

## Appendix C – Licence conditions 2.6 GHz band

This document is a non-binding translation to English of the Swedish appendix (to the Open Invitation Part 2) published 26 April 2023

### Area of use and technical conditions for FDD (2500–2570/2620–2690 MHz)

1. The licence is national.
2. The licence shall be used for terrestrial systems which can provide mobile broadband services.
3. Frequency Division Duplex (FDD) technology shall be used as the duplex method for downlink and uplink transmission respectively.

Base stations are radio transmitters whose transmission shall be in the downlink direction in the frequency range 2620–2690 MHz (Downlink FDD).

Terminals are radio transmitters whose transmission shall be in the uplink direction in the 2500–2570 MHz frequency range (Uplink FDD).

Repeaters<sup>1</sup> shall comply with the respective conditions for base stations and terminals.

4. In the 2500–2620 MHz frequency range, base stations shall comply with power limits as specified in Table 1.

Table 1 Power limits in the frequency range 2500-2620 MHz

BEM <sup>2</sup> element	Frequency range	Maximum mean EIRP <sup>3</sup> (non-AAS) per antenna	Maximum mean TRP <sup>4</sup> (AAS <sup>5</sup> ) per cell (*)
Baseline level	Frequency range 2500–2615 MHz	-45 dBm/MHz	-52 dBm/MHz

<sup>1</sup> Repeaters are radio transmitters that transmit both downlink and uplink.

<sup>2</sup> BEM – Block Edge Mask. BEM is a spectrum mask that defines power limits as a function of the frequency distance from the edge of a frequency block assigned to a license holder.

<sup>3</sup> EIRP – Equivalent Isotropically Radiated Power

<sup>4</sup> TRP – Total Radiated Power

<sup>5</sup> AAS – Active Antenna System

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	Frequency range 2615–2620 MHz	4 dBm/MHz	5 dBm/MHz
(*) For base stations with multiple sectors, the maximum mean power applies per sector.			

5. In the frequency range 2620–2690 MHz, outside the assigned frequency block, base stations shall comply with power limits pursuant to Table 2.

Table 2 Power limits in the frequency range 2620–2690 MHz, outside the assigned frequency block

<b>BEM element</b>	<b>Frequency range</b>	<b>Maximum mean EIRP (non-AAS) per antenna</b>	<b>Maximum mean TRP (AAS) per cell (*)</b>
Transitional region	0 to 5 MHz outside the block edge	16 dBm/5 MHz	16 dBm/5 MHz
Baseline level	>5 MHz outside the block edge	4 dBm/MHz	5 dBm/MHz
(*) For base stations with multiple sectors, the maximum mean power applies per sector.			

6. If the licence holder has been assigned several contiguous frequency blocks, the restrictions on maximum average power under condition 5 above apply only outside the contiguous frequency blocks.
7. The licence holder may, by agreement with other licence holders in 2500–2690 MHz, deviate from the conditions pursuant to conditions 4 and 5 above, as far as the 2500–2690 MHz frequency range is concerned.
8. The licence holder is responsible for planning the radio network.

### **Area of use and technical conditions for TDD (2570–2620 MHz)**

9. The licence is national.
10. The licence shall be used for terrestrial systems which can provide mobile broadband services.
11. Time Division Duplex (TDD) technology shall be used as the duplex method for downlink and uplink transmission respectively.

Base stations are radio transmitters whose transmission shall be in the downlink direction in the frequency range 2570–2620 MHz (TDD).

Terminals are radio transmitters whose transmission shall be in the uplink direction in the frequency range 2570–2620 MHz (TDD).

Repeaters<sup>6</sup> shall comply with the respective conditions for base stations and terminals.

12. Within the assigned frequency block in 2570–2575 MHz (restricted block), base stations shall comply with power limits as specified in Table 3.

Table 3 Power limits within assigned frequency block in 2570–2575 MHz (restricted block)

<b>BEM element</b>	<b>Frequency range</b>	<b>Maximum mean EIRP<sup>7</sup> (non-AAS) per antenna</b>	<b>Maximum mean TRP<sup>8</sup> (AAS<sup>9</sup>) per cell (*)</b>
In-block	Restricted block in 2570–2575 MHz	25 dBm/5 MHz	22 dBm/5 MHz
(*) For base stations with multiple sectors, the maximum mean power applies per sector.			

13. In the 2500–2570 MHz and 2620–2690 MHz frequency ranges, base stations shall comply with power limits as specified in Table 4.

Table 4 Power limits within frequency ranges 2500–2570 and MHz 2620– 2690 MHz

<b>BEM element</b>	<b>Frequency range</b>	<b>Maximum mean EIRP (non-AAS) per antenna</b>	<b>Maximum mean TRP (AAS) per cell (*)</b>
Baseline	Frequency range 2500–2570 MHz	-45 dBm/MHz	-52 dBm/MHz
	Frequency range 2620–2690 MHz	4 dBm/MHz	5 dBm/MHz
(*) For base stations with multiple sectors, the maximum mean power applies per sector.			

14. In the frequency range 2570–2620 MHz, outside the assigned frequency block, base stations shall comply with power limits pursuant to Table 5.

Table 5 Power limits in the frequency range 2570–2620 MHz, outside the assigned frequency block

<b>BEM element</b>	<b>Frequency range</b>	<b>Maximum mean EIRP (non-AAS) per antenna</b>	<b>Maximum mean TRP (AAS) per cell (*)</b>
Transitional region	0 to 5 MHz outside the block edge for TDD blocks synchronised	16 dBm/5 MHz	16 dBm/5 MHz

<sup>6</sup> Repeaters are radio transmitters that transmit both downlink and uplink.

<sup>7</sup> EIRP – Equivalent Isotropically Radiated Power

<sup>8</sup> TRP – Total Radiated Power

<sup>9</sup> AAS – Active Antenna System

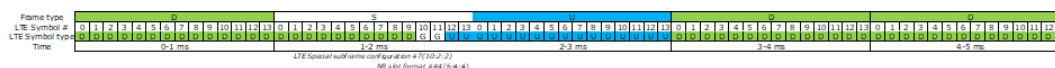
	with the TDD block in question		
Baseline	>5 MHz outside the block edge for TDD blocks synchronised with the TDD block in question and for TDD blocks used for downlink only	4 dBm/MHz	5 dBm/MHz
Restricted baseline	TDD blocks not synchronised with the TDD block in question	-45 dBm/MHz	-52 dBm/MHz
(*) For base stations with multiple sectors, the maximum mean power applies per sector.			

15. If the licence holder has been assigned several contiguous frequency blocks, the restrictions on maximum average power under condition 14 above apply only outside the contiguous frequency blocks.
16. The licence holder may, by agreement with other licence holders in 2500–2690 MHz, deviate from the conditions pursuant to conditions 12 13 and 14 above, as far as the 2500–2690 MHz frequency range is concerned.
17. The licence holder is responsible for planning the radio network.

### Synchronisation for TDD (2570–2620 MHz)

18. The licence holder may, where relevant, agree with other licence holders in the frequency band 2570–2620MHz on the conditions for synchronisation.
19. If the licence holder is unable to reach an agreement according to the above, the following synchronisation conditions apply:
  - a. If any licence holder announces that deployment will be based on LTE in the band, all licence holders in the band shall apply the following frame structure, which corresponds to LTE-TDD *Uplink-downlink configuration #2 (DSUDD)* with *Special subframe configuration #7* for S<sup>10</sup>, and DDDSUDDDD for NR (See Figure 1).

Figure 1 Frame structure for synchronisation of LTE-LTE and LTE-NR in the 2.6 GHz band. After 5 ms, the frame structure is repeated. (D Downlink, U Uplink, G "Guard period"). The figure shows the symbol level for LTE. For a more detailed figure, see Addendum.

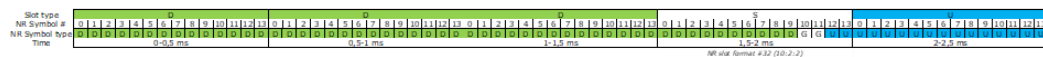


<sup>10</sup> 3GPP TS 36.211 (Special subframe configuration, normal cyclic prefix; SCS 15 kHz)

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- b. If no licence holder in the band announces that deployment will be based on LTE in the band, all licence holders in the band shall apply the following frame structure, which is equivalent to the DDDSU for NR (see Figure 2).

Figure 2 Frame structure for synchronisation of NR-NR in the 2.6 GHz band. After 2.5 ms, the frame structure is repeated. (D Downlink, U Uplink, G "Guard period"). For a more detailed figure, see Addendum.



- c. The initial frame of the frame structure shall start at a common reference time so that all licence holders' frames are aligned with each other and the networks thereby synchronised.
- d. To establish and maintain the reference time, a common time reference among licence holders is required. The common time reference shall be continuously related to UTC(SP)<sup>11</sup> throughout the country with a maximum deviation of  $\pm 1.5$  microseconds.
- e. The transitional region level of 16 dBm/5 MHz for both non-AAS and AAS, as well as the baseline levels of 4 dBm/MHz and 5 dBm/MHz for AAS and non-AAS respectively, pursuant to condition 14 (Table 5) above, may only be used with a frame structure equivalent to that described in item a or b.
20. The licence holder may locally deviate from the general requirement for synchronisation, pursuant to condition 19 above, if it can otherwise be ensured that interference between licence holders' networks does not occur.
21. PTS reserves the right to review the conditions regarding synchronisation pursuant to condition 19 above every five years during the licence period.

### Conditions for the protection of other use

22. Licence holders may not, in proximity to the Onsala Space Observatory (long: 11°55'35", latitude: 57°23'45", elevation above sea level: 20 metres) exceed the power flux density limit of  $-205$  dBW/m<sup>2</sup>/Hz in the frequency band 2690–2700 MHz, as specified in ITU-R Recommendation RA 769-2. The licence holder

<sup>11</sup> UTC (Coordinated Universal Time) is the reference time worldwide. The Swedish national time scale UTC(SP) is a national realization of UTC.

may deviate from the limit in the frequency band 2690–2700 MHz provided that the Onsala Space Observatory approves the deviation.

### **Coverage and deployment conditions<sup>12</sup>**

23. The licence holder shall provide coverage for mobile services pursuant to condition 26 along a total of 97% of the railway sections Shown in Appendix B1.

In the event that there is more than one track along any railway section in Appendix B1 the covered section shall be calculated pursuant to the formula: *(number of tracks with coverage along a section / total number of tracks along the same section) \* the length of the section in question.*

24. Capacity and performance<sup>13</sup> area shall be at least equivalent to what can be achieved by using 2x20 MHz LTE<sup>14</sup> with 2x2 MIMO<sup>15</sup> (if FDD is used) or 40 MHz LTE with 2x2 MIMO (if TDD is used).
25. At least 40 MHz of the licence holder's spectrum holdings in frequency bands above 1 GHz<sup>16</sup> shall be used to provide coverage.
26. Coverage for mobile services is deemed to exist if, with a handheld terminal, it is possible to receive data at a rate of 30 Mbit/s and to transmit data at a rate of 256 kbit/s, under normal conditions.

The signal strength level for coverage shall be based on the following assumptions:

- a. Base station receiver sensitivity of the equipment used in the network
- b. Terminal output power and receiver sensitivity of a "smartphone-type" hand-held terminal<sup>17</sup>
- c. Terminal antenna gain: -3 dBi

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<sup>12</sup> Licence holders winning at least 40 MHz in the 2.1 GHz and/or 2.6 GHz bands shall comply with these conditions

<sup>13</sup> In terms of speed and latency

<sup>14</sup> LTE – Long Term Evolution: technical standard for wireless broadband services

<sup>15</sup> MIMO – Multiple Input Multiple Output: technology for wireless digital data transmission in which both the transmitter and the receiver have multiple radio receivers and transmitters respectively

<sup>16</sup> Any frequency band above 1 GHz that is harmonised within the European Union for terrestrial systems capable of providing electronic communications services may be used.

<sup>17</sup> If, for the technology used in the network, there is more than one standardised terminal class, which corresponds to a "smartphone-type" hand-held terminal, the one with the lowest output power and the worst receiver sensitivity shall be assumed.

- d. The height of the terminal: 4 metres above the railway track, measured from the top of the rails (RÖK)
  - e. Margin of signal attenuation relative to a terminal free of body contact: 17 dB
  - f. Interference margin (load) in uplink: 2 dB
  - g. Lowest data speed in uplink: 256 kbit/s, under normal conditions
  - h. Lowest data speed in downlink: 30 Mbit/s, under normal conditions
  - i. Coverage probability on the cell edge (edge of the coverage area):  $\geq 80\%$
27. The above conditions must be met no later than 31 December 2030 and the coverage must be maintained for the duration of the licence.

### **Sharing conditions**

28. The licence holder has, pursuant to this licence, priority in the assigned frequency range over licence holders who may be added later. The frequency range is shared with others provided that the licence holder, pursuant to this licence, is not subject to harmful interference.

### **Conditions on coordination**

29. The licence holders shall obtain the consent from the Swedish Armed Forces for all new installations of radio transmitters and changes to existing installations of radio transmitters (e.g., updated technologies, directions/tilt, power, channel bandwidth) in the following municipalities: Ekerö, Gotland, Karlskrona, Kungsbacka, Marks, Simrishamn, Skurup, Trelleborg, Varberg, Vellinge and Ystad.
30. The licence holder shall comply with the conditions according to applicable coordination agreements between Sweden and other states.

### **Conditions regarding requirements that are of importance to the national security of Sweden**

31. The licence holder shall take the technical and organizational measures required to ensure that the radio usage does not cause harm to the national security of Sweden.
32. Conditions 33–35 apply to central functions, i.e., functions in:
- the radio access network,
  - the transmission networks,
  - the core network, and
  - the operation and maintenance network

that are necessary to maintain overall network functionality and electronic communications services provided by the holder of the licence.

33. Central functions used for the provision of services in the 900 MHz, 2.1 GHz and 2.6 GHz frequency bands must not contain products from Huawei and ZTE.
34. If the primary source for the common time reference is reception of signals from satellite (GNSS), or if the source is otherwise located outside Sweden, then a redundant source located in Sweden shall be functionality-tested and ready to be put into service when needed.
35. Central functions must not be dependent on staff or functions located abroad.



## **Information**

### **Notification obligation**

Public communication networks of the type that are normally provided against payment or publicly available electronic communication services may only be provided after notification to PTS.

### **Information obligation**

Anyone operating under the Electronic Communications Act is obliged to provide PTS, upon request, with the information and documents necessary for verifying compliance with the conditions imposed under the Act.

### **Changes of conditions**

The licence conditions may be amended with regard to future changes in radio technology or changes in radio usage due to international agreements to which Sweden is a party or provisions adopted on the basis of the Treaty on the Functioning of the European Union.

Licence conditions may also be changed immediately if it can be assumed that the radio usage will cause harm to Sweden's security.

### **Coordination with the Swedish Armed Forces**

Coordination with the Swedish Armed Forces regarding the expansion, deployment or modification of base stations in certain municipalities is initiated by filling out a form available on the Swedish Armed Forces website.<sup>18</sup> The completed form is sent to the Armed Forces according to the instructions on the form. For questions, please contact the Swedish Armed Forces at [fysplan@mil.se](mailto:fysplan@mil.se).

### **Existing coordination agreements**

Information on existing coordination agreements for block licences can be found on PTS's website<sup>19</sup>.

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<sup>18</sup> <https://www.forsvarsmakten.se/sv/om-forsvarsmakten/dokument/remissblanketter/>

<sup>19</sup> <https://www.pts.se/en/english-b/radio/coordination-agreements/>

### Addendum to Appendix C: Frame structure

Frame structure to be applied in the event that licence holders in 2570–2620 MHz do not agree otherwise.

#### Frame structure for synchronisation of LTE–LTE and LTE–NR

The figure below shows the symbol level for LTE. For NR with 30 kHz subcarrier spacing (SCS<sup>20</sup>), each subframe contains twice as many symbols as LTE, i.e. 28 instead of 14, distributed over two slots with 14 symbols in each slot, so that each LTE symbol is realised with two NR symbols.

Frame type	D														S														U														D														D													
LTE Symbol #	0	1	2	3	4	5	6	7	8	9	10	11	12	13	0	1	2	3	4	5	6	7	8	9	10	11	12	13	0	1	2	3	4	5	6	7	8	9	10	11	12	13	0	1	2	3	4	5	6	7	8	9	10	11	12	13	0	1	2	3	4	5	6	7	8	9	10	11	12	13
LTE Symbol type	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	G	G	U	U	U	U	U	U	U	U	U	U	U	U	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D
Time	0-1 ms														1-2 ms														2-3 ms														3-4 ms														4-5 ms													

*LTE Special subframe configuration #7 (10:2:2)*  
*NR slot format #44 (6:4:4)*

The proposed frame structure corresponds to LTE-TDD *Uplink-downlink configuration #2 (DSUDD)* with *Special subframe configuration #7* for S.<sup>21</sup> For NR with 30 kHz subcarrier spacing (SCS), the corresponding frame structure is DDDSUUDD, where each letter in this case corresponds to a "slot" and where S is realised by *NR slot format #44 (6:4:4)*.<sup>22</sup> SCS values other than 30 kHz are allowed as long as the uplink (U), downlink (D) and guard period (G) times according to the frame structures are met.

#### Frame structure for synchronisation of NR-NR

Slot type	D														D														D														S														U													
NR Symbol #	0	1	2	3	4	5	6	7	8	9	10	11	12	13	0	1	2	3	4	5	6	7	8	9	10	11	12	13	0	1	2	3	4	5	6	7	8	9	10	11	12	13	0	1	2	3	4	5	6	7	8	9	10	11	12	13	0	1	2	3	4	5	6	7	8	9	10	11	12	13
NR Symbol type	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	G	G	U	U	U	U	U	U	U	U	U	U	U	U
Time	0-0,5 ms														0,5-1 ms														1-1,5 ms														1,5-2 ms														2-2,5 ms													

*NR slot format #32 (10:2:2)*

The proposed frame structure corresponds to NR DDDSU for 30 kHz subcarrier spacing (SCS), where each letter corresponds to a "slot" and where S is realised by *NR slot format #32 (10:2:2)*.<sup>23</sup> SCS values other than 30 kHz are allowed so long as the uplink (U), downlink (D) and guard period (G) times according to the frame structures are met.

<sup>20</sup> SCS, Subcarrier Spacing

<sup>21</sup> 3GPP TS 36.211 (Special subframe configuration, normal cyclic prefix; SCS 15 kHz)

<sup>22</sup> 3GPP TS 38.213 (Slot formats for normal cyclic prefix; SCS 30 kHz)

<sup>23</sup> 3GPP TS 38.213 (Slot formats for normal cyclic prefix; SCS 30 kHz)