ATIS 3GPP SPECIFICATION

ATIS.3GPP.36.762.V1600

3rd Generation Partnership Project;

Technical Specification Group Radio Access Network;

410 – 430 MHz Evolved Universal Terrestrial Radio Access (E-UTRA) Frequency Division Duplex (FDD) Band(s) for LTE Public Protection and Disaster Relief (PPDR) and Professional Mobile Radio (PMR) / Public Access Mobile Radio (PAMR) in Europe;

(Release 16**)**

Approved by

WTSC

Wireless Technologies and Systems Committee

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Contents

Foreword

This Technical Report has been produced by the 3rd Generation Partnership Project (3GPP).

The contents of the present document are subject to continuing work within the TSG and may change following formal TSG approval. Should the TSG modify the contents of the present document, it will be re-released by the TSG with an identifying change of release date and an increase in version number as follows:

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where:

- x the first digit:
  - 1 presented to TSG for information;
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- y the second digit is incremented for all changes of substance, i.e. technical enhancements, corrections, updates, etc.
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1 Scope

The present document is a technical report for the work item of 410 – 430 MHz E-UTRA FDD Band(s) for LTE PPDR and PMR/PAMR in Europe.

2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies. In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest version of that document *in the same Release as the present document*.

[1] 3GPP TR 21.905: "Vocabulary for 3GPP Specifications"

[2] RP-182898, “New WID on 410 – 430 MHz E-UTRA FDD Band(s) for LTE PPDR and PMR/PAMR in Europe”

[3] ECC Report 283, Compatibility and sharing studies related to the introduction of broadband and narrowband systems in the bands 410-430 MHz and 450-470 MHz

[4] ECC Decision (04)06, The availability of frequency bands for the introduction of Wide Band Digital Land Mobile PMR/PAMR in the 400 MHz and 800/900 MHz bands

[5] ECC Decision (16)02, Harmonised technical conditions and frequency bands for the implementation of Broadband Public Protection and Disaster Relief (BB-PPDR) systems, [amended xx yy 2019]

[6] ECC Decision (19)02, Land mobile systems in the frequency ranges 68-87.5 MHz, 146-174 MHz, 406.1-410 MHz, 410-430 MHz, 440-450 MHz, and 450-470 MHz

[7] 3GPP TR 36.101: "Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) radio transmission and reception"

[8] 3GPP TR 36.104: "Evolved Universal Terrestrial Radio Access (E-UTRA); Base Station (BS) radio transmission and reception"

3 Abbreviations

3.1 Abbreviations

For the purposes of the present document, the abbreviations given in 3GPP TR 21.905 [1] and the following apply. An abbreviation defined in the present document takes precedence over the definition of the same abbreviation, if any, in 3GPP TR 21.905 [1].

PAMR	Public Access Mobile Radio
PMR	Private Mobile Radio
PMSE	Programme Making and Special Events

4 Frequency band arrangements and regulatory background

4.1 Frequency allocations and compatibility studies

The ECC Report 283 [3] considers the compatibility and sharing studies related to the introduction of broadband and narrowband systems in the band 410-430 MHz and in adjacent bands. It is stated that the 400 MHz band is very complex – both in terms of which services already use the bands and on the density of usage by country.

ECC Decision (04)06 [4] decides that Wide Band Digital Land Mobile PMR/PAMR systems in this band shall be with 10 MHz duplex spacing between the transmit frequencies of mobile stations (410-420 MHz) and the transmit frequencies of base stations (420-430 MHz). The same duplex spacing applies to 450 MHz bands.

Figure 4.1-1: Illustrative mobile service allocations in the 400 MHz range: Simplex (SI) and paired Mobile station (MS) Base station (BS) use (from [3])

The band 406.1-410 MHz is allocated to fixed, mobile (except aeronautical) and radio astronomy services on a primary basis. Many countries in Europe have this band registered for radio astronomy service, and administrations are urged to take all practical steps to protect the service from harmful interference. The service involves only passive systems, which are very sensitive. To meet the needs of radio astronomy, there may be a need to limit the unwanted emission levels of the radio transmitters and their use in the vicinity of the radio astronomy observatories. The band is also used for many simplex PMR/PAMR services.

In the band 420-430 MHz there is a secondary allocation to radiolocation service in the majority of European countries, except for the UK where it is allocated on a primary basis. On 430-440 MHz, radiolocation has a primary allocation. 420-450 MHz is the tuning range of airborne and ground radars. This frequency range is harmonised for NATO ground, air and naval military radar systems.

The ECC Report 283 includes sharing studies with new LTE-based systems as aggressors and various other systems as victims, and concludes on required protection distances and unwanted emission masks. The compatibility is considered with narrowband PMR, digital television above 470 MHz, radars (radiolocation), radio astronomy, fixed links, PMSE, paging devices, and short range devices. The study results are used for basis of the regulatory decisions, which are outlined in section 4.2.

4.2 Relevant ECC Decisions

The technical conditions for operating broadband PPDR systems in the frequency range 410-430 MHz in Europe are listed in ECC Decision (16)02, which has been amended on [5]. The same Decision covers PPDR also for 700 MHz range and 450 MHz range. Regarding 410 MHz operation, the document lists the following new frequency bands:

> CEPT administrations wishing to introduce additional spectrum for BB-PPDR in parts of the 400 MHz range **shall apply** LRTC with channelling arrangements 1.4 MHz, 3 MHz or 5 MHz within the following paired frequency ranges:
>
> a) 450.5-456.0 MHz (uplink) / 460.5-466.0 MHz (downlink) those specified in Annex 2;
>
> b) 452.0-457.5 MHz (uplink) / 462.0-467.5 MHz (downlink) those specified in Annex 2;

c) 410.0-415.0 MHz (uplink) / 420.0-425.0 MHz (downlink) those specified in Annex 3;

d) 411.0-416.0 MHz (uplink) / 421.0-426.0 MHz (downlink) those specified in Annex 3;

e) 412.0-417.0 MHz (uplink) / 422.0-427.0 MHz (downlink) those specified in Annex 3.

Annex 3 of the Decision include the least restrictive technical conditions derived from ECC Report 283 [3] for both user equipment and base stations. Channel bandwidths of 1.4, 3, and 5 MHz are allowed.

The maximum mean in-block power for UE uplink transmissions is 23 dBm. Some administrations may allow up to 31 dBm for special deployment scenarios e.g. for fixed rural installations. Also the uplink maximum power may be limited to protect other services on a cell-by-cell basis. The UE maximum unwanted emission levels are the same as E-UTRA general spectrum emission mask (as in TS 36.101 [7]).

The base station conditions only specify unwanted emission levels to protect the UL band at 410-420 MHz with -43 dBm/100 kHz EIRP, and also the same level is required to be met at 1 MHz offset from the DL transmit band edge. Based on national requirements, additional 40 dB of unwanted emissions suppression may be needed to protect radiolocation services.

The technical conditions for operating land mobile systems in the 410-430 MHz range in Europe are covered in ECC Decision (19)02 [6]. The same frequency ranges are identified as for PPDR systems:

CEPT administrations wishing to introduce spectrum for land mobile systems with channel bandwidth of 1.25 MHz, 1.4 MHz, 3 MHz and 5 MHz in parts of the 400 MHz range shall apply technical conditions within the following paired frequency arrangements:

a) 410-415 MHz (uplink) / 420-425 MHz (downlink) those specified in Annex 2;

b) 411-416 MHz (uplink) / 421-426 MHz (downlink) those specified in Annex 2;

c) 412-417 MHz (uplink) / 422-427 MHz (downlink) those specified in Annex 2;

d) 451-456 MHz (uplink) / 461-466 MHz (downlink) those specified in Annex 3;

e) 452.5-457.5 MHz (uplink) / 462.5-467.5 MHz (downlink) those specified in Annex 3;

For land mobile, the least restrictive technical conditions in Annex 2 of the Decision allow the same 1.4, 3, and 5 MHz channels as the PPDR for E-UTRA, but additionally 1.25 MHz channels for CDMA systems.

The UE conditions for transmit power and unwanted emission mask are the same as for PPDR, including the provision for 31 dBm output power in special deployments. While the PPDR conditions do not include limits for spurious emissions, the land mobile conditions include limits that are the same as for E-UTRA in TS 36.101 [7] and TS 36.104 [8].

The base station conditions likewise are the same as for PPDR, except that additional unwanted emission requirements apply within 0 to 1 MHz offset from the band edge.

The following tables collect the regulatory requirements regarding in-block and out-of-block emission requirements for E-UTRA UE and BS.

Table 4.2-1: UE transmitter characteristics (from [5] and [6])

Parameter	Value
Channel bandwidth	1.25 MHz (CDMA) 1.4, 3, or 5 MHz (LTE)
Maximum mean in-block power	23 dBm (Note)
Note: administrations may use higher UE maximum mean in-block power for special deployment scenarios, e.g. fixed terminal stations in rural areas provided that protection of other services, networks and applications is not compromised. Vice-versa, the maximum mean in-block power of UEs for the protection of other services may be limited on a cell-by-cell basis.	

Table 4.2-2: UE maximum unwanted emission levels (from [5] and [6])

Frequency offset from channel edge (MHz)	Channel width			Measurement bandwidth
	1.4 MHz	3 MHz	5 MHz	
± 0-1	-10 dBm	-13 dBm	-15 dBm	30 kHz
± 1-2.5	-10 dBm	-10 dBm	-10 dBm	1 MHz
± 2.5-2.8	-25 dBm	-10 dBm	-10 dBm	1 MHz
± 2.8-5		-10 dBm	-10 dBm	1 MHz
± 5-6		-25 dBm	-13 dBm	1 MHz
± 6-10			-25 dBm	1 MHz

Table 4.2-3: BS in-block e.i.r.p (dBm/cell) (from [5] and [6])

Parameter	Value (dBm/cell)
Maximum in-block e.i.r.p.	56 (optionally: no limit for macro cells)

Table 4.2-4: BS frequency range of out-of-block emissions (OOBE) (from [5] and [6])

Frequency range	Maximum mean out-of-block e.i.r.p. (dBm/cell)	Measurement bandwidth
UL band 410-420 MHz	-43	100 kHz
0 MHz ≤ Δ f < 0.2 MHz offset from BS transmit band edge	-11 dBm (see note)	100 kHz
0.2 MHz ≤ Δ f < 1 MHz offset from BS transmit band edge	-26 dBm (see note)	100 kHz
1 MHz ≤ Δ f < 10 MHz offset from BS transmit band edge	-43 dBm (see note)	100 kHz
Note: additional 40 dB of out-of-block emission reduction may be needed on national level for the protection of radiolocation services.		

Requirements regarding transmitter unwanted emissions in the spurious domain follow the same limits that apply for E-UTRA UE and BS in Europe. For receivers, the requirements likewise follow 3GPP definitions.

5 Operating band, channel bandwidths, channel numbering

The core objectives of the WI stated the new operating bands to be standardized:

- Standardization of two new FDD E-UTRA bands within 410-415 MHz UL / 420-425 MHz DL range and 412-417 MHz UL / 422-427 MHz DL range

====== *Start of text extracted from TS 36.101* ======

5.5 Operating bands

New FDD E-UTRA bands will get operating band numbers from 65 – 256 range. NR has used numbers up to n86 thus 87 is the first available.

Table 5.5-1 E-UTRA operating bands

E-UTRA Operating Band	Uplink (UL) operating band BS receive UE transmit	Downlink (DL) operating band BS transmit UE receive	Duplex Mode
	F_{UL_low} – F_{UL_high}	F_{DL_low} – F_{DL_high}	
76	N/A	1427 MHz – 1432 MHz	FDD[2]
85	698 MHz – 716 MHz	728 MHz – 746 MHz	FDD
87	410 MHz – 415 MHz	420 MHz – 425 MHz	FDD
88	412 MHz – 417 MHz	422 MHz – 427 MHz	FDD
NOTE 1: Band 6, 23 is not applicable			

5.5E Operating bands for UE category 0, UE category M1 and M2 and UE category 1bis

UE category M1 and M2 are in the scope of the WI this those are added into the list of applicable M1/M2 bands.

UE category M1 and M2 is designed to operate in the E-UTRA operating bands 1, 2, 3, 4, 5, 7, 8, 11, 12, 13, 14, 18, 19, 20, 21, 25, 26, 27, 28, 31, 66, 71, 72, 73, 74, 85, 87 and 88 in both half duplex FDD mode and full-duplex FDD mode, and in bands 39, 40 and 41 in TDD mode. The E-UTRA bands are defined in Table 5.5-1.

5.5F Operating bands for category NB1 and NB2

UE category NB1 and NB2 are in the scope of the WI this those are added into the list of applicable NB1/NB2 bands.

Category NB1 and NB2 are designed to operate in the E-UTRA operating bands 1, 2, 3, 4, 5, 8, 11, 12, 13, 14, 17, 18, 19, 20, 21, 25, 26, 28, 31, 41, 66, 70, 71, 72, 73, 74, 85, 87 and 88 which are defined in Table 5.5-1. Category NB1 and NB2 systems operate in HD-FDD duplex mode or in TDD mode.

5.6 UE channel bandwidth

From the WID objectives we can determine the applicable channel bandwidths.

Table 5.6.1-1: E-UTRA channel bandwidth

E-UTRA band / Channel bandwidth						
E-UTRA Band	1.4 MHz	3 MHz	5 MHz	10 MHz	15 MHz	20 MHz
74	Yes	Yes	Yes	Yes[1]	Yes[1]	Yes[1]
85			Yes[1]	Yes[1]		
87	Yes	Yes[1]	Yes[1]			
88	Yes	Yes[1]	Yes[1]			
NOTE 1: [1] refers to the bandwidth for which a relaxation of the specified UE receiver sensitivity requirement (subclause 7.3) is allowed. ...						

5.7.3 Carrier frequency and EARFCN

EARFCN is specified as follows.

Table 5.7.3-1: E-UTRA channel numbers

E-UTRA Operating Band	Downlink			Uplink		
	F_{DL_low} (MHz)	$N_{Offs-DL}$	Range of N_{DL}	F_{UL_low} (MHz)	$N_{Offs-UL}$	Range of N_{UL}
85	728	70366	70366 - 70545	698	134002	134002 - 134181
87	420	70546	70546 - 70595	410	134182	134182 - 134231
88	422	70596	70596 - 70645	422	134231	134231 - 134280
NOTE 1: The channel numbers that designate carrier frequencies so close to the operating band edges that the carrier extends beyond the operating band edge shall not be used. This implies that the first 7, 15, 25, 50, 75 and 100 channel numbers at the lower operating band edge and the last 6, 14, 24, 49, 74 and 99 channel numbers at the upper operating band edge shall not be used for channel bandwidths of 1.4, 3, 5, 10, 15 and 20 MHz respectively.						
...						

5.7.4 TX–RX frequency separation

TX-RX separation is 10 MHz.

Table 5.7.4-1: Default UE TX-RX frequency separation

E-UTRA Operating Band	TX – RX carrier centre frequency separation
85	30 MHz
87	10 MHz
88	10 MHz
NOTE 1: Default TX-RX carrier centre frequency separation.	

====== *End of text extracted from TS 36.101* ======

6 Study of UE and BS requirements

6.1 UE requirements

Due to exactly same operating band arrangement with bands 31 and 72 i.e. uplink and downlink bandwidth of 5 MHz with a duplex-gap of 5 MHz and the fact that these new bands are also very close to bands 31 and 72 in terms of center frequency it is proposed to define the requirements based on the work done for bands 31 and 72 [2].

====== *Start of text extracted from TS 36.101* ======

6.2.2 UE maximum output power

This work-item is for PC1 and PC3. Tolerances are adopted from E-UTRA bands 31 and 72.

Table 6.2.2-1: UE Power Class

EUTRA band	Class 1 (dBm)	Tolerance (dB)	Class 2 (dBm)	Tolerance (dB)	Class 3 (dBm)	Tolerance (dB)	Class 4 (dBm)	Tolerance (dB)
85					23	±2[2]		
87	31	+2/-3			23	±2		
88	31	+2/-3			23	±2		
NOTE 1: Void ... NOTE 8: Generally, PC1 UE is not targeted for smartphone form factor.								

6.2.2E UE maximum output power for Category M1 and M2 UE

Bands 87 and 88 are added to M1 and M2 power class table.

Table 6.2.2E-1: UE Power Class

EUTRA band	Class 3 (dBm)	Tolerance (dB)	Class 5 (dBm)	Tolerance (dB)	Class 6 (dBm)	Tolerance (dB)
31	23	±2	20	±2	14	±2.5
72	23	±2	20	±2	14	±2.5
87	23	±2	20	±2	14	±2.5
88	23	±2	20	±2	14	±2.5
NOTE 1: Void ...						

6.2.2F UE maximum output power for category NB1 and NB2

Bands 87 and 88 are added to NB1 and NB2 power class table.

Table 6.2.2F-1: UE Power Class

EUTRA band	Class 3 (dBm)	Tolerance (dB)	Class 5 (dBm)	Tolerance (dB)	Class 6 (dBm)	Tolerance (dB)
31	23	±2	20	±2	14	±2.5
72	23	±2	20	±2	14	±2.5
87	23	±2	20	±2	14	±2.5
88	23	±2	20	±2	14	±2.5

6.2.4 UE maximum output power with additional requirements

No A-MPR is necessary.

6.6.3.2 Spurious emission band UE co-existence

UE to UE co-existence is specified as for band 72 with an exception that there is no harmonic impact to bands 3, 8 or 40. Band 87 has second harmonic for band 20.

Table 6.6.3.2-1: Requirements

E-UTRA Band	Spurious emission						
	Protected band	Frequency range (MHz)			Maximum Level (dBm)	MBW (MHz)	NOTE
72	E-UTRA Band 1, 7, 20, 22, 28, 31, 32, 33, 34, 38, 42, 43, 47, 52, 65, 68, [72]	F_{DL_low}	-	F_{DL_high}	-50	1	
	E-UTRA Band 3, 8, 40	F_{DL_low}	-	F_{DL_high}	-50	1	2
	Frequency range	470	-	694	-42	8	
87	E-UTRA Band 1, 3, 7, 8, 20, 22, 28, 31, 32, 33, 34, 38, 40, 42, 43, 47, 52, 65, 68, 72	F_{DL_low}	-	F_{DL_high}	-50	1	
	E-UTRA Band, 20	F_{DL_low}	-	F_{DL_high}	-50	1	2
	Frequency range	470	-	694	-42	8	
88	E-UTRA Band 1, 3, 7, 8, 20, 22, 28, 31, 32, 33, 34, 38, 40, 42, 43, 47, 52, 65, 68, 72	F_{DL_low}	-	F_{DL_high}	-50	1	
	Frequency range	470	-	694	-42	8	
NOTE 1: F_{DL_low} and F_{DL_high} refer to each E-UTRA frequency band specified in Table 5.5-1 ...							

6.6.3G Spurious emission for V2X Communication

Bands 87 and 88 are added as protected bands for applicable V2X con-current band Configurations.

Table 6.6.3G-0: Requirements for inter-band con-current V2X operation

V2X con-current band Configuration	Spurious emission						
	Protected band	Frequency range (MHz)			Maximum Level (dBm)	MBW (MHz)	NOTE
V2X_3A-47A	E-UTRA Band 1, 5, 7, 8, 26, 28, 34, 39, 40, 44, 45, 65, 87, 88	F_{DL_low}	-	F_{DL_high}	-50	1	
	E-UTRA Band 3	F_{DL_low}	-	F_{DL_high}	-50	1	3
	E-UTRA Band 22, 41, 42, 52	F_{DL_low}	-	F_{DL_high}	-50	1	2
	Frequency range	5925	-	5950	-30	1	7,8
	Frequency range	5815	-	5855	-30	1	7
V2X_7A-47A	E-UTRA Band 1, 3, 5, 7, 8, 22, 26, 28, 34, 39, 40, 41, 42, 44, 45, 52, 65, 87, 88	F_{DL_low}	-	F_{DL_high}	-50	1	
	Frequency range	2570	-	2575	+1.6	5	3, 6, 4
	Frequency range	2575	-	2595	-15.5	5	3, 6, 4
	Frequency range	2595	-	2620	-40	1	3, 6
	Frequency range	5925	-	5950	-30	1	7, 8
	Frequency range	5815	-	5855	-30	1	7
V2X_8A-47A	E-UTRA Band 1, 5, 26, 28, 34, 39, 40, 44, 45, 65, 87, 88	F_{DL_low}	-	F_{DL_high}	-50	1	
	E-UTRA Band 7, 22, 41, 42, 52	F_{DL_low}	-	F_{DL_high}	-50	1	2
	E-UTRA Band 3, 8	F_{DL_low}	-	F_{DL_high}	-50	1	2, 3
	Frequency range	5925	-	5950	-30	1	7, 8
	Frequency range	5815	-	5855	-30	1	7
V2X_20A-47A	E-UTRA Band 1, 3, 7, 8, 22, 31, 32, 33, 34, 40, 43, 65, 67, 87, 88	F_{DL_low}	-	F_{DL_high}	-50	1	
	E-UTRA Band 20	F_{DL_low}	-	F_{DL_high}	-50	1	3
	E-UTRA Band 38, 42, 52, 69	F_{DL_low}	-	F_{DL_high}	-50	1	2
	Frequency range	758	-	788	-50	1	
	Frequency range	5925	-	5950	-30	1	7, 8
	Frequency range	5815	-	5855	-30	1	7
V2X_28A-47A	E-UTRA Band 1, 22, 42, 43, 65, 87, 88	F_{DL_low}	-	F_{DL_high}	-50	1	2
	E-UTRA Band 1	F_{DL_low}	-	F_{DL_high}	-50	1	10, 11
	E-UTRA Band 3, 7, 8, 20, 31, 38, 40	F_{DL_low}	-	F_{DL_high}	-50	1	
	Frequency range	470	-	694	-42	8	3, 12
	Frequency range	470	-	710	-26.2	6	13
	Frequency range	662	-	694	-26.2	6	3
	Frequency range	758	-	773	-32	1	3
	Frequency range	773	-	803	-50	1	
	Frequency range	5925	-	5950	-30	1	7, 8
	Frequency range	5815	-	5855	-30	1	7
V2X_34A-47A	E-UTRA Band 1, 3, 5, 7, 8, 11, 18, 19, 20, 21, 22, 26, 28, 31, 32, 33, 34, 38,39, 40, 41, 42, 43, 44, 45, 52, 65, 67, 69, 87, 88	F_{DL_low}	-	F_{DL_high}	-50	1	9
	Frequency range	5925	-	5950	-30	1	7, 8
	Frequency range	5815	-	5855	-30	1	7

7.3 Reference sensitivity power level

Band 31 and 72 REFSENS is adopted.

Table 7.3.1-1: Reference sensitivity QPSK $P_{REFSENS}$

Channel bandwidth							
E-UTRA Band	1.4 MHz (dBm)	3 MHz (dBm)	5 MHz (dBm)	10 MHz (dBm)	15 MHz (dBm)	20 MHz (dBm)	Duplex Mode
31	-99.0	-95.7	-93.5				FDD
72	-99.0	-95.7	-93.5				FDD
87	-99.0	-95.7	-93.5				FDD
88	-99.0	-95.7	-93.5				FDD
NOTE 1: The transmitter shall be set to P_{UMAX} as defined in subclause 6.2.5							
...							

Table 7.3.1-2: Uplink configuration for reference sensitivity

E-UTRA Band / Channel bandwidth / N_{RB} / Duplex mode							
E-UTRA Band	1.4 MHz	3 MHz	5 MHz	10 MHz	15 MHz	20 MHz	Duplex Mode
31	6	5[4]	5[4]				FDD
72	6	5[4]	5[4]				FDD
31	6	5[4]	5[4]				FDD
72	6	5[4]	5[4]				FDD
NOTE 1: [1] refers to the UL resource blocks shall be located as close as possible to the downlink operating band but confined within the transmission bandwidth configuration for the channel bandwidth (Table 5.6-1).							
NOTE 2: For the UE which supports both Band 11 and Band 21 the uplink configuration for reference sensitivity is FFS.							
NOTE 3: [3] refers to Band 20; in the case of 15MHz channel bandwidth, the UL resource blocks shall be located at RB_{start} 11 and in the case of 20MHz channel bandwidth, the UL resource blocks shall be located at RB_{start} 16							
NOTE 4: [4] refers to Bands 31, 72, 73, 87 and 88; in the case of 3 MHz channel bandwidth, the UL resource blocks shall be located at RB_{start} 9 and in the case of 5 MHz channel bandwidth, the UL resource blocks shall be located at RB_{start} 10.							

7.3.1E Minimum requirements (QPSK) for UE category 0, M1, M2 and 1bis

Bands 87 and 88 are added to M1 and M2 REFSENS tables.

Table 7.3.1E-3: Reference sensitivity for FDD and TDD UE category M1 QPSK PREFSENS

E-UTRA Band	REFSENS (dBm)	Duplex Mode
31	-96.5	FDD
72	-96.5	FDD
87	-96.5	FDD
88	-96.5	FDD
NOTE 1: The transmitter shall be set to P_{UMAX} as defined in subclause 6.2.5		
...		

Table 7.3.1E-4: Reference sensitivity for HD-FDD UE category M1 QPSK $P_{REFSENS}$

E-UTRA Band	REFSENS (dBm)	Duplex Mode
31	-97.3	HD-FDD
72	-97.3	HD-FDD
87	-97.3	HD-FDD
88	-97.3	HD-FDD
NOTE 1: The transmitter shall be set to P_{UMAX} as defined in subclause 6.2.5 ...		

Table 7.3.1E-5: FDD and TDD UE category M1 Uplink configuration for reference sensitivity

E-UTRA Band	N_{RB}	Duplex Mode
31	6[1]	FDD and HD-FDD
72	6[1]	FDD and HD-FDD
87	6[1]	FDD and HD-FDD
88	6[1]	FDD and HD-FDD
NOTE 1: [1] refers to the UL resource blocks shall be located as close as possible to the downlink operating band but confined within the transmission bandwidth configuration for the channel bandwidth (Table 5.6-1).		

7.3.1F.1 Reference sensitivity for UE category NB1 and NB2

Bands 87 and 88 are added to NB1 and NB2 REFSENS table.

Table 7.3.1F.1-1: Reference sensitivity for UE category NB1 and NB2

Operating band	REFSENS [dBm]
1, 2, 3, 5, 8, 11, 12, 13, 14, 17, 18, 19, 20, 21, 25, 26, 28, 31, 41, 66, 70, 71, 72, 73, 74, 85, 87, 88	- 108.2

7.6.1 In-band blocking

Bands 87 and 88 are added to in-band blocking table.

Table 7.6.1.1-2: In-band blocking

E-UTRA band	Parameter	Unit	Case 1	Case 2	Case 3	Case 4	Case 5	Case 6
	$P_{Interferer}$	dBm	-56	-44	Void	Void	-38	-15
	$F_{Interferer}$ (offset)	MHz	=-BW/2 – $F_{loffset,case\ 1}$ & =+BW/2 + $F_{loffset,case\ 1}$	≤-BW/2 – $F_{loffset,case\ 2}$ & ≥+BW/2 + $F_{loffset,case\ 2}$			-BW/2 - 11	
1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 17, 18, 19, 20, 21, 22, 23, 25, 26, 27, 28, 31, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 48, 50, 51, 52, 65, 66, 68, 70, 72, 73, 74, 85, 87, 88	$F_{Interferer}$	MHz	(NOTE 2)	F_{DL_low} – 15 to F_{DL_high} + 15				
30	$F_{Interferer}$	MHz	(NOTE 2)	F_{DL_low} – 15 to F_{DL_high} + 15			F_{DL_low} – 11	
71	$F_{Interferer}$	MHz	(NOTE 2)	F_{DL_low} – 12 to F_{DL_high} + 15				$F_{DL\text{-}low}$ - 12
NOTE 1: For certain bands, the unwanted modulated interfering signal may not fall inside the UE receive band, but within the first 15 MHz below or above the UE receive band ...								

7.6.2 Out-of-band blocking

Bands 87 and 88 are added to Out-of-band blocking table.

Table 7.6.2.1-2: Out of band blocking

E-UTRA band	Parameter	Units	Frequency			
			Range 1	Range 2	Range 3	Range 4
	$P_{Interferer}$	dBm	-44	-30	-15	-15
1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 30, 31, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42 (NOTE 2), 43 (NOTE 2), 44, 45, 48 (NOTE 2), 50, 51, 52 (NOTE 6), 65, 66, 68, 70, 71, 72, 73, 74, 85, 87, 88	$F_{Interferer}$ (CW)	MHz	F_{DL_low} -15 to F_{DL_low} -60	F_{DL_low} -60 to F_{DL_low} -85	F_{DL_low} -85 to 1 MHz	-
			F_{DL_high} +15 to F_{DL_high} + 60	F_{DL_high} +60 to F_{DL_high} +85	F_{DL_high} +85 to +12750 MHz	-
2, 5, 12, 17, 85	$F_{Interferer}$	MHz	-	-	-	F_{UL_low} - F_{UL_high} (NOTE 5)
NOTE 1: For the UE which supports both Band 11 and Band 21 the out of blocking is FFS. ...						

====== End of text extracted from TS 36.101 ======

6.2 BS requirements

The following BS specific TS 36.104 [8] changes are expected due to introduction of Band 87 and 88:

====== *Start of text extracted from TS 36.104* ======

6.6.3.1 Minimum requirements for Wide Area BS (Category A)

For E-UTRA BS operating in Bands 5, 6, 8, 12, 13, 14, 17, 18, 19, 26, 27, 28, 29, 31, 44, 68, 71, 72, 73, 85, 87, 88 emissions shall not exceed the maximum levels specified in Tables 6.6.3.1-1 to 6.6.3.1-3.

6.6.3.2.1 Category B requirements (Option 1)

For E-UTRA BS operating in Bands 5, 8, 12, 13, 14, 17, 20, 26, 27, 28, 29, 31, 44, 68, 67, 71, 72, 73, 85, 87, 88 emissions shall not exceed the maximum levels specified in Tables 6.6.3.2.1-1 to 6.6.3.2.1-3:

6.6.4.3 Additional spurious emissions requirements

Table 6.6.4.3.1-1: BS Spurious emissions limits for E-UTRA BS for co-existence with systems operating in other frequency bands

System type for E-UTRA to co-exist with	Frequency range for co-existence requirement	Maximum Level	Measurement Bandwidth	Note
E-UTRA Band 87	420 - 425 MHz	-52 dBm	1 MHz	This requirement does not apply to E-UTRA BS operating in band 87 or 88.
	410 – 415 MHz	-49 dBm	1 MHz	This requirement does not apply to E-UTRA BS operating in band 87, since it is already covered by the requirement in sub-clause 6.6.4.2
E-UTRA Band 88	422 - 427 MHz	-52 dBm	1 MHz	This requirement does not apply to E-UTRA BS operating in band 87 or 88.
	412 - 417 MHz	-49 dBm	1 MHz	This requirement does not apply to E-UTRA BS operating in band 88, since it is already covered by the requirement in sub-clause 6.6.4.2. This requirement does not apply to E-UTRA BS operating in band 87.

6.6.4.4 Co-location with other base stations

Table 6.6.4.4.1-1: BS Spurious emissions limits for Wide Area BS co-located with another BS

Type of co-located BS	Frequency range for co-location requirement	Maximum Level	Measurement Bandwidth	Note
WA E-UTRA Band 87	410 - 415 MHz	-96 dBm	100 kHz	
WA E-UTRA Band 88	412 - 417 MHz	-96 dBm	100 kHz	

Table 6.6.4.4.1-2: BS Spurious emissions limits for Local Area BS co-located with another BS

Type of co-located BS	Frequency range for co-location requirement	Maximum Level	Measurement Bandwidth	Note
LA E-UTRA Band 87	410 - 415 MHz	-88 dBm	100 kHz	
LA E-UTRA Band 88	412 - 417 MHz	-88 dBm	100 kHz	

Table 6.6.4.4.1-3: BS Spurious emissions limits for Medium range BS co-located with another BS

Type of co-located BS	Frequency range for co-location requirement	Maximum Level	Measurement Bandwidth	Note
MR E-UTRA Band 87	410 - 415 MHz	-91 dBm	100 kHz	
MR E-UTRA Band 88	412 - 417 MHz	-91 dBm	100 kHz	

7.6.1.1 Minimum requirement

Table 7.6.1.1-1: Blocking performance requirement for Wide Area BS for E-UTRA

Operating Band	Centre Frequency of Interfering Signal [MHz]	Interfering Signal mean power [dBm]	Wanted Signal mean power [dBm]	Interfering signal centre frequency minimum frequency offset from the lower/upper Base Station RF Bandwidth edge or sub-block edge inside a sub-block gap [MHz]	Type of Interfering Signal
31, 72, 73, 74, 87, 88	(F_{UL_low} -20) to (F_{UL_high} +5)	-43	$P_{REFSENS}$ +6dB (Note 1)	See table 7.6.1.1-2	See table 7.6.1.1-2
	1 to (F_{UL_low} -20) (F_{UL_high} +5) to 12750	-15	$P_{REFSENS}$ +6dB (Note 1)	—	CW carrier

Table 7.6.1.1-1a: Blocking performance requirement for Local Area BS for E-UTRA

Operating Band	Centre Frequency of Interfering Signal [MHz]	Interfering Signal mean power [dBm]	Wanted Signal mean power [dBm]	Interfering signal centre frequency minimum frequency offset from the lower/upper Base Station RF Bandwidth edge or sub-block edge inside a sub-block gap [MHz]	Type of Interfering Signal
31, 72, 73, 74, 87, 88	(F_{UL_low} -20) to (F_{UL_high} +5)	-35	$P_{REFSENS}$ +6dB (Note 1)	See table 7.6.1.1-2	See table 7.6.1.1-2
	1 to (F_{UL_low} -20) (F_{UL_high} +5) to 12750	-15	$P_{REFSENS}$ +6dB (Note 1)	—	CW carrier

Table 7.6.1.1-1c: Blocking performance requirement for Medium Range BS for E-UTRA

Operating Band	Centre Frequency of Interfering Signal [MHz]	Interfering Signal mean power [dBm]	Wanted Signal mean power [dBm]	Interfering signal centre frequency minimum frequency offset to the lower/higher Base Station RF Bandwidth edge or sub-block edge inside a sub-block gap [MHz]	Type of Interfering Signal
31, 72, 73, 74, 87, 88	(F_{UL_low} -20) to (F_{UL_high} +5)	-38	$P_{REFSENS}$ +6dB (Note 1)	See table 7.6.1.1-2	See table 7.6.1.1-2
	1 to (F_{UL_low} -20) (F_{UL_high} +5) to 12750	-15	$P_{REFSENS}$ +6dB (Note 1)	—	CW carrier

Table 7.6.1.1-3: Blocking performance requirement for Wide Area BS for NB-IoT standalone operation

Operating Band	Centre Frequency of Interfering Signal [MHz]	Interfering Signal mean power [dBm]	Wanted Signal mean power [dBm]	Interfering signal centre frequency minimum frequency offset from the lower/upper Base Station RF Bandwidth edge or sub-block edge inside a sub-block gap [MHz]	Type of Interfering Signal
31, 72, 73, 74, 87, 88	(F_{UL_low} -20) to (F_{UL_high} +5)	-43	$P_{REFSENS}$ +6dB (Note 1)	See table 7.6.1.1-4	See table 7.6.1.1-4
	1 to (F_{UL_low} -20) (F_{UL_high} +5) to 12750	-15 (Note 2)	$P_{REFSENS}$ +6dB (Note 1)	—	CW carrier

Table 7.6.1.1-3a: Blocking performance requirement for Local Area BS for NB-IoT standalone operation

Operating Band	Centre Frequency of Interfering Signal [MHz]	Interfering Signal mean power [dBm]	Wanted Signal mean power [dBm]	Interfering signal centre frequency minimum frequency offset from the lower/upper Base Station RF Bandwidth edge or sub-block edge inside a sub-block gap [MHz]	Type of Interfering Signal
31, 72, 74, 87, 88	(F_{UL_low} -20) to (F_{UL_high} +5)	-35	$P_{REFSENS}$ +6dB (Note 2)	See table 7.6.1.1-4	See table 7.6.1.1-4
	1 to (F_{UL_low} -20) (F_{UL_high} +5) to 12750	-15 (Note 2)	$P_{REFSENS}$ +6dB (Note 2)	—	CW carrier

Table 7.6.1.1-3c: Blocking performance requirement for Medium Range BS for NB-IoT standalone operation

Operating Band	Centre Frequency of Interfering Signal [MHz]	Interfering Signal mean power [dBm]	Wanted Signal mean power [dBm]	Interfering signal centre frequency minimum frequency offset from the lower/upper Base Station RF Bandwidth edge or sub-block edge inside a sub-block gap [MHz]	Type of Interfering Signal
31, 72, 74, 87, 88	(F_{UL_low} -20) to (F_{UL_high} +5)	-38	$P_{REFSENS}$ +6dB (Note 1)	See table 7.6.1.1-4	See table 7.6.1.1-4
	1 to (F_{UL_low} -20) (F_{UL_high} +5) to 12750	-15 (Note 2)	$P_{REFSENS}$ +6dB (Note 1)	—	CW carrier

Table 7.6.1.1-5: Blocking performance requirement for Wide Area BS for E-UTRA with NB-IoT in-band/guard band operation

Operating Band	Centre Frequency of Interfering Signal [MHz]	Interfering Signal mean power [dBm]	Wanted Signal mean power [dBm]	Interfering signal centre frequency minimum frequency offset from the lower/upper Base Station RF Bandwidth edge or sub-block edge inside a sub-block gap [MHz]	Type of Interfering Signal
31, 72, 73, 74, 87, 88	(F_{UL_low} -20) to (F_{UL_high} +5)	-43	$P_{REFSENS}$ +6dB (Note 1)	See table 7.6.1.1-6	See table 7.6.1.1-6
	1 to (F_{UL_low} -20) (F_{UL_high} +5) to 12750	-15 (Note 3)	$P_{REFSENS}$ +6dB (Note 1)	—	CW carrier

Table 7.6.1.1-5a: Blocking performance requirement for Local Area BS for E-UTRA with NB-IoT in-band/guard band operation

Operating Band	Centre Frequency of Interfering Signal [MHz]	Interfering Signal mean power [dBm]	Wanted Signal mean power [dBm]	Interfering signal centre frequency minimum frequency offset from the lower/upper Base Station RF Bandwidth edge or sub-block edge inside a sub-block gap [MHz]	Type of Interfering Signal
31, 72, 74, 87, 88	(F_{UL_low} -20) to (F_{UL_high} +5)	-35	$P_{REFSENS}$ +6dB (Note 1)	See table 7.6.1.1-6	See table 7.6.1.1-6
	1 to (F_{UL_low} -20) (F_{UL_high} +5) to 12750	-15 (Note 3)	$P_{REFSENS}$ +6dB (Note 1)	—	CW carrier

Table 7.6.1.1-5c: Blocking performance requirement for Medium Range BS for E-UTRA with NB-IoT in-band/guard band operation

Operating Band	Centre Frequency of Interfering Signal [MHz]	Interfering Signal mean power [dBm]	Wanted Signal mean power [dBm]	Interfering signal centre frequency minimum frequency offset from the lower/upper Base Station RF Bandwidth edge or sub-block edge inside a sub-block gap [MHz]	Type of Interfering Signal
31, 72, 74, 87, 88	(F_{UL_low} -20) to (F_{UL_high} +5)	-38	$P_{REFSENS}$ +6dB (Note 1)	See table 7.6.1.1-6	See table 7.6.1.1-6
	1 to (F_{UL_low} -20) (F_{UL_high} +5) to 12750	-15 (Note 3)	$P_{REFSENS}$ +6dB (Note 1)	—	CW carrier

7.6.2 Co-location with other base stations

Table 7.6.2.1-1: Blocking performance requirement for E-UTRA and NB-IoT Wide Area BS when co-located with BS in other frequency bands.

Co-located BS type	Centre Frequency of Interfering Signal (MHz)	Interfering Signal mean power (dBm)	Wanted Signal mean power (dBm)	Type of Interfering Signal
WA E-UTRA Band 87	420 – 425	+16**	$P_{REFSENS}$ + 6dB*	CW carrier
WA E-UTRA Band 88	422 – 427	+16**	$P_{REFSENS}$ + 6dB*	CW carrier

Table 7.6.2.1-2: Blocking performance requirement for E-UTRA and NB-IoT Local Area BS when co-located with BS in other frequency bands.

Co-located BS type	Centre Frequency of Interfering Signal (MHz)	Interfering Signal mean power (dBm)	Wanted Signal mean power (dBm)	Type of Interfering Signal
LA E-UTRA Band 87	420 – 425	-6**	$P_{REFSENS}$ + 6dB*	CW carrier
LA E-UTRA Band 88	422 – 427	-6**	$P_{REFSENS}$ + 6dB*	CW carrier

Table 7.6.2.1-3: Blocking performance requirement for E-UTRA and NB-IoT Medium Range BS when co-located with BS in other frequency bands.

Co-located BS type	Centre Frequency of Interfering Signal (MHz)	Interfering Signal mean power (dBm)	Wanted Signal mean power (dBm)	Type of Interfering Signal
MR E-UTRA Band 87	420 – 425	+8**	$P_{REFSENS}$ + 6dB*	CW carrier
MR E-UTRA Band 88	422 – 427	+8**	$P_{REFSENS}$ + 6dB*	CW carrier

====== End of text extracted from TS 36.104 ======

Annex A:
Change history

Change history							
Date	**Meeting**	**TDoc**	**CR**	**Rev**	**Cat**	**Subject/Comment**	**New version**
2019-02	RAN4#90	R4-1900058				TR skeleton for TR 36.762	0.0.1
2019-04	RAN4#90-Bis	R4-1903531				Approved TPs from RAN4#90 captured R4-1900060 TP to TR 36.762: Regulatory background for LTE 410 - 430 MHz WI R4-1900059 TP to TR 36.762: Analysis on UE requirements for LTE 410 – 430 MHz R4-1900403 TP to TR 36.762: BS requirements	0.1.0
2019-06	RAN#84					3GPP TR 36.762 V1.0.0 is submitted for 1 step approval	1.0.0
2019-06	RAN#84	RP-191288				Approved by plenary – Rel-16 spec under change control	16.0.0