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Radio Frequency (RF) system scenarios  
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# Foreword

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# 1 Scope

During the E-UTRA standards development, the physical layer parameters will be decided using system scenarios, together with implementation issues, reflecting the environments that E-UTRA will be designed to operate in.

# 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 25.896, "Feasibility Study for Enhanced Uplink for UTRA FDD"
- [2] 3GPP TR 25.816, "UMTS 900 MHz Work Item Technical Report"
- [3] 3GPP TR 25.942, "Radio Frequency (RF) system scenarios"
- [4] 3GPP TR 25.814, "Physical Layer Aspects for Evolved UTRA"
- [5] 3GPP TR 30.03, "Selection procedures for the choice of radio transmission technologies of the UMTS"
- [6] R4-051146, "Some operators' requirements for prioritization of performance requirements work in RAN WG4", RAN4#37
- [7] 3GPP TR 25.951, "FDD Base Station (BS) classification"
- [8] 3GPP TR 25.895, "Analysis of higher chip rates for UTRA TDD evolution."
- [9] R4-070235, "Analysis of co-existence simulation results", RAN4#42
- [10] R4-070084, "Coexistence Simulation Results for 5MHz E-UTRA -> UTRA FDD Uplink with Revised Simulation Assumptions", RAN4#42
- [11] R4-070034, "Additional simulation results on 5 MHz LTE to WCDMA FDD UL co-existence studies", RAN4#42
- [12] R4-070262, "Simulation results on 5 MHz LTE to WCDMA FDD UL co-existence studies with revised simulation assumptions", RAN4#42
- [13] R4-070263, "Proposal on LTE ACLR requirements for UE", RAN4#42
- [14] R4-061288, "Downlink LTE 900 (Rural Macro) with Downlink GSM900 (Rural Macro) Co-existence Simulation Results", RAN4#41
- [15] R4-070391, "LTE 900 - GSM 900 Downlink Coexistence", RAN4#42bis
- [16] R4-061304, "LTE 900 - GSM 900 Uplink Simulation Results", RAN4#41
- [17] R4-070390, "LTE 900 - GSM 900 Uplink Simulation Results", RAN4#42bis
- [18] R4-070392 "LTE-LTE Coexistence with asymmetrical bandwidth", RAN4#42bis
- [19] 3GPP TS 36.104, "Base Station (BS) radio transmission and reception"
- [20] 3GPP TS 25.104, "Base Station (BS) radio transmission and reception (FDD)"

- [21] 3GPP TS 36.141, "Base Station (BS) conformance testing"
- [22] Recommendation ITU-R SM.329-10, "Unwanted emissions in the spurious domain"
- [23] "International Telecommunications Union Radio Regulations", Edition 2004, Volume 1 – Articles, ITU, December 2004.
- [24] "Adjacent Band Compatibility between UMTS and Other Services in the 2 GHz Band", ERC Report 65, Menton, May 1999, revised in Helsinki, November 1999.
- [25] "Title 47 of the Code of Federal Regulations (CFR)", Federal Communications Commission.
- [26] R4-070337, "Impact of second adjacent channel ACLR/ACS on ACIR" (Nokia Siemens Networks).
- [27] R4-070430, "UE ACS and BS ACLRs" (Fujitsu ).
- [28] R4-070264, "Proposal on LTE ACLR requirements for Node B" (NTT DoCoMo).
- [29] Recommendation ITU-R M.1580-1, "Generic unwanted emission characteristics of base stations using the terrestrial radio interfaces of IMT-2000".
- [30] Report ITU-R M.2039, "Characteristics of terrestrial IMT-2000 systems for frequency sharing/interference analyses".
- [31] ETSI EN 301 908-3 V2.2.1 (2003-10), "Electromagnetic compatibility and Radio spectrum Matters (ERM); Base Stations (BS), Repeaters and User Equipment (UE) for IMT-2000 Third-Generation cellular networks; Part 3: Harmonized EN for IMT-2000, CDMA Direct Spread (UTRA FDD) (BS) covering essential requirements of article 3.2 of the R&TTE Directive".

---

## 3 Definitions, symbols and abbreviations

### 3.1 Definitions

### 3.2 Symbols

### 3.3 Abbreviations

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

|      |                                      |
|------|--------------------------------------|
| ACIR | Adjacent Channel Interference Ratio  |
| ACLR | Adjacent Channel Leakage power Ratio |
| ACS  | Adjacent Channel Selectivity         |
| AMC  | Adaptive Modulation and Coding       |
| AWGN | Additive White Gaussian Noise        |
| BS   | Base Station                         |
| CDF  | Cumulative Distribution Function     |
| DL   | Downlink                             |
| FDD  | Frequency Division Duplex            |

|     |                              |
|-----|------------------------------|
| MC  | Monte-Carlo                  |
| MCL | Minimum Coupling Loss        |
| MCS | Modulation and Coding Scheme |
| PC  | Power Control                |
| PSD | Power Spectral Density       |
| RX  | Receiver                     |
| TDD | Time Division Duplex         |
| TX  | Transmitter                  |
| UE  | User Equipment               |
| UL  | Uplink                       |

## 4 General assumptions

The present document discusses system scenarios for E-UTRA operation primarily with respect to the radio transmission and reception including the RRM aspects. To develop the E-UTRA standard, all the relevant scenarios need to be considered for the various aspects of operation and the most critical cases identified. The process may then be iterated to arrive at final parameters that meet both service and implementation requirements.

The E-UTRA system is intended to be operated in the same frequency bands specified for UTRA. In order to limit the number of frequency bands to be simulated in the various simulation scenarios a mapping of frequency bands to two simulation frequencies (900 MHz and 2000 MHz) is applied. When using the macro cell propagation model of TR25.942 [3], the frequency contributes to the path loss by  $21 \cdot \log_{10}(f)$ . The maximum path loss difference between the lowest/highest frequencies per E-UTRA frequency band and corresponding simulation frequency is shown in tables 4.1 and 4.2.

**Table 4.1: Simulation frequencies for FDD mode E-UTRA frequency bands**

| E-UTRA Band | UL frequencies (MHz) |         | DL frequencies (MHz) |         | Simulation frequency (MHz) | Path loss difference (dB) |                      |
|-------------|----------------------|---------|----------------------|---------|----------------------------|---------------------------|----------------------|
|             | lowest               | highest | lowest               | highest |                            | lowest UL frequency       | highest DL frequency |
| 1           | 1920                 | 1980    | 2110                 | 2170    | 2000                       | 0.37                      | 0.74                 |
| 2           | 1850                 | 1910    | 1930                 | 1990    | 2000                       | 0.71                      | 0.05                 |
| 3           | 1710                 | 1785    | 1805                 | 1880    | 2000                       | 1.43                      | 0.56                 |
| 4           | 1710                 | 1755    | 2110                 | 2155    | 2000                       | 1.43                      | 0.68                 |
| 5           | 824                  | 849     | 869                  | 894     | 900                        | 0.80                      | 0.06                 |
| 6           | 830                  | 840     | 875                  | 885     | 900                        | 0.74                      | 0.15                 |
| 7           | 2500                 | 2570    | 2620                 | 2690    | 2000                       | 2.04                      | 2.70                 |
| 8           | 880                  | 915     | 925                  | 960     | 900                        | 0.20                      | 0.59                 |
| 9           | 1749.9               | 1784.9  | 1844.9               | 1879.9  | 2000                       | 1.22                      | 0.56                 |
| 10          | 1710                 | 1770    | 2110                 | 2170    | 2000                       | 1.43                      | 0.74                 |
| 11          | 1427.9               | 1452.9  | 1475.9               | 1500.9  | 2000                       | 3.07                      | 2.62                 |

**Table 4.2: Simulation frequencies for TDD mode E-UTRA frequency bands**

| E-UTRA band | UL/DL frequencies (MHz) |         | Simulation frequency (MHz) | Path loss difference (dB) |                   |
|-------------|-------------------------|---------|----------------------------|---------------------------|-------------------|
|             | lowest                  | highest |                            | lowest frequency          | highest frequency |
| 33          | 1900                    | 1920    | 2000                       | 0.47                      | 0.37              |
| 34          | 2010                    | 2025    | 2000                       | 0.05                      | 0.11              |
| 35          | 1850                    | 1910    | 2000                       | 0.71                      | 0.42              |
| 36          | 1930                    | 1990    | 2000                       | 0.32                      | 0.05              |
| 37          | 1910                    | 1930    | 2000                       | 0.42                      | 0.32              |
| 38          | 2570                    | 2620    | 2000                       | 2.29                      | 2.46              |

It can be observed that the difference of path loss between simulation frequency and operating frequency (except bands 7, 11 and 38) is in the worst case less than 0.8 dB for the downlink and less the 1,5 dB for the uplink. Hence the mapping of operating frequency to simulation frequency will provide valid results.

The validity of simulations performed at 2 GHz for the 2.6 GHz bands 7 and 38 was already analyzed in TR 25.810. Considering the expected higher antenna gain in the 2.6 GHz band the difference in path loss is in the order of 1 dB what is comparable to the other frequency bands.

## 4.1 Interference scenarios

This chapter should cover how the interference scenarios could occur e.g. BS-BS, UE-BS etc.

## 4.2 Antenna Models

This chapter contains the various antenna models for BS and UE

### 4.2.1 BS antennas

#### 4.2.1.1 BS antenna radiation pattern

The BS antenna radiation pattern to be used for each sector in 3-sector cell sites is plotted in Figure 4.1. The pattern is identical to those defined in [1], [2] and [4]:

$$A(\theta) = -\min \left[ 12 \left( \frac{\theta}{\theta_{3dB}} \right)^2, A_m \right] \text{ where } -180 \leq \theta \leq 180,$$

$\theta_{3dB}$  is the 3dB beam width which corresponds to 65 degrees, and  $A_m = 20dB$  is the maximum attenuation

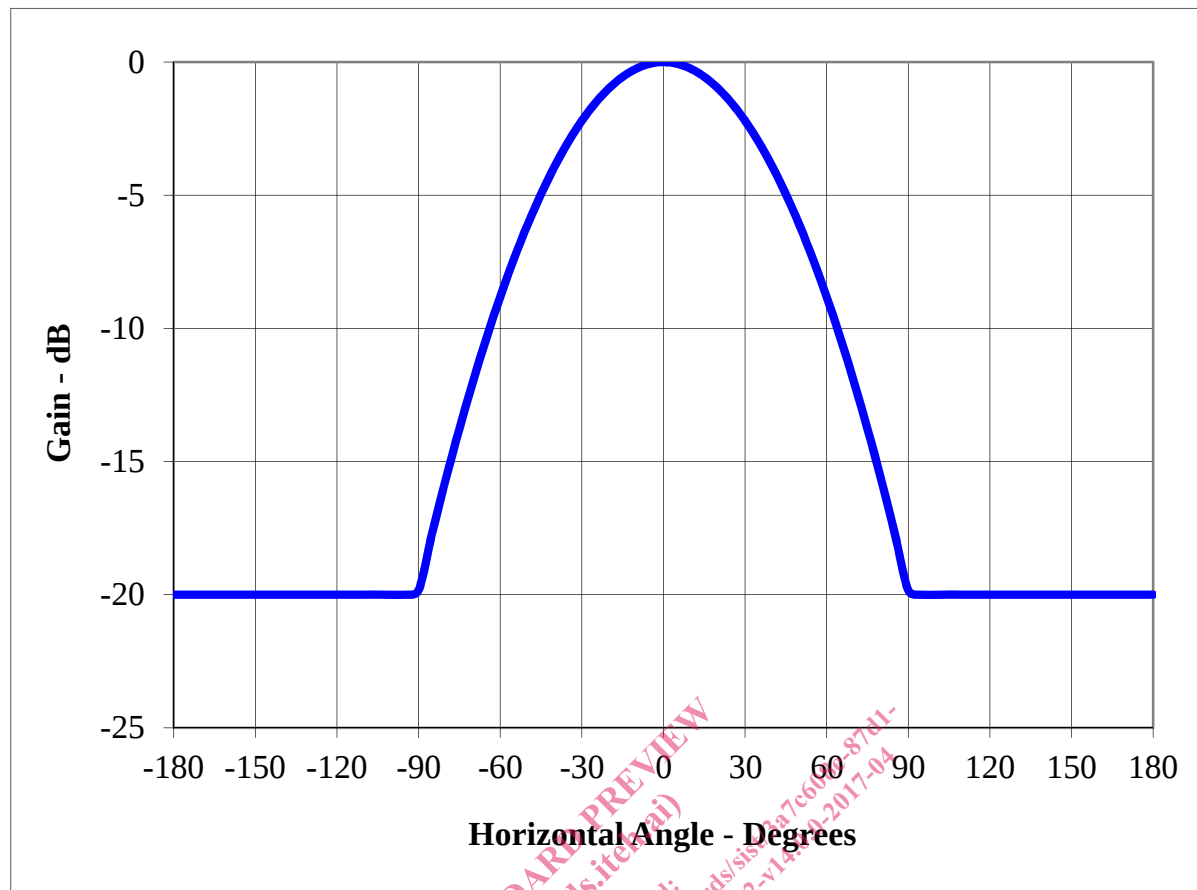


Figure 4.1: Antenna Pattern for 3-Sector Cells

#### 4.2.1.2 BS antenna heights and antenna gains for macro cells

Antenna heights and gains for macro cells are given in table 4.3.

Table 4.3: Antenna height and gain for Macro Cells

|                                                  | Rural Area | Urban Area |         |
|--------------------------------------------------|------------|------------|---------|
|                                                  | 900 MHz    | 2000 MHz   | 900 MHz |
| BS antenna gain (dBi)<br>(including feeder loss) | 15         | 15         | 12      |
| BS antenna height (m)                            | 45         | 30         | 30      |

#### 4.2.2 UE antenna

For UE antennas, a omni-directional radiation pattern with antenna gain 0dBi is assumed [2], [3], [4].

#### 4.2.3 MIMO antenna Characteristics

xxxx

### 4.3 Cell definitions

This chapter contain the cell properties e.g. cell range, cell type (omni, sector), MIMO cell definitions etc.

## 4.4 Cell layouts

This chapter contains different cell layouts in form of e.g. single operator, multi-operator and multi layer cell layouts (e.g. macro-micro etc).

### 4.4.1 Single operator cell layouts

#### 4.4.1.1 Macro cellular deployment

Base stations with 3 sectors per site are placed on a hexagonal grid with distance of  $3 \cdot R$ , where  $R$  is the cell radius (see Figure 4.2), with wrap around. The number of sites shall be equal to or higher than 19. [2] [4].

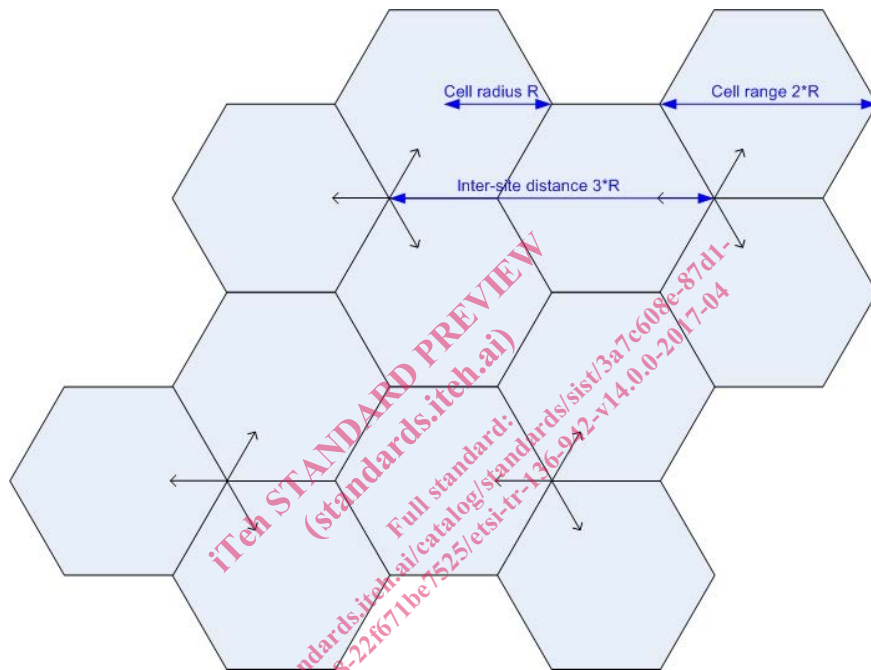


Figure 4.2: Single operator cell layout

### 4.4.2 Multi operator / Multi layer cell layouts

#### 4.4.2.1 Uncoordinated macro cellular deployment

For uncoordinated network simulations, identical cell layouts for each network shall be applied, with worst case shift between sites. Second network's sites are located at the first network's cell edge, as shown in Figure 4.3 [2].