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Contents

Foreword

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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 of the UMTS/LTE in 900 MHz band study item, which was established at TSG RAN#52. The objective of the study item is to study how we can provide UTRA and E-UTRA specification support for FDD in the 900 MHz band in Japan, and also to study the possible harmonized specification support between the 900 MHz band in Japan and 900 MHz band in Korea.

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] R4-112429, "Information on band usage plan in 900 MHz band in Japan" , RAN4#59

[3] RP-110901, "New Study item proposal for 900MHz UMTS/LTE operation", RAN#52

[4] "Report of technical conditions for mobile communications in 900 MHz band" (In Japanese, May, 2011) http://www.soumu.go.jp/main_content/000115335.pdf

[5] RP-110447, "Study Item proposal for 800~900MHz interference issue", RAN#51

[6] R4-113677: "Japanese 900 MHz: A-MPR study and whether to create new band or re-use band 8", Nokia

[7] R4-113792: "Band 5 and Band 8 coexistence", Qualcomm

[8] R4-113678: "A-MPR study for 905-915 MHz uplink in Korea", Nokia

[9] R4-113328: "LTE A-MPR Consideration for Band 8 in Japan", SOFTBANK MOBILE

[10] R4-113525 "Coexistence in 900 MHz bands for UMTS", Qualcomm Incorporated

[11] R4-113506 "Band XIX DL protection from UMTS Band VIII UEs in Japan", NTT DOCOMO, NEC, Fujitsu, Panasonic

[12] R4-121387 "Way Forward Proposal for Japanese 900MHz", SOFTBANK MOBILE

[13] R4-122134 "Updated WF for Japanese 900MHz", SOFTBANK MOBILE

[14] R4-122508 "Coexistence Study for LTE 900MHz", LG Electronics

[15] R4-122825 "UL emissions study for Band 8 in Japan", Nokia

[16] R4-122915 "Japanese LTE900 study", Renesas Mobile Europe

[17] R4-123012 "Band 8 UE in Japan", Ericsson, ST-Ericsson

[18] R4-123231 "Spurious Emission Simulation Results", Intel

[19] R4-123284 "900 MHz UE coexistence in Japan", Qualcomm

3 Definitions, symbols and abbreviations

Delete from the above heading those words which are not applicable.

Clause numbering depends on applicability and should be renumbered accordingly.

3.1 Definitions

For the purposes of the present document, the terms and definitions given in TR 21.905 [1] and the following apply. A term defined in the present document takes precedence over the definition of the same term, if any, in TR 21.905 [1].

Definition format (Normal)

<defined term>: *<definition>.*

example: text used to clarify abstract rules by applying them literally.

3.2 Symbols

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

Symbol format (EW)

<symbol> <Explanation>

3.3 Abbreviations

For the purposes of the present document, the abbreviations given in 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 TR 21.905 [1].

Abbreviation format (EW)

<ACRONYM> <Explanation>

4 Background

In Japan, "Action plan for frequency reorganization toward realizing Wireless Broadband" was discussed in the Working Group (WG) under the ICT Policy Task Force for a Global Era of the Ministry of Internal Affairs and Communications (MIC). The WG concluded that 900 – 905 MHz for UL and 945 – 950 MHz for DL will be allocated in 2011, and 10 MHz bandwidths will be added to the UL and DL from 2012 if all progress smoothly. Eventually 900 – 915 MHz for UL and 945 – 960 MHz for DL will be allocated by 2015 (note: the reorganization may not be completed in some geographical areas until 2015, however, assignment to the areas will be completed by March 2018) [2]. Taking this plan into account, the Telecommunications Council under the MIC studied technical conditions in the 900 MHz band, and the final report was issued in May, 2011. It should be noted that these technical conditions are developed considering the co-existence with the UMTS/LTE operation in the 800 MHz band, such as Bands 18 and 19/XIX.

Meanwhile, in Korea, the KCC (Korea Communications Commission) has re-allocated the 800 MHz band (i.e., 839 – 849 MHz for UL and 884 – 894 MHz for DL) and the 900 MHz band (i.e., 905 – 915 MHz for UL and 950 – 960 MHz for DL) for IMT service. In order to investigate the impact of interference both in UE and BS operating between these 800~900 MHz bands, the SI "Interference analysis between 800~900 MHz bands" is ongoing in RAN4.

Since the possible new WI for the 900MHz band in Japan and the existing SI for interference analysis between 800~900 MHz bands in Korea are targeting for similar frequency ranges, it would be useful to study the possibility of harmonized WI proposal for these different band plans among these two countries, before the possible new WI for the 900 MHz band in Japan is established in the RAN#53.

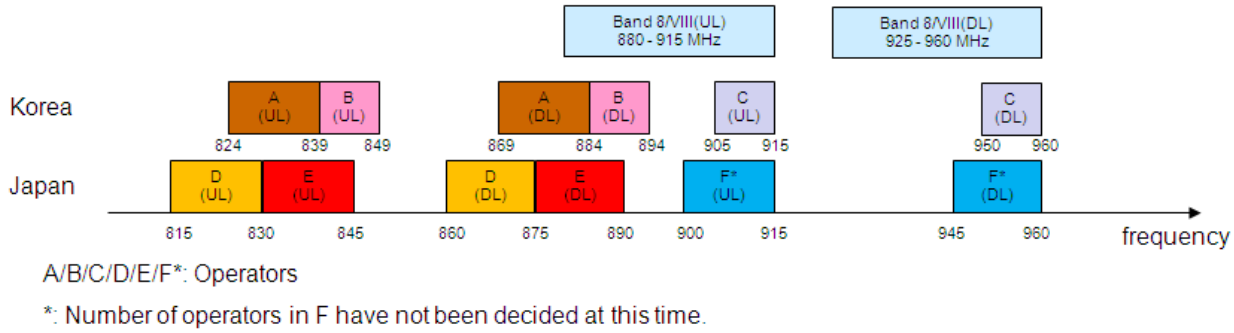


Figure 4-1: Frequency allocation of 900 MHz bands in Japan and Korea and relationship to the Band 8/VIII

4.1 Objective of the SI

The purpose of this work item is to:

- Study the feasibility to add the Japanese technical conditions in the 900 MHz band to UMTS Band VIII
- Study the feasibility to add the Japanese technical conditions in the 900 MHz band to LTE Band 8 considering the required A-MPR value and associated NS signalling
- Study the creation of a new UMTS/LTE Band to match the Japanese technical conditions in the 900 MHz band
- Study the possibility of a harmonized WI proposal for the different frequency allocations in the 900 MHz ranges Japan and Korea

The Study Item description for New Study item proposal for 900MHz UMTS/LTE operation was approved in RAN#52 [3].

5 Frequency band arrangements and regulatory background

5.1 Regulatory Requirements

5.1.1 Japanese regulatory requirement

5.1.1.1 Co-existing with other technologies in Japan

As a result of the co-existing studies with the following technologies: Personal radio communication, MCA, RFID, Broadcast auxiliary service, and Aeronautical radio-navigation systems, the required guard bands between each system were lead in Telecommunications Council of Japan as provided in [X]. Furthermore, after the co-existing studies in Telecommunications Council of Japan, technical conditions of UTRA and E-UTRA were lead as provided in [X].

5.1.1.2 Technical conditions for UTRA in Japan

The technical conditions for 900 MHz UMTS operation in Japan were derived based on the requirements for 900MHz band (UTRA Band VIII). Necessary changes such as the spurious emissions or Adjacent Channel Leakage power Ratio requirements were made. Those changes and its rationale are summarized in the following sub sections. Revised parts compared with requirements for Band VIII are underlined.

5.1.1.2.1 Mandatory regulatory requirements:

(a) Frequency error:

Frequency error requirements for 900 MHz UMTS operation in Japan are specified same as other Bands shown following;

BS: The modulated carrier frequency of the BS shall be accurate to within ± (0.05ppm+12Hz).
For UMTS BS whose maximum output power is not exceed 38dBm, the modulated carrier frequency shall be accurate to within ± (0.1ppm+12Hz).
For UMTS BS whose maximum output power is not exceed 20dBm, the modulated carrier frequency shall be accurate to within ± (0.25ppm+12Hz).

UE: The UE modulated carrier frequency shall be accurate to within ± (0.1 ppm+ 10Hz) compared to the carrier frequency received from the Node B.

(b) Spurious emissions:

Spurious emissions requirements for 900 MHz UMTS operation in Japan are specified as in Table 5.1.1.2.1-1.

Table 5.1.1.2.1-1: Spurious emission requirements for 900 MHz UMTS operation in Japan

<table>
<tr><th colspan="2">Parameter</th><th>Requirement</th></tr>
<tr><td>Spurious emissions limits</td><td>BS</td><td>
Table 5.1.1.2.1-1-1 Spurious emissions limits for 900 MHz UMTS BS
<table>
<tr><th>Frequency range</th><th>Maximum level</th></tr>
<tr><td>9kHz – 150kHz</td><td>-13dBm/1kHz</td></tr>
<tr><td>150kHz – 30MHz</td><td>-13dBm/10kHz</td></tr>
<tr><td>30MHz – 1000MHz</td><td>-13dBm/100kHz</td></tr>
<tr><td>1000MHz – 12.75GHz</td><td>-13dBm/1MHz</td></tr>
<tr><td colspan="2">The requirements apply at frequencies within the specified frequency ranges, which are more than 12.5MHz below the first carrier frequency used or more than 12.5MHz above the last carrier frequency used.</td></tr>
</table>
Table 5.1.1.2.1-1-2 Additional spurious emission limits for 900 MHz UMTS BS
<table>
<tr><th>Frequency range</th><th>Maximum level</th></tr>
<tr><td>1884.5MHz – 1919.6MHz</td><td>-41dBm/300kHz</td></tr>
<tr><td>2010MHz – 2025MHz</td><td>-52dBm/1MHz</td></tr>
</table>
</td></tr>
<tr><td></td><td>UE</td><td>
The requirements below are only applicable for frequencies, which are greater than 12.5 MHz away from the UE centre carrier frequency.
Table 5.1.1.2.1-1-3 Spurious emission limits for 900 MHz UMTS UE
<table>
<tr><th>Frequency range</th><th>Maximum level</th></tr>
<tr><td>9kHz – 150kHz</td><td>-36dBm/1kHz</td></tr>
<tr><td>150kHz – 30MHz</td><td>-36dBm/10kHz</td></tr>
<tr><td>30MHz – 1000MHz</td><td>-36dBm/100kHz</td></tr>
<tr><td>1000MHz – 12.75GHz</td><td>-30dBm/1MHz</td></tr>
</table>
Table 5.1.1.2.1-1-4 Additional spurious emission limits for 900 MHz UMTS UE
<table>
<tr><th>Frequency range</th><th>Maximum level</th></tr>
<tr><td>860MHz – 890MHz</td><td>-37dBm/1MHz</td></tr>
<tr><td>1475.9MHz –1510.9MHz</td><td>-60dBm/3.84MHz</td></tr>
<tr><td>1844.9MHz – 1879.9MHz</td><td>-60dBm/3.84MHz</td></tr>
<tr><td>1884.5MHz – 1919.6MHz</td><td>-41dBm/300kHz</td></tr>
<tr><td>2110MHz – 2170MHz</td><td>-60dBm/3.84MHz</td></tr>
</table>
</td></tr>
</table>

(c) Adjacent Channel Leakage power Ratio (ACLR):

Adjacent Channel Leakage power Ratio (ACLR) requirements for 900 MHz UMTS operation in Japan are specified as in Table 5.1.1.2.1-2. ACLR limits include the test tolerance which is specified in TS25.141 and TS34.121-1.

Table 5.1.1.2.1-2: ACLR requirements for 900 MHz UMTS operation in Japan

<table>
<tr><th></th><th>Requirement</th></tr>
<tr><td>BS</td><td>The ACLR limits in the Table 5.1.1.2.1-2-1 below.

Table 5.1.1.2.1.-2-1 ACLR for 900 MHz UMTS BS
<table><tr><th>Adjacent channel offset</th><th>ACLR limit</th><th>Measurement bandwidth</th></tr><tr><td>5MHz</td><td>-44.2dBc or +2.8dBm</td><td>3.84MHz</td></tr><tr><td>10MHz</td><td>-49.2dBc or +2.8dBm</td><td>3.84MHz</td></tr></table></td></tr>
<tr><td>UE</td><td>The ACLR limits in the Table 5.1.1.2.1-2-2 below.

Table 5.1.1.2.1-2-2 ACLR for 900 MHz UMTS UE
<table><tr><th>Adjacent channel offset</th><th>ACLR limit</th><th>Measurement bandwidth</th></tr><tr><td>5MHz</td><td>-32.2dBc or -50dBm</td><td>3.84MHz</td></tr><tr><td>10MHz</td><td>-42.2dBc or -50dBm</td><td>3.84MHz</td></tr></table></td></tr>
</table>

(d) Spectrum emission mask:

Spectrum emission mask for 900 MHz UMTS operation in Japan are specified same as other Bands shown following;

BS: Not specified.

UE: Spectrum emission mask requirements for 900 MHz UMTS operation in Japan are specified as in Table 5.1.1.2.1-3. Spectrum emission mask limits include the test tolerance which is specified in TS34.121-1.

Table 5.1.1.2.1-3: Spectrum emission mask requirements for 900 MHz UMTS UE

Δf in MHz (Note)	Requirements	Measurement bandwidth
2.5 ≤ Δf < 3.5	-33.5-15X(Δf-2.5) dBc	30kHz
3.5 ≤ Δf < 7.5	-33.5-1X(Δf-3.5) dBc	1MHz
7.5 ≤ Δf < 8.5	-37.5-10X(Δf-7.5) dBc	1MHz
8.5 ≤ Δf < 12.5	-47.5dBc	1MHz

Note: Δf is the separation between the carrier frequency and the centre of the measurement bandwidth.

(e) Occupied bandwidth:

Occupied channel bandwidth shall be less than 5 MHz, specified same as other Bands for BS/UE.

(f) Maximum output power

Maximum output power for 900 MHz UMTS operation in Japan are specified same as other Bands shown following;

BS: In normal conditions, the Base station maximum output power shall remain within +2.7dB and -2.7dB of the manufacturer's rated output power. Maximum output power include the test tolerance which is specified in TS25.141.

UE: The maximum output power which is defined 23dBm in normal conditions, shall remain within +2.7dB and -2.7dB.
And for 24dBm UE, the maximum output power shall remain between +1.7dB and -3.7dB in normal conditions. Maximum output power include the test tolerance which is specified in TS34.121-1.

(g) Transmit OFF power

Transmit OFF power for 900 MHz UMTS operation in Japan are specified same as other Bands shown following;

BS: Not specified.

UE: Transmit OFF power requirement is defined -55dBm/3.84MHz. Transmit OFF power include the test tolerance which is specified in TS34.121-1.

(h) Transmit Intermodulation

Transmit Intermodulation for 900 MHz UMTS operation in Japan are specified same as other Bands shown following;

BS: The transmit intermodulation level is the power of the intermodulation products when a W-CDMA modulated interference signal is injected into the antenna connector at a mean power level of 30 dB lower than that of the mean power of the wanted signal. The frequency of the interference signal shall be ±5 MHz, ±10 MHz, ±15MHz offset from the subject signal carrier frequency. The transmitter intermodulation level shall not exceed the ACLR or the spurious emission requirements.

UE: Not specified.

(i) Receiver Spurious emissions:

Receiver Spurious emissions requirements for 900 MHz UMTS operation in Japan are specified as in Table 5.1.1.2.1-4.

Table 5.1.1.2.1-4: Receiver Spurious emission requirements for 900 MHz UMTS operation in Japan

<table>
<tr><th colspan="2">Parameter</th><th>Requirement</th></tr>
<tr><td rowspan="2">Receiver spurious emissions limits</td><td>BS</td><td>
Table 5.1.1.2.1-4-1 Receiver spurious emission limits for 900 MHz UMTS BS
<table>
<tr><th>Frequency range</th><th>Maximum level</th></tr>
<tr><td>30MHz – 1000MHz</td><td>-57dBm/100kHz*</td></tr>
<tr><td>1GHz – 12.75GHz</td><td>-47dBm/1MHz</td></tr>
<tr><td>2010MHz – 2025MHz</td><td>-52dBm/1MHz</td></tr>
<tr><td colspan="2">*With the exception of frequencies between 935MHz and 970MHz.</td></tr>
</table>
</td></tr>
<tr><td>UE</td><td>
Table 5.1.1.2.1-4-2 Receiver spurious emissions limits for 900 MHz UMTS UE
<table>
<tr><th>Frequency range</th><th>Maximum level</th></tr>
<tr><td>30MHz – 1000MHz</td><td>-57dBm/100kHz</td></tr>
<tr><td>1GHz – 12.75GHz</td><td>-47dBm/1MHz</td></tr>
<tr><td>900MHz – 915MHz</td><td>-60dBm/3.84MHz</td></tr>
<tr><td>945MHz – 960MHz</td><td>-60dBm/3.84MHz</td></tr>
</table>
</td></tr>
</table>

5.1.1.2.2 Other technical conditions referred in Japan's regulations:

(a) Reference sensitivity level

BS: The reference sensitivity level for 900 MHz UMTS operation in Japan are specified as in Table 5.1.1.2.2-1. The reference sensitivity level includes the test tolerance which is specified in TS25.141.

Table 5.1.1.2.2-1: UMTS BS reference sensitivity levels

Rated output power	BS reference sensitivity level
> 38dBm	-120.3dBm
≤ 38dBm	-110.3dBm
≤ 24dBm	-106.3dBm

UE: The reference sensitivity level is -113.3dBm. In case DC-HSDPA, the reference sensitivity level is -109.3dBm. The reference sensitivity level includes the test tolerance which is specified in TS 34.121-1.

(b) Adjacent Channel Selectivity (ACS)

BS: With the conditions described in Table 5.1.1.2.2-2, BER shall be not exceeded 0.1%.

Table 5.1.1.2.2-2: Test conditions of Adjacent channel selectivity for UMTS BS

Parameter	Rated output power	Conditions	Unit
Propagation condition	-	Static	-
Wanted signal mean power	-	<REFSENS>+6	dBm
Interfering signal mean power	> 38	-52	dBm
	≤ 38	-42	dBm
	≤ 24	-38	dBm

UE: Requirements of UE ACS for 900 MHz UMTS operation in Japan are specified as in Table 5.1.1.2.2-3.

Table 5.1.1.2-2.3 Requirements and Test conditions of Adjacent channel selectivity for UMTS UE

Parameter	Rel99	DC-HSDPA
Propagation condition	Static	
Wanted signal mean power	(<REFSENS>+14) dBm	
Interfering signal mean power	-52dBm	
Bit rate	12.2 kbps	60 kbps
Requirements	BER shall be not exceeded 0.1%.	BLER shall be not exceeded 10%.

(c) Blocking characteristics

BS: With the conditions described in Table 5.1.1.2.2-4, BER shall be not exceeded 0.1%.

Table 5.1.1.2.2-4: Test conditions of Blocking characteristics for UMTS BS

Parameter	Rated output power	Conditions	Unit
Propagation condition	-	Static	-
Wanted signal mean power	-	<REFSENS>+6	dBm
Interfering signal mean power	> 38	-40	dBm
	≤ 38	-35	dBm
	≤ 24	-30	dBm

UE: Requirements of UE Blocking characteristics for 900 MHz UMTS operation in Japan are specified as in Table 5.1.1.2.2-5.

Table 5.1.1.2.2-5: Requirements and Test conditions of Blocking characteristics for UMTS UE

Parameter	Rel99	DC-HSDPA
Propagation condition	Static	
Wanted signal mean power	(<REFSENS>+3) dBm	
Interfering signal mean power	-44dBm	
Bit rate	12.2 kbps	60 kbps
Requirements	BER shall be not exceeded 0.1%.	BLER shall be not exceeded 10%.

(d) Receiver intermodulation characteristics

BS: With the conditions described in Table 5.1.1.2.2-6, BER shall be not exceeded 0.1%.

Table 5.1.1.2.2-6: Test conditions of Receiver intermodulation characteristics for UMTS BS

Parameter	Rated output power	Conditions	Unit
Propagation condition	-	Static	-
Wanted signal mean power	-	<REFSENS>+6	dBm
Mean power of Interfering signal 1 and 2	> 38	-48	dBm
	≤ 38	-44	dBm
	≤ 24	-38	dBm
Interfering signal 1 characteristic	-	CW, 10MHz offset	-
Interfering signal 2 characteristic	-	Modulated, 20MHz offset	-

UE: Requirements of UE Blocking characteristics for 900 MHz UMTS operation in Japan are specified as in Table 5.1.1.2.2-7.

Table 5.1.1.2.2-7: Requirements and Test conditions of Receiver intermodulation characteristics for UMTS UE

Parameter	Rel99	DC-HSDPA
Propagation condition	Static	
Wanted signal mean power	(<REFSENS>+3) dBm	
Mean power of Interfering signal 1 and 2	-46dBm	
Interfering signal 1	CW, 10MHz offset	
Interfering signal 2	Modulated, 20MHz offset	
Bit rate	12.2 kbps	60 kbps
Requirements	BER shall be not exceeded 0.1%.	BLER shall be not exceeded 10%.

5.1.1.3 Technical conditions for E-UTRA in Japan

The technical conditions for 900 MHz LTE operation in Japan were derived based on the requirements for 900MHz band (E-UTRA Band 8). Necessary changes such as the spurious emissions or receiver spurious emissions requirements were made. Those changes and its rationale are summarized in the following sub sections. Revised parts compared with requirements for Band 8 are underlined.

5.1.1.3.1 Mandatory regulatory requirements:

(a) Frequency error

Frequency error requirements for 900 MHz LTE operation in Japan are specified same as other Bands shown following;

BS: The modulated carrier frequency of the BS shall be accurate to within ± (0.05ppm+12Hz).
For LTE BS whose maximum output power is not exceed 24dBm, the modulated carrier frequency shall be accurate to within ± (0.1ppm+12Hz).

For LTE BS whose maximum output power is not exceed 20dBm, the modulated carrier frequency shall be accurate to within ± (0.25ppm+12Hz).

UE: The UE modulated carrier frequency shall be accurate to within ± (0.1 ppm+ 15Hz) compared to the carrier frequency received from the Node B.

(b) Spurious emissions

Spurious emissions requirements for 900 MHz LTE operation in Japan are specified as in Table 5.1.1.3.1-1.

Table 5.1.1.3.1-1: ACLR requirements for 900 MHz LTE operation in Japan

<table>
<tr><th colspan="2">Parameter</th><th>Requirement</th></tr>
<tr><td>Spurious emissions limits</td><td>BS</td><td>
Table 5.1.1.3.1-1-1 Spurious emissions limits for 900 MHz LTE BS
<table>
<tr><th>Frequency range</th><th>Maximum level</th></tr>
<tr><td>9kHz – 150kHz</td><td>-13dBm/1kHz</td></tr>
<tr><td>150kHz – 30MHz</td><td>-13dBm/10kHz</td></tr>
<tr><td>30MHz – 1000MHz</td><td>-13dBm/100kHz</td></tr>
<tr><td>1000MHz – 12.75GHz</td><td>-13dBm/1MHz</td></tr>
<tr><td colspan="2">The requirements are only applicable for frequencies, which are greater than 10 MHz away from the BS transmitter operating band edge.</td></tr>
</table>
Table 5.1.1.3.1-1-2 Additional spurious emission limits for 900 MHz LTE BS
<table>
<tr><th>Frequency range</th><th>Maximum level</th></tr>
<tr><td>1884.5MHz – 1919.6MHz</td><td>-41dBm/300kHz</td></tr>
<tr><td>2010MHz – 2025MHz</td><td>-52dBm/1MHz</td></tr>
</table>
</td></tr>
<tr><td></td><td>UE</td><td>
The requirements below are only applicable for frequencies, which are greater than 12.5 MHz away from the UE centre carrier frequency for 5MHz LTE system. Likewise, greater than 20MHz for 10MHz LTE system and greater than 27.5MHz for 15MHz LTE system.
Table 5.1.1.3.1-1-3 Spurious emission limits for 900 MHz LTE UE
<table>
<tr><th>Frequency range</th><th>Maximum level</th></tr>
<tr><td>9kHz – 150kHz</td><td>-36dBm/1kHz</td></tr>
<tr><td>150kHz – 30MHz</td><td>-36dBm/10kHz</td></tr>
<tr><td>30MHz – 1000MHz</td><td>-36dBm/100kHz</td></tr>
<tr><td>1000MHz – 12.75GHz</td><td>-30dBm/1MHz</td></tr>
</table>
Table 5.1.1.3.1-1-4 Additional spurious emission limits for 900 MHz LTE UE
<table>
<tr><th>Frequency range</th><th>Maximum level</th></tr>
<tr><td>860MHz – 890MHz</td><td>-40dBm/1MHz</td></tr>
<tr><td>945MHz – 960MHz</td><td>-50dBm/1MHz</td></tr>
<tr><td>1475.9MHz –1510.9MHz</td><td>-50dBm/1MHz</td></tr>
<tr><td>1844.9MHz – 1879.9MHz</td><td>-50dBm/1MHz</td></tr>
<tr><td>1884.5MHz – 1919.6MHz</td><td>-41dBm/300kHz</td></tr>
<tr><td>2010MHz – 2025MHz</td><td>-50dBm/1MHz</td></tr>
<tr><td>2110MHz – 2170MHz</td><td>-50dBm/1MHz</td></tr>
</table>
</td></tr>
</table>

(c) **Adjacent Channel Leakage power Ratio (ACLR)**

Adjacent Channel Leakage power Ratio (ACLR) requirements for 900 MHz LTE operation in Japan are specified same as other Bands shown in Table 5.1.1.3.1-2. ACLR limits include the test tolerance which is specified in TS36.141 and TS36.521-1.

Table 5.1.1.3.1-2: ACLR requirements for 900 MHz LTE operation in Japan

<table>
<tr><th></th><th>Requirement</th></tr>
<tr><td>BS</td><td>Either the ACLR limits in the Table 5.1.1.3.1-2-1 below or the absolute limit of -13dBm/MHz shall apply, whichever is less stringent

Table 5.1.1.3.1-2-1 ACLR for 900 MHz LTE BS

<table>
<tr><th>System</th><th>Adjacent channel offset</th><th>ACLR limit</th><th>Measurement bandwidth</th></tr>
<tr><td rowspan="4">5MHz</td><td>5MHz</td><td>-44.2dBc</td><td>4.5MHz</td></tr>
<tr><td>10MHz</td><td>-44.2dBc</td><td>4.5MHz</td></tr>
<tr><td>5MHz</td><td>-44.2dBc</td><td>3.84MHz</td></tr>
<tr><td>10MHz</td><td>-44.2dBc</td><td>3.84MHz</td></tr>
<tr><td rowspan="4">10MHz</td><td>10MHz</td><td>-44.2dBc</td><td>9MHz</td></tr>
<tr><td>20MHz</td><td>-44.2dBc</td><td>9MHz</td></tr>
<tr><td>7.5MHz</td><td>-44.2dBc</td><td>3.84MHz</td></tr>
<tr><td>12.5MHz</td><td>-44.2dBc</td><td>3.84MHz</td></tr>
<tr><td rowspan="4">15MHz</td><td>15MHz</td><td>-44.2dBc</td><td>13.5MHz</td></tr>
<tr><td>30MHz</td><td>-44.2dBc</td><td>13.5MHz</td></tr>
<tr><td>10MHz</td><td>-44.2dBc</td><td>3.84MHz</td></tr>
<tr><td>15MHz</td><td>-44.2dBc</td><td>3.84MHz</td></tr>
</table>
</td></tr>
<tr><td>UE</td><td>The adjacent channel power shall be less than or equal to -50 dBm/ 4.5MHz (5MHz CBW) or -50 dBm/ 9MHz (10MHz CBW) or -50 dBm/ 13.5MHz (15MHz CBW) or -50 dBm/ 3.84MHz or as specified by the ACLR limit in the Table 5.1.1.3.1-2-2, whichever is least stringent.

Table 5.1.1.3.1-2-2 ACLR for 900 MHz LTE UE

<table>
<tr><th>System</th><th>Adjacent channel offset</th><th>ACLR limit</th><th>Measurement bandwidth</th></tr>
<tr><td rowspan="3">5MHz</td><td>5MHz</td><td>-29.2dBc</td><td>4.5MHz</td></tr>
<tr><td>5MHz</td><td>-32.2dBc</td><td>3.84MHz</td></tr>
<tr><td>10MHz</td><td>-35.2dBc</td><td>3.84MHz</td></tr>
<tr><td rowspan="3">10MHz</td><td>10MHz</td><td>-29.2dBc</td><td>9MHz</td></tr>
<tr><td>7.5MHz</td><td>-32.2dBc</td><td>3.84MHz</td></tr>
<tr><td>12.5MHz</td><td>-35.2dBc</td><td>3.84MHz</td></tr>
<tr><td rowspan="3">15MHz</td><td>15MHz</td><td>-29.2dBc</td><td>13.5MHz</td></tr>
<tr><td>10MHz</td><td>-32.2dBc</td><td>3.84MHz</td></tr>
<tr><td>15MHz</td><td>-35.2dBc</td><td>3.84MHz</td></tr>
</table>
</td></tr>
</table>

(d) **Spectrum emission mask**

Spectrum emission mask requirements for 900 MHz LTE operation in Japan are specified in Table 5.1.1.3.1-3.

Table 5.1.1.3.1-3: Spectrum emission mask requirements for 900 MHz LTE operation in Japan

<table>
<tr><th></th><th>Requirement</th></tr>
<tr><td>BS</td><td>The spectrum emission mask limits in the Table 5.1.1.3.1-3-1 below.

Table 5.1.1.3.1-3-1 Spectrum emission mask for 900 MHz LTE BS

<table>
<tr><th>Frequency offset
|f_offset| MHz</th><th>Limit</th><th>Measurement bandwidth</th></tr>
<tr><td>0.05 – 5.05 MHz</td><td>-5.5dBm - 7/5x
(f_offset - 0.05)dB</td><td>100kHz</td></tr>
<tr><td>5.05 – 10.05MHz</td><td>-12.5dBm</td><td>100kHz</td></tr>
<tr><td>10.05 – f_offsetmax MHz</td><td>-13 dBm</td><td>100kHz</td></tr>
<tr><td colspan="3">Note: f_offset| is offset frequency from edge of channel bandwidth.</td></tr>
</table></td></tr>
<tr><td>UE</td><td>The spectrum emission mask limits in the Table 5.1.1.3.1-3-2 below.

Table 5.1.1.3.1-3-2 Spectrum emission mask for 900 MHz LTE UE

<table>
<tr><th rowspan="2">Frequency offset
|ΔfOOB|</th><th colspan="3">limit</th><th rowspan="2">Measurement bandwidth</th></tr>
<tr><th>5MHz</th><th>10MHz</th><th>15MHz</th></tr>
<tr><td>0–1MHz</td><td>-13.5</td><td>-16.5</td><td>-18.5</td><td>30kHz</td></tr>
<tr><td>1–2.5MHz</td><td>-8.5</td><td>-8.5</td><td>-8.5</td><td>1MHz</td></tr>
<tr><td>2.5–5MHz</td><td>-8.5</td><td>-8.5</td><td>-8.5</td><td>1MHz</td></tr>
<tr><td>5–6MHz</td><td>-11.5</td><td>-11.5</td><td>-11.5</td><td>1MHz</td></tr>
<tr><td>6–10MHz</td><td>-23.5</td><td>-11.5</td><td>-11.5</td><td>1MHz</td></tr>
<tr><td>10–15MHz</td><td></td><td>-23.5</td><td>-11.5</td><td>1MHz</td></tr>
<tr><td>15–20MHz</td><td></td><td></td><td>-23.5</td><td>1MHz</td></tr>
<tr><td>20–25MHz</td><td></td><td></td><td></td><td>1MHz</td></tr>
<tr><td colspan="5">Note: |ΔfOOB| is offset frequency from edge of channel bandwidth.</td></tr>
</table></td></tr>
</table>

(e) **Occupied bandwidth**

Occupied channel bandwidth requirements for 900MHz LTE BS and UE are specified as following:

BS: Occupied channel bandwidth shall be less than 5, 10 and 15 MHz for 5, 10 and 15MHz system, respectively.

UE: Occupied channel bandwidth shall be less than 5, 10 and 15 MHz for 5, 10 and 15MHz system, respectively.

(f) **Maximum output power**

Maximum output power requirements for 900MHz LTE operation in Japan are specified as following:

BS: In normal conditions, the Base station maximum output power shall remain within +2.7dB and -2.7dB of the manufacturer's rated output power.

UE: The maximum output power which is defined 23dBm in normal conditions, shall remain within +2.7dB and -2.7dB.

(g) **Transmit OFF power**

Transmit OFF power requirements for 900 MHz LTE operation in Japan are specified as following:

BS: Not specified.

UE: Transmit OFF power requirements are specified in Table 5.1.1.3.1-4.

Table 5.1.1.3.1-4: Transmit OFF power for LTE UE

	5MHz system	10MHz system	15MHz system
Transmit OFF power	-48.5dBm	-48.5dBm	-48.5dBm
Measurement bandwidth	4.5MHz	9MHz	13.5MHz

Transmit OFF power requirements include the test tolerance which is specified in TS36.521-1.

(h) **Transmit Intermodulation**

Transmit Intermodulation for 900 MHz LTE operation in Japan are specified same as other Bands shown following:

BS: The transmit intermodulation level is the power of the intermodulation products when a LTE modulated interference signal is injected into the antenna connector at a mean power level of 30 dB lower than that of the mean power of the wanted signal. The occupied bandwidth for the interference signal is specified as 5MHz. The frequency of the interference signal shall be ±5 MHz, ±10 MHz, ±15MHz offset from the subject signal carrier frequency for 5MHz system, ±7.5 MHz, ±12.5 MHz, ±17.5MHz offset from the subject signal carrier frequency for 10MHz system, and ±10 MHz, ±15MHz, ±20MHz offset from the subject signal carrier frequency for 15MHz system. The transmitter intermodulation level shall not exceed the out of band emission or spectrum emission mask or the spurious emission requirements.

UE: Not specified.

(i) Receiver Spurious emissions

Receiver Spurious emissions requirements for 900 MHz LTE operation in Japan are specified as in Table 5.1.1.3.1-5.

Table 5.1.1.3.1-5: Receiver Spurious emission requirements for 900 MHz LTE operation in Japan

<table>
<tr><th colspan="2">Parameter</th><th>Requirement</th></tr>
<tr><td rowspan="2">Receiver spurious emissions limits</td><td>BS</td><td>
Table 5.1.1.3.1-5-1 Receiver spurious emission limits for 900 MHz LTE BS
<table>
<tr><th>Frequency range</th><th>Maximum level</th></tr>
<tr><td>30MHz – 1000MHz</td><td>-57dBm/100kHz*</td></tr>
<tr><td>1GHz – 12.75GHz</td><td>-47dBm/1MHz</td></tr>
<tr><td>2010MHz – 2025MHz</td><td>-52dBm/1MHz</td></tr>
<tr><td colspan="2">*With the exception of frequencies between 935MHz and 970MHz.</td></tr>
</table>
</td></tr>
<tr><td>UE</td><td>
Table 5.1.1.3.1-5-2 Receiver spurious emissions limits for 900 MHz LTE UE
<table>
<tr><th>Frequency range</th><th>Maximum level</th></tr>
<tr><td>30MHz – 1GHz</td><td>-57dBm/100kHz</td></tr>
<tr><td>1GHz – 12.75GHz</td><td>-47dBm/1MHz</td></tr>
</table>
</td></tr>
</table>

5.1.1.3.2 Other technical conditions referred in Japan's regulations:

(a) Reference sensitivity level

BS: The reference sensitivity level for 900 MHz LTE operation in Japan are specified as in Table 5.1.1.3.2-1. The reference sensitivity level includes the test tolerance which is specified in TS36.141.

Table 5.1.1.3.2-1: LTE BS reference sensitivity levels

Rated output power	BS reference sensitivity level
> 24dBm	-100.8dBm
≤ 24dBm	-92.8dBm

UE: The reference sensitivity level for 900MHz LTE operation in Japan are specified as in Table 5.1.1.3.2-2. The reference sensitivity level includes the test tolerance which is specified in TS36.521-1.

Table 5.1.1.3.2-2: LTE UE reference sensitivity levels

Channel BW	UE reference sensitivity level
5MHz	-96.3dBm
10MHz	-93.3dBm
15MHz	-91.5dBm

(b) Adjacent Channel Selectivity (ACS)

BS: With the conditions described in Tables 5.1.1.3.2-3-1, 5.1.1.3.2-3-2 and 5.1.1.3.2-3-3, the throughput shall be larger than or equal to 95 percent of the maximum throughput.

Table 5.1.1.3.2-3-1: Test conditions of Adjacent channel selectivity for LTE BS - LTE BS with maximum output power > 24dBm

Parameter	Channel Bandwidth			Unit
	5MHz	10MHz	15MHz	
Propagation condition	Static			-
Wanted signal characteristics	QPSK, code rate 1/3			-
Wanted signal mean power	<REFSENS>+6			dBm
Interfering signal characteristics	5MHz BW modulated			-
Interfering signal mean power	-52			dBm
Few Offset (modulated)	5.0	7.5	10	MHz

Table 5.1.1.3.2-3-2: Test conditions of Adjacent channel selectivity for LTE BS - LTE BS with maximum output power ≤ 24dBm and > 20dBm

Parameter	Channel Bandwidth			Unit
	5MHz	10MHz	15MHz	
Propagation condition	Static			-
Wanted signal characteristics	QPSK, code rate 1/3			-
Wanted signal mean power	<REFSENS>+6			dBm
Interfering signal characteristics	5MHz BW modulated			-
Interfering signal mean power	-44			dBm
Few Offset (modulated)	5.0	7.5	10	MHz

Table 5.1.1.3.2-3-3: Test conditions of Adjacent channel selectivity for LTE BS - LTE BS with maximum output power ≤ 20dBm

Parameter	Channel Bandwidth			Unit
	5MHz	10MHz	15MHz	
Propagation condition	Static			-
Wanted signal characteristics	QPSK, code rate 1/3			-
Wanted signal mean power	<REFSENS>+22			dBm
Interfering signal characteristics	5MHz BW modulated			-
Interfering signal mean power	-28			dBm
Few Offset (modulated)	5.0	7.5	10	MHz

UE: With the conditions described in Table 5.1.1.3.2-4, the throughput shall be larger than or equal to 95 percent of the maximum throughput.

Table 5.1.1.3.2-4: Test conditions of Adjacent channel selectivity for LTE UE

Parameter	Channel Bandwidth			Unit
	5MHz	10MHz	15MHz	
Propagation condition	Static			-
Wanted signal characteristics	QPSK, code rate 1/3			-
Wanted signal mean power	<REFSENS>+14			dBm
Interfering signal characteristics	5MHz BW modulated			-
Interfering signal mean power	<REFSENS> +45.5	<REFSENS> +45.5	<REFSENS> +42.5	dBm
Few Offset (modulated)	5.0	7.5	10	MHz

(c) Blocking Characteristics

BS: With the conditions described in Tables 5.1.1.3.2-5-1, 5.1.1.3.2-5-2 and 5.1.1.3.2-5-3the throughput shall be larger than or equal to 95 percent of the maximum throughput.

Table 5.1.1.3.2-5-1: Test conditions of Blocking characteristics for LTE BS - for 900 MHz LTE BS with maximum output power > 24dBm

Parameter	Channel Bandwidth			Unit
	5MHz	10MHz	15MHz	
Propagation condition	Static			-
Wanted signal characteristics	QPSK, code rate 1/3			-
Wanted signal mean power	<REFSENS> +6dB			dBm
Interfering signal mean power	-43			dBm
Interfering signal channel bandwidth	5			MHz
Few offset (modulated)	10	12.5	15	MHz

Table 5.1.1.3.2-5-2: Test conditions of Blocking characteristics for LTE BS -for 900 MHz LTE BS with maximum output power ≤ 24dBm and > 20dBm

Parameter	Channel Bandwidth			Unit
	5MHz	10MHz	15MHz	
Propagation condition	Static			-
Wanted signal characteristics	QPSK, code rate 1/3			-
Wanted signal mean power	<REFSENS> +6dB	<REFSENS> +6dB	<REFSENS> +6dB	dBm
Interfering signal mean power	-35			dBm
Interfering signal channel bandwidth	5			MHz
Few offset (modulated)	10	12.5	15	MHz

Table 5.1.1.3.2-5-3: Test conditions of Blocking characteristics for LTE BS -LTE BS with maximum output power ≤ 20dBm

Parameter	Channel Bandwidth			Unit
	5MHz	10MHz	15MHz	
Propagation condition	Static			-
Wanted signal characteristics	QPSK, code rate 1/3			-
Wanted signal mean power	<REFSENS> +14dB	<REFSENS> +14dB	<REFSENS> +14dB	dBm
Interfering signal mean power	-27			dBm
Interfering signal channel bandwidth	5			MHz
Few offset (modulated)	10	12.5	15	MHz

UE: With the conditions described in Table 5.1.1.3.2-6, the throughput shall be larger than or equal to 95 percent of the maximum throughput.

Table 5.1.1.3.2-6: Test conditions of Blocking characteristics for LTE UE

Parameter		Channel Bandwidth			Unit
		5MHz	10MHz	15MHz	
Propagation condition		Static			-
Wanted signal characteristics		QPSK, code rate 1/3			-
Wanted signal mean power		<REFSENS> +6dB	<REFSENS> +6dB	<REFSENS> +7dB	dBm
Interfering signal 1	Characteristics	5MHz BW modulated			-
	Mean power	-56			dBm
	Few offset	10	12.5	15	MHz
Interfering signal 2	Characteristics	5MHz BW modulated			-
	Mean power	-44			dBm
	Few offset	≧15	≧17.5	≧20	MHz

(d) Reciever Intermodulation Characteristics

BS: With the conditions described in Tables 5.1.1.3.2-7-1, 5.1.1.3.2-7-2 and 5.1.1.3.2-7-3the throughput shall be larger than or equal to 95 percent of the maximum throughput.

Table 5.1.1.3.2-7-1: Test conditions of Receiver Intermodulation characteristics for LTE BS- for 900 MHz LTE BS with maximum output power > 24dBm

Parameter		Channel Bandwidth			Unit
		5MHz	10MHz	15MHz	
Propagation condition		Static			-
Wanted signal characteristics		QPSK, code rate 1/3			-
Wanted signal mean power		<REFSENS>+6dB			dBm
Interfering signal 1	Characteristics	CW			-
	Mean power	-52			dBm
	Few offset	10	12.5	15	MHz
Interfering signal 2	Characteristics	5MHz BW modulated			-
	Mean power	-52			dBm
	Few offset	20	22.7	25.5	MHz

Table 5.1.1.3.2-7-2: Test conditions of Receiver Intermodulation characteristics for LTE BS-for 900 MHz LTE BS with maximum output power ≤ 24dBm and > 20dBm

Parameter		Channel Bandwidth			Unit
		5MHz	10MHz	15MHz	
Propagation condition		Static			-
Wanted signal characteristics		QPSK, code rate 1/3			-
Wanted signal mean power		<REFSENS>+6dB			dBm
Interfering signal 1	Characteristics	CW			-
	Mean power	-44			dBm
	Few offset	10	12.5	15	MHz
Interfering signal 2	Characteristics	5MHz BW modulated			-
	Mean power	-44			dBm
	Few offset	20	22.7	25.5	MHz

Table 5.1.1.3.2-7-3: Test conditions of Receiver Intermodulation characteristics for LTE BS-LTE BS with maximum output power ≤ 20dBm

Parameter		Channel Bandwidth			Unit
		5MHz	10MHz	15MHz	
Propagation condition		Static			-
Wanted signal characteristics		QPSK, code rate 1/3			-
Wanted signal mean power		<REFSENS>+14dB			dBm
Interfering signal 1	Characteristics	CW			-
	Mean power	-36			dBm
	Few offset	10	12.5	15	MHz
Interfering signal 2	Characteristics	5MHz BW modulated			-
	Mean power	-36			dBm
	Few offset	20	22.7	25.5	MHz

UE: With the conditions described in Table 5.1.1.3.2-8, the throughput shall be larger than or equal to 95 percent of the maximum throughput.

Table 5.1.1.3.2-8: Test conditions of Receiver Intermodulation characteristics for LTE UE

Parameter		Channel Bandwidth			Unit
		5MHz	10MHz	15MHz	
Propagation condition		Static			-
Wanted signal characteristics		QPSK, code rate 1/3			-
Wanted signal mean power		<REFSENS> +6dB	<REFSENS> +6dB	<REFSENS> +7dB	dBm
Interfering signal 1	Characteristics	CW			-
	Mean power	-46			dBm
	Few offset	10	12.5	15	MHz
Interfering signal 2	Characteristics	5MHz BW modulated			-
	Mean power	-46			dBm
	Few offset	20	25	30	MHz

5.1.2 Korean regulatory requirement

In June 2010, the KCC (Korea Communications Commission) had allocated 2x10MHz bandwidth (UL: 839~849MHz, DL: 884~894MHz) of Band 5 to LG Uplus and 2x10MHz bandwidth (UL: 905~915MHz, DL: 950~960MHz) of Band 8 to KT for IMT services as shown in Figure 5.1.2-1.

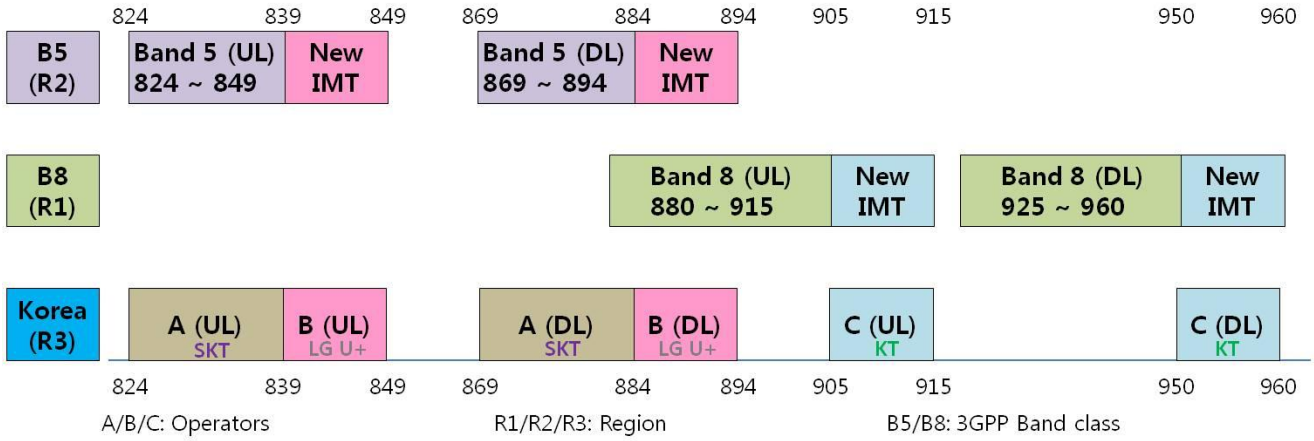


Figure 5.1.2-1: The status of 800-900MHz band in Korea

As there is no technical requirement for unwanted emission between Band 5 and Band 8 in TS25.101 and TS36.101, a technical regulation group, consisted of KCC and operators (SKT, KT and LG Uplus), was formed under the control of KCC in July 2010. The technical regulation group was responsible for making domestic standards on unwanted emission requirements between Band 5 and Band 8. As there was no consensus among members of the study group in spite of several meetings, KCC formed the technical expert committee organized with professors and, member of government R&D centre, and all of the three operators

KCC regulatory requirements had been discussed within technical expert committee from December 2010. As there was, still no consensus made among members of the technical expert committee, KCC made a tentative decision to set for the strictest requirement for available for UE and BS requirement based on field test. This tentative decision has been published in May 2011.

5.1.2.1 Technical conditions for UTRA in Korea

900MHz spectrum has been awarded to KT for use of UTRA or E-UTRA in Korea. KT will deploy E-UTRA in this spectrum and technical conditions for UTRA is not needed to be studied in this study item.

5.1.2.2 Technical conditions for E-UTRA in Korea

900MHz spectrum has been awarded to KT for use of UTRA or E-UTRA in Korea. KT will deploy E-UTRA in this spectrum.

5.1.2.2.1 Base Station (BS) requirements

Table 5.1.2.2.1-1 shows the BS Spurious emissions limits for Wide Area BS. Korean regulatory specifies Wide Area BS as BS with transmission power of more than +24dBm.

Table 5.1.2.2.1-1: BS Spurious emissions limits for Wide Area BS

Type of BS	Frequency range for co-location requirement	Maximum Level	Measurement Bandwidth	Note
WA UTRA FDD Band yyy or E-UTRA Band yyy	905-915 MHz	-76 dBm	100 kHz	

Table 5.1.2.2.1-2 shows the BS Spurious emissions limits for Local Area BS. Korean regulatory specifies Local Area BS as BS with transmission power of more than +20dBm but less than or equal to +24dBm.

Table 5.1.2.2.1-2: BS Spurious emissions limits for Local Area BS

Type of BS	Frequency range for co-location requirement	Maximum Level	Measurement Bandwidth	Note
LA UTRA FDD Band yyy or E-UTRA Band yyy	905-915 MHz	-76 dBm	100 kHz	

Table 5.1.2.2.1-3 shows the BS Spurious emissions limits for Home Area BS. Korean regulatory specifies Home Area BS as BS with transmission power of less than or equal to +20dBm.

Table 5.1.2.2.1-3: BS Spurious emissions limits for Home BS

Type of BS	Frequency range for co-location requirement	Maximum Level	Measurement Bandwidth	Note
Home UTRA FDD Band yyy or E-UTRA Band yyy	905-915 MHz	-71 dBm	100 kHz	

Above requirements had been acquired by actual field test on BS antennas. Two different types of antenna had been used but only result from Omni antenna had been considered for the evaluation. The distance between two antenna were set as 2 meters as most of the BS deployment in Korea is likely to be located within this distance. For this reason, 3GPP co-existence specification is not likely to be applicable for BS deployment in Korea.

Since BS requirements are operator specific, BS vendors shall meet this requirement in Korea. However, these Korean specific requirements are not intended to be implemented in any of 3GPP Technical Specifications.

5.1.2.2.2 UE to UE Coexistence requirements

Table 5.1.2.2.2-1 shows the UE to UE coexistence requirement between 900MHz UE and 800MHz UE. Korean regulatory specifies maximum emission level to be -30dBm/MHz.

Table 5.1.2.2.2-1: UE to UE Coexistence requirements

LTE UE Frequency Range	Spurious emission						
	Protected band	Frequency range (MHz)			Maximum Level (dBm)	MBW (MHz)	Comment
905-915MHz	Frequency range	884	-	894	-30	1	

Above requirement had been acquired based on the field test from commercial LTE network.

5.2 Frequency arrangement

5.2.1 Frequency arrangement in Japan

The frequency band for 900 MHz UMTS/LTE operation in Japan is as follows:

UL: 900MHz – 915MHz

DL: 945MHz – 960MHz

Tx-Rx frequency separation: 45MHz

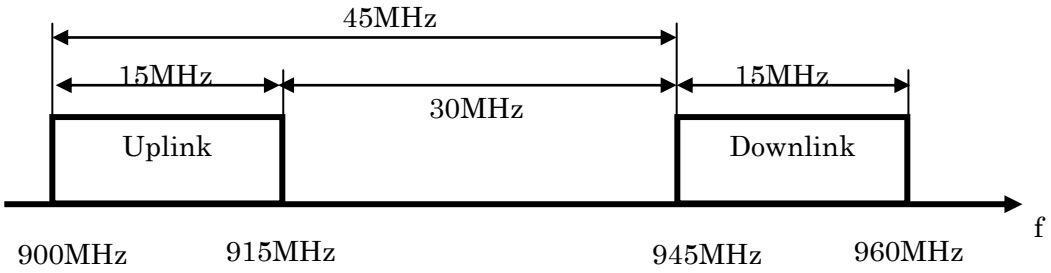


Figure 5.2.1-1: Frequency band for 900 MHz UMTS/LTE operation in Japan

5.2.2 Frequency arrangement in Korea

The frequency band for 900 MHz LTE operation in Korea is as follows:

UL: 905MHz – 915MHz

DL: 950MHz – 960MHz

Tx-Rx frequency separation: 45MHz

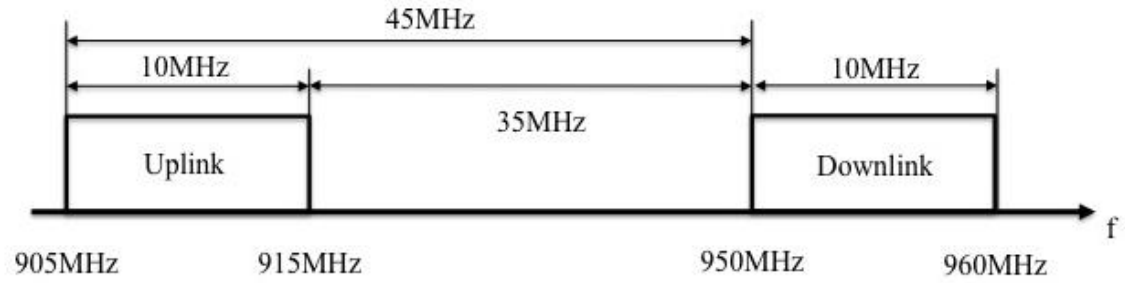


Figure 5.2.2-1: Frequency band for 900 MHz LTE operation in Korea

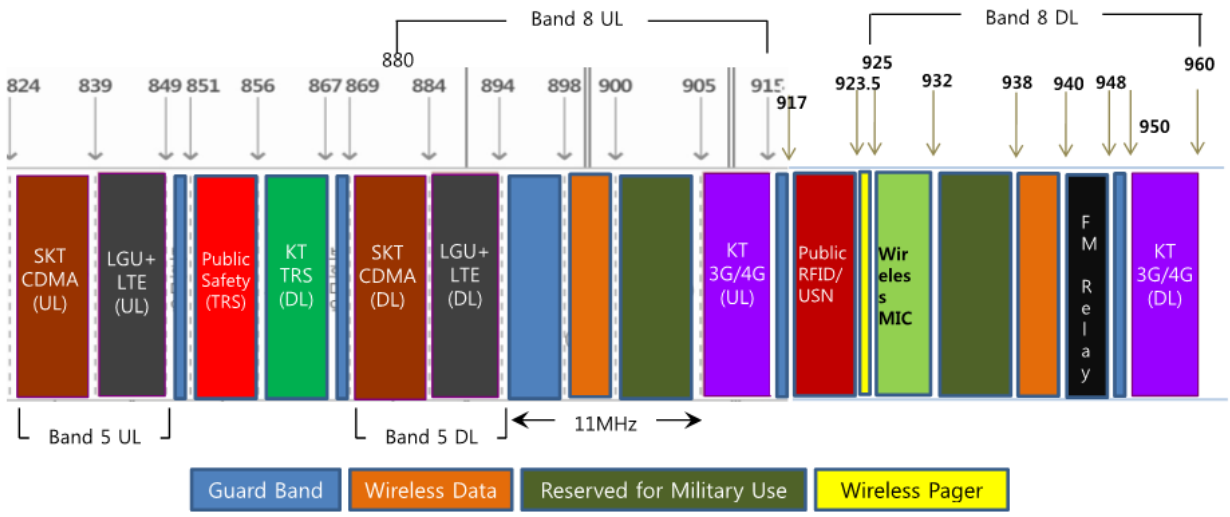


Figure 5.2.2-2: Detailed Frequency Arrangement of 800-900MHz band in Korea

Figure 5.2.2-2 shows detailed frequency arrangement of 800/900MHz band in Korea. Other usage of 900MHz includes Public RFID/USN, Wireless Pager, Wireless Data and FM relay. Co-existence with these technologies are out of scope for this study item.

6 List of band specific issues for UMTS/LTE in 900 MHz band

- <General issues>
  - Harmonization in the 900 MHz ranges Japan and Korea
- <UTRA issues>
  - Reuse of Band VIII for Japanese and/or Korean 900 MHz bands
    - Band VIII and 800 MHz band UE co-existence
    - Band VIII and 800 MHz band BS co-existence
  - Definition of a new band for Japanese and/or Korean 900 MHz bands
- <E-UTRA issues>
  - Reuse of Band 8 for Japanese and/or Korean 900 MHz bands
    - Band 8 and 800 MHz band UE co-existence
      - MPR and NS signalling addition for protection of 800 MHz to Band 8 UE
    - Addition of 15 MHz CBW requirements to Band 8 UE
    - Band 8 and 800 MHz band BS co-existence
  - Definition of a new band for Japanese and/or Korean 900 MHz bands
    - 900MHz band with Band 8 duplex filter
    - 900MHz band with dedicated duplex filter
- <MSR issues>
  - No issues found

7 General issues

7.1 Harmonization in the 900 MHz ranges Japan and Korea

For LTE deployment in Japan, only 5MHz and 10MHz are considered and 10MHz deployment is limited to upper 10MHz (UL: 905-915MHz, DL: 950-960MHz). Limiting UL RB allocation is considered for satisfying the Japanese protection requirement of -40dBm/MHz.

For LTE deployment in Korea, 10MHz deployment is planned with the same range as Japanese upper 10MHz deployment (UL: 905-915MHz, DL: 950-960MHz). Following clauses will examine whether Band 8 can satisfy the Korean regulation requirement of -30dBm/MHz.

The feasibility of using Band 8 LTE UE for both Japan and Korea is considered in the following clauses.

8 Study of UTRA specific issues

8.1 Reuse of Band VIII for Japanese and/or Korean 900 MHz bands

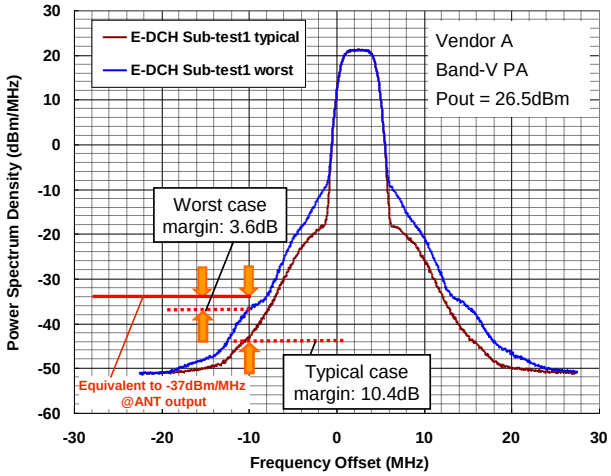
8.1.1 Band VIII and 800 MHz band UE co-existence

There are 2 cases of co-existence between Band VIII UE and 800 MHz band in Korea and Japan.

- In Korea, Band V DL (869-894 MHz) needs to be protected from the UL in 905-915 MHz.
- In Japan, Band XVIII DL (860-875 MHz) and XIX DL (875-890 MHz) need to be protected from the UL in 900-915 MHz.

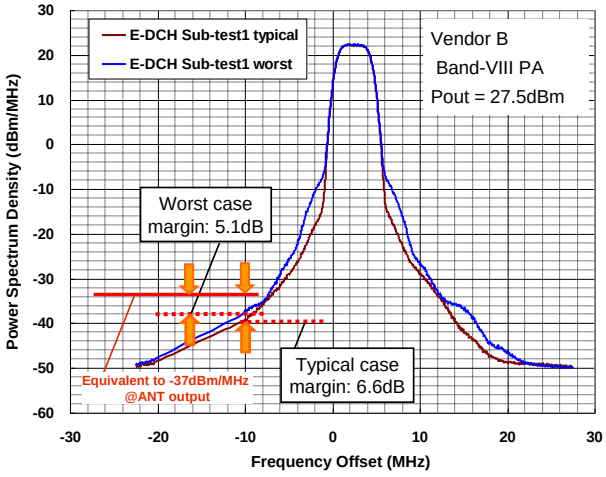
Assuming the typical minimum distance from the band edge for a carrier frequency is 2.4 MHz, the minimum carrier spacing between the aggressor and victim UEs is 14.8 MHz. Based on the model, which is verified by measuring an actual PA device, the PA ACLR is approximated by an ACLR level of 36 dBc at 5 MHz offset and an ACLR slope of 13 dB/5 MHz for a single uplink carrier [10]. Approximating the minimum carrier spacing is 15MHz, thus, the ACLR term of 62 dBc/3.84MHz can be applicable. Assuming a 24 dBm R99 output power at antenna port, the spurious emission is -38 dBm/3.84 MHz (=24-62). This is equivalent to -43.8 dBm/1MHz for a single uplink. Furthermore, assuming the ACLR level at 5MHz is 33 dBc, which is specified as ACLR1 level in TS25.101, the spurious emission becomes -40.8 dBm/1MHz in the same manner.

In addition, Band XIX DL protection from Band VIII UE is analysed using the measurement results of commercially available PAs [11]. These PAs are evaluated for ACLR1 under the condition by intentionally manipulating its voltage bias with 33 dBc.



PA vendor A

Figure 8.1.1 (a)



PA vendor B

Figure 8.1.1 (b)

Figure 8.1.1-1 Power Amplifier Output Spectrum [11].

Figure 8.1.1 shows that typical PAs have at least 3.6 dB margin from Japanese regulation of -37 dBm/1MHz.

In Japan, the spurious emission requirement is -37 dBm/1MHz in 800 MHz DL bands (860-890 MHz), which can be achieved without any changes to hardware or to software.

8.1.2 Band VIII and 800 MHz band BS co-existence

Figure 8.1.2-1 shows the summary of the frequency allocations of 900 MHz bands in Japan and Korea, and the corresponding 3GPP bands.

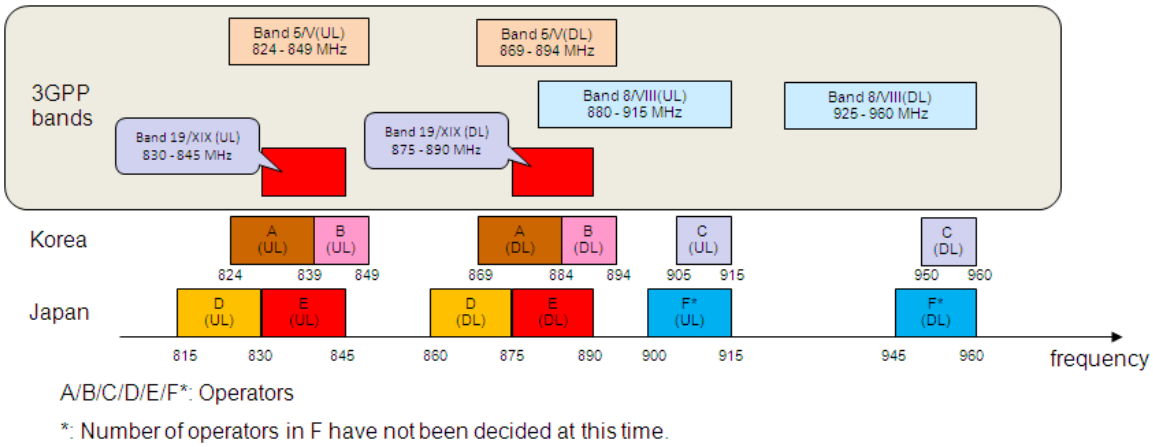


Figure 8.1.2-1: Frequency allocations of 900 MHz bands in Japan and Korea, and the corresponding 3GPP bands

With respect to the frequency allocations of 900 MHz bands in Japan and Korea, the following issues on the co-existence between 800 MHz BS and 900 MHz BS should be studied:

- a-1) 900 MHz band BS blocking under the interference from 800 MHz band DL
- b-1) Spurious emission power levels of 800 MHz band DL for protection of 900 MHz band UL

Here, the above co-existence issues a-1) and b-1) could be replaced with the following if the design of the Rx filters for 900 MHz band BS in Japan and Korea are equivalent to that of Band VIII BS:

- a-2) Band VIII BS blocking under the interference from Band V/XIX DL
- b-2) Spurious emission power levels of Band V/XIX BS for protection of band VIII UL

Considering Band VIII UL is overlapping in Band V/XIX DL, the above co-existence issues a-2) and b-2) could not be solved due to the little attenuation of Rx filter for Band VIII BS in Band V/XIX DL.

However, the actual frequency allocations of 800 MHz and 900 MHz bands in Japan and Korea are not overlapping Then the above co-existence issues a-1) and b-1) could be solved through the following manner.

- a-3) Expecting additional coupling loss by the site-engineering between 800 MHz band BS and 900 MHz band BS and/or additional attenuation by installing the operator specific Rx filter.
- b-3) Introducing the exception of spurious emission requirement of Band V/XIX BS for protection of the not operated frequency range in Band VIII UL in Japan and Korea.

As conclusion, the co-existence between 800 MHz band BS and 900 MHz band BS would not be the issue on the feasibility to use UMTS band VIII in Japan and Korea. However, whether the above regional solution should be captured in 3GPP specification and, if necessary, how to capture this regional solution needs to be further discussed.

8.2 Definition of a new band for Japanese and/or Korean 900 MHz bands

In Japan, use of UMTS Band VIII UE and BS for Japanese 900 MHz band is feasible as described in the previous section. Therefore, consideration of a new UMTS band for the Japanese 900 MHz band is not required.

9 Study of E-UTRA specific issues

9.1 Reuse of Band 8 for Japanese and/or Korean 900 MHz band

This section summarizes issues and additional requirements when Band 8 E-UTRA UE/BS is to be operated under Japanese/Korean regulations.

9.1.1 Band 8 and 800 MHz band UE co-existence

9.1.1.1 A-MPR and NS signalling addition for protection of 800MHz to Band 8 UE

In Japan, -40dBm/MHz will be required for a UE operating in 900MHz to protect Band 18/19 as mentioned in 5.1.1.2.1(b). With Band 8 RF frontend, part of Band 19 spectrum is within the pass band of Band 8 Tx filter and it is impossible to comply with the regulation. The introduction of appropriate A-MPR (and relevant NS signalling) is a method to satisfy the protection requirement. Study results were presented for A-MPR values required to be compliant with the regulation[6, 7]:

Table 9.1.1.1-1: A-MPR Study Results for Japanese 900MHz

E-UTRA channel BW [MHz]	Nokia (R4-113677)[6]	Qualcomm (R4-113792)[7]
5	0dB	0dB (Small Margin)
10	5dB/50RB (0dB, <20RB)	4dB/50RB
15	10dB/1RB	TBD

Protection requirement for Band 5 in Korea is settled as -30dBm/MHz. In order to examine the feasibility of using Band 8 LTE UE for Korean 900MHz following results are driven from various contributions [8], [9], [10]. It can be seen from these results that Band 8 satisfies Korean domestic regulation with 1-2dB margins and Band 8 can be used in Korea without any restrictions:

Table 9.1.1.1-2: Feasibility of Band 8 LTE UE for Korean 900MHz

E-UTRA channel BW [MHz]	Ericsson [8] (R4-121813)	Nokia [9] (R4-122815)	Qualcomm [10] (R4-123280)
10	-31dBm/MHz	32dBm/MHz	-31dBm/MHz

It should be noted that 15MHz CBW is not applicable in Korea.

9.1.2 Addition of 15 MHz CBW requirements to Band 8 UE

At present, E-UTRA Band 8 supports up to 10MHz channel bandwidths but Japanese 900MHz is possible to support up to 15MHz. In case of 15MHz CBW, special care must be taken for "counter IM issues" mentioned in [9] and complicated A-MPR table would be required. The initial study result for necessary A-MPR scheme was shown in Table 9.1.2-1[6].

Table 9.1.2-1: A-MPR for 15MHz CBW for Japan [6]

Parameters	Region A	Region B		Region C
RB_start	0 – 5	6 – 68		69 – 74
L_CRB [RBs]	1 – 75	1 – 25	≥26	1 – 6
A-MPR [dB]	≤ 10	0	≤ 6	≤ 7

9.1.3 Band 8 and 800 MHz band BS co-existence

The conclusion of the UMTS (section 8.1.2) could be also applied to the LTE.

9.2 Definition of a new band for Japanese and/or Korean 900 MHz bands

9.2.1 900MHz band with Band 8 duplex filter

There are a couple of RF frontend configurations possible for defining a new band for Japanese/Korean 900MHz. One approach is to reuse Band 8 RF components to minimize diversity with the introduction of the new band. This scheme

will be advantageous from economical standpoint, i.e. merit of scale of UE or RF parts. Apparently this scheme will inherit the same RF issues discussed in 9.1 but is considered easier to introduce new capabilities than reusing Band 8. The discussion in 9.1 can be applied directly in terms of A-MPR.

9.2.2 900MHz band with dedicated duplex filter

An alternative approach is to provide RF frontend tuned for Japan/Korea spectrum arrangement. While this approach promises the best possible RF performance, concerns are beyond technical aspects, such as UE/parts supply.

9.3 Finalized spectrum allocation and relevant studies for Japan

9.3.1 Finalized spectrum allocation

In February 2012, SOFTBANK MOBILE was awarded for full 15MHz. Spectrum usage plan was proposed in [13], which assumed the reuse of Band 8 UE. For E-UTRA, spectrum is divided into 5MHz (900 – 905MHz) and 10 MHz (905 – 915MHz) for compatibility with the existing Band 8 specification and 15MHz is to be realized with intra-band carrier aggregation (out of the scope of the SI). The arrangement is shown in Figure 9.3.1.

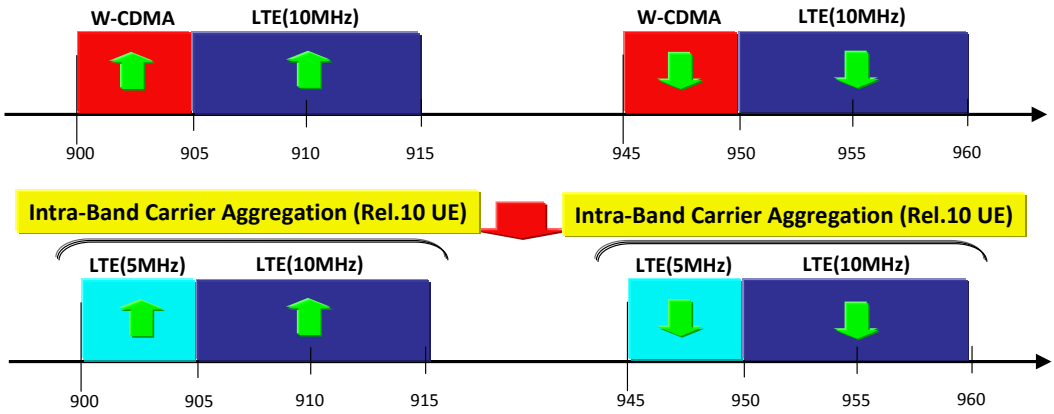


Figure 9.3.1-1: Spectrum Allocation Plan for Japanese 900MHz

9.3.2 UE evaluation results

A number of evaluation results for UE performance were presented in [14 – 19] in response to the spectrum allocation proposal in the previous section. Note that, in the course of discussion, it was confirmed impossible to introduce a newly defined A-MPR to Band 8. Instead, evaluations are conducted for the necessity of RB allocation limitation and PUCCH over-provisioning for both 5MHz and 10MHz cases. Proposed results are summarized in Table 9.3.2. Note that the following results are based on Rel-8 performance assumptions, i.e. -25dBc for I/Q impairment and LO leakage.

Table 9.3.2-1: UE evaluation results for Band 8 for Japan

	RB Limitation for 5MHz	Over-Provisioning for 5MHz	RB Limitation for 10MHz	Over-Provisioning for 10MHz
LG[14]	20RB	Not Needed	32RB	Not Needed
Nokia[15]	Not Needed	Not Needed	40RB	Not Needed
Renesas[16]	Not Needed	Not Needed	40RB	4RB
Er/ST-Er[17]	20RB	Not Needed	36RB	3RB
Intel[18]	20RB	Not Needed	32RB	Not Needed
Qualcomm[19]	20RB	Not Needed	36RB	3-4RB

While there is some diversity observed among results, it can be understood that the diversity reflects possible different implementations, esp. on the performance of power amplifiers. To utilize an existing LTE UE for Band 8 in Japan, it is necessary to accept all the limits shown in the table above: up to 20RBs and no PUCCH over-provisioning for 5MHz (900-905MHz), up to 32RBs and 3-4 PUCCH over-provisioning needed for 10MHz (905-915MHz).

9.4 Summary of findings and way forward for Japan

As discussed above, from technical standpoint, it can be concluded that Band 8 is possible to operate in Japan with some operational remedies, such as limiting RB allocations and PUCCH over-provisioning. The reflection of these results to relevant technical specifications, in addition to Japanese regulatory requirements, will be the main subject of the forthcoming WI. Further refinements might be needed on some details, for example, how to treat RBs outside PUCCH when over-provisioning is applied.

On the other hand, from operational standpoint, limiting RB with an aid of eNodeB scheduler does not show any explicit sign of regulatory enforcement like A-MPR. Therefore there should be some agreements/arrangements needed among the relevant parties for the compliance to the regulations. While this aspect is out of the scope of 3GPP in principle, there might be additional requirements coming from the negotiation process.

10 Study of MSR specific issues

<Text will be added>

11 Void

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12 Required changes to E-UTRA, UTRA and MSR specifications

The required changes to the 3GPP specifications for the new band are summarised in a Table 12-1.

Table 12-1: Overview of 3GPP specifications with required changes

3GPP specification	Clause in TR 30.007 where the required changes are given	Clause in the present document identifying additional changes
TS 36.101	8.2.1.1	
TS 36.104	8.2.1.2	
TS 36.106	8.2.1.3	
TS 36.113	8.2.1.4	
TS 36.124	8.2.1.5	
TS 36.133	8.2.1.6	
TS 36.141	8.2.1.7	
TS 36.143	8.2.1.8	
TS 36.307	8.2.1.9	
TS 25.101	8.2.2.1	
TS 25.102	8.2.2.2	
TS 25.104	8.2.2.3	
TS 25.105	8.2.2.4	
TS 25.106	8.2.2.5	
TS 25.113	8.2.2.6	
TS 25.123	8.2.2.7	
TS 34.124	8.2.2.8	
TS 25.133	8.2.2.9	
TS 25.141	8.2.2.10	
TS 25.142	8.2.2.11	
TS 25.143	8.2.2.12	
TS 25.307	8.2.2.13	
TS 25.331	8.2.2.14	
TS 25.461	8.2.2.15	
TS 25.466	8.2.2.16	
TS 37.104	8.2.3.1	
TS 37.113	8.2.2.2	
TS 37.141	8.2.2.3	

Annex A:
Change history

Change history							
Date	**TSG #**	**TSG Doc.**	**CR**	**Rev**	**Subject/Comment**	**Old**	**New**
2011-06	RAN4#59AH	R4-113655			TR skeleton		0.0.1
2011-06	RAN4#59AH	R4-113871			Addition of table 12-1 based on the TR 30.007(R4-113644)	0.0.1	0.0.2
2011-06	RAN4#59AH	R4-113656			Agreed Text Proposals in RAN4#59AH: R4-113657, "Text proposal for UMTS/LTE in 900 MHz band TR: frequency band arrangements and regulatory background in Japan"	0.0.2	0.1.0
2011-08	RAN4#60	R4-114197			Agreed Text Proposals in RAN4#59AH: R4-113986, "TP on E-UTRA UE related Issues to the UMTS/LTE in 900 MHz band SI TR" R4-114068, "TP for 900 MHz band SI TR: Definition of a new UMTS band for Japanese 900 MHz band" R4-114194, "TP on 900 MHz band specific issues to the UMTS/LTE in 900 MHz band SI TR" R4-114195, "TP to the UMTS/LTE in 900 MHz band TR about co-existence between Band 5/19 BS and Band 8 BS" R4-114716, "TP for 900 MHz band SI TR: Study of UTRA UE specific issues"	0.1.0	0.2.0
2011-11	RAN4#61	R4-115984			Agreed Text Proposals in RAN4#59AH: R4-114871 TP for Korean Regulations regarding BS-BS co-existence issues in the 800/900MHz Spectrum R4-114872 TP for UMTS/LTE 900MHz band Study Item regarding Technical conditions for UTRA in Korea R4-115178 TP for 900MHz frequency allocation in Korea R4-115327 TP for Study of Korean regulation requirements for 900 MHz band R4-115456 TP for Study of co-existence with other technologies in 900 MHz band in Korea	0.2.0	0.3.0
2012-05	RAN4#63	R4-123367			Agreed Text Proposals in RAN4#62bis: R4-122128 TP for TR 37.804 Technical conditions for E-UTRA in Korea	0.3.0	0.4.0
2012-05	RAN4#63	R4-123632			Agreed Text Proposals in RAN4#63: R4-123510 Text Proposal for TR37.804 on band arrangement and UE evaluation result of band 8 in Japan R4-123622 TP for TR 37.804 Study of E-UTRA specific issues R4-123631 TP for TR 37.804 Harmonization in the 900MHz ranges Japan and Korea	0.4.0	0.5.0
2012-06	RAN #56	RP-120618			Presentation to TSG RAN for approval	0.5.0	1.0.0
2012-06	RAN#56				Approved by RAN	1.0.0	11.0.0