TSG RAN *R4.01* *V 0.0.2 (1999-03)*

3rd Generation Partnership Project (3GPP);
Technical Specification Group (TSG) RAN;
Working Group 4 (WG4);
RF System Scenarios

Contents

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[Editor's note: This section needs to be reviewed. It is assumed here than a 3GPP IPR report will be available in the near future.]

1 Scope

During the UTRA standards development, the physical layer parameters will be decided using system scenarios, together with implementation issues, reflecting the environments that 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.
- A non-specific reference to an ETS shall also be taken to refer to later versions published as an EN with the same number.

[1] Reference 1.

3 Definitions, symbols and abbreviations

3.1 Definitions

For the purposes of the present document, the following terms and definitions apply:

definition 1: to be completed.

3.2 Symbols

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

S1 Symbol 1

3.3 Abbreviations

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

A1 Abbreviation 1

4 General

The present document discusses system scenarios for UTRA operation primarily with respect to the radio transmission and reception. To develop the 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.

Each scenario has four sections:

a) lists the system constraints such as the separation of the MS and BTS, coupling loss;
b) lists those parameters that are affected by the constraints;
c) describes the methodology to adopt in studying the scenario;
d) lists the inputs required to examine the implications of the scenarios.

The following scenarios will be discussed for FDD and TDD modes (further scenarios will be added as and when identified):

1) Single MS, single BTS;
2) MS to MS;
3) MS to BS;
4) BS to MS;

5) BS to BS.

These scenarios will be considered for coordinated and uncoordinated operation. Parameters possibly influenced by the scenarios are listed in XX.06 for FDD and XX.12 for TDD. These include, but are not limited to:

- Out of band emissions;
- Spurious emissions;
- Intermodulation rejection;
- Intermodulation between MS;
- Reference interference level;
- Blocking.

5 Single MS and BTS

5.1 Constraints

The main constraint is the physical separation of the MS and BTS. The extereme conditions are when the MS is close to or remote from the BTS.

5.1.1 Frequency Bands and Channel Arrangement

5.1.2 Proximity

Table 1: Examples of close proximity scenarios in urban and rural environments

	Rural	Urban			
		Building	Street	pedestrian	indoor
BTS antenna height, Hb (m)	[20]	[30]	[15]	[6]	[2]
MS antennaheight, Hm (m)	1,5	[15]	1,5	1,5	1,5
Horizontal separation (m)	[30]	[30]	[10]	[2]	[2]
BTS antenna gain, Gb (dB)	[17]	[17]	[9]	[5]	[0]
MS antenna gain, Gm (dB)	[0]	[0]	[0]	[0]	[0]
Path loss into building (dB)					
Cable/connector Loss (dB)	2	2	2	2	2
Body Loss (dB)	[1]	[1]	[1]	[1]	[1]
Path Loss - Antenna gain (dB)					

Path loss is assumed to be free space i.e. 38,25 +20 log d (m) dB, where d is the length of the sloping line connecting the transmit and receive antennas.

<Editor’s note: This will be used to determine MCL >

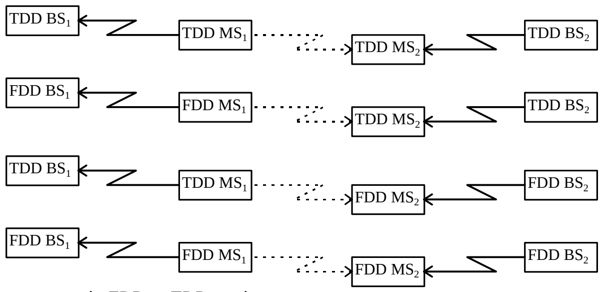
6 Mobile Station to Mobile Station

6.1 Near-far effect

a) System constraints

Dual mode operation of a terminal and hand-over between FDD and TDD are not considered here, since the hand-over protocols are assumed to avoid simultaneous transmission and reception in both modes.

The two mobile stations can potentially come very close to each other (less than 1m). However, the probability for this to occur is very limited and depends on deployment.



Both MS can operate in FDD or TDD mode.

Figure 1: Possible MS to MS scenarios

b) Affected parameters
[FDD and TDD] MS Out-of-band emissions
[FDD and TDD] MS Spurious emissions
[FDD and TDD] MS Blocking
[FDD and TDD] MS Reference interference level
c) Methodology
The first approach is to calculate the minimum coupling loss between the two mobiles, taking into account a minimum separation distance. It requires to assume that the interfering mobile operates at maximum power and that the victim mobile operates [3] dB above sensitivity.
Another approach is to take into account the deployment of mobile stations in a dense environment, and to base the interference criterion on:

- the actual power received by the victim mobile station;
- the actual power transmitted by the interfering mobile station, depending on power control.

This approach gives as a result a probability of interference.
The second approach should be preferred, since the power control has a major impact in this scenario.
d) Inputs required
For the first approach, a minimum distance separation and the corresponding path loss is necessary.
For the second approach, mobile and base station densities, power control algorithm, and maximum acceptable probability of interference are needed.
Minimum separation distance: 5 m[for outdoor, 1 m for indoor]
Mobile station density: [TBD in relation with service, cell radius and system capacity]
Base station density: [cell radius equal to 4 km for rural, 0,5 km for urban or 0,1 km for indoor]
Power control algorithm: [TBD]
Maximum acceptable probability of interference: 2 %
e) scenarios for coexistence studies
The most critical case occurs at the edge of FDD and TDD bands. Other scenarios need to be considered for TDD operation in case different networks are not synchronised or are operating with different frame switching points.
FDD MS → TDD MS at 1 920 MHz (macro/micro, macro/pico)
TDD MS → FDD MS at 1 920 MHz (micro/micro, pico/pico)
TDD MS → TDD MS (micro/micro, pico/pico) for non synchronised networks
These scenarios should be studied for the following services:

Environment	Services
Rural Macro	Speech, LCD 144
Urban Micro/Macro	Speech, LCD 384
Indoor Pico	Speech, LCD 384, LCD 2 048

6.2 Co-located MS and intermodulation

a) System constraints

Close mobile stations can produce intermodulation products, which can fall into mobile or base stations receiver bands. This can occur with MS operating in FDD and TDD modes, and the victim can be BS or MS operating in both modes.

Figure 2: Possible collocated MS scenarios

b) Affected parameters
[FDD and TDD] intermodulation between MS
[FDD and TDD] MS and BS blocking
[FDD and TDD] MS and BS reference interference level
c) Methodology
The first approach is to assume that the two mobile stations are collocated, and to derive the minimum coupling loss. It requires to assume that both mobiles are transmitting at maximum power.
Another approach can take into account the probability that the two mobiles come close to each other, in a dense environment, and to calculate the probability that the intermodulation products interfere with the receiver.
The second approach should be preferred.
d) Inputs required
Minimum separation distance: 5 m[for outdoor, 1 m for indoor]
Mobile station density: [TBD]
Base station density: [TBD in relation with MS density]
Power control algorithm: [TBD]
Maximum acceptable probability of interference: 2 %

7 Mobile Station to Base Station

a) System constraints
A mobile station, when far away from its base station, transmits at high power. If it comes close to a receiving base station, interference can occur.
The separation distance between the interfering mobile station and the victim base station can be small, but not as small as between two mobile stations.
Both the mobile and the base stations can operate in FDD and TDD modes, thus four scenarios are to be considered, as shown in Figure 3.

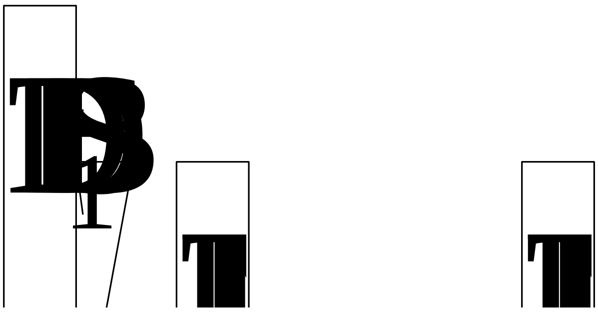


Figure 3: Possible MS to BS scenarios

b) Affected parameters
[FDD and TDD] MS Out-of-band emissions
[FDD and TDD] MS Spurious emissions
[FDD and TDD] BS Blocking
[FDD and TDD] BS Reference interference level
c) Methodology
The first approach is to assume that the mobile station transmits at maximum power, and to make calculations for a minimum distance separation. This approach is particularly well suited for the blocking phenomenon.
Another approach is to estimate the loss of uplink capacity at the level of the victim base station, due to the interfering power level coming from a distribution of interfering mobile stations. Those mobile stations are power controlled. A hexagonal cell lay-out is considered for the BS deployment with specified cell radius. Large cell radius are chosen since they correspond to worst case scenarios for coexistence studies.
The second approach should be preferred.
With both approaches two specific cases are to be considered:
Both base stations (BS_1 and BS_2) are co-located. This case occurs in particular when the same operator operates both stations (or one station with two carriers) on the same HCS layer.
The base stations are not co-located and uncoordinated. This case occurs between two operators, or between two layers.
d) Inputs required
Minimum separation distance: [30 m for rural, 15 m for urban, 3 m for indoor]
Base station density: [cell radius equal to 4 km for rural/macro, 1,5 km for urban/macro, 0,5 km for urban/micro or 0,1 km for indoor/pico]
Interfering mobile station density: [TBD in relation with service, cell radius and system capacity]
Power control algorithm: [TBD]
Maximum acceptable loss of capacity: [10 %]
e) scenarios for coexistence studies
Inter-operator guard band (uncoordinated deployment)
FDD macro/ FDD macro
FDD macro/ FDD micro
FDD macro/ FDD pico (indoor)
FDD micro/ FDD pico (indoor)
TDD macro/ TDD macro
TDD macro/ TDD micro
TDD macro/ TDD pico (indoor)
TDD micro/ TDD pico (indoor)
FDD macro/ TDD macro at 1 920 MHz
FDD macro/ TDD micro at 1 920 MHz
FDD macro/ TDD pico at 1 920 MHz
FDD micro/ TDD micro at 1 920 MHz
FDD micro/ TDD pico at 1 920 MHz
Intra-operator guard bands

FDD macro/ FDD macro (colocated)
FDD macro/ FDD micro
FDD macro/ FDD pico (indoor)
FDD micro/ FDD pico (indoor)
TDD macro/ TDD macro
TDD macro/ TDD micro
TDD macro/ TDD pico (indoor)
TDD micro/ TDD pico (indoor)
FDD macro/ TDD macro at 1 920 MHz
FDD macro/ TDD micro at 1 920 MHz
FDD macro/ TDD pico at 1 920 MHz
FDD micro/ TDD micro at 1 920 MHz
FDD micro/ TDD pico at 1 920 MHz
These scenarios should be studied for the following services:

Environment	Services
Rural Macro	Speech, LCD 144
Urban Micro/Macro	Speech, LCD 384
Indoor Pico	Speech, LCD 384, LCD 2 048

8 Base Station to Mobile Station

8.1 Near-far effect

a) System constraints
A mobile station, when far away from its base station, receives at minimum power. If it comes close to a transmitting base station, interference can occur.
The separation distance between the interfering base station and the victim mobile station can be small, but not as small as between two mobile stations.
Both the mobile and the base stations can operate in FDD and TDD modes, thus four scenarios are to be considered, as shown in Figure 4.

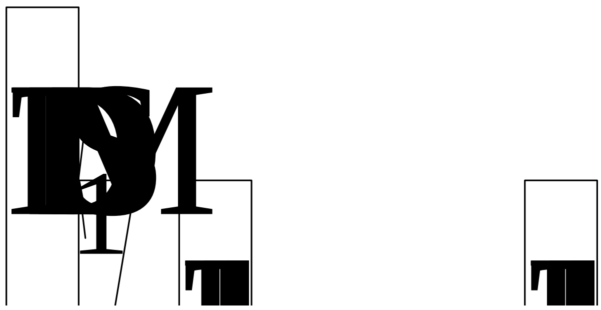


Figure 4: Possible BS to MS scenarios

b) Affected parameters
[FDD and TDD] BS Out-of-band emissions
[FDD and TDD] BS Spurious emissions
[FDD and TDD] MS Blocking
[FDD and TDD] MS Reference interference level
c) Methodology
The first approach is to calculate the minimum coupling loss between the base station and the mobile, taking into account a minimum separation distance. It requires to assume that the mobile is operating [3] dB above sensitivity.

The second approach is to take into account the deployment of mobile stations in a dense environment, and to base the interference criterion on the actual power received by the victim mobile station. This approach gives a probability of interference. An hexagonal cell lay-out is considered for the BS deployment with specified cell radius. Large cell radius are chosen since they correspond to worst case scenarios for coexistence studies.
The second approach should be preferred.
d) Inputs required
Minimum separation distance: [30 m for rural, 15 m for urban, 3 m for indoor]
Base station density: [cell radius equal to 4 km for rural/macro, 1,5 km for urban/macro, 0,5 km for urban/micro or 0,1 km for indoor/pico]
Victim mobile station density: [TBD in relation with service, cell radius and system capacity]
Downlink power control algorithm: [TBD]
Maximum acceptable probability of interference: 2 %
e) scenarios for coexistence studies
Inter-operator guard band (uncoordinated deployment)
FDD macro/ FDD macro
TDD macro/ TDD macro
TDD macro/ FDD macro at 1 920 MHz
Intra-operator guard bands
FDD macro/ FDD micro
TDD macro/ TDD micro
TDD macro/ FDD macro at 1 920 MHz
These scenarios should be studied for the following services:

Environment	Services
Rural Macro	Speech, LCD 144
Urban Micro/Macro	Speech, LCD 384
Indoor Pico	Speech, LCD 384, LCD 2 048

8.2 Co-located Base Stations and intermodulation

a) System constraints
Co-located base stations can produce intermodulation products, which can fall into mobile or base stations receiver bands. This can occur with BS operating in FDD and TDD modes, and the victim can be BS or MS operating in both modes.

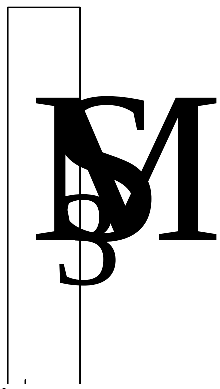


Figure 5: Possible collocated BS scenarios

b) Affected parameters
[FDD and TDD] intermodulation between BS
[FDD and TDD] MS and BS blocking
[FDD and TDD] MS and BS reference interference level
c) Methodology

The first approach is to set a minimum separation distance between the two interfering base stations and the victim.
Another approach can take into account the probability that the intermodulation products interfere with the receiver, which does not necessarily receive at a fixed minimum level.
The second approach should be preferred.
d) Inputs required
Minimum separation distance between the two BS and the victim: [30 m for rural, 15 m for urban, 3m for indoor]
Mobile station density: [TBD]
Base station density: [TBD in relation with MS density]
Power control algorithm: [TBD]
Maximum acceptable probability of interference: 2 %

9 Base Station to Base Station

a) System constraints
Interference from one base station to another can occur when both are co-sited, or when they are in close proximity with directional antenna. De-coupling between the BS can be achieved by correct site engineering on the same site, or by a large enough separation between two BS.
The base stations can operate either in FDD or TDD modes, as shown in Figure 6.

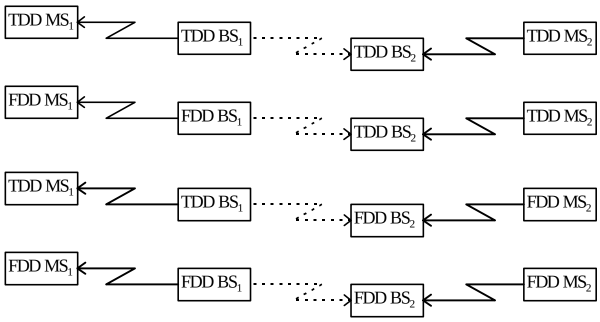


Figure 6: Possible BS to BS scenarios

b) Affected parameters
[FDD and TDD] BS Out-of-band emissions
[FDD and TDD] BS Spurious emissions
[FDD and TDD] BS Blocking
[FDD and TDD] BS Reference interference level
c) Methodology
This scenario appears to be fixed, and the minimum coupling loss could be here more appropriate than in other scenarios.
However, many factors are of statistical nature (number and position of mobile stations, power control behaviour, path losses, ...) and a probability of interference should here again be preferred.
d) Inputs required
Minimum coupling between two base stations: [50] dB
Mobile station density: [TBD in relation with service, cell radius and system capacity]
Base station density: [cell radius equal to 4 km for rural/macro, 1,5 km for urban/macro, 0,5 km for urban/micro or 0,1 km for indoor/pico]
Uplink and downlink power control algorithm: [TBD]
Maximum acceptable probability of interference: 2 %
e) scenarios for coexistence studies
TDD BS → FDD BS at 1 920 MHz (macro/micro, macro/pico)
TDD BS → TDD BS (micro/micro, pico/pico) for non synchronised networks
These scenarios should be studied for the following services:

Environment	Services
Rural Macro	Speech, LCD 144
Urban Micro/Macro	Speech, LCD 384
Indoor Pico	Speech, LCD 384, LCD 2 048

10 Methodology for coexistence studies

The scenarios defined above are to be studied in order to define RF parameters and to evaluate corresponding carrier spacing values for various configurations. The following methodology should be used to derive these results:
Define spectrum masks for UTRA MS and BS, with associated constraints on PA.
Evaluate the ACP as a function of carrier spacing for each proposed spectrum mask.
Evaluate system capacity loss as a function of ACP for various system scenarios (need to agree on power control algorithm).
Establish the overall trade-off between carrier spacing and capacity loss, including considerations on PA constraints if required. Conclude on the optimal spectrum masks or eventually come back to the definition of spectrum masks to achieve a better performance/cost trade-off.

11 Results and recommendation

This section is intended to collect results on carrier spacing evaluations and maybe some recommendation on deployment coordination, or on multi-layers deployment. Requirements related to RF parameters are expected to be included in document XX.06 and XX.12.

History

Document history		
Date	**Version**	**Comment**
Februrary 1999	0.0.1	Based on XX.17 v 1.0.1 approved by ETSI at SMG # 29
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