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Technical Report

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UMTS 2.6 GHz (FDD) Work Item Technical Report;
(Release 7)**



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Postal address

3GPP support office address

650 Route des Lucioles - Sophia Antipolis
Valbonne - FRANCE
Tel.: +33 4 92 94 42 00 Fax: +33 4 93 65 47 16

Internet

<http://www.3gpp.org>

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Foreword

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

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1 Scope

This document is the technical report of the UMTS 2.6 GHz WI which was approved in TSG RAN meeting #26 [1].

The purpose of this TR is to summarize a study of radio requirements UTRA FDD in the 2.6 GHz Band:

- 2500 – 2570 MHz: Up-link (UE transmit, Node B receive)
- 2620 – 2690 MHz: Down-link (Node B transmit, UE receive)

The co-existence with IMT2000 technology within 2500 – 2690 MHz is considered.

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] RP-040397, "UMTS 2.6 GHz WI sheet update"
- [2] RP-040394, ECC PT1, CEPT bandplan for IMT-2000 in the 2500-2690 MHz band, Reg TP/221-5, 15 September 2004
- [3] 3GPP TR 25.889 V6.0.0 (2003-06), Feasibility Study considering the viable deployment of UTRA in additional and diverse spectrum arrangements
- [4] ECC REPORT 45, SHARING AND ADJACENT BAND COMPATIBILITY BETWEEN UMTS/IMT-2000 IN THE BAND 2500-2690 MHZ AND OTHER SERVICES
- [5] ETSI EN 301 908-1: "Harmonized EN for IMT-2000, introduction and common requirements, covering essential requirements of article 3.2 of the R&TTE Directive"
- [6] ETSI EN 301 908-2: "Harmonized EN for IMT-2000, CDMA Direct Spread (UTRA FDD) (UE) covering essential requirements of article 3.2 of the R&TTE Directive"
- [7] ETSI EN 301 908-3: "Harmonized EN for IMT-2000, CDMA Direct Spread (UTRA FDD) (BS) covering essential requirements of article 3.2 of the R&TTE Directive"
- [8] ETSI EN 301 908-4: "Harmonized EN for IMT-2000, CDMA Multi-Carrier (cdma2000) (UE) covering essential requirements of article 3.2 of the R&TTE Directive"
- [9] ETSI EN 301 908-5: "Harmonized EN for IMT-2000, CDMA Multi-Carrier (cdma2000) (BS and Repeaters) covering essential requirements of article 3.2 of the R&TTE Directive"
- [10] REPORT ITU-R M.2030, "Coexistence between IMT-2000 time division duplex and frequency division duplex terrestrial radio interface technologies around 2 600 MHz operating in adjacent bands and in the same geographical area"
- [11] FCC 04-135 (FCC Report and Order and further notice of proposed rulemaking, released July 29, 2004)

3 Definitions, symbols and abbreviations

3.1 Definitions

Void

3.2 Symbols

Void

3.3 Abbreviations

For the purposes of the present document, the following abbreviations apply:

WCDMA	Wideband Code Division Multiple Access, a type of cellular system meeting ITU-2000 requirement
UMTS	Universal Mobile Telecommunications System, often used synonymously with WCDMA
GSM	Mobile cellular system (throughout this document, this acronym is generally to also mean the services GPRS and EDGE, both enhancements to GSM, unless not applicable to the discussion.)
UE	User Equipment, also cellular terminal
BS	Cellular system base station
DL	Downlink, the RF path from BS to UE
ACIR	Adjacent Channel Interference Rejection
TX	Transmitter
RX	Receiver

4 CEPT bandplan for IMT-2000 in the 2500-2690 MHz band

At its 15th meeting in September 2004, ECC PT1 completed work on the draft ECC Decision on the harmonised utilisation of spectrum for IMT-2000/UMTS operating within the band 2500 – 2690 MHz [2]. The key features of the draft ECC Decision, relevant to the development of technical specifications are as follows [2]:

- 1) That the frequency band 2500 – 2690 MHz is designated for terrestrial IMT-2000/UMTS systems.
- 2) The frequency band 2500 – 2570 MHz is paired with 2620 – 2690 MHz for FDD operation with the mobile transmit within the lower band and base transmit within the upper band.
- 3) Administrations may assign the frequency band 2570 – 2620 MHz either for TDD or for FDD downlink (external). Any guard bands required to ensure adjacent band compatibility at 2570 MHz and 2620 MHz boundaries will be decided on a national basis and taken within the band 2570 – 2620 MHz.
- 4) Assigned blocks shall be in multiple of 5.0 MHz.
- 5) The upper and lower frequency edges of FDD uplink and downlink blocks are specified in Annex 2 of [2]
- 6) For 5 MHz UTRA FDD, the block edge frequency is defined with an offset of 2.5 MHz from the nearest carrier center frequency
- 7) For other IMT-2000 radio interfaces, the block edge is to be defined on a case by case basis depending on receiver and transmitter characteristics of the radio interface in adjacent channels

Furthermore it was considered in [2] that:

- a) ECC Report 45 addresses sharing and adjacent band compatibility studies between IMT-2000/UMTS in the band 2500 – 2690 MHz and other services;

- b) co-ordination may be required on a national basis to protect the Radioastronomy Service (see RR.4.6, RR.5.30, RR.5.149, RR5.340)

This ECC draft Decision is expected to be finally approved by ECC in March 2005, following a period for public comments [2].

This WI is based on the above draft ECC decision. It should be noted that there exist a FCC Report and Order and further notice of proposed rulemaking [11] regarding the usage of the 2.6 GHz band within the US. Further study may be required in future to address other regional issues.

5 Study of the RF requirements

5.1 Reusability of existing 1.9 ... 2.1 GHz simulation results and RF requirements

Some of the Band I RF requirements have been determined by system simulations assuming the 2 GHz propagation models of TR 25.942. In [3] the path loss difference between 2.5 and 2.1 GHz was estimated to be 2.57 dB assuming a $10 \cdot \log_{10}(f^{3.39})$ dependency. However, some of this loss may be compensated by higher antenna gains across the 2.6 GHz band which is highly desirable from the UL coverage perspective. Assuming the same physical size for the BS antennas, antenna gains in 2.5 GHz are expected to be by 1.5 dB larger (scaling with $10 \cdot \log_{10}(f^2)$). Hence, the overall coupling loss differences between the bands may be only in the order of 1 dB or less. Simulation results obtained for 2.1 GHz can therefore assumed to be essentially valid for the 2.6 GHz band as well. It is proposed, that whenever applicable, numerical values of the Band I RF requirements (e.g. ACLR/ACS) are re-used for UMTS2600 as well.

As for receiver demodulation performance in multipath fading channels, it is proposed to apply the technique of velocity scaling as currently used in TS 25.101, 25.104 for the Band-specific definition of the Multi-path fading propagation conditions as well for UMTS2600.

5.2 Channel Raster

According to [2], the block edge frequency is defined with an offset of 2.5 MHz from the nearest carrier center frequency. In addition to the fundamental 200 kHz channel raster, this would indicate the need for 14 additional “odd” channels (and UARFCNs) for each, the UL and DL portion of the 2.6 GHz paired band.

5.3 Co-existence with other IMT-2000 systems within the 2.6 GHz bands

CEPT has been mandated to develop channeling arrangements for the band 2500-2690 MHz taking into account the following issues (refer to [2]):

- 1) The desirability to take utmost account of making regulation technologically neutral, and
- 2) Efficient and harmonised use of spectrum

The primary issue to be considered here, is the co-existence of IMT-2000 FDD systems (i.e. UMTS and cdma2000), operating within 2500 – 2570 / 2620 – 2690 MHz with either FDD DL ext or TDD operating within 2570 – 2620 MHz.

In light of aspect 1., technologically neutral spurious emission requirements for IMT-2000 FDD BS and UE transmitters to protect the 2570 – 2620 MHz would be desirable. However, CEPT PT1 is not expected to develop or mandate any such “generic” spurious emission limits for IMT-2000 FDD transmitters operating within the 2.6 GHz band.

As for the co-existence of IMT-2000 FDD systems with TDD within the 2 GHz bands there exists a harmonized EN for IMT-2000 (refer to [5,6,7,8,9]), covering essential RF requirements related to article 3.2 of the R&TTE Directive. Even though many of these IMT-2000 FDD RF requirements follow their respective 3GPP / 3GPP2 specifications, there do exist examples for technologically neutral other-band protection limits: for both, UMTS and cdma2000 BS transmitters, a common spurious emission limit of -52 dBm/MHz across the 2 GHz TDD bands is mandated.

5.3.1 Co-existence with IMT-2000 / FDD DL ext (within 2570 – 2620 MHz)

The potential for interference has been recognised in [3] and needs to be separately addressed for the UE and BS.

5.3.2 Co-existence with IMT-2000 / TDD (within 2570 – 2620 MHz)

The potential for interference has been recognised in the ITU-R Report M.2030 and needs to be separately addressed for the UE and BS.

5.3.3 Co-existence with cdma2000 (within 2500 – 2570 MHz / 2620 – 2690 MHz)

Similar to Band I, the frequency band 2500 – 2690 MHz is designated for IMT-2000/UMTS systems within CEPT countries and hence NB blocking/IMD requirements are not required. The essential UTRA RF requirements of the harmonized EN for IMT-2000 ([6,7]) are a subset of the corresponding Band I RF requirements and this has been assumed as sufficient for ensuring co-existence of UMTS with cdma2000 within the 2 GHz bands. The same is foreseen also for the 2.6 GHz band.

For UMTS850/1900/1700+2100/1800 NB blocking/IMD requirements have been adopted in order to support co-existence with NB systems such as GSM. Also for most of these bands (but not Band I) co-existence of UTRA FDD and cdma2000 has been studied by means of system simulations. Based on similar reasoning as in 5.1, it is assumed that these simulation results are also valid for the 2.6 GHz band. It should be noted that the simulations results most critical¹ to UTRA/cdma2000 co-existence, did not rely on fulfilment of the NB blocking/IMD requirements.

Hence, no additional RF requirements are foreseen for UMTS2600 in order to support co-existence with cdma2000.

5.4 Co-existence with adjacent services

ECC REPORT 45 [4] has studied compatibility of IMT-2000 FDD with adjacent services:

- a) MSS in 2500 – 2520 / 2670 – 2690 MHz
- b) Radio Astronomy Services in 2690-2700 MHz
- c) MMDS within the 2.6 GHz band

Case a. is no longer relevant, as the whole frequency band 2500 – 2690 MHz is designated for terrestrial IMT-2000/UMTS systems.

As to case b., [1] noted that co-ordination might be required on a national basis to protect the Radioastronomy Service. The number of radio astronomy stations in Europe, operating in this frequency band, is about 10. This may result in exclusion zones around the RA sites, where any IMT-2000 emissions are forbidden.

Case c. is specific to a few European countries, which use MMDS. Co-ordination to control co- and adjacent channel interference with IMT-2000 may be required in some geographical areas; this will be done on a national basis.

Based on this, no general additional requirements to protect adjacent services are foreseen for UMTS2600.

¹ Interference from [UTRA, cdma2000]UE -> [cdma2000, UTRA] BS

5.5 Specific Node B requirements for UMTS2600

5.5.1 Proposed Transmitter Characteristics to support co-existence with IMT-2000 within 2570 – 2620 MHz

5.5.1.1 Requirements to support co-existence with IMT-2000 FDD DL external

As noted in [3], this case will not pose any particular interference problems. The range of applicability of the “in-band” transmitter requirements for spectrum emission mask, ACLR and spurious emissions could even be extended from the 2620 – 2690 MHz TX band of the ‘FDD internal’ to a common ‘FDD internal + external’ TX band ranging from 2570+x ... 2690 MHz. This would support a single set of transmitter requirements applicable for both, a ‘FDD internal’ and ‘FDD external’ BS, facilitating BS equipment supporting both FDD modes.

5.5.1.2 Requirements to support co-existence with IMT-2000 TDD BS receivers within 2570 – 2620 MHz

This case has a potential for interference and additional FDD transmitter requirements should be considered. The relevant interference mechanisms are the adjacent channel leakage power and spurious emissions from the FDD BS interfering with the TDD BS UL below the 2620 MHz boundary. The corresponding interference mechanisms due to TDD BS ACS/blocking have been identified as relevant, however, these are not considered further in this TR.

ITU-R report M.2030 has studied several scenarios related to this interference case and noted the potential problems from the basic fact when FDD BS DL transmitters are geographically and spectrally close to TDD BS UL receivers. The study assumed some of the minimum performance requirements for FDD transmitter and TDD receiver characteristics as defined for Band I. For several scenarios (e.g. macro -> macro) large values for the required isolation and/or separation distances were obtained in order to obtain low interference conditions. But some scenarios (e.g. macro -> micro, pico) showed lower separation distances and/or did not require additional isolation. Among the various solution proposals for reducing BS-BS interference, higher performance filters (compared to Band I) at both FDD transmitter and TDD receiver side were mentioned.

This last aspect will be taken up in the following and a proposal for UMTS2600 FDD BS transmitter characteristics to support co-existence with TDD within 2570 – 2620 MHz will be presented.

5.5.1.3 Proposal for Transmitter Characteristics to support co-existence with IMT-2000 within 2570 – 2620 MHz

The feasibility of tighter UMTS2600 FDD BS transmit filtering was already studied in [3], Section 7.4.4.1. for the interference case of ACLR and spurious emissions from the TX of a Node B of a “FDD external” system falling into the RX band of a Node B of a “FDD internal” system – this is comparable to the FDD/TDD interference case considered here.

It was noted, that from the perspective of achieving a cost of UMTS2600 Node comparable to that of equipment for Band I/II, it is desirable that re-use of existing RF modules and designs related to the UMTS2100/1900 standards is maximised and that the duplex filtering requirements can be met with comparable assumptions about size / complexity / performance and filtering technology. An estimate of required additional TX filtering for Node B of the “FDD external” system was provided for a 30 dB co-location scenario and it was concluded that with 20 MHz carrier separation the required filter attenuation could be achieved at a cost and complexity comparable to that of a Band I/II Node B.

Hence, 20 MHz carrier separation can be considered as an appropriate starting point for defining the FDD TX requirements regarding co-existence with TDD.

When defining the UMTS2600 FDD transmitter characteristics, the following aspects need to be considered:

- 1) Regarding potential TDD victim BS carriers, their highest potential carrier centre frequency location below 2620 MHz is dependent upon national regulatory bodies. It is assumed here, that appropriate blocking requirements, including those for co-location with FDD BS, will be defined and are not the limiting case when compared with the corresponding FDD requirements. Also only the 3.84 Mcps TDD option is considered here. However, these aspects may need to be re-checked as the TDD2600 work progresses.

- 2) It is recognized that there exists a trade-off between FDD BS equipment cost and isolation requirements for protection of TDD below the 2620 MHz boundary. It is desirable that the use of the 2570-2620 MHz band can be maximised. However, general transmitter requirements should enable also the licensee just above the 2620 MHz boundary to obtain FDD equipment with similar cost, performance and availability as the other licensees in the 2.6 GHz FDD band.
- 3) Cost, size and performance aspects (such as IL and GDD) of the TX filter of the UMTS2600 BS are of concern. With 2x70 MHz of available spectrum, the assigned blocks per-licensee could be 20 MHz wide. Even when subband filtering is considered, support of these passband widths (together with other performance criteria) is likely to constrain the practically achievable TX filter attenuation below the 2620 MHz boundary.

Keeping these aspects in mind, the following transmitter characteristics are proposed:

5.5.1.3.1 Spectrum emission mask and ACLR requirements as for Band I

It is proposed to use the spectrum emission mask as specified for Band I.

It is proposed to use the general ACLR requirements as specified for Band I:

6.6.2.2 Adjacent Channel Leakage power Ratio (ACLR)

Adjacent Channel Leakage power Ratio (ACLR) is the ratio of the RRC filtered mean power centered on the assigned channel frequency to the RRC filtered mean power centered on an adjacent channel frequency.

6.6.2.2.1 Minimum requirement

The ACLR shall be higher than the value specified in Table 6.7.

Table 6.7: BS ACLR

BS adjacent channel offset below the first or above the last carrier frequency used	ACLR limit
5 MHz	45 dB
10 MHz	50 dB

5.5.1.3.2 Spurious emissions

Add a spurious emission requirement, which may be applied for the protection of bands adjacent to the 2620 – 2690 MHz portion of the 2.6 GHz band in geographic areas in which both an adjacent band service and UTRA FDD are deployed.

This requirement would look as follows:

6.6.3.6 Co-existence with services in adjacent frequency bands

This requirement may be applied for the protection in bands adjacent to bands I, II, or III or VII, as defined in clause 5.2 in geographic areas in which both an adjacent band service and UTRA FDD are deployed.

6.6.3.6.1 Minimum requirement

The power of any spurious emission shall not exceed:

Table 6.16: BS spurious emissions limits for protection of adjacent band services

Operating Band	Band	Maximum Level	Measurement Bandwidth	Note
I	2100-2105 MHz	$-30 + 3.4 \cdot (f - 2100 \text{ MHz}) \text{ dBm}$	1 MHz	
	2175-2180 MHz	$-30 + 3.4 \cdot (2180 \text{ MHz} - f) \text{ dBm}$	1 MHz	
II	1920-1925 MHz	$-30 + 3.4 \cdot (f - 1920 \text{ MHz}) \text{ dBm}$	1 MHz	
	1995-2000 MHz	$-30 + 3.4 \cdot (2000 \text{ MHz} - f) \text{ dBm}$	1 MHz	
III	1795-1800 MHz	$-30 + 3.4 \cdot (f - 1795 \text{ MHz}) \text{ dBm}$	1 MHz	
	1885-1890 MHz	$-30 + 3.4 \cdot (1890 \text{ MHz} - f) \text{ dBm}$	1 MHz	
VII	2610-2615 MHz	$-30 + 3.4 \cdot (f - 2610 \text{ MHz}) \text{ dBm}$	1 MHz	
	2695-2700 MHz	$-30 + 3.4 \cdot (2700 \text{ MHz} - f) \text{ dBm}$	1 MHz	

Add Category B spurious emission limits for the 2620 – 2690 MHz portion of the 2.6 GHz band.

This requirement would look as follows:

Table 6.9E: BS Mandatory spurious emissions limits, operating band VII, Category B

Band	Maximum Level	Measurement Bandwidth	Note
9kHz ↔ 150kHz	-36 dBm	1 kHz	Note 1
150kHz ↔ 30MHz	-36 dBm	10 kHz	Note 1
30MHz ↔ 1GHz	-36 dBm	100 kHz	Note 1
1GHz ↔ Fc1 - 60 MHz or 2610 MHz whichever is the higher	-30 dBm	1 MHz	Note 1
Fc1 - 60 MHz or 2610 MHz whichever is the higher ↔ Fc1 - 50 MHz or 2610 MHz whichever is the higher	-25 dBm	1 MHz	Note 2
Fc1 - 50 MHz or 2610 MHz whichever is the higher ↔ Fc2 + 50 MHz or 2700 MHz whichever is the lower	-15 dBm	1 MHz	Note 2
Fc2 + 50 MHz or 2700 MHz whichever is the lower ↔ Fc2 + 60 MHz or 2700 MHz whichever is the lower	-25 dBm	1 MHz	Note 2
Fc2 + 60 MHz or 2700 MHz whichever is the lower ↔ 12.75 GHz	-30 dBm	1 MHz	Note 3
NOTE 1: Bandwidth as in ITU-R SM.329[1], s4.1			
NOTE 2: Specification in accordance with ITU-R SM.329[1], s4.3 and Annex 7			
NOTE 3: Bandwidth as in ITU-R SM.329[1], s4.1. Upper frequency as in ITU-R SM.329[1], s2.5 table 1			

Add a spurious emission requirement, which may be applied to geographic areas in which both UTRA-TDD and UTRA-FDD are deployed

UTRA FDD, cdma2000 and GSM BS specifications have adopted a common spurious emission limit of -52dBm/MHz for protection of UE receivers operating within the 2 GHz TDD bands in the same geographical area. It has also been adopted as harmonized EN for IMT-2000 BS (refer to [5,7,9]). Hence, this limit can be viewed as a harmonized and technologically neutral 2 GHz TDD band protection limit within the CEPT area and could therefore be taken as a starting point for discussing appropriate limits for protecting potential IMT-2000 TDD UE receivers within 2570 – 2620 MHz.

It should also be noted that the level of -52 dBm/MHz is actually by 7 dB lower, than the corresponding 2 GHz TDD (3.84 Mcps option) BS spurious emissions limits of -39 dBm/3.84 MHz for operation in same geographic area with unsynchronised TDD. Hence, assuming current 2 GHz TDD specifications also for TDD2600, the FDD BS would protect the TDD UE better than the TDD BS does. Hence, a relaxation of the -52 dBm/MHz limit could be considered for the UMTS2600 FDD BS.

Add a spurious emission requirement for BS co-located with UTRA-TDD

As a practical alignment with the previous requirement for “co-existence with TDD in the same geographical area”, it is proposed here that the co-location requirements cover the same frequency range. The protection levels for Wide Area and Local Area BS should be -86 dBm and -55 dBm respectively, the same values as in the other TDD bands 1900-1920 MHz and 2010 – 2025 MHz.

It is expected that the TX filter complexity will need to be increased again (relative to the previous requirement (-52 dBm level) in order to meet this requirement.

This requirement would look as follows:

6.6.3.7.2 Co-located base stations

This requirement may be applied for the protection of UTRA-TDD BS receivers when UTRA-TDD BS and UTRA FDD BS are co-located.

6.6.3.7.2.1 Minimum Requirement

The power of any spurious emission shall not exceed:

Table 6.18: BS Spurious emissions limits for BS co-located with UTRA-TDD

BS class	Band	Maximum Level	Measurement Bandwidth	Note
Wide Area BS	1900 - 1920 MHz	-86 dBm	1 MHz	
Local Area BS	1900 - 1920 MHz	-55 dBm	1 MHz	
Wide Area BS	2010 - 2025 MHz	-86 dBm	1 MHz	
Local Area BS	2010 - 2025 MHz	-55 dBm	1 MHz	
Wide Area BS	2570 – 2610 MHz	-86 dBm	1 MHz	
Local Area BS	2570 – 2610 MHz	-55 dBm	1 MHz	

These values assume a 30 dB coupling loss between transmitter and receiver. If BSs of different classes are co-sited, the coupling loss must be increased by the difference between the corresponding values from the table above.

Add a spurious emission requirement, which shall be applied in order to prevent the receivers of the BSs being desensitised by emissions from a BS transmitter.

This requirement would look as follows:

6.6.3.4 Co-existence with co-located and co-sited base stations

These requirements may be applied for the protection of other BS receivers when GSM900, DCS1800, PCS1900, GSM850 and/or FDD BS operating in Bands I to VII are co-located with a UTRA FDD BS.

The requirements in this chapter assume a 30 dB coupling loss between transmitter and receiver. If BSs of different classes are co-sited, the coupling loss should be increased by the value as stated in TR 25.942 [4] chapter 10.3 in Table 10.1 and Table 10.2.

6.6.3.4.1 Minimum Requirements

The power of any spurious emission shall not exceed the limits of Table 6.12 for a Wide Area (WA) BS where requirements for co-location with a BS type listed in the first column apply.

Table 6.12: BS Spurious emissions limits for Wide Area BS co-located with another BS

Type of co-located BS	Band for co-location requirement	Maximum Level	Measurement Bandwidth	Note
Macro GSM900	876-915 MHz	-98 dBm	100 kHz	
Macro DCS1800	1710 - 1785 MHz	-98 dBm	100 kHz	
Macro PCS1900	1850 – 1910 MHz	-98 dBm	100 kHz	
Macro GSM850	824 - 849 MHz	-98 dBm	100 kHz	
WA UTRA FDD Band I	1920 - 1980 MHz	-96 dBm	100 kHz	
WA UTRA FDD Band II	1850 – 1910 MHz	-96 dBm	100 kHz	
WA UTRA FDD Band III	1710 – 1785 MHz	-96 dBm	100 kHz	
WA UTRA FDD Band IV	1710 – 1755 MHz	-96 dBm	100 kHz	
WA UTRA FDD Band V	824 – 849 MHz	-96 dBm	100 kHz	
WA UTRA FDD Band VI	830 – 840 MHz	-96 dBm	100 kHz	
WA UTRA FDD Band VII	2500 – 2570 MHz	-96 dBm	100 KHz	

It should be noted that due to this requirement the -52 dBm/MHz spurious emission limit is expected to be exceeded by a large margin for most parts of the 2570 - 2610 MHz portion of the 2.6 GHz band.

5.5.1.3.3 Isolation requirements for protection of TDD within 2570 – 2620 MHz

As already noted above, regarding potential TDD victim BS carriers, their bandwidth, RX characteristics (sensitivity, blocking) and highest potential carrier centre frequency location below 2620 MHz are not yet known as the work on UMTS2600 TDD is currently ongoing. However, in order to provide results for FDD/TDD isolation requirements, the following assumptions are made for TDD2600:

- 1) 3.84 Mcps TDD option
- 2) Blocking requirements, including those for co-location with FDD BS, will be defined and are not limiting (when compared with the corresponding FDD TX requirements). However, this may need to be re-checked as the TDD2600 work progresses.
- 3) A protection limit of -110 dBm/3.84 MHz @ 0.8 dB desensitisation for the WA TDD BS (assumes 5 dB NF).
- 4) 43 dBm FDD WA BS operating on the lowest carrier location at 2622.5 MHz.
- 5) Only the macro FDD \rightarrow macro TDD scenario (i.e. the worst case) is considered. Refer to ITU-R report M.2030 for several other scenarios related to this interference case, such as macro- \rightarrow micro, macro- \rightarrow pico, micro- \rightarrow pico, etc.

5.5.1.3.3.1 Protection of a TDD UE receiver

Based on the above assumptions and the proposal for the FDD transmitter the following considerations apply regarding FDD BS \rightarrow TDD UE DL adjacent channel interference at the 2620 MHz boundary:

- There are FDD/FDD adjacent channel interference results for the DL available in TR 25.942 and it is reasonable to assume that these results would also cover the case for FDD/TDD DL for similar system scenarios and propagation. In fact, Table 21 in TR 25.942, Sect. 8.3.3.1.2 provides a comparison between the FDD and TDD DL adjacent channel interference results and concludes that on DL system performances are similar and that in this case an ACIR value close to 30 dB would be sufficient. These existing results show that a FDD BS ACLR of 45 dB is conservative.
- The TDD UE ACS would still dominate the ACIR assuming a TDD UE ACS of 33 and a FDD BS ACLR of 45 dB.
- The TDD BS ACLR in TS 25.105 of 45 dB is considered as sufficient.

Based on this, protection of the TDD UE receiver across the 2620 MHz boundary does not need to be considered further.

5.5.1.3.3.2 Protection of a TDD WA BS receiver

Based on the above assumptions and the proposal for the FDD transmitter, the isolation requirements for protection of a TDD WA BS receiver in the same geographical area are summarised in Table 1:

Table 1: Worst case isolation requirements for protection of TDD macro BS operating within 2570 – 2620 MHz in the same geographical area

TDD operating at centre frequency	Level of WA FDD BS unwanted emissions [dBm/3.84 MHz],	Isolation requirement [dB]
2617.5 MHz	-2 dBm	108 dB
2612.5 MHz	-7 dBm	103 dB
2607.5 MHz or lower	-46 dBm	64 dB

These are the absolute worst-case isolation requirements for a WA FDD BS operating on the lowest possible carrier location at 2622.5 MHz; when operating at higher carrier locations, the isolation requirements will be lower.

In TR 25.942 a MCL of 67 dB is considered as a reference scenario for Macro BS to Macro BS interference for operation in the same geographic area and a MCL of 74 dB is suggested when considering adjacent channel operation due to the lower number of interfering base stations. For the worst-case scenario shown in Table 1, additional isolation may be required if FDD/TDD would be operated on adjacent channels around the 2620 MHz block boundary. Should a specific FDD/TDD deployment scenario require lower isolation values, these may be obtained by site engineering solutions similar to what has been described in TR 25.942 or the ITU-R draft report IMT.MITIGATION.

5.6 Specific UE requirements for UMTS2600

5.6.1 Proposed Transmitter Characteristics to support co-existence with IMT-2000 within 2570 – 2620 MHz

5.6.1.1 Requirements to support co-existence with IMT-2000 FDD DL external

FDD UE transmitter emissions are specified with spectrum emission mask for frequencies that are 2.5 to 12.5MHz away from the carrier center frequency and with spurious emissions that apply when the frequency offset is larger than 12.5MHz. In addition to the -30dBm/MHz spurious emission requirement when the frequency is higher than 1GHz an additional spurious emission requirement of $-60\text{dBm}/3.84\text{MHz}$ has been specified for FDD DL bands that can exist within the same geographical area.

The protection level of $-60\text{dBm}/3.84\text{MHz}$ can be derived with a deterministic analysis and a 40dB (1m) UE-UE MCL assumption. This situation is, however, an extreme worst case that will happen rarely in real networks. The requirement is also more stringent than the protection of for example the GSM1800 band². There are also physical limitations in UE TX filters that make it difficult to achieve sufficient attenuation for TX emissions with small offset from the 2570 MHz block boundary while keeping the losses of the filter such that terminal form factor and talk times are not sacrificed.

5.6.1.2 Requirements to support co-existence with IMT-2000 TDD within 2570 – 2620 MHz

This case has no additional potential for interference when compared to co-existence with FDD DL external. In existing 25.102 specifications -30dBm/MHz ($\sim -24\text{dBm}/3.84\text{MHz}$) spurious emission level is seen as sufficient protection for TDD from itself.

5.6.1.3 Proposal for Transmitter Characteristics to support co-existence with IMT-2000 within 2570 – 2620 MHz

When making a proposal for the FDD internal UE transmitter characteristics, the following aspects need to be considered:

² $-71\text{dBm}/100\text{kHz}$ equals $\sim -55.2\text{dBm}/3.84\text{MHz}$

- a) Requirements to support co-existence with IMT-2000 FDD DL external UEs or TDD UEs may significantly differ, and the limiting case is FDD.
- b) Cost, size and performance aspects (such as IL) of the UE TX filter are of concern.

In addition to the co-existence requirements the implementation aspects of multi band terminal needs to be kept in mind. Most probably UMTS2600 UE needs to support also other FDD bands e.g. Band I, which will increase the complexity of the TX chain and increase the losses, which then set additional challenges for TX design. The following proposal is made:

- 1) Analyze the need for modified maximum output power requirements
- 2) Reuse UE spectrum emission mask requirements from existing UMTS frequency variants
- 3) Create spurious emission requirements based on ITU category B limits when frequency offset to UE carrier frequency is higher than 12.5MHz.
- 4) Specify additional spurious emission requirements for GSM900, GSM1800, WCDMA1800, WCDMA2100 and WCDMA2600 down link bands in similar manner as done in existing specifications.
- 5) Specify $-50\text{dBm}/3.84\text{MHz}$ additional spurious emission requirement for 2590-2620 MHz band. This proposal has been derived by taking the above mentioned limitations in UE TX filter technologies into account, but on the other hand, aiming at a protection level which is close to the deterministic case for large parts of the band.
- 6) Similar protection requirements need to be defined for other IMT-2000 FDD technologies that are standardized for the 2.6 GHz band as well in order to maintain technology neutrality.

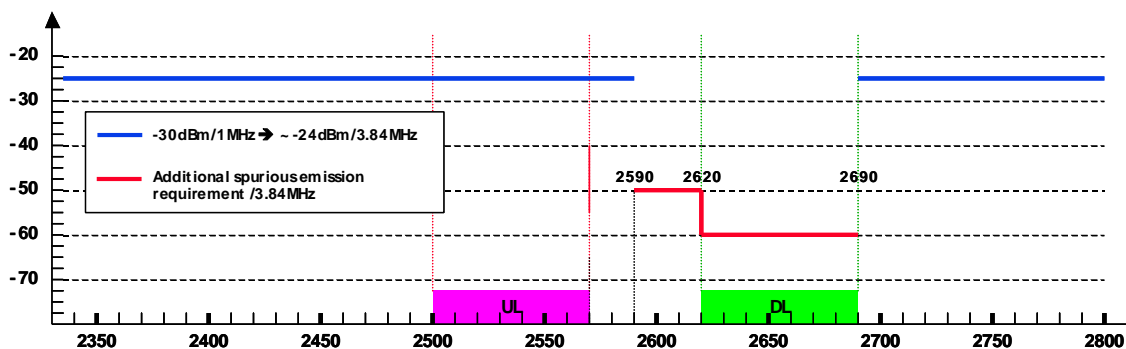


Figure 1: Additional spurious emission requirement to protect the 2590-2620 MHz band

5.6.1.4 Considerations for multi band UE transmitter

Since administrations may assign the frequency band 2570-2620 MHz to FDD downlink (external) according to the draft ECC Decision [2], it is likely that multi-band terminals will be designed to support Band VII (2.6 GHz FDD paired band – 2500-2570 / 2620-2690 MHz), as well as the 2.6 GHz FDD DL external band. The support of internal and external band in the same terminal increases the complexity of terminal RF front-end, which increases the losses between the PA and antenna and therefore it is proposed to introduce a new output power class for UMTS2600 terminals. Nominal output power of UE supporting the new power class would be 1dB lower than in PC3 (+24dBm), but MIN and MAX limits would be the same as in PC3.

It is therefore proposed to adopt:

- an additional UE power class of +23 dBm +2/-2 dB

As a consequence, the requirements would look as follows:

5.6.1.5 Text proposal for transmitter requirement

6.2 Transmit power

6.2.1 UE maximum output power

The following Power Classes define the nominal maximum output power. The nominal power defined is the broadband transmit power of the UE, i.e. the power in a bandwidth of at least $(1+\alpha)$ times the chip rate of the radio access mode. The period of measurement shall be at least one timeslot.

Table 6.1: UE Power Classes

Operating Band	Power Class 1		Power Class 2		Power Class 3		Power Class 3bis		Power Class 4	
	Power (dBm)	Tol (dB)	Power (dBm)	Tol (dB)	Power (dBm)	Tol (dB)	Power (dBm)	Tol (dB)	Power (dBm)	Tol (dB)
Band I	+33	+1/-3	+27	+1/-3	+24	+1/-3	-	-	+21	+2/-2
Band II	-	-	-	-	+24	+1/-3	-	-	+21	+2/-2
Band III	-	-	-	-	+24	+1/-3	-	-	+21	+2/-2
Band IV	-	-	-	-	+24	+1/-3	-	-	+21	+2/-2
Band V	-	-	-	-	+24	+1/-3	-	-	+21	+2/-2
Band VI	-	-	-	-	+24	+1/-3	-	-	+21	+2/-2
Band VII	-	-	-	-	+24	+1/-3	+23	+2/-2	+21	+2/-2

NOTE: The tolerance allowed for the nominal maximum output power applies even for the multi-code DPDCH transmission mode.

5.6.2 Proposed Receiver Characteristics to support co-existence with IMT-2000 within 2570 – 2620 MHz

5.6.2.1 Requirements to support co-existence with IMT-2000 FDD external DL within 2570 – 2620 MHz

As noted in [3], this case has no potential for interference since FDD external DL carriers can be seen as in-band blocking signals for FDD internal UE receiver.

When considering out-of-band blocking requirements one needs to take into account also other frequency allocations just below and above 2.6GHz band, for example 2.4 GHz ISM band.

5.6.2.2 Requirements to support co-existence with IMT-2000 TDD within 2570 – 2620 MHz

This case has a potential for UE-UE interference. Due to potentially low MCL between the two UEs the transmitter of TDD UE can impose more stringent blocking requirements for FDD UE receiver than either FDD internal or TDD BS. UE performance under blocking conditions is however a combination of selectivity of the interfered UE and emissions of the interfering UE and therefore both of them need to be considered simultaneously.

In current 2 GHz specifications, the TDD UE emissions and FDD UE selectivity requirement are balanced and therefore, both of them would need to be improved if a higher protection against UE-UE interference would be aimed at. Assuming current 3.84Mcps TDD UE ACLR and TX emission requirements it not seen as reasonable to introduce tighter blocking requirements for the FDD internal UE either.

5.6.2.3 Proposal for Receiver Characteristics to support co-existence with IMT-2000 within 2570 – 2620 MHz

Regarding potential requirements to support co-existence with the various IMT-2000 technologies considered for 2570 – 2620 MHz, the following aspects need to be considered:

- a. Requirements to support co-existence with the various IMT-2000 technologies considered for 2570 – 2620 MHz may significantly differ; e.g. support of co-existence with FDD external is substantially easier than co-existence with TDD.
- b. Cost, size and performance aspects (such as IL) of the UE RX filter UE are of concern.

5.6.2.4 Considerations for multi band UE receiver

Since administrations may assign the frequency band 2570-2620 MHz to FDD downlink (external) according to the draft ECC Decision [2], it is likely that multi-band terminals will be designed to support Band VII (2.6 GHz FDD paired band – 2500-2570 / 2620-2690 MHz), as well as the 2.6 GHz FDD DL external band. It is therefore proposed to adopt one single value for REFSENS for Band VII, whether the FDD DL external band is supported or not. Having two different values would result in some UEs with one sensitivity level, and other UEs with another sensitivity level. Therefore, if an operator which does not support the 2.6 GHz external DL band deploys its network only taking into account UEs supporting Band VII, then terminals supporting also the 2.6 GHz external DL band might not work properly on the network, which could cause roaming issues.

It is therefore proposed to adopt:

- a single UE REFSENS value of -115 dBm

As a consequence, the requirements would look as follows:

5.6.2.5 Text proposal for sensitivity requirement

7.3 Reference sensitivity level

The reference sensitivity level <REFSENS> is the minimum mean power received at the UE antenna port at which the Bit Error Ratio (BER) shall not exceed a specific value.

7.3.1 Minimum requirement

The BER shall not exceed 0.001 for the parameters specified in Table 7.2.

Table 7.2: Test parameters for reference sensitivity

Operating Band	Unit	DPCH_Ec <REFSENS>	<REF _{or} >
I, VI	dBm/3.84 MHz	-117	-106.7
II	dBm/3.84 MHz	-115	-104.7
III	dBm/3.84 MHz	-114	-103.7
IV	dBm/3.84 MHz	-117	-106.7
V	dBm/3.84 MHz	-115	-104.7
VII	dBm/3.84 MHz	-115	-104.7
NOTE 1. For Power class 3 this shall be at the maximum output power			
NOTE 2. For Power class 4 this shall be at the maximum output power			

6 Required changes to the Specifications

6.1 Required changes to TS 25.104

Required changes in specification TS 25.104 are discussed in Table 2. Requirements which are not shown are applicable to UMTS 2.6 GHz without any modifications from the existing Band I specifications.

Table 2: Required Changes in TS 25.104

Section	Requirement	Discussion / Required Changes in TS 25.104
5.2	Frequency bands	Add a new 2x70 MHz frequency band as Band VII. - 2500 – 2570 MHz: Up-link (UE transmit, Node B receive) - 2620 – 2690 MHz: Down-link (Node B transmit, UE receive)
5.3	TX-RX frequency separation	Add for Band VII a 120 MHz TX-RX frequency separation.
5.4.3	Channel number	Existing UARFCN definitions in Table 5.1 can be used for Band VII. Add 2x14 additional "odd" channel number (UARFCN) using equation $N_u = 5 * (F_{UL} - 2150.1 \text{ MHz})$ for the uplink and $N_d = 5 * (F_{DL} - 2150.1 \text{ MHz})$ for the downlink.
6.6.2.1	Spectrum emission mask	Add requirements for band VII, Same values as for Band I
6.6.3.1.2.1	Spurious emissions (Category B)	Add appropriate table for band VII, similar to Table 6.9 for Band I
6.6.3.2.1.	Spurious emissions – Protection of the BS Receiver of own or different BS	Add requirements for uplink of band VII (2500-2570 MHz) with same figures as in band I to band VI
6.6.3.3	Spurious emissions – Co-existence with other systems in the same geographic area	Extend the scope of the requirement to band I to band VII; Add requirements for band VII with same figures as in band I to band VI
6.6.3.4	Spurious emissions – Co-existence with co-located and co-sited base stations	Extend the scope of the requirement to band I to band VII; Add requirements for band VII with same figures as in band I to band VI
6.6.3.6.1	Spurious emissions – Co-existence with services in adjacent frequency bands	Add table entry for band VII
6.6.3.7.1	Co-existence with UTRA-TDD – operation in the same geographic area	Add table entry for 2.6GHz TDD band, same figures as in other TDD bands.
7.2	Reference sensitivity level	Band I REFSENS levels can be used for Band VII for all BS classes.
7.5.1	Blocking characteristics	Add requirements for Band VII. Follow the same pattern as for Band I
7.5.2	Blocking/Co-location	Add requirements for Band VII. Extend the scope of these requirements from Band I to VII
7.7.1	RX Spurious emissions	Add requirements for Band VII.
Annex B	Multi-path fading propagation conditions	Add velocity scaled speeds for Band VII

6.2 Required changes to TS 25.101

Required changes in specification TS 25.101 are discussed in Table 3. Requirements which are not shown are applicable to UMTS 2.6 GHz without any modifications from the existing Band I specifications.

Table 3: Required Changes in TS 25.101

Section	Requirement	Discussion / Required Changes in TS 25.101
5.2	Frequency bands	New operating band 2x70 MHz needs to be added as Band VII. <ul style="list-style-type: none"> - 2500 – 2570 MHz: Up-link (UE transmit, Node B receive) - 2620 – 2690 MHz: Down-link (Node B transmit, UE receive)
5.3	TX-RX frequency separation	Add this requirement for Band VII. 120 MHz
5.4.2	Channel raster	Add this requirement for Band VII. <ul style="list-style-type: none"> - 200 kHz raster as in Band I - Additional channels are needed in the middle of 5 MHz blocks - 2502.5, 2507.5, 2512.5, 2517.5, 2522.5, 2527.5, 2532.5, 2537.5, 2542.5, 2547.5, 2552.5, 2557.5, 2562.5 and 2567.5 MHz for UL - 2622.5, 2627.5, 2632.5, 2637.5, 2642.5, 2647.5, 2652.5, 2657.5, 2662.5, 2667.5, 2672.5, 2677.5, 2682.5 and 2687.5 MHz for DL
5.4.3	Channel number	Additional UARFCN definitions for Band VII. Add 2 * 14 additional "odd" channels / UARFCNs
5.4.4	UARFCN	Define UARFCN range for band VII. <ul style="list-style-type: none"> - 12512 to 12838 for UL, 13112 to 13438 for DL - Additional UARFCNs need to be defined
6.2.1	UE maximum output power	Add UE power classes for band VII. <ul style="list-style-type: none"> - +24dBm +1/-3dB: Power class 3 - +23dBm +2/-2dB Power class 3bis - +21dBm +2/-2dB: Power class 4
6.6.2.1	Spectrum emission mask	Add spectrum emission mask requirement for Band VII.
6.6.3	TX spurious emissions	Add additional TX spurious emissions requirements for Band VII. <ul style="list-style-type: none"> - Requirements can be set according to the patterns used in the existing specifications. - Requirements should be written for GSM900, GSM1800, UMTS1800, UMTS2000 and UMTS2600 down-link bands. - -50dBm/3.84MHz requirement for 2590-2620 MHz
7.3.1	Reference sensitivity level	Add reference sensitivity level requirement for band VII. Existing REFSENS definitions for Band II could be used for Band VII (assuming the blocking requirements proposed for 7.6.1 and 7.6.2 in this table).
7.6.1	Minimum requirement (In-band blocking)	Add in-band blocking requirements for band VII. Requirements can be set according to the patterns used in the existing specifications
7.6.2	Minimum requirement (Out of-band blocking)	Add out-of-band blocking requirements for band VII. <ul style="list-style-type: none"> - Requirements can be set according to the patterns used in the existing specifications with following exceptions. - FDD external DL only frequency block will have -44 dBm out of band requirement. - 1 to 2570 MHz covers any UE TX transmissions and hence blocking level is -15dBm.
7.9	RX spurious emissions	Add additional receiver spurious emission requirements for band VII. <ul style="list-style-type: none"> - -60 dBm/3.84MHz UE transmit band in URA_PCH, Cell_PCH and idle state - -60 dBm/3.84MHz UE receive band
8, Annex B	Performance requirement	Add velocity scaled speeds for Band VII

6.3 Required changes to TS 25.141

No changes are required concerning measurement uncertainties, test tolerances and test procedures. Minimum requirements shall be aligned with TS25.104 as well as test requirements (considering test tolerances).

6.4 Required changes to TS 25.133

Required changes in specification TS 25.133 are discussed in Table 4. Requirements which are not shown are applicable to UMTS 2.6 GHz without any modifications from the existing Band I specifications.

Table 4: Required Changes in TS 25.133

Section	Requirement	Discussion / Required Changes in TS 25.133
9.1	UE measurement performance - accuracy requirements	Since the UE reference sensitivity requirements are different depending on supported band, this is noted in each case with definition of the range lo for each frequency band. Assuming that UE reference sensitivity in band VII is the same as in band II and V, the ranges specified for band II and V can be used for band VII as well. If different reference sensitivity is considered for band VII, ranges need to be adopted accordingly.
A.9.1	UE measurement performance – test cases	Since the UE reference sensitivity requirements are different depending on supported band, this is noted in each case with definition of the range lo, loc and CPICH RSCP for each frequency band. Assuming that UE reference sensitivity in band VII is the same as in band II and V, the ranges specified for band II and V can be used for band VII as well. If different reference sensitivity is considered for band VII, ranges need to be adopted accordingly.

6.5 Required changes to TS 25.113

Required changes in specification TS 25.113 are discussed in Table 5. Requirements which are not shown are applicable to UMTS 2.6 GHz without any modifications from the existing Band I specifications.

Table 5: Required Changes in TS 25.113

Section	Requirement	Discussion / Required Changes in TS 25.113
4.5.2	Receiver exclusion bands	Add receiver exclusion band for frequency band VII.

6.6 Required changes to TS 34.124

Required changes in specification TS 34.124 are discussed in Table 6. Requirements which are not shown are applicable to UMTS 2.6 GHz without any modifications from the existing Band I specifications.

Table 6: Required Changes in TS 34.124

Section	Requirement	Discussion / Required Changes in TS 34.124
4.4	Receiver exclusion bands	Add receiver exclusion band for frequency band VII.

6.7 Required changes to TS 25.461

Required changes in specification TS 25.461 are discussed in Table 6. Requirements which are not shown are applicable to UMTS 2.6 GHz without any modifications from the existing Band I specifications.

Table 7: Required Changes in TS 25.461

Section	Requirement	Discussion / Required Changes in TS 25.461
4.3.7	Modem operating bands	Add frequency band VII.

Annex A (informative): Change history

Change history							
Date	TSG #	TSG Doc.	CR	Rev	Subject/Comment	Old	New
2005-02	WG4#34	R4-050093			TR created, Baseline proposal for the UMTS2600 FDD WI TR		0.0.1
2005-02	WG4#34	R4-050026			Introduction of UMTS2600 frequency band definitions in TS 25.104	0.0.1	0.0.2
2005-02	WG4#34	R4-050057			NodeB transmitter requirements in TS 25.104 related to UMTS2600 WI	0.0.1	0.0.2
2005-02	WG4#34	R4-050094			Text proposal for the UMTS2600 WI TR, Section 4	0.0.1	0.0.2
2005-02	WG4#34	R4-050095			Text proposal for the UMTS2600 WI TR, Section 5	0.0.1	0.0.2
2005-02	WG4#34	R4-050096			NodeB receiver requirements in TS 25.104 related to UMTS2600 WI	0.0.1	0.0.2
2005-02	WG4#34	R4-050262			UE transmitter and receiver requirements in TS 25.101 related to UMTS2600 WI	0.0.1	0.0.2
2005-05	WG4#35	R4-050352			Text proposal for the UMTS2600 WI TR, Section 5.5, text endorsed by the UMTS2600 FDD Telcos	0.0.2	0.0.3
2005-05	WG4#35	R4-050353			Text proposal for the UMTS2600 WI TR, Section 5.5, Proposal for Transmitter Characteristics to support co-existence with IMT-2000 within 2570-2620 MHz	0.0.2	0.0.3
2005-05	WG4#35	R4-050357			Text proposal for the UMTS2600 WI TR, Section 5.6	0.0.2	0.0.3
2005-05	WG4#35	R4-050358			Text proposal for the UMTS2600 WI TR, Section 6.2	0.0.2	0.0.3
2005-05	WG4#35	R4-050373			Affected RAN4 specifications and required changes for UMTS2600	0.0.2	0.0.3
2005-05	WG4#35	R4-050548			Text proposal for the UMTS2600 WI TR, Section 4	0.0.2	0.0.3
2005-05	RAN#28	RP-050347			Presentation at RAN#28 for approval	0.0.3	1.0.0
2005-06	RAN #28				Approved version	1.0.0	7.0.0