# INtrODUCTION

As per the EC Mandate, WBB LMP BS in 3.8-4.2 GHz would need to coexist with users in the adjacent band, such as the 5G MFCN services below 3.8 GHz. In the sections below we provide the results of the study for a range of scenarios.

# adjacent channel coexistence studies wbb lmp vs 5g mfcn

## Study parameters

### Parameters for WBB LMP

In the Table 1 below, we provide the deployment parameters of WBB LMP BS used in the studies.

Table 1: Deployment parameters of WBB LMP

|  |  |  |  |
| --- | --- | --- | --- |
| **Parameter** | **Low Power BS** | **Medium Power BS** | **Incremental Medium Power BS** |
| EIRP | 31dBm/100 MHz | 49dBm/100 MHz | 51dBm/100 MHz |
| Antenna height | Specified to align with the clutter assumptions | | |
| BS Sectorization | 1 | 1 | 1 |
| UEs per sector | 3 | 3 | 3 |
| Use case information  single BS cell range | 0.05 km | 0.4 km | 0.4 km |
| BS TDD activity factor | 50% | 50% | 50% |
| Network loading factor | 100% | 100% | 100% |
| Terminal antenna gain | -4 dBi | -4 dBi | -4 dBi |
| Antenna gain for AAS/non-AAS | 12 dBi | AAS: 21.5 dBi  (4x8 elements) | AAS: 21.5 dBi  (4x8 elements) |
| Antenna pattern for AAS/non-AAS | F.1336 Omni | AAS: M.2101 | AAS: M.2101 |
| BS Noise Figure | 13 dB | 10 dB | 10 dB |
| UE Noise Figure | 9 dB | 9 dB | 9 dB |
| UE height | For outdoor BS: 1.5 m | For outdoor BS: 1.5 m | For outdoor BS: 1.5 m |
| Protection criterion | I/N = -6 dB | | |

In Table 2 below, we provide the AAS antenna characteristics of WBB MP BS used in the studies.

Table 2: AAS Antenna characteristics

|  |  |
| --- | --- |
| **AAS antenna pattern** | Recommendation ITU-R M.2101 (section 5) |
| Element gain (dBi) | 6.4 |
| Horizontal/vertical front‑to‑back ratio (dB) | 30 for both H/V |
| Antenna polarization | Linear ±45º |
| Antenna array configuration (Row × Column) (Note 2) | 4 x 8 elements |
| Horizontal/Vertical radiating element/sub-array spacing, *dh* /*dv* | 0.5 of wavelength for H, 0.7 of wavelength for V |
| Number of element rows in sub-array, *Msub* (Note 1) | 3 |
| Vertical radiating element spacing in sub-array, *dv,sub* (Note 1) | 0.7 of wavelength of V |
| Pre-set sub-array down-tilt, *θsubtilt* (degrees) (Note 1) | 3 |
| Base station horizontal coverage range (degrees) | ±60° |
| Base station vertical coverage range (degrees) (Note 3) | 0 to -30 |
| Mechanical downtilt (degrees) | 10 |
| Note 1: Only needed when subarray antenna model is used  Note 2: For the small/micro cell case, 8 × 8 means there are 8 vertical and 8 horizontal radiating elements. For the extended AAS model case, 4 × 8 means there are 4 vertical and 8 horizontal radiating sub-arrays.  Note 3: The vertical coverage range is given in global coordinate system, i.e. 0° being at the horizon. | |

In Table 3 we provide the out-of-band emissions mask for WBB LMPs used in the studies.

Table 3: WBB LMP Out-of-band emissions mask

|  |  |
| --- | --- |
| **Frequency offset** | **Maximum mean EIRP density** |
| 3795 MHz-3800 MHz | (Pmax – 40) dBm / 5 MHz EIRP per antenna |
| 3790 MHz-3795 MHz | (Pmax – 43) dBm / 5 MHz EIRP per antenna |
| 3760 MHz-3790 MHz | (Pmax – 43) dBm / 5 MHz EIRP per antenna |
| Below 3760 MHz | -2 dBm / 5 MHz EIRP per antenna |
| Note: Pmax is the maximum mean carrier power in dBm for the base station measured as e.i.r.p. per carrier, interpreted as per antenna | |

In Table 4 we provide the WBB LMP Receiver mask characteristics used in the studies.

Table 4: WBB LMP Receiver Mask

|  |  |  |
| --- | --- | --- |
| **Frequency offset** | **Medium Power (Attenuation)** | **Low Power (Attenuation)** |
| 3800 MHz-3780 MHz | 35.5 dB | 29.5 dB |
| 3780 MHz-3740 MHz | 44.5 dB | 38.5 dB |
| Below 3740 | 64.5 dB | 61.5 dB |

### Parameters for 5G MFCN BS

In Table 5, we provide the 5G MFCN BS characteristics used in the studies as agreed in PT1 #74.

Table 5: Deployment parameters for 5G MFCN BS

|  |  |  |
| --- | --- | --- |
| **Parameter** | **5G NR BS** | **5G NR UE** |
| Channel bandwidth (MHz) | 100 | |
| BS noise figure (dB) | 3 | 9 |
| Cell range (m)  Note: typical values from deployed networks | Urban: 600  Suburban: 1500  Rural: 3000 | |
| UE Tx power (dBm) |  | 23 |
| UE antenna gain (dBi) |  | -4 |
| Body loss (dB) |  | 4 |
| UE heights (above ground or building floors) (m) | N/A | 1.5 |
| TDD activity factor | 75% DL | 25% UL |

In Table 6, we provide the 5G MFCN AAS antenna characteristics used in the studies.

Table 6: 5G MFCN AAS antenna characteristics

|  |  |  |
| --- | --- | --- |
| Parameter No. | Parameter | Value |
| 1 | Base station antenna characteristics | | |
| 1.1 | Antenna pattern | extended AAS |
| 1.2 | Element gain (dBi) (Note 1) | 6.4 |
| 1.3 | Horizontal/vertical 3 dB beam width of single element (degree) | 90º for H 65º for V |
| 1.4 | Horizontal/vertical front‑to‑back ratio (dB) | 30 for both H/V |
| 1.5 | Antenna polarization | Linear ±45º |
| 1.6 | Antenna array configuration (Row × Column) (Note 2) | 4 × 8 elements  8 x 8 elements |
| 1.7 | Horizontal/Vertical radiating element/sub-array spacing, *dh* /*dv* | 0.5 of wavelength for H, 2.1 of wavelength for V |
| 1.7a | Number of element rows in sub-array, *Msub* | 3 |
| 1.7b | Vertical radiating element spacing in sub-array, *dv,sub* | 0.7 of wavelength of V |
| 1.7c | Pre-set sub-array down-tilt, *θsubtilt* (degrees) | 3 |
| 1.8 | Array Ohmic loss (dB) (Note 1) | 2 |
| 1.9 | Conducted power (before Ohmic loss) per antenna element/sub-array (dBm) (Note 5, 6) | 31.7 for 4x8 elements  25.7 for 8x8 elements |
| 1.10 | Base station horizontal coverage range (degrees) | ±60 |
| 1.11 | Base station vertical coverage range (degrees) (Notes 3, 4, 7) | 90-100 |
| 1.12 | Mechanical downtilt (degrees) (Note 4) | 6 |
| 1.13 | Maximum base station output power/sector (e.i.r.p.) (dBm) | 76 |

In Table 7, we provide the 5G MFCN out-of-band emissions mask used in the simulations.

Table 7: 5G MFCN out-of-band emissions mask

|  |  |
| --- | --- |
| **Frequency offset** | **Maximum mean TRP density** |
| 3800 MHz-3805 MHz | Min(Pmax’-40, 16) / 5 MHz |
| 3805 MHz-3810 MHz | Min(Pmax’-43, 12) / 5 MHz |
| 3810 MHz-3840 MHz | Min(Pmax’-43, 1) / 5 MHz |
| Above 3840 MHz | -23 dBm / 5 MHz |
| Note: Pmax’ is the maximum mean carrier power in dBm for the base station measured as TRP. per carrier, interpreted as per antenna | |

In Table 8, we provide the 5G MFCN receiver mask used in the studies.

Table 8: 5G MFCN receiver mask

|  |  |
| --- | --- |
| **Frequency offset** | **Medium Power (Attenuation)** |
| 3800 MHz-3820 MHz | 34.3 dB |
| 3820 MHz-3860 MHz | 43.3 dB |
| Above 3860 | 71.3 dB |

### Propagation parameters

In Table 9 we provide the propagation parameters used in the studies.

Table 9: Propagation parameters used in coexistence studies

|  |  |  |
| --- | --- | --- |
| Case | Urban/Suburban | Rural |
| Both ends above clutter | ITU-R P.452  50% of time, without use of clutter loss | |
| One end above clutter and one end within clutter | ITU-R P.452  50% of time  with ITU-R P.2108 fixed clutter loss corresponding to  50% locations (for urban) or  30% (for sub-urban)  applied to one end. |  |
| Both ends within clutter | ITU-R P.452  50% of time  with- ITU-R P.2108 fixed clutter loss corresponding to  50% locations (for urban) or  30% (for sub-urban) applied to two ends. |  |

## Coexistence simulations

Our simulations capture the probability of interference from an unsynchronised WBB LMP BS into 5G MFCN BS operating in immediately adjacent channels in adjacent bands.

We have selected a range of representative scenarios to simulate, including WBB LMPs with different EIRP values, heights in different environments.

### Simulation methodology

To assess the coexistence feasibility of unsynchronised WBB LMP BSs in the 3.8-4.2 GHz band with 5G MFCN BS in the adjacent band, we performed Monte Carlo simulations in a 3GPP compliant simulator, where the dynamic nature of WBB LMP and 5G MFCN services was captured. The WBB LMP BSs were assumed to serve three UE within the sector, with UEs uniformly distributed in the sector area. For the configurations based on AAS, at each snapshot the WBB LMP BS steers the beam in the direction of the UE to be served. For a conservative assessment of coexistence, full (100%) BS load was assumed.

Our methodology assumes that the WBB LMP BS acting as the interferer is initially placed 250 m away from the victim 5G MFCN BS receiver. Maintaining the separation distance fixed, the interference observed in 10,000 independent simulation runs (snapshots) is captured. The separation distance is then increased in steps of 250 m, with the received interference levels in 10,000 snapshots for each separation distance step being captured. Since there is no % of time associated with the I/N protection criterion of WBB LMP BS, for each separation distance step of 250m, we have considered only the worst-case interfering snapshot. We then plotted the resulting I/N from the worst-case interfering snapshot for each separation distance step and compared it against the I/N protection criterion to determine the minimum separation distance required to protect the WBB LMP BS receiver.

### Simulating the potential interference from outdoor non-AAS WBB LP BS into 5G MFCN BS

#### Simulation scenarios (interference from outdoor non-AAS WBB LP BS into 5G MFCN BS)

In Table 10 below, we demonstrate the details of the scenarios that we have simulated for the interference potential of outdoor non-AAS WBB LP BS into 5G MFCN BS.

Table 10: Simulation scenarios WBB LP into 5G MFCN

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Scenario No.** | **Scenario type** | **Clutter assumption** | **Interference from** | **Interference to** |
| 1  Urban | Outdoor WBB LP vs  Outdoor 5G MFCN BS | 50% applied only at one side | Outdoor WBB LP BS  EIRP = 31 dBm  Non-AAS  10m height | Outdoor 5G MFCN  26.2 dBi antenna gain  AAS  20m height |
| 2  Rural | Outdoor WBB LP vs  Outdoor 5G MFCN BS | Both sides above clutter  (no clutter considered) | Outdoor WBB LP BS  EIRP = 31dBm  Non-AAS  10m height | Outdoor 5G MFCN  26.2 dBi antenna gain  AAS  25m height |
| 3  Urban | Outdoor WBB LP vs  Outdoor 5G MFCN BS | 50% applied only at one side | Outdoor WBB LP BS  EIRP = 31 dBm  Non-AAS  10m height | Outdoor 5G MFCN  29.2 dBi antenna gain  AAS  20m height |
| 4  Rural | Outdoor WBB LP vs  Outdoor 5G MFCN BS | Both sides above clutter  (no clutter considered) | Outdoor WBB LP BS  EIRP = 31dBm  Non-AAS  10m height | Outdoor 5G MFCN  29.2 dBi antenna gain  AAS  25m height |

#### Results of the studies (interference from WBB LP BS to 5G MFCN BS)



Figure 1: non-AAS WBB LP into 5G MFCN

### Simulating the potential interference from outdoor WBB MP BS into 5G MFCN

#### Simulation scenarios and results (interference from outdoor AAS WBB MP BS into 5G MFCN with 4x8 AAS antenna configuration)

Table 11: Simulation scenarios between WBB LMP MP and 5G MFCN (4x8)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Scenario No. | Scenario type | Clutter assumption | Interference from | Interference to |
| 5  Urban | Outdoor WBB MP vs  Outdoor 5G MFCN | 50% applied only at one side | Outdoor WBB MP BS  EIRP = 49 dBm/100MHz  AAS (4x8), 10m height | Outdoor 5G MFCN BS 26.2 dBi antenna gain  AAS (4x8), 20m height |
| 6  Dense suburban | Outdoor WBB MP vs  Outdoor 5G MFCN | 30% applied only at one side | Outdoor WBB MP BS  EIRP = 49 dBm/100MHz  AAS (4x8), 10m height | Outdoor 5G MFCN BS 26.2 dBi antenna gain  AAS (4x8), 25m height |
| 7  Dense suburban | Outdoor WBB MP vs  Outdoor 5G MFCN | 30% applied only at one side | Outdoor WBB MP BS  EIRP = 51 dBm/100MHz  AAS (4x8), 10m height | Outdoor 5G MFCN BS 26.2 dBi antenna gain  AAS (4x8), 25m height |
| 8  rural | Outdoor WBB MP  vs  Outdoor 5G MFCN | Both sides above clutter  (no clutter assumed) | Outdoor WBB MP BS  EIRP =49dBm  AAS (4x8), 15m height | Outdoor 5G MFCN BS 26.2 dBi antenna gain  AAS (4x8), 25m height |
| 9  rural | Outdoor WBB MP  vs  Outdoor 5G MFCN | Both sides above clutter  (no clutter assumed) | Outdoor WBB MP BS  EIRP =51dBm  AAS (4x8), 15m height | Outdoor 5G MFCN BS 26.2 dBi antenna gain  AAS (4x8), 25m height |



Figure 2: AAS WBB MP into 5G MFCN (4x8)

#### Simulation scenarios and results (interference from outdoor AAS WBB MP BS into 5G MFCN with 8x8 AAS antenna configuration)

Table 12: Simulation scenarios between WBB MP and 5G MFCN (8x8)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Scenario No. | Scenario type | Clutter assumption | Interference from | Interference to |
| 10  Urban | Outdoor WBB MP vs  Outdoor 5G MFCN | 50% applied only at one side | Outdoor WBB MP BS  EIRP = 49 dBm/100MHz  AAS (4x8)  10m height | Outdoor 5G MFCN BS 29.2 dBi antenna gain  AAS (8x8)  20m height |
| 11  Dense suburban | Outdoor WBB MP vs  Outdoor 5G MFCN | 30% applied only at one side | Outdoor WBB MP BS  EIRP = 49 dBm/100MHz  AAS (4x8)  10m height | Outdoor 5G MFCN BS 29.2 dBi antenna gain  AAS (8x8)  25m height |
| 12  Dense suburban | Outdoor WBB MP vs  Outdoor 5G MFCN | 30% applied only at one side | Outdoor WBB MP BS  EIRP = 51 dBm/100MHz  AAS (4x8)  10m height | Outdoor 5G MFCN BS 29.2 dBi antenna gain  AAS (8x8)  25m height |
| 13  rural | Outdoor WBB MP  vs  Outdoor 5G MFCN | Both sides above clutter  (no clutter assumed) | Outdoor WBB MP BS  EIRP =49dBm  AAS (4x8)  15m height | Outdoor 5G MFCN BS 29.2 dBi antenna gain  AAS (8x8)  25m height |
| 14  rural | Outdoor WBB MP  vs  Outdoor 5G MFCN | Both sides above clutter  (no clutter assumed) | Outdoor WBB MP BS  EIRP =51dBm  AAS (4x8)  15m height | Outdoor 5G MFCN BS 29.2 dBi antenna gain  AAS (8x8)  25m height |



Figure 3: AAS WBB MP into 5G MFCN (8x8)

# aDJACENT BAND Coexistence STUDIES from 5G mfcn into unsynchronised wbb lmp BS

## cOEXISTENCE SIMULATIONS (5g mfcn INTO wbb lmp)

Our simulations capture the potential of interference from 5G MFCN BS into unsynchronised WBB LMP BS operating in immediately adjacent channels of adjacent bands.

### Simulating the potential interference from 5G MFCN into unsynchronised outdoor WBB LMP BS in the adjacent band

#### Simulation scenarios (interference from 5G MFCN (4x8) into unsynchronised outdoor WBB LMPs)

Table 13: Simulation scenarios 5G MFCN (4x8) into WBB LMP

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Scenario No. | Scenario type | Clutter assumption | Interference from | Interference to |
| 15  Dense Urban | Outdoor 5G MFCN BS  vs  Outdoor WBB LP | 50% applied at each side | Outdoor 5G MFCN BS EIRP= 76dBm/100MHz  AAS (4x8)  20m height | Outdoor WBB LP BS  12 dBi antenna gain  Non-AAS  10m height |
| 16  Urban | Outdoor 5G MFCN BS  vs  Outdoor WBB LP | 50% applied at one side | Outdoor 5G MFCN BS EIRP= 76dBm/100MHz  AAS (4x8)  20m height | Outdoor WBB LP BS  12 dBi antenna gain  Non-AAS  10m height |
| 17  Rural | Outdoor 5G MFCN BS  vs  Outdoor WBB LP | Both sides above clutter  (no clutter considered) | Outdoor 5G MFCN BS EIRP= 76dBm/100MHz  AAS (4x8)  25m height | Outdoor WBB LP BS  12 dBi antenna gain  Non-AAS  10m height |
| 18  Dense Suburban | Outdoor 5G MFCN BS  vs  Outdoor WBB MP | 30% applied at one side | Outdoor 5G MFCN BS EIRP= 76dBm/100MHz  AAS (4x8)  25m height | Outdoor WBB MP BS21.5 dBi antenna gain  AAS (4x8)  12m height |
| 19  Rural | Outdoor WBB MP  vs  Outdoor WBB MP | Both sides above clutter  (no clutter considered) | Outdoor 5G MFCN BS EIRP= 76dBm/100MHz  AAS (4x8)  25m height | Outdoor WBB MP BS21.5 dBi antenna gain  AAS (4x8)  15m height |



Figure 4: 5G MFCN (4x8) into WBB LMP

#### Simulation scenarios (interference from 5G MFCN (8x8) into unsynchronised outdoor WBB LMPs)

Table 14: Simulation scenarios 5G MFCN (8x8) into WBB LMP

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Scenario No. | Scenario type | Clutter assumption | Interference from | Interference to |
| 20  Dense Urban | Outdoor 5G MFCN BS  vs  Outdoor WBB LP | 50% applied at each side | Outdoor 5G MFCN BS EIRP= 76dBm/100MHz  AAS (8x8)  20m height | Outdoor WBB LP BS  12 dBi antenna gain  Non-AAS  10m height |
| 21  Urban | Outdoor 5G MFCN BS  vs  Outdoor WBB LP | 50% applied at one side | Outdoor 5G MFCN BS EIRP= 76dBm/100MHz  AAS (8x8)  20m height | Outdoor WBB LP BS  12 dBi antenna gain  Non-AAS  10m height |
| 22  Rural | Outdoor 5G MFCN BS  vs  Outdoor WBB LP | Both sides above clutter  (no clutter considered) | Outdoor 5G MFCN BS EIRP= 76dBm/100MHz  AAS (8x8)  25m height | Outdoor WBB LP BS  12 dBi antenna gain  Non-AAS  10m height |
| 23  Dense Suburban | Outdoor 5G MFCN BS  vs  Outdoor WBB MP | 30% applied at one side | Outdoor 5G MFCN BS EIRP= 76dBm/100MHz  AAS (8x8)  25m height | Outdoor WBB MP BS21.5 dBi antenna gain  AAS (4x8)  12m height |
| 24  Rural | Outdoor WBB MP  vs  Outdoor WBB MP | Both sides above clutter  (no clutter considered) | Outdoor 5G MFCN BS EIRP= 76dBm/100MHz  AAS (8x8)  25m height | Outdoor WBB MP BS21.5 dBi antenna gain  AAS (4x8)  15m height |



Figure 5: 5G MFCN (8x8) into WBB LMP

# conclusions

In summary, the results of the separation distances we observed from the simulations are shown in Table 16.

Table 16: Summary of results of the simulation scenarios

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Scenario No. | Scenario type | Clutter assumption | Interference from | Interference to | Separation distance |
| 1  Urban | Outdoor WBB LP vs  Outdoor 5G MFCN BS | 50% applied only at one side | Outdoor WBB LP BS  EIRP = 31 dBm  Non-AAS  10m height | Outdoor 5G MFCN  26.2 dBi antenna gain  AAS (4x8)  20m height | No separation distance requirement observed, beyond the initial 250m configuration setup |
| 2  Rural | Outdoor WBB LP vs  Outdoor 5G MFCN BS | Both sides above clutter  (no clutter considered) | Outdoor WBB LP BS  EIRP = 31dBm  Non-AAS  10m height | Outdoor 5G MFCN  26.2 dBi antenna gain  AAS (4x8)  25m height | ~850m |
| 3  Urban | Outdoor WBB LP vs  Outdoor 5G MFCN BS | 50% applied only at one side | Outdoor WBB LP BS  EIRP = 31 dBm  Non-AAS  10m height | Outdoor 5G MFCN  29.2 dBi antenna gain  AAS (8x8)  20m height | No separation distance requirement observed, beyond the initial 250m configuration setup |
| 4  Rural | Outdoor WBB LP vs  Outdoor 5G MFCN BS | Both sides above clutter  (no clutter considered) | Outdoor WBB LP BS  EIRP = 31dBm  Non-AAS  10m height | Outdoor 5G MFCN  29.2 dBi antenna gain  AAS (8x8)  25m height | ~850m |
| 5  Urban | Outdoor WBB MP vs  Outdoor 5G MFCN | 50% applied only at one side | Outdoor WBB MP BS  EIRP = 49 dBm/100MHz  AAS (4x8)  10m height | Outdoor 5G MFCN BS 26.2 dBi antenna gain  AAS (4x8)  20m height | No separation distance requirement observed, beyond the initial 250m configuration setup |
| 6  Dense suburban | Outdoor WBB MP vs  Outdoor 5G MFCN | 30% applied only at one side | Outdoor WBB MP BS  EIRP = 49 dBm/100MHz  AAS (4x8)  10m height | Outdoor 5G MFCN BS 26.2 dBi antenna gain  AAS (4x8)  25m height | No separation distance requirement observed, beyond the initial 250m configuration setup |
| 7  Dense suburban | Outdoor WBB MP vs  Outdoor 5G MFCN | 30% applied only at one side | Outdoor WBB MP BS  EIRP = 51 dBm/100MHz  AAS (4x8)  10m height | Outdoor 5G MFCN BS 26.2 dBi antenna gain  AAS (4x8)  25m height | No separation distance requirement observed, beyond the initial 250m configuration setup |
| 8  rural | Outdoor WBB MP  vs  Outdoor 5G MFCN | Both sides above clutter  (no clutter assumed) | Outdoor WBB MP BS  EIRP =49dBm  AAS (4x8)  15m height | Outdoor 5G MFCN BS 26.2 dBi antenna gain  AAS (4x8)  25m height | ~1km |
| 9  rural | Outdoor WBB MP  vs  Outdoor 5G MFCN | Both sides above clutter  (no clutter assumed) | Outdoor WBB MP BS  EIRP =51dBm  AAS (4x8)  15m height | Outdoor 5G MFCN BS 26.2 dBi antenna gain  AAS (4x8)  25m height | ~1km |
| 10  Urban | Outdoor WBB MP vs  Outdoor 5G MFCN | 50% applied only at one side | Outdoor WBB MP BS  EIRP = 49 dBm/100MHz  AAS (4x8)  10m height | Outdoor 5G MFCN BS 29.2 dBi antenna gain  AAS (8x8)  20m height | No separation distance requirement observed, beyond the initial 250m configuration setup |
| 11  Dense suburban | Outdoor WBB MP vs  Outdoor 5G MFCN | 30% applied only at one side | Outdoor WBB MP BS  EIRP = 49 dBm/100MHz  AAS (4x8)  10m height | Outdoor 5G MFCN BS 29.2 dBi antenna gain  AAS (8x8)  25m height | No separation distance requirement observed, beyond the initial 250m configuration setup |
| 12  Dense suburban | Outdoor WBB MP vs  Outdoor 5G MFCN | 30% applied only at one side | Outdoor WBB MP BS  EIRP = 51 dBm/100MHz  AAS (4x8)  10m height | Outdoor 5G MFCN BS 29.2 dBi antenna gain  AAS (8x8)  25m height | No separation distance requirement observed, beyond the initial 250m configuration setup |
| 13  rural | Outdoor WBB MP  vs  Outdoor 5G MFCN | Both sides above clutter  (no clutter assumed) | Outdoor WBB MP BS  EIRP =49dBm  AAS (4x8)  15m height | Outdoor 5G MFCN BS 29.2 dBi antenna gain  AAS (8x8)  25m height | ~1km |
| 14  rural | Outdoor WBB MP  vs  Outdoor 5G MFCN | Both sides above clutter  (no clutter assumed) | Outdoor WBB MP BS  EIRP =51dBm  AAS (4x8)  15m height | Outdoor 5G MFCN BS 29.2 dBi antenna gain  AAS (8x8)  25m height | ~1km |
| ***Interference from 5G MFCN into WBB LMP*** | | | | | |
| 15  Dense Urban | Outdoor 5G MFCN BS  vs  Outdoor WBB LP | 50% applied at each side | Outdoor 5G MFCN BS EIRP= 76dBm/100MHz  AAS (4x8)  20m height | Outdoor WBB LP BS  12 dBi antenna gain  Non-AAS  10m height | No separation distance requirement observed, beyond the initial 250m configuration setup |
| 16  Urban | Outdoor 5G MFCN BS  vs  Outdoor WBB LP | 50% applied at one side | Outdoor 5G MFCN BS EIRP= 76dBm/100MHz  AAS (4x8)  20m height | Outdoor WBB LP BS  12 dBi antenna gain  Non-AAS  10m height | No separation distance requirement observed, beyond the initial 250m configuration setup |
| 17  Rural | Outdoor 5G MFCN BS  vs  Outdoor WBB LP | Both sides above clutter  (no clutter considered) | Outdoor 5G MFCN BS EIRP= 76dBm/100MHz  AAS (4x8)  25m height | Outdoor WBB LP BS  12 dBi antenna gain  Non-AAS  10m height | ~1.6 km |
| 18  Dense Suburban | Outdoor 5G MFCN BS  vs  Outdoor WBB MP | 30% applied at one side | Outdoor 5G MFCN BS EIRP= 76dBm/100MHz  AAS (4x8)  25m height | Outdoor WBB MP BS21.5 dBi antenna gain  AAS (4x8)  12m height | ~300 m |
| 19  Rural | Outdoor WBB MP  vs  Outdoor WBB MP | Both sides above clutter  (no clutter considered) | Outdoor 5G MFCN BS EIRP= 76dBm/100MHz  AAS (4x8)  25m height | Outdoor WBB MP BS21.5 dBi antenna gain  AAS (4x8)  15m height | ~5.75 km |
| 20  Dense Urban | Outdoor 5G MFCN BS  vs  Outdoor WBB LP | 50% applied at each side | Outdoor 5G MFCN BS EIRP= 76dBm/100MHz  AAS (8x8)  20m height | Outdoor WBB LP BS  12 dBi antenna gain  Non-AAS  10m height | No separation distance requirement observed, beyond the initial 250m configuration setup |
| 21  Urban | Outdoor 5G MFCN BS  vs  Outdoor WBB LP | 50% applied at one side | Outdoor 5G MFCN BS EIRP= 76dBm/100MHz  AAS (8x8)  20m height | Outdoor WBB LP BS  12 dBi antenna gain  Non-AAS  10m height | No separation distance requirement observed, beyond the initial 250m configuration setup |
| 22  Rural | Outdoor 5G MFCN BS  vs  Outdoor WBB LP | Both sides above clutter  (no clutter considered) | Outdoor 5G MFCN BS EIRP= 76dBm/100MHz  AAS (8x8)  25m height | Outdoor WBB LP BS  12 dBi antenna gain  Non-AAS  10m height | ~1.6 km |
| 23  Dense Suburban | Outdoor 5G MFCN BS  vs  Outdoor WBB MP | 30% applied at one side | Outdoor 5G MFCN BS EIRP= 76dBm/100MHz  AAS (8x8)  25m height | Outdoor WBB MP BS21.5 dBi antenna gain  AAS (4x8)  12m height | ~250 m |
| 24  Rural | Outdoor WBB MP  vs  Outdoor WBB MP | Both sides above clutter  (no clutter considered) | Outdoor 5G MFCN BS EIRP= 76dBm/100MHz  AAS (8x8)  25m height | Outdoor WBB MP BS21.5 dBi antenna gain  AAS (4x8)  15m height | ~5.75 km |

As mentioned in the methodology section of this document, the simulations assume that the initial separation distance between the WBB LMPs and 5G MFCN BS was 250m. For the scenarios which assumed clutter at both sides, clutter only at one side was applied for the Monte Carlo steps between 250m-750m and clutter at both sides was applied for the rest of the simulation steps from 1000m onwards.

From the above results, we can see that when clutter (of either 30% of 50%) was applied to the side of outdoor WBB LMPs, we did not observe a separation distance requirement, beyond the 250m initial separation configuration, from outdoor WBB LMP BS, operating with EIRPs of 31dBm/100MHz, 49dBm/100MHz and 51dBm/100MHz to satisfy the I/N threshold of outdoor 5G MFCN BS, with either 4x8 or 8x8 AAS configuration, operating in the adjacent band in an unsynchronised manner. When no clutter was applied at any of the sides of WBB LMP or 5G MFCN BS (with 4x8 or 8x8 AAS configuration), we found that the required separation distance for coexistence in the adjacent channel unsynchronised case is ranging from approximately 850m for WBB LP BS to approximately 1km for WBB MP BS. We also see when comparing the effect of EIRPs of 49dBm/100MHz and 51dBm/100MHz, that the difference in separation distances is in the range of a few metres.

In the case of 5G MFCN BS acting as an interferer, when clutter was applied at both sides or only at the side of WBB LP BS, we did not observe a separation distance requirement, beyond the initial 250m separation configuration to achieve coexistence in the adjacent channel unsynchronised operation, assuming either a 4x8 or 8x8 5G MFCN AAS configuration. When 30% clutter was applied at the WBB MP side, we found that a separation distance of approximately 300m and 250m was required to satisfy the WBB LP BS I/N criterion, when a 5G MFCN BS with 4x8 and 8x8 AAS configuration was used respectively at the interfering side. When no clutter at all was applied to any of the WBB LP or 5G MFCN sides, we found that the separation distance for coexistence was approximately 1.6 km for both 4x8 and 8x8 5G MFCN BS configurations. Finally, when no clutter at all was applied to any of the WBB MP or 5G MFCN sides, we found that the separation distance to satisfy the I/N WBB MP criterion was approximately 5.75 km for both 4x8 and 8x8 5G MFCN configurations.

In the assessment of the above results, it is worth highlighting the following assumptions that were taken into consideration:

* The results represent separation distances for unsynchronised adjacent channel operation between WBB LMPs and 5G MFCN services.
* The EIRP of 5G MFCN BS was assumed to be 76dBm/100MHz
* The results range captures separation distances from 250m onwards.
* The minimum separation distance to satisfy the I/N criterion was derived based on the worst-case I/N value from each set of 10,000 snapshots simulated for each separation distance step.
* The 15m height assumed for the WBB MP BS is based on the evidence we have from the medium power licences of the UK framework and reflects at least 57% of the existing medium power deployments in the UK.
* No clutter was assumed at any of the scenarios for 5G MFCN services (except scenario 15 and 20)
* The out-of-band emissions mask for outdoor AAS WBB MP BS was assumed to be following the non-AAS out-of-band emission mask, as agreed in PT1 #74.
* The assumption of no clutter applied at any of the WBB LMP or 5G MFCN sides, implies no obstruction of the propagation path between the Tx and the Rx.
* The consideration of 100% network loading factor for WBB LMP BS represents a conservative assumption
* The antenna gain of the non-ASS omni WBB LP BS antenna was assumed to be 12dBi