	75.9	85.4	139.5
4	88.8	96.9	89.5	170.4
5	91.4	97.0	92.8	164.9
6	93.5	97.9	95.5	162.3
7	95.3	98.9	97.9	162.2
8	96.9	99.9	100.0	163.2
9	98.3	100.9	101.8	164.7
10	99.6	101.9	103.5	166.5
11	100.8	102.9	105.0	168.4
12	102.0	103.9	106.5	170.3
13	103.1	104.9	107.8	172.3
14	104.2	105.9	109.0	174.2
15	105.2	106.9	110.2	175.9
16	106.3	107.9	111.3	177.5
17	107.3	108.9	112.3	178.8
18	108.3	109.9	113.3	179.9
19	109.2	110.9	114.2	180.6
20	110.2	111.9	115.1	181.2
21	111.2	112.9	115.9	181.6
22	112.1	113.9	116.7	181.8
23	113.0	114.9	117.5	182.0
24	113.9	115.9	118.3	182.1

Table 56: Extended NFDs, LTE EIRP = 74 dBm/20 MHz, FL CS = 1 MHz

21.1.4 FL CS 500 KHz

FL Channel	Generic (dB)	Hi-Perf Rx (dB)	Hi-Perf Tx (dB)	Hi-Perf Tx and Rx (dB)
1	65.6	69.9	67.8	125.5
2	70.7	73.7	73.8	125.8
3	73.9	75.9	78.2	125.8
4	74.8	76.1	81.5	125.7
5	75.3	75.9	84.2	138.8

6	86.3	99.9	86.5	162.6
7	88.2	99.9	88.5	168.2
8	89.9	99.9	90.4	172.3
9	91.3	99.9	92.0	169.3
10	92.6	100.2	93.5	166.7
11	93.8	100.7	94.8	165.5
12	94.9	101.2	96.1	165.1
13	95.9	101.7	97.3	165.1
14	96.9	102.2	98.4	165.4
15	97.8	102.7	99.5	165.8
16	98.6	103.2	100.4	166.5
17	99.4	103.7	101.4	167.2
18	100.1	104.2	102.3	168.0
19	100.8	104.7	103.1	168.9
20	101.5	105.2	103.9	169.8
21	102.1	105.7	104.7	170.7
22	102.8	106.2	105.4	171.7
23	103.4	106.7	106.1	172.6
24	104.0	107.2	106.8	173.5
25	104.6	107.7	107.5	174.4
26	105.1	108.2	108.1	175.3
27	105.7	108.7	108.7	176.1
28	106.2	109.2	109.3	176.9
29	106.8	109.7	109.9	177.7
30	107.3	110.2	110.5	178.4
31	107.8	110.7	111.0	179.0
32	108.3	111.2	111.5	179.5
33	108.8	111.7	112.0	180.0
34	109.3	112.2	112.5	180.4
35	109.8	112.7	113.0	180.7
36	110.3	113.2	113.5	181.0
37	110.8	113.7	114.0	181.3
38	111.3	114.2	114.4	181.5
39	111.7	114.7	114.9	181.6
40	112.2	115.2	115.3	181.8
41	112.7	115.7	115.7	181.9
42	113.1	116.2	116.1	182.0
43	113.6	116.7	116.5	182.0
44	114.0	117.2	116.9	182.1
45	114.5	117.7	117.3	182.1
46	114.9	118.2	117.7	182.2
47	115.3	118.7	118.1	182.2
48	115.8	119.2	118.4	182.2

Table 57: Extended NFDs, LTE EIRP = 74 dBm/20 MHz, FL CS = 500 kHz

21.1.5 FL CS 250 KHz

FL Channel	Generic (dB)	Hi-Perf Rx (dB)	Hi-Perf Tx (dB)	Hi-Perf Tx and Rx (dB)
1	65.2	71.3	66.5	125.8
2	68.2	74.9	69.3	125.6
3	71.1	76.7	72.5	125.8
4	72.8	76.7	75.1	125.9
5	75.0	78.9	77.2	125.9

6	76.0	78.9	79.1	125.9
7	76.7	79.0	80.7	125.8
8	77.2	79.1	82.2	125.8
9	77.6	78.9	83.6	141.2
10	77.9	78.9	84.8	142.5
11	85.9	102.8	86.0	162.5
12	86.9	102.9	87.0	164.6
13	87.9	102.9	88.1	167.2
14	88.8	102.9	89.0	169.9
15	89.7	102.9	89.9	172.2
16	90.5	102.9	90.8	172.9
17	91.3	102.9	91.6	172.2
18	92.0	102.9	92.4	170.9
19	92.7	103.0	93.1	169.8
20	93.4	103.3	93.8	169.1
21	94.0	103.5	94.5	168.6
22	94.6	103.8	95.2	168.2
23	95.2	104.0	95.8	168.0
24	95.8	104.3	96.4	167.9
25	96.3	104.5	97.0	167.9
26	96.8	104.8	97.6	168.0
27	97.3	105.0	98.1	168.2
28	97.8	105.3	98.7	168.4
29	98.3	105.5	99.2	168.6
30	98.7	105.8	99.7	168.9
31	99.2	106.0	100.2	169.2
32	99.6	106.3	100.7	169.5
33	100.0	106.5	101.1	169.9
34	100.4	106.8	101.6	170.3
35	100.8	107.0	102.0	170.7
36	101.2	107.3	102.5	171.1
37	101.6	107.5	102.9	171.5
38	102.0	107.8	103.3	171.9
39	102.3	108.0	103.7	172.3
40	102.7	108.3	104.1	172.8
41	103.0	108.5	104.5	173.2
42	103.4	108.8	104.9	173.7
43	103.7	109.0	105.2	174.1
44	104.0	109.3	105.6	174.5
45	104.4	109.5	106.0	174.9
46	104.7	109.8	106.3	175.4
47	105.0	110.0	106.6	175.8
48	105.3	110.3	107.0	176.2
49	105.6	110.5	107.3	176.6
50	105.9	110.8	107.6	177.0
51	106.2	111.0	107.9	177.3
52	106.5	111.3	108.3	177.7
53	106.8	111.5	108.6	178.0
54	107.1	111.8	108.9	178.4
55	107.4	112.0	109.2	178.7
56	107.6	112.3	109.5	179.0
57	107.9	112.5	109.8	179.3
58	108.2	112.8	110.0	179.5
59	108.5	113.0	110.3	179.8
60	108.7	113.3	110.6	180.0
61	109.0	113.5	110.9	180.2

62	109.2	113.8	111.1	180.4
63	109.5	114.0	111.4	180.6
64	109.8	114.3	111.7	180.8
65	110.0	114.5	111.9	180.9
66	110.3	114.8	112.2	181.0
67	110.5	115.0	112.4	181.2
68	110.8	115.3	112.7	181.3
69	111.0	115.5	112.9	181.4
70	111.3	115.8	113.1	181.5
71	111.5	116.0	113.4	181.6
72	111.7	116.3	113.6	181.7
73	112.0	116.5	113.8	181.7
74	112.2	116.8	114.1	181.8
75	112.4	117.0	114.3	181.8
76	112.7	117.3	114.5	181.9
77	112.9	117.5	114.7	181.9
78	113.1	117.8	115.0	182.0
79	113.4	118.0	115.2	182.0
80	113.6	118.3	115.4	182.0
81	113.8	118.5	115.6	182.1
82	114.0	118.8	115.8	182.1
83	114.3	119.0	116.0	182.1
84	114.5	119.3	116.2	182.1
85	114.7	119.5	116.4	182.1
86	114.9	119.8	116.6	182.2
87	115.1	120.0	116.8	182.2
88	115.3	120.3	117.0	182.2
89	115.6	120.5	117.2	182.2
90	115.8	120.8	117.4	182.2
91	116.0	121.0	117.6	182.2
92	116.2	121.3	117.8	182.2
93	116.4	121.5	118.0	182.2
94	116.6	121.8	118.2	182.2
95	116.8	122.0	118.3	182.2
96	117.0	122.3	118.5	182.2

Table 58: Extended NFDs, LTE EIRP = 74 dBm/20 MHz, FL CS = 250 kHz

21.1.6 FL CS 75 KHz

FL Channel	Generic (dB)	Hi-Perf Rx (dB)	Hi-Perf Tx (dB)	Hi-Perf Tx and Rx (dB)
1	65.2	74.3	65.9	125.7
2	65.9	75.3	66.4	125.9
3	66.6	76.4	67.1	125.9
4	67.4	77.5	67.9	125.8
5	68.4	78.6	68.8	125.8
6	69.4	79.7	69.8	125.8
7	70.4	80.7	70.8	125.8
8	71.2	80.9	71.8	125.8
9	72.0	80.9	72.6	125.9
10	72.7	80.9	73.5	125.9
11	73.4	80.9	74.2	125.9
12	74.0	80.9	74.9	125.9
13	74.5	80.9	75.6	125.9

14	75.3	82.5	76.3	125.9
15	76.0	83.1	76.9	125.9
16	76.4	83.1	77.5	125.9
17	76.9	83.1	78.1	125.9
18	77.3	83.1	78.6	125.9
19	77.7	83.1	79.2	125.9
20	78.0	83.2	79.7	125.9
21	78.4	83.2	80.2	125.9
22	78.7	83.2	80.6	125.9
23	79.0	83.2	81.1	125.9
24	79.2	83.3	81.6	125.9
25	79.5	83.3	82.0	125.9
26	79.7	83.4	82.4	125.9
27	79.9	83.1	82.8	144.8
28	80.1	83.1	83.2	145.0
29	80.3	83.1	83.6	145.3
30	80.5	83.1	84.0	145.7
31	80.7	83.1	84.4	146.1
32	80.8	83.1	84.8	146.5
33	81.0	83.1	85.1	147.0
34	84.0	89.4	85.5	153.2
35	85.8	106.9	85.8	162.7
36	86.1	106.9	86.1	163.6
37	86.4	106.9	86.5	164.1
38	86.7	107.0	86.8	164.7
39	87.1	107.0	87.1	165.3
40	87.4	107.0	87.4	166.0
41	87.7	107.0	87.7	166.8
42	88.0	107.0	88.0	167.5
43	88.2	107.0	88.3	168.3
44	88.5	107.0	88.6	169.0
45	88.8	107.0	88.9	169.7
46	89.1	107.1	89.2	170.4
47	89.4	107.1	89.4	171.1
48	89.6	107.1	89.7	171.7
49	89.9	107.1	90.0	172.3
50	90.1	107.1	90.2	172.8
51	90.4	107.1	90.5	173.3
52	90.6	107.1	90.7	173.6
53	90.9	107.1	91.0	173.9
54	91.1	107.1	91.2	174.0
55	91.4	107.1	91.5	174.1
56	91.6	107.1	91.7	174.1
57	91.8	107.1	92.0	174.0
58	92.0	107.1	92.2	173.9
59	92.3	107.1	92.4	173.7
60	92.5	107.1	92.6	173.6
61	92.7	107.2	92.9	173.4
62	92.9	107.2	93.1	173.2
63	93.1	107.3	93.3	173.1
64	93.3	107.4	93.5	172.9
65	93.5	107.5	93.7	172.8
66	93.7	107.5	93.9	172.7
67	94.0	107.6	94.1	172.5
68	94.1	107.7	94.3	172.4
69	94.3	107.8	94.6	172.3

70	94.5	107.8	94.8	172.2
71	94.7	107.9	94.9	172.1
72	94.9	108.0	95.1	172.1
73	95.1	108.1	95.3	172.0
74	95.3	108.1	95.5	172.0
75	95.5	108.2	95.7	171.9
76	95.7	108.3	95.9	171.9
77	95.8	108.4	96.1	171.9
78	96.0	108.4	96.3	171.9
79	96.2	108.5	96.5	171.8
80	96.4	108.6	96.6	171.8
81	96.5	108.7	96.8	171.9
82	96.7	108.7	97.0	171.9
83	96.9	108.8	97.2	171.9
84	97.0	108.9	97.3	171.9
85	97.2	109.0	97.5	171.9
86	97.4	109.0	97.7	172.0
87	97.5	109.1	97.8	172.0
88	97.7	109.2	98.0	172.1
89	97.8	109.3	98.2	172.1
90	98.0	109.3	98.3	172.2
91	98.2	109.4	98.5	172.2
92	98.3	109.5	98.7	172.3
93	98.5	109.6	98.8	172.3
94	98.6	109.6	99.0	172.4
95	98.8	109.7	99.1	172.5
96	98.9	109.8	99.3	172.6
97	99.0	109.9	99.4	172.6
98	99.2	109.9	99.6	172.7
99	99.3	110.0	99.7	172.8
100	99.5	110.1	99.9	172.9
101	99.6	110.2	100.0	173.0
102	99.8	110.2	100.2	173.1
103	99.9	110.3	100.3	173.1
104	100.0	110.4	100.5	173.2
105	100.2	110.5	100.6	173.3
106	100.3	110.5	100.7	173.4
107	100.4	110.6	100.9	173.5
108	100.6	110.7	101.0	173.6
109	100.7	110.8	101.2	173.7
110	100.8	110.8	101.3	173.8
111	101.0	110.9	101.4	173.9
112	101.1	111.0	101.6	174.0
113	101.2	111.1	101.7	174.1
114	101.4	111.1	101.8	174.3
115	101.5	111.2	102.0	174.4
116	101.6	111.3	102.1	174.5
117	101.7	111.4	102.2	174.6
118	101.9	111.4	102.4	174.7
119	102.0	111.5	102.5	174.8
120	102.1	111.6	102.6	174.9
121	102.2	111.7	102.7	175.0
122	102.3	111.7	102.9	175.1
123	102.5	111.8	103.0	175.2
124	102.6	111.9	103.1	175.4
125	102.7	112.0	103.2	175.5

126	102.8	112.0	103.4	175.6
127	102.9	112.1	103.5	175.7
128	103.0	112.2	103.6	175.8
129	103.2	112.3	103.7	175.9
130	103.3	112.3	103.8	176.0
131	103.4	112.4	104.0	176.1
132	103.5	112.5	104.1	176.2
133	103.6	112.6	104.2	176.3
134	103.7	112.6	104.3	176.5
135	103.8	112.7	104.4	176.6
136	103.9	112.8	104.5	176.7
137	104.0	112.9	104.7	176.8
138	104.1	112.9	104.8	176.9
139	104.3	113.0	104.9	177.0
140	104.4	113.1	105.0	177.1
141	104.5	113.2	105.1	177.2
142	104.6	113.2	105.2	177.3
143	104.7	113.3	105.3	177.4
144	104.8	113.4	105.4	177.5
145	104.9	113.5	105.5	177.6
146	105.0	113.5	105.6	177.7
147	105.1	113.6	105.8	177.8
148	105.2	113.7	105.9	177.9
149	105.3	113.8	106.0	178.0
150	105.4	113.8	106.1	178.1
151	105.5	113.9	106.2	178.2
152	105.6	114.0	106.3	178.3
153	105.7	114.1	106.4	178.4
154	105.8	114.1	106.5	178.5
155	105.9	114.2	106.6	178.6
156	106.0	114.3	106.7	178.7
157	106.1	114.4	106.8	178.8
158	106.2	114.4	106.9	178.9
159	106.3	114.5	107.0	178.9
160	106.4	114.6	107.1	179.0
161	106.5	114.7	107.2	179.1
162	106.6	114.7	107.3	179.2
163	106.7	114.8	107.4	179.3
164	106.8	114.9	107.5	179.3
165	106.8	115.0	107.6	179.4
166	106.9	115.0	107.7	179.5
167	107.0	115.1	107.8	179.6
168	107.1	115.2	107.9	179.7
169	107.2	115.3	108.0	179.7
170	107.3	115.3	108.1	179.8
171	107.4	115.4	108.2	179.9
172	107.5	115.5	108.2	179.9
173	107.6	115.6	108.3	180.0
174	107.7	115.6	108.4	180.1
175	107.8	115.7	108.5	180.1
176	107.8	115.8	108.6	180.2
177	107.9	115.9	108.7	180.3
178	108.0	115.9	108.8	180.3
179	108.1	116.0	108.9	180.4
180	108.2	116.1	109.0	180.4
181	108.3	116.2	109.1	180.5

182	108.4	116.2	109.2	180.5
183	108.5	116.3	109.2	180.6
184	108.5	116.4	109.3	180.6
185	108.6	116.5	109.4	180.7
186	108.7	116.5	109.5	180.7
187	108.8	116.6	109.6	180.8
188	108.9	116.7	109.7	180.8
189	109.0	116.8	109.8	180.9
190	109.0	116.8	109.9	180.9
191	109.1	116.9	109.9	181.0
192	109.2	117.0	110.0	181.0
193	109.3	117.1	110.1	181.1
194	109.4	117.1	110.2	181.1
195	109.5	117.2	110.3	181.1
196	109.5	117.3	110.4	181.2
197	109.6	117.4	110.4	181.2
198	109.7	117.4	110.5	181.2
199	109.8	117.5	110.6	181.3
200	109.9	117.6	110.7	181.3
201	110.0	117.7	110.8	181.3
202	110.0	117.7	110.8	181.4
203	110.1	117.8	110.9	181.4
204	110.2	117.9	111.0	181.4
205	110.3	118.0	111.1	181.5
206	110.3	118.0	111.2	181.5
207	110.4	118.1	111.2	181.5
208	110.5	118.2	111.3	181.5
209	110.6	118.3	111.4	181.6
210	110.7	118.3	111.5	181.6
211	110.7	118.4	111.6	181.6
212	110.8	118.5	111.6	181.6
213	110.9	118.6	111.7	181.7
214	111.0	118.6	111.8	181.7
215	111.0	118.7	111.9	181.7
216	111.1	118.8	111.9	181.7
217	111.2	118.9	112.0	181.7
218	111.3	118.9	112.1	181.8
219	111.3	119.0	112.2	181.8
220	111.4	119.1	112.3	181.8
221	111.5	119.2	112.3	181.8
222	111.6	119.2	112.4	181.8
223	111.6	119.3	112.5	181.8
224	111.7	119.4	112.6	181.9
225	111.8	119.5	112.6	181.9
226	111.9	119.5	112.7	181.9
227	111.9	119.6	112.8	181.9
228	112.0	119.7	112.8	181.9
229	112.1	119.8	112.9	181.9
230	112.2	119.8	113.0	181.9
231	112.2	119.9	113.1	181.9
232	112.3	120.0	113.1	182.0
233	112.4	120.1	113.2	182.0
234	112.5	120.1	113.3	182.0
235	112.5	120.2	113.3	182.0
236	112.6	120.3	113.4	182.0
237	112.7	120.4	113.5	182.0

238	112.7	120.4	113.6	182.0
239	112.8	120.5	113.6	182.0
240	112.9	120.6	113.7	182.0
241	113.0	120.7	113.8	182.0
242	113.0	120.7	113.8	182.1
243	113.1	120.8	113.9	182.1
244	113.2	120.9	114.0	182.1
245	113.2	121.0	114.0	182.1
246	113.3	121.0	114.1	182.1
247	113.4	121.1	114.2	182.1
248	113.4	121.2	114.2	182.1
249	113.5	121.3	114.3	182.1
250	113.6	121.3	114.4	182.1
251	113.6	121.4	114.4	182.1
252	113.7	121.5	114.5	182.1
253	113.8	121.6	114.6	182.1
254	113.8	121.6	114.6	182.1
255	113.9	121.7	114.7	182.1
256	114.0	121.8	114.8	182.1
257	114.1	121.9	114.8	182.2
258	114.1	121.9	114.9	182.2
259	114.2	122.0	115.0	182.2
260	114.3	122.1	115.0	182.2
261	114.3	122.2	115.1	182.2
262	114.4	122.2	115.2	182.2
263	114.5	122.3	115.2	182.2
264	114.5	122.4	115.3	182.2
265	114.6	122.5	115.4	182.2
266	114.6	122.5	115.4	182.2
267	114.7	122.6	115.5	182.2
268	114.8	122.7	115.6	182.2
269	114.8	122.8	115.6	182.2
270	114.9	122.8	115.7	182.2
271	115.0	122.9	115.7	182.2
272	115.0	123.0	115.8	182.2
273	115.1	123.1	115.9	182.2
274	115.2	123.1	115.9	182.2
275	115.2	123.2	116.0	182.2
276	115.3	123.3	116.1	182.2
277	115.4	123.4	116.1	182.2
278	115.4	123.4	116.2	182.2
279	115.5	123.5	116.2	182.2
280	115.5	123.6	116.3	182.2
281	115.6	123.7	116.4	182.2
282	115.7	123.7	116.4	182.2
283	115.7	123.8	116.5	182.2
284	115.8	123.9	116.5	182.2
285	115.9	124.0	116.6	182.2
286	115.9	124.0	116.7	182.2
287	116.0	124.1	116.7	182.2
288	116.0	124.2	116.8	182.2
289	116.1	124.3	116.8	182.2
290	116.2	124.3	116.9	182.2
291	116.2	124.4	117.0	182.2
292	116.3	124.5	117.0	182.2
293	116.4	124.6	117.1	182.2

294	116.4	124.6	117.1	182.2
295	116.5	124.7	117.2	182.2
296	116.5	124.8	117.2	182.2
297	116.6	124.9	117.3	182.2
298	116.7	124.9	117.4	182.3
299	116.7	125.0	117.4	182.3
300	116.8	125.1	117.5	182.3
301	116.8	125.2	117.5	182.3
302	116.9	125.2	117.6	182.3
303	117.0	125.3	117.6	182.3
304	117.0	125.4	117.7	182.3
305	117.1	125.5	117.8	182.3
306	117.1	125.5	117.8	182.3
307	117.2	125.6	117.9	182.3
308	117.3	125.7	117.9	182.3
309	117.3	125.8	118.0	182.3
310	117.4	125.8	118.0	182.3
311	117.4	125.9	118.1	182.3
312	117.5	126.0	118.2	182.3
313	117.5	126.1	118.2	182.3
314	117.6	126.1	118.3	182.3
315	117.7	126.2	118.3	182.3
316	117.7	126.3	118.4	182.3
317	117.8	126.4	118.4	182.3
318	117.8	126.4	118.5	182.3
319	117.9	126.5	118.5	182.3
320	117.9	126.6	118.6	182.3

Table 59: Extended NFDs, LTE EIRP = 74 dBm/20 MHz, FL CS = 75 kHz

21.1.7 FL CS 25 KHz

FL Channel	Generic (dB)	Hi-Perf Rx (dB)	Hi-Perf Tx (dB)	Hi-Perf Tx and Rx (dB)
1	65.5	78.5	65.7	125.8
2	65.6	78.9	65.9	125.8
3	65.8	79.2	66.1	125.9
4	66.0	79.6	66.2	125.9
5	66.2	79.9	66.4	125.9
6	66.4	80.3	66.6	125.9
7	66.7	80.6	66.9	125.9
8	66.9	81.0	67.1	125.9
9	67.2	81.4	67.4	125.9
10	67.5	81.7	67.6	125.9
11	67.7	82.1	67.9	125.9
12	68.0	82.4	68.2	125.9
13	68.4	82.8	68.5	125.9
14	68.7	83.2	68.8	125.9
15	69.0	83.5	69.2	125.9
16	69.3	83.9	69.5	125.9
17	69.7	84.3	69.8	125.9
18	70.0	84.6	70.2	125.9
19	70.3	85.0	70.5	125.9
20	70.7	85.4	70.8	125.9
21	71.0	85.5	71.1	125.9

22	71.3	85.5	71.4	125.9
23	71.6	85.5	71.8	125.9
24	71.9	85.5	72.1	125.9
25	72.1	85.5	72.3	125.9
26	72.4	85.5	72.6	125.9
27	72.7	85.5	72.9	125.9
28	72.9	85.5	73.2	125.9
29	73.2	85.5	73.5	125.9
30	73.4	85.5	73.7	125.9
31	73.7	85.5	74.0	125.9
32	73.9	85.5	74.2	125.9
33	74.1	85.5	74.5	125.9
34	74.3	85.5	74.7	125.9
35	74.6	85.5	74.9	125.9
36	74.8	85.5	75.2	125.9
37	75.0	85.5	75.4	125.9
38	75.2	85.5	75.6	125.9
39	75.4	85.5	75.9	125.9
40	75.6	85.5	76.1	125.9
41	76.0	87.7	76.3	125.9
42	76.2	87.7	76.5	125.9
43	76.4	87.7	76.7	125.9
44	76.5	87.7	76.9	125.9
45	76.7	87.7	77.1	125.9
46	76.9	87.7	77.3	125.9
47	77.1	87.7	77.5	125.9
48	77.3	87.7	77.7	125.9
49	77.4	87.7	77.9	125.9
50	77.6	87.7	78.1	125.9
51	77.8	87.7	78.3	125.9
52	77.9	87.7	78.4	125.9
53	78.1	87.7	78.6	125.9
54	78.3	87.7	78.8	125.9
55	78.4	87.7	79.0	125.9
56	78.6	87.7	79.2	125.9
57	78.7	87.7	79.3	125.9
58	78.9	87.7	79.5	125.9
59	79.0	87.8	79.7	125.9
60	79.2	87.8	79.8	125.9
61	79.3	87.8	80.0	125.9
62	79.4	87.8	80.2	125.9
63	79.6	87.8	80.3	125.9
64	79.7	87.8	80.5	125.9
65	79.8	87.8	80.6	125.9
66	80.0	87.8	80.8	125.9
67	80.1	87.8	81.0	125.9
68	80.2	87.8	81.1	125.9
69	80.3	87.8	81.3	125.9
70	80.5	87.8	81.4	125.9
71	80.6	87.9	81.6	125.9
72	80.7	87.9	81.7	125.9
73	80.8	87.9	81.9	125.9
74	80.9	87.9	82.0	125.9
75	81.0	87.9	82.1	125.9
76	81.2	87.9	82.3	125.9
77	81.3	88.0	82.4	125.9

78	81.4	88.0	82.6	125.9
79	81.5	88.0	82.7	125.9
80	81.6	88.0	82.8	125.9
81	81.7	87.7	83.0	149.0
82	81.8	87.7	83.1	149.1
83	81.9	87.7	83.2	149.2
84	82.0	87.7	83.4	149.3
85	82.1	87.7	83.5	149.4
86	82.2	87.7	83.6	149.5
87	82.3	87.7	83.8	149.6
88	82.3	87.7	83.9	149.8
89	82.4	87.7	84.0	149.9
90	82.5	87.7	84.1	150.0
91	82.6	87.7	84.3	150.2
92	82.7	87.7	84.4	150.3
93	82.8	87.7	84.5	150.5
94	82.8	87.7	84.6	150.6
95	82.9	87.7	84.8	150.8
96	83.0	87.7	84.9	150.9
97	83.1	87.7	85.0	151.1
98	83.2	87.7	85.1	151.3
99	83.2	87.7	85.2	151.5
100	83.3	87.7	85.3	151.7
101	85.4	111.1	85.5	161.8
102	85.6	111.1	85.6	162.2
103	85.7	111.2	85.7	162.6
104	85.8	111.2	85.8	163.0
105	85.9	111.2	85.9	163.5
106	86.0	111.2	86.0	163.7
107	86.1	111.2	86.1	163.9
108	86.2	111.2	86.2	164.1
109	86.3	111.2	86.4	164.2
110	86.4	111.2	86.5	164.4
111	86.6	111.2	86.6	164.6
112	86.7	111.3	86.7	164.8
113	86.8	111.3	86.8	164.9
114	86.9	111.3	86.9	165.1
115	87.0	111.3	87.0	165.3
116	87.1	111.3	87.1	165.6
117	87.2	111.3	87.2	165.8
118	87.3	111.3	87.3	166.0
119	87.4	111.3	87.4	166.3
120	87.5	111.3	87.5	166.5
121	87.6	111.4	87.6	166.7
122	87.7	111.4	87.7	167.0
123	87.8	111.4	87.8	167.2
124	87.9	111.4	87.9	167.5
125	88.0	111.4	88.0	167.7
126	88.1	111.4	88.1	167.9
127	88.2	111.4	88.2	168.2
128	88.3	111.4	88.3	168.4
129	88.4	111.5	88.4	168.6
130	88.5	111.5	88.5	168.9
131	88.6	111.5	88.6	169.1
132	88.7	111.5	88.7	169.3
133	88.8	111.5	88.8	169.5

134	88.9	111.5	88.9	169.8
135	88.9	111.5	89.0	170.0
136	89.0	111.5	89.1	170.2
137	89.1	111.5	89.2	170.4
138	89.2	111.6	89.3	170.7
139	89.3	111.6	89.3	170.9
140	89.4	111.6	89.4	171.1
141	89.5	111.6	89.5	171.3
142	89.6	111.6	89.6	171.5
143	89.7	111.6	89.7	171.7
144	89.8	111.6	89.8	171.9
145	89.8	111.6	89.9	172.1
146	89.9	111.6	90.0	172.3
147	90.0	111.7	90.1	172.5
148	90.1	111.7	90.1	172.7
149	90.2	111.7	90.2	172.9
150	90.3	111.7	90.3	173.1
151	90.4	111.7	90.4	173.3
152	90.4	111.7	90.5	173.4
153	90.5	111.7	90.6	173.6
154	90.6	111.7	90.7	173.8
155	90.7	111.7	90.7	173.9
156	90.8	111.7	90.8	174.1
157	90.9	111.7	90.9	174.2
158	90.9	111.7	91.0	174.4
159	91.0	111.7	91.1	174.5
160	91.1	111.7	91.2	174.6
161	91.2	111.7	91.2	174.7
162	91.3	111.7	91.3	174.9
163	91.4	111.7	91.4	175.0
164	91.4	111.7	91.5	175.1
165	91.5	111.7	91.6	175.2
166	91.6	111.7	91.6	175.3
167	91.7	111.7	91.7	175.3
168	91.7	111.7	91.8	175.4
169	91.8	111.7	91.9	175.5
170	91.9	111.7	92.0	175.5
171	92.0	111.7	92.0	175.6
172	92.1	111.7	92.1	175.7
173	92.1	111.7	92.2	175.7
174	92.2	111.7	92.3	175.8
175	92.3	111.7	92.3	175.8
176	92.4	111.7	92.4	175.8
177	92.4	111.7	92.5	175.9
178	92.5	111.7	92.6	175.9
179	92.6	111.7	92.6	175.9
180	92.7	111.7	92.7	175.9
181	92.7	111.7	92.8	175.9
182	92.8	111.8	92.9	176.0
183	92.9	111.8	92.9	176.0
184	93.0	111.8	93.0	176.0
185	93.0	111.8	93.1	176.0
186	93.1	111.9	93.2	176.0
187	93.2	111.9	93.2	176.0
188	93.2	111.9	93.3	176.0
189	93.3	111.9	93.4	176.0

190	93.4	112.0	93.4	176.0
191	93.5	112.0	93.5	176.0
192	93.5	112.0	93.6	176.0
193	93.6	112.0	93.7	176.0
194	93.7	112.1	93.7	176.0
195	93.7	112.1	93.8	176.0
196	93.8	112.1	93.9	176.0
197	93.9	112.1	93.9	175.9
198	93.9	112.2	94.0	175.9
199	94.0	112.2	94.1	175.9
200	94.1	112.2	94.1	175.9
201	94.1	112.2	94.2	175.9
202	94.2	112.3	94.3	175.9
203	94.3	112.3	94.3	175.9
204	94.3	112.3	94.4	175.9
205	94.4	112.3	94.5	175.9
206	94.5	112.4	94.6	175.9
207	94.5	112.4	94.6	175.8
208	94.6	112.4	94.7	175.8
209	94.7	112.4	94.8	175.8
210	94.7	112.5	94.8	175.8
211	94.8	112.5	94.9	175.8
212	94.9	112.5	94.9	175.8
213	94.9	112.5	95.0	175.8
214	95.0	112.6	95.1	175.8
215	95.1	112.6	95.1	175.8
216	95.1	112.6	95.2	175.8
217	95.2	112.6	95.3	175.8
218	95.3	112.7	95.3	175.8
219	95.3	112.7	95.4	175.7
220	95.4	112.7	95.5	175.7
221	95.4	112.7	95.5	175.7
222	95.5	112.8	95.6	175.7
223	95.6	112.8	95.7	175.7
224	95.6	112.8	95.7	175.7
225	95.7	112.8	95.8	175.7
226	95.8	112.9	95.8	175.7
227	95.8	112.9	95.9	175.7
228	95.9	112.9	96.0	175.7
229	95.9	112.9	96.0	175.7
230	96.0	113.0	96.1	175.7
231	96.1	113.0	96.2	175.7
232	96.1	113.0	96.2	175.7
233	96.2	113.0	96.3	175.7
234	96.2	113.1	96.3	175.7
235	96.3	113.1	96.4	175.7
236	96.4	113.1	96.5	175.7
237	96.4	113.1	96.5	175.7
238	96.5	113.2	96.6	175.7
239	96.5	113.2	96.6	175.7
240	96.6	113.2	96.7	175.7
241	96.7	113.2	96.8	175.7
242	96.7	113.3	96.8	175.7
243	96.8	113.3	96.9	175.7
244	96.8	113.3	96.9	175.7
245	96.9	113.3	97.0	175.7

246	96.9	113.4	97.0	175.8
247	97.0	113.4	97.1	175.8
248	97.1	113.4	97.2	175.8
249	97.1	113.4	97.2	175.8
250	97.2	113.5	97.3	175.8
251	97.2	113.5	97.3	175.8
252	97.3	113.5	97.4	175.8
253	97.3	113.5	97.4	175.8
254	97.4	113.6	97.5	175.8
255	97.4	113.6	97.6	175.8
256	97.5	113.6	97.6	175.8
257	97.6	113.6	97.7	175.9
258	97.6	113.7	97.7	175.9
259	97.7	113.7	97.8	175.9
260	97.7	113.7	97.8	175.9
261	97.8	113.7	97.9	175.9
262	97.8	113.8	97.9	175.9
263	97.9	113.8	98.0	175.9
264	97.9	113.8	98.1	175.9
265	98.0	113.8	98.1	176.0
266	98.0	113.9	98.2	176.0
267	98.1	113.9	98.2	176.0
268	98.2	113.9	98.3	176.0
269	98.2	113.9	98.3	176.0
270	98.3	114.0	98.4	176.0
271	98.3	114.0	98.4	176.1
272	98.4	114.0	98.5	176.1
273	98.4	114.0	98.5	176.1
274	98.5	114.1	98.6	176.1
275	98.5	114.1	98.7	176.1
276	98.6	114.1	98.7	176.1
277	98.6	114.1	98.8	176.2
278	98.7	114.2	98.8	176.2
279	98.7	114.2	98.9	176.2
280	98.8	114.2	98.9	176.2
281	98.8	114.2	99.0	176.2
282	98.9	114.3	99.0	176.3
283	98.9	114.3	99.1	176.3
284	99.0	114.3	99.1	176.3
285	99.0	114.3	99.2	176.3
286	99.1	114.4	99.2	176.3
287	99.1	114.4	99.3	176.4
288	99.2	114.4	99.3	176.4
289	99.2	114.4	99.4	176.4
290	99.3	114.5	99.4	176.4
291	99.3	114.5	99.5	176.4
292	99.4	114.5	99.5	176.5
293	99.4	114.5	99.6	176.5
294	99.5	114.6	99.6	176.5
295	99.5	114.6	99.7	176.5
296	99.6	114.6	99.7	176.6
297	99.6	114.6	99.8	176.6
298	99.7	114.7	99.8	176.6
299	99.7	114.7	99.9	176.6
300	99.8	114.7	99.9	176.6
301	99.8	114.7	100.0	176.7

302	99.9	114.8	100.0	176.7
303	99.9	114.8	100.1	176.7
304	100.0	114.8	100.1	176.7
305	100.0	114.8	100.2	176.8
306	100.1	114.9	100.2	176.8
307	100.1	114.9	100.3	176.8
308	100.2	114.9	100.3	176.8
309	100.2	114.9	100.4	176.9
310	100.3	115.0	100.4	176.9
311	100.3	115.0	100.5	176.9
312	100.4	115.0	100.5	176.9
313	100.4	115.0	100.6	177.0
314	100.4	115.1	100.6	177.0
315	100.5	115.1	100.7	177.0
316	100.5	115.1	100.7	177.0
317	100.6	115.1	100.7	177.1
318	100.6	115.2	100.8	177.1
319	100.7	115.2	100.8	177.1
320	100.7	115.2	100.9	177.2
321	100.8	115.2	100.9	177.2
322	100.8	115.3	101.0	177.2
323	100.9	115.3	101.0	177.2
324	100.9	115.3	101.1	177.3
325	101.0	115.3	101.1	177.3
326	101.0	115.4	101.2	177.3
327	101.0	115.4	101.2	177.3
328	101.1	115.4	101.3	177.4
329	101.1	115.4	101.3	177.4
330	101.2	115.5	101.3	177.4
331	101.2	115.5	101.4	177.4
332	101.3	115.5	101.4	177.5
333	101.3	115.5	101.5	177.5
334	101.4	115.6	101.5	177.5
335	101.4	115.6	101.6	177.6
336	101.4	115.6	101.6	177.6
337	101.5	115.6	101.7	177.6
338	101.5	115.7	101.7	177.6
339	101.6	115.7	101.8	177.7
340	101.6	115.7	101.8	177.7
341	101.7	115.7	101.8	177.7
342	101.7	115.8	101.9	177.7
343	101.7	115.8	101.9	177.8
344	101.8	115.8	102.0	177.8
345	101.8	115.8	102.0	177.8
346	101.9	115.9	102.1	177.9
347	101.9	115.9	102.1	177.9
348	102.0	115.9	102.1	177.9
349	102.0	115.9	102.2	177.9
350	102.0	116.0	102.2	178.0
351	102.1	116.0	102.3	178.0
352	102.1	116.0	102.3	178.0
353	102.2	116.0	102.4	178.1
354	102.2	116.1	102.4	178.1
355	102.3	116.1	102.4	178.1
356	102.3	116.1	102.5	178.1
357	102.3	116.1	102.5	178.2

358	102.4	116.2	102.6	178.2
359	102.4	116.2	102.6	178.2
360	102.5	116.2	102.7	178.2
361	102.5	116.2	102.7	178.3
362	102.5	116.3	102.7	178.3
363	102.6	116.3	102.8	178.3
364	102.6	116.3	102.8	178.4
365	102.7	116.3	102.9	178.4
366	102.7	116.4	102.9	178.4
367	102.8	116.4	103.0	178.4
368	102.8	116.4	103.0	178.5
369	102.8	116.4	103.0	178.5
370	102.9	116.5	103.1	178.5
371	102.9	116.5	103.1	178.5
372	103.0	116.5	103.2	178.6
373	103.0	116.5	103.2	178.6
374	103.0	116.6	103.2	178.6
375	103.1	116.6	103.3	178.6
376	103.1	116.6	103.3	178.7
377	103.2	116.6	103.4	178.7
378	103.2	116.7	103.4	178.7
379	103.2	116.7	103.4	178.8
380	103.3	116.7	103.5	178.8
381	103.3	116.7	103.5	178.8
382	103.4	116.8	103.6	178.8
383	103.4	116.8	103.6	178.9
384	103.4	116.8	103.6	178.9
385	103.5	116.8	103.7	178.9
386	103.5	116.9	103.7	178.9
387	103.6	116.9	103.8	179.0
388	103.6	116.9	103.8	179.0
389	103.6	116.9	103.8	179.0
390	103.7	117.0	103.9	179.0
391	103.7	117.0	103.9	179.1
392	103.7	117.0	104.0	179.1
393	103.8	117.0	104.0	179.1
394	103.8	117.1	104.0	179.1
395	103.9	117.1	104.1	179.2
396	103.9	117.1	104.1	179.2
397	103.9	117.1	104.2	179.2
398	104.0	117.2	104.2	179.2
399	104.0	117.2	104.2	179.3
400	104.1	117.2	104.3	179.3
401	104.1	117.2	104.3	179.3
402	104.1	117.3	104.4	179.3
403	104.2	117.3	104.4	179.4
404	104.2	117.3	104.4	179.4
405	104.2	117.3	104.5	179.4
406	104.3	117.4	104.5	179.4
407	104.3	117.4	104.5	179.5
408	104.4	117.4	104.6	179.5
409	104.4	117.4	104.6	179.5
410	104.4	117.5	104.7	179.5
411	104.5	117.5	104.7	179.6
412	104.5	117.5	104.7	179.6
413	104.5	117.5	104.8	179.6

414	104.6	117.6	104.8	179.6
415	104.6	117.6	104.8	179.6
416	104.6	117.6	104.9	179.7
417	104.7	117.6	104.9	179.7
418	104.7	117.7	105.0	179.7
419	104.8	117.7	105.0	179.7
420	104.8	117.7	105.0	179.8
421	104.8	117.7	105.1	179.8
422	104.9	117.8	105.1	179.8
423	104.9	117.8	105.1	179.8
424	104.9	117.8	105.2	179.8
425	105.0	117.8	105.2	179.9
426	105.0	117.9	105.3	179.9
427	105.0	117.9	105.3	179.9
428	105.1	117.9	105.3	179.9
429	105.1	117.9	105.4	180.0
430	105.2	118.0	105.4	180.0
431	105.2	118.0	105.4	180.0
432	105.2	118.0	105.5	180.0
433	105.3	118.0	105.5	180.0
434	105.3	118.1	105.5	180.1
435	105.3	118.1	105.6	180.1
436	105.4	118.1	105.6	180.1
437	105.4	118.1	105.6	180.1
438	105.4	118.2	105.7	180.1
439	105.5	118.2	105.7	180.2
440	105.5	118.2	105.8	180.2
441	105.5	118.2	105.8	180.2
442	105.6	118.3	105.8	180.2
443	105.6	118.3	105.9	180.2
444	105.6	118.3	105.9	180.3
445	105.7	118.3	105.9	180.3
446	105.7	118.4	106.0	180.3
447	105.8	118.4	106.0	180.3
448	105.8	118.4	106.0	180.3
449	105.8	118.4	106.1	180.4
450	105.9	118.5	106.1	180.4
451	105.9	118.5	106.1	180.4
452	105.9	118.5	106.2	180.4
453	106.0	118.5	106.2	180.4
454	106.0	118.6	106.2	180.4
455	106.0	118.6	106.3	180.5
456	106.1	118.6	106.3	180.5
457	106.1	118.6	106.4	180.5
458	106.1	118.7	106.4	180.5
459	106.2	118.7	106.4	180.5
460	106.2	118.7	106.5	180.6
461	106.2	118.7	106.5	180.6
462	106.3	118.8	106.5	180.6
463	106.3	118.8	106.6	180.6
464	106.3	118.8	106.6	180.6
465	106.4	118.8	106.6	180.6
466	106.4	118.9	106.7	180.7
467	106.4	118.9	106.7	180.7
468	106.5	118.9	106.7	180.7
469	106.5	118.9	106.8	180.7

470	106.5	119.0	106.8	180.7
471	106.6	119.0	106.8	180.7
472	106.6	119.0	106.9	180.8
473	106.6	119.0	106.9	180.8
474	106.7	119.1	106.9	180.8
475	106.7	119.1	107.0	180.8
476	106.7	119.1	107.0	180.8
477	106.8	119.1	107.0	180.8
478	106.8	119.2	107.1	180.8
479	106.8	119.2	107.1	180.9
480	106.9	119.2	107.1	180.9
481	106.9	119.2	107.2	180.9
482	106.9	119.3	107.2	180.9
483	107.0	119.3	107.2	180.9
484	107.0	119.3	107.3	180.9
485	107.0	119.3	107.3	180.9
486	107.1	119.4	107.3	181.0
487	107.1	119.4	107.4	181.0
488	107.1	119.4	107.4	181.0
489	107.1	119.4	107.4	181.0
490	107.2	119.5	107.5	181.0
491	107.2	119.5	107.5	181.0
492	107.2	119.5	107.5	181.0
493	107.3	119.5	107.6	181.1
494	107.3	119.6	107.6	181.1
495	107.3	119.6	107.6	181.1
496	107.4	119.6	107.6	181.1
497	107.4	119.6	107.7	181.1
498	107.4	119.7	107.7	181.1
499	107.5	119.7	107.7	181.1
500	107.5	119.7	107.8	181.1
501	107.5	119.7	107.8	181.2
502	107.6	119.8	107.8	181.2
503	107.6	119.8	107.9	181.2
504	107.6	119.8	107.9	181.2
505	107.7	119.8	107.9	181.2
506	107.7	119.9	108.0	181.2
507	107.7	119.9	108.0	181.2
508	107.7	119.9	108.0	181.2
509	107.8	119.9	108.1	181.2
510	107.8	120.0	108.1	181.3
511	107.8	120.0	108.1	181.3
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513	107.9	120.0	108.2	181.3
514	107.9	120.1	108.2	181.3
515	108.0	120.1	108.2	181.3
516	108.0	120.1	108.3	181.3
517	108.0	120.1	108.3	181.3
518	108.1	120.2	108.3	181.3
519	108.1	120.2	108.4	181.4
520	108.1	120.2	108.4	181.4
521	108.1	120.2	108.4	181.4
522	108.2	120.3	108.5	181.4
523	108.2	120.3	108.5	181.4
524	108.2	120.3	108.5	181.4
525	108.3	120.3	108.6	181.4

526	108.3	120.4	108.6	181.4
527	108.3	120.4	108.6	181.4
528	108.4	120.4	108.6	181.4
529	108.4	120.4	108.7	181.5
530	108.4	120.5	108.7	181.5
531	108.4	120.5	108.7	181.5
532	108.5	120.5	108.8	181.5
533	108.5	120.5	108.8	181.5
534	108.5	120.6	108.8	181.5
535	108.6	120.6	108.9	181.5
536	108.6	120.6	108.9	181.5
537	108.6	120.6	108.9	181.5
538	108.7	120.7	108.9	181.5
539	108.7	120.7	109.0	181.5
540	108.7	120.7	109.0	181.6
541	108.7	120.7	109.0	181.6
542	108.8	120.8	109.1	181.6
543	108.8	120.8	109.1	181.6
544	108.8	120.8	109.1	181.6
545	108.9	120.8	109.2	181.6
546	108.9	120.9	109.2	181.6
547	108.9	120.9	109.2	181.6
548	108.9	120.9	109.2	181.6
549	109.0	120.9	109.3	181.6
550	109.0	121.0	109.3	181.6
551	109.0	121.0	109.3	181.6
552	109.1	121.0	109.4	181.6
553	109.1	121.0	109.4	181.7
554	109.1	121.1	109.4	181.7
555	109.2	121.1	109.4	181.7
556	109.2	121.1	109.5	181.7
557	109.2	121.1	109.5	181.7
558	109.2	121.2	109.5	181.7
559	109.3	121.2	109.6	181.7
560	109.3	121.2	109.6	181.7
561	109.3	121.2	109.6	181.7
562	109.4	121.3	109.7	181.7
563	109.4	121.3	109.7	181.7
564	109.4	121.3	109.7	181.7
565	109.4	121.3	109.7	181.7
566	109.5	121.4	109.8	181.7
567	109.5	121.4	109.8	181.7
568	109.5	121.4	109.8	181.8
569	109.6	121.4	109.9	181.8
570	109.6	121.5	109.9	181.8
571	109.6	121.5	109.9	181.8
572	109.6	121.5	109.9	181.8
573	109.7	121.5	110.0	181.8
574	109.7	121.6	110.0	181.8
575	109.7	121.6	110.0	181.8
576	109.7	121.6	110.0	181.8
577	109.8	121.6	110.1	181.8
578	109.8	121.7	110.1	181.8
579	109.8	121.7	110.1	181.8
580	109.9	121.7	110.2	181.8
581	109.9	121.7	110.2	181.8

582	109.9	121.8	110.2	181.8
583	109.9	121.8	110.2	181.8
584	110.0	121.8	110.3	181.8
585	110.0	121.8	110.3	181.9
586	110.0	121.9	110.3	181.9
587	110.1	121.9	110.4	181.9
588	110.1	121.9	110.4	181.9
589	110.1	121.9	110.4	181.9
590	110.1	122.0	110.4	181.9
591	110.2	122.0	110.5	181.9
592	110.2	122.0	110.5	181.9
593	110.2	122.0	110.5	181.9
594	110.2	122.1	110.5	181.9
595	110.3	122.1	110.6	181.9
596	110.3	122.1	110.6	181.9
597	110.3	122.1	110.6	181.9
598	110.4	122.2	110.7	181.9
599	110.4	122.2	110.7	181.9
600	110.4	122.2	110.7	181.9
601	110.4	122.2	110.7	181.9
602	110.5	122.3	110.8	181.9
603	110.5	122.3	110.8	181.9
604	110.5	122.3	110.8	181.9
605	110.5	122.3	110.8	181.9
606	110.6	122.4	110.9	181.9
607	110.6	122.4	110.9	181.9
608	110.6	122.4	110.9	182.0
609	110.6	122.4	111.0	182.0
610	110.7	122.5	111.0	182.0
611	110.7	122.5	111.0	182.0
612	110.7	122.5	111.0	182.0
613	110.8	122.5	111.1	182.0
614	110.8	122.6	111.1	182.0
615	110.8	122.6	111.1	182.0
616	110.8	122.6	111.1	182.0
617	110.9	122.6	111.2	182.0
618	110.9	122.7	111.2	182.0
619	110.9	122.7	111.2	182.0
620	110.9	122.7	111.2	182.0
621	111.0	122.7	111.3	182.0
622	111.0	122.8	111.3	182.0
623	111.0	122.8	111.3	182.0
624	111.0	122.8	111.4	182.0
625	111.1	122.8	111.4	182.0
626	111.1	122.9	111.4	182.0
627	111.1	122.9	111.4	182.0
628	111.1	122.9	111.5	182.0
629	111.2	122.9	111.5	182.0
630	111.2	123.0	111.5	182.0
631	111.2	123.0	111.5	182.0
632	111.3	123.0	111.6	182.0
633	111.3	123.0	111.6	182.0
634	111.3	123.1	111.6	182.0
635	111.3	123.1	111.6	182.0
636	111.4	123.1	111.7	182.0
637	111.4	123.1	111.7	182.1

638	111.4	123.2	111.7	182.1
639	111.4	123.2	111.7	182.1
640	111.5	123.2	111.8	182.1
641	111.5	123.2	111.8	182.1
642	111.5	123.3	111.8	182.1
643	111.5	123.3	111.8	182.1
644	111.6	123.3	111.9	182.1
645	111.6	123.3	111.9	182.1
646	111.6	123.4	111.9	182.1
647	111.6	123.4	111.9	182.1
648	111.7	123.4	112.0	182.1
649	111.7	123.4	112.0	182.1
650	111.7	123.5	112.0	182.1
651	111.7	123.5	112.1	182.1
652	111.8	123.5	112.1	182.1
653	111.8	123.5	112.1	182.1
654	111.8	123.6	112.1	182.1
655	111.8	123.6	112.2	182.1
656	111.9	123.6	112.2	182.1
657	111.9	123.6	112.2	182.1
658	111.9	123.7	112.2	182.1
659	111.9	123.7	112.3	182.1
660	112.0	123.7	112.3	182.1
661	112.0	123.7	112.3	182.1
662	112.0	123.8	112.3	182.1
663	112.0	123.8	112.4	182.1
664	112.1	123.8	112.4	182.1
665	112.1	123.8	112.4	182.1
666	112.1	123.9	112.4	182.1
667	112.1	123.9	112.5	182.1
668	112.2	123.9	112.5	182.1
669	112.2	123.9	112.5	182.1
670	112.2	124.0	112.5	182.1
671	112.2	124.0	112.6	182.1
672	112.3	124.0	112.6	182.1
673	112.3	124.0	112.6	182.1
674	112.3	124.1	112.6	182.1
675	112.3	124.1	112.6	182.1
676	112.4	124.1	112.7	182.1
677	112.4	124.1	112.7	182.1
678	112.4	124.2	112.7	182.1
679	112.4	124.2	112.7	182.1
680	112.5	124.2	112.8	182.1
681	112.5	124.2	112.8	182.1
682	112.5	124.3	112.8	182.1
683	112.5	124.3	112.8	182.1
684	112.6	124.3	112.9	182.2
685	112.6	124.3	112.9	182.2
686	112.6	124.4	112.9	182.2
687	112.6	124.4	112.9	182.2
688	112.7	124.4	113.0	182.2
689	112.7	124.4	113.0	182.2
690	112.7	124.5	113.0	182.2
691	112.7	124.5	113.0	182.2
692	112.8	124.5	113.1	182.2
693	112.8	124.5	113.1	182.2

694	112.8	124.6	113.1	182.2
695	112.8	124.6	113.1	182.2
696	112.8	124.6	113.2	182.2
697	112.9	124.6	113.2	182.2
698	112.9	124.7	113.2	182.2
699	112.9	124.7	113.2	182.2
700	112.9	124.7	113.3	182.2
701	113.0	124.7	113.3	182.2
702	113.0	124.8	113.3	182.2
703	113.0	124.8	113.3	182.2
704	113.0	124.8	113.3	182.2
705	113.1	124.8	113.4	182.2
706	113.1	124.9	113.4	182.2
707	113.1	124.9	113.4	182.2
708	113.1	124.9	113.4	182.2
709	113.2	124.9	113.5	182.2
710	113.2	125.0	113.5	182.2
711	113.2	125.0	113.5	182.2
712	113.2	125.0	113.5	182.2
713	113.3	125.0	113.6	182.2
714	113.3	125.1	113.6	182.2
715	113.3	125.1	113.6	182.2
716	113.3	125.1	113.6	182.2
717	113.3	125.1	113.7	182.2
718	113.4	125.2	113.7	182.2
719	113.4	125.2	113.7	182.2
720	113.4	125.2	113.7	182.2
721	113.4	125.2	113.7	182.2
722	113.5	125.3	113.8	182.2
723	113.5	125.3	113.8	182.2
724	113.5	125.3	113.8	182.2
725	113.5	125.3	113.8	182.2
726	113.6	125.4	113.9	182.2
727	113.6	125.4	113.9	182.2
728	113.6	125.4	113.9	182.2
729	113.6	125.4	113.9	182.2
730	113.6	125.5	114.0	182.2
731	113.7	125.5	114.0	182.2
732	113.7	125.5	114.0	182.2
733	113.7	125.5	114.0	182.2
734	113.7	125.6	114.0	182.2
735	113.8	125.6	114.1	182.2
736	113.8	125.6	114.1	182.2
737	113.8	125.6	114.1	182.2
738	113.8	125.7	114.1	182.2
739	113.9	125.7	114.2	182.2
740	113.9	125.7	114.2	182.2
741	113.9	125.7	114.2	182.2
742	113.9	125.8	114.2	182.2
743	113.9	125.8	114.2	182.2
744	114.0	125.8	114.3	182.2
745	114.0	125.8	114.3	182.2
746	114.0	125.9	114.3	182.2
747	114.0	125.9	114.3	182.2
748	114.1	125.9	114.4	182.2
749	114.1	125.9	114.4	182.2

750	114.1	126.0	114.4	182.2
751	114.1	126.0	114.4	182.2
752	114.1	126.0	114.4	182.2
753	114.2	126.0	114.5	182.2
754	114.2	126.1	114.5	182.2
755	114.2	126.1	114.5	182.2
756	114.2	126.1	114.5	182.2
757	114.3	126.1	114.6	182.2
758	114.3	126.2	114.6	182.2
759	114.3	126.2	114.6	182.2
760	114.3	126.2	114.6	182.2
761	114.3	126.2	114.6	182.2
762	114.4	126.3	114.7	182.2
763	114.4	126.3	114.7	182.2
764	114.4	126.3	114.7	182.2
765	114.4	126.3	114.7	182.2
766	114.5	126.4	114.8	182.2
767	114.5	126.4	114.8	182.2
768	114.5	126.4	114.8	182.2
769	114.5	126.4	114.8	182.2
770	114.5	126.5	114.8	182.2
771	114.6	126.5	114.9	182.2
772	114.6	126.5	114.9	182.2
773	114.6	126.5	114.9	182.2
774	114.6	126.6	114.9	182.2
775	114.7	126.6	115.0	182.2
776	114.7	126.6	115.0	182.2
777	114.7	126.6	115.0	182.2
778	114.7	126.7	115.0	182.2
779	114.7	126.7	115.0	182.2
780	114.8	126.7	115.1	182.2
781	114.8	126.7	115.1	182.2
782	114.8	126.8	115.1	182.2
783	114.8	126.8	115.1	182.2
784	114.9	126.8	115.2	182.2
785	114.9	126.8	115.2	182.2
786	114.9	126.9	115.2	182.2
787	114.9	126.9	115.2	182.2
788	114.9	126.9	115.2	182.2
789	115.0	126.9	115.3	182.2
790	115.0	127.0	115.3	182.2
791	115.0	127.0	115.3	182.2
792	115.0	127.0	115.3	182.2
793	115.0	127.0	115.3	182.2
794	115.1	127.1	115.4	182.2
795	115.1	127.1	115.4	182.2
796	115.1	127.1	115.4	182.2
797	115.1	127.1	115.4	182.2
798	115.2	127.2	115.4	182.2
799	115.2	127.2	115.5	182.2
800	115.2	127.2	115.5	182.2
801	115.2	127.2	115.5	182.2
802	115.2	127.3	115.5	182.2
803	115.3	127.3	115.6	182.2
804	115.3	127.3	115.6	182.3
805	115.3	127.3	115.6	182.3

806	115.3	127.4	115.6	182.3
807	115.3	127.4	115.6	182.3
808	115.4	127.4	115.7	182.3
809	115.4	127.4	115.7	182.3
810	115.4	127.5	115.7	182.3
811	115.4	127.5	115.7	182.3
812	115.5	127.5	115.7	182.3
813	115.5	127.5	115.8	182.3
814	115.5	127.6	115.8	182.3
815	115.5	127.6	115.8	182.3
816	115.5	127.6	115.8	182.3
817	115.6	127.6	115.8	182.3
818	115.6	127.7	115.9	182.3
819	115.6	127.7	115.9	182.3
820	115.6	127.7	115.9	182.3
821	115.6	127.7	115.9	182.3
822	115.7	127.8	116.0	182.3
823	115.7	127.8	116.0	182.3
824	115.7	127.8	116.0	182.3
825	115.7	127.8	116.0	182.3
826	115.7	127.9	116.0	182.3
827	115.8	127.9	116.1	182.3
828	115.8	127.9	116.1	182.3
829	115.8	127.9	116.1	182.3
830	115.8	128.0	116.1	182.3
831	115.9	128.0	116.1	182.3
832	115.9	128.0	116.2	182.3
833	115.9	128.0	116.2	182.3
834	115.9	128.1	116.2	182.3
835	115.9	128.1	116.2	182.3
836	116.0	128.1	116.2	182.3
837	116.0	128.1	116.3	182.3
838	116.0	128.2	116.3	182.3
839	116.0	128.2	116.3	182.3
840	116.0	128.2	116.3	182.3
841	116.1	128.2	116.3	182.3
842	116.1	128.3	116.4	182.3
843	116.1	128.3	116.4	182.3
844	116.1	128.3	116.4	182.3
845	116.1	128.3	116.4	182.3
846	116.2	128.4	116.4	182.3
847	116.2	128.4	116.5	182.3
848	116.2	128.4	116.5	182.3
849	116.2	128.4	116.5	182.3
850	116.2	128.5	116.5	182.3
851	116.3	128.5	116.5	182.3
852	116.3	128.5	116.6	182.3
853	116.3	128.5	116.6	182.3
854	116.3	128.6	116.6	182.3
855	116.3	128.6	116.6	182.3
856	116.4	128.6	116.6	182.3
857	116.4	128.6	116.7	182.3
858	116.4	128.7	116.7	182.3
859	116.4	128.7	116.7	182.3
860	116.4	128.7	116.7	182.3
861	116.5	128.7	116.7	182.3

862	116.5	128.8	116.8	182.3
863	116.5	128.8	116.8	182.3
864	116.5	128.8	116.8	182.3
865	116.5	128.8	116.8	182.3
866	116.6	128.9	116.8	182.3
867	116.6	128.9	116.9	182.3
868	116.6	128.9	116.9	182.3
869	116.6	128.9	116.9	182.3
870	116.6	129.0	116.9	182.3
871	116.7	129.0	116.9	182.3
872	116.7	129.0	117.0	182.3
873	116.7	129.0	117.0	182.3
874	116.7	129.1	117.0	182.3
875	116.7	129.1	117.0	182.3
876	116.8	129.1	117.0	182.3
877	116.8	129.1	117.1	182.3
878	116.8	129.2	117.1	182.3
879	116.8	129.2	117.1	182.3
880	116.8	129.2	117.1	182.3
881	116.9	129.2	117.1	182.3
882	116.9	129.3	117.2	182.3
883	116.9	129.3	117.2	182.3
884	116.9	129.3	117.2	182.3
885	116.9	129.3	117.2	182.3
886	117.0	129.4	117.2	182.3
887	117.0	129.4	117.2	182.3
888	117.0	129.4	117.3	182.3
889	117.0	129.4	117.3	182.3
890	117.0	129.5	117.3	182.3
891	117.1	129.5	117.3	182.3
892	117.1	129.5	117.3	182.3
893	117.1	129.5	117.4	182.3
894	117.1	129.6	117.4	182.3
895	117.1	129.6	117.4	182.3
896	117.2	129.6	117.4	182.3
897	117.2	129.6	117.4	182.3
898	117.2	129.7	117.5	182.3
899	117.2	129.7	117.5	182.3
900	117.2	129.7	117.5	182.3
901	117.3	129.7	117.5	182.3
902	117.3	129.8	117.5	182.3
903	117.3	129.8	117.6	182.3
904	117.3	129.8	117.6	182.3
905	117.3	129.8	117.6	182.3
906	117.4	129.9	117.6	182.3
907	117.4	129.9	117.6	182.3
908	117.4	129.9	117.6	182.3
909	117.4	129.9	117.7	182.3
910	117.4	130.0	117.7	182.3
911	117.4	130.0	117.7	182.3
912	117.5	130.0	117.7	182.3
913	117.5	130.0	117.7	182.3
914	117.5	130.1	117.8	182.3
915	117.5	130.1	117.8	182.3
916	117.5	130.1	117.8	182.3
917	117.6	130.1	117.8	182.3

918	117.6	130.2	117.8	182.3
919	117.6	130.2	117.9	182.3
920	117.6	130.2	117.9	182.3
921	117.6	130.2	117.9	182.3
922	117.7	130.3	117.9	182.3
923	117.7	130.3	117.9	182.3
924	117.7	130.3	117.9	182.3
925	117.7	130.3	118.0	182.3
926	117.7	130.4	118.0	182.3
927	117.8	130.4	118.0	182.3
928	117.8	130.4	118.0	182.3
929	117.8	130.4	118.0	182.3
930	117.8	130.5	118.1	182.3
931	117.8	130.5	118.1	182.3
932	117.8	130.5	118.1	182.3
933	117.9	130.5	118.1	182.3
934	117.9	130.6	118.1	182.3
935	117.9	130.6	118.2	182.3
936	117.9	130.6	118.2	182.3
937	117.9	130.6	118.2	182.3
938	118.0	130.7	118.2	182.3
939	118.0	130.7	118.2	182.3
940	118.0	130.7	118.2	182.3
941	118.0	130.7	118.3	182.3
942	118.0	130.8	118.3	182.3
943	118.1	130.8	118.3	182.3
944	118.1	130.8	118.3	182.3
945	118.1	130.8	118.3	182.3
946	118.1	130.9	118.4	182.3
947	118.1	130.9	118.4	182.3
948	118.1	130.9	118.4	182.3
949	118.2	130.9	118.4	182.3
950	118.2	131.0	118.4	182.3
951	118.2	131.0	118.4	182.3
952	118.2	131.0	118.5	182.3
953	118.2	131.0	118.5	182.3
954	118.3	131.1	118.5	182.3
955	118.3	131.1	118.5	182.3
956	118.3	131.1	118.5	182.3
957	118.3	131.1	118.6	182.3
958	118.3	131.2	118.6	182.3
959	118.4	131.2	118.6	182.3
960	118.4	131.2	118.6	182.3

Table 60: Extended NFDs, LTE EIRP = 74 dBm/20 MHz, FL CS = 25 kHz

21.2 LTE EIRP = 68 dBm/20MHz

The Extended NFDs in this section were derived in line with the suburban assumptions, i.e. LTE EIRP equal 68 dBm/20MHz.

21.2.1 FL CS 3.5 MHz

FL Channel	Generic (dB)	Hi-Perf Rx (dB)	Hi-Perf Tx (dB)	Hi-Perf Tx and Rx (dB)

1	68.5	68.2	88.5	124.5
2	86.6	86.7	98.4	133.4
3	90.2	90.2	104.7	142.9
4	93.7	93.7	109.3	150.4
5	97.2	97.2	113.0	156.8
6	100.7	100.7	116.1	161.8

Table 61: Extended NFDs, LTE EIRP = 68 dBm/20 MHz, FL CS = 3.5 MHz

21.2.2 FL CS 2 MHz

FL Channel	Generic (dB)	Hi-Perf Rx (dB)	Hi-Perf Tx (dB)	Hi-Perf Tx and Rx (dB)
1	62.4	62.6	76.2	121.6
2	76.2	76.5	87.6	140.8
3	87.4	88.4	94.2	154.3
4	89.8	90.4	98.9	153.7
5	92.0	92.4	102.7	156.6
6	94.1	94.4	105.8	160.5
7	96.2	96.4	108.4	164.7
8	98.2	98.4	110.7	168.9
9	100.2	100.4	112.8	172.9
10	102.2	102.4	114.6	176.4
11	104.1	104.4	116.3	179.1
12	106.1	106.4	117.9	180.8

Table 62: Extended NFDs, LTE EIRP = 68 dBm/20 MHz, FL CS = 2 MHz

21.2.3 FL CS 1 MHz

FL Channel	Generic (dB)	Hi-Perf Rx (dB)	Hi-Perf Tx (dB)	Hi-Perf Tx and Rx (dB)
1	62.7	63.5	71.0	123.1
2	66.7	67.0	79.9	124.4
3	69.8	69.9	85.4	133.5
4	87.1	90.9	89.5	168.6
5	88.8	91.0	92.8	159.1
6	90.3	91.9	95.5	156.3
7	91.7	92.9	97.9	156.3
8	92.9	93.9	100.0	157.2
9	94.1	94.9	101.8	158.8
10	95.2	95.9	103.5	160.5
11	96.3	96.9	105.0	162.5
12	97.3	97.9	106.5	164.5
13	98.4	98.9	107.8	166.6
14	99.4	99.9	109.0	168.7
15	100.4	100.9	110.2	170.7
16	101.4	101.9	111.3	172.7
17	102.4	102.9	112.3	174.6
18	103.4	103.9	113.3	176.3
19	104.4	104.9	114.2	177.8
20	105.4	105.9	115.1	179.0
21	106.4	106.9	115.9	180.0
22	107.4	107.9	116.7	180.7

23	108.4	108.9	117.5	181.3
24	109.3	109.9	118.3	181.6

Table 63: Extended NFDs, LTE EIRP = 68 dBm/20 MHz, FL CS = 1 MHz

21.2.4 FL CS 500 KHz

FL Channel	Generic (dB)	Hi-Perf Rx (dB)	Hi-Perf Tx (dB)	Hi-Perf Tx and Rx (dB)
1	62.3	63.9	67.8	124.4
2	66.7	67.7	73.8	125.1
3	69.3	69.9	78.2	125.4
4	69.6	70.1	81.5	124.8
5	69.8	69.9	84.2	132.9
6	85.8	93.9	86.5	159.2
7	87.4	93.9	88.5	166.2
8	88.8	93.9	90.4	170.2
9	89.8	93.9	92.0	163.9
10	90.8	94.2	93.5	160.8
11	91.7	94.7	94.8	159.6
12	92.6	95.2	96.1	159.1
13	93.4	95.7	97.3	159.1
14	94.1	96.2	98.4	159.4
15	94.8	96.7	99.5	159.9
16	95.5	97.2	100.4	160.6
17	96.1	97.7	101.4	161.3
18	96.7	98.2	102.3	162.2
19	97.3	98.7	103.1	163.1
20	97.9	99.2	103.9	164.0
21	98.5	99.7	104.7	165.0
22	99.0	100.2	105.4	166.0
23	99.6	100.7	106.1	167.0
24	100.1	101.2	106.8	168.0
25	100.6	101.7	107.5	169.0
26	101.2	102.2	108.1	170.0
27	101.7	102.7	108.7	171.0
28	102.2	103.2	109.3	172.0
29	102.7	103.7	109.9	173.0
30	103.2	104.2	110.5	173.9
31	103.8	104.7	111.0	174.8
32	104.3	105.2	111.5	175.7
33	104.8	105.7	112.0	176.5
34	105.3	106.2	112.5	177.3
35	105.8	106.7	113.0	178.0
36	106.3	107.2	113.5	178.6
37	106.7	107.7	114.0	179.2
38	107.2	108.2	114.4	179.7
39	107.7	108.7	114.9	180.2
40	108.2	109.2	115.3	180.5
41	108.7	109.7	115.7	180.9
42	109.2	110.2	116.1	181.1
43	109.7	110.7	116.5	181.3
44	110.1	111.2	116.9	181.5
45	110.6	111.7	117.3	181.7
46	111.1	112.2	117.7	181.8

47	111.6	112.7	118.1	181.9
48	112.0	113.2	118.4	182.0

Table 64: Extended NFDs, LTE EIRP = 68 dBm/20MHz, FL CS = 500 kHz

21.2.5 FL CS 250 KHz

FL Channel	Generic (dB)	Hi-Perf Rx (dB)	Hi-Perf Tx (dB)	Hi-Perf Tx and Rx (dB)
1	62.7	65.3	66.5	125.3
2	66.0	68.9	69.3	124.5
3	68.5	70.7	72.5	125.1
4	69.3	70.7	75.1	125.7
5	71.5	72.9	77.2	125.7
6	72.0	72.9	79.1	125.5
7	72.2	73.0	80.7	125.3
8	72.4	73.1	82.2	125.3
9	72.5	72.9	83.6	135.3
10	72.6	72.9	84.8	136.6
11	85.6	96.8	86.0	160.0
12	86.6	96.9	87.0	162.4
13	87.5	96.9	88.1	165.6
14	88.3	96.9	89.0	169.3
15	89.1	96.9	89.9	171.8
16	89.8	96.9	90.8	170.4
17	90.5	96.9	91.6	167.8
18	91.1	96.9	92.4	165.7
19	91.6	97.0	93.1	164.3
20	92.2	97.3	93.8	163.4
21	92.8	97.5	94.5	162.8
22	93.3	97.8	95.2	162.4
23	93.8	98.0	95.8	162.2
24	94.2	98.3	96.4	162.1
25	94.7	98.5	97.0	162.1
26	95.1	98.8	97.6	162.1
27	95.5	99.0	98.1	162.3
28	96.0	99.3	98.7	162.5
29	96.3	99.5	99.2	162.7
30	96.7	99.8	99.7	163.0
31	97.1	100.0	100.2	163.4
32	97.5	100.3	100.7	163.7
33	97.8	100.5	101.1	164.1
34	98.2	100.8	101.6	164.5
35	98.5	101.0	102.0	164.9
36	98.8	101.3	102.5	165.3
37	99.1	101.5	102.9	165.8
38	99.5	101.8	103.3	166.2
39	99.8	102.0	103.7	166.7
40	100.1	102.3	104.1	167.2
41	100.4	102.5	104.5	167.6
42	100.7	102.8	104.9	168.1
43	101.0	103.0	105.2	168.6
44	101.3	103.3	105.6	169.1
45	101.6	103.5	106.0	169.6
46	101.8	103.8	106.3	170.1

47	102.1	104.0	106.6	170.6
48	102.4	104.3	107.0	171.1
49	102.7	104.5	107.3	171.6
50	103.0	104.8	107.6	172.0
51	103.2	105.0	107.9	172.5
52	103.5	105.3	108.3	173.0
53	103.8	105.5	108.6	173.5
54	104.0	105.8	108.9	173.9
55	104.3	106.0	109.2	174.4
56	104.6	106.3	109.5	174.8
57	104.8	106.5	109.8	175.3
58	105.1	106.8	110.0	175.7
59	105.4	107.0	110.3	176.1
60	105.6	107.3	110.6	176.5
61	105.9	107.5	110.9	176.9
62	106.1	107.8	111.1	177.3
63	106.4	108.0	111.4	177.7
64	106.6	108.3	111.7	178.0
65	106.9	108.5	111.9	178.3
66	107.1	108.8	112.2	178.7
67	107.4	109.0	112.4	178.9
68	107.6	109.3	112.7	179.2
69	107.9	109.5	112.9	179.5
70	108.1	109.8	113.1	179.7
71	108.4	110.0	113.4	180.0
72	108.6	110.3	113.6	180.2
73	108.9	110.5	113.8	180.4
74	109.1	110.8	114.1	180.6
75	109.3	111.0	114.3	180.7
76	109.6	111.3	114.5	180.9
77	109.8	111.5	114.7	181.0
78	110.1	111.8	115.0	181.1
79	110.3	112.0	115.2	181.3
80	110.5	112.3	115.4	181.4
81	110.8	112.5	115.6	181.5
82	111.0	112.8	115.8	181.5
83	111.3	113.0	116.0	181.6
84	111.5	113.3	116.2	181.7
85	111.7	113.5	116.4	181.8
86	112.0	113.8	116.6	181.8
87	112.2	114.0	116.8	181.9
88	112.4	114.3	117.0	181.9
89	112.7	114.5	117.2	181.9
90	112.9	114.8	117.4	182.0
91	113.1	115.0	117.6	182.0
92	113.3	115.3	117.8	182.0
93	113.6	115.5	118.0	182.1
94	113.8	115.8	118.2	182.1
95	114.0	116.0	118.3	182.1
96	114.2	116.3	118.5	182.1

Table 65: Extended NFDs, LTE EIRP = 68 dBm/20MHz, FL CS = 250 kHz

21.2.6 FL CS 75 KHz

FL Channel	Generic (dB)	Hi-Perf Rx (dB)	Hi-Perf Tx (dB)	Hi-Perf Tx and Rx (dB)
1	63.8	68.3	65.9	124.8
2	64.5	69.3	66.4	125.6
3	65.4	70.4	67.1	125.7
4	66.3	71.5	67.9	125.4
5	67.3	72.6	68.8	125.3
6	68.3	73.7	69.8	125.3
7	69.3	74.7	70.8	125.4
8	70.0	74.9	71.8	125.4
9	70.6	74.9	72.6	125.5
10	71.1	74.9	73.5	125.6
11	71.5	74.9	74.2	125.7
12	71.9	74.9	74.9	125.7
13	72.2	74.9	75.6	125.8
14	73.3	76.5	76.3	125.8
15	74.0	77.1	76.9	125.7
16	74.3	77.1	77.5	125.7
17	74.5	77.1	78.1	125.7
18	74.8	77.1	78.6	125.7
19	75.0	77.1	79.2	125.6
20	75.2	77.2	79.7	125.6
21	75.3	77.2	80.2	125.6
22	75.5	77.2	80.6	125.6
23	75.6	77.2	81.1	125.6
24	75.7	77.3	81.6	125.6
25	75.9	77.3	82.0	125.6
26	76.0	77.4	82.4	125.6
27	76.0	77.1	82.8	139.0
28	76.1	77.1	83.2	139.2
29	76.2	77.1	83.6	139.5
30	76.3	77.1	84.0	139.8
31	76.3	77.1	84.4	140.2
32	76.4	77.1	84.8	140.7
33	76.4	77.1	85.1	141.2
34	81.3	83.4	85.5	147.7
35	85.7	100.9	85.8	161.4
36	86.0	100.9	86.1	162.2
37	86.3	100.9	86.5	162.8
38	86.6	101.0	86.8	163.4
39	86.9	101.0	87.1	164.2
40	87.2	101.0	87.4	164.9
41	87.5	101.0	87.7	165.8
42	87.8	101.0	88.0	166.6
43	88.1	101.0	88.3	167.5
44	88.3	101.0	88.6	168.4
45	88.6	101.0	88.9	169.3
46	88.9	101.1	89.2	170.1
47	89.1	101.1	89.4	170.9
48	89.4	101.1	89.7	171.6
49	89.6	101.1	90.0	172.1
50	89.9	101.1	90.2	172.4
51	90.1	101.1	90.5	172.5
52	90.3	101.1	90.7	172.4
53	90.6	101.1	91.0	172.1

54	90.8	101.1	91.2	171.7
55	91.0	101.1	91.5	171.3
56	91.2	101.1	91.7	170.8
57	91.4	101.1	92.0	170.3
58	91.6	101.1	92.2	169.8
59	91.9	101.1	92.4	169.4
60	92.1	101.1	92.6	168.9
61	92.3	101.2	92.9	168.6
62	92.5	101.2	93.1	168.3
63	92.7	101.3	93.3	168.0
64	92.8	101.4	93.5	167.7
65	93.0	101.5	93.7	167.5
66	93.2	101.5	93.9	167.3
67	93.4	101.6	94.1	167.1
68	93.6	101.7	94.3	167.0
69	93.8	101.8	94.6	166.8
70	94.0	101.8	94.8	166.7
71	94.1	101.9	94.9	166.6
72	94.3	102.0	95.1	166.5
73	94.5	102.1	95.3	166.4
74	94.7	102.1	95.5	166.4
75	94.8	102.2	95.7	166.3
76	95.0	102.3	95.9	166.3
77	95.2	102.4	96.1	166.2
78	95.3	102.4	96.3	166.2
79	95.5	102.5	96.5	166.2
80	95.6	102.6	96.6	166.2
81	95.8	102.7	96.8	166.2
82	95.9	102.7	97.0	166.2
83	96.1	102.8	97.2	166.2
84	96.3	102.9	97.3	166.2
85	96.4	103.0	97.5	166.3
86	96.6	103.0	97.7	166.3
87	96.7	103.1	97.8	166.3
88	96.8	103.2	98.0	166.4
89	97.0	103.3	98.2	166.4
90	97.1	103.3	98.3	166.5
91	97.3	103.4	98.5	166.5
92	97.4	103.5	98.7	166.6
93	97.5	103.6	98.8	166.7
94	97.7	103.6	99.0	166.8
95	97.8	103.7	99.1	166.8
96	97.9	103.8	99.3	166.9
97	98.1	103.9	99.4	167.0
98	98.2	103.9	99.6	167.1
99	98.3	104.0	99.7	167.2
100	98.5	104.1	99.9	167.3
101	98.6	104.2	100.0	167.4
102	98.7	104.2	100.2	167.5
103	98.8	104.3	100.3	167.6
104	99.0	104.4	100.5	167.7
105	99.1	104.5	100.6	167.8
106	99.2	104.5	100.7	167.9
107	99.3	104.6	100.9	168.0
108	99.5	104.7	101.0	168.1
109	99.6	104.8	101.2	168.2

110	99.7	104.8	101.3	168.3
111	99.8	104.9	101.4	168.4
112	99.9	105.0	101.6	168.6
113	100.0	105.1	101.7	168.7
114	100.2	105.1	101.8	168.8
115	100.3	105.2	102.0	168.9
116	100.4	105.3	102.1	169.0
117	100.5	105.4	102.2	169.2
118	100.6	105.4	102.4	169.3
119	100.7	105.5	102.5	169.4
120	100.8	105.6	102.6	169.5
121	100.9	105.7	102.7	169.7
122	101.0	105.7	102.9	169.8
123	101.2	105.8	103.0	169.9
124	101.3	105.9	103.1	170.1
125	101.4	106.0	103.2	170.2
126	101.5	106.0	103.4	170.3
127	101.6	106.1	103.5	170.5
128	101.7	106.2	103.6	170.6
129	101.8	106.3	103.7	170.7
130	101.9	106.3	103.8	170.9
131	102.0	106.4	104.0	171.0
132	102.1	106.5	104.1	171.1
133	102.2	106.6	104.2	171.3
134	102.3	106.6	104.3	171.4
135	102.4	106.7	104.4	171.5
136	102.5	106.8	104.5	171.7
137	102.6	106.9	104.7	171.8
138	102.7	106.9	104.8	172.0
139	102.8	107.0	104.9	172.1
140	102.9	107.1	105.0	172.2
141	103.0	107.2	105.1	172.4
142	103.1	107.2	105.2	172.5
143	103.2	107.3	105.3	172.6
144	103.3	107.4	105.4	172.8
145	103.4	107.5	105.5	172.9
146	103.5	107.5	105.6	173.0
147	103.6	107.6	105.8	173.2
148	103.6	107.7	105.9	173.3
149	103.7	107.8	106.0	173.5
150	103.8	107.8	106.1	173.6
151	103.9	107.9	106.2	173.7
152	104.0	108.0	106.3	173.9
153	104.1	108.1	106.4	174.0
154	104.2	108.1	106.5	174.1
155	104.3	108.2	106.6	174.3
156	104.4	108.3	106.7	174.4
157	104.5	108.4	106.8	174.5
158	104.6	108.4	106.9	174.7
159	104.7	108.5	107.0	174.8
160	104.7	108.6	107.1	174.9
161	104.8	108.7	107.2	175.0
162	104.9	108.7	107.3	175.2
163	105.0	108.8	107.4	175.3
164	105.1	108.9	107.5	175.4
165	105.2	109.0	107.6	175.6

166	105.3	109.0	107.7	175.7
167	105.4	109.1	107.8	175.8
168	105.4	109.2	107.9	175.9
169	105.5	109.3	108.0	176.1
170	105.6	109.3	108.1	176.2
171	105.7	109.4	108.2	176.3
172	105.8	109.5	108.2	176.4
173	105.9	109.6	108.3	176.5
174	106.0	109.6	108.4	176.7
175	106.0	109.7	108.5	176.8
176	106.1	109.8	108.6	176.9
177	106.2	109.9	108.7	177.0
178	106.3	109.9	108.8	177.1
179	106.4	110.0	108.9	177.2
180	106.5	110.1	109.0	177.3
181	106.5	110.2	109.1	177.4
182	106.6	110.2	109.2	177.6
183	106.7	110.3	109.2	177.7
184	106.8	110.4	109.3	177.8
185	106.9	110.5	109.4	177.9
186	107.0	110.5	109.5	178.0
187	107.0	110.6	109.6	178.1
188	107.1	110.7	109.7	178.2
189	107.2	110.8	109.8	178.3
190	107.3	110.8	109.9	178.4
191	107.4	110.9	109.9	178.5
192	107.4	111.0	110.0	178.6
193	107.5	111.1	110.1	178.7
194	107.6	111.1	110.2	178.7
195	107.7	111.2	110.3	178.8
196	107.8	111.3	110.4	178.9
197	107.8	111.4	110.4	179.0
198	107.9	111.4	110.5	179.1
199	108.0	111.5	110.6	179.2
200	108.1	111.6	110.7	179.3
201	108.2	111.7	110.8	179.3
202	108.2	111.7	110.8	179.4
203	108.3	111.8	110.9	179.5
204	108.4	111.9	111.0	179.6
205	108.5	112.0	111.1	179.7
206	108.5	112.0	111.2	179.7
207	108.6	112.1	111.2	179.8
208	108.7	112.2	111.3	179.9
209	108.8	112.3	111.4	179.9
210	108.9	112.3	111.5	180.0
211	108.9	112.4	111.6	180.1
212	109.0	112.5	111.6	180.1
213	109.1	112.6	111.7	180.2
214	109.2	112.6	111.8	180.3
215	109.2	112.7	111.9	180.3
216	109.3	112.8	111.9	180.4
217	109.4	112.9	112.0	180.4
218	109.5	112.9	112.1	180.5
219	109.5	113.0	112.2	180.5
220	109.6	113.1	112.3	180.6
221	109.7	113.2	112.3	180.6

222	109.8	113.2	112.4	180.7
223	109.8	113.3	112.5	180.7
224	109.9	113.4	112.6	180.8
225	110.0	113.5	112.6	180.8
226	110.1	113.5	112.7	180.9
227	110.1	113.6	112.8	180.9
228	110.2	113.7	112.8	181.0
229	110.3	113.8	112.9	181.0
230	110.4	113.8	113.0	181.1
231	110.4	113.9	113.1	181.1
232	110.5	114.0	113.1	181.1
233	110.6	114.1	113.2	181.2
234	110.7	114.1	113.3	181.2
235	110.7	114.2	113.3	181.2
236	110.8	114.3	113.4	181.3
237	110.9	114.4	113.5	181.3
238	110.9	114.4	113.6	181.3
239	111.0	114.5	113.6	181.4
240	111.1	114.6	113.7	181.4
241	111.2	114.7	113.8	181.4
242	111.2	114.7	113.8	181.5
243	111.3	114.8	113.9	181.5
244	111.4	114.9	114.0	181.5
245	111.4	115.0	114.0	181.5
246	111.5	115.0	114.1	181.6
247	111.6	115.1	114.2	181.6
248	111.7	115.2	114.2	181.6
249	111.7	115.3	114.3	181.6
250	111.8	115.3	114.4	181.6
251	111.9	115.4	114.4	181.7
252	111.9	115.5	114.5	181.7
253	112.0	115.6	114.6	181.7
254	112.1	115.6	114.6	181.7
255	112.2	115.7	114.7	181.7
256	112.2	115.8	114.8	181.8
257	112.3	115.9	114.8	181.8
258	112.4	115.9	114.9	181.8
259	112.4	116.0	115.0	181.8
260	112.5	116.1	115.0	181.8
261	112.6	116.2	115.1	181.8
262	112.6	116.2	115.2	181.9
263	112.7	116.3	115.2	181.9
264	112.8	116.4	115.3	181.9
265	112.8	116.5	115.4	181.9
266	112.9	116.5	115.4	181.9
267	113.0	116.6	115.5	181.9
268	113.1	116.7	115.6	181.9
269	113.1	116.8	115.6	182.0
270	113.2	116.8	115.7	182.0
271	113.3	116.9	115.7	182.0
272	113.3	117.0	115.8	182.0
273	113.4	117.1	115.9	182.0
274	113.5	117.1	115.9	182.0
275	113.5	117.2	116.0	182.0
276	113.6	117.3	116.1	182.0
277	113.7	117.4	116.1	182.0

278	113.7	117.4	116.2	182.0
279	113.8	117.5	116.2	182.0
280	113.9	117.6	116.3	182.1
281	113.9	117.7	116.4	182.1
282	114.0	117.7	116.4	182.1
283	114.1	117.8	116.5	182.1
284	114.1	117.9	116.5	182.1
285	114.2	118.0	116.6	182.1
286	114.3	118.0	116.7	182.1
287	114.3	118.1	116.7	182.1
288	114.4	118.2	116.8	182.1
289	114.5	118.3	116.8	182.1
290	114.5	118.3	116.9	182.1
291	114.6	118.4	117.0	182.1
292	114.7	118.5	117.0	182.1
293	114.7	118.6	117.1	182.1
294	114.8	118.6	117.1	182.1
295	114.9	118.7	117.2	182.1
296	114.9	118.8	117.2	182.2
297	115.0	118.9	117.3	182.2
298	115.0	118.9	117.4	182.2
299	115.1	119.0	117.4	182.2
300	115.2	119.1	117.5	182.2
301	115.2	119.2	117.5	182.2
302	115.3	119.2	117.6	182.2
303	115.4	119.3	117.6	182.2
304	115.4	119.4	117.7	182.2
305	115.5	119.5	117.8	182.2
306	115.6	119.5	117.8	182.2
307	115.6	119.6	117.9	182.2
308	115.7	119.7	117.9	182.2
309	115.8	119.8	118.0	182.2
310	115.8	119.8	118.0	182.2
311	115.9	119.9	118.1	182.2
312	115.9	120.0	118.2	182.2
313	116.0	120.1	118.2	182.2
314	116.1	120.1	118.3	182.2
315	116.1	120.2	118.3	182.2
316	116.2	120.3	118.4	182.2
317	116.3	120.4	118.4	182.2
318	116.3	120.4	118.5	182.2
319	116.4	120.5	118.5	182.2
320	116.4	120.6	118.6	182.2

Table 66: Extended NFDs, LTE EIRP = 68 dBm/20 MHz, FL CS = 75 kHz

21.2.7 FL CS 25 KHz

FL Channel	Generic (dB)	Hi-Perf Rx (dB)	Hi-Perf Tx (dB)	Hi-Perf Tx and Rx (dB)
1	64.8	72.5	65.7	125.3
2	65.0	72.9	65.9	125.4
3	65.2	73.2	66.1	125.5
4	65.4	73.6	66.2	125.6
5	65.7	73.9	66.4	125.7

6	65.9	74.3	66.6	125.7
7	66.1	74.6	66.9	125.7
8	66.4	75.0	67.1	125.7
9	66.7	75.4	67.4	125.7
10	67.0	75.7	67.6	125.7
11	67.3	76.1	67.9	125.6
12	67.6	76.4	68.2	125.6
13	67.9	76.8	68.5	125.6
14	68.2	77.2	68.8	125.6
15	68.5	77.5	69.2	125.6
16	68.9	77.9	69.5	125.6
17	69.2	78.3	69.8	125.6
18	69.6	78.6	70.2	125.6
19	69.9	79.0	70.5	125.6
20	70.2	79.4	70.8	125.6
21	70.5	79.5	71.1	125.6
22	70.8	79.5	71.4	125.6
23	71.1	79.5	71.8	125.6
24	71.3	79.5	72.1	125.6
25	71.6	79.5	72.3	125.7
26	71.8	79.5	72.6	125.7
27	72.0	79.5	72.9	125.7
28	72.2	79.5	73.2	125.7
29	72.5	79.5	73.5	125.7
30	72.7	79.5	73.7	125.7
31	72.9	79.5	74.0	125.7
32	73.1	79.5	74.2	125.7
33	73.2	79.5	74.5	125.7
34	73.4	79.5	74.7	125.7
35	73.6	79.5	74.9	125.7
36	73.8	79.5	75.2	125.7
37	73.9	79.5	75.4	125.8
38	74.1	79.5	75.6	125.8
39	74.2	79.5	75.9	125.8
40	74.4	79.5	76.1	125.8
41	75.2	81.7	76.3	125.8
42	75.3	81.7	76.5	125.8
43	75.5	81.7	76.7	125.8
44	75.6	81.7	76.9	125.7
45	75.8	81.7	77.1	125.7
46	75.9	81.7	77.3	125.7
47	76.1	81.7	77.5	125.7
48	76.2	81.7	77.7	125.7
49	76.3	81.7	77.9	125.7
50	76.5	81.7	78.1	125.7
51	76.6	81.7	78.3	125.7
52	76.7	81.7	78.4	125.7
53	76.8	81.7	78.6	125.7
54	77.0	81.7	78.8	125.7
55	77.1	81.7	79.0	125.7
56	77.2	81.7	79.2	125.7
57	77.3	81.7	79.3	125.7
58	77.4	81.7	79.5	125.7
59	77.5	81.8	79.7	125.7
60	77.6	81.8	79.8	125.7
61	77.7	81.8	80.0	125.7

62	77.8	81.8	80.2	125.7
63	77.9	81.8	80.3	125.7
64	78.0	81.8	80.5	125.7
65	78.1	81.8	80.6	125.7
66	78.2	81.8	80.8	125.7
67	78.2	81.8	81.0	125.7
68	78.3	81.8	81.1	125.7
69	78.4	81.8	81.3	125.7
70	78.5	81.8	81.4	125.7
71	78.6	81.9	81.6	125.7
72	78.6	81.9	81.7	125.7
73	78.7	81.9	81.9	125.7
74	78.8	81.9	82.0	125.7
75	78.8	81.9	82.1	125.7
76	78.9	81.9	82.3	125.7
77	79.0	82.0	82.4	125.7
78	79.0	82.0	82.6	125.7
79	79.1	82.0	82.7	125.7
80	79.1	82.0	82.8	125.7
81	79.2	81.7	83.0	143.5
82	79.3	81.7	83.1	143.6
83	79.3	81.7	83.2	143.7
84	79.4	81.7	83.4	143.8
85	79.4	81.7	83.5	143.9
86	79.5	81.7	83.6	144.0
87	79.5	81.7	83.8	144.1
88	79.6	81.7	83.9	144.2
89	79.6	81.7	84.0	144.3
90	79.7	81.7	84.1	144.4
91	79.7	81.7	84.3	144.6
92	79.7	81.7	84.4	144.7
93	79.8	81.7	84.5	144.9
94	79.8	81.7	84.6	145.0
95	79.9	81.7	84.8	145.2
96	79.9	81.7	84.9	145.3
97	79.9	81.7	85.0	145.5
98	80.0	81.7	85.1	145.7
99	80.0	81.7	85.2	145.9
100	80.1	81.7	85.3	146.1
101	85.4	105.1	85.5	161.3
102	85.5	105.1	85.6	161.6
103	85.6	105.2	85.7	162.0
104	85.7	105.2	85.8	162.4
105	85.9	105.2	85.9	162.8
106	86.0	105.2	86.0	163.1
107	86.1	105.2	86.1	163.3
108	86.2	105.2	86.2	163.4
109	86.3	105.2	86.4	163.6
110	86.4	105.2	86.5	163.8
111	86.5	105.2	86.6	164.0
112	86.6	105.3	86.7	164.2
113	86.7	105.3	86.8	164.4
114	86.8	105.3	86.9	164.6
115	86.9	105.3	87.0	164.8
116	87.0	105.3	87.1	165.0
117	87.1	105.3	87.2	165.2

118	87.2	105.3	87.3	165.5
119	87.3	105.3	87.4	165.7
120	87.4	105.3	87.5	166.0
121	87.5	105.4	87.6	166.2
122	87.6	105.4	87.7	166.5
123	87.7	105.4	87.8	166.7
124	87.8	105.4	87.9	167.0
125	87.9	105.4	88.0	167.2
126	88.0	105.4	88.1	167.5
127	88.1	105.4	88.2	167.7
128	88.2	105.4	88.3	168.0
129	88.3	105.5	88.4	168.2
130	88.4	105.5	88.5	168.5
131	88.5	105.5	88.6	168.7
132	88.6	105.5	88.7	169.0
133	88.7	105.5	88.8	169.2
134	88.8	105.5	88.9	169.5
135	88.9	105.5	89.0	169.7
136	89.0	105.5	89.1	170.0
137	89.0	105.5	89.2	170.2
138	89.1	105.6	89.3	170.5
139	89.2	105.6	89.3	170.7
140	89.3	105.6	89.4	170.9
141	89.4	105.6	89.5	171.1
142	89.5	105.6	89.6	171.4
143	89.6	105.6	89.7	171.6
144	89.7	105.6	89.8	171.8
145	89.8	105.6	89.9	172.0
146	89.8	105.6	90.0	172.2
147	89.9	105.7	90.1	172.4
148	90.0	105.7	90.1	172.6
149	90.1	105.7	90.2	172.7
150	90.2	105.7	90.3	172.9
151	90.3	105.7	90.4	173.0
152	90.3	105.7	90.5	173.1
153	90.4	105.7	90.6	173.3
154	90.5	105.7	90.7	173.4
155	90.6	105.7	90.7	173.4
156	90.7	105.7	90.8	173.5
157	90.7	105.7	90.9	173.6
158	90.8	105.7	91.0	173.6
159	90.9	105.7	91.1	173.6
160	91.0	105.7	91.2	173.6
161	91.1	105.7	91.2	173.7
162	91.1	105.7	91.3	173.7
163	91.2	105.7	91.4	173.6
164	91.3	105.7	91.5	173.6
165	91.4	105.7	91.6	173.6
166	91.5	105.7	91.6	173.5
167	91.5	105.7	91.7	173.5
168	91.6	105.7	91.8	173.4
169	91.7	105.7	91.9	173.4
170	91.8	105.7	92.0	173.3
171	91.8	105.7	92.0	173.3
172	91.9	105.7	92.1	173.2
173	92.0	105.7	92.2	173.1

174	92.1	105.7	92.3	173.0
175	92.1	105.7	92.3	173.0
176	92.2	105.7	92.4	172.9
177	92.3	105.7	92.5	172.8
178	92.3	105.7	92.6	172.7
179	92.4	105.7	92.6	172.6
180	92.5	105.7	92.7	172.5
181	92.6	105.7	92.8	172.5
182	92.6	105.8	92.9	172.4
183	92.7	105.8	92.9	172.3
184	92.8	105.8	93.0	172.3
185	92.8	105.8	93.1	172.2
186	92.9	105.9	93.2	172.1
187	93.0	105.9	93.2	172.1
188	93.1	105.9	93.3	172.0
189	93.1	105.9	93.4	171.9
190	93.2	106.0	93.4	171.9
191	93.3	106.0	93.5	171.8
192	93.3	106.0	93.6	171.8
193	93.4	106.0	93.7	171.7
194	93.5	106.1	93.7	171.6
195	93.5	106.1	93.8	171.6
196	93.6	106.1	93.9	171.5
197	93.7	106.1	93.9	171.5
198	93.7	106.2	94.0	171.4
199	93.8	106.2	94.1	171.4
200	93.9	106.2	94.1	171.3
201	93.9	106.2	94.2	171.3
202	94.0	106.3	94.3	171.3
203	94.1	106.3	94.3	171.2
204	94.1	106.3	94.4	171.2
205	94.2	106.3	94.5	171.1
206	94.3	106.4	94.6	171.1
207	94.3	106.4	94.6	171.1
208	94.4	106.4	94.7	171.0
209	94.5	106.4	94.8	171.0
210	94.5	106.5	94.8	171.0
211	94.6	106.5	94.9	170.9
212	94.6	106.5	94.9	170.9
213	94.7	106.5	95.0	170.9
214	94.8	106.6	95.1	170.9
215	94.8	106.6	95.1	170.8
216	94.9	106.6	95.2	170.8
217	95.0	106.6	95.3	170.8
218	95.0	106.7	95.3	170.8
219	95.1	106.7	95.4	170.7
220	95.1	106.7	95.5	170.7
221	95.2	106.7	95.5	170.7
222	95.3	106.8	95.6	170.7
223	95.3	106.8	95.7	170.7
224	95.4	106.8	95.7	170.7
225	95.4	106.8	95.8	170.6
226	95.5	106.9	95.8	170.6
227	95.6	106.9	95.9	170.6
228	95.6	106.9	96.0	170.6
229	95.7	106.9	96.0	170.6

230	95.7	107.0	96.1	170.6
231	95.8	107.0	96.2	170.6
232	95.9	107.0	96.2	170.6
233	95.9	107.0	96.3	170.6
234	96.0	107.1	96.3	170.6
235	96.0	107.1	96.4	170.6
236	96.1	107.1	96.5	170.6
237	96.1	107.1	96.5	170.6
238	96.2	107.2	96.6	170.6
239	96.3	107.2	96.6	170.6
240	96.3	107.2	96.7	170.6
241	96.4	107.2	96.8	170.6
242	96.4	107.3	96.8	170.6
243	96.5	107.3	96.9	170.6
244	96.5	107.3	96.9	170.6
245	96.6	107.3	97.0	170.6
246	96.6	107.4	97.0	170.6
247	96.7	107.4	97.1	170.6
248	96.8	107.4	97.2	170.6
249	96.8	107.4	97.2	170.6
250	96.9	107.5	97.3	170.6
251	96.9	107.5	97.3	170.6
252	97.0	107.5	97.4	170.6
253	97.0	107.5	97.4	170.6
254	97.1	107.6	97.5	170.6
255	97.1	107.6	97.6	170.7
256	97.2	107.6	97.6	170.7
257	97.2	107.6	97.7	170.7
258	97.3	107.7	97.7	170.7
259	97.3	107.7	97.8	170.7
260	97.4	107.7	97.8	170.7
261	97.5	107.7	97.9	170.7
262	97.5	107.8	97.9	170.8
263	97.6	107.8	98.0	170.8
264	97.6	107.8	98.1	170.8
265	97.7	107.8	98.1	170.8
266	97.7	107.9	98.2	170.8
267	97.8	107.9	98.2	170.8
268	97.8	107.9	98.3	170.9
269	97.9	107.9	98.3	170.9
270	97.9	108.0	98.4	170.9
271	98.0	108.0	98.4	170.9
272	98.0	108.0	98.5	170.9
273	98.1	108.0	98.5	171.0
274	98.1	108.1	98.6	171.0
275	98.2	108.1	98.7	171.0
276	98.2	108.1	98.7	171.0
277	98.3	108.1	98.8	171.0
278	98.3	108.2	98.8	171.1
279	98.4	108.2	98.9	171.1
280	98.4	108.2	98.9	171.1
281	98.5	108.2	99.0	171.1
282	98.5	108.3	99.0	171.2
283	98.6	108.3	99.1	171.2
284	98.6	108.3	99.1	171.2
285	98.7	108.3	99.2	171.2

286	98.7	108.4	99.2	171.3
287	98.8	108.4	99.3	171.3
288	98.8	108.4	99.3	171.3
289	98.9	108.4	99.4	171.3
290	98.9	108.5	99.4	171.4
291	98.9	108.5	99.5	171.4
292	99.0	108.5	99.5	171.4
293	99.0	108.5	99.6	171.4
294	99.1	108.6	99.6	171.5
295	99.1	108.6	99.7	171.5
296	99.2	108.6	99.7	171.5
297	99.2	108.6	99.8	171.6
298	99.3	108.7	99.8	171.6
299	99.3	108.7	99.9	171.6
300	99.4	108.7	99.9	171.6
301	99.4	108.7	100.0	171.7
302	99.5	108.8	100.0	171.7
303	99.5	108.8	100.1	171.7
304	99.6	108.8	100.1	171.8
305	99.6	108.8	100.2	171.8
306	99.6	108.9	100.2	171.8
307	99.7	108.9	100.3	171.9
308	99.7	108.9	100.3	171.9
309	99.8	108.9	100.4	171.9
310	99.8	109.0	100.4	172.0
311	99.9	109.0	100.5	172.0
312	99.9	109.0	100.5	172.0
313	100.0	109.0	100.6	172.1
314	100.0	109.1	100.6	172.1
315	100.1	109.1	100.7	172.1
316	100.1	109.1	100.7	172.2
317	100.1	109.1	100.7	172.2
318	100.2	109.2	100.8	172.2
319	100.2	109.2	100.8	172.3
320	100.3	109.2	100.9	172.3
321	100.3	109.2	100.9	172.3
322	100.4	109.3	101.0	172.4
323	100.4	109.3	101.0	172.4
324	100.4	109.3	101.1	172.4
325	100.5	109.3	101.1	172.5
326	100.5	109.4	101.2	172.5
327	100.6	109.4	101.2	172.5
328	100.6	109.4	101.3	172.6
329	100.7	109.4	101.3	172.6
330	100.7	109.5	101.3	172.6
331	100.7	109.5	101.4	172.7
332	100.8	109.5	101.4	172.7
333	100.8	109.5	101.5	172.7
334	100.9	109.6	101.5	172.8
335	100.9	109.6	101.6	172.8
336	101.0	109.6	101.6	172.9
337	101.0	109.6	101.7	172.9
338	101.0	109.7	101.7	172.9
339	101.1	109.7	101.8	173.0
340	101.1	109.7	101.8	173.0
341	101.2	109.7	101.8	173.0

342	101.2	109.8	101.9	173.1
343	101.2	109.8	101.9	173.1
344	101.3	109.8	102.0	173.2
345	101.3	109.8	102.0	173.2
346	101.4	109.9	102.1	173.2
347	101.4	109.9	102.1	173.3
348	101.5	109.9	102.1	173.3
349	101.5	109.9	102.2	173.3
350	101.5	110.0	102.2	173.4
351	101.6	110.0	102.3	173.4
352	101.6	110.0	102.3	173.5
353	101.7	110.0	102.4	173.5
354	101.7	110.1	102.4	173.5
355	101.7	110.1	102.4	173.6
356	101.8	110.1	102.5	173.6
357	101.8	110.1	102.5	173.6
358	101.9	110.2	102.6	173.7
359	101.9	110.2	102.6	173.7
360	101.9	110.2	102.7	173.8
361	102.0	110.2	102.7	173.8
362	102.0	110.3	102.7	173.8
363	102.1	110.3	102.8	173.9
364	102.1	110.3	102.8	173.9
365	102.1	110.3	102.9	174.0
366	102.2	110.4	102.9	174.0
367	102.2	110.4	103.0	174.0
368	102.2	110.4	103.0	174.1
369	102.3	110.4	103.0	174.1
370	102.3	110.5	103.1	174.2
371	102.4	110.5	103.1	174.2
372	102.4	110.5	103.2	174.2
373	102.4	110.5	103.2	174.3
374	102.5	110.6	103.2	174.3
375	102.5	110.6	103.3	174.4
376	102.6	110.6	103.3	174.4
377	102.6	110.6	103.4	174.4
378	102.6	110.7	103.4	174.5
379	102.7	110.7	103.4	174.5
380	102.7	110.7	103.5	174.6
381	102.7	110.7	103.5	174.6
382	102.8	110.8	103.6	174.6
383	102.8	110.8	103.6	174.7
384	102.9	110.8	103.6	174.7
385	102.9	110.8	103.7	174.7
386	102.9	110.9	103.7	174.8
387	103.0	110.9	103.8	174.8
388	103.0	110.9	103.8	174.9
389	103.0	110.9	103.8	174.9
390	103.1	111.0	103.9	174.9
391	103.1	111.0	103.9	175.0
392	103.2	111.0	104.0	175.0
393	103.2	111.0	104.0	175.1
394	103.2	111.1	104.0	175.1
395	103.3	111.1	104.1	175.1
396	103.3	111.1	104.1	175.2
397	103.3	111.1	104.2	175.2

398	103.4	111.2	104.2	175.3
399	103.4	111.2	104.2	175.3
400	103.4	111.2	104.3	175.3
401	103.5	111.2	104.3	175.4
402	103.5	111.3	104.4	175.4
403	103.6	111.3	104.4	175.5
404	103.6	111.3	104.4	175.5
405	103.6	111.3	104.5	175.5
406	103.7	111.4	104.5	175.6
407	103.7	111.4	104.5	175.6
408	103.7	111.4	104.6	175.7
409	103.8	111.4	104.6	175.7
410	103.8	111.5	104.7	175.7
411	103.8	111.5	104.7	175.8
412	103.9	111.5	104.7	175.8
413	103.9	111.5	104.8	175.8
414	104.0	111.6	104.8	175.9
415	104.0	111.6	104.8	175.9
416	104.0	111.6	104.9	176.0
417	104.1	111.6	104.9	176.0
418	104.1	111.7	105.0	176.0
419	104.1	111.7	105.0	176.1
420	104.2	111.7	105.0	176.1
421	104.2	111.7	105.1	176.2
422	104.2	111.8	105.1	176.2
423	104.3	111.8	105.1	176.2
424	104.3	111.8	105.2	176.3
425	104.3	111.8	105.2	176.3
426	104.4	111.9	105.3	176.3
427	104.4	111.9	105.3	176.4
428	104.4	111.9	105.3	176.4
429	104.5	111.9	105.4	176.5
430	104.5	112.0	105.4	176.5
431	104.5	112.0	105.4	176.5
432	104.6	112.0	105.5	176.6
433	104.6	112.0	105.5	176.6
434	104.6	112.1	105.5	176.6
435	104.7	112.1	105.6	176.7
436	104.7	112.1	105.6	176.7
437	104.7	112.1	105.6	176.8
438	104.8	112.2	105.7	176.8
439	104.8	112.2	105.7	176.8
440	104.8	112.2	105.8	176.9
441	104.9	112.2	105.8	176.9
442	104.9	112.3	105.8	176.9
443	104.9	112.3	105.9	177.0
444	105.0	112.3	105.9	177.0
445	105.0	112.3	105.9	177.1
446	105.0	112.4	106.0	177.1
447	105.1	112.4	106.0	177.1
448	105.1	112.4	106.0	177.2
449	105.1	112.4	106.1	177.2
450	105.2	112.5	106.1	177.2
451	105.2	112.5	106.1	177.3
452	105.2	112.5	106.2	177.3
453	105.3	112.5	106.2	177.3

454	105.3	112.6	106.2	177.4
455	105.3	112.6	106.3	177.4
456	105.4	112.6	106.3	177.4
457	105.4	112.6	106.4	177.5
458	105.4	112.7	106.4	177.5
459	105.5	112.7	106.4	177.6
460	105.5	112.7	106.5	177.6
461	105.5	112.7	106.5	177.6
462	105.6	112.8	106.5	177.7
463	105.6	112.8	106.6	177.7
464	105.6	112.8	106.6	177.7
465	105.7	112.8	106.6	177.8
466	105.7	112.9	106.7	177.8
467	105.7	112.9	106.7	177.8
468	105.8	112.9	106.7	177.9
469	105.8	112.9	106.8	177.9
470	105.8	113.0	106.8	177.9
471	105.9	113.0	106.8	178.0
472	105.9	113.0	106.9	178.0
473	105.9	113.0	106.9	178.0
474	106.0	113.1	106.9	178.1
475	106.0	113.1	107.0	178.1
476	106.0	113.1	107.0	178.1
477	106.0	113.1	107.0	178.2
478	106.1	113.2	107.1	178.2
479	106.1	113.2	107.1	178.2
480	106.1	113.2	107.1	178.3
481	106.2	113.2	107.2	178.3
482	106.2	113.3	107.2	178.3
483	106.2	113.3	107.2	178.4
484	106.3	113.3	107.3	178.4
485	106.3	113.3	107.3	178.4
486	106.3	113.4	107.3	178.4
487	106.4	113.4	107.4	178.5
488	106.4	113.4	107.4	178.5
489	106.4	113.4	107.4	178.5
490	106.5	113.5	107.5	178.6
491	106.5	113.5	107.5	178.6
492	106.5	113.5	107.5	178.6
493	106.5	113.5	107.6	178.7
494	106.6	113.6	107.6	178.7
495	106.6	113.6	107.6	178.7
496	106.6	113.6	107.6	178.8
497	106.7	113.6	107.7	178.8
498	106.7	113.7	107.7	178.8
499	106.7	113.7	107.7	178.8
500	106.8	113.7	107.8	178.9
501	106.8	113.7	107.8	178.9
502	106.8	113.8	107.8	178.9
503	106.9	113.8	107.9	179.0
504	106.9	113.8	107.9	179.0
505	106.9	113.8	107.9	179.0
506	106.9	113.9	108.0	179.0
507	107.0	113.9	108.0	179.1
508	107.0	113.9	108.0	179.1
509	107.0	113.9	108.1	179.1

510	107.1	114.0	108.1	179.2
511	107.1	114.0	108.1	179.2
512	107.1	114.0	108.2	179.2
513	107.2	114.0	108.2	179.2
514	107.2	114.1	108.2	179.3
515	107.2	114.1	108.2	179.3
516	107.2	114.1	108.3	179.3
517	107.3	114.1	108.3	179.3
518	107.3	114.2	108.3	179.4
519	107.3	114.2	108.4	179.4
520	107.4	114.2	108.4	179.4
521	107.4	114.2	108.4	179.4
522	107.4	114.3	108.5	179.5
523	107.4	114.3	108.5	179.5
524	107.5	114.3	108.5	179.5
525	107.5	114.3	108.6	179.5
526	107.5	114.4	108.6	179.6
527	107.6	114.4	108.6	179.6
528	107.6	114.4	108.6	179.6
529	107.6	114.4	108.7	179.6
530	107.7	114.5	108.7	179.7
531	107.7	114.5	108.7	179.7
532	107.7	114.5	108.8	179.7
533	107.7	114.5	108.8	179.7
534	107.8	114.6	108.8	179.8
535	107.8	114.6	108.9	179.8
536	107.8	114.6	108.9	179.8
537	107.9	114.6	108.9	179.8
538	107.9	114.7	108.9	179.9
539	107.9	114.7	109.0	179.9
540	107.9	114.7	109.0	179.9
541	108.0	114.7	109.0	179.9
542	108.0	114.8	109.1	180.0
543	108.0	114.8	109.1	180.0
544	108.1	114.8	109.1	180.0
545	108.1	114.8	109.2	180.0
546	108.1	114.9	109.2	180.0
547	108.1	114.9	109.2	180.1
548	108.2	114.9	109.2	180.1
549	108.2	114.9	109.3	180.1
550	108.2	115.0	109.3	180.1
551	108.3	115.0	109.3	180.1
552	108.3	115.0	109.4	180.2
553	108.3	115.0	109.4	180.2
554	108.3	115.1	109.4	180.2
555	108.4	115.1	109.4	180.2
556	108.4	115.1	109.5	180.3
557	108.4	115.1	109.5	180.3
558	108.5	115.2	109.5	180.3
559	108.5	115.2	109.6	180.3
560	108.5	115.2	109.6	180.3
561	108.5	115.2	109.6	180.4
562	108.6	115.3	109.7	180.4
563	108.6	115.3	109.7	180.4
564	108.6	115.3	109.7	180.4
565	108.6	115.3	109.7	180.4

566	108.7	115.4	109.8	180.4
567	108.7	115.4	109.8	180.5
568	108.7	115.4	109.8	180.5
569	108.8	115.4	109.9	180.5
570	108.8	115.5	109.9	180.5
571	108.8	115.5	109.9	180.5
572	108.8	115.5	109.9	180.6
573	108.9	115.5	110.0	180.6
574	108.9	115.6	110.0	180.6
575	108.9	115.6	110.0	180.6
576	109.0	115.6	110.0	180.6
577	109.0	115.6	110.1	180.6
578	109.0	115.7	110.1	180.7
579	109.0	115.7	110.1	180.7
580	109.1	115.7	110.2	180.7
581	109.1	115.7	110.2	180.7
582	109.1	115.8	110.2	180.7
583	109.1	115.8	110.2	180.7
584	109.2	115.8	110.3	180.8
585	109.2	115.8	110.3	180.8
586	109.2	115.9	110.3	180.8
587	109.3	115.9	110.4	180.8
588	109.3	115.9	110.4	180.8
589	109.3	115.9	110.4	180.8
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595	109.5	116.1	110.6	180.9
596	109.5	116.1	110.6	180.9
597	109.5	116.1	110.6	181.0
598	109.5	116.2	110.7	181.0
599	109.6	116.2	110.7	181.0
600	109.6	116.2	110.7	181.0
601	109.6	116.2	110.7	181.0
602	109.7	116.3	110.8	181.0
603	109.7	116.3	110.8	181.0
604	109.7	116.3	110.8	181.1
605	109.7	116.3	110.8	181.1
606	109.8	116.4	110.9	181.1
607	109.8	116.4	110.9	181.1
608	109.8	116.4	110.9	181.1
609	109.8	116.4	111.0	181.1
610	109.9	116.5	111.0	181.1
611	109.9	116.5	111.0	181.1
612	109.9	116.5	111.0	181.2
613	109.9	116.5	111.1	181.2
614	110.0	116.6	111.1	181.2
615	110.0	116.6	111.1	181.2
616	110.0	116.6	111.1	181.2
617	110.1	116.6	111.2	181.2
618	110.1	116.7	111.2	181.2
619	110.1	116.7	111.2	181.2
620	110.1	116.7	111.2	181.3
621	110.2	116.7	111.3	181.3

622	110.2	116.8	111.3	181.3
623	110.2	116.8	111.3	181.3
624	110.2	116.8	111.4	181.3
625	110.3	116.8	111.4	181.3
626	110.3	116.9	111.4	181.3
627	110.3	116.9	111.4	181.3
628	110.3	116.9	111.5	181.3
629	110.4	116.9	111.5	181.3
630	110.4	117.0	111.5	181.4
631	110.4	117.0	111.5	181.4
632	110.4	117.0	111.6	181.4
633	110.5	117.0	111.6	181.4
634	110.5	117.1	111.6	181.4
635	110.5	117.1	111.6	181.4
636	110.5	117.1	111.7	181.4
637	110.6	117.1	111.7	181.4
638	110.6	117.2	111.7	181.4
639	110.6	117.2	111.7	181.4
640	110.6	117.2	111.8	181.5
641	110.7	117.2	111.8	181.5
642	110.7	117.3	111.8	181.5
643	110.7	117.3	111.8	181.5
644	110.7	117.3	111.9	181.5
645	110.8	117.3	111.9	181.5
646	110.8	117.4	111.9	181.5
647	110.8	117.4	111.9	181.5
648	110.9	117.4	112.0	181.5
649	110.9	117.4	112.0	181.5
650	110.9	117.5	112.0	181.5
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652	111.0	117.5	112.1	181.6
653	111.0	117.5	112.1	181.6
654	111.0	117.6	112.1	181.6
655	111.0	117.6	112.2	181.6
656	111.1	117.6	112.2	181.6
657	111.1	117.6	112.2	181.6
658	111.1	117.7	112.2	181.6
659	111.1	117.7	112.3	181.6
660	111.2	117.7	112.3	181.6
661	111.2	117.7	112.3	181.6
662	111.2	117.8	112.3	181.6
663	111.2	117.8	112.4	181.6
664	111.3	117.8	112.4	181.7
665	111.3	117.8	112.4	181.7
666	111.3	117.9	112.4	181.7
667	111.3	117.9	112.5	181.7
668	111.4	117.9	112.5	181.7
669	111.4	117.9	112.5	181.7
670	111.4	118.0	112.5	181.7
671	111.4	118.0	112.6	181.7
672	111.5	118.0	112.6	181.7
673	111.5	118.0	112.6	181.7
674	111.5	118.1	112.6	181.7
675	111.5	118.1	112.6	181.7
676	111.5	118.1	112.7	181.7
677	111.6	118.1	112.7	181.7

678	111.6	118.2	112.7	181.7
679	111.6	118.2	112.7	181.8
680	111.6	118.2	112.8	181.8
681	111.7	118.2	112.8	181.8
682	111.7	118.3	112.8	181.8
683	111.7	118.3	112.8	181.8
684	111.7	118.3	112.9	181.8
685	111.8	118.3	112.9	181.8
686	111.8	118.4	112.9	181.8
687	111.8	118.4	112.9	181.8
688	111.8	118.4	113.0	181.8
689	111.9	118.4	113.0	181.8
690	111.9	118.5	113.0	181.8
691	111.9	118.5	113.0	181.8
692	111.9	118.5	113.1	181.8
693	112.0	118.5	113.1	181.8
694	112.0	118.6	113.1	181.8
695	112.0	118.6	113.1	181.8
696	112.0	118.6	113.2	181.9
697	112.1	118.6	113.2	181.9
698	112.1	118.7	113.2	181.9
699	112.1	118.7	113.2	181.9
700	112.1	118.7	113.3	181.9
701	112.2	118.7	113.3	181.9
702	112.2	118.8	113.3	181.9
703	112.2	118.8	113.3	181.9
704	112.2	118.8	113.3	181.9
705	112.3	118.8	113.4	181.9
706	112.3	118.9	113.4	181.9
707	112.3	118.9	113.4	181.9
708	112.3	118.9	113.4	181.9
709	112.3	118.9	113.5	181.9
710	112.4	119.0	113.5	181.9
711	112.4	119.0	113.5	181.9
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713	112.4	119.0	113.6	181.9
714	112.5	119.1	113.6	181.9
715	112.5	119.1	113.6	181.9
716	112.5	119.1	113.6	181.9
717	112.5	119.1	113.7	181.9
718	112.6	119.2	113.7	181.9
719	112.6	119.2	113.7	182.0
720	112.6	119.2	113.7	182.0
721	112.6	119.2	113.7	182.0
722	112.7	119.3	113.8	182.0
723	112.7	119.3	113.8	182.0
724	112.7	119.3	113.8	182.0
725	112.7	119.3	113.8	182.0
726	112.8	119.4	113.9	182.0
727	112.8	119.4	113.9	182.0
728	112.8	119.4	113.9	182.0
729	112.8	119.4	113.9	182.0
730	112.8	119.5	114.0	182.0
731	112.9	119.5	114.0	182.0
732	112.9	119.5	114.0	182.0
733	112.9	119.5	114.0	182.0

734	112.9	119.6	114.0	182.0
735	113.0	119.6	114.1	182.0
736	113.0	119.6	114.1	182.0
737	113.0	119.6	114.1	182.0
738	113.0	119.7	114.1	182.0
739	113.1	119.7	114.2	182.0
740	113.1	119.7	114.2	182.0
741	113.1	119.7	114.2	182.0
742	113.1	119.8	114.2	182.0
743	113.1	119.8	114.2	182.0
744	113.2	119.8	114.3	182.0
745	113.2	119.8	114.3	182.0
746	113.2	119.9	114.3	182.0
747	113.2	119.9	114.3	182.0
748	113.3	119.9	114.4	182.0
749	113.3	119.9	114.4	182.1
750	113.3	120.0	114.4	182.1
751	113.3	120.0	114.4	182.1
752	113.4	120.0	114.4	182.1
753	113.4	120.0	114.5	182.1
754	113.4	120.1	114.5	182.1
755	113.4	120.1	114.5	182.1
756	113.4	120.1	114.5	182.1
757	113.5	120.1	114.6	182.1
758	113.5	120.2	114.6	182.1
759	113.5	120.2	114.6	182.1
760	113.5	120.2	114.6	182.1
761	113.6	120.2	114.6	182.1
762	113.6	120.3	114.7	182.1
763	113.6	120.3	114.7	182.1
764	113.6	120.3	114.7	182.1
765	113.6	120.3	114.7	182.1
766	113.7	120.4	114.8	182.1
767	113.7	120.4	114.8	182.1
768	113.7	120.4	114.8	182.1
769	113.7	120.4	114.8	182.1
770	113.8	120.5	114.8	182.1
771	113.8	120.5	114.9	182.1
772	113.8	120.5	114.9	182.1
773	113.8	120.5	114.9	182.1
774	113.9	120.6	114.9	182.1
775	113.9	120.6	115.0	182.1
776	113.9	120.6	115.0	182.1
777	113.9	120.6	115.0	182.1
778	113.9	120.7	115.0	182.1
779	114.0	120.7	115.0	182.1
780	114.0	120.7	115.1	182.1
781	114.0	120.7	115.1	182.1
782	114.0	120.8	115.1	182.1
783	114.1	120.8	115.1	182.1
784	114.1	120.8	115.2	182.1
785	114.1	120.8	115.2	182.1
786	114.1	120.9	115.2	182.1
787	114.1	120.9	115.2	182.1
788	114.2	120.9	115.2	182.1
789	114.2	120.9	115.3	182.1

790	114.2	121.0	115.3	182.1
791	114.2	121.0	115.3	182.1
792	114.3	121.0	115.3	182.1
793	114.3	121.0	115.3	182.1
794	114.3	121.1	115.4	182.1
795	114.3	121.1	115.4	182.1
796	114.3	121.1	115.4	182.1
797	114.4	121.1	115.4	182.2
798	114.4	121.2	115.4	182.2
799	114.4	121.2	115.5	182.2
800	114.4	121.2	115.5	182.2
801	114.5	121.2	115.5	182.2
802	114.5	121.3	115.5	182.2
803	114.5	121.3	115.6	182.2
804	114.5	121.3	115.6	182.2
805	114.5	121.3	115.6	182.2
806	114.6	121.4	115.6	182.2
807	114.6	121.4	115.6	182.2
808	114.6	121.4	115.7	182.2
809	114.6	121.4	115.7	182.2
810	114.6	121.5	115.7	182.2
811	114.7	121.5	115.7	182.2
812	114.7	121.5	115.7	182.2
813	114.7	121.5	115.8	182.2
814	114.7	121.6	115.8	182.2
815	114.8	121.6	115.8	182.2
816	114.8	121.6	115.8	182.2
817	114.8	121.6	115.8	182.2
818	114.8	121.7	115.9	182.2
819	114.8	121.7	115.9	182.2
820	114.9	121.7	115.9	182.2
821	114.9	121.7	115.9	182.2
822	114.9	121.8	116.0	182.2
823	114.9	121.8	116.0	182.2
824	115.0	121.8	116.0	182.2
825	115.0	121.8	116.0	182.2
826	115.0	121.9	116.0	182.2
827	115.0	121.9	116.1	182.2
828	115.0	121.9	116.1	182.2
829	115.1	121.9	116.1	182.2
830	115.1	122.0	116.1	182.2
831	115.1	122.0	116.1	182.2
832	115.1	122.0	116.2	182.2
833	115.1	122.0	116.2	182.2
834	115.2	122.1	116.2	182.2
835	115.2	122.1	116.2	182.2
836	115.2	122.1	116.2	182.2
837	115.2	122.1	116.3	182.2
838	115.3	122.2	116.3	182.2
839	115.3	122.2	116.3	182.2
840	115.3	122.2	116.3	182.2
841	115.3	122.2	116.3	182.2
842	115.3	122.3	116.4	182.2
843	115.4	122.3	116.4	182.2
844	115.4	122.3	116.4	182.2
845	115.4	122.3	116.4	182.2

846	115.4	122.4	116.4	182.2
847	115.4	122.4	116.5	182.2
848	115.5	122.4	116.5	182.2
849	115.5	122.4	116.5	182.2
850	115.5	122.5	116.5	182.2
851	115.5	122.5	116.5	182.2
852	115.5	122.5	116.6	182.2
853	115.6	122.5	116.6	182.2
854	115.6	122.6	116.6	182.2
855	115.6	122.6	116.6	182.2
856	115.6	122.6	116.6	182.2
857	115.7	122.6	116.7	182.2
858	115.7	122.7	116.7	182.2
859	115.7	122.7	116.7	182.2
860	115.7	122.7	116.7	182.2
861	115.7	122.7	116.7	182.2
862	115.8	122.8	116.8	182.2
863	115.8	122.8	116.8	182.2
864	115.8	122.8	116.8	182.2
865	115.8	122.8	116.8	182.2
866	115.8	122.9	116.8	182.2
867	115.9	122.9	116.9	182.2
868	115.9	122.9	116.9	182.2
869	115.9	122.9	116.9	182.2
870	115.9	123.0	116.9	182.2
871	115.9	123.0	116.9	182.2
872	116.0	123.0	117.0	182.2
873	116.0	123.0	117.0	182.2
874	116.0	123.1	117.0	182.2
875	116.0	123.1	117.0	182.2
876	116.0	123.1	117.0	182.2
877	116.1	123.1	117.1	182.2
878	116.1	123.2	117.1	182.2
879	116.1	123.2	117.1	182.2
880	116.1	123.2	117.1	182.2
881	116.2	123.2	117.1	182.2
882	116.2	123.3	117.2	182.2
883	116.2	123.3	117.2	182.2
884	116.2	123.3	117.2	182.2
885	116.2	123.3	117.2	182.2
886	116.3	123.4	117.2	182.2
887	116.3	123.4	117.2	182.2
888	116.3	123.4	117.3	182.2
889	116.3	123.4	117.3	182.2
890	116.3	123.5	117.3	182.2
891	116.4	123.5	117.3	182.2
892	116.4	123.5	117.3	182.2
893	116.4	123.5	117.4	182.2
894	116.4	123.6	117.4	182.2
895	116.4	123.6	117.4	182.2
896	116.5	123.6	117.4	182.2
897	116.5	123.6	117.4	182.2
898	116.5	123.7	117.5	182.2
899	116.5	123.7	117.5	182.2
900	116.5	123.7	117.5	182.2
901	116.6	123.7	117.5	182.2

902	116.6	123.8	117.5	182.2
903	116.6	123.8	117.6	182.2
904	116.6	123.8	117.6	182.2
905	116.6	123.8	117.6	182.2
906	116.7	123.9	117.6	182.2
907	116.7	123.9	117.6	182.2
908	116.7	123.9	117.6	182.2
909	116.7	123.9	117.7	182.2
910	116.7	124.0	117.7	182.2
911	116.8	124.0	117.7	182.2
912	116.8	124.0	117.7	182.2
913	116.8	124.0	117.7	182.2
914	116.8	124.1	117.8	182.2
915	116.8	124.1	117.8	182.2
916	116.9	124.1	117.8	182.2
917	116.9	124.1	117.8	182.2
918	116.9	124.2	117.8	182.2
919	116.9	124.2	117.9	182.3
920	116.9	124.2	117.9	182.3
921	117.0	124.2	117.9	182.3
922	117.0	124.3	117.9	182.3
923	117.0	124.3	117.9	182.3
924	117.0	124.3	117.9	182.3
925	117.0	124.3	118.0	182.3
926	117.1	124.4	118.0	182.3
927	117.1	124.4	118.0	182.3
928	117.1	124.4	118.0	182.3
929	117.1	124.4	118.0	182.3
930	117.1	124.5	118.1	182.3
931	117.2	124.5	118.1	182.3
932	117.2	124.5	118.1	182.3
933	117.2	124.5	118.1	182.3
934	117.2	124.6	118.1	182.3
935	117.2	124.6	118.2	182.3
936	117.3	124.6	118.2	182.3
937	117.3	124.6	118.2	182.3
938	117.3	124.7	118.2	182.3
939	117.3	124.7	118.2	182.3
940	117.3	124.7	118.2	182.3
941	117.4	124.7	118.3	182.3
942	117.4	124.8	118.3	182.3
943	117.4	124.8	118.3	182.3
944	117.4	124.8	118.3	182.3
945	117.4	124.8	118.3	182.3
946	117.5	124.9	118.4	182.3
947	117.5	124.9	118.4	182.3
948	117.5	124.9	118.4	182.3
949	117.5	124.9	118.4	182.3
950	117.5	125.0	118.4	182.3
951	117.5	125.0	118.4	182.3
952	117.6	125.0	118.5	182.3
953	117.6	125.0	118.5	182.3
954	117.6	125.1	118.5	182.3
955	117.6	125.1	118.5	182.3
956	117.6	125.1	118.5	182.3
957	117.7	125.1	118.6	182.3

958	117.7	125.2	118.6	182.3
959	117.7	125.2	118.6	182.3
960	117.7	125.2	118.6	182.3

Table 67: Extended NFDs, LTE EIRP = 68 dBm/20 MHz, FL CS = 25 kHz

21.3 LTE EIRP = 65 dBm/20 MHz

The Extended NFDs in this section were derived in line with the urban assumptions, i.e. LTE EIRP equal 65 dBm/20MHz.

21.3.1 FL CS 3.5 MHz

FL Channel	Generic (dB)	Hi-Perf Rx (dB)	Hi-Perf Tx (dB)	Hi-Perf Tx and Rx (dB)
1	65.5	65.2	88.5	123.7
2	83.7	83.7	98.4	133.3
3	87.3	87.2	104.7	142.7
4	90.8	90.7	109.3	150.2
5	94.3	94.2	113.0	156.6
6	97.8	97.7	116.1	161.6

Table 68: Extended NFDs, LTE EIRP = 65 dBm/20 MHz, FL CS = 3.5 MHz

21.3.2 FL CS 2 MHz

FL Channel	Generic (dB)	Hi-Perf Rx (dB)	Hi-Perf Tx (dB)	Hi-Perf Tx and Rx (dB)
1	59.5	59.6	76.2	120.5
2	73.4	73.5	87.6	137.8
3	84.9	85.4	94.2	151.3
4	87.1	87.4	98.9	150.7
5	89.2	89.4	102.7	153.6
6	91.3	91.4	105.8	157.5
7	93.3	93.4	108.4	161.7
8	95.3	95.4	110.7	166.0
9	97.3	97.4	112.8	170.2
10	99.3	99.4	114.6	174.0
11	101.3	101.4	116.3	177.3
12	103.3	103.4	117.9	179.6

Table 69: Extended NFDs, LTE EIRP = 65 dBm/20 MHz, FL CS = 2 MHz

21.3.3 FL CS 1 MHz

FL Channel	Generic (dB)	Hi-Perf Rx (dB)	Hi-Perf Tx (dB)	Hi-Perf Tx and Rx (dB)
1	60.1	60.5	71.0	121.3
2	63.8	64.0	79.9	123.3
3	66.8	66.9	85.4	130.5
4	85.6	87.9	89.5	167.0
5	86.7	88.0	92.8	156.1
6	88.1	88.9	95.5	153.3
7	89.3	89.9	97.9	153.3

8	90.4	90.9	100.0	154.3
9	91.5	91.9	101.8	155.8
10	92.6	92.9	103.5	157.6
11	93.6	93.9	105.0	159.5
12	94.6	94.9	106.5	161.6
13	95.6	95.9	107.8	163.7
14	96.7	96.9	109.0	165.8
15	97.7	97.9	110.2	167.9
16	98.7	98.9	111.3	170.0
17	99.7	99.9	112.3	172.0
18	100.7	100.9	113.3	173.9
19	101.7	101.9	114.2	175.6
20	102.7	102.9	115.1	177.2
21	103.6	103.9	115.9	178.5
22	104.6	104.9	116.7	179.6
23	105.6	105.9	117.5	180.4
24	106.6	106.9	118.3	181.0

Table 70: Extended NFDs, LTE EIRP = 65 dBm/20 MHz, FL CS = 1 MHz

21.3.4 FL CS 250 KHz

FL Channel	Generic (dB)	Hi-Perf Rx (dB)	Hi-Perf Tx (dB)	Hi-Perf Tx and Rx (dB)
1	60.0	60.9	67.8	123.2
2	64.2	64.7	73.8	124.4
3	66.6	66.9	78.2	124.9
4	66.8	67.1	81.5	123.9
5	66.8	66.9	84.2	129.9
6	85.1	90.9	86.5	156.9
7	86.5	90.9	88.5	164.5
8	87.6	90.9	90.4	168.4
9	88.4	90.9	92.0	161.0
10	89.2	91.2	93.5	157.9
11	90.0	91.7	94.8	156.6
12	90.7	92.2	96.1	156.1
13	91.4	92.7	97.3	156.1
14	92.0	93.2	98.4	156.4
15	92.6	93.7	99.5	156.9
16	93.2	94.2	100.4	157.6
17	93.8	94.7	101.4	158.3
18	94.4	95.2	102.3	159.2
19	94.9	95.7	103.1	160.1
20	95.5	96.2	103.9	161.0
21	96.0	96.7	104.7	162.0
22	96.6	97.2	105.4	163.0
23	97.1	97.7	106.1	164.0
24	97.6	98.2	106.8	165.1
25	98.1	98.7	107.5	166.1
26	98.6	99.2	108.1	167.1
27	99.2	99.7	108.7	168.2
28	99.7	100.2	109.3	169.2
29	100.2	100.7	109.9	170.2
30	100.7	101.2	110.5	171.2
31	101.2	101.7	111.0	172.2

32	101.7	102.2	111.5	173.2
33	102.2	102.7	112.0	174.1
34	102.7	103.2	112.5	175.0
35	103.2	103.7	113.0	175.9
36	103.7	104.2	113.5	176.7
37	104.2	104.7	114.0	177.4
38	104.7	105.2	114.4	178.1
39	105.2	105.7	114.9	178.7
40	105.7	106.2	115.3	179.3
41	106.2	106.7	115.7	179.8
42	106.6	107.2	116.1	180.2
43	107.1	107.7	116.5	180.6
44	107.6	108.2	116.9	180.9
45	108.1	108.7	117.3	181.1
46	108.6	109.2	117.7	181.4
47	109.1	109.7	118.1	181.5
48	109.6	110.2	118.4	181.7

Table 71: Extended NFDs, LTE EIRP = 65 dBm/20 MHz, FL CS = 500 kHz

21.3.5 FL CS 250 KHz

FL Channel	Generic (dB)	Hi-Perf Rx (dB)	Hi-Perf Tx (dB)	Hi-Perf Tx and Rx (dB)
1	60.7	62.3	66.5	124.7
2	64.2	65.9	69.3	123.5
3	66.4	67.7	72.5	124.4
4	66.9	67.7	75.1	125.4
5	69.2	69.9	77.2	125.4
6	69.4	69.9	79.1	125.0
7	69.5	70.0	80.7	124.7
8	69.6	70.1	82.2	124.6
9	69.7	69.9	83.6	132.3
10	69.8	69.9	84.8	133.6
11	85.3	93.8	86.0	158.1
12	86.2	93.9	87.0	160.6
13	87.0	93.9	88.1	164.0
14	87.8	93.9	89.0	168.5
15	88.4	93.9	89.9	171.4
16	89.0	93.9	90.8	168.5
17	89.6	93.9	91.6	165.1
18	90.0	93.9	92.4	162.8
19	90.5	94.0	93.1	161.3
20	91.0	94.3	93.8	160.4
21	91.5	94.5	94.5	159.8
22	92.0	94.8	95.2	159.4
23	92.4	95.0	95.8	159.2
24	92.8	95.3	96.4	159.1
25	93.2	95.5	97.0	159.1
26	93.6	95.8	97.6	159.2
27	93.9	96.0	98.1	159.3
28	94.3	96.3	98.7	159.5
29	94.6	96.5	99.2	159.8
30	95.0	96.8	99.7	160.1
31	95.3	97.0	100.2	160.4

32	95.6	97.3	100.7	160.7
33	96.0	97.5	101.1	161.1
34	96.3	97.8	101.6	161.5
35	96.6	98.0	102.0	161.9
36	96.9	98.3	102.5	162.4
37	97.2	98.5	102.9	162.8
38	97.5	98.8	103.3	163.3
39	97.7	99.0	103.7	163.8
40	98.0	99.3	104.1	164.2
41	98.3	99.5	104.5	164.7
42	98.6	99.8	104.9	165.2
43	98.9	100.0	105.2	165.7
44	99.2	100.3	105.6	166.2
45	99.4	100.5	106.0	166.7
46	99.7	100.8	106.3	167.2
47	100.0	101.0	106.6	167.7
48	100.2	101.3	107.0	168.2
49	100.5	101.5	107.3	168.7
50	100.8	101.8	107.6	169.3
51	101.0	102.0	107.9	169.8
52	101.3	102.3	108.3	170.3
53	101.6	102.5	108.6	170.8
54	101.8	102.8	108.9	171.3
55	102.1	103.0	109.2	171.8
56	102.3	103.3	109.5	172.3
57	102.6	103.5	109.8	172.7
58	102.8	103.8	110.0	173.2
59	103.1	104.0	110.3	173.7
60	103.4	104.3	110.6	174.1
61	103.6	104.5	110.9	174.6
62	103.9	104.8	111.1	175.0
63	104.1	105.0	111.4	175.5
64	104.4	105.3	111.7	175.9
65	104.6	105.5	111.9	176.3
66	104.9	105.8	112.2	176.7
67	105.1	106.0	112.4	177.1
68	105.4	106.3	112.7	177.5
69	105.6	106.5	112.9	177.8
70	105.9	106.8	113.1	178.2
71	106.1	107.0	113.4	178.5
72	106.4	107.3	113.6	178.8
73	106.6	107.5	113.8	179.1
74	106.9	107.8	114.1	179.3
75	107.1	108.0	114.3	179.6
76	107.3	108.3	114.5	179.8
77	107.6	108.5	114.7	180.0
78	107.8	108.8	115.0	180.3
79	108.1	109.0	115.2	180.4
80	108.3	109.3	115.4	180.6
81	108.6	109.5	115.6	180.8
82	108.8	109.8	115.8	180.9
83	109.0	110.0	116.0	181.1
84	109.3	110.3	116.2	181.2
85	109.5	110.5	116.4	181.3
86	109.8	110.8	116.6	181.4
87	110.0	111.0	116.8	181.5

88	110.2	111.3	117.0	181.6
89	110.5	111.5	117.2	181.6
90	110.7	111.8	117.4	181.7
91	111.0	112.0	117.6	181.8
92	111.2	112.3	117.8	181.8
93	111.4	112.5	118.0	181.9
94	111.7	112.8	118.2	181.9
95	111.9	113.0	118.3	182.0
96	112.1	113.3	118.5	182.0

Table 72: Extended NFDs, LTE EIRP = 65 dBm/20 MHz, FL CS = 250 kHz

21.3.6 FL CS 75 kHz

FL Channel	Generic (dB)	Hi-Perf Rx (dB)	Hi-Perf Tx (dB)	Hi-Perf Tx and Rx (dB)
1	62.4	65.3	65.9	123.9
2	63.2	66.3	66.4	125.2
3	64.1	67.4	67.1	125.3
4	65.1	68.5	67.9	124.9
5	66.1	69.6	68.8	124.6
6	67.2	70.7	69.8	124.6
7	68.2	71.7	70.8	124.8
8	68.8	71.9	71.8	124.9
9	69.2	71.9	72.6	125.1
10	69.6	71.9	73.5	125.2
11	69.9	71.9	74.2	125.4
12	70.1	71.9	74.9	125.5
13	70.3	71.9	75.6	125.5
14	71.6	73.5	76.3	125.5
15	72.2	74.1	76.9	125.5
16	72.4	74.1	77.5	125.5
17	72.6	74.1	78.1	125.4
18	72.8	74.1	78.6	125.4
19	72.9	74.1	79.2	125.3
20	73.0	74.2	79.7	125.3
21	73.1	74.2	80.2	125.2
22	73.2	74.2	80.6	125.2
23	73.3	74.2	81.1	125.2
24	73.4	74.3	81.6	125.2
25	73.4	74.3	82.0	125.2
26	73.5	74.4	82.4	125.2
27	73.5	74.1	82.8	136.1
28	73.6	74.1	83.2	136.3
29	73.6	74.1	83.6	136.5
30	73.7	74.1	84.0	136.8
31	73.7	74.1	84.4	137.2
32	73.7	74.1	84.8	137.7
33	73.7	74.1	85.1	138.2
34	79.2	80.4	85.5	144.8
35	85.5	97.9	85.8	160.1
36	85.8	97.9	86.1	160.9
37	86.1	97.9	86.5	161.5
38	86.4	98.0	86.8	162.2
39	86.7	98.0	87.1	163.0

40	87.0	98.0	87.4	163.8
41	87.3	98.0	87.7	164.7
42	87.6	98.0	88.0	165.7
43	87.8	98.0	88.3	166.7
44	88.1	98.0	88.6	167.7
45	88.4	98.0	88.9	168.7
46	88.6	98.1	89.2	169.8
47	88.9	98.1	89.4	170.7
48	89.1	98.1	89.7	171.4
49	89.3	98.1	90.0	171.9
50	89.5	98.1	90.2	172.0
51	89.8	98.1	90.5	171.7
52	90.0	98.1	90.7	171.2
53	90.2	98.1	91.0	170.5
54	90.4	98.1	91.2	169.8
55	90.6	98.1	91.5	169.1
56	90.8	98.1	91.7	168.5
57	91.0	98.1	92.0	167.8
58	91.2	98.1	92.2	167.3
59	91.4	98.1	92.4	166.7
60	91.5	98.1	92.6	166.2
61	91.7	98.2	92.9	165.8
62	91.9	98.2	93.1	165.5
63	92.1	98.3	93.3	165.2
64	92.3	98.4	93.5	164.9
65	92.5	98.5	93.7	164.6
66	92.6	98.5	93.9	164.4
67	92.8	98.6	94.1	164.2
68	93.0	98.7	94.3	164.1
69	93.1	98.8	94.6	163.9
70	93.3	98.8	94.8	163.8
71	93.5	98.9	94.9	163.7
72	93.6	99.0	95.1	163.6
73	93.8	99.1	95.3	163.5
74	93.9	99.1	95.5	163.4
75	94.1	99.2	95.7	163.4
76	94.2	99.3	95.9	163.3
77	94.4	99.4	96.1	163.3
78	94.5	99.4	96.3	163.3
79	94.7	99.5	96.5	163.2
80	94.8	99.6	96.6	163.2
81	95.0	99.7	96.8	163.2
82	95.1	99.7	97.0	163.2
83	95.3	99.8	97.2	163.3
84	95.4	99.9	97.3	163.3
85	95.5	100.0	97.5	163.3
86	95.7	100.0	97.7	163.3
87	95.8	100.1	97.8	163.4
88	95.9	100.2	98.0	163.4
89	96.1	100.3	98.2	163.5
90	96.2	100.3	98.3	163.5
91	96.3	100.4	98.5	163.6
92	96.4	100.5	98.7	163.7
93	96.6	100.6	98.8	163.7
94	96.7	100.6	99.0	163.8
95	96.8	100.7	99.1	163.9

96	96.9	100.8	99.3	164.0
97	97.1	100.9	99.4	164.1
98	97.2	100.9	99.6	164.2
99	97.3	101.0	99.7	164.2
100	97.4	101.1	99.9	164.3
101	97.5	101.2	100.0	164.4
102	97.6	101.2	100.2	164.5
103	97.8	101.3	100.3	164.6
104	97.9	101.4	100.5	164.7
105	98.0	101.5	100.6	164.8
106	98.1	101.5	100.7	165.0
107	98.2	101.6	100.9	165.1
108	98.3	101.7	101.0	165.2
109	98.4	101.8	101.2	165.3
110	98.5	101.8	101.3	165.4
111	98.6	101.9	101.4	165.5
112	98.7	102.0	101.6	165.7
113	98.8	102.1	101.7	165.8
114	98.9	102.1	101.8	165.9
115	99.1	102.2	102.0	166.0
116	99.2	102.3	102.1	166.1
117	99.3	102.4	102.2	166.3
118	99.4	102.4	102.4	166.4
119	99.5	102.5	102.5	166.5
120	99.6	102.6	102.6	166.7
121	99.7	102.7	102.7	166.8
122	99.8	102.7	102.9	166.9
123	99.9	102.8	103.0	167.1
124	100.0	102.9	103.1	167.2
125	100.1	103.0	103.2	167.3
126	100.2	103.0	103.4	167.5
127	100.3	103.1	103.5	167.6
128	100.4	103.2	103.6	167.7
129	100.4	103.3	103.7	167.9
130	100.5	103.3	103.8	168.0
131	100.6	103.4	104.0	168.2
132	100.7	103.5	104.1	168.3
133	100.8	103.6	104.2	168.4
134	100.9	103.6	104.3	168.6
135	101.0	103.7	104.4	168.7
136	101.1	103.8	104.5	168.9
137	101.2	103.9	104.7	169.0
138	101.3	103.9	104.8	169.2
139	101.4	104.0	104.9	169.3
140	101.5	104.1	105.0	169.4
141	101.6	104.2	105.1	169.6
142	101.7	104.2	105.2	169.7
143	101.7	104.3	105.3	169.9
144	101.8	104.4	105.4	170.0
145	101.9	104.5	105.5	170.2
146	102.0	104.5	105.6	170.3
147	102.1	104.6	105.8	170.5
148	102.2	104.7	105.9	170.6
149	102.3	104.8	106.0	170.7
150	102.4	104.8	106.1	170.9
151	102.5	104.9	106.2	171.0

152	102.5	105.0	106.3	171.2
153	102.6	105.1	106.4	171.3
154	102.7	105.1	106.5	171.5
155	102.8	105.2	106.6	171.6
156	102.9	105.3	106.7	171.8
157	103.0	105.4	106.8	171.9
158	103.1	105.4	106.9	172.0
159	103.1	105.5	107.0	172.2
160	103.2	105.6	107.1	172.3
161	103.3	105.7	107.2	172.5
162	103.4	105.7	107.3	172.6
163	103.5	105.8	107.4	172.8
164	103.6	105.9	107.5	172.9
165	103.7	106.0	107.6	173.0
166	103.7	106.0	107.7	173.2
167	103.8	106.1	107.8	173.3
168	103.9	106.2	107.9	173.5
169	104.0	106.3	108.0	173.6
170	104.1	106.3	108.1	173.7
171	104.2	106.4	108.2	173.9
172	104.2	106.5	108.2	174.0
173	104.3	106.6	108.3	174.2
174	104.4	106.6	108.4	174.3
175	104.5	106.7	108.5	174.4
176	104.6	106.8	108.6	174.6
177	104.6	106.9	108.7	174.7
178	104.7	106.9	108.8	174.8
179	104.8	107.0	108.9	175.0
180	104.9	107.1	109.0	175.1
181	105.0	107.2	109.1	175.2
182	105.0	107.2	109.2	175.4
183	105.1	107.3	109.2	175.5
184	105.2	107.4	109.3	175.6
185	105.3	107.5	109.4	175.7
186	105.4	107.5	109.5	175.9
187	105.4	107.6	109.6	176.0
188	105.5	107.7	109.7	176.1
189	105.6	107.8	109.8	176.2
190	105.7	107.8	109.9	176.4
191	105.8	107.9	109.9	176.5
192	105.8	108.0	110.0	176.6
193	105.9	108.1	110.1	176.7
194	106.0	108.1	110.2	176.8
195	106.1	108.2	110.3	176.9
196	106.2	108.3	110.4	177.1
197	106.2	108.4	110.4	177.2
198	106.3	108.4	110.5	177.3
199	106.4	108.5	110.6	177.4
200	106.5	108.6	110.7	177.5
201	106.5	108.7	110.8	177.6
202	106.6	108.7	110.8	177.7
203	106.7	108.8	110.9	177.8
204	106.8	108.9	111.0	177.9
205	106.9	109.0	111.1	178.0
206	106.9	109.0	111.2	178.1
207	107.0	109.1	111.2	178.2

208	107.1	109.2	111.3	178.3
209	107.2	109.3	111.4	178.4
210	107.2	109.3	111.5	178.5
211	107.3	109.4	111.6	178.6
212	107.4	109.5	111.6	178.7
213	107.5	109.6	111.7	178.8
214	107.5	109.6	111.8	178.9
215	107.6	109.7	111.9	179.0
216	107.7	109.8	111.9	179.1
217	107.8	109.9	112.0	179.1
218	107.8	109.9	112.1	179.2
219	107.9	110.0	112.2	179.3
220	108.0	110.1	112.3	179.4
221	108.1	110.2	112.3	179.5
222	108.1	110.2	112.4	179.5
223	108.2	110.3	112.5	179.6
224	108.3	110.4	112.6	179.7
225	108.4	110.5	112.6	179.8
226	108.4	110.5	112.7	179.8
227	108.5	110.6	112.8	179.9
228	108.6	110.7	112.8	180.0
229	108.7	110.8	112.9	180.0
230	108.7	110.8	113.0	180.1
231	108.8	110.9	113.1	180.2
232	108.9	111.0	113.1	180.2
233	109.0	111.1	113.2	180.3
234	109.0	111.1	113.3	180.3
235	109.1	111.2	113.3	180.4
236	109.2	111.3	113.4	180.5
237	109.3	111.4	113.5	180.5
238	109.3	111.4	113.6	180.6
239	109.4	111.5	113.6	180.6
240	109.5	111.6	113.7	180.7
241	109.5	111.7	113.8	180.7
242	109.6	111.7	113.8	180.8
243	109.7	111.8	113.9	180.8
244	109.8	111.9	114.0	180.9
245	109.8	112.0	114.0	180.9
246	109.9	112.0	114.1	180.9
247	110.0	112.1	114.2	181.0
248	110.1	112.2	114.2	181.0
249	110.1	112.3	114.3	181.1
250	110.2	112.3	114.4	181.1
251	110.3	112.4	114.4	181.1
252	110.3	112.5	114.5	181.2
253	110.4	112.6	114.6	181.2
254	110.5	112.6	114.6	181.2
255	110.6	112.7	114.7	181.3
256	110.6	112.8	114.8	181.3
257	110.7	112.9	114.8	181.3
258	110.8	112.9	114.9	181.4
259	110.8	113.0	115.0	181.4
260	110.9	113.1	115.0	181.4
261	111.0	113.2	115.1	181.5
262	111.1	113.2	115.2	181.5
263	111.1	113.3	115.2	181.5

264	111.2	113.4	115.3	181.5
265	111.3	113.5	115.4	181.6
266	111.3	113.5	115.4	181.6
267	111.4	113.6	115.5	181.6
268	111.5	113.7	115.6	181.6
269	111.5	113.8	115.6	181.7
270	111.6	113.8	115.7	181.7
271	111.7	113.9	115.7	181.7
272	111.8	114.0	115.8	181.7
273	111.8	114.1	115.9	181.7
274	111.9	114.1	115.9	181.7
275	112.0	114.2	116.0	181.8
276	112.0	114.3	116.1	181.8
277	112.1	114.4	116.1	181.8
278	112.2	114.4	116.2	181.8
279	112.2	114.5	116.2	181.8
280	112.3	114.6	116.3	181.8
281	112.4	114.7	116.4	181.9
282	112.5	114.7	116.4	181.9
283	112.5	114.8	116.5	181.9
284	112.6	114.9	116.5	181.9
285	112.7	115.0	116.6	181.9
286	112.7	115.0	116.7	181.9
287	112.8	115.1	116.7	181.9
288	112.9	115.2	116.8	182.0
289	112.9	115.3	116.8	182.0
290	113.0	115.3	116.9	182.0
291	113.1	115.4	117.0	182.0
292	113.1	115.5	117.0	182.0
293	113.2	115.6	117.1	182.0
294	113.3	115.6	117.1	182.0
295	113.3	115.7	117.2	182.0
296	113.4	115.8	117.2	182.0
297	113.5	115.9	117.3	182.0
298	113.6	115.9	117.4	182.0
299	113.6	116.0	117.4	182.1
300	113.7	116.1	117.5	182.1
301	113.8	116.2	117.5	182.1
302	113.8	116.2	117.6	182.1
303	113.9	116.3	117.6	182.1
304	114.0	116.4	117.7	182.1
305	114.0	116.5	117.8	182.1
306	114.1	116.5	117.8	182.1
307	114.2	116.6	117.9	182.1
308	114.2	116.7	117.9	182.1
309	114.3	116.8	118.0	182.1
310	114.4	116.8	118.0	182.1
311	114.4	116.9	118.1	182.1
312	114.5	117.0	118.2	182.1
313	114.6	117.1	118.2	182.1
314	114.6	117.1	118.3	182.1
315	114.7	117.2	118.3	182.2
316	114.8	117.3	118.4	182.2
317	114.8	117.4	118.4	182.2
318	114.9	117.4	118.5	182.2
319	115.0	117.5	118.5	182.2

320	115.0	117.6	118.6	182.2

Table 73: Extended NFDs, LTE EIRP = 65 dBm/20 MHz, FL CS = 75 kHz

21.3.7 FL CS 25 kHz

FL Channel	Generic (dB)	Hi-Perf Rx (dB)	Hi-Perf Tx (dB)	Hi-Perf Tx and Rx (dB)
1	64.1	69.5	65.7	124.6
2	64.3	69.9	65.9	124.9
3	64.5	70.2	66.1	125.1
4	64.8	70.6	66.2	125.3
5	65.0	70.9	66.4	125.4
6	65.3	71.3	66.6	125.5
7	65.5	71.6	66.9	125.5
8	65.8	72.0	67.1	125.5
9	66.1	72.4	67.4	125.4
10	66.4	72.7	67.6	125.4
11	66.7	73.1	67.9	125.3
12	67.0	73.4	68.2	125.2
13	67.3	73.8	68.5	125.2
14	67.7	74.2	68.8	125.2
15	68.0	74.5	69.2	125.2
16	68.3	74.9	69.5	125.2
17	68.7	75.3	69.8	125.2
18	69.0	75.6	70.2	125.2
19	69.4	76.0	70.5	125.2
20	69.7	76.4	70.8	125.3
21	70.0	76.5	71.1	125.3
22	70.2	76.5	71.4	125.3
23	70.5	76.5	71.8	125.3
24	70.7	76.5	72.1	125.3
25	70.9	76.5	72.3	125.3
26	71.1	76.5	72.6	125.4
27	71.3	76.5	72.9	125.4
28	71.5	76.5	73.2	125.4
29	71.7	76.5	73.5	125.4
30	71.8	76.5	73.7	125.4
31	72.0	76.5	74.0	125.5
32	72.1	76.5	74.2	125.5
33	72.3	76.5	74.5	125.5
34	72.4	76.5	74.7	125.5
35	72.6	76.5	74.9	125.5
36	72.7	76.5	75.2	125.5
37	72.8	76.5	75.4	125.5
38	73.0	76.5	75.6	125.5
39	73.1	76.5	75.9	125.5
40	73.2	76.5	76.1	125.5
41	74.3	78.7	76.3	125.5
42	74.4	78.7	76.5	125.5
43	74.5	78.7	76.7	125.5
44	74.6	78.7	76.9	125.5
45	74.8	78.7	77.1	125.5
46	74.9	78.7	77.3	125.5
47	75.0	78.7	77.5	125.5

48	75.1	78.7	77.7	125.5
49	75.2	78.7	77.9	125.5
50	75.3	78.7	78.1	125.5
51	75.4	78.7	78.3	125.5
52	75.5	78.7	78.4	125.5
53	75.6	78.7	78.6	125.5
54	75.7	78.7	78.8	125.5
55	75.8	78.7	79.0	125.5
56	75.8	78.7	79.2	125.4
57	75.9	78.7	79.3	125.4
58	76.0	78.7	79.5	125.4
59	76.1	78.8	79.7	125.4
60	76.1	78.8	79.8	125.4
61	76.2	78.8	80.0	125.4
62	76.3	78.8	80.2	125.4
63	76.3	78.8	80.3	125.4
64	76.4	78.8	80.5	125.4
65	76.5	78.8	80.6	125.4
66	76.5	78.8	80.8	125.4
67	76.6	78.8	81.0	125.4
68	76.6	78.8	81.1	125.4
69	76.7	78.8	81.3	125.4
70	76.8	78.8	81.4	125.4
71	76.8	78.9	81.6	125.4
72	76.9	78.9	81.7	125.4
73	76.9	78.9	81.9	125.4
74	76.9	78.9	82.0	125.4
75	77.0	78.9	82.1	125.4
76	77.0	78.9	82.3	125.4
77	77.1	79.0	82.4	125.4
78	77.1	79.0	82.6	125.4
79	77.2	79.0	82.7	125.4
80	77.2	79.0	82.8	125.4
81	77.2	78.7	83.0	140.6
82	77.3	78.7	83.1	140.7
83	77.3	78.7	83.2	140.8
84	77.3	78.7	83.4	140.9
85	77.4	78.7	83.5	141.0
86	77.4	78.7	83.6	141.1
87	77.4	78.7	83.8	141.2
88	77.5	78.7	83.9	141.3
89	77.5	78.7	84.0	141.4
90	77.5	78.7	84.1	141.5
91	77.5	78.7	84.3	141.6
92	77.6	78.7	84.4	141.8
93	77.6	78.7	84.5	141.9
94	77.6	78.7	84.6	142.1
95	77.6	78.7	84.8	142.2
96	77.7	78.7	84.9	142.4
97	77.7	78.7	85.0	142.6
98	77.7	78.7	85.1	142.7
99	77.7	78.7	85.2	142.9
100	77.7	78.7	85.3	143.1
101	85.3	102.1	85.5	160.7
102	85.5	102.1	85.6	161.0
103	85.6	102.2	85.7	161.4

104	85.7	102.2	85.8	161.7
105	85.8	102.2	85.9	162.1
106	85.9	102.2	86.0	162.4
107	86.0	102.2	86.1	162.6
108	86.1	102.2	86.2	162.7
109	86.2	102.2	86.4	162.9
110	86.3	102.2	86.5	163.1
111	86.4	102.2	86.6	163.3
112	86.5	102.3	86.7	163.5
113	86.6	102.3	86.8	163.7
114	86.7	102.3	86.9	163.9
115	86.9	102.3	87.0	164.1
116	87.0	102.3	87.1	164.4
117	87.1	102.3	87.2	164.6
118	87.2	102.3	87.3	164.8
119	87.3	102.3	87.4	165.1
120	87.4	102.3	87.5	165.4
121	87.5	102.4	87.6	165.6
122	87.5	102.4	87.7	165.9
123	87.6	102.4	87.8	166.2
124	87.7	102.4	87.9	166.4
125	87.8	102.4	88.0	166.7
126	87.9	102.4	88.1	167.0
127	88.0	102.4	88.2	167.2
128	88.1	102.4	88.3	167.5
129	88.2	102.5	88.4	167.8
130	88.3	102.5	88.5	168.0
131	88.4	102.5	88.6	168.3
132	88.5	102.5	88.7	168.6
133	88.6	102.5	88.8	168.9
134	88.7	102.5	88.9	169.1
135	88.8	102.5	89.0	169.4
136	88.8	102.5	89.1	169.7
137	88.9	102.5	89.2	169.9
138	89.0	102.6	89.3	170.2
139	89.1	102.6	89.3	170.5
140	89.2	102.6	89.4	170.7
141	89.3	102.6	89.5	170.9
142	89.4	102.6	89.6	171.2
143	89.5	102.6	89.7	171.4
144	89.5	102.6	89.8	171.6
145	89.6	102.6	89.9	171.8
146	89.7	102.6	90.0	172.0
147	89.8	102.7	90.1	172.2
148	89.9	102.7	90.1	172.4
149	90.0	102.7	90.2	172.5
150	90.0	102.7	90.3	172.6
151	90.1	102.7	90.4	172.7
152	90.2	102.7	90.5	172.8
153	90.3	102.7	90.6	172.8
154	90.4	102.7	90.7	172.9
155	90.4	102.7	90.7	172.9
156	90.5	102.7	90.8	172.8
157	90.6	102.7	90.9	172.8
158	90.7	102.7	91.0	172.8
159	90.8	102.7	91.1	172.7

160	90.8	102.7	91.2	172.6
161	90.9	102.7	91.2	172.5
162	91.0	102.7	91.3	172.4
163	91.1	102.7	91.4	172.3
164	91.1	102.7	91.5	172.2
165	91.2	102.7	91.6	172.1
166	91.3	102.7	91.6	172.0
167	91.4	102.7	91.7	171.9
168	91.4	102.7	91.8	171.7
169	91.5	102.7	91.9	171.6
170	91.6	102.7	92.0	171.5
171	91.6	102.7	92.0	171.3
172	91.7	102.7	92.1	171.2
173	91.8	102.7	92.2	171.1
174	91.9	102.7	92.3	170.9
175	91.9	102.7	92.3	170.8
176	92.0	102.7	92.4	170.7
177	92.1	102.7	92.5	170.6
178	92.1	102.7	92.6	170.4
179	92.2	102.7	92.6	170.3
180	92.3	102.7	92.7	170.2
181	92.3	102.7	92.8	170.1
182	92.4	102.8	92.9	170.0
183	92.5	102.8	92.9	169.9
184	92.6	102.8	93.0	169.8
185	92.6	102.8	93.1	169.7
186	92.7	102.9	93.2	169.6
187	92.8	102.9	93.2	169.5
188	92.8	102.9	93.3	169.4
189	92.9	102.9	93.4	169.4
190	93.0	103.0	93.4	169.3
191	93.0	103.0	93.5	169.2
192	93.1	103.0	93.6	169.1
193	93.2	103.0	93.7	169.1
194	93.2	103.1	93.7	169.0
195	93.3	103.1	93.8	168.9
196	93.4	103.1	93.9	168.9
197	93.4	103.1	93.9	168.8
198	93.5	103.2	94.0	168.7
199	93.6	103.2	94.1	168.7
200	93.6	103.2	94.1	168.6
201	93.7	103.2	94.2	168.6
202	93.7	103.3	94.3	168.5
203	93.8	103.3	94.3	168.5
204	93.9	103.3	94.4	168.4
205	93.9	103.3	94.5	168.4
206	94.0	103.4	94.6	168.3
207	94.1	103.4	94.6	168.3
208	94.1	103.4	94.7	168.3
209	94.2	103.4	94.8	168.2
210	94.2	103.5	94.8	168.2
211	94.3	103.5	94.9	168.2
212	94.4	103.5	94.9	168.1
213	94.4	103.5	95.0	168.1
214	94.5	103.6	95.1	168.1
215	94.5	103.6	95.1	168.0

216	94.6	103.6	95.2	168.0
217	94.7	103.6	95.3	168.0
218	94.7	103.7	95.3	168.0
219	94.8	103.7	95.4	167.9
220	94.8	103.7	95.5	167.9
221	94.9	103.7	95.5	167.9
222	95.0	103.8	95.6	167.9
223	95.0	103.8	95.7	167.9
224	95.1	103.8	95.7	167.8
225	95.1	103.8	95.8	167.8
226	95.2	103.9	95.8	167.8
227	95.2	103.9	95.9	167.8
228	95.3	103.9	96.0	167.8
229	95.4	103.9	96.0	167.8
230	95.4	104.0	96.1	167.8
231	95.5	104.0	96.2	167.8
232	95.5	104.0	96.2	167.7
233	95.6	104.0	96.3	167.7
234	95.6	104.1	96.3	167.7
235	95.7	104.1	96.4	167.7
236	95.7	104.1	96.5	167.7
237	95.8	104.1	96.5	167.7
238	95.9	104.2	96.6	167.7
239	95.9	104.2	96.6	167.7
240	96.0	104.2	96.7	167.7
241	96.0	104.2	96.8	167.7
242	96.1	104.3	96.8	167.7
243	96.1	104.3	96.9	167.7
244	96.2	104.3	96.9	167.7
245	96.2	104.3	97.0	167.7
246	96.3	104.4	97.0	167.7
247	96.3	104.4	97.1	167.7
248	96.4	104.4	97.2	167.8
249	96.4	104.4	97.2	167.8
250	96.5	104.5	97.3	167.8
251	96.5	104.5	97.3	167.8
252	96.6	104.5	97.4	167.8
253	96.6	104.5	97.4	167.8
254	96.7	104.6	97.5	167.8
255	96.7	104.6	97.6	167.8
256	96.8	104.6	97.6	167.8
257	96.8	104.6	97.7	167.8
258	96.9	104.7	97.7	167.9
259	97.0	104.7	97.8	167.9
260	97.0	104.7	97.8	167.9
261	97.1	104.7	97.9	167.9
262	97.1	104.8	97.9	167.9
263	97.2	104.8	98.0	167.9
264	97.2	104.8	98.1	167.9
265	97.2	104.8	98.1	168.0
266	97.3	104.9	98.2	168.0
267	97.3	104.9	98.2	168.0
268	97.4	104.9	98.3	168.0
269	97.4	104.9	98.3	168.0
270	97.5	105.0	98.4	168.1
271	97.5	105.0	98.4	168.1

272	97.6	105.0	98.5	168.1
273	97.6	105.0	98.5	168.1
274	97.7	105.1	98.6	168.1
275	97.7	105.1	98.7	168.2
276	97.8	105.1	98.7	168.2
277	97.8	105.1	98.8	168.2
278	97.9	105.2	98.8	168.2
279	97.9	105.2	98.9	168.3
280	98.0	105.2	98.9	168.3
281	98.0	105.2	99.0	168.3
282	98.1	105.3	99.0	168.3
283	98.1	105.3	99.1	168.3
284	98.2	105.3	99.1	168.4
285	98.2	105.3	99.2	168.4
286	98.2	105.4	99.2	168.4
287	98.3	105.4	99.3	168.5
288	98.3	105.4	99.3	168.5
289	98.4	105.4	99.4	168.5
290	98.4	105.5	99.4	168.5
291	98.5	105.5	99.5	168.6
292	98.5	105.5	99.5	168.6
293	98.6	105.5	99.6	168.6
294	98.6	105.6	99.6	168.7
295	98.7	105.6	99.7	168.7
296	98.7	105.6	99.7	168.7
297	98.7	105.6	99.8	168.7
298	98.8	105.7	99.8	168.8
299	98.8	105.7	99.9	168.8
300	98.9	105.7	99.9	168.8
301	98.9	105.7	100.0	168.9
302	99.0	105.8	100.0	168.9
303	99.0	105.8	100.1	168.9
304	99.1	105.8	100.1	169.0
305	99.1	105.8	100.2	169.0
306	99.1	105.9	100.2	169.0
307	99.2	105.9	100.3	169.1
308	99.2	105.9	100.3	169.1
309	99.3	105.9	100.4	169.1
310	99.3	106.0	100.4	169.2
311	99.4	106.0	100.5	169.2
312	99.4	106.0	100.5	169.2
313	99.4	106.0	100.6	169.3
314	99.5	106.1	100.6	169.3
315	99.5	106.1	100.7	169.3
316	99.6	106.1	100.7	169.4
317	99.6	106.1	100.7	169.4
318	99.7	106.2	100.8	169.4
319	99.7	106.2	100.8	169.5
320	99.7	106.2	100.9	169.5
321	99.8	106.2	100.9	169.5
322	99.8	106.3	101.0	169.6
323	99.9	106.3	101.0	169.6
324	99.9	106.3	101.1	169.7
325	99.9	106.3	101.1	169.7
326	100.0	106.4	101.2	169.7
327	100.0	106.4	101.2	169.8

328	100.1	106.4	101.3	169.8
329	100.1	106.4	101.3	169.8
330	100.1	106.5	101.3	169.9
331	100.2	106.5	101.4	169.9
332	100.2	106.5	101.4	170.0
333	100.3	106.5	101.5	170.0
334	100.3	106.6	101.5	170.0
335	100.3	106.6	101.6	170.1
336	100.4	106.6	101.6	170.1
337	100.4	106.6	101.7	170.1
338	100.5	106.7	101.7	170.2
339	100.5	106.7	101.8	170.2
340	100.5	106.7	101.8	170.3
341	100.6	106.7	101.8	170.3
342	100.6	106.8	101.9	170.3
343	100.7	106.8	101.9	170.4
344	100.7	106.8	102.0	170.4
345	100.7	106.8	102.0	170.5
346	100.8	106.9	102.1	170.5
347	100.8	106.9	102.1	170.5
348	100.9	106.9	102.1	170.6
349	100.9	106.9	102.2	170.6
350	100.9	107.0	102.2	170.7
351	101.0	107.0	102.3	170.7
352	101.0	107.0	102.3	170.8
353	101.1	107.0	102.4	170.8
354	101.1	107.1	102.4	170.8
355	101.1	107.1	102.4	170.9
356	101.2	107.1	102.5	170.9
357	101.2	107.1	102.5	171.0
358	101.2	107.2	102.6	171.0
359	101.3	107.2	102.6	171.0
360	101.3	107.2	102.7	171.1
361	101.4	107.2	102.7	171.1
362	101.4	107.3	102.7	171.2
363	101.4	107.3	102.8	171.2
364	101.5	107.3	102.8	171.2
365	101.5	107.3	102.9	171.3
366	101.5	107.4	102.9	171.3
367	101.6	107.4	103.0	171.4
368	101.6	107.4	103.0	171.4
369	101.7	107.4	103.0	171.5
370	101.7	107.5	103.1	171.5
371	101.7	107.5	103.1	171.5
372	101.8	107.5	103.2	171.6
373	101.8	107.5	103.2	171.6
374	101.8	107.6	103.2	171.7
375	101.9	107.6	103.3	171.7
376	101.9	107.6	103.3	171.8
377	101.9	107.6	103.4	171.8
378	102.0	107.7	103.4	171.8
379	102.0	107.7	103.4	171.9
380	102.1	107.7	103.5	171.9
381	102.1	107.7	103.5	172.0
382	102.1	107.8	103.6	172.0
383	102.2	107.8	103.6	172.1

384	102.2	107.8	103.6	172.1
385	102.2	107.8	103.7	172.1
386	102.3	107.9	103.7	172.2
387	102.3	107.9	103.8	172.2
388	102.3	107.9	103.8	172.3
389	102.4	107.9	103.8	172.3
390	102.4	108.0	103.9	172.4
391	102.4	108.0	103.9	172.4
392	102.5	108.0	104.0	172.5
393	102.5	108.0	104.0	172.5
394	102.6	108.1	104.0	172.5
395	102.6	108.1	104.1	172.6
396	102.6	108.1	104.1	172.6
397	102.7	108.1	104.2	172.7
398	102.7	108.2	104.2	172.7
399	102.7	108.2	104.2	172.8
400	102.8	108.2	104.3	172.8
401	102.8	108.2	104.3	172.8
402	102.8	108.3	104.4	172.9
403	102.9	108.3	104.4	172.9
404	102.9	108.3	104.4	173.0
405	102.9	108.3	104.5	173.0
406	103.0	108.4	104.5	173.1
407	103.0	108.4	104.5	173.1
408	103.0	108.4	104.6	173.2
409	103.1	108.4	104.6	173.2
410	103.1	108.5	104.7	173.2
411	103.1	108.5	104.7	173.3
412	103.2	108.5	104.7	173.3
413	103.2	108.5	104.8	173.4
414	103.2	108.6	104.8	173.4
415	103.3	108.6	104.8	173.5
416	103.3	108.6	104.9	173.5
417	103.3	108.6	104.9	173.5
418	103.4	108.7	105.0	173.6
419	103.4	108.7	105.0	173.6
420	103.4	108.7	105.0	173.7
421	103.5	108.7	105.1	173.7
422	103.5	108.8	105.1	173.8
423	103.5	108.8	105.1	173.8
424	103.6	108.8	105.2	173.9
425	103.6	108.8	105.2	173.9
426	103.6	108.9	105.3	173.9
427	103.7	108.9	105.3	174.0
428	103.7	108.9	105.3	174.0
429	103.7	108.9	105.4	174.1
430	103.8	109.0	105.4	174.1
431	103.8	109.0	105.4	174.2
432	103.8	109.0	105.5	174.2
433	103.9	109.0	105.5	174.2
434	103.9	109.1	105.5	174.3
435	103.9	109.1	105.6	174.3
436	104.0	109.1	105.6	174.4
437	104.0	109.1	105.6	174.4
438	104.0	109.2	105.7	174.5
439	104.1	109.2	105.7	174.5

440	104.1	109.2	105.8	174.5
441	104.1	109.2	105.8	174.6
442	104.2	109.3	105.8	174.6
443	104.2	109.3	105.9	174.7
444	104.2	109.3	105.9	174.7
445	104.3	109.3	105.9	174.8
446	104.3	109.4	106.0	174.8
447	104.3	109.4	106.0	174.8
448	104.3	109.4	106.0	174.9
449	104.4	109.4	106.1	174.9
450	104.4	109.5	106.1	175.0
451	104.4	109.5	106.1	175.0
452	104.5	109.5	106.2	175.1
453	104.5	109.5	106.2	175.1
454	104.5	109.6	106.2	175.1
455	104.6	109.6	106.3	175.2
456	104.6	109.6	106.3	175.2
457	104.6	109.6	106.4	175.3
458	104.7	109.7	106.4	175.3
459	104.7	109.7	106.4	175.4
460	104.7	109.7	106.5	175.4
461	104.8	109.7	106.5	175.4
462	104.8	109.8	106.5	175.5
463	104.8	109.8	106.6	175.5
464	104.9	109.8	106.6	175.6
465	104.9	109.8	106.6	175.6
466	104.9	109.9	106.7	175.6
467	104.9	109.9	106.7	175.7
468	105.0	109.9	106.7	175.7
469	105.0	109.9	106.8	175.8
470	105.0	110.0	106.8	175.8
471	105.1	110.0	106.8	175.8
472	105.1	110.0	106.9	175.9
473	105.1	110.0	106.9	175.9
474	105.2	110.1	106.9	176.0
475	105.2	110.1	107.0	176.0
476	105.2	110.1	107.0	176.1
477	105.3	110.1	107.0	176.1
478	105.3	110.2	107.1	176.1
479	105.3	110.2	107.1	176.2
480	105.3	110.2	107.1	176.2
481	105.4	110.2	107.2	176.3
482	105.4	110.3	107.2	176.3
483	105.4	110.3	107.2	176.3
484	105.5	110.3	107.3	176.4
485	105.5	110.3	107.3	176.4
486	105.5	110.4	107.3	176.5
487	105.6	110.4	107.4	176.5
488	105.6	110.4	107.4	176.5
489	105.6	110.4	107.4	176.6
490	105.6	110.5	107.5	176.6
491	105.7	110.5	107.5	176.6
492	105.7	110.5	107.5	176.7
493	105.7	110.5	107.6	176.7
494	105.8	110.6	107.6	176.8
495	105.8	110.6	107.6	176.8

496	105.8	110.6	107.6	176.8
497	105.9	110.6	107.7	176.9
498	105.9	110.7	107.7	176.9
499	105.9	110.7	107.7	177.0
500	105.9	110.7	107.8	177.0
501	106.0	110.7	107.8	177.0
502	106.0	110.8	107.8	177.1
503	106.0	110.8	107.9	177.1
504	106.1	110.8	107.9	177.1
505	106.1	110.8	107.9	177.2
506	106.1	110.9	108.0	177.2
507	106.1	110.9	108.0	177.3
508	106.2	110.9	108.0	177.3
509	106.2	110.9	108.1	177.3
510	106.2	111.0	108.1	177.4
511	106.3	111.0	108.1	177.4
512	106.3	111.0	108.2	177.4
513	106.3	111.0	108.2	177.5
514	106.3	111.1	108.2	177.5
515	106.4	111.1	108.2	177.5
516	106.4	111.1	108.3	177.6
517	106.4	111.1	108.3	177.6
518	106.5	111.2	108.3	177.6
519	106.5	111.2	108.4	177.7
520	106.5	111.2	108.4	177.7
521	106.6	111.2	108.4	177.8
522	106.6	111.3	108.5	177.8
523	106.6	111.3	108.5	177.8
524	106.6	111.3	108.5	177.9
525	106.7	111.3	108.6	177.9
526	106.7	111.4	108.6	177.9
527	106.7	111.4	108.6	178.0
528	106.8	111.4	108.6	178.0
529	106.8	111.4	108.7	178.0
530	106.8	111.5	108.7	178.1
531	106.8	111.5	108.7	178.1
532	106.9	111.5	108.8	178.1
533	106.9	111.5	108.8	178.2
534	106.9	111.6	108.8	178.2
535	107.0	111.6	108.9	178.2
536	107.0	111.6	108.9	178.3
537	107.0	111.6	108.9	178.3
538	107.0	111.7	108.9	178.3
539	107.1	111.7	109.0	178.4
540	107.1	111.7	109.0	178.4
541	107.1	111.7	109.0	178.4
542	107.1	111.8	109.1	178.5
543	107.2	111.8	109.1	178.5
544	107.2	111.8	109.1	178.5
545	107.2	111.8	109.2	178.5
546	107.3	111.9	109.2	178.6
547	107.3	111.9	109.2	178.6
548	107.3	111.9	109.2	178.6
549	107.3	111.9	109.3	178.7
550	107.4	112.0	109.3	178.7
551	107.4	112.0	109.3	178.7

552	107.4	112.0	109.4	178.8
553	107.5	112.0	109.4	178.8
554	107.5	112.1	109.4	178.8
555	107.5	112.1	109.4	178.9
556	107.5	112.1	109.5	178.9
557	107.6	112.1	109.5	178.9
558	107.6	112.2	109.5	178.9
559	107.6	112.2	109.6	179.0
560	107.6	112.2	109.6	179.0
561	107.7	112.2	109.6	179.0
562	107.7	112.3	109.7	179.1
563	107.7	112.3	109.7	179.1
564	107.8	112.3	109.7	179.1
565	107.8	112.3	109.7	179.1
566	107.8	112.4	109.8	179.2
567	107.8	112.4	109.8	179.2
568	107.9	112.4	109.8	179.2
569	107.9	112.4	109.9	179.2
570	107.9	112.5	109.9	179.3
571	107.9	112.5	109.9	179.3
572	108.0	112.5	109.9	179.3
573	108.0	112.5	110.0	179.4
574	108.0	112.6	110.0	179.4
575	108.1	112.6	110.0	179.4
576	108.1	112.6	110.0	179.4
577	108.1	112.6	110.1	179.5
578	108.1	112.7	110.1	179.5
579	108.2	112.7	110.1	179.5
580	108.2	112.7	110.2	179.5
581	108.2	112.7	110.2	179.6
582	108.2	112.8	110.2	179.6
583	108.3	112.8	110.2	179.6
584	108.3	112.8	110.3	179.6
585	108.3	112.8	110.3	179.7
586	108.4	112.9	110.3	179.7
587	108.4	112.9	110.4	179.7
588	108.4	112.9	110.4	179.7
589	108.4	112.9	110.4	179.8
590	108.5	113.0	110.4	179.8
591	108.5	113.0	110.5	179.8
592	108.5	113.0	110.5	179.8
593	108.5	113.0	110.5	179.9
594	108.6	113.1	110.5	179.9
595	108.6	113.1	110.6	179.9
596	108.6	113.1	110.6	179.9
597	108.6	113.1	110.6	179.9
598	108.7	113.2	110.7	180.0
599	108.7	113.2	110.7	180.0
600	108.7	113.2	110.7	180.0
601	108.7	113.2	110.7	180.0
602	108.8	113.3	110.8	180.1
603	108.8	113.3	110.8	180.1
604	108.8	113.3	110.8	180.1
605	108.9	113.3	110.8	180.1
606	108.9	113.4	110.9	180.1
607	108.9	113.4	110.9	180.2

608	108.9	113.4	110.9	180.2
609	109.0	113.4	111.0	180.2
610	109.0	113.5	111.0	180.2
611	109.0	113.5	111.0	180.2
612	109.0	113.5	111.0	180.3
613	109.1	113.5	111.1	180.3
614	109.1	113.6	111.1	180.3
615	109.1	113.6	111.1	180.3
616	109.1	113.6	111.1	180.3
617	109.2	113.6	111.2	180.4
618	109.2	113.7	111.2	180.4
619	109.2	113.7	111.2	180.4
620	109.2	113.7	111.2	180.4
621	109.3	113.7	111.3	180.4
622	109.3	113.8	111.3	180.5
623	109.3	113.8	111.3	180.5
624	109.3	113.8	111.4	180.5
625	109.4	113.8	111.4	180.5
626	109.4	113.9	111.4	180.5
627	109.4	113.9	111.4	180.5
628	109.5	113.9	111.5	180.6
629	109.5	113.9	111.5	180.6
630	109.5	114.0	111.5	180.6
631	109.5	114.0	111.5	180.6
632	109.6	114.0	111.6	180.6
633	109.6	114.0	111.6	180.7
634	109.6	114.1	111.6	180.7
635	109.6	114.1	111.6	180.7
636	109.7	114.1	111.7	180.7
637	109.7	114.1	111.7	180.7
638	109.7	114.2	111.7	180.7
639	109.7	114.2	111.7	180.8
640	109.8	114.2	111.8	180.8
641	109.8	114.2	111.8	180.8
642	109.8	114.3	111.8	180.8
643	109.8	114.3	111.8	180.8
644	109.9	114.3	111.9	180.8
645	109.9	114.3	111.9	180.8
646	109.9	114.4	111.9	180.9
647	109.9	114.4	111.9	180.9
648	110.0	114.4	112.0	180.9
649	110.0	114.4	112.0	180.9
650	110.0	114.5	112.0	180.9
651	110.0	114.5	112.1	180.9
652	110.1	114.5	112.1	180.9
653	110.1	114.5	112.1	181.0
654	110.1	114.6	112.1	181.0
655	110.1	114.6	112.2	181.0
656	110.2	114.6	112.2	181.0
657	110.2	114.6	112.2	181.0
658	110.2	114.7	112.2	181.0
659	110.2	114.7	112.3	181.0
660	110.3	114.7	112.3	181.1
661	110.3	114.7	112.3	181.1
662	110.3	114.8	112.3	181.1
663	110.3	114.8	112.4	181.1

664	110.4	114.8	112.4	181.1
665	110.4	114.8	112.4	181.1
666	110.4	114.9	112.4	181.1
667	110.4	114.9	112.5	181.1
668	110.5	114.9	112.5	181.2
669	110.5	114.9	112.5	181.2
670	110.5	115.0	112.5	181.2
671	110.5	115.0	112.6	181.2
672	110.6	115.0	112.6	181.2
673	110.6	115.0	112.6	181.2
674	110.6	115.1	112.6	181.2
675	110.6	115.1	112.6	181.2
676	110.7	115.1	112.7	181.3
677	110.7	115.1	112.7	181.3
678	110.7	115.2	112.7	181.3
679	110.7	115.2	112.7	181.3
680	110.8	115.2	112.8	181.3
681	110.8	115.2	112.8	181.3
682	110.8	115.3	112.8	181.3
683	110.8	115.3	112.8	181.3
684	110.9	115.3	112.9	181.3
685	110.9	115.3	112.9	181.4
686	110.9	115.4	112.9	181.4
687	110.9	115.4	112.9	181.4
688	111.0	115.4	113.0	181.4
689	111.0	115.4	113.0	181.4
690	111.0	115.5	113.0	181.4
691	111.0	115.5	113.0	181.4
692	111.1	115.5	113.1	181.4
693	111.1	115.5	113.1	181.4
694	111.1	115.6	113.1	181.4
695	111.1	115.6	113.1	181.5
696	111.2	115.6	113.2	181.5
697	111.2	115.6	113.2	181.5
698	111.2	115.7	113.2	181.5
699	111.2	115.7	113.2	181.5
700	111.2	115.7	113.3	181.5
701	111.3	115.7	113.3	181.5
702	111.3	115.8	113.3	181.5
703	111.3	115.8	113.3	181.5
704	111.3	115.8	113.3	181.5
705	111.4	115.8	113.4	181.5
706	111.4	115.9	113.4	181.5
707	111.4	115.9	113.4	181.6
708	111.4	115.9	113.4	181.6
709	111.5	115.9	113.5	181.6
710	111.5	116.0	113.5	181.6
711	111.5	116.0	113.5	181.6
712	111.5	116.0	113.5	181.6
713	111.6	116.0	113.6	181.6
714	111.6	116.1	113.6	181.6
715	111.6	116.1	113.6	181.6
716	111.6	116.1	113.6	181.6
717	111.7	116.1	113.7	181.6
718	111.7	116.2	113.7	181.6
719	111.7	116.2	113.7	181.6

720	111.7	116.2	113.7	181.7
721	111.8	116.2	113.7	181.7
722	111.8	116.3	113.8	181.7
723	111.8	116.3	113.8	181.7
724	111.8	116.3	113.8	181.7
725	111.8	116.3	113.8	181.7
726	111.9	116.4	113.9	181.7
727	111.9	116.4	113.9	181.7
728	111.9	116.4	113.9	181.7
729	111.9	116.4	113.9	181.7
730	112.0	116.5	114.0	181.7
731	112.0	116.5	114.0	181.7
732	112.0	116.5	114.0	181.7
733	112.0	116.5	114.0	181.7
734	112.1	116.6	114.0	181.7
735	112.1	116.6	114.1	181.8
736	112.1	116.6	114.1	181.8
737	112.1	116.6	114.1	181.8
738	112.2	116.7	114.1	181.8
739	112.2	116.7	114.2	181.8
740	112.2	116.7	114.2	181.8
741	112.2	116.7	114.2	181.8
742	112.2	116.8	114.2	181.8
743	112.3	116.8	114.2	181.8
744	112.3	116.8	114.3	181.8
745	112.3	116.8	114.3	181.8
746	112.3	116.9	114.3	181.8
747	112.4	116.9	114.3	181.8
748	112.4	116.9	114.4	181.8
749	112.4	116.9	114.4	181.8
750	112.4	117.0	114.4	181.8
751	112.5	117.0	114.4	181.8
752	112.5	117.0	114.4	181.8
753	112.5	117.0	114.5	181.9
754	112.5	117.1	114.5	181.9
755	112.6	117.1	114.5	181.9
756	112.6	117.1	114.5	181.9
757	112.6	117.1	114.6	181.9
758	112.6	117.2	114.6	181.9
759	112.6	117.2	114.6	181.9
760	112.7	117.2	114.6	181.9
761	112.7	117.2	114.6	181.9
762	112.7	117.3	114.7	181.9
763	112.7	117.3	114.7	181.9
764	112.8	117.3	114.7	181.9
765	112.8	117.3	114.7	181.9
766	112.8	117.4	114.8	181.9
767	112.8	117.4	114.8	181.9
768	112.9	117.4	114.8	181.9
769	112.9	117.4	114.8	181.9
770	112.9	117.5	114.8	181.9
771	112.9	117.5	114.9	181.9
772	112.9	117.5	114.9	181.9
773	113.0	117.5	114.9	181.9
774	113.0	117.6	114.9	181.9
775	113.0	117.6	115.0	182.0

776	113.0	117.6	115.0	182.0
777	113.1	117.6	115.0	182.0
778	113.1	117.7	115.0	182.0
779	113.1	117.7	115.0	182.0
780	113.1	117.7	115.1	182.0
781	113.2	117.7	115.1	182.0
782	113.2	117.8	115.1	182.0
783	113.2	117.8	115.1	182.0
784	113.2	117.8	115.2	182.0
785	113.2	117.8	115.2	182.0
786	113.3	117.9	115.2	182.0
787	113.3	117.9	115.2	182.0
788	113.3	117.9	115.2	182.0
789	113.3	117.9	115.3	182.0
790	113.4	118.0	115.3	182.0
791	113.4	118.0	115.3	182.0
792	113.4	118.0	115.3	182.0
793	113.4	118.0	115.3	182.0
794	113.4	118.1	115.4	182.0
795	113.5	118.1	115.4	182.0
796	113.5	118.1	115.4	182.0
797	113.5	118.1	115.4	182.0
798	113.5	118.2	115.4	182.0
799	113.6	118.2	115.5	182.0
800	113.6	118.2	115.5	182.0
801	113.6	118.2	115.5	182.0
802	113.6	118.3	115.5	182.0
803	113.6	118.3	115.6	182.0
804	113.7	118.3	115.6	182.0
805	113.7	118.3	115.6	182.0
806	113.7	118.4	115.6	182.1
807	113.7	118.4	115.6	182.1
808	113.8	118.4	115.7	182.1
809	113.8	118.4	115.7	182.1
810	113.8	118.5	115.7	182.1
811	113.8	118.5	115.7	182.1
812	113.9	118.5	115.7	182.1
813	113.9	118.5	115.8	182.1
814	113.9	118.6	115.8	182.1
815	113.9	118.6	115.8	182.1
816	113.9	118.6	115.8	182.1
817	114.0	118.6	115.8	182.1
818	114.0	118.7	115.9	182.1
819	114.0	118.7	115.9	182.1
820	114.0	118.7	115.9	182.1
821	114.1	118.7	115.9	182.1
822	114.1	118.8	116.0	182.1
823	114.1	118.8	116.0	182.1
824	114.1	118.8	116.0	182.1
825	114.1	118.8	116.0	182.1
826	114.2	118.9	116.0	182.1
827	114.2	118.9	116.1	182.1
828	114.2	118.9	116.1	182.1
829	114.2	118.9	116.1	182.1
830	114.2	119.0	116.1	182.1
831	114.3	119.0	116.1	182.1

832	114.3	119.0	116.2	182.1
833	114.3	119.0	116.2	182.1
834	114.3	119.1	116.2	182.1
835	114.4	119.1	116.2	182.1
836	114.4	119.1	116.2	182.1
837	114.4	119.1	116.3	182.1
838	114.4	119.2	116.3	182.1
839	114.4	119.2	116.3	182.1
840	114.5	119.2	116.3	182.1
841	114.5	119.2	116.3	182.1
842	114.5	119.3	116.4	182.1
843	114.5	119.3	116.4	182.1
844	114.6	119.3	116.4	182.1
845	114.6	119.3	116.4	182.1
846	114.6	119.4	116.4	182.1
847	114.6	119.4	116.5	182.1
848	114.6	119.4	116.5	182.1
849	114.7	119.4	116.5	182.1
850	114.7	119.5	116.5	182.1
851	114.7	119.5	116.5	182.1
852	114.7	119.5	116.6	182.1
853	114.8	119.5	116.6	182.1
854	114.8	119.6	116.6	182.2
855	114.8	119.6	116.6	182.2
856	114.8	119.6	116.6	182.2
857	114.8	119.6	116.7	182.2
858	114.9	119.7	116.7	182.2
859	114.9	119.7	116.7	182.2
860	114.9	119.7	116.7	182.2
861	114.9	119.7	116.7	182.2
862	114.9	119.8	116.8	182.2
863	115.0	119.8	116.8	182.2
864	115.0	119.8	116.8	182.2
865	115.0	119.8	116.8	182.2
866	115.0	119.9	116.8	182.2
867	115.1	119.9	116.9	182.2
868	115.1	119.9	116.9	182.2
869	115.1	119.9	116.9	182.2
870	115.1	120.0	116.9	182.2
871	115.1	120.0	116.9	182.2
872	115.2	120.0	117.0	182.2
873	115.2	120.0	117.0	182.2
874	115.2	120.1	117.0	182.2
875	115.2	120.1	117.0	182.2
876	115.2	120.1	117.0	182.2
877	115.3	120.1	117.1	182.2
878	115.3	120.2	117.1	182.2
879	115.3	120.2	117.1	182.2
880	115.3	120.2	117.1	182.2
881	115.4	120.2	117.1	182.2
882	115.4	120.3	117.2	182.2
883	115.4	120.3	117.2	182.2
884	115.4	120.3	117.2	182.2
885	115.4	120.3	117.2	182.2
886	115.5	120.4	117.2	182.2
887	115.5	120.4	117.2	182.2

888	115.5	120.4	117.3	182.2
889	115.5	120.4	117.3	182.2
890	115.5	120.5	117.3	182.2
891	115.6	120.5	117.3	182.2
892	115.6	120.5	117.3	182.2
893	115.6	120.5	117.4	182.2
894	115.6	120.6	117.4	182.2
895	115.7	120.6	117.4	182.2
896	115.7	120.6	117.4	182.2
897	115.7	120.6	117.4	182.2
898	115.7	120.7	117.5	182.2
899	115.7	120.7	117.5	182.2
900	115.8	120.7	117.5	182.2
901	115.8	120.7	117.5	182.2
902	115.8	120.8	117.5	182.2
903	115.8	120.8	117.6	182.2
904	115.8	120.8	117.6	182.2
905	115.9	120.8	117.6	182.2
906	115.9	120.9	117.6	182.2
907	115.9	120.9	117.6	182.2
908	115.9	120.9	117.6	182.2
909	115.9	120.9	117.7	182.2
910	116.0	121.0	117.7	182.2
911	116.0	121.0	117.7	182.2
912	116.0	121.0	117.7	182.2
913	116.0	121.0	117.7	182.2
914	116.0	121.1	117.8	182.2
915	116.1	121.1	117.8	182.2
916	116.1	121.1	117.8	182.2
917	116.1	121.1	117.8	182.2
918	116.1	121.2	117.8	182.2
919	116.2	121.2	117.9	182.2
920	116.2	121.2	117.9	182.2
921	116.2	121.2	117.9	182.2
922	116.2	121.3	117.9	182.2
923	116.2	121.3	117.9	182.2
924	116.3	121.3	117.9	182.2
925	116.3	121.3	118.0	182.2
926	116.3	121.4	118.0	182.2
927	116.3	121.4	118.0	182.2
928	116.3	121.4	118.0	182.2
929	116.4	121.4	118.0	182.2
930	116.4	121.5	118.1	182.2
931	116.4	121.5	118.1	182.2
932	116.4	121.5	118.1	182.2
933	116.4	121.5	118.1	182.2
934	116.5	121.6	118.1	182.2
935	116.5	121.6	118.2	182.2
936	116.5	121.6	118.2	182.2
937	116.5	121.6	118.2	182.2
938	116.5	121.7	118.2	182.2
939	116.6	121.7	118.2	182.2
940	116.6	121.7	118.2	182.2
941	116.6	121.7	118.3	182.2
942	116.6	121.8	118.3	182.2
943	116.6	121.8	118.3	182.2

944	116.7	121.8	118.3	182.2
945	116.7	121.8	118.3	182.2
946	116.7	121.9	118.4	182.2
947	116.7	121.9	118.4	182.2
948	116.7	121.9	118.4	182.2
949	116.8	121.9	118.4	182.2
950	116.8	122.0	118.4	182.2
951	116.8	122.0	118.4	182.2
952	116.8	122.0	118.5	182.2
953	116.9	122.0	118.5	182.2
954	116.9	122.1	118.5	182.2
955	116.9	122.1	118.5	182.2
956	116.9	122.1	118.5	182.2
957	116.9	122.1	118.6	182.2
958	117.0	122.2	118.6	182.2
959	117.0	122.2	118.6	182.2
960	117.0	122.2	118.6	182.2

Table 74: Extended NFDs, LTE EIRP = 65 dBm/20 MHz, FL CS = 25 kHz

22. ANNEX 11: FL NOISE FLOOR

Annex E of OfW446 [1] provides FL noise floor assumed by OFCOM for EIRP assignment purpose, as shown in the Figure 155 below:

1.4 GHz										
Radio System Type *(kbit/s in kHz)*	*RSL* *(dBW)*	Modulation type assumed for planning	*C/(N+ΣI)* *(dB)*	*N+ΣI* *(dBW)*	M_I *(dB)*	*N* *(dBW)*	*ΣI* *(dBW)*	*n*	*I* *(dBW)*	*W/U* *(dB)*
32 in 25	-133	4 state	13.5	-146.5	1	-147.5	-153.4	4.0	-159.4	26
64 in 25	-131	16 state	17.6	-148.6	1	-149.6	-155.5	4.0	-161.5	30
96 in 75	-122	4 state	13.5	-135.5	1	-136.5	-142.4	4.0	-148.4	26
192 in 75	-127	16 state	17.6	-144.6	1	-145.6	-151.5	4.0	-157.5	30
256 in 250	-127	4 state	13.5	-140.5	1	-141.5	-147.4	4.0	-153.4	26
512 in 250	-121	16 state	17.6	-138.6	1	-139.6	-145.5	4.0	-151.5	30
512 in 500	-125	4 state	13.5	-138.5	1	-139.5	-145.4	4.0	-151.4	26
704 in 500	-121	4 state	13.5	-134.5	1	-135.5	-141.4	4.0	-147.4	26
1024 in 500	-119	16 state	17.6	-136.6	1	-137.6	-143.5	4.0	-149.5	30
2048 in 500	-116	16 state	17.6	-133.6	1	-134.6	-140.5	4.0	-146.5	30
1024 in 1000	-122	4 state	13.5	-135.5	1	-136.5	-142.4	4.0	-148.4	26
2048 in 1000	-116	16 state	17.6	-133.6	1	-134.6	-140.5	4.0	-146.5	30
2048 in 2000	-119	4 state	13.5	-132.5	1	-133.5	-139.4	4.0	-145.4	26
4096 in 2000	-113	16 state	17.6	-130.6	1	-131.6	-137.5	4.0	-143.5	30
4500 in 3500	-116	4 state	13.5	-129.5	1	-130.5	-136.4	4.0	-142.4	26
9100 in 3500	-110	32 QAM	20.6	-130.6	1	-131.6	-137.5	4.0	-143.5	33

Figure 155: Extract from Annex E of OfW 446

In the absence of knowledge of the exact systems deployed for specific Fixed Links, the MCL study in Section 5 adopted the lowest noise floor for each system carrier spacing for a worst case analysis, as detailed in the Table 75 below.

CS (kHz)	N assumed in MCL studies (dBm)
25	-119.6
75	-115.6
250	-111.5
500	-109.5
1000	-106.5
2000	-103.5
3500	-101.6

Table 75: Noise floor assumption for each Carrier Spacing

23. ANNEX 12: CLASSIFICATION OF FLS PER GEOTYPE AROUND FL RX

Link ID	Geotype around FL Rx	In London?
1	Rural	No
2	Sea	No
3	Sea	No
4	Sea	No
5	Suburban	No
6	Rural	No
7	Rural	No
8	Rural	No
9	Rural	No
10	Rural	No
11	Rural	No
12	Suburban	No
13	Rural	No
14	Rural	No
15	Rural	No
16	Rural	No
17	Rural	No
18	Rural	No
19	Rural	No
20	Rural	No
21	Rural	No
22	Rural	No
23	Rural	No
24	Rural	No
25	Suburban	No
26	Rural	No
27	Rural	No
28	Sea	No
29	Rural	No
30	Rural	No
31	Rural	No
32	Suburban	No
33	Sea	No
34	Sea	No
35	Sea	No
36	Sea	No
37	Sea	No
38	Sea	No
39	Suburban	No
40	Sea	No
41	Rural	No
42	Sea	No
43	Rural	No
44	Suburban	No
45	Urban	No
46	Suburban	No
47	Urban	Yes
48	Urban	Yes
49	Urban	Yes
50	Urban	Yes
51	Urban	Yes

52	Suburban	No
53	Rural	No
54	Suburban	No
55	Rural	No
56	Urban	No
57	Rural	No
58	Suburban	No
59	Rural	No
60	Suburban	No
61	Rural	No
62	Suburban	No
63	Urban	No
64	Rural	No
65	Rural	No
66	Rural	No
67	Sea	No
68	Rural	No
69	Rural	No
70	Rural	No
71	Suburban	No
74	Rural	No
75	Rural	No
76	Rural	No
77	Suburban	No
78	Suburban	No
79	Urban	No
80	Suburban	No
81	Suburban	No
82	Urban	Yes
83	Rural	No
84	Urban	No
85	Rural	No
86	Urban	No
87	Suburban	No
88	Rural	No
89	Rural	No
90	Suburban	No
91	Rural	No
92	Suburban	No
93	Rural	No
96	Rural	No
97	Suburban	No
98	Rural	No
99	Rural	No
100	Suburban	No
102	Suburban	No
103	Suburban	No
104	Rural	No
105	Rural	No
106	Rural	No
107	Rural	No
108	Rural	No
109	Rural	No
110	Rural	No
111	Suburban	No
112	Suburban	No

113	Suburban	No
114	Suburban	No
115	Rural	No
116	Urban	No
117	Suburban	No
118	Rural	No
119	Rural	No
120	Rural	No
121	Suburban	No
122	Suburban	No
123	Suburban	No
124	Rural	No
125	Rural	No
126	Rural	No
127	Suburban	No
128	Rural	No
129	Rural	No
130	Rural	No
131	Rural	No
132	Rural	No
133	Rural	No
134	Rural	No
135	Rural	No
136	Suburban	No
137	Rural	No
138	Suburban	No
139	Rural	No
140	Urban	Yes
142	Rural	No
143	Suburban	No
144	Rural	No
145	Rural	No
146	Rural	No
147	Urban	Yes
148	Rural	No
149	Sea	No
150	Sea	No
151	Sea	No
152	Suburban	No
153	Rural	No
154	Suburban	No
155	Rural	No
156	Rural	No
157	Suburban	No
158	Rural	No
159	Suburban	No
160	Rural	No
161	Suburban	No
162	Rural	No
163	Rural	No
164	Suburban	No
165	Rural	No
166	Suburban	No
167	Rural	No
168	Suburban	No
169	Suburban	No

170	Rural	No
171	Suburban	No
172	Suburban	No
173	Suburban	No
174	Urban	No
175	Suburban	No
176	Suburban	No
177	Rural	No
178	Rural	No
179	Suburban	No
180	Rural	No
181	Urban	Yes
182	Suburban	No
183	Rural	No
184	Urban	No
185	Rural	No
186	Rural	No
187	Urban	No
188	Rural	No
189	Suburban	No
190	Suburban	No
191	Urban	No
192	Suburban	No
193	Suburban	No
194	Rural	No
195	Rural	No
196	Rural	No
197	Rural	No
198	Rural	No
199	Rural	No
200	Rural	No
201	Suburban	No
202	Rural	No
203	Rural	No
204	Suburban	No
205	Rural	No
206	Rural	No
207	Suburban	No
208	Rural	No
209	Rural	No
210	Urban	No
211	Rural	No
212	Rural	No
213	Rural	No
214	Suburban	No
215	Rural	No
216	Rural	No
217	Rural	No
218	Rural	No
219	Suburban	No
220	Suburban	No
221	Urban	No
222	Rural	No
223	Rural	No
224	Rural	No
225	Rural	No

226	Suburban	No
227	Rural	No
228	Suburban	No
229	Suburban	No
230	Suburban	Yes
231	Rural	No
232	Rural	No
233	Rural	No
234	Rural	No
235	Rural	No
236	Rural	No
237	Suburban	No
238	Suburban	No
239	Rural	No
240	Rural	No
241	Suburban	No
242	Sea	No
243	Suburban	No
244	Rural	No
245	Suburban	No
246	Suburban	No
247	Rural	No
248	Rural	No
249	Rural	No
250	Rural	No
251	Rural	No
252	Rural	No
253	Rural	No
254	Urban	Yes
255	Urban	Yes
256	Urban	Yes
257	Urban	Yes
258	Urban	Yes
259	Urban	Yes
260	Urban	Yes
261	Rural	No
262	Rural	No
263	Rural	No
264	Rural	No
265	Urban	Yes
266	Urban	Yes
267	Rural	No
268	Rural	No
269	Rural	No
270	Rural	No
271	Rural	No
272	Rural	No
273	Rural	No
274	Rural	No
275	Rural	No
276	Rural	No
277	Rural	No
278	Rural	No
279	Rural	No
280	Rural	No
281	Rural	No

282	Rural	No
283	Rural	No
284	Rural	No
285	Rural	No
286	Rural	No
287	Rural	No
288	Rural	No
289	Rural	No
290	Rural	No
291	Rural	No
292	Rural	No
293	Rural	No
294	Rural	No
295	Rural	No
296	Rural	No
297	Rural	No
298	Rural	No
299	Rural	No
300	Rural	No
301	Rural	No
302	Rural	No
303	Rural	No
304	Rural	No
305	Rural	No
306	Rural	No
307	Rural	No
308	Rural	No
309	Rural	No
310	Rural	No
311	Rural	No
312	Rural	No
313	Rural	No
314	Rural	No
315	Rural	No
316	Rural	No
317	Rural	No
318	Rural	No
319	Rural	No
320	Rural	No
321	Rural	No
322	Rural	No
323	Rural	No
324	Rural	No
325	Rural	No
326	Rural	No
327	Rural	No
328	Rural	No
329	Rural	No
330	Rural	No
331	Rural	No
332	Rural	No
333	Rural	No
334	Suburban	No
335	Rural	No
336	Rural	No
337	Rural	No

338	Rural	No
339	Rural	No
340	Rural	No
341	Rural	No
342	Rural	No
343	Suburban	No
344	Rural	No
345	Rural	No
346	Rural	No
347	Rural	No
348	Rural	No
349	Rural	No
350	Suburban	No
351	Rural	No
352	Suburban	No
353	Suburban	No
354	Rural	No
355	Rural	No
356	Rural	No
357	Suburban	No
358	Rural	No
359	Rural	No
360	Rural	No
361	Urban	Yes
362	Suburban	No
363	Rural	No
364	Rural	No
365	Rural	No
366	Suburban	No
367	Suburban	No
368	Rural	No
369	Suburban	No
370	Sea	No
371	Rural	No
372	Rural	No
373	Suburban	No
374	Suburban	No
375	Suburban	No
376	Rural	No
377	Rural	No
378	Rural	No
379	Rural	No
380	Suburban	No
381	Urban	No
382	Suburban	No
383	Suburban	No
384	Suburban	No
385	Sea	No
386	Rural	No
387	Rural	No
388	Rural	No
389	Rural	No
390	Suburban	No
391	Suburban	No
392	Rural	No
393	Suburban	No

394	Rural	No
395	Sea	No
396	Rural	No
397	Suburban	No
398	Suburban	No
399	Rural	No
400	Suburban	No
401	Rural	No
402	Rural	No
403	Rural	No
404	Suburban	No
405	Suburban	No
406	Suburban	No
407	Suburban	No
408	Suburban	No
409	Suburban	No
410	Sea	No
411	Rural	No
412	Rural	No
413	Rural	No
414	Rural	No
415	Rural	No
416	Rural	No
417	Rural	No
418	Urban	No
419	Suburban	No
420	Suburban	No
421	Suburban	No
422	Suburban	No
423	Suburban	No
424	Suburban	No
425	Suburban	No
426	Suburban	No
427	Suburban	No
428	Suburban	No
429	Rural	No
430	Rural	No
431	Sea	No
432	Sea	No
433	Rural	No
434	Suburban	No
435	Suburban	No
436	Suburban	No
437	Rural	No
438	Rural	No
439	Rural	No
440	Rural	No
441	Sea	No
442	Rural	No
443	Rural	No
444	Rural	No
445	Rural	No
446	Suburban	No
447	Rural	No
448	Rural	No
449	Suburban	No

450	Rural	No
451	Suburban	No
452	Suburban	No
453	Rural	No
454	Rural	No
455	Rural	No
456	Rural	No
457	Suburban	No
458	Rural	No
459	Rural	No
460	Rural	No
461	Rural	No
462	Suburban	No
463	Suburban	No
464	Rural	No
465	Rural	No
466	Suburban	No
467	Urban	No
468	Rural	No
469	Rural	No
470	Rural	No
471	Rural	No
472	Rural	No
473	Rural	No
474	Suburban	No
475	Rural	No
476	Suburban	No
477	Suburban	No
478	Suburban	No
479	Rural	No
480	Suburban	No
481	Suburban	No
482	Suburban	No
483	Suburban	No
484	Rural	No
485	Suburban	No
486	Suburban	No
487	Suburban	No
488	Suburban	No
489	Suburban	No
490	Sea	No
491	Rural	No
492	Rural	No
493	Rural	No
494	Urban	No
495	Suburban	No
496	Rural	No
497	Rural	No
498	Rural	No
499	Suburban	No
500	Suburban	No
501	Rural	No
502	Rural	No
503	Rural	No
504	Rural	No
505	Urban	No

506	Rural	No
507	Rural	No
508	Rural	No
509	Rural	No
510	Suburban	No
511	Rural	No
512	Urban	No
513	Suburban	No
514	Rural	No
515	Urban	No
516	Rural	No
517	Rural	No
518	Rural	No
519	Rural	No
520	Rural	No
521	Rural	No
522	Suburban	No
523	Suburban	No
524	Suburban	No
525	Rural	No
526	Suburban	No
527	Rural	No
528	Suburban	No
529	Suburban	No
530	Suburban	No
531	Suburban	No
532	Suburban	No
533	Suburban	No
534	Suburban	No
537	Suburban	No
538	Rural	No
539	Rural	No
540	Suburban	No
541	Rural	No
542	Suburban	No
543	Suburban	No
544	Sea	No
545	Sea	No
546	Rural	No
547	Rural	No
548	Rural	No
549	Suburban	No
550	Urban	No
551	Rural	No
552	Rural	No
553	Rural	No
554	Rural	No
555	Rural	No
556	Rural	No
557	Rural	No
558	Suburban	No
559	Rural	No
560	Suburban	No
561	Rural	No
562	Suburban	No
563	Rural	No

564	Suburban	No
565	Suburban	Yes
566	Rural	No
567	Suburban	No
568	Suburban	No
569	Suburban	No
570	Rural	No
571	Rural	No
572	Suburban	No
573	Rural	No
574	Rural	No
575	Suburban	No
576	Rural	No
577	Rural	No
578	Suburban	No
579	Suburban	No
580	Suburban	No
581	Rural	No
582	Rural	No
583	Sea	No
584	Suburban	No
585	Suburban	No
586	Rural	No
587	Suburban	No
588	Suburban	No
589	Suburban	No
590	Rural	No
591	Rural	No
592	Suburban	No
593	Urban	No
594	Suburban	No
595	Urban	No
596	Suburban	No
597	Rural	No
598	Suburban	No
599	Suburban	No
600	Rural	No
601	Rural	No
602	Suburban	Yes
603	Sea	No
604	Suburban	No
605	Suburban	No
606	Rural	No
607	Rural	No
608	Urban	No
609	Rural	No
610	Rural	No
611	Suburban	No
612	Rural	No
613	Suburban	No
614	Suburban	No
615	Suburban	No
616	Suburban	No
617	Urban	No
618	Suburban	No
619	Suburban	No

620	Urban	No
621	Rural	No
622	Suburban	No
623	Suburban	No
624	Rural	No
625	Rural	No
626	Rural	No
627	Rural	No
628	Rural	No
629	Rural	No
630	Rural	No
631	Suburban	No
632	Suburban	No
633	Suburban	No
634	Rural	No
635	Rural	No
636	Rural	No
637	Suburban	No
638	Rural	No
639	Rural	No
640	Rural	No
641	Rural	No
642	Rural	No
643	Rural	No
644	Rural	No
645	Rural	No
646	Rural	No
647	Rural	No
648	Rural	No
649	Suburban	No
650	Rural	No
651	Rural	No
652	Suburban	No
653	Rural	No
654	Suburban	No
655	Rural	No
656	Rural	No
657	Rural	No
658	Suburban	No
659	Rural	No
660	Suburban	No
661	Sea	No
662	Rural	No
663	Rural	No
664	Rural	No
665	Suburban	No
666	Rural	No
667	Rural	No
668	Rural	No
669	Rural	No
670	Rural	No
671	Rural	No
672	Sea	No
673	Urban	No
674	Rural	No
675	Suburban	No

676	Suburban	No
677	Suburban	No
678	Rural	No
679	Rural	No
680	Rural	No
681	Suburban	No
682	Rural	No
683	Suburban	No
684	Suburban	No
685	Rural	No
686	Suburban	No
687	Suburban	No
688	Rural	No
689	Rural	No
690	Rural	No
691	Rural	No
692	Rural	No
693	Suburban	No
694	Rural	No
695	Rural	No
696	Rural	No
697	Rural	No
698	Suburban	No
699	Suburban	No
700	Rural	No
701	Rural	No
702	Suburban	No
703	Suburban	No
704	Suburban	No
705	Suburban	No
706	Urban	No
707	Rural	No
708	Rural	No
709	Suburban	No
710	Rural	No
711	Suburban	No
712	Rural	No
713	Suburban	No
714	Rural	No
715	Suburban	No
716	Rural	No
717	Urban	No
718	Rural	No
719	Suburban	No
720	Rural	No
721	Rural	No
722	Rural	No
723	Suburban	No
724	Suburban	No
725	Rural	No
726	Rural	No
727	Suburban	No
728	Suburban	No
729	Suburban	No
730	Sea	No
731	Sea	No

732	Sea	No
733	Sea	No
734	Sea	No
735	Rural	No
736	Sea	No
737	Sea	No
738	Sea	No
739	Sea	No
740	Sea	No
741	Rural	No
742	Sea	No
743	Sea	No
744	Sea	No
745	Sea	No
746	Sea	No
747	Sea	No
748	Sea	No
749	Sea	No
750	Sea	No
751	Sea	No
752	Sea	No
753	Sea	No
754	Sea	No
755	Rural	No
756	Suburban	No
757	Suburban	No
758	Rural	No
759	Suburban	No
760	Rural	No
769	Suburban	No
770	Rural	No
771	Urban	No
772	Suburban	No
773	Rural	No
774	Rural	No
775	Suburban	No
776	Rural	No
777	Rural	No
778	Suburban	No
779	Rural	No
780	Suburban	No
781	Rural	No
782	Suburban	No
783	Suburban	No
784	Rural	No
785	Rural	No
786	Rural	No
787	Rural	No
788	Suburban	No
789	Rural	No
790	Suburban	No
791	Rural	No
792	Rural	No
793	Rural	No
794	Rural	No
795	Suburban	No

796	Rural	No
797	Rural	No
798	Rural	No
799	Rural	No
800	Rural	No
801	Rural	No
802	Rural	No
803	Rural	No
804	Urban	Yes
805	Urban	No
806	Rural	No
807	Suburban	No
808	Rural	No
809	Rural	No
810	Rural	No
811	Suburban	No
812	Rural	No
813	Rural	No
814	Suburban	No
815	Suburban	No
816	Sea	No
817	Urban	No
818	Suburban	No
819	Suburban	No
820	Suburban	No
821	Suburban	No
822	Rural	No
823	Suburban	No
824	Suburban	No
825	Rural	No
827	Suburban	No
828	Sea	No
829	Suburban	No
830	Rural	No
831	Rural	No
832	Rural	No
833	Sea	No
834	Rural	No
835	Rural	No
836	Suburban	No
837	Rural	No
838	Suburban	No
839	Suburban	No
840	Rural	No
841	Suburban	No
842	Suburban	No
843	Suburban	No
844	Suburban	No
845	Suburban	No
846	Suburban	No
847	Suburban	No
848	Suburban	No
849	Rural	No
850	Rural	No
851	Rural	No
852	Rural	No

853	Sea	No
854	Rural	No
855	Suburban	No
856	Suburban	No
857	Suburban	No
858	Suburban	No
859	Rural	No
860	Suburban	No
861	Suburban	No
862	Suburban	No
863	Suburban	No
864	Suburban	No
865	Urban	No
866	Rural	No
867	Suburban	No
868	Suburban	No

Figure 156: Classification of all FLs per geotype