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|  | | Doc. Group(2X)XXX |
| PT1 CG 3400-3800 MHz MFCN TDD X-border coordination #1 | | |
| Webmeeting, 1 April 2020 | | |
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| Date issued: | 25 March 2020 | |
| Source: | Ofcom, UK | |
| Subject: | Harmonised approach for TDD networks synchronisation in frequency band 3400-3800 MHz at border of CEPT countries | |
| Group membership required to read? (Y/N)  N | | |
|  | | |
| Summary: | | |
| The UK has awarded 3410-3680 MHz licences with requirements for outdoor networks to synchronise or semi‑synchronise and the UK intends to award 3680-3800 MHz later this year with the same requirements. All UK operators have launched 5G using 3410-3680 MHz spectrum and under these synchronisation requirements which we describe later in this submission.  Given all UK mobile operators have launched 5G services using the current synchronisation requirements we consider them suitable for 5G. However, we acknowledge that they may not be optimal for some 5G services and we also acknowledge that there may be future, as yet unknown, services which may not be supported by the synchronisation requirements we have set. For example, the target for URLLC services is that the air-interface can support <1ms latency which unlikely to be supported under the current synchronisation requirements if 3.4-3.8 GHz is not used in a dual connectivity arrangement with an FDD band. For these reasons, we consider that the current synchronisation requirements may need to change when we know more about future services. | | |
| Proposal: | | |
| The UK invites PT1 to  Add the UK synchronised and semi-synchronised frame structures to the list of frame structures for cross-border coordination in the new recommendation. | | |
| Background: | | |
| ECC Recommendation 15(01) which includes recommendations on C-band cross-border coordination was updated in February 2020 with new field strength limits.  ECC Report 296, 8 March 2019, which sets out the options for national synchronisation frameworks  ECC Decision 11(06), Harmonised frequency arrangements and least restrictive technical conditions (LRTC) for mobile/fixed communications networks (MFCN) operating in the band 3400-3800 MHz, 26 October 2018 | | |

# UK C-BAND SYNCHRONISATION REQUREMENTS

## Summary

In the UK, licensees are required to synchronise or semi-synchronise their outdoor base stations with each other in the 3400-3800 MHz band, which means that base stations must time align frames and operate using one of two specified frame structures and its associated out-of-band emissions requirements:

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| --- | --- | --- |
| **Full synchronisation**  *Frame Structure A; and Permissive mask* |  | The fully synchronised frame structure is a 10 ms frame with a 1:3 uplink/downlink ratio[[1]](#footnote-2) and we observe that TD-LTE frame configuration 2 using special sub-frame configuration 6 is compatible with this frame structure. A licensee operating radio equipment which uses this frame structure must comply with the permissive emissions mask.[[2]](#footnote-3) |
| **Semi-synchronisation**  *Frame Structure B; and Restrictive mask* |  | The semi-synchronised frame structure is a 10 ms frame which contains three synchronised sub-frames and seven flexible sub-frames which can be used for either downlink or uplink.[[3]](#footnote-4) This is compatible with all TD-LTE frame configurations. A licensee operating radio equipment which uses this frame structure must comply with the restrictive mask which is required to reduce the risk of interference to adjacent mobile networks in the absence of full synchronisation. |

Indoor base stations with a transmit power level below 24 dBm are exempt from synchronisation requirements unless they cause interference to the outdoor mobile network, in which case they are required to synchronise.

## Frame structures and their equivalent 5G nr respresentation

### Frame Structure A, “full synchronisation”, 10 ms frame



### Frame Structure B, “semi-synchronisation”, 10 ms frame



1. Detail of uk c-band synchronisation requirements

This is an extract of text relevant to synchronisation from the example licences published alongside the UK statement for the award of 3680‑3800 MHz.[[4]](#footnote-5)

1. When transmitting, the Licensee must either transmit in accordance with the condition in paragraph (a) or in accordance with the condition in paragraph (b). –
   * 1. The condition referred to is that the Licensee must transmit within the limits of the Permissive Transmission Mask and, if doing so, the Licensee must also transmit within the limits of transmission Frame Structure A;
     2. The condition referred to is that the Licensee must transmit within the limits of the Restrictive Transmission Mask, and, if doing so, the Licensee must also transmit within the limits of transmission Frame Structure B.
2. The Permissive Transmission Mask means that –

for transmissions on the downlink frequencies, the maximum mean EIRP or TRP emanating from the Radio Equipment transmissions at any frequency outside the Permitted Frequency Blocks, but within 3410 – 3800 MHz, shall not exceed the transitional and baseline requirements in the following table:

|  |  |  |
| --- | --- | --- |
|  | Non-AAS | AAS |
|  | *dBm / 5 MHz EIRP per antenna* | *dBm / 5 MHz TRP  per cell* |
| -5 to 0 MHz offset from lower block edge  0 to 5 MHz offset from upper block edge | Min(PMax – 40, 21) | Min(PMax’ – 40, 16) |
| -10 to -5 MHz offset from lower block edge  5 to 10 MHz offset from upper block edge | Min(PMax – 43, 15) | Min(PMax’ – 43, 12) |
| Out of block baseline power limit (BS)  < -10 MHz offset from lower block edge  > 10 MHz offset from upper block edge | Min(PMax – 43, 13) | Min(PMax’ – 43, 1) |

1. The Restrictive Transmission Mask means that –

for transmissions on the downlink frequencies, the maximum mean EIRP emanating from the Radio Equipment transmissions at any frequency outside the Permitted Frequency Blocks, but within 3410 – 3800 MHz, shall not exceed baseline in the following table:

|  |  |  |
| --- | --- | --- |
|  | Non-AAS | AAS |
|  | *dBm / 5 MHz EIRP per cell* | *dBm / 5 MHz TRP  per cell* |
| Out of block baseline power limit (BS) | -34 | -43 |

1. Frame Structure A (also commonly known as the “Preferred Frame Structure”) means that

transmissions from the Licensee’s base stations have a frame structure as shown in Figure 1. Timeslots (or subframes) 0, 2 to 5 and 7 to 9 must be allocated to Downlink (D) or Uplink (U) transmissions as indicated or may be left with no transmissions;

the Licensee must ensure that the special subframe (S) in timeslots 1 and 6 have a structure that is compatible with TD-LTE special subframe configuration 6, also known as 9:3:2 (DwPTS: GP: UpPTS). For the avoidance of doubt, a special subframe structure is compatible where there are no uplink transmissions within the downlink pilot timeslot (DwPTS) or guard period (GP) and no downlink transmissions within the uplink pilot timeslot (UpPTS) or guard period (GP);

timeslots must have a duration of 1 millisecond;

the Licensee shall ensure that frames start at a common reference time so that all licensees’ frames are aligned and transmissions synchronised;

Note TD-LTE frame configuration 2 (3:1) is compatible with this frame structure, as are some 5G NR frame configurations. Other technologies are permitted provided that the requirements of 12(a) to 12(d) are met.

1. Frame Structure B (also commonly known as the “Compatible Frame Structure”) means that:

transmissions from the Licensee’s base stations must have a frame structure as shown in Figure 2. Timeslots (or subframes) 0 and 2 must be allocated to Downlink (D), or Uplink (U) transmissions as indicated;

the Licensee must ensure that the special subframe (S) in timeslot 1 has a structure that is compatible with TD-LTE special subframe configuration 6, also known as 9:3:2 (DwPTS: GP: UpPTS). For the avoidance of doubt, a special subframe structure is compatible where there are no uplink transmissions within the downlink pilot timeslot (DwPTS) or guard period (GP) and no downlink transmissions within the uplink pilot timeslot (UpPTS) or guard period (GP);

timeslots must have a duration of 1 millisecond;

the Licensee shall ensure that frames start at a common reference time so that all licensees’ frames are aligned and transmissions synchronised;

timeslots with no transmission indicated may have no transmission or must be determined as a Downlink, Uplink or Special subframe as necessary in order to ensure compliance with paragraph 13(c) and 13(f);

the Licensee must cooperate with other licensees to minimise harmful sub-frame overlaps if different technologies are used. On rare occasions this may require the frame alignment or guard period to be slightly offset;

for the avoidance of doubt downlink-only frame structures such as Supplementary Downlink (SDL) are not permitted.

Note all current TD-LTE frame configurations are compatible with this frame structure, as are some 5G NR frame configurations. Other technologies are permitted provided that the requirements of 13(a) to 13(d) are met.

Figure 1: Frame Structure A

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| DL/UL ratio | Subframe Number | | | | | | | | | |
| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 3:1 | D | S | U | D | D | D | S | U | D | D |

Figure 2: Frame Structure B

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| DL/UL ratio | Subframe Number | | | | | | | | | |
| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|  | D | S | U |  |  |  |  |  |  |  |

1. Irrespective of whether the Restrictive Transmission Mask or the Permissive Transmission Mask is being used, the EIRP or TRP emanating from the Radio Equipment transmissions at any frequency outside the Permitted Frequency Blocks shall not exceed the following additional band edge requirements:

|  |  |  |
| --- | --- | --- |
|  | Non-AAS | AAS |
|  | *dBm / MHz*[a] *EIRP per antenna* | *dBm / MHz*[a] *TRP  per cell* |
| Below 3390 MHz | -50 | -52 |

[a] We note this level is defined in the Commission Decision 2019/235/EU as per MHz rather than per 5 MHz

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| --- | --- | --- |
|  | Non-AAS | AAS |
|  | *dBm / 5 MHz EIRP per antenna* | *dBm / 5 MHz TRP  per cell* |
| 3390 – 3400 MHz | Min(PMax – 43, 13) | Min(PMax’ – 43, 1) |
| 3400 – 3405 MHz | Min(PMax – 43, 15) | Min(PMax’ – 43, 12) |
| 3405 – 3410 MHz | Min(PMax – 40, 21) | Min(PMax’ – 40, 16) |
| 3800 – 3805 MHz | Min(PMax – 40, 21) | Min(PMax’ – 40, 16) |
| 3805 – 3810 MHz | Min(PMax – 43, 15) | Min(PMax’ – 43, 12) |
| 3810 – 3840 MHz | Min(PMax – 43, 13) | Min(PMax’ – 43, 1) |
| Above 3840 MHz | -2 | -14 |

Small Cells

1. The Licensee is required to comply with the Permissive Transmission Mask as set out in paragraph 10 of this schedule but is not required to comply with the frame structure requirements set out in paragraphs 12 or 13 above, for:

(a) Indoor Domestic Small Cells; or

(b) Indoor Non-domestic Small Cells, except where another licensee demonstrates that they are suffering harmful interference as a result.

If another licensee demonstrates that they are suffering harmful interference as a result of an Indoor Non-domestic Small Cell, the Indoor Non-domestic Small Cell must comply with the requirements set out in paragraphs 9 and 12 above, where Frame Structure A is used or those requirements set out in both paragraphs 9 and 13 above where Frame Structure B is used.

1. Frame Structure A has a DSUDDDSUDD structure where each character represents a 1 ms sub-frame and “D” means downlink; “U” means uplink; and “S” is a special sub-frame which contains a guard period. [↑](#footnote-ref-2)
2. The “Permissive” and “Restrictive” masks correspond to the “Baseline” and “Restricted” power limits respectively as described in ECC Decision 11(06), Harmonised frequency arrangements and least restrictive technical conditions (LRTC) for mobile/fixed communications networks (MFCN) operating in the band 3400-3800 MHz, 26 October 2018, <https://www.ecodocdb.dk/download/34f57e2a-1c04/ECCDEC1106.PDF> [↑](#footnote-ref-3)
3. Frame Structure B has a DSUXXXXXXX structure where “X” is a flexible sub-frame which can be either uplink or downlink. [↑](#footnote-ref-4)
4. “Information Memorandum: Award of the 700 MHz and 3.6-3.8 GHz spectrum bands”, Ofcom, UK, 13 March 2020, <https://www.ofcom.org.uk/__data/assets/pdf_file/0019/192412/information-memorandum-award-700mhz-3.6-3.8ghz-spectrum.pdf> [↑](#footnote-ref-5)