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Foreword

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

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Introduction

Void

1 Scope

This document is the technical report of the UMTS 900 MHz WI which was approved in TSG RAN meeting #26 [1].

The purpose of this TR is to summarize the study of radio frequency (RF) requirements for UTRA-FDD operating in the 900 MHz Band defined as follows :

- 880 – 915 MHz: Up-link (UE transmit, Node B receive)
- 925 – 960 MHz: Down-link (Node B transmit, UE receive)

2 References

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

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

[1] RP-040541, "WI proposal for UMTS 900 MHz"

[2] 3GPP TR25.942, "Radio Frequency (RF) system scenarios"

[3] 3GPP TR25.885, "UMTS1800/1900 Work Items Technical Report "

[4] R4-031025, "Summary of T1P1.2 Conclusions Regarding UMTS 850 Simulation Results"

[5] R4-050248, "Additional simulation scenarios for UMTS900 work "

[6] R4-050423, Initial simulation results for UMTS 900MHz (Siemens)

[7] R4-050503, UMTS 900 / GSM coexistence simulation results in Urban area in uncoordinated operation (UMTS900 Scenario 1) (Motorola)

[8] R4-050504, UMTS 900 / GSM coexistence simulation results in Rural area in uncoordinated operation (UMTS900 Scenario 2) (Motorola)

[9] R4-050526, Uplink simulation results for UMTS900 co-existence Scenario 4 (Qualcomm)

[10] R4-050536, UMTS900 (Macro)-GSM (Macro) Co-existence Simulation Results for Scenario 1, Downlink (Lucent)

[11] R4-050539, Initial simulation results for UMTS900 Scenario 4 (Ericsson)

[12] R4-050758, UMTS900 (Macro)-GSM900 (Micro) Co-existence Simulation Results for Scenario 5, GSM as victim (Lucent)

[13] R4-050832, UMTS900 (Macro)-GSM (Macro) Co-existence Simulation Results for Scenario 1, Uplink (Lucent)

[14] R4-050869, Partial simulation results for UMTS900 (Nortel)

[15] R4-050906, Simulation results for UMTS900 scenarios 1 and 2 (Nokia)

[16] R4-050929, Simulation results for UMTS900 co-existence Scenario 1 (Qualcomm)

[17] R4-050930, Simulation results for UMTS900 co-existence Scenario 2 (Qualcomm)

[18] R4-050931, Simulation results for UMTS900 co-existence Scenario 4 (Qualcomm)

[19] R4-050935, Simulation Results for UMTS 900MHz Coexistence Scenarios 1 to 4 (Siemens)

[20] R4-050653, Simulation results for UMTS900 Scenarios 1 and 2 (Ericsson)

[21] R4-050998, Simulation results for UMTS900 scenarios 3 (Nokia)

[22] R4-051033r1, UMTS900, GSM and WCDMA emissions as a function of carrier separation

[23] R4-051067, UMTS900 simulation results summary

[24] R4-051307, Band VIII Rx sensitivity

[25] R4-051204, Possible impact on UMTS900 coverage/capacity due to UE sensitivity degradation

[26] R4-051206, ACIR for UMTS UL/DL as victim and for GSM UL/DL as victim

[27] R4-051182, Simulation results for UMTS900 co-existence Scenario 5

[28] R4-051183, Simulation and Analysis of Interference for UMTS900 co-existence Scenario 6

[29] R4-051097, Simulation results for UMTS900, Scenario 1-4

[30] R4-051098, Simulation results for UMTS900, Scenario 5

[31] R4-051176, Scenario 5 - UMTS900 (Macro) - GSM900 (Micro) Co-existence Simulation Results.

[32] R4-051076, UMTS 900 macro/ GSM micro coexistence simulation results in urban area in uncoordinated operation (UMTS900 Scenario 5)

[33] R4-051177, Analysis results for UMTS900 (macro)-GSM (pico) co-existence scenario 6

[34] R4-051325, Analysis of scenario 6

[35] R4-051359, Simulated UE Tx powers for the Scenario 6 interference analysis

[36] ECC report 82 "Compatibility study for UMTS operating within the GSM 900 and GSM 1800 frequency bands", Roskilde, May 2006

[37] Larkin, R.S "Multiple-signal intermodulation and stability considerations in the use of linear repeater", Vehicular Technology Conference, 19-22 May 1991

3 Definitions, symbols and abbreviations

3.1 Definitions

For the purposes of the present document, the [following] terms and definitions [given in ... and the following] apply.

3.2 Symbols

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

3.3 Abbreviations

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

WCDMA Wideband Code Division Multiple Access, a type of cellular system meeting ITU-2000 requirement

UMTS	Universal Mobile Telecommunications System, often used synonymously with WCDMA
GSM	Global System for Mobile communications (throughout this document, this acronym is generally to also means the services GPRS and EDGE, both enhancements to GSM, unless not applicable to the discussion.)
UE	User Equipment, also cellular terminal
MS	Mobile Station
BS	Base Station
DL	Downlink, the RF path from BS to UE
ACIR	Adjacent Channel Interference Rejection
TX	Transmitter
RX	Receiver

4 Study of the RF requirements

This chapter describes the reusability of the existing UMTS850/1800 simulation results, the additional UMTS900 deployment scenarios, simulation assumptions, and derived RF requirements for UMTS900 BS and UE.

4.1 Reusability of existing UMTS 850 and UMTS 1800 MHz simulation results and RF requirements

The Band I RF requirements have been determined by system simulations assuming the 2 GHz propagation models of TR 25.942[2]. The system simulation methodology, assumptions, and results for the derivation of UMTS1800/1900 RF requirements are reported and described in TR25.885[3]. The same deployment scenarios and similar system simulation assumptions were used for the derivation of UMTS850 RF requirements, the summary of the simulation results can be found in the document R4-031025[4]. The difference of propagation pathloss between 900 MHz band and 1800 MHz/2100 MHz bands can be as big as 10 dB, but the propagation pathloss difference between 900 MHz band and 850 MHz band is only of 0.46 dB, calculated with Hata model. So the simulation results for UMTS850 can be considered as valid for UMTS900. Therefore, it is proposed that, whenever applicable, the Band V (850 MHz band) simulation results and RF requirements will be reused for UMTS900.

4.2 Additional deployment scenarios and simulation results

Six additional deployment scenarios have been identified and agreed for UMTS 900 [5], the simulation assumptions and the simulation results for these additional deployment scenarios are described below.

4.2.1 Scenario_1: UMTS(macro)-GSM(macro) in Urban area with cell range of 500 m in uncoordinated operation

4.2.1.1 2x5 MHz uncoordinated operation between UMTS macrocell and GSM macrocell

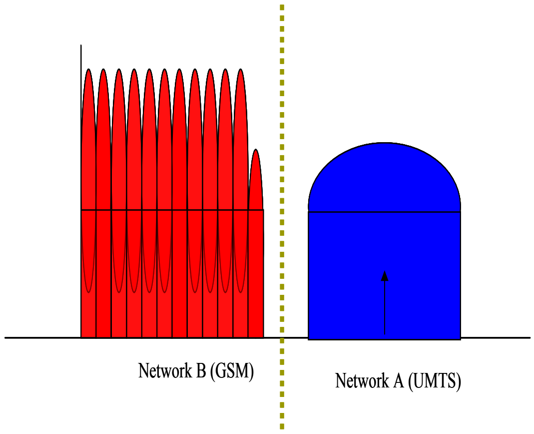

Figure 1A: 2x5 MHz uncoordinated operation

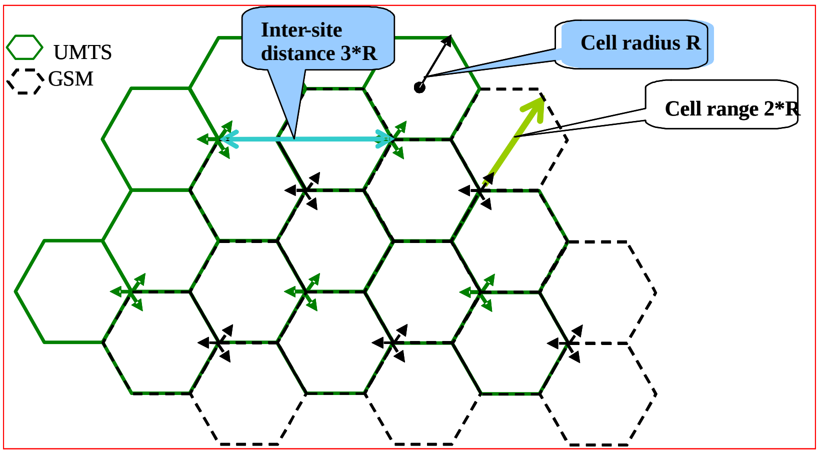

Figure 1B: 2x5 MHz uncoordinated operation

The co-existence scenario is presented in the figure 1A and 1B. UMTS carrier and GSM carriers are in adjacent placement. In this uncoordinated operation, GSM sites are located at the cell edge of UMTS cells as shown in figure 1. Simulation assumptions for this co-existence scenario are summarized in the table 1.

Table 1: Summary of UMTS900/GSM900 simulation parameters for Scenario 1

Scenario_1		UMTS(macro)-GSM(macro) in Urban area with cell range of 500 m in uncoordinated operation
Simulation cases		Both UMTS and GSM as victims in uplink and downlink. In total 4 simulation cases. 1) Downlink -GSM (BCCH only)/WCDMA for WCDMA victim -GSM (non-BCCH with PC)/WCDMA for GSM victim 2) Uplink - WCDMA victim (GSM load maximum – all time slots in use. Simulate GSM system, then add UMTS users until the total noise rise hits 6 dB) - GSM victim (WCDMA loaded to 6 dB noise rise) No frequency hopping for GSM Both networks in macro environment Run simulations with various ACIRs by considering a center frequency separation of 2.8 MHz.
Network layout		As shown in figure 1 above - Urban environment - 3-sector configuration -GSM cell reuse GSM: 4/12 -36 cells (i.e., 108 sectors) with wrap-around -Cell radius R=250m, cell range 2R=500m, inter-site distance 3R= 750 m (as shown in figure 1) -Worst-case shift between operators, GSM site is located at WCDMA cell edge
System parameters	**WCDMA**	- BS antenna gain with cable loss included = 12 dBi - BS antenna height Hbs=30 m; - UE antenna height Hms=1.5 m - BS-UE MCL=70 dB - BS antenna(65° horiziontal opening) radiation pattern is refered to 3GPP TR 25.896 V6.0.0 (2004-03), Section A.3 - UE antenna gain 0 dBi (omni-directional pattern)
	GSM	- BS antenna gain with cable loss included = 12 dBi - BS antenna height Hbs=30 m; - MS antenna height Hms=1.5 m - BS-MS MCL=70 dB - BS antenna(65° horizinal opening) radiation pattern is refered to 3GPP TR 25.896 V6.0.0 (2004-03), Section A.3 - UE antenna gain 0 dBi (omni-directional pattern)
Services	**WCDMA**	8 kbps Speech (chip rate: 3.84 Mcps) - Eb/Nt target (downlink): 7.9 dB - Eb/Nt target (uplink): 6.1 dB
	GSM	Speech - SINR target (downlink): 9 dB - SINR target (uplink): 6 dB
Propagation Model	**WCDMA and GSM**	As per TR 25.942 Log_normal_Fading = 10 dB Urban propagation model: L(R) = 40*(1-0.004*DHb)*LOG10(R)-18*LOG10(DHb)+21*LOG10(f)+80 DHb is BS antenna height above average building top, for urban area with Hbs=30m, DHb=15m, f is frequency in MHz, R is distance in km L(R) = 37.6* LOG10(R) + 121.1 The path loss from a transmitter antenna connector to a receiver antenna connector (including both antenna gains and cable losses) will be determined by: Path_Loss = max (L(R) + Log_normal_Fading - G_Tx – G_Rx, Free_Space_Loss + Log_normal_Fading - G_Tx – G_Rx, MCL) where : - G_Tx is the transmitter antenna gain in the direction toward the receiver antenna, which takes into account the transmitter antenna pattern and cable loss, - G_Rx is the receiver antenna gain in the direction toward the transmitter antenna,

		which takes into account the receiver antenna pattern and cable loss, Log_normal_Fading is the shadowing fade following the log-normal distribution.
Cell selection	**WCDMA**	As per TR 25.942
	GSM	As for WCDMA in TR 25.942, but with only one link selected at random within a 3 dB handover margin
SIR calculation	**WCDMA**	As per TR 25.942, except for the following changes: - Interference contributions from GSM TRXs or MSs are added to the total noise-plus-interference. - Processing gain is changed to 26.8 dB for 8 kbps - Thermal noise level is raised to -96 dBm for downlink
	GSM	Total noise-plus-interference is sum of thermal noise, GSM co-channel, and WCDMA interference. Cells are synchronised on a time slot basis. Adjacent channel GSM interference is neglected. Noise floor (downlink): -111 dBm Noise floor (uplink): -113 dBm
Power Control assumption	**WCDMA**	As per TR 25.942 - 21 dBm terminals - Maximum BS power: 43 dBm - Maximum power per DL traffic channel: 30 dBm - Minimum BS power per user: 15 dBm. - Minimum UE power: –50 dBm. - Total CCH power: 33 dBm
	GSM	Stabilization algorithm same as for WCDMA (C/I based) with a margin of 5 dB added to the SIR target. - Maximum power (TRx): 43 dBm - Minimum power (TRx): 10 dBm (non-BCCH) - Maximum power (MS): 33 dBm - Minimum power (MS): 5 dBm
Capacity	**WCDMA**	Capacity loss versus ACIR as per TR 25.942
	GSM	Load to maximum number of users and observe change in outage (i.e., 0.5 dB less than SINR target)
ACIR	**WCDMA to GSM**	As per spectrum masks defined in TS 25.101, TS 25.104 (applying the appropriate measurement BW correction), unless capacity loss is found to be significant.
	GSM	$\mathrm{ACIR}(f) = C(f_0) + m(f - f_0) \quad \text{(dB)}$ GSM BTS to WCDMA UE: Consider 3GPP TS45005 GSM BTS transmitter emission mask for 900 band and WCDMA UE receiver selectivity slope, m = 0.8 dB / 200 kHz GSM MS to WCDMA BS: Consider 3GPP TS45005 GSM MS transmitter emission mask for 900 band and WCDMA BS receiver characteristics, m = 0.5 dB / 200 kHz

4.2.1.2 Analysis method

The objective of Monte-carlo simulations is to determine the appropriate UMTS BS & UE RF system parameters, Spectrum mask, ACLR (Adjacent Channel power Leakage Ratio), ACS (Adjacent Channel Selectivity), receiver narrow band blocking, etc. for ensuring the good co-existence of UMTS and GSM. In the simulation, the UMTS UL/DL capacity losses as function of ACIR (Adjacent Channel Interference Ratio) are simulated, the GSM UL/DL system outage degradations at given ACIR values or as function of ACIR are also simulated. In the simulations, the ACIR is used as a variable parameter.

In order to analyse the simulation results, it is supposed that UMTS900 system (BS & UE) has the same RF requirements, such as Tx spectrum mask, ACLR, ACS, narrow band blocking characteristics as defined in TS25.104 and TS25.101 for UMTS850/1800 (band V, band III), the spectrum mask of GSM BS & MS are defined in 3GPP TS45.005. Then the simulation results are analyzed based on these assumptions for checking if the assumed RF characteristics are sufficient or not for ensuring the required good co-existence between UMTS900 and GSM900 in the same geographical area.

RAN WG4 agreed threshold for co-existence is that UMTS UL/DL capacity loss due to interferences from GSM UL/DL should not be bigger than 5%. Concerning the impact on GSM network performance, since GSM network capacity is fixed, the evaluation criterion is the system outage degradation, the system outage degradation should be as small as possible.

For the co-existence between UMTS and GSM, the ACLR of UMTS BS & UE are calculated with the BS & UE Tx spectrum mask by the integration over a 200 kHz bandwidth centered at the carrier separation between UMTS and GSM.

WCDMA node B emissions to GSM MS as a function of carrier separation are plotted in figure 2. WCDMA UE emissions to GSM BS as a function of carrier separation are given in figure 3.

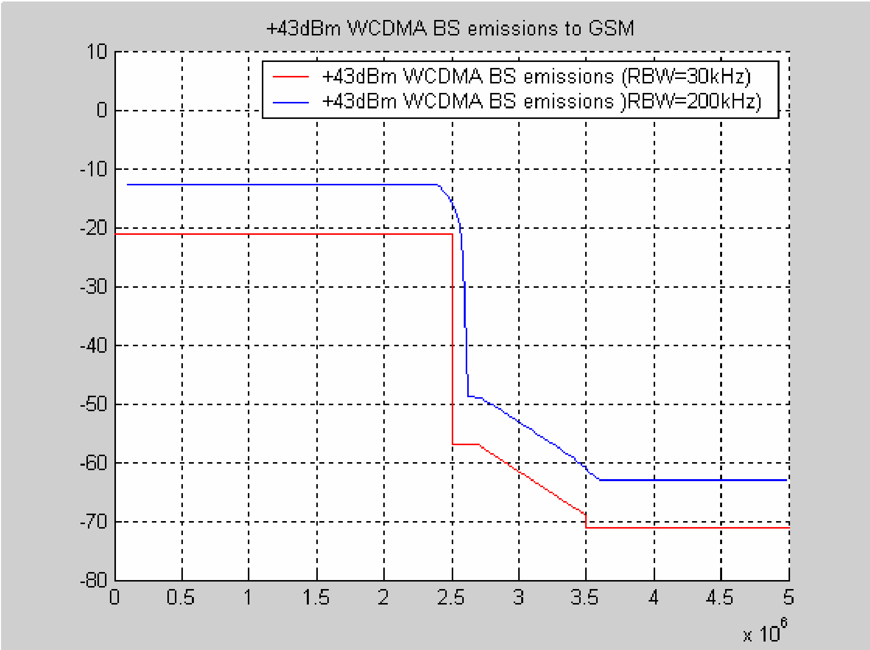

Figure 2: WCDMA Node B emissions to GSM MS as a function of carrier separation

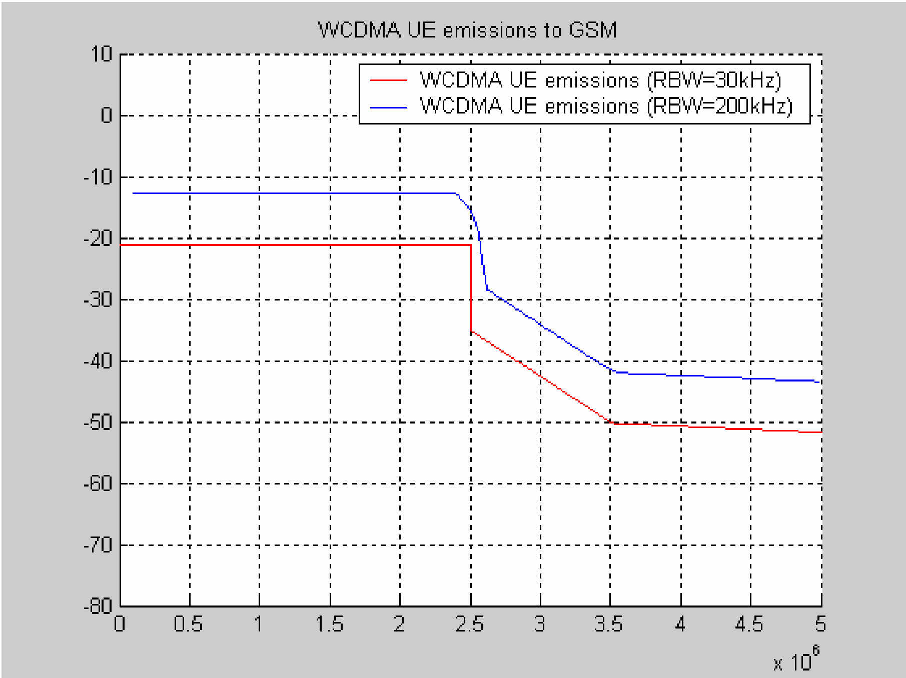

Figure 3: WCDMA UE emissions to GSM BS as a function of carrier separation

GSM BS emissions to WCDMA UE as a function of carrier separation are plotted in figure 4, and the GSM MS emissions to WCDMA Node B as a function of carrier separation are given in figure 5.

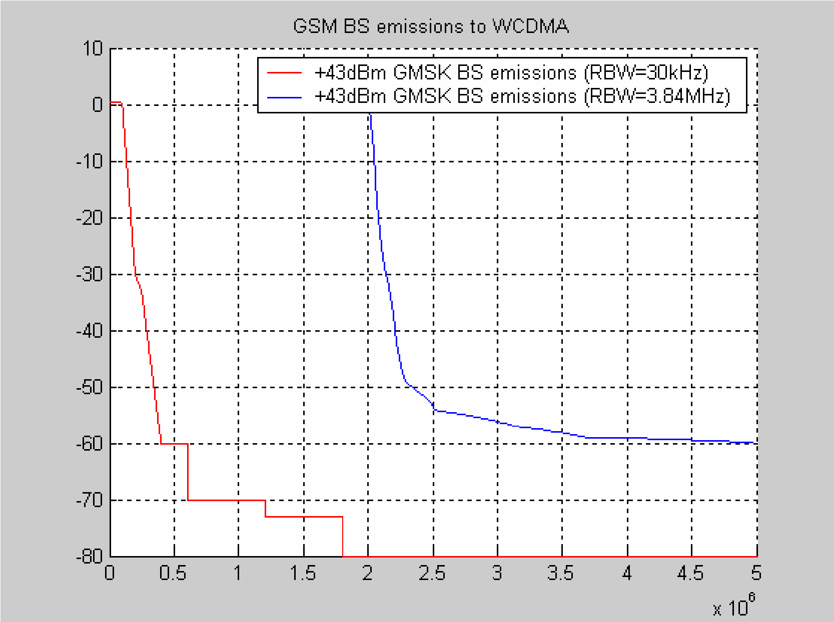

Figure 4: GSM BS emissions to WCDMA UE as a function of carrier separation

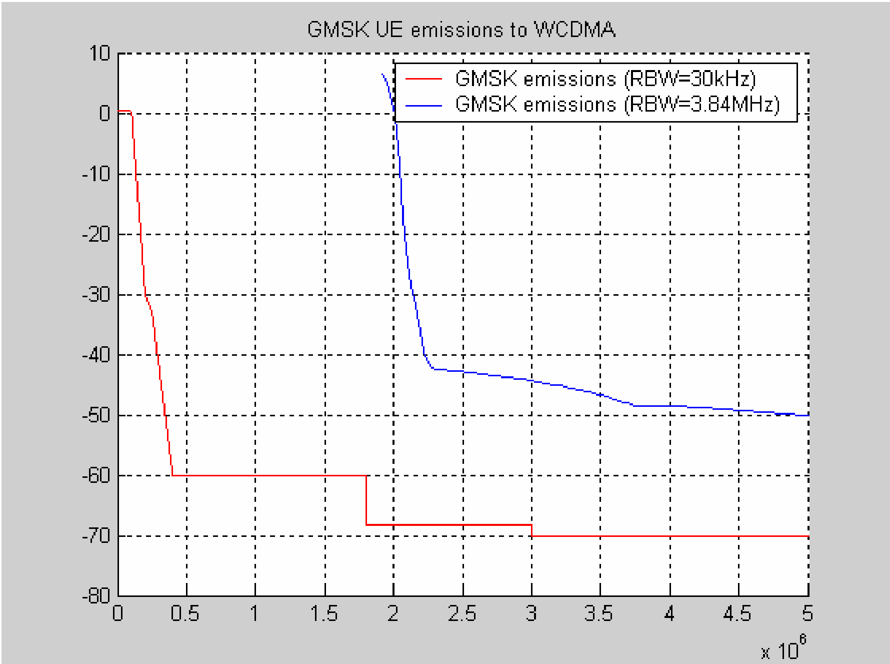

Figure 5: GSM MS emissions to WCDMA Node B as a function of carrier separation

The ACS of UMTS BS and UE are derived from the assumed narrow band blocking (GSM interferer) requirements at 2.8 MHz carrier separation. The narrow band blocking of WCDMA BS was defined in TS25.104 as -47 dBm at 2.8 MHz carrier separation which is measured with a useful signal at -115 dBm (6 dB above reference sensitivity level of WCDMA BS). The narrow band blocking of WCDMA UE was defined in TS25.101 as -56 dBm at 2.8 MHz carrier separation which was measured with useful signal at a level of 10 dB above UE reference sensitivity.

The ACLR and ACS of UMTS BS & UE for carrier separation of 2.8 MHz and 4.8 MHz are given in the table 2.

Table 2: ACLR and ACS of UMTS BS and UE for co-existence with GSM

Carrier separation	2.8 MHz		4.8 MHz	
	UTRA-FDD BS	UTRA-FDD UE	UTRA-FDD BS	UTRA-FDD UE
ACLR (dB)	50	31.3	63	43.3
ACS (dB)	51.3	30.5*	> 51.3	> 30.5*

Note* ACS =30.5 dB is derived with the UMTS UE noise floor of -96 dBm. At the noise floor of -99 dBm, the UE ACS will be 33.5 dB.

The ACLR (over 3.84 MHz bandwidth) of GSM BS and MS can be derived from the GSM BS and MS transmission mask defined in 3GPP TS45.005. The derived ACLR of GSM900 BS and MS for the co-existence with UMTS at carrier separation of 2.8 MHz and 4.8 MHz are respectively given in the table 3.

Table 3: ACLR of GSM900 BS and MS for co-existence with UMTS

Carrier separation	2.8 MHz		4.8 MHz	
	GSM900 BS	GSM900 MS	GSM900 BS	GSM900 MS
ACLR (dB) measured over 3.84 MHz bandwidth	55.2	43.8	59.8	49.7

The ACIR is calculated with the formula (1). The obtained ACIR values for UMTS UL as victim and for UMTS DL as victim for both 2.8 MHz and 4.8 MHz carrier separations are given in table 4.

$$\mathrm{ACIR} = \frac{1}{\frac{1}{\mathrm{ACLR}} + \frac{1}{\mathrm{ACS}}} \qquad (1)$$

Table 4: ACIR for UMTS UL/DL as victim when being interfered by GSM UL/DL

Carrier separation	2.8 MHz		4.8 MHz	
	UMTS UL as victim	UMTS DL as victim	UMTS UL as victim	UMTS DL as victim
ACIR (dB)	43.1	30.5	> 47.4	> 30.5

The derived ACIR for GSM UL as victim and for GSM DL as victim when GSM UL/DL being interfered by UMTS UL/DL for the carrier separation of 2.8 MHz and 4.8 MHz are respectively given in the table 5.

Table 5: ACIR for GSM UL/DL as victim when being interfered by UMTS UL/DL

Carrier separation	2.8 MHz		4.8 MHz	
	GSM UL as victim	GSM DL as victim	GSM UL as victim	GSM DL as victim
ACIR (dB)	31.3	50	43.3	63

4.2.1.3 Simulation results and analysis

Based on the Ran 4 agreed co-existence scenario and simulation assumptions described in section 4.2.1.1, several Monte-carlo simulation results have been presented and discussed. The simulation results data from different companies for this co-existence scenario (Scenario 1) are summarized in the tables 5A to 5F.

Table 5A: UMTS DL as victim / UMTS DL Capacity Loss (%)

ACIR	Ericsson	Lucent	Motorola	Nortel	Qualcomm	Siemens
20	9,3	10,9	7,2	6		
25	3,7	4,1	2,4	2,5	1,75	3
30	1,3	1,3	0,8	1,6	0,5	0,9
35	0,7	0,3		0,9	0,1	0,3
40	0,4			0,5		0,1
45						
50	0,3					

Table 5B: UMTS UL as victim / UMTS UL Capacity Loss (%)

ACIR	Ericsson	Lucent	Motorola	Qualcomm	Siemens
20					
25					
30					
35	29,3	11,8	17,6	21,7	
40	9,6	3,8	5,3	6,8	
45	3,1	1,2	2	2,5	8
50	1,1	0,5	0,5		2,7
55					0,9
60					0,3

Table 5C: GSM DL as victim / Capacity Loss

ACIR	Ericsson	Nokia	Siemens
20	22,6		
25	12,2	10	
30	5,8	3	
35	2,1	1	
40	0,6	0,2	0,8
45		0,4	0,15
50	0	0	0,05

Table 5D: GSM System DL Outage Degradation (%)

	Lucent	Motorola	Qualcomm
Without WCDMA interference	0,01	0,06	
With WCDMA interference	0,014		
System Outage Increase		negligible	negligible

Table 5E: GSM UL as victim

ACIR	Ericsson	Siemens
10	0	
20	0	
25	0	0,1
30	0	0,01
35	0	0
40	0	
45	0	
50	0	

Table 5F: GSM System UL Outage Degradation (%)

	Lucent	Motorola	Nokia	Qualcomm
Without WCDMA interference		0,04		
With WCDMA interference				
System Outage Degradation	negligible	negligible	negligible	negligible

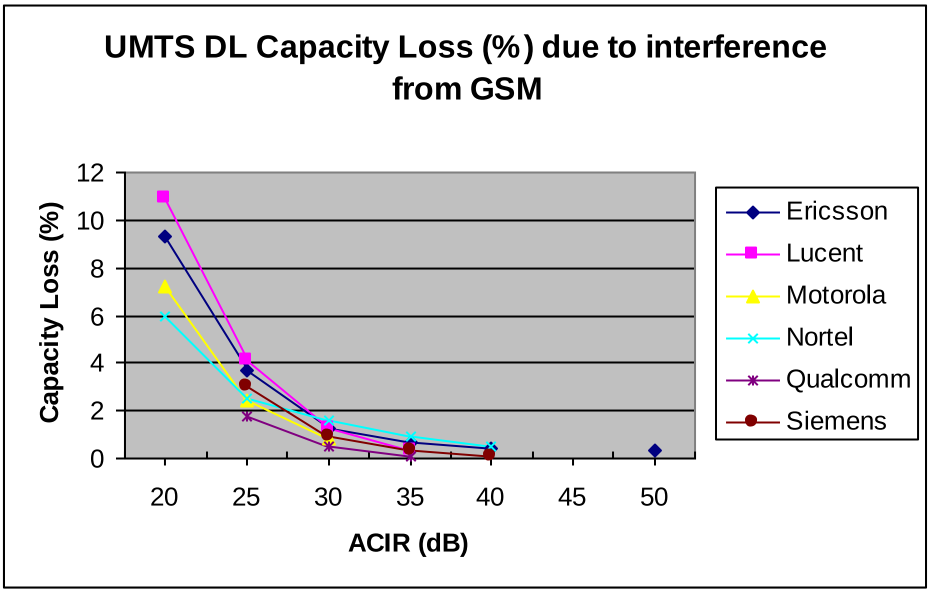

Figure 5A

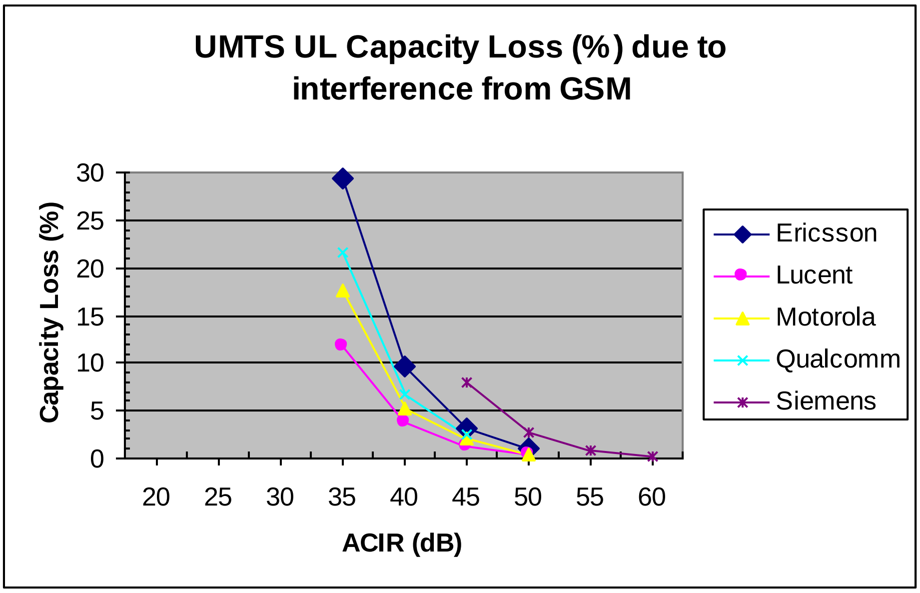

Figure 5B

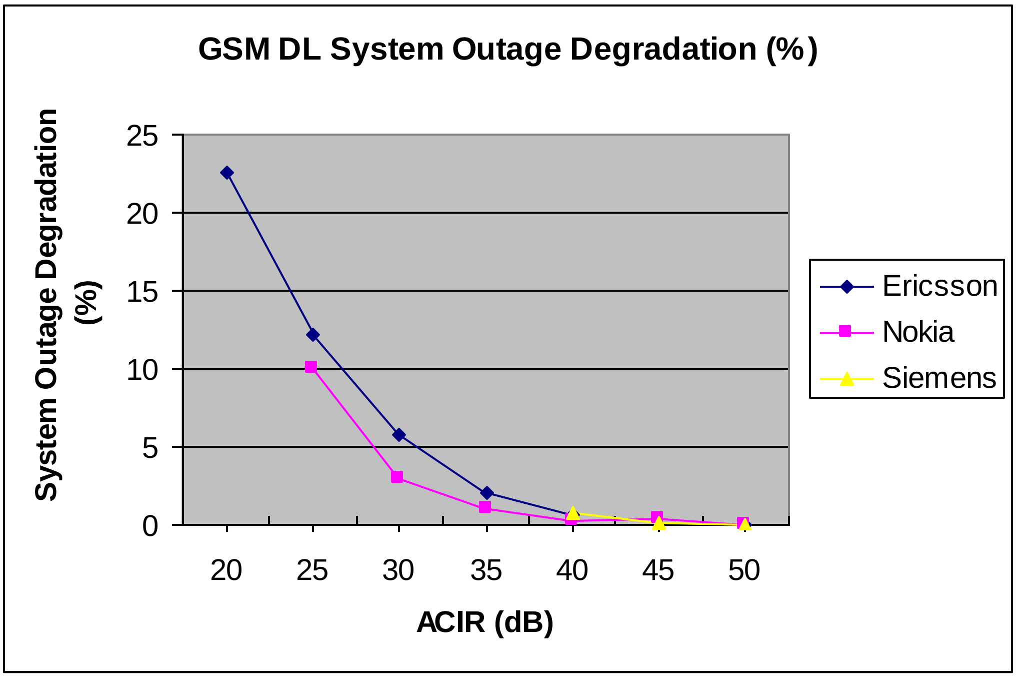

Figure 5C

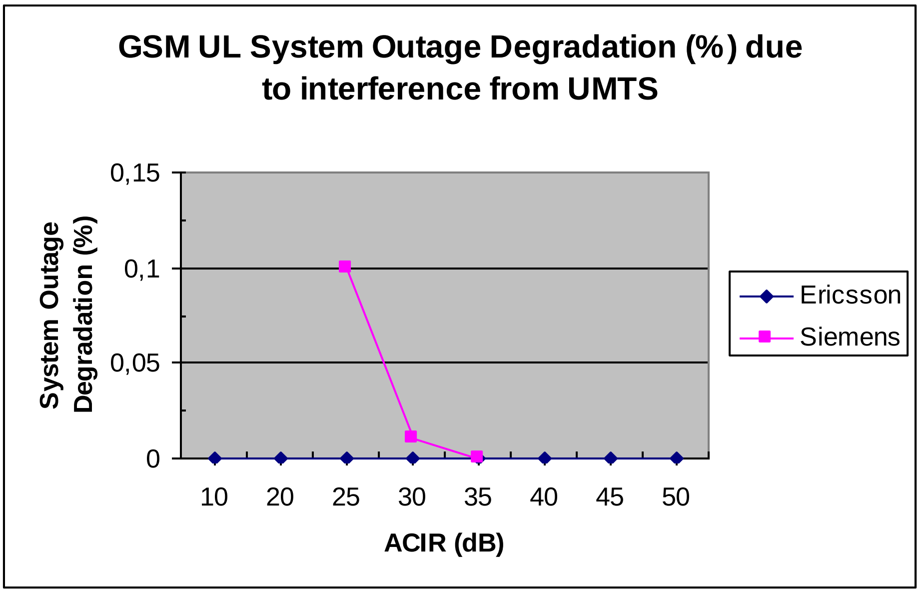

Figure 5D

4.2.1.3.1 UMTS DL Capacity Loss (%) due to interference from GSM DL

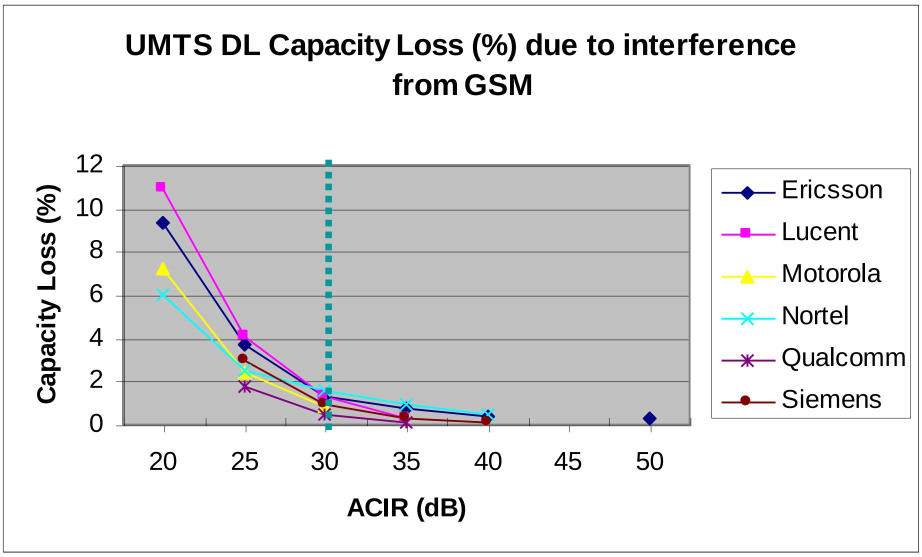

Figure 6: UMTS DL capacity loss due to interference from GSM DL (Scenario 1)

Figure 6 gives the simulation results of UMTS DL as victim, the UMTS downlink capacity loss (%) due to interference from GSM downlink as function of ACIR between UMTS carrier and the nearest GSM carrier. Six simulation curves plotted in figure 6 show that, at ACIR=30.5 dB, the UMTS downlink capacity loss due to interference from GSM downlink is smaller than 1.5%.

4.2.1.3.2 UMTS UL Capacity Loss (%) due to interference from GSM UL

The simulation results for the case of UMTS UL as victim, the UMTS UL capacity loss (%) due to interference from GSM uplink as function of ACIR between UMTS carrier and the nearest GSM carrier, are given in figure 7.

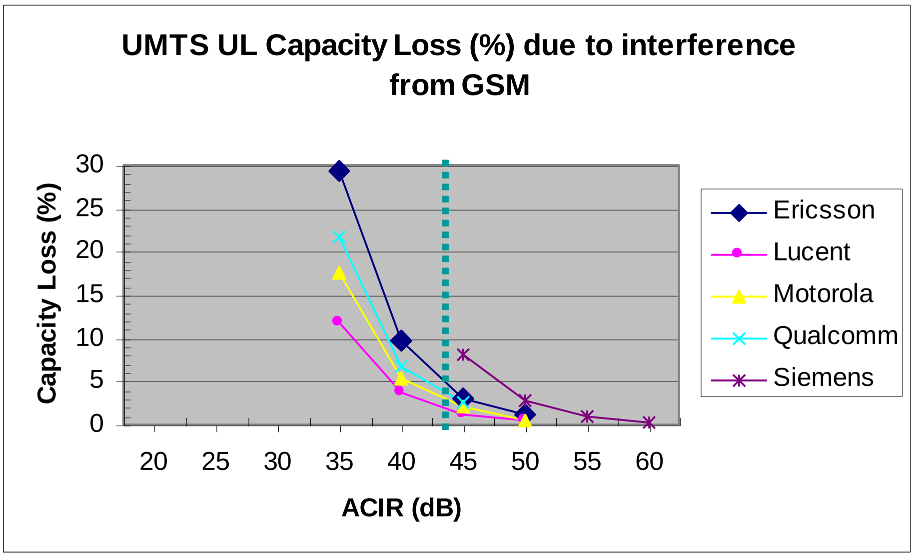

Figure 7: UMTS UL capacity loss due to interference from GSM UL (Scenario 1)

Five simulation results are available for the case of UMTS uplink as victim, as shown in the figure 7. Taking the average of the results at the point of ACIR=43.1 dB , the UMTS uplink capacity loss due to interference from GSM uplink is expected to be smaller than 5%.

4.2.1.3.3 GSM DL System Outage Degradation (%) due to interference from UMTS DL

The simulation results of GSM system downlink outage degradation due to interference from UMTS downlink are summarized in table 6. It can be seen that the GSM system downlink outage degradations are negligibles.

Table 6: GSM system DL outage degradation (%)

	Lucent	Motorola	Qualcomm
Without WCDMA interference	0.01	0.06	
With WCDMA interference	0.014		
System Outage Increase		negligible	negligible

Three simulation curves of GSM downlink system outage degradation due to interference from UMTS downlink are plotted in figure 8. As shown in the figure 8, at the point of ACIR=50 dB, the GSM downlink system outage degradation is unnoticeable, which is in line with the results given in the table 6.

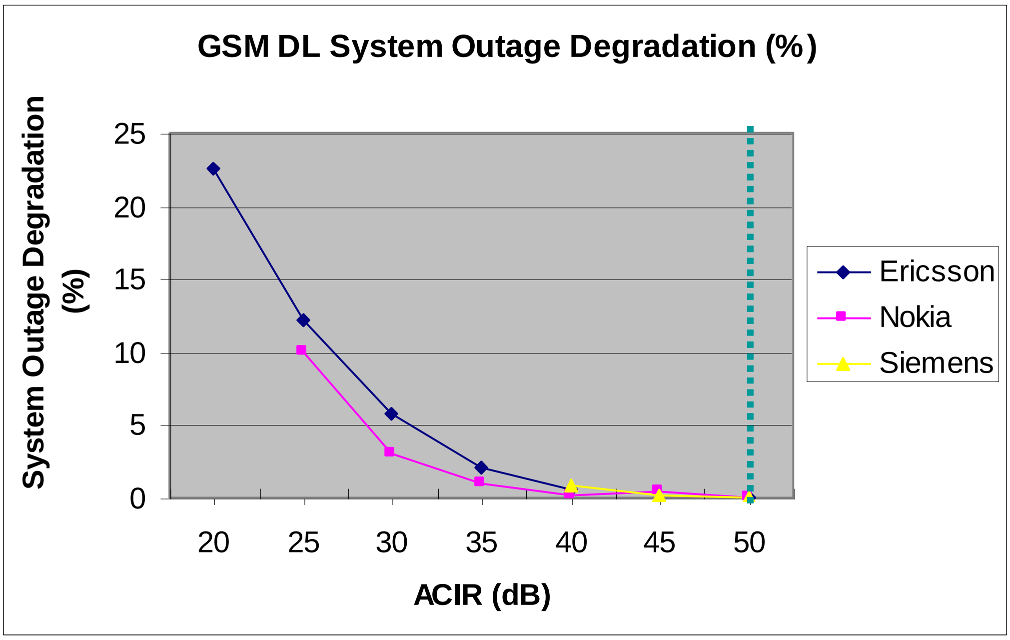

Figure 8: GSM DL System Outage Degradation (%) due to interference from UMTS DL (Scenario_1)

4.2.1.3.4 GSM UL System Outage Degradation (%) due to interference from UMTS UL

4 simulation results of GSM system uplink outage degradation due to interference from UMTS uplink are summarized in table 7, all of these results show that the GSM system uplink outage degradation due to interference from UMTS uplink is negligible.

Table 7: GSM system UL outage degradation (%)

	Lucent	Motorola	Nokia	Qualcomm
Without WCDMA interference		0.04		
With WCDMA interference				
System Outage Degradation	negligible	negligible	negligible	negligible

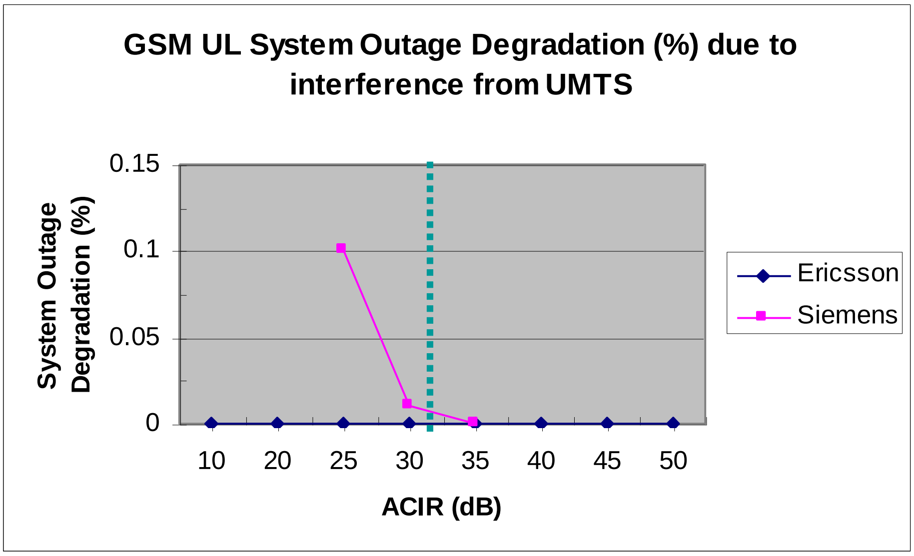

Figure 9: GSM UL System Outage Degradation (%) due to interference from UMTS UL (Scenario_1)

Two simulation results of GSM uplink system outage degradation (%) as function of ACIR were given in figure 9. For the carrier separation between UMTS carrier and the nearest GSM carrier of 2.8 MHz, the GSM uplink as victim ACIR=31.3 dB. Both simulation curves indicate that the GSM uplink system outage degradation at ACIR=31.3 dB is negligible, which is in line with the simulation results presented in table 7.

4.2.1.4 Conclusion

Based on the analysis of the simulation results for the co-existence scenario 1 between UMTS(macro)-GSM(macro) in urban area with cell range of 500 m in uncoordinated operation, the following conclusions can be made :

- RF system characteristics assumed for UMTS900 in section 4.2.1.2 are suitable and sufficient for UMTS900 to be deployed in urban environment in co-existence with GSM;
- UMTS and GSM in urban environment can co-exist with 2.8 MHz carrier separation between UMTS carrier and the nearest GSM carrier.

4.2.2 Scenario_2: UMTS(macro)-GSM(macro) in Rural area with cell range of 5000 m in uncoordinated operation

4.2.2.1 Co-existence scenario and simulation assumption

Frequency arrangement and Network layout for this scenario is given in figure 1 above. Simulation parameters are summarized in table 8.

Table 8: Summary of UMTS900/GSM900 simulation parameters for Scenario 2

Scenario_2		UMTS(macro)-GSM(macro) in Rural area with cell range of 5000 m in uncoordinated operation
Simulation cases		Both UMTS and GSM as victims in uplink and downlink. In total 4 simulation cases. 1) Downlink -GSM (BCCH only)/WCDMA for WCDMA victim -GSM (non-BCCH with PC)/WCDMA for GSM victim 2) Uplink - WCDMA victim (GSM load maximum – all time slots in use. Simulate GSM system, then add UMTS users until the total noise rise hits 6 dB) - GSM victim (WCDMA loaded to 6 dB noise rise) -No frequency hopping for GSM -Both networks in macro environment -Run simulations with various ACIRs by considering a center frequency separation of 2.8 MHz.
Network layout		As shown in figure 1 above - Rural environment - 3-sector configuration -GSM cell reuse GSM: 4/12 -36 cells (i.e., 108 sectors) with wrap-around -Cell radius R=2500m, cell range 2R=5000m, inter-site distance 3R= 7500 m (as shown in figure 1) -Worst-case shift between operators, GSM site is located at WCDMA cell edge
System parameters	**WCDMA**	- BS antenna gain with cable loss included = 15dBi - BS antenna height H_{bs}=45 m; - UE antenna height H_{ms}=1.5 m - BS-UE MCL=80 dB - BS antenna(65° horizontal opening) radiation pattern is refered to 3GPP TR 25.896 V6.0.0 (2004-03), Section A.3 - UE antenna gain 0 dBi (omni-directional pattern)
	GSM	- BS antenna gain with cable loss included = 15dBi - BS antenna height H_{bs}=45 m; - UE antenna height H_{ms}=1.5 m - BS-MS MCL=80 dB - BS antenna(65° horizinal opening) radiation pattern is refered to 3GPP TR 25.896 V6.0.0 (2004-03), Section A.3 - UE antenna gain 0 dBi (omni-directional pattern)
Services	**WCDMA**	8 kbps Speech (chip rate: 3.84 Mcps) - Eb/Nt target (downlink): 7.9 dB - Eb/Nt target (uplink): 6.1 dB
	GSM	Speech - SINR target (downlink): 9 dB - SINR target (uplink): 6 dB
Propagation model	**WCDMA and GSM**	Log_normal_Fading = 10 dB Rural area propagation model(Hata model) $L(R)= 69.55 +26.16 \log f – 13.82\log(H_b)+[44.9-6.55\log(H_b)]\log R – 4.78(\log f)^2+18.33 \log f -40.94$ Hb is BS antenna height above ground in m, f is frequency in MHz, R is distance in km. With Hb=45m, f=920 MHz, the propagation model is simplified as $L(R) = 34.1 * \log(R) + 95.6$ The path loss from a transmitter antenna connector to a receiver antenna connector (including both antenna gains and cable losses) will be determined by: Path_Loss = max (L(R) + Log_normal_Fading - G_Tx – G_Rx, Free_Space_Loss + Log_normal_Fading - G_Tx – G_Rx, MCL) where G_Tx is the transmitter antenna gain in the direction toward the receiver antenna, which takes into account the transmitter antenna pattern and cable loss, G_Rx is the receiver antenna gain in the direction toward the transmitter antenna, which takes into account the receiver antenna pattern and cable loss, Log_normal_Fading is the shadowing fade following the log-normal distribution.
Cell selection	**WCDMA**	As per TR 25.942

	GSM	As for WCDMA in TR 25.942, but with only one link selected at random within a 3 dB handover margin
SIR calculation	**WCDMA**	As per TR 25.942, except for the following changes: - Interference contributions from GSM TRXs or MSs are added to the total noise-plus-interference. - Processing gain is changed to 26.8 dB for 8 kbps - Thermal noise level is raised to -96 dBm for downlink
	GSM	Total noise-plus-interference is sum of thermal noise, GSM co-channel, and WCDMA interference. Cells are synchronised on a time slot basis. Adjacent channel GSM interference is neglected. - Noise floor (downlink): -111 dBm - Noise floor (uplink): -113 dBm
Power Control assumption	**WCDMA**	As per TR 25.942 - 21 dBm terminals - Maximum BS power: 43 dBm - Maximum power per DL traffic channel: 30 dBm - Minimum BS power per user: 15 dBm. - Minimum UE power: –50 dBm. - Total CCH power: 33 dBm
	GSM	Stabilization algorithm same as for WCDMA (C/I based) with a margin of 5 dB added to the SIR target. - Maximum power (TRx): 43 dBm - Minimum power (TRx): 10 dBm (non-BCCH) - Maximum power (MS): 33 dBm - Minimum power (MS): 5 dBm
Capacity	**WCDMA**	Capacity loss versus ACIR as per TR 25.942
	GSM	Load to maximum number of users and observe change in outage (i.e., 0.5 dB less than SINR target)
ACIR	**WCDMA to GSM**	As per spectrum masks defined in TS 25.101, TS 25.104 (applying the appropriate measurement BW correction), unless capacity loss is found to be significant.
	GSM	$\mathrm{ACIR}(f) = C(f_0) + m(f - f_0)$ (dB) GSM BTS to WCDMA UE: Consider 3GPP TS45005 GSM BTS transmitter emission mask for 900 band and WCDMA UE receiver selectivity slope, m = 0.8 dB / 200 kHz GSM MS to WCDMA BS: Consider 3GPP TS45005 GSM MS transmitter emission mask for 900 band and WCDMA BS receiver characteristics, m = 0.5 dB / 200 kHz

4.2.2.2 Analysis method

The objective of Monte-carlo simulations is to determine the appropriate UMTS BS & UE RF system parameters, Spectrum mask, ACLR (Adjacent Channel power Leakage Ratio), ACS (Adjacent Channel Selectivity), receiver narrow band blocking, etc. for ensuring the good co-existence of UMTS and GSM. In the simulation, the UMTS UL/DL capacity losses as function of ACIR (Adjacent Channel Interference Ratio) are simulated, the GSM UL/DL system outage degradations at given ACIR values or as function of ACIR are also simulated. In the simulations, the ACIR is used as a variable parameter.

The assumptions of UMTS BS & UE RF characterics (Spectrum mask, ACLR, ACS) were described in the section 4.2.1.2, the GSM system (BS & MS) RF characteristics and the derived ACIR values were also given in the section 4.2.1.2.

Ran_4 agreed threshold for co-existence is that UMTS UL/DL capacity loss due to interferences from GSM UL/DL should not be bigger than 5%. Concerning the impact on GSM network performance, since GSM network capacity is fixed, the evaluation criterion is the system outage degradation, the system outage degradation should be as small as possible.

4.2.2.3 Simulation results & analysis

Based on the Ran 4 agreed co-existence scenario 2 and simulation assumptions described in section 4.2.2.1, simulation results for this co-existence scenario 2 from several companies have been presented and discussed. The simulation results data from different companies for this co-existence scenario are summarized in the enclosed excel table.

The simulation results data from different companies for this co-existence scenario are summarized in tables 8A to 8G.

Table 8A: UMTS DL as victim / UMTS DL Capacity Loss (%)

ACIR	Ericsson	Motorola	Nortel	Qualcomm	Siemens
20	5,5	4	5,7		
25	2,1	1,4	1,3	0,9	1,1
30	1,3	0,4	0,8	0,3	0,4
35	0,9		0,9	0,1	0
40	0,2		0,7		0
45					
50	0,3				

Table 8B: UMTS UL as victim / UMTS UL Capacity Loss (%)

ACIR	Ericsson	Motorola	Qualcomm	Siemens
20				
25				
30	25,8			
35	8,2	3,1	5,7	
40	2,6	1	2	5,6
45		0,4	1	1,8
50	0,2	0	0	0,6
55				0,1
60				0

Table 8C: GSM DL as victim / Capacity Loss (%)

ACIR	Ericsson	Nokia	Siemens
20	21,8		
25	10,8	6	
30	4,3	1,9	
35	1,4	1	
40	0,4	1	0,4
45		0,8	0,05
50	0,01	0,1	0

Table 8D: GSM System DL Outage Degradation (%)

	Motorola	Qualcomm
Without WCDMA interference	0,2	
With WCDMA interference		
System Outage Increase	negligible	negligible

Table 8F: GSM UL as victim

ACIR	Ericsson	Siemens
10	0,01	
20	0	0,7
25	0	0,3
30	0	0
35	0	
40	0	
45		
50		

Table 8G: GSM System UL Outage Degradation (%)

	Motorola	Nokia	Qualcomm
Without WCDMA interference	0,1		
With WCDMA interference			
System Outage Increase	negligible	negligible	negligible

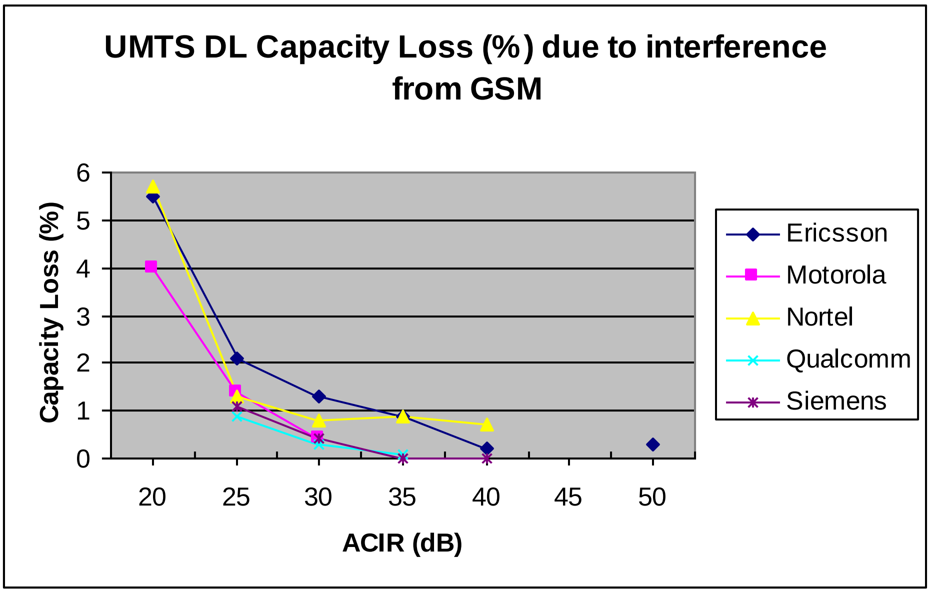

Figure 9A

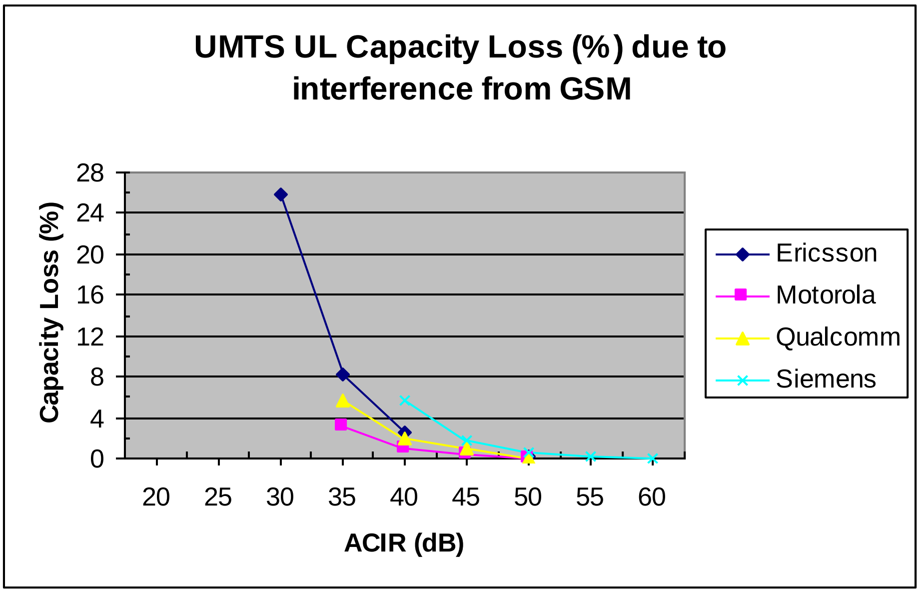

Figure 9B

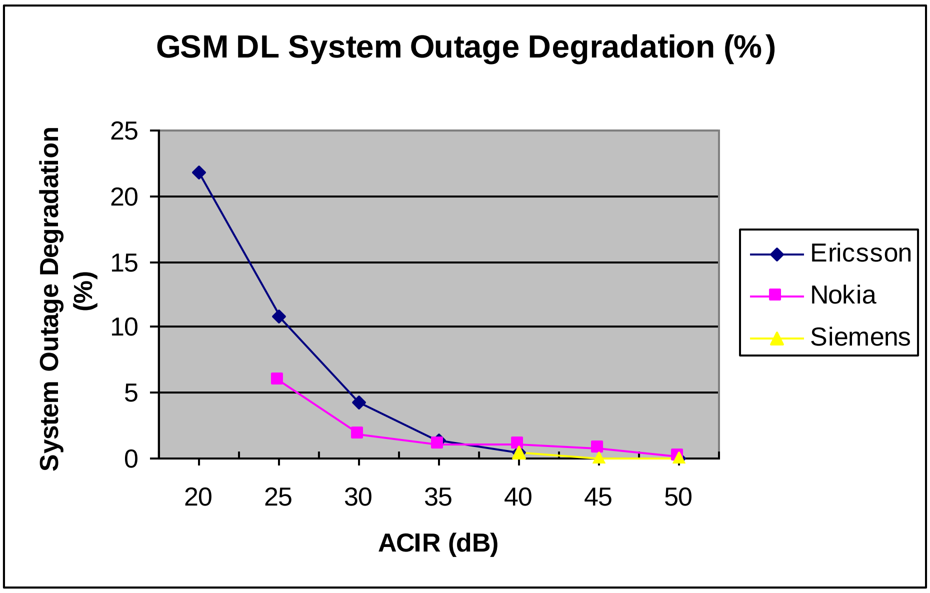

Figure 9C

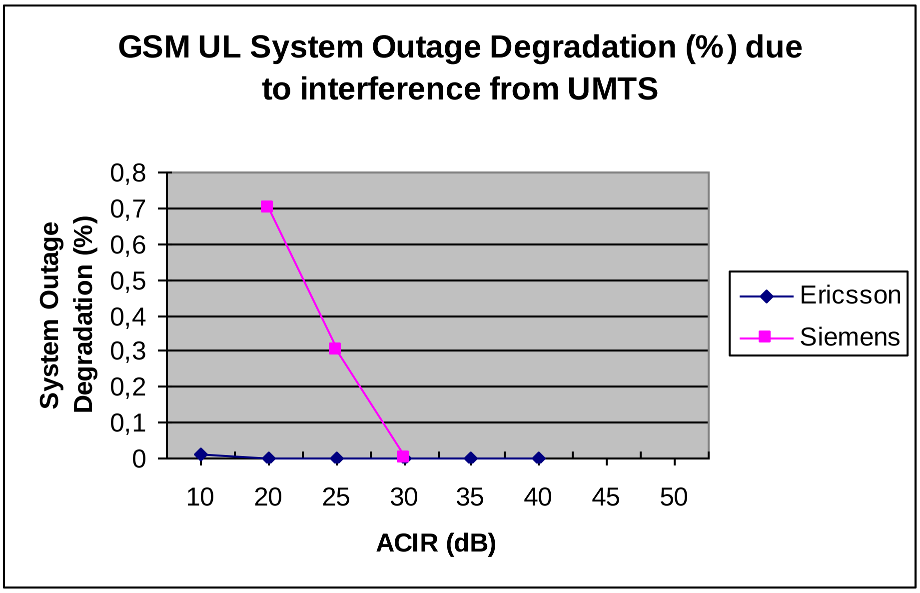

Figure 9D

4.2.2.3.1 UMTS DL Capacity Loss (%) due to interference from GSM DL

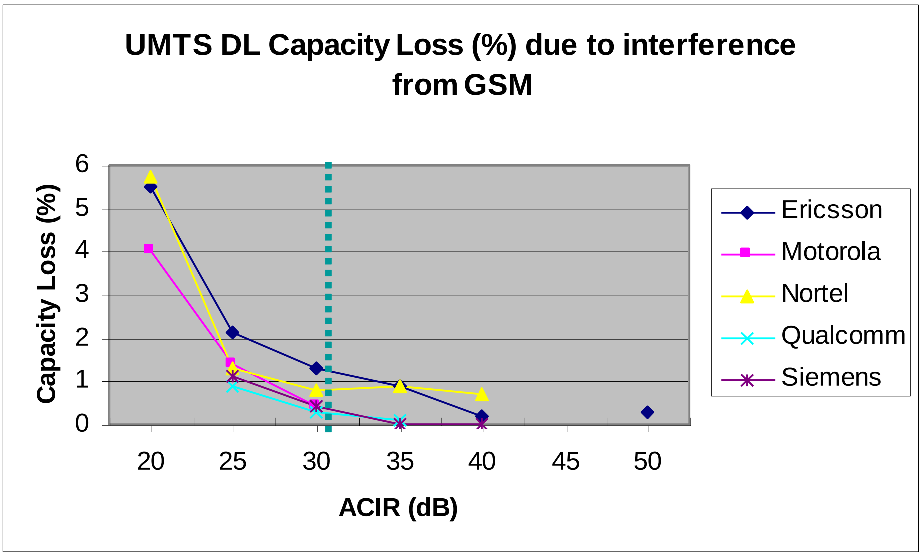

Figure 10: UMTS DL Capacity Loss (%) due to interference from GSM DL (Scenario_2)

Figure 10 gives the simulation results (5 simulation curves) of UMTS DL as victim for the co-existence scenario 2, the UMTS downlink capacity loss due to interference from GSM downlink as function of ACIR between UMTS carrier and the nearest GSM carrier. At the operating point of ACIR=30.5 dB, the UMTS downlink capacity loss is below 1.2%.

4.2.2.3.2 UMTS UL Capacity Loss (%) due to interference from GSM UL

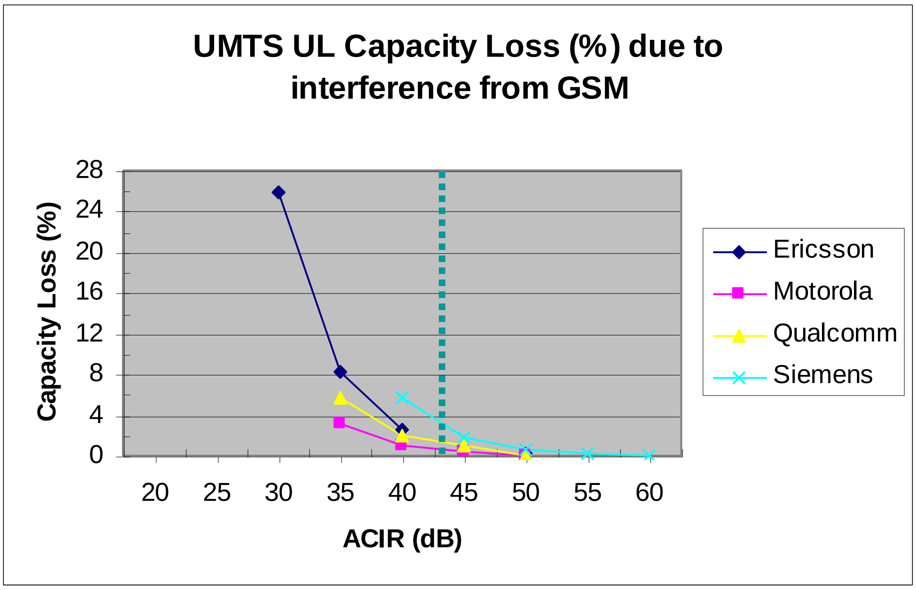

Figure 11: UMTS UL Capacity Loss (%) due to interference from GSM UL (Scenario_2)

The simulation results (4 simulation curves) for the case of UMTS UL as victim, the UMTS UL capacity loss (%) due to interference from GSM uplink as function of ACIR between UMTS carrier and the nearest GSM carrier, are given in figure 11. As shown in figure 11, all of the 4 simulation curves indicate that the UMTS uplink capacity loss due to interference from GSM MS at ACIR=43.1 dB is smaller than 3% .

4.2.2.3.3 GSM DL System Outage Degradation (%) due to interference from UMTS DL

Two simulation results of GSM system downlink outage degradation due to interference from UMTS downlink are summarized in table 9. It can be seen that both results show the GSM system downlink outage degradations are negligibles.

Table 9: GSM system DL outage degradation (%)

	Motorola	Qualcomm
Without WCDMA interference	0.2	
With WCDMA interference		
System Outage Increase	negligible	negligible

Three other simulation curves of GSM system downlink outage degradation as function of ACIR between UMTS carrier and the nearest GSM carrier are plotted in figure 12. At ACIR=50 dB, the GSM downlink system outage degradation is negligible as shown in the figure 12. It is in line with the two simulation results summarized in the table 8.

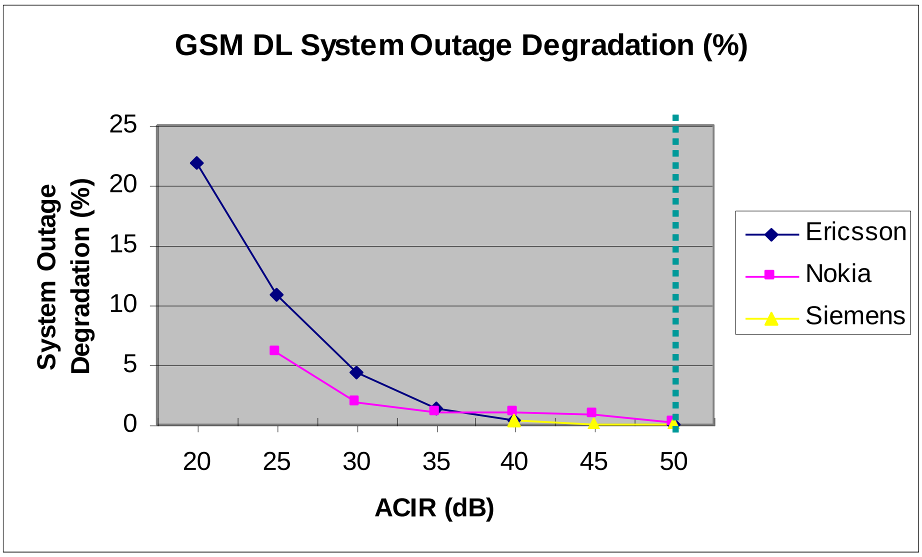

Figure 12: GSM DL System Outage Degradation (%) due to interference from UMTS DL (Scenario_2)

4.2.2.3.4 GSM UL System Outage Degradation (%) due to interference from UMTS UL

3 simulation results of GSM system uplink outage degradation due to interference from UMTS uplink at the carrier separation of 2.8 MHz between UMTS carrier and the nearest GSM carrier are summarized in table 10, all of these three results show that the GSM system uplink outage degradation due to interference from UMTS uplink is negligible.

Table 10: GSM system UL outage degradation (%)

	Motorola	Nokia	Qualcomm
Without WCDMA interference	0.1		
With WCDMA interference			
System Outage Increase	negligible	negligible	negligible

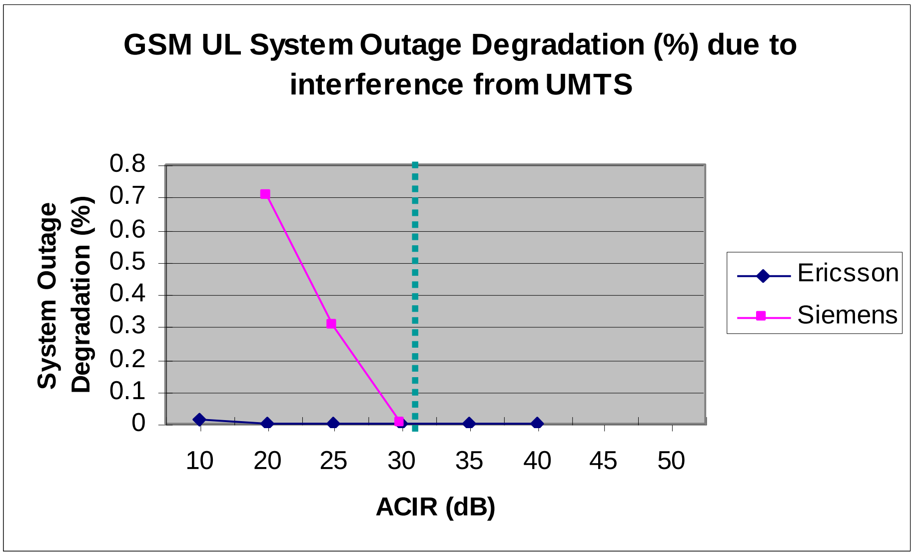

Figure 13: GSM UL System Outage Degradation (%) due to interference from UMTS UL (Scenario_2)

Two simulation results of GSM uplink system outage degradation due to interference from UMTS uplink as function of ACIR are given in the figure 13. As indicated in the figure 13, at ACIR=31.3 dB, the GSM uplink system outage degradation is negligible, they are in line with the three simulation results given in the table 10 above.

4.2.2.4 Conclusion

Based on the analysis of the simulation results for the co-existence scenario 2 between UMTS(macro)-GSM(macro) in rural area with cell range of 5000 m in uncoordinated operation, the following conclusions can be drawn :

- RF system characteristics assumed for UMTS900 are suitable and sufficient for UMTS900 to be deployed in rural environment in co-existence with GSM in uncoordinated operation with cell range of 5000 m;
- UMTS and GSM can co-exist at 2.8 MHz carrier separation between UMTS carrier and the nearest GSM carrier in the deployment scenario 2 described in section 4.2.2.1.

4.2.3 Scenario_3: UMTS(macro)-GSM(macro) in Rural area with cell range of 5000 m in coordinated operation

4.2.3.1 Co-existence scenario and simulation assumption

2x10 MHz "sandwich" coordinated operation between UMTS macrocell and GSM macrocell.

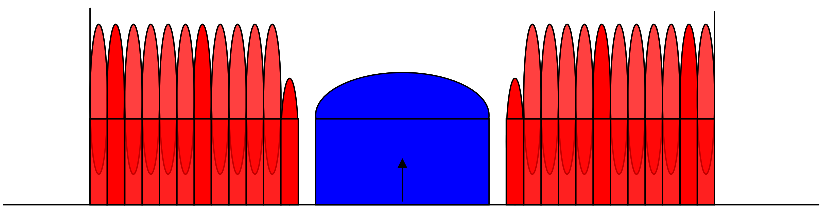

Figure 14: 2x10 MHz "sandwich" coordinated operation

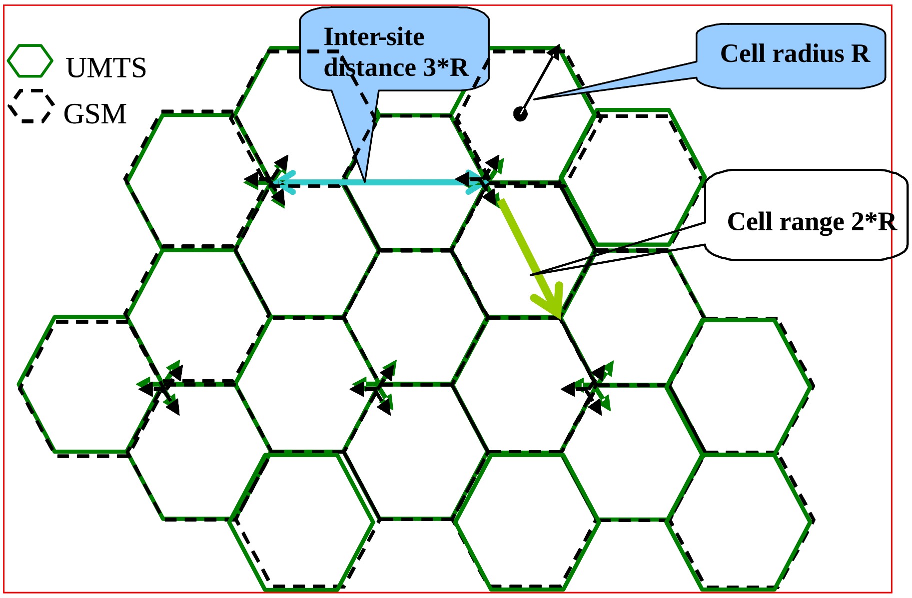

Figure 14B: 2x10 MHz "sandwich" coordinated operation

In this coordinated operation case, the UMTS and GSM base stations are co-located which represent the re-banding deployment within the same GSM network.

Table 11: Summary of UMTS900 simulation parameters for Scenario 3

Scenario_3		UMTS(macro)-GSM(macro) in Rural area with cell range of 5000m in coordinated operation
Simulation cases		Interference from GSM to UMTS with no power control activated in GSM mobiles. Uplink is considered as limiting case, but it is considered useful to study downlink as well. There will be 2 simulation cases *: 1) Downlink -GSM (BCCH only)/WCDMA for WCDMA victim 2) Uplink - WCDMA victim (GSM load maximum – all time slots in use. Simulate GSM system, then add UMTS users until the total noise rise hits 6 dB) -No frequency hopping Both networks in macro environment Run simulations with various ACIRs by considering a center frequency separation of 2.8 MHz. *Note: It was agreed that if the simulation results for scenario 1 and 2 show serious interferences from UMTS to GSM, then additional simulation cases of interference from UMTS to GSM with this scenario_3 will be studied.
Network layout		As shown in figure 14above, but WCDMA and GSM BS are co-located. - Rural environment - 3-sector configuration -GSM cell reuse GSM: 4/12 -36 cells (i.e., 108 sectors) with wrap-around-Cell radius R=2500m, cell range 2R=5000m, inter-site distance 3R= 7500 m (as shown in figure 14)
System parameters	**WCDMA**	- BS antenna gain with cable loss included = 15 dBi - BS antenna height H_{bs}=45 m; - UE antenna height H_{ms}=1.5 m - BS-UE MCL=80 dB - BS antenna(65° horizontal opening) radiation pattern is refered to 3GPP TR 25.896 V6.0.0 (2004-03), Section A.3 - UE antenna gain 0 dBi (omni-directional pattern)
	GSM	- BS antenna gain with cable loss included = 15 dBi - BS antenna height H_{bs}=45 m; - UE antenna height H_{ms}=1.5 m - BS-MS MCL=80 dB - BS antenna(65° horizontal opening) radiation pattern is referred to 3GPP TR 25.896 V6.0.0 (2004-03), Section A.3 - UE antenna gain 0 dBi (omni-directional pattern)
Services	**WCDMA**	8 kbps Speech (chip rate: 3.84 Mcps) - Eb/Nt target (downlink): 7.9 dB - Eb/Nt target (uplink): 6.1 dB
	GSM	Speech - SINR target (downlink): 9 dB - SINR target (uplink): 6 dB
Propagation Model	**WCDMA and GSM**	Log_normal_Fading = 10 dB Rural area propagation model (Hata model) $L(R) = 69.55 + 26.16 \log f - 13.82\log(H_b) + [44.9 - 6.55\log(H_b)]\log R - 4.78(\log f)^2 + 18.33 \log f - 40.94$ Hb is BS antenna height above ground in m, f is frequency in MHz, R is distance in km. With Hb=45m, f=920 MHz, the propagation model is simplified as *L (R)= 34.1* log(R)+ 95.6* The path loss from a transmitter antenna connector to a receiver antenna connector (including both antenna gains and cable losses) will be determined by: Path_Loss = max (L(R) + Log_normal_Fading - G_Tx – G_Rx, Free_Space_Loss + Log_normal_Fading - G_Tx – G_Rx, MCL) where G_Tx is the transmitter antenna gain in the direction toward the receiver antenna, which takes into account the transmitter antenna pattern and cable loss, G_Rx is the receiver antenna gain in the direction toward the transmitter antenna, which takes into account the receiver antenna pattern and cable loss, Log_normal_Fading is the shadowing fade following the log-normal distribution.
Cell selection	**WCDMA**	As per TR 25.942

	GSM	As for WCDMA in TR 25.942, but with only one link selected at random within a 3 dB handover margin
SIR calculation	**WCDMA**	As per TR 25.942, except for the following changes: - Interference contributions from GSM TRXs or MSs are added to the total noise-plus-interference. - Processing gain is changed to 26.8 dB for 8 kbps - Thermal noise level is raised to –96 dBm for downlink
	GSM	Total noise-plus-interference is sum of thermal noise, GSM co-channel, and WCDMA interference. Cells are synchronised on a time slot basis. Adjacent channel GSM interference is neglected. - Noise floor (downlink): -111 dBm - Noise floor (uplink): -113 dBm
Power Control assumption	**WCDMA**	As per TR 25.942 - 21 dBm terminals - Maximum BS power: 43 dBm - Maximum power per DL traffic channel: 30 dBm - Minimum BS power per user: 15 dBm. - Minimum UE power: –50 dBm. - Total CCH power: 33 dBm
	GSM	Stabilization algorithm same as for WCDMA (C/I based) with a margin of 5 dB added to the SIR target. - Maximum power (TRx): 43 dBm - Minimum power (TRx): 10 dBm (non-BCCH) - Maximum power (MS): 33 dBm - Minimum power (MS): 5 dBm
Capacity	**WCDMA**	Capacity loss versus ACIR as per TR 25.942
	GSM	Load to maximum number of users and observe change in outage (i.e., 0.5 dB less than SINR target)
ACIR	**WCDMA to GSM**	As per spectrum masks defined in TS 25.101, TS 25.104 (applying the appropriate measurement BW correction), unless capacity loss is found to be significant.
	GSM	$\mathrm{ACIR}(f) = C(f_0) + m(f - f_0)$ (dB) GSM BTS to WCDMA UE: Consider 3GPP TS45005 GSM BTS transmitter emission mask for 900 band and WCDMA UE receiver selectivity slope, m = 0.8 dB / 200 kHz GSM MS to WCDMA BS: Consider 3GPP TS45005 GSM MS transmitter emission mask for 900 band and WCDMA BS receiver characteristics, m = 0.5 dB / 200 kHz

4.2.3.2 Analysis method

The objective of Monte-carlo simulations is to determine the appropriate UMTS BS & UE RF system parameters, Spectrum mask, ACLR (Adjacent Channel power Leakage Ratio), ACS (Adjacent Channel Selectivity), receiver narrow band blocking, etc. for ensuring the good co-existence of UMTS and GSM. In the simulation, the UMTS UL/DL capacity losses as function of ACIR (Adjacent Channel Interference Ratio) are simulated, the GSM UL/DL system outage degradations at given ACIR values or as function of ACIR are also simulated. In the simulations, the ACIR is used as a variable parameter.

The assumptions of UMTS BS & UE RF characterics (Spectrum mask, ACLR, ACS) were described in the section 4.2.1.2, the GSM system (BS & MS) RF characteristics and the derived ACIR values were also given in the section 4.2.1.2.

Ran_4 agreed threshold for co-existence is that UMTS UL/DL capacity loss due to interferences from GSM UL/DL should not be bigger than 5%. Concerning the impact on GSM network performance, since GSM network capacity is fixed, the evaluation criterion is the system outage degradation, the system outage degradation should be as small as possible.

4.2.3.3 Simulation results & analysis

Based on the Ran 4 agreed co-existence scenario and simulation assumptions described in section 4.2.3.1, simulation results for this co-existence scenario 3 from several companies have been presented and discussed. The simulation result data from different companies for this co-existence scenario 3 are summarized in tables 11A and 11B.

Table 11A: UMTS DL as victim/ UMTS DL Capacity Loss (%)

ACIR	Ericsson	Nokia	Nortel	Siemens
20	1,1	2,9	3,6	
25	0,4	1,1	1,2	0,4
30	0	0,3	1,1	0,2
35	0,1	0,1	0,6	0,1
40	0,1	0	0,1	0
45		0		
50	0,1			

Table 11B: UMTS UL as victim/ UMTS UL Capacity Loss (%)

ACIR	Ericsson	Nokia	Siemens
20	59		
25	17,4		73,2
30	5,7	12	22,8
35	1,7	4	6,5
40	0,6	0,9	2
45	0,2	0,1	
50	0,1	0	

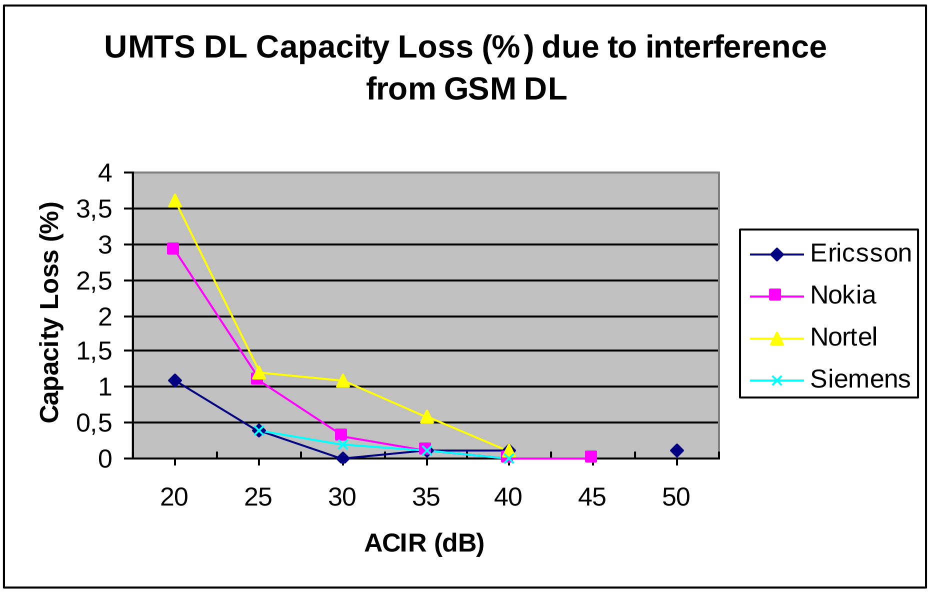

Figure 14C

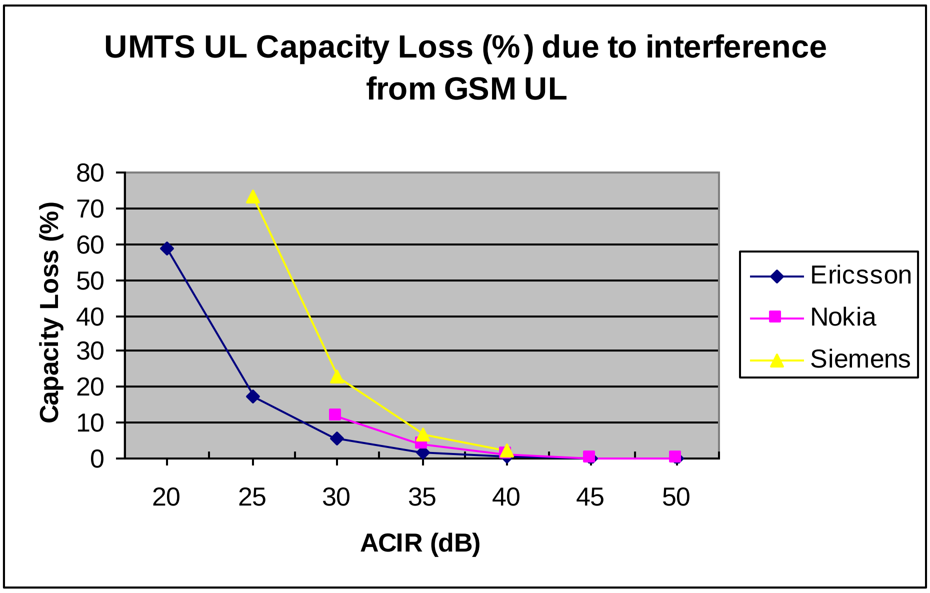

Figure 14D

4.2.3.3.1 UMTS DL Capacity Loss (%) due to interference from GSM DL

As described in the simulation assumption, two simulation cases (UMTS DL and UL as victim) are studied for this co-existence scenario 3.

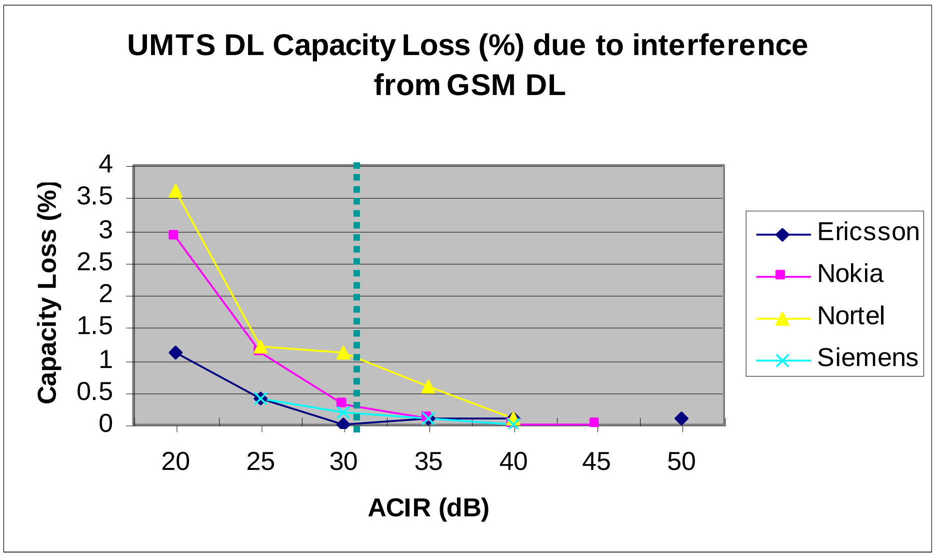

Figure 15: UMTS DL Capacity Loss (%) due to interference from GSM DL (Scenario_3)

Four simulation curves of simulation results of UMTS DL as victim are plotted in figure 15, the UMTS downlink capacity loss due to interference from GSM downlink as function of ACIR between UMTS carrier and the nearest GSM carrier. It is shown in the figure 15 that at the operating point of ACIR=30.5 dB, the UMTS downlink capacity loss is below 1%.

4.2.3.3.2 UMTS UL Capacity Loss (%) due to interference from GSM UL

The simulation results for the case of UMTS UL as victim, the UMTS UL capacity loss (%) due to interference from GSM uplink as function of ACIR between UMTS carrier and the nearest GSM carrier, are given in figure 16. Three simulation results/curves of UMTS uplink capacity loss due to interference from GSM uplink for the scenario 3 are plotted in figure 16. As shown in the figure 16, at ACIR=43.1 dB, the UMTS uplink capacity loss is very small, it is negligible.

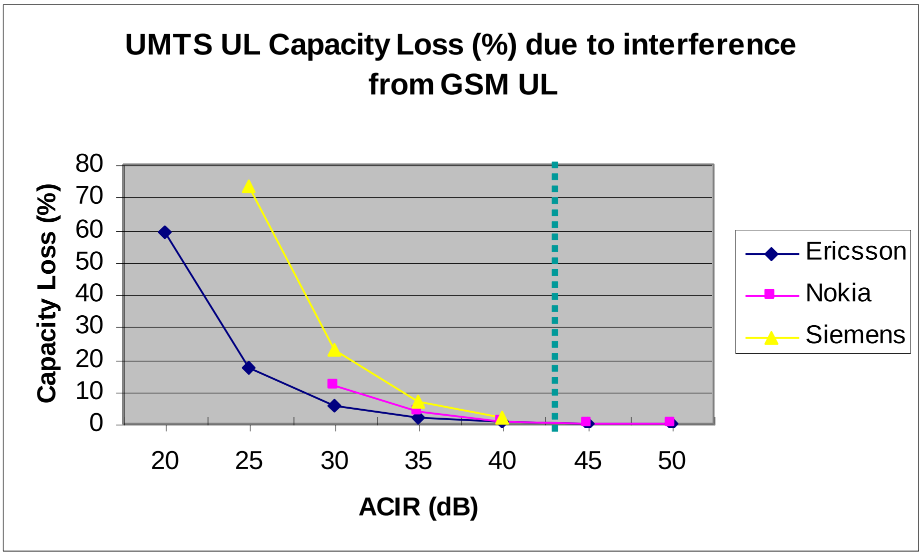

Figure 16: UMTS UL Capacity Loss (%) due to interference from GSM UL (Scenario_3)

4.2.3.4 Conclusion

The following conclusions can be made from the analysis of the simulation results for the co-existence scenario 3 between UMTS(macro)-GSM(macro) in rural area with cell range of 5000 m in coordinated operation :

- RF system characteristics assumed for UMTS900 in section 4.2.1.2 are suitable and sufficient for UMTS900 to be deployed in rural environment in co-existence with GSM at cell range of 5000 m in coordinated operation;
- UMTS and GSM in rural environment can be deployed in the same geographical area in coordinated operation with 2.8 MHz carrier separation between UMTS carrier and the nearest GSM carrier.

4.2.4 Scenario_4: UMTS(macro)-UMTS(macro) in Rural area with cell range of 5000 m in uncoordinated operation

4.2.4.1 Co-existence scenario and simulation assumption

2x5 MHz uncoordinated operation between UMTS macrocell and UMTS macrocell.

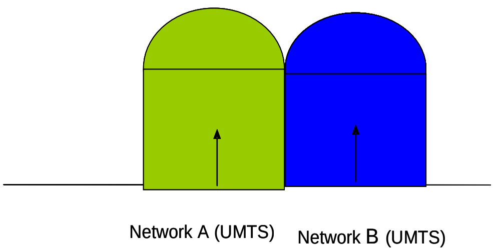

Figure 17A: 2x5 MHz uncoordinated operation

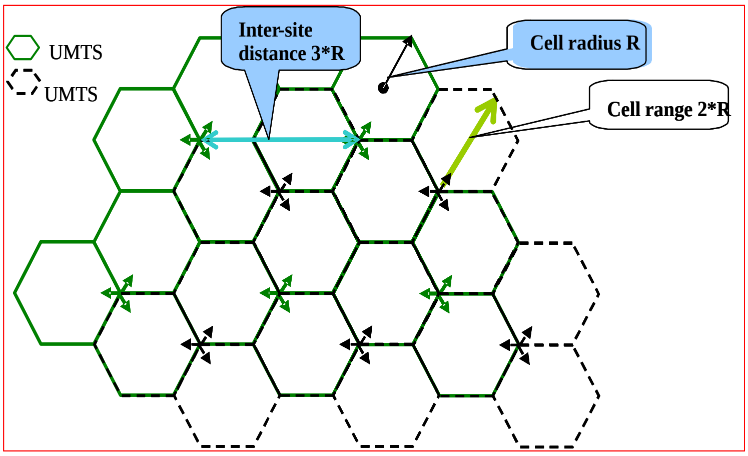

Figure 17B: 2x5 MHz uncoordinated operation

Carrier separation between two UMTS networks is of 5 MHz. The cell range is of 5000 m. As shown in figure 17, the BS of network B is located at the cell edge of network A. The simulation assumptions for the co-existence scenario 4 are summarized in table 12.

Table 12: Summary of UMTS900/UMTS900 simulation parameters for Scenario 4

Scenario_4		UMTS(macro)-UMTS(macro) in Rural area with cell range of 5000m in uncoordinated operation
Simulation cases		UMTS victims on both uplink and downlink. 2 simulation cases. 1) Downlink -WCDMA victim 2)Uplink - WCDMA victim Run simulations with various ACIRs by considering a center frequency separation of 5.0 MHz.
Network layout		As shown in figure 17 above - Rural environment - 3-sector configuration -36 cells (i.e., 108 sectors) with wrap-around -Cell radius R=2500m, cell range 2R=5000m, inter-site distance 3R= 7500 m (as shown in figure 17) -Worst-case shift between operators, Operator A's WCDMA site is located at Operator B's WCDMA cell edge
System parameters	**WCDMA**	- BS antenna gain with cable loss included = 15 dBi - BS antenna height H_{bs}=45 m; - UE antenna height H_{ms}=1.5 m - BS-UE MCL=80 dB - BS antenna(65° horizontal opening) radiation pattern is referred to 3GPP TR 25.896 V6.0.0 (2004-03), Section A.3 - UE antenna gain 0 dBi (omni-directional pattern)
Services	**WCDMA**	8 kbps Speech (chip rate: 3.84 Mcps) - Eb/Nt target (downlink): 7.9 dB - Eb/Nt target (uplink): 6.1 dB
Propagation Model	**WCDMA**	Log_normal_Fading = 10 dB Rural area propagation model (Hata model) $L(R) = 69.55 + 26.16 \log f - 13.82\log(H_b) + [44.9 - 6.55\log(H_b)]\log R - 4.78(\log f)^2 + 18.33 \log f - 40.94$ Hb is BS antenna height above ground in m, f is frequency in MHz, R is distance in km. With Hb=45m, f=920 MHz, the propagation model is simplified as $L(R) = 34.1 * \log(R) + 95.6$ The path loss from a transmitter antenna connector to a receiver antenna connector (including both antenna gains and cable losses) will be determined by: Path_Loss = max (L(R) + Log_normal_Fading - G_Tx – G_Rx, Free_Space_Loss + Log_normal_Fading - G_Tx – G_Rx, MCL) where G_Tx is the transmitter antenna gain in the direction toward the receiver antenna, which takes into account the transmitter antenna pattern and cable loss, G_Rx is the receiver antenna gain in the direction toward the transmitter antenna, which takes into account the receiver antenna pattern and cable loss, Log_normal_Fading is the shadowing fade following the log-normal distribution.
Cell selection	**WCDMA**	As per TR 25.942
SIR calculation	**WCDMA**	As per TR 25.942, except for the following changes: - Processing gain is changed to 26.8 dB for 8 kbps - Thermal noise level is raised to -96 dBm for downlink
Power Control assumption	**WCDMA**	As per TR 25.942 - 21 dBm terminals - Maximum BS power: 43 dBm - Maximum power per DL traffic channel: 30 dBm - Minimum BS power per user: 15 dBm. - Minimum UE power: –50 dBm. - Total CCH power: 33 dBm
Capacity	**WCDMA**	Capacity loss versus ACIR as per TR 25.942

ACIR	**WCDMA to WCDMA**	As per spectrum masks defined in TS 25.101, TS 25.104.

4.2.4.2 Analysis method

The objective of Monte-carlo simulations is to determine the appropriate UMTS BS & UE RF system parameters, Spectrum mask, ACLR (Adjacent Channel power Leakage Ratio), ACS (Adjacent Channel Selectivity), etc. for ensuring the good co-existence of UMTS and UMTS. In the simulation, the UMTS UL/DL capacity losses as function of ACIR (Adjacent Channel Interference Ratio) are simulated. In the simulations, the ACIR is used as a variable parameter.

In order to analyse the simulation results, it is supposed that UMTS900 system (BS & UE) has the same RF characteristics, such as Tx spectrum mask, ACLR, ACS, as defined in TS25.104 and TS25.101 for UMTS850/1800 (band V, band III). The simulation results will be analyzed based on these assumptions for checking if the assumed RF characteristics are sufficient or not for UMTS900 deployment in co-existence with other UMTS900 network.

The ACLR and ACS of UTRA-FDD BS and UTRA-FDD UE defined in TS25.104 and TS25.101 are summarized in the table 13 below.

Table 13: ACLR and ACS of UTRA-FDD BS and UE

	UTRA-FDD BS	**UTRA-FDD UE**
ACLR (dB)	45	33
ACS (dB)	46.3	33

The ACIR (Adjacent Channel Interference Ratio) can be calculated by the formula (1) given in section 4.2.1.2 and the results are given in the table 14.

Table 14: ACIR for UMTS UL/DL as victim being interfered by UMTS UL/DL

	UMTS UL as victim	**UMTS DL as victim**
ACIR (dB)	32.8	32.7

RAN WG4 agreed threshold for co-existence is that UMTS UL/DL capacity loss due to interferences from UMTS UL/DL should not be bigger than 5%.

4.2.4.3 Simulation results & analysis

Based on the Ran 4 agreed co-existence scenario 4 and simulation assumptions as described in the section 4.2.4.1, two cases (UMTS UL & DL as victim) are simulated. The simulation results for this co-existence scenario 4 from several companies have been presented and discussed. The simulation results data from different companies for this co-existence scenario are summarized in tables 14A and 14B.

Table 14A: UMTS DL as victim / UMTS DL Capacity Loss (%)

ACIR	**Ericsson**	**Nortel**	**Qualcomm**	**Siemens**
20	9,3	5,3	10,1	
25	3,4	2,3	2,7	2,3
30	0,9	1,4	0,9	0,8
35	0,5	0,5	0,4	0,4
40	0,2	0,2		0,2
45				
50	0			

Table 14B: UMTS UL as victim / UMTS UL Capacity Loss (%)

ACIR	Ericsson	Qualcomm	Siemens
20	7,3	7,6	
25	2,4	2,5	1,5
30	0,8	0,8	0,4
35	0,3	0,3	0,1
40	0,1		0
45			
50	0		

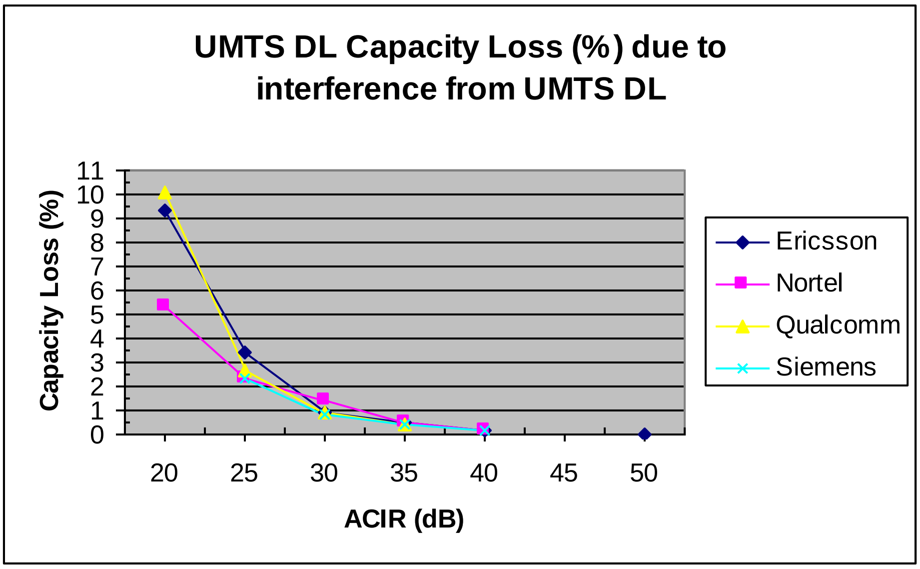

Figure 17C

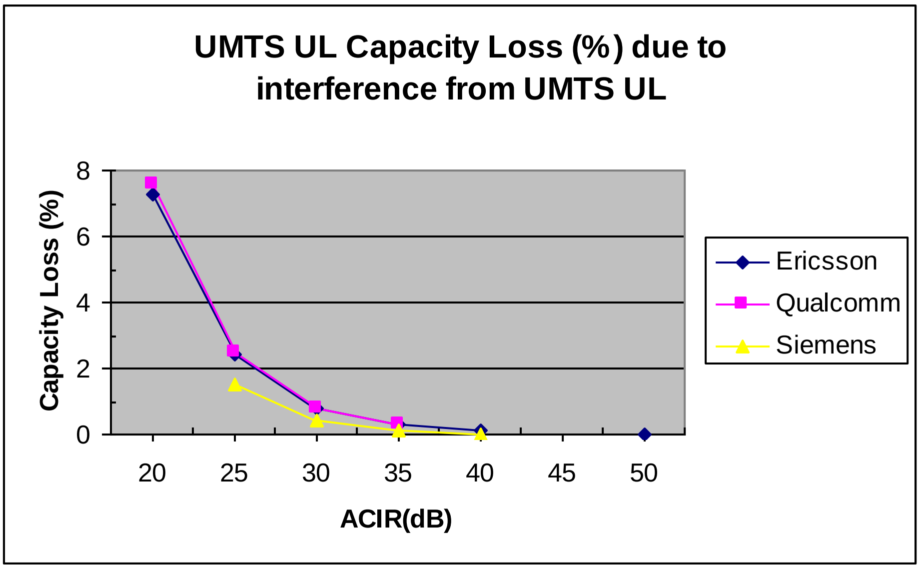

Figure 17D

4.2.4.3.1 UMTS DL Capacity Loss (%) due to interference from UMTS DL

Figure 18 gives the simulation results (4 simulation curves) of UMTS DL as victim, the UMTS downlink capacity loss due to interference from GSM downlink as function of ACIR between UMTS carrier and the nearest GSM carrier. All of the four simulation curves of UMTS downlink capacity loss due to interference from UMTS DL for the co-existence scenario 4 plotted in figure 18 shown that at the operating point of ACIR=32.7 dB, the UMTS DL capacity loss is below 1%.

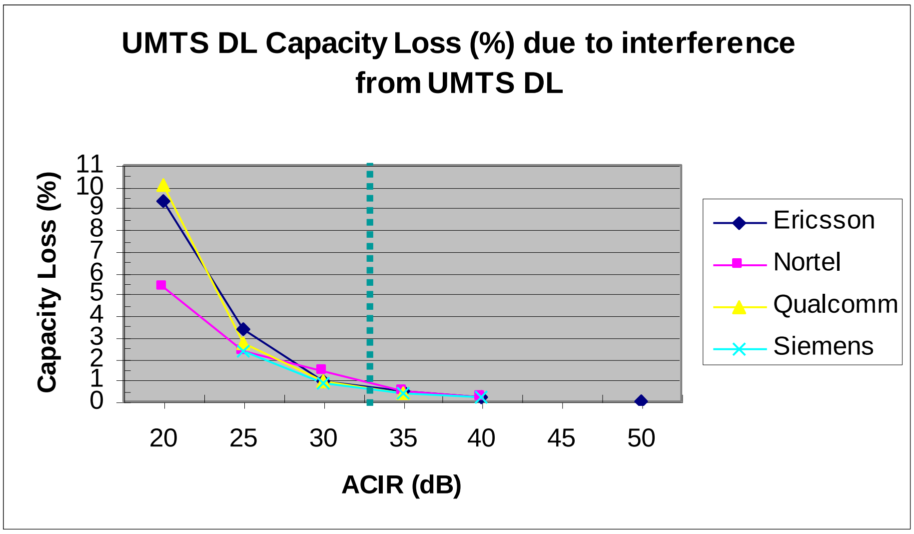

Figure 18: UMTS DL Capacity Loss (%) due to interference from UMTS DL (Scenario_4)

4.2.4.3.2 UMTS UL Capacity Loss (%) due to interference from UMTS UL

The simulation results (3 simulation curves) for the case of UMTS UL as victim, the UMTS UL capacity loss (%) due to interference from UMTS uplink as function of ACIR are given in figure 19. As shown in the figure 19, at the operating point of ACIR=32.8 dB, the UMTS UL capacity loss is smaller than 0.7%.

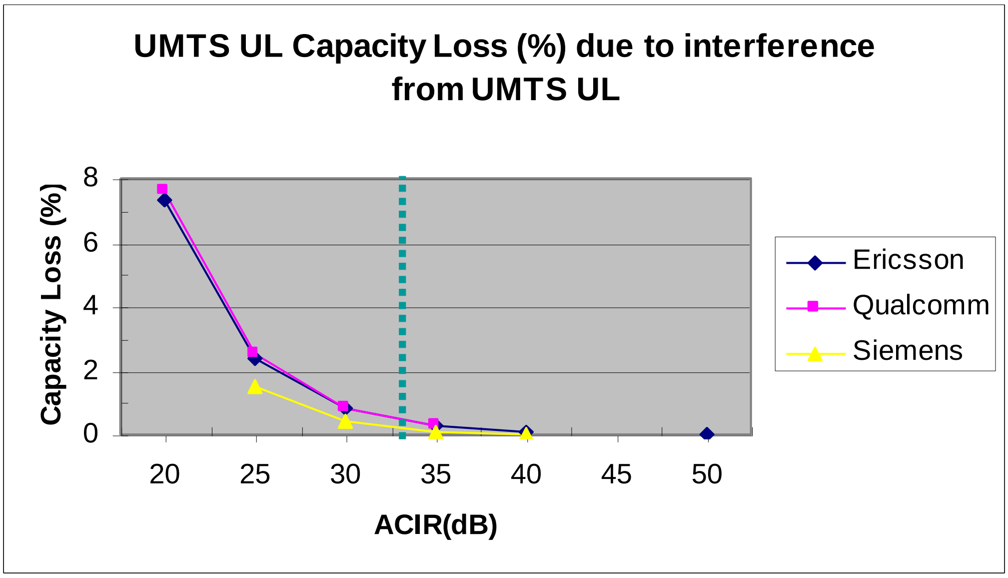

Figure 19: UMTS UL Capacity Loss (%) due to interference from UMTS UL (Scenario_4)

4.2.4.4 Conclusion

Based on the analysis of the simulation results for the co-existence scenario 4 between UMTS(macro) and UMTS(macro) in rural area with cell range of 5000 m in uncoordinated operation , the following conclusions can be made :

- RF system characteristics assumed in section 4.2.4.2 for UMTS900 are suitable and sufficient for UMTS900 to be deployed in rural environment with cell range of 5000 m in uncoordinated operation;

- UMTS and UMTS in rural environment can co-exist in uncoordinated operation with 5 MHz carrier separation.

4.2.5 Scenario_5: UMTS(macro)-GSM(micro) in Urban area in uncoordinated operation

4.2.5.1 Co-existence scenario and simulation assumption

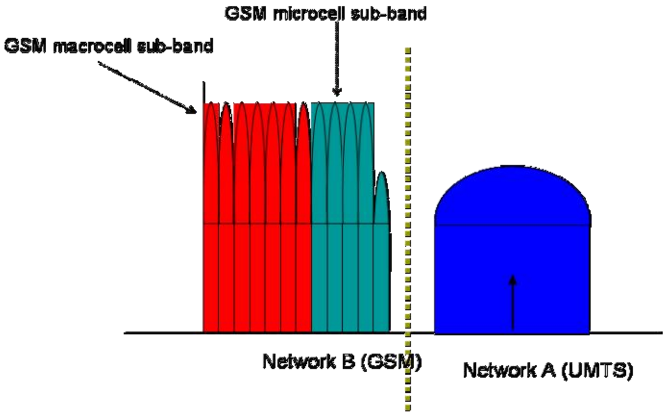

Figure 20A: Micro-Macro 2x5 MHz uncoordinated operation – band plan

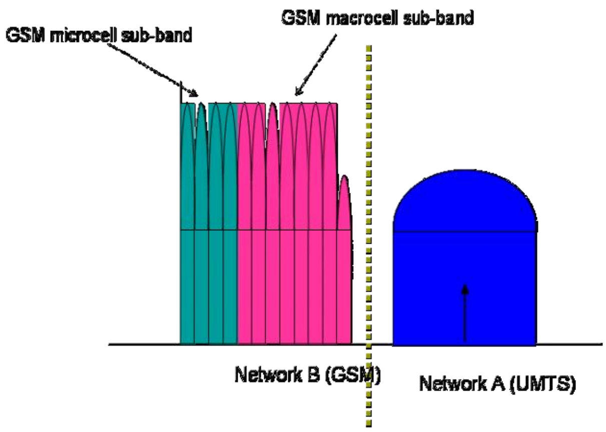

Figure 20B: Micro-Macro 2x5 MHz uncoordinated operation – band plan

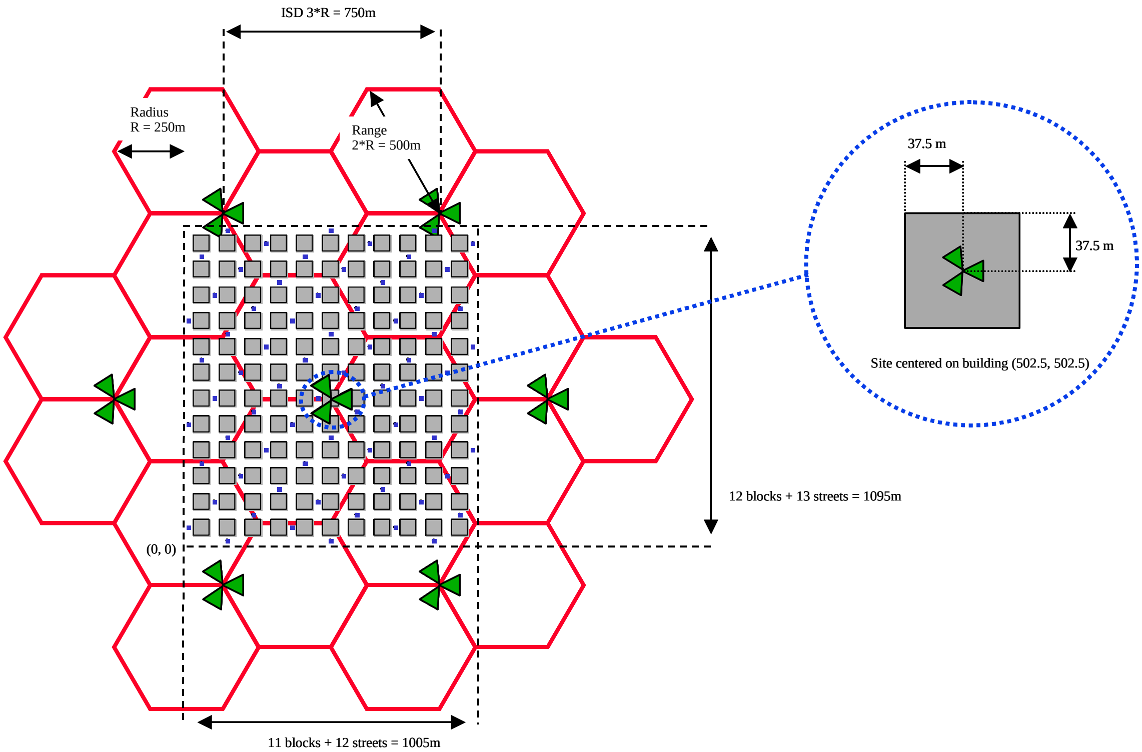

Figure 21: Micro-Macro 2x5 MHz uncoordinated operation – network layout

Simulation assumptions for the co-existence scenario 5 are summarized in table 15. As described in the table 15, two simulation cases of GSM downlink and GSM upink as victim will be studied by Monte-carlo simulation. Some of UMTS UE and GSM MS are placed inside of the buildings (for UE and MS located on the building blocks). The UMTS UE and GSM MS located in the streat are considered as outdoot UE.

Table 15: Summary of UMTS900 simulation parameters for Scenario 5

Scenario_5		UMTS(macro)-GSM(micro) in urban area in uncoordinated operation
Simulation cases		GSM victims on both uplink and downlink. 2 simulation cases. 1) Downlink -GSM (non-BCCH with PC)/WCDMA for GSM victim 2) Uplink - GSM victim (WCDMA loaded to 6 dB noise rise) No frequency hopping for GSM WCDMA network in macro environment, GSM in microcellular environment Run simulations with various ACIRs by considering a center frequency separation of 2.8 MHz and 4.8 MHz (see Figure 20).
Network layout		As shown in Figure 21. - Urban environment, UMTS macrocells - 3-sector configuration -7 sites (i.e., 21 sectors), the position (coordinates in meters related to the left-low corner) of the central macrocellular site are indicated on the figure 21 as (502.5, 502.5) -Cell radius R=250m, cell range 2R=500m, inter-site distance 3R= 750 m -Urban environment, GSM microcells -omni-directional GSM microcell configuration -GSM microcells are placed in the middle of street as shown in figure 21 -GSM cell frequency reuse : 8 as shown in figure 24 and 25.
System parameters	**WCDMA**	- BS antenna gain with cable loss included = 12 dBi - BS antenna height H_{bs}=30 m; - UE antenna height H_{UE}=1.5 m - BS-UE MCL=70 dB - BS antenna(65° horizontal opening) radiation pattern is referred to 3GPP TR 25.896 V6.0.0 (2004-03), Section A.3 - UE antenna gain 0 dBi (omni-directional pattern)
	GSM	- BS antenna gain with cable loss included = 6 dBi - BS antenna height H_{bs}=7 m; - MS antenna height H_{ms}=1.5 m - BS-MS MCL=53 dB - BS antenna omni-directional radiation pattern - UE antenna gain 0 dBi (omni-directional pattern)
Services	**WCDMA**	- 8 kbps Speech (chip rate: 3.84 Mcps) - Eb/Nt target (downlink): 7.9 dB - Eb/Nt target (uplink): 6.1 dB -UEs are uniformly distributed over the macro cell area, within the GSM microcellular zone where building blocks are present as shown in figure 21, WCDMA UEs situated on the building blocks are considered as indoor UEs, on the streats are considered as outdoor UEs
	GSM	Speech - SINR target (downlink): 9 dB - SINR target (uplink): 6 dB - MSs are uniformly distributed over the micro cell area, that means 67.5% of UEs are located in indoor area, and 32.5% of UEs are located in outdoor area
Outdoor Propagation model	**WCDMA and GSM**	As per TR 25.942, but modified for 920 MHz. Log_normal_Fading logF = 10 dB for WCDMA macrocell and GSM microcell Urban area propagation model for WCDMA macrocells: L(R) = 40*(1-0.004*DHb)*LOG10(R)-18*LOG10(DHb)+21*LOG10(f)+80 DHb est BS antenna height above average building top, for urban area with Hbs=30m, DHb=15m, f is frequency in MHz (f = 920 MHz) , R is distance in km. L(R) = 37.6* LOG10(R) + 121.1 The path loss from a transmitter antenna connector to a receiver antenna connector (including both antenna gains and cable losses) will be determined by: (1a) Path_Loss_a = max{L(R) , Free_Space_Loss}+ LogF (1b) Path_Loss_b = max{Path_Loss_a , Free_Space_Loss} – G_Tx – G_Rx (1c) Path_Loss = max{Path_Loss_b, MCL} where G_Tx is the transmitter antenna gain in the direction toward the receiver antenna, which takes into account the transmitter antenna pattern and cable loss,

		G_Rx is the receiver antenna gain in the direction toward the transmitter antenna, which takes into account the receiver antenna pattern and cable loss, logF, Log_normal_Fading is the shadowing fade following the log-normal distribution, it is to be added as a random variable with 10 dB standard deviation In calculating the total path loss in figures 22 and 23, lognormal fading should be drawn as one single random value that is used for all 4 paths. Microcellular propagation model for GSM microcell Manhattan pathloss (Dual Slope model in TR25.942 section 5.1.4.3) $$Manhatten\_pathloss = 20 \cdot \log_{10}\left(\frac{4\pi d_n}{\lambda} \cdot D\left(\sum_{j=1}^{n} s_{j-1}\right)\right)$$ (2) $$D(x) = \begin{cases} x/x_{br}, x > x_{br} \\ 1, x \le x_{br} \end{cases}$$ The pathloss slope before the break point xbr is 2, after the break point it increases to 4. The break point xbr is set to 300 m. x is the distance from the transmitter to the receiver. Where: - dn is the "illusory" distance; - λ is the wavelength; - n is the number of straight street segments between BS and UE (along the shortest path). The illusory distance is the sum of these street segments and can be obtained by recursively using the expressions $k_n = k_{n-1} + d_{n-1} \cdot c$ and $d_n = k_n \cdot s_{n-1} + d_{n-1}$ where c is a function of the angle of the street crossing. For a 90° street crossing the value c should be set to 0,5. Further, sn-1 is the length in meters of the last segment. A segment is a straight path. The initial values are set according to: k0 is set to 1 and d0 is set to 0. The illusory distance is obtained as the final dn when the last segment has been added. Small macrocell pathloss model for propagation below rooftop macrocell pathloss = 8.3 + 46 log (d) Where d is the distance in meters. (3) Pathloss_micro = max{min (Manhattan_pathloss, macrocell pathloss) + LogF - G_Tx – G_Rx, MCL}. Detail pathloss calculation method is described in TR25.942 section 5.1.4.3.
Indoor propagation model, Building Penetration Loss (BPL)	**Towards WCDMA macrocell**	See Figure 22 for the geometry. For the meaning and values of the following parameters, please refer to Table 1 below. Compute macro cell Path_Loss(i) according to eqn (1) for each of the 4 “virtual transmitter” locations x(i), i = 1, …4 (to be used as outdoor reference values). $$BPL(i) := W_e + W_{ge} - G_{FH} + a * R_i$$ $$Total\_Path\_loss := \min_{1 \le i \le 4} \{\text{Path\_Loss(i)+BPL(i)}\}$$ (4)
	Towards GSM microcell	See Figure 23 for the geometry. For the meaning and values of the following parameters, please refer to Table 1 below. Compute micro cell Pathloss_micro(i) according to eqn (3) for each of the 4 “virtual transmitter” locations x(i), i = 1, …4 (to be used as outdoor reference values). The BPL for the LOS and the NLOS paths is computed separately: For the LOS path: $$BPL(i_{LOS}) := W_e + WG_e\left(1 - \frac{D}{S}\right)^2 + a * R_{i_{LOS}}$$ For the NLOS paths: $$BPL(i) := W_e + W_{ge} + a * R_i$$ $$Total\_Path\_loss := \min_{1 \le i \le 4} \{\text{Pathloss\_micro(i)+BPL(i)}\}$$ (5)
	BPL Parameters	Parameters to be used for computing the BPL (please refer to “Final report of the COST Action 231, Chapter 4.6.” for a description of these parameters): See table 15B below.

Cell selection	**WCDMA**	As per TR 25.942
	GSM	As for WCDMA in TR 25.942, but with only one link selected at random within a 3 dB handover margin
SIR calculation	**GSM**	Total noise-plus-interference is sum of thermal noise, GSM co-channel, and WCDMA interference. Cells are synchronised on a time slot basis. Adjacent channel GSM interference is neglected. Noise floor (downlink): -111 dBm Noise floor (uplink): -106 dBm
Power Control assumption	**WCDMA**	As per TR 25.942 - BS maximum Tx power: 43 dBm - 21 dBm terminals - Minimum BS power per user: 15 dBm. - Minimum UE power: –50 dBm. - Total CCH power: 33 dBm
	GSM	Stabilization algorithm same as for WCDMA (C/I based) with a margin of 5 dB added to the SIR target. - Maximum power (TRx): 24 dBm - Minimum power (TRx): 0 dBm (non-BCCH) - Maximum power (MS): 33 dBm - Minimum power (MS): 5 dBm
Capacity	**WCDMA**	The WCDMA macro cellular network should be loaded as per TR 25.942 (5% outage on the DL, 6dB noise rise on the UL). Considering the cell edge affects and the impact of the Manhattan grid, the WCDMA macro cellular network load will be set based on the cell loading of the three central sectors. That is: -For the WCDMA DL: the WCDMA macro cellular network is loaded so that 95 % of the users within the three central sectors achieve an Eb/No of (target Eb/No -0.5 dB). -For the WCDMA UL: the WCDMA macro cellular network is loaded to obtain an average (linear) noise rise for the centre three sectors of 6dB over thermal noise. UEs are considered to belong to the three central sectors if they meet the following criteria: - The UE is affiliated to one of the centre three sectors, but not in soft handover. - The UE is in soft handover with two of the three central sectors. - The UE is in soft handover with one of the centre three sectors and the propagation loss between the UE and the centre sector is less than the propagation loss between the UE and the other sector involved in the handover. In the unlikely event that the propagation losses to both sectors in the handover are equal a random allocation between the two sectors should be made.
	GSM	Load to maximum number of users and observe change in outage (i.e., 0.5 dB less than SINR target)
ACIR	**WCDMA to GSM**	As per spectrum masks defined in TS 25.101, TS 25.104 (applying the appropriate measurement BW correction), unless capacity loss is found to be significant.

Table 15B: BPL Parameters

Parameter	Value	Comment
W_e	7 dB	External wall loss in dB at perpendicular penetration
W_{ge}	3 dB	Additional external wall loss in dB for NLOS conditions due to non-perpendicular penetration of the impinging waves
WG_e	20 dB	Additional external wall loss in dB at 0 deg grazing angle
A	0.6 dB / m	Additional internal building loss in dB/m
D, S	Depends on the geometry, see Fig. 7	
G_{FH}	5.0 dB	Floor height gain; assumed to be 1.75 dB/floor

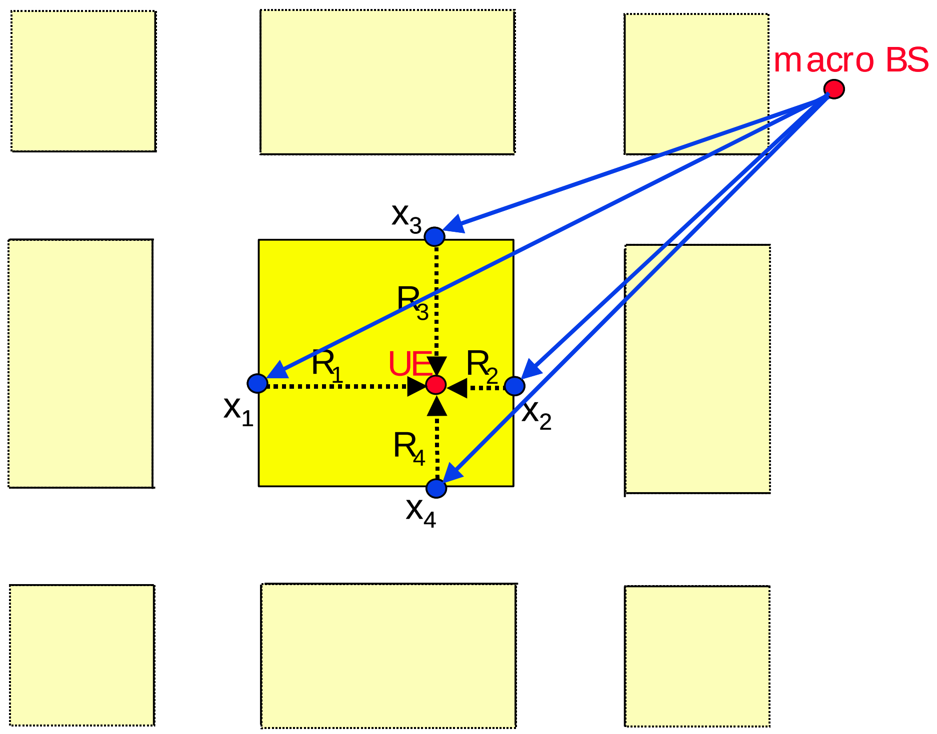

Figure 22: Calculation of BPL towards a macro cell

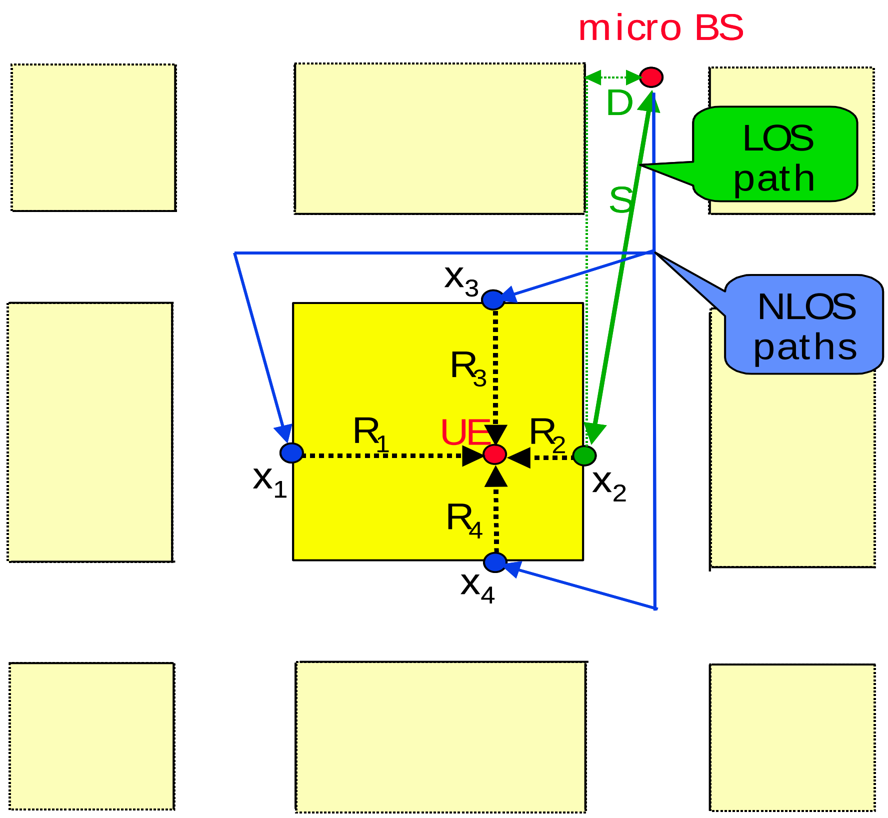

Figure 23: Calculation of BPL towards a micro cell

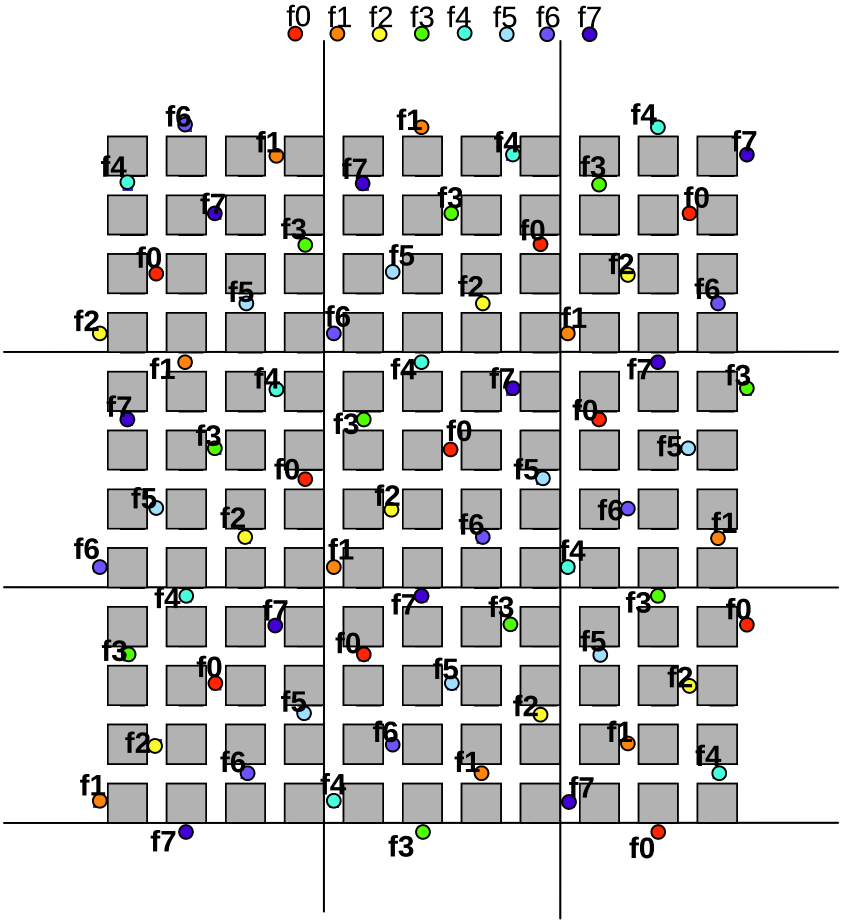

Figure 24: GSM microcell frequency reuse pattern

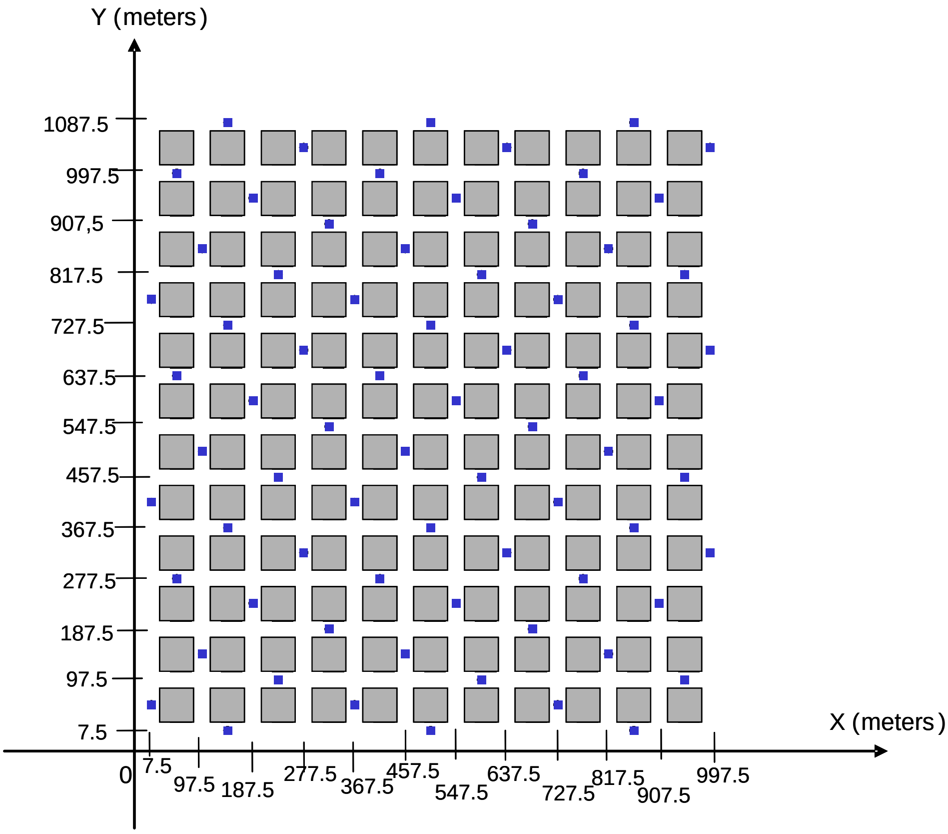

Figure 25A: GSM microcell sites positions and frequencies

Frequency	X	Y
f6	142.5	1087.5
f1	277.5	1042.5
f4	52.5	997.5
f7	187.5	952.5
f3	322.5	907.5
f0	97.5	862.5
f5	232.5	817.5
f2	7.5	772.5
f1	142.5	727.5
f4	277.5	682.5
f7	52.5	637.5
f3	187.5	592.5
f0	322.5	547.5
f5	97.5	502.5
f2	232.5	457.5
f6	7.5	412.5
f4	142.5	367.5
f7	277.5	322.5
f3	52.5	277.5
f0	187.5	232.5
f5	322.5	187.5
f2	97.5	142.5
f6	232.5	97.5
f1	7.5	52.5
f7	142.5	7.5

Frequency	X	Y
f1	502.5	1087.5
f4	637.5	1042.5
f7	412.5	997.5
f3	547.5	952.5
f0	682.5	907.5
f5	457.5	862.5
f2	592.5	817.5
f6	367.5	772.5
f4	502.5	727.5
f7	637.5	682.5
f3	412.5	637.5
f0	547.5	592.5
f5	682.5	547.5
f2	457.5	502.5
f6	592.5	457.5
f1	367.5	412.5
f7	502.5	367.5
f3	637.5	322.5
f0	412.5	277.5
f5	547.5	232.5
f2	682.5	187.5
f6	457.5	142.5
f1	592.5	97.5
f4	367.5	52.5
f3	502.5	7.5

Frequency	X	Y
f4	862.5	1087.5
f7	997.5	1042.5
f3	772.5	997.5
f0	907.5	952.5
f2	817.5	862.5
f6	952.5	817.5
f1	727.5	772.5
f7	862.5	727.5
f3	997.5	682.5
f0	772.5	637.5
f5	907.5	592.5
f6	817.5	502.5
f1	952.5	457.5
f4	727.5	412.5
f3	862.5	367.5
f0	997.5	322.5
f5	772.5	277.5
f2	907.5	232.5
f1	817.5	142.5
f4	952.5	97.5
f7	727.5	52.5
f0	862.5	7.5

Figure 25B: GSM microcell sites positions and frequencies

4.2.5.2 Analysis method

The objective of Monte-carlo simulations is to determine the appropriate UMTS BS & UE RF system parameters, Spectrum mask, ACLR (Adjacent Channel power Leakage Ratio), ACS (Adjacent Channel Selectivity), receiver narrow band blocking, etc. for ensuring the good co-existence of UMTS and GSM. In the simulation, the GSM UL/DL system outage degradations at given ACIR values or as function of ACIR are simulated. In the simulations, the ACIR is used as a variable parameter.

The assumptions of UMTS BS & UE RF characterics (Spectrum mask, ACLR, ACS) were described in the section 4.2.1.2, the GSM system (BS & MS) RF characteristics (ACLR, ACS) were also given in the section 4.2.1.2. The derived ACIR of GSM DL/UL for the carrier separation of 2.8 MHz and 4.8 MHz between UMTS carrier and the nearest GSM carrier were described in the section 4.1.2.2.

The threshold used for the evaluation of the impact on GSM network performance due to interference from UMTS is the system outage degradation. The system outage degradation should be as small as possible.

4.2.5.3 Simulation results & analysis

Based on the Ran 4 agreed co-existence scenario 5 and simulation assumptions as described in the section 4.2.5.1, simulation results data for this co-existence scenario 5 are summarized in tables 15C and 15D.

Table 15C: GSM DL as victim / GSM DL Outage degradation (%)

ACIR	Ericsson	Lucent	Motorola	Nokia	Siemens	Qualcomm
20	26,9		12,7			14,53
25	16,3				23,8	7,96
30	8,7	6,4	1,98	18		3,78
35	4	3,8		10,2	7,5	1,57
40	1,5	2,5	0,1	5	4,9	0,55
45		1,4		2	2,4	0,17
50	0,1	0,9	0	0,7		0,042
55		0,6		0,2	0,46	
60		0,4	0	0,1		

Table 15D: GSM UL as victim / GSM UL Outage degradation (%)

ACIR	Ericsson	Lucent	Motorola	Nokia	Siemens	Qualcomm
20	0,01		0,23	0,035	2,8	0,0042
25		1,2	0,04	0,04	1,3	0,0014
30	0	0,7	0,03	0,04		0
35		0,4	0,01	0,045	0,17	0
40		0,3	0,01	0,05		0
45		0,2	0,01	0,05	0	0
50		0,1	0,01	0,05		0

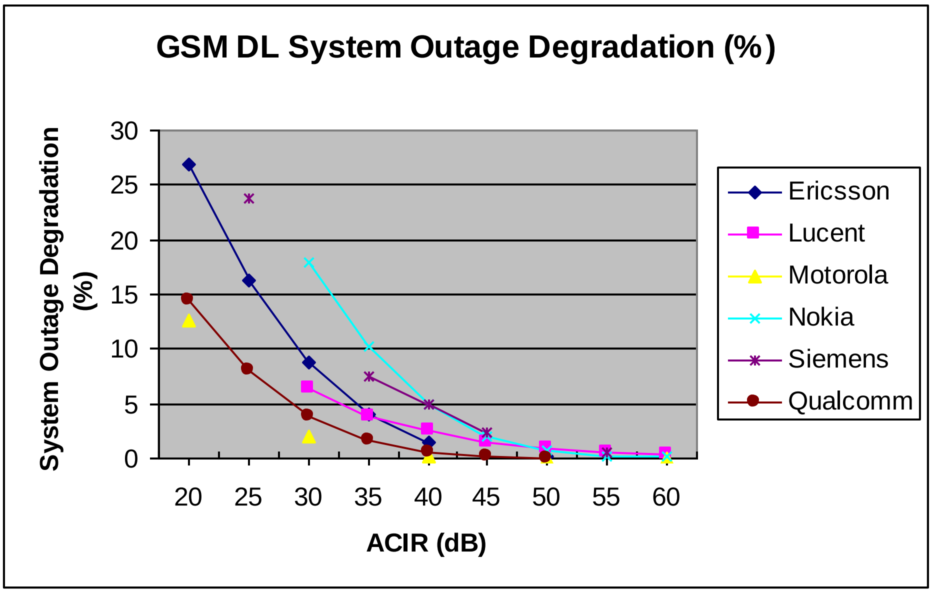

Figure 25C

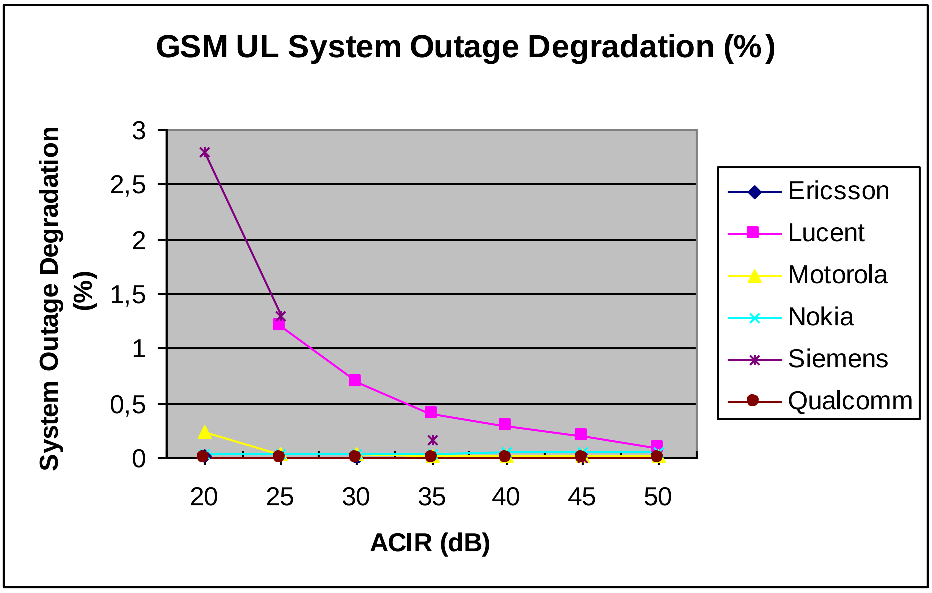

Figure 25D

4.2.5.3.1 GSM microcell DL System Outage Degradation (%) due to interference from UMTS macrocell DL

Six simulation curves of GSM downlink system outage degradation in function of ACIR between UMTS carrier and the nearest GSM carrier for the co-existence scenario 5 is plotted in figure 26.

The calculated ACIR of GSM DL for the carrier separation of 2.8 MHz and 4.8 MHz between UMTS carrier and the nearest GSM carrier were described in the section 4.1.2.2, they are respectively of 50 dB and 63 dB for 2.8 MHz and 4.8 MHz carrier separations. As shown in the figure 26, the GSM DL system outage degradation at ACIR=50 dB is below 0.9%, at ACIR=63 dB is smaller than 0.3%.

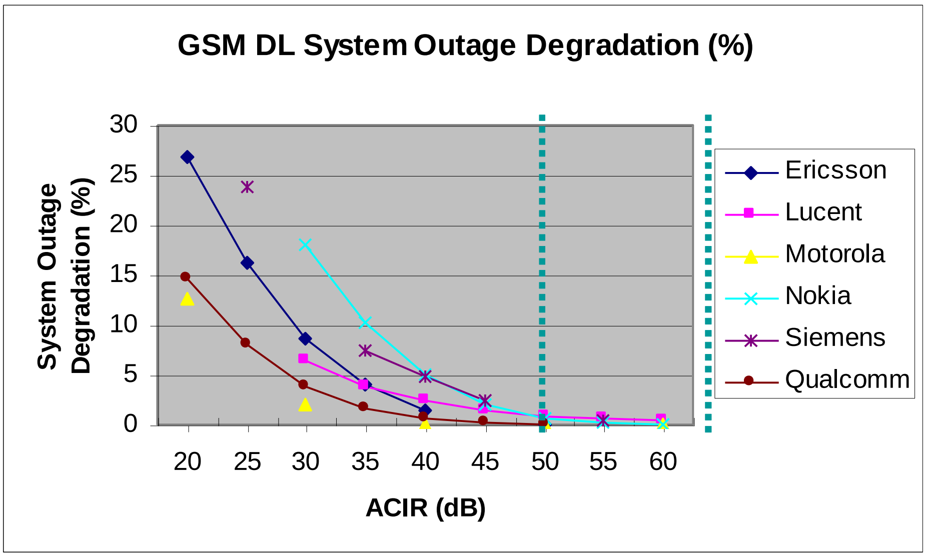

Figure 26: GSM DL System Outage Degradation (%) due to interference from UMTS DL (Scenario_5)

4.2.5.3.2 GSM microcell UL System Outage Degradation (%) due to interference from UMTS macrocell UL

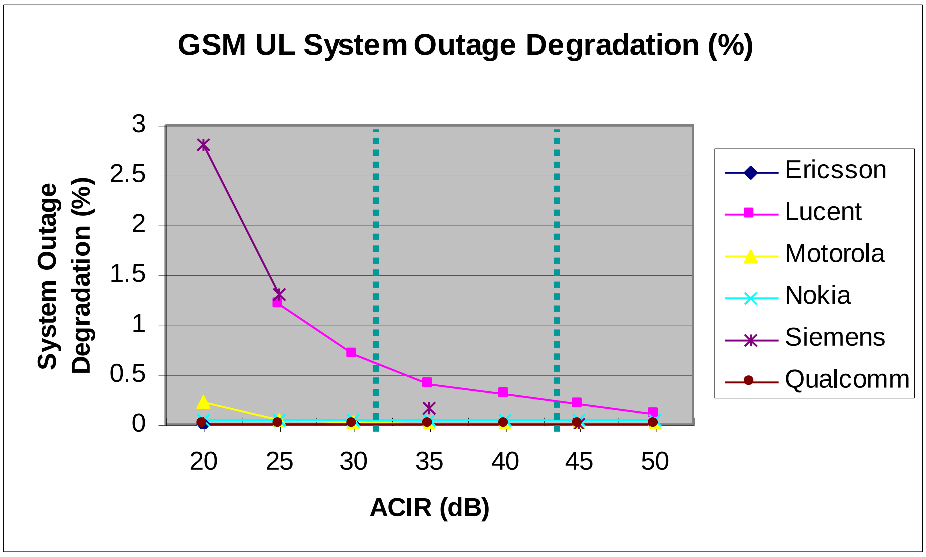

Figure 27: GSM UL System Outage Degradation (%) due to interference from UMTS UL (Scenario_5)

Six simulation results of GSM uplink system outage degradation due to interference from UMTS uplink for the co-existence scenario 5 as function of ACIR between UMTS carrier and the nearest GSM carrier are plotted in figure 27.

The derived ACIR of GSM UL for the carrier separation of 2.8 MHz and 4.8 MHz between UMTS carrier and the nearest GSM carrier were described in the section 4.1.2.2, they are respectively of 31.3 dB and 43.3 dB for 2.8 MHz and 4.8 MHz carrier separations. As shown in the figure 27, the GSM microcell UL system outage degradation at ACIR=31.3 dB corresponding 2.8 MHz carrier separation is below 0.6%, that at ACIR=43.3 dB corresponding 4.8 MHz carrier separation is smaller than 0.25%.

It can be observed that GSM microcell DL/UL system outage degradation due to interference from UMTS DL/UL is bigger than that for the co-existence case between UMTS macrocell and GSM macrocell in urban environment. This GSM microcell DL/UL system outage degradation increase can come from several possible reasons:

- GSM microcell BS antenna height is lower, the MCL and propagation loss between GSM BS and MS is smaller, it is also smaller between GSM BS and UMTS UE;

- Distribution of GSM MS and UMTS UE inside of the buildings are considered in the simulation for this microcellular scenario.

It can also be seen that GSM downlink system outage degradation is higher than that of GSM uplink, even GSM microcellular base station antenna is much lower than GSM macrocellular base station antenna, the distance between GSM microcell BS and the interfering UMTS UE is relatively small.

The simulation results show that the GSM DL/UL system outage degradation at carrier separation of 4.8 MHz is much smaller than that at carrier separation of 2.8 MHz.

4.2.5.4 Conclusion

Based on the analysis of the simulation results for the co-existence scenario 5 between UMTS(macro) and GSM(micro) in urban area in uncoordinated operation, it can be concluded that :

1) GSM DL/UL system outage degradation due to interference from UMTS DL/UL for GSM microcellular case is higher than that for GSM macrocellular case;

2) The GSM microcell DL/UL system outage degradation due to interference from UMTS macrocell DL/UL at carrier separation between UMTS carrier and the nearest GSM carrier of 4.8 MHz is much smaller than that at the carrier separation of 2.8 MHz;

3) RF system characteristics assumed for UMTS900 seem to be sufficient, there could be some impact on GSM microcell DL/UL system performance, but the impact is limited and small. The increase of carrier separation between UMTS carrier and the nearest GSM microcell carrier will help to reduce the GSM microcellular system outage degradation. It is recommended to use a GSM micellular sub-band as far as possible from UMTS carrier.

4) In order to minimise the impact on GSM microcellular network outage degradation due to UMTS, the recommended frequency band plan is shown below in Figure 28, GSM macrocell sub-band should be placed between the GSM microcell sub-band and UMTS carrier.

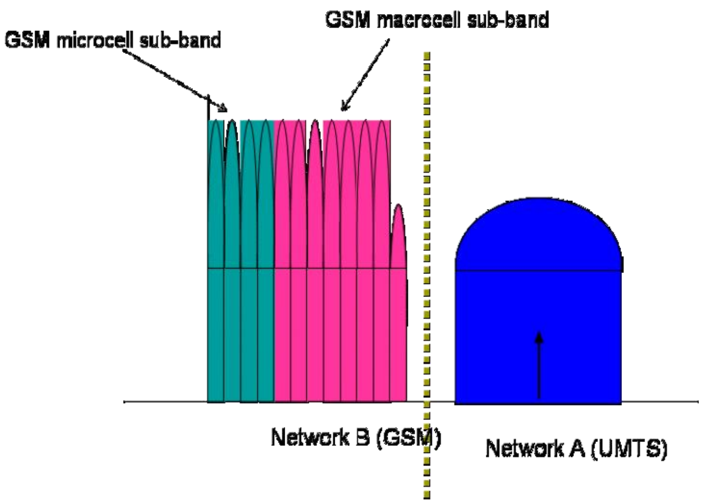

Figure 28: Recommended band plan for UMTS macrocell, GSM macrocell, and GSM microcell

4.2.6 Scenario_6: UMTS(macro)-GSM(pico) in Urban area in uncoordinated operation

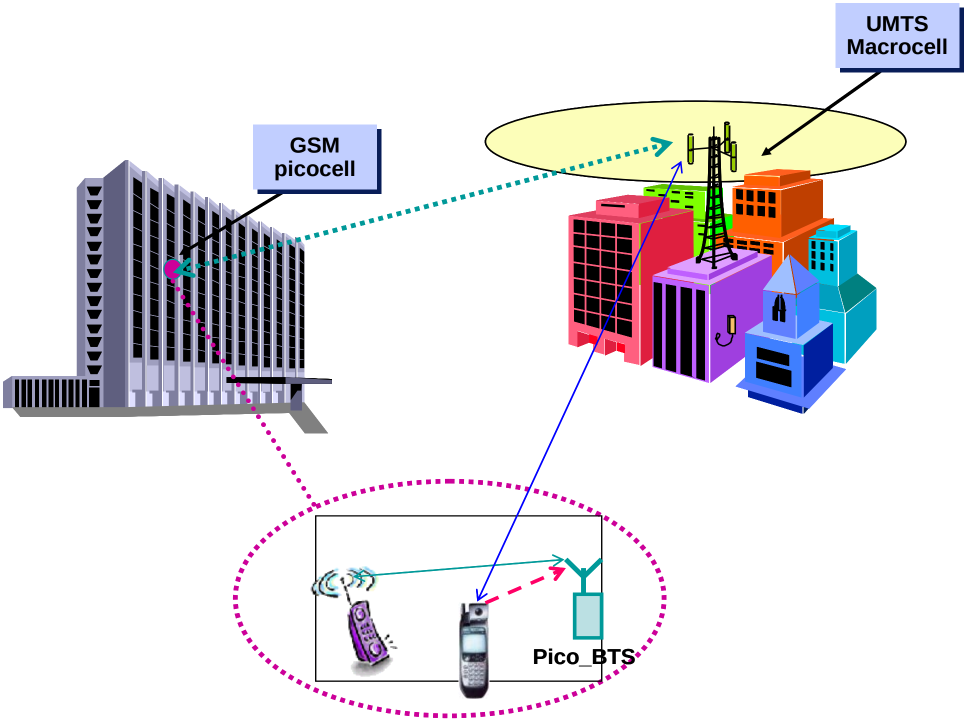

Figure 29: UMTS macrocell and GSM picocell co-existence scenario

The co-existence scenario 6 of UMTS macrocell and GSM picocell is indicated in the figure 29. In urban area, the UMTS macrocellular network layout is defined in the scenario 1 of TR25.816 section 4.2.1. GSM pico BTS is situated inside of a building. UMTS macro BTS antenna is installed on the top of a different building, as shown in the figure 29. Both GSM MS and UMTS UE are located inside of the building within the GSM picocell coverage area.

The interference from UMTS UE to GSM pico-BTS will be analyzed.

4.2.6.1 Link analysis assumptions for scenario 6

The interference analysis assumptions for scenario 6 are summarized in the table 16.

Table 16: Interference analysis assumptions for scenario 6

	UMTS macrocell		GSM picocell	
	BS	UE	BTS	MS
Maximum Tx power (dBm)	43	21	20	33
Antenna height (m)	TR25.816 Section 4.2.1	TR25.816 Section 4.2.1	3	1.5
Antenna gain (dBi)	TR25.816 Section 4.2.1	TR25.816 Section 4.2.1	0	0
Reference sensitivity (dBm)	TR25.816 Section 4.2.1	TR25.816 Section 4.2.1	-88	-102
Noise floor (dBm)	-103 dBm/3.84 MHz	-96 dBm/3.84 MHz	-94 dBm/200 kHz	-111 dBm/200 kHz
Spectrum mask	TS25.104	TS25.101	TS45005	TS45005
Blocking characteristics	TS25.104	TS25.101	TS45005	TS45005
Cell range (m)	TR25.816 Section 4.2.1		50	
UMTS UE Tx power typical values from the scenario 1 or scenario 5 simulations	90%, 50%			
Carrier separation (MHz)	2.8, 4.8			
Distance between UMTS UE and GSM pico_BTS (m)	3, 15			

4.2.6.2 Interference analysis with simulated outdoor UE Tx power

4.2.6.2.1 Simulated outdoor UE Tx power

Outdoor UMTS UE Tx power distribution are simulated based on the co-existence scenario 1 described in the section 4.2.1. It is simulated without the interference from GSM.

Figure 30 gives an example of the simulated outdoor UE Tx power distribution. An example of the cumulative probability of outdoor UE Tx power is plotted in figure 31.

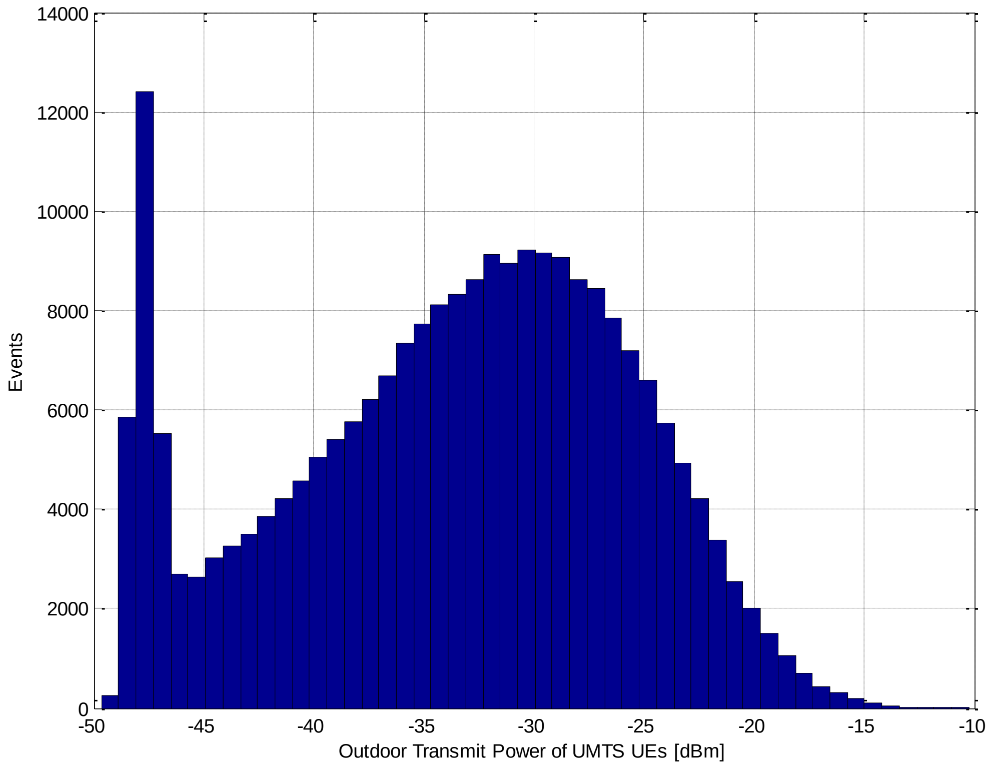

Figure 30: Outdoor UMTS UE Transmit Power distribution

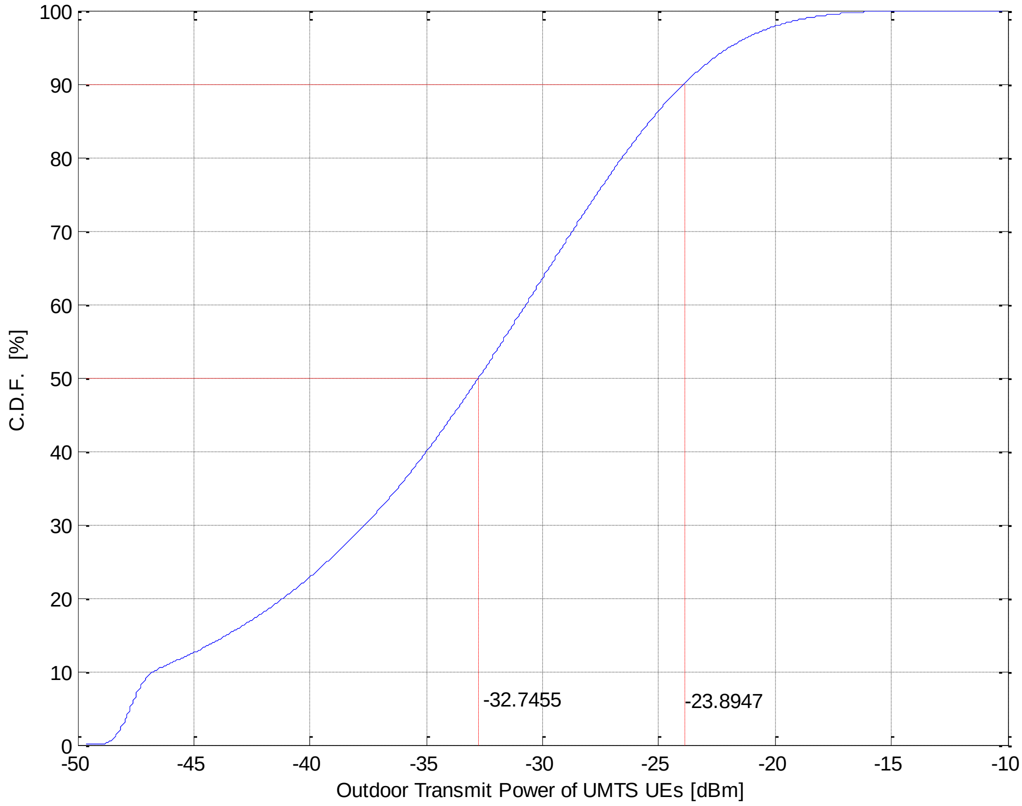

Figure 31: C. D. F. of Outdoor Transmit Power of UMTS UE

The table 17 summarizes the outdoor UMTS UE Tx power values at 50th percentile and 90th percentile from simulations performed by different companies. It was agreed to use the averaged values for interference analysis.

Table 17: Simulated outdoor UMTS UE transmit powers at 90% and 50%

Percentile	90%	50%
Ericsson	-23.7 dBm	-32.6 dBm
Nokia	-24.0 dBm	-32.5 dBm
Nortel	-19.6 dBm	-30.4 dBm
Qualcomm	-23.9 dBm	-32.7 dBm
Lucent	-21.0 dBm	-30.6 dBm
Average	-22.4 dBm	-31.8 dBm

4.2.6.2.2 Interference analysis

4.2.6.2.2.1 Tx power of Indoor UMTS UEs

The Tx power of Indoor UMTS Ues for in-building penetration factor (IPF) of 10 dB and 15 dB is given in Table 18.

Table 18: Indoor Tx power of UMTS Ues for different IPF

C.D.F.	90%		50%	
Outdoor Tx power [dBm]	-22.4		-31.8	
IPF [dB]	10	15	10	15
Indoor Tx power [dBm]	-12.4	-7.4	-21.8	-16.8

4.2.6.2.2.2 Determination of UMTS UE Tx power in GSM BS receiving channel

The frequency separation between the carriers of UMTS UE and GSM BS is denoted by df. In this study, it is assumed that df is 2.8 MHz and 4.8 MHz. The adjacent channel leakage ration (ACLR) of UMTS UE for these carrier separations in Table 19 is obtained from the spectrum emission mask of UMTS UE defined in TS25.101, as shown in figure 32.

Table 19: ACLR at carrier separations 2.8MHz and 4.8MHz

Frequency separation	2.8MHz	4.8MHz
ACLR [dB]	31.3	43.3

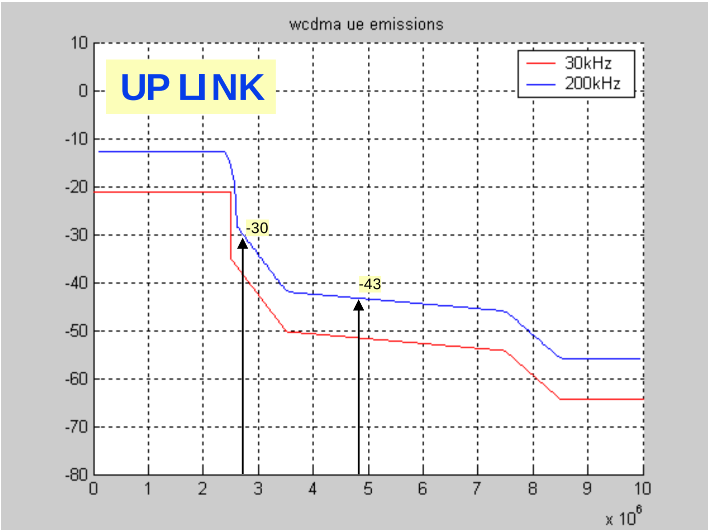

Figure 32: WCDMA UE emissions to GSM

The power of UMTS UE emissions in the GSM uplink channel for considered *df* values is calculated in Tables 20 and 21.

Table 20: Tx Power of UMTS UE in GSM BS channel for df = 2.8 MHz

C.D.F.	90%		50%	
Outdoor Tx power [dBm]	-22.4		-31.8	
IPF [dB]	10	15	10	15
Indoor Tx power [dBm]	-12.4	-7.4	-21.8	-16.8
Tx power in GSM channel [dBm/200kHz]	-43.7	-38.7	-53.1	-48.1

Table 21: Tx Power of UMTS UE in GSM channel for df = 4.8 MHz

C.D.F.	90%		50%	
Outdoor Tx power [dBm]	-22.4		-31.8	
IPF [dB]	10	15	10	15
Indoor Tx power [dBm]	-12.4	-7.4	-21.8	-16.8
Tx power in GSM channel [dBm/200kHz]	-55,7	-50.7	-65.1	-60.1

4.2.6.2.2.3 Typical GSM picocell cell range

It is assumed that the typical cell range of the GSM picocellular is 50 m, as shown in figure 33. In addition, the separation distance between UMTS UE and GSM pico BS is considered to be 3 m and 15 m.

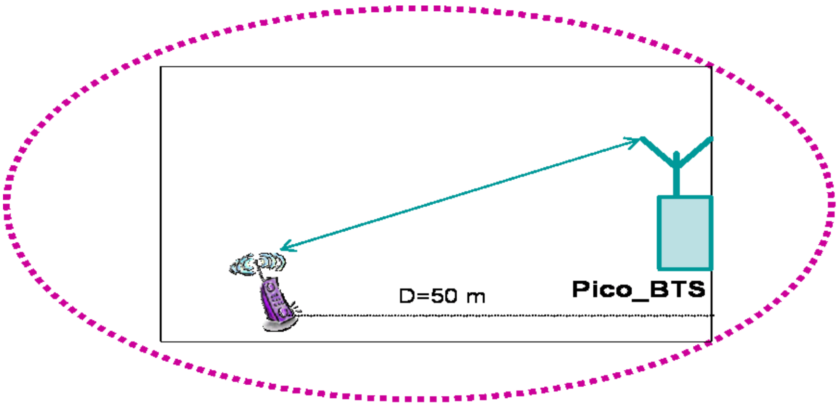

Figure 33: Illustration of relative position of GSM MS and GSM pico-BTS

4.2.6.2.2.4 Indoor propagation model and COST231 indoor propagation model is used for the indoor pathloss calculation:

$$PL(D)\ (dB) = 37 + 30\ Log\ (D) \qquad (1)$$

Where D is the distance in meter.

The pathloss as function of distance D(m) calculated by the equation (1) is plotted in figure 34. the pathloss for three typical distances are given in table 22.

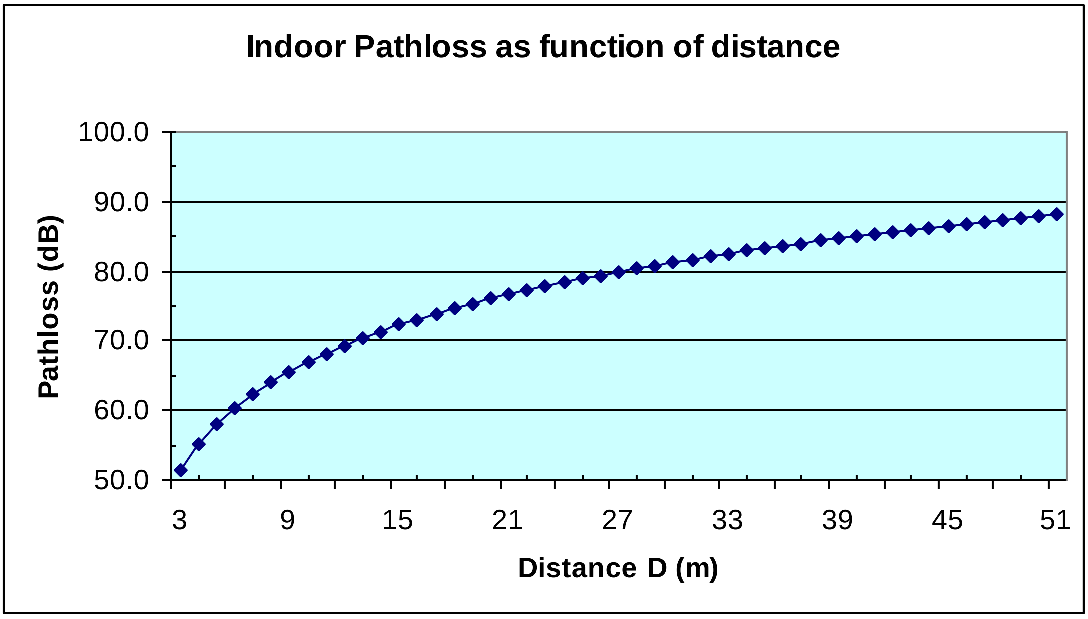

Figure 34: Indoor propagation pathloss in function of distance D(m)

Table 22: Pathloss for three typical distances

D (m)	Pathloss (dB)
3	51.3
15	72.3
50	88.0

4.2.6.2.2.5 Determination of interference level on GSM uplink

The Interference level (I_{ext}) from UMTS UE emissions to the GSM pico-cell uplink for the considered separation distances are presented in Tables 23 and 24.

Table 23: Interference Power in GSM channel from UMTS UE (Iext) for df = 2.8MHz

C.D.F.	**90%**				**50%**			
Outdoor Tx power [dBm]	-22.4				-31.8			
IPF [dB]	10		15		10		15	
Indoor Tx power [dBm]	-12.4		-7.4		-21.8		-16.8	
Tx power in GSM channel [dBm/200kHz]	-43.7		-38.7		-53.1		-48.1	
D [m]	3	15	3	15	3	15	3	15
Iext [dBm/200kHz]	-95	-116	-90	-111	-104.4	-125.4	-99.4	-120.4

Table 24: Interference Power in GSM channel from UMTS UE (Iext) for df = 4.8MHz

C.D.F.	**90%**				**50%**			
Outdoor Tx power [dBm]	-22.4				-31.8			
IPF [dB]	10		15		10		15	
Indoor Tx power [dBm]	-12.4		-7.4		-21.8		-16.8	
Tx power in GSM channel [dBm/200kHz]	-55,7		-50.7		-65.1		-60.1	
D [m]	3	15	3	15	3	15	3	15
Iext [dBm/200kHz]	-107	-128	-102	-123	-116.4	-137.4	-111.4	-132.4

4.2.6.2.2.6 Analysis of the impact on GSM picocell uplink

The GSM picocell uplink performance should be analyzed in the cases with and without the presence of interference from the UMTS UE for the assumptions given above; i.e. *df* = 2.8 MHz & 4.8 MHz, *IPF* = 10 dB & 15 dB and separation distance between UMTS UE and GSM pico BS = 3 m & 15 m. It is assumed that GSM uplink is power controlled and the link performance is achieved at 6 dB target *SIR*. In addition, the thermal noise floor is N_t = -94 dBm/200 kHz and 10 dB margin is assumed for interference and shadow fading denoted by *M*.

4.2.6.2.2.7 GSM picocell uplink without UMTS UE interference

The required received power at the GSM pico BS to achieve the target SIR is denoted by Rx_required and given as

$$\text{Rx\_required} = \text{Nt} + \text{M} + \text{SIR} = -78 \text{ dBm}$$

Hence, the required transmit power of GSM MS at the cell edge denoted by Tx_required in dBm is

$$\text{Tx\_required} = \text{Rx\_required} + \text{Pathloss(D=50)} = 10 \text{ dBm}$$

Table 25 summarizes these results.

Table 25: Required Tx and Rx power at the cell edge without UMTS UE interference

GSM picocell uplink without interference	
Rx_required [dBm]	-78
Tx_required [dBm]	10

4.2.6.2.2.8 GSM picocell uplink with UMTS UE interference (Iext)

When the interference from UMTS UE is introduced, the required receive power at GSM BS and the required transmit power of GSM MS at the cell edge is

$$\text{Rx\_required} = (N_t + I_{ext}) + M + \text{SIR},$$

Where $(N_t + I_{ext})$ in dBm is the sum of noise floor and the interference caused by UMTS UE. The required transmit power of GSM MS is again calculated as

$$\text{Tx\_required} = \text{Rx\_required} + \text{Pathloss(D=50)}$$

Rx_required and *Tx_required* are determined in the following tables.

Table 26: Required Tx and Rx power at the cell edge for df = 2.8 MHz with the presence of Iext

C.D.F.	90%				50%			
Outdoor Tx power [dBm]	-22.4				-31.8			
IPF [dB]	10		15		10		15	
Indoor Tx power [dBm]	-12.4		-7.4		-21.8		-16.8	
Tx power in GSM channel [dBm/200kHz]	-43.7		-38.7		-53.1		-48.1	
D [m]	3	15	3	15	3	15	3	15
Iext [dBm/200kHz]	-95	-116	-90	-111	-104.4	-125.4	-99.4	-120.4
Nt+Iext [dBm/200kHz]	-91,5	-94,0	-88.5	-93.9	-93.6	-94.0	-92.9	-94.0
Rx_required [dBm]	-75,5	-78,0	-72.5	-77.9	-77.6	-78.0	-76.9	-78.0
Tx_required [dBm]	12,5	10,0	15.5	10.1	10.4	10.0	11.1	10.0

Table 27: Required Tx and Rx power at the cell edge for df = 4.8 MHz with the presence of Iext

C.D.F.	90%				50%			
Outdoor Tx power [dBm]	-22.4				-31.8			
IPF [dB]	10		15		10		15	
Indoor Tx power [dBm]	-12.4		-7.4		-21.8		-16.8	
Tx power in GSM channel[dBm/200kHz]	-55,7		-50.7		-65.1		-60.1	
D [m]	3	15	3	15	3	15	3	15
Iext [dBm/200kHz]	-107	-128	-102	-123	-116.4	-137.4	-111.4	-132.4
Nt+Iext [dBm/200kHz]	-93,8	-94,0	-93,4	-94,0	-94,0	-94,0	-93,9	-94,0
Rx_required [dBm]	-77,8	-78,0	-77,4	-78,0	-78,0	-78,0	-77,9	-78,0
Tx_required [dBm]	10,2	10,0	10,6	10,0	10,0	10,0	10,1	10,0

4.2.6.3 Interference analysis with simulated indoor UE Tx power

4.2.6.3.1 Indoor UMTS UE Tx power

The C.D.F. of WCDMA Indoor UE Tx power is simulated in scenario 5, an example of the cumulative probability of simulated indoor UMTS UE Tx power is shown in Figure 35. 90^{th}-percentile and 50^{th}-percentile points of the distribution from simulations are summarized in Table 28.

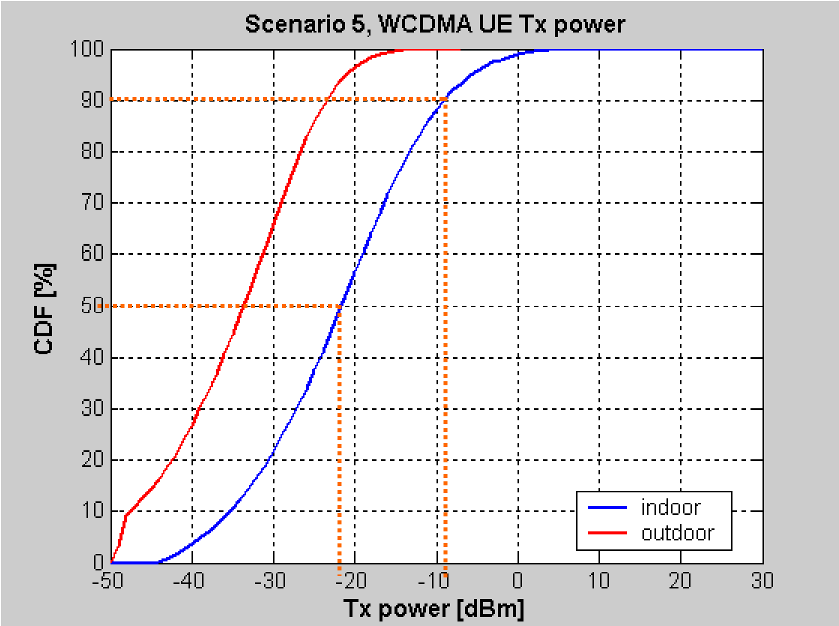

Figure 35: C. D. F. of Indoor Transmit Power of UMTS UE

Table 28: Simulated indoor UMTS UE transmit powers at 90% and 50%

Percentile	**90%**	**50%**
Ericsson	-9.1 dBm	-21.7 dBm
Lucent	0 dBm	-9.7 dBm
Average	-4.5 dBm	-15.7 dBm

4.2.6.3.2 UMTS UE Tx power in GSM channel

The UE Tx power falling into the GSM Base Station (BS) receive channel can be determined by the following equation:

UE Tx power in GSM channel = Indoor UE Tx power – ACIR(Δf) in dB (2)

where Δf denotes the center frequency spacing between UMTS and GSM carriers. When the UMTS UEs interfere with GSM picocell, the ACIR is 31.3 dB for 2.8 MHz center frequency separation and 43.3 dB for 4.8 MHz center frequency separation. Table 29 shows the UE Tx power in GSM channel for various UE Tx power percentiles and center frequency separations.

Table 29: UMTS UE Tx Power in GSM channel

Cumulative Distribution Function (CDF)	90%		50%	
Indoor UE Tx power (dBm)	-4.5		-15.7	
Δf (MHz)	2.8	4.8	2.8	4.8
UMTS UE Tx power in GSM channel (dBm/200kHz)	-35.8	-47.8	-47.0	-59.0

4.2.6.3.3 UMTS UE interference level received by GSM picocell

It is assumed that the distance (*D*) between the interfering UMTS UE and affected GSM picocell could be 3 m and 15 m. The associated UE to picocell propagation losses based on the COST231 indoor model are 51.3 dB and 72.3 dB, respectively. The GSM picocell received interference power (I_{ext}) from UMTS UE can be expressed as

I_{ext} = UMTS UE Tx power in GSM channel – PL(D) in dB (3)

where PL is the path loss (including the propagation loss and antenna gains) from UMTS UE to GSM picocell. Table 30 shows the UMTS UE interference power received by GSM picocell for various UE Tx power percentiles, center frequency separations and UE-to-picocell distances.

Table 30: UMTS UE interference power received by GSM picocell

CDF	90%				50%			
Indoor UE Tx power (dBm)	-4.5				-15.7			
Δf (MHz)	2.8		4.8		2.8		4.8	
UMTS UE Tx power in GSM channel (dBm/200kHz)	-35.8		-47.8		-47.0		-59.0	
UE-to-picocell Distance (m)	3	15	3	15	3	15	3	15
Iext (dBm/200kHz)	-87.1	-108.1	-99.1	-120.1	-98.3	-119.3	-110.3	-131.3

4.2.6.3.4 Impact of UMTS UE interference on GSM picocell uplink

When the GSM uplink power control is activated and the UMTS UE interference is present, GSM mobile needs to transmit more power to maintain the uplink SINR target (*SINR*) in the GSM picocell receiver as long as the required mobile transit power does not exceed the maximum power (33 dBm). Without UMTS UE interference, the required Tx power of a GSM mobile at the picocell edge can be determined by:

$$GSM\_mobile\_Tx\_required = N_t + SINR + PL(D{=}50\ m) + M \quad \text{in dB} \qquad (4)$$

where Nt denotes the GSM picocell receiver noise floor (-94 dBm/200 kHz), PL(D=50 m) denotes the path loss (88.0 dB) for a 50 m distance between the GSM picocell and the GSM mobile at the picocell edge, and M denotes the lognormal fading and interference margin (10 dB). Consequently, in the absence of UMTS UE interference, the GSM mobile power requirement is 10 dBm.

In the presence of UMTS UE interference, the required Tx power of a GSM mobile at the picocell edge can be expressed as:

$$GSM\_mobile\_Tx\_required = (N_t + I_{ext}) + SINR + PL(D{=}50\ m) + M \quad \text{in dB} \qquad (5)$$

where (Nt + Iext) in dBm is the linear sum of the GSM picocell noise floor and the UMTS UE interference. Table 31 shows the required GSM mobile Tx power with UMTS UE interference for various UE power percentiles, center frequency separations and UE-to-picocell distances.

Table 31: Required GSM mobile transmit power in the presence of UMTS UE interference

CDF	**90%**				**50%**			
Indoor UE Tx power (dBm)	-4.5				-15.7			
Δf (MHz)	2.8		4.8		2.8		4.8	
UMTS UE Tx power in GSM channel (dBm/200kHz)	-35.8		-47.8		-47.0		-59.0	
UE-to-picocell Distance (m)	3	15	3	15	3	15	3	15
I_{ext} (dBm/200kHz)	-87.1	-108.1	-99.1	-120.1	-98.3	-119.3	-110.3	-131.3
N_t+I_{ext} (dBm/200kHz)	-86.3	-93.8	-92.8	-94.0	-92.6	-94.0	-93.9	-94.0
GSM_mobile_Rx_power (dBm)	-70.3	-77.8	-76.8	-78.0	-76.6	-78.0	-77.9	-78.0
GSM_mobile_Tx_power (dBm)	**17.7**	**10.2**	**11.2**	**10.0**	**11.4**	**10.0**	**10.1**	**10.0**

4.2.6.4 Conclusion

The Interference from UMTS UE to GSM picocell BS has been analyzed with the simulated outdoor UE Tx powers and indoor UE Tx power. Based on the analysis results for the co-existence scenario 6 between UMTS macrocell and GSM picocell, the following conclusions can be made

1) When UMTS UE is located at 15 m distance from GSM pico-BTS, the interference from UMTS UE to GSM pico-BTS is lower than the GSM pico-BTS noise floor hence the transmitting power of GSM MS located at cell edge is not affected.

2) When UMTS UE is located at 3 m distance from GSM picro-BTS and the carrier separation between UMTS and GSM is of 2.8 MHz, the transmitting power of GSM MS at cell edge (50 m from pico-BTS) will be increased of a quantity between 0 and 7.7 dB depending on the interference caused by the UMTS UE transmitter. However, the required GSM MS transmitting power stays still below the maximum power and therefore it is considered that there is no call dropping in GSM system caused by the interference from UMTS UE.

3) When UMTS UE is located at 3 m distance from GSM pico-BTS and the carrier separation between UMTS and GSM is of 4.8 MHz, the transmitting power of GSM MS at cell edge (50 m from pico-BTS) will be increased of a quantity between 0 and 1.2 dB depending on the interference caused by the UMTS UE transmitter. As the interference is small and GSM transmitters have more than enough power margin to compete against it is considered that there is no call dropping in GSM system caused by the interference from UMTS UE.

4) UMTS UE spectrum mask allow a good co-existence between UMTS macrocell and GSM picocell for the defined co-existence scenario hence there is no need to harden the UMTS UE spectrum mask.

5) For ensuring a good co-existence between UMTS macrocells and GSM picocell, it is recommended to have maximum separation between UMTS carrier and GSM picocell carrier in order to minimize the possible interference from UMTS UE to GSM picocellular BS.

4.2.7 Compatibility between GSM MCBTS and UMTS 900 systems

4.2.7.1 Purpose of the investigation

Co-existence studies have been performed regarding the possible impact from introduction of UMTS 900 allocated in an adjacent frequency range to GSM 900 systems. The results are well known and established in the European Community.

Recently 3GPP TSG GERAN has finalized the work on specifying Multicarrier BTS (MCBTS) for GSM. To make the implementations feasible with wideband multicarrier transmitter and receiver, relaxations of the requirements for IM attenuation and inband spurious emissions in the transmitter and reduction of blocking requirements in the receiver were introduced. The decision is based a number of studies on the impacts of relaxations of the specifications for GSM MCBTS on coexistence of public coordinated and uncoordinated GSM networks operating in the same frequency band and the same geographical area. The conclusion has been that there was no noticeable impact of the relaxations in such scenarios.

The purpose of this study is to see what possible impact the relaxations of the requirements for GSM MCBTS could have on

- UMTS 900 system operating in adjacent channel in the same area due to relaxed intermodulation attenuation and inband spurious emissions
- The susceptibility of MCBTS receiver to UMTS900 system uplink emissions due to reduced blocking characteristics.

4.2.7.2 Impact on UMTS 900 downlink from MCBTS

4.2.7.2.1 Principles used in the analysis

A simplified approach has been taken:

The emission spectrum from a UMTS BS with 43 dBm rated power into the adjacent frequency band, where another UMTS 900 system is allocated, is calculated. The ACLR according to the 3GPP specification is defined accordingly.

Then the UMTS BS is replaced by GSM MCBTS and the emission spectrum for different number of active GSM carriers calculated by aggregating the spectrum masks including IM products according to TS 45.005 v8.5.0. The carriers are transmitting at 43 dBm each and are located with varying frequency spacing (from minimum 600 kHz and upwards), giving IM products in the downlink of the adjacent UMTS 900 system. The equivalent maximum emission is calculated within the UMTS bandwidth, thus giving an upper limit of the ACLR from the GSM system. The ACLR was derived in the same way as was done in TR 25.816 assuming a 3.84 MHz "box filter".

This ACLR was calculated for one carrier (i.e. no IM products) up to 8 carriers. Both single-sided and double-sided (sandwiched) carrier configurations are investigated (see figure 35A). Depending on the GSM frequency spacing and allocation, the number of IM products that would fit into the UMTS filter bandwidth will vary. All GSM carriers are assumed to be served by the same MCPA, which is pessimistic in terms of IM emission.

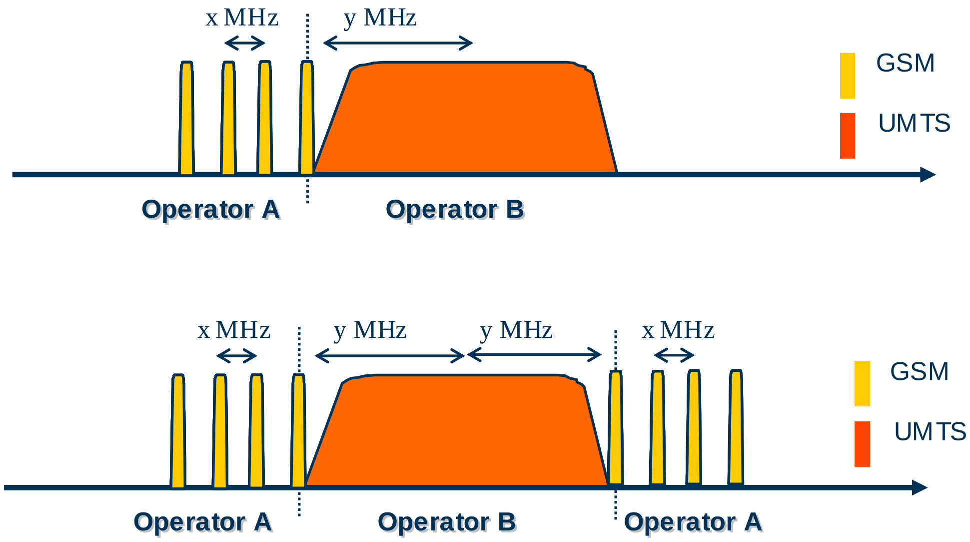

Figure 35A: The figure shows the single- and double-sided scenarios, where the smallest carrier separation between GSM and UMTS is varied (y), as well as GSM carrier spacing (x).

One single carrier will result in an ACLR of 63.5 dB which differs from the value derived from the GSM spectrum mask in TR 25.816 (55.2 dB). This difference corresponds to a bandwidth conversion factor from 30 kHz to 200 kHz and is believed to be the correct interpretation of TS 45.005. Note that the ACLR is always relative one GSM carrier of 43 dBm.

To calculate the total impact ACIR the following formula is used:

$$ACIR = \frac{1}{\frac{1}{ACLR} + \frac{1}{ACS}}$$

ACS GSM BS->UMTS UE is assumed to be 30.5 dB for carrier seperation 2.8 MHz with an additional 0.8 dB receiver selectivity slope of for every 200 kHz, as described in the assumptions in 3GPP TR 25.816.

4.2.7.2.2 Results

IM emission levels are according to specification and are 200 kHz wide, with 3 dB attenuated emission into the adjacent 200 kHz channel for third-order IM. For the fifth order IM, the emissions are attenuated 2 dB into the first adjacent 200 kHz channel and further 3 dB into the second adjacent 200 kHz channel.

Assuming a frequency separation between the last GSM carrier and the centre frequency of the UMTS in adjacent band of 2.8 MHz (as used in TR 25.816 in the uncoordinated case), the ACLR is calculated for different GSM carrier separation and different number of carriers. It is assumed that the MCPA intermodulation attenuation is designed for the number of carriers used in each scenario.

For comparison the same calculations were also performed with no IM from GSM present, which approximates the existing situation utilizing single carrier BTS (SCBTS).

Using the method described above to calculate the ACLR , the following result is achieved in UMTS channel, allocated 2.8 MHz from any GSM carrier:

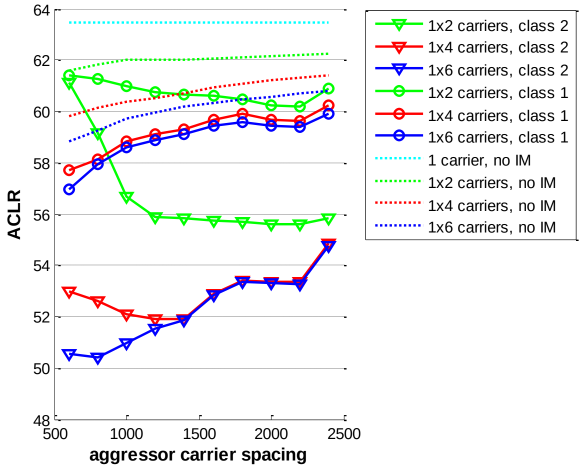

Figure 35B: ACLR for single-sided carrier configurations. IM levels according to specification. IM levels according to specification. Smallest carrier separation between GSM and UMTS 2.8 MHz.

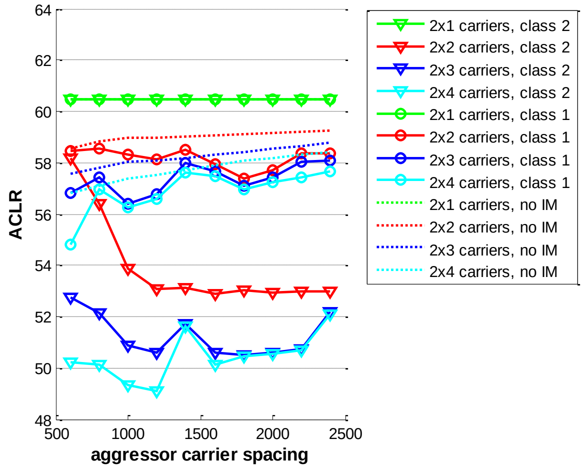

Figure 35C: ACLR for double-sided carrier configurations. IM levels according to specification. IM levels according to specification. Smallest carrier separation between GSM and UMTS 2.8 MHz.

As can be seen in figures 35B and 35C, it is not the smallest GSM carrier spacing that gives the highest levels of interference to the adjacent UMTS carrier, which is due to different numbers of IM products in the UMTS receiver. It should be noted that all ACLR values are above the UMTS requirement of 45 dB.

Related to the ACS performance of the UMTS UE in case of multicarrier GSM reception with closest GSM carrier at frequency offset y=2.8 MHz, a slope for the receiver selectivity performance of the UMTS UE according to the depicted assumptions in 3GPP TR 25.816 has been assumed:

$$ACS(\Delta f) = 30.5 \text{ dB} + n * 0.8 \text{ dB} \qquad \text{with } \Delta f = 2.8 \text{ MHz} + n * 200 \text{ kHz}$$

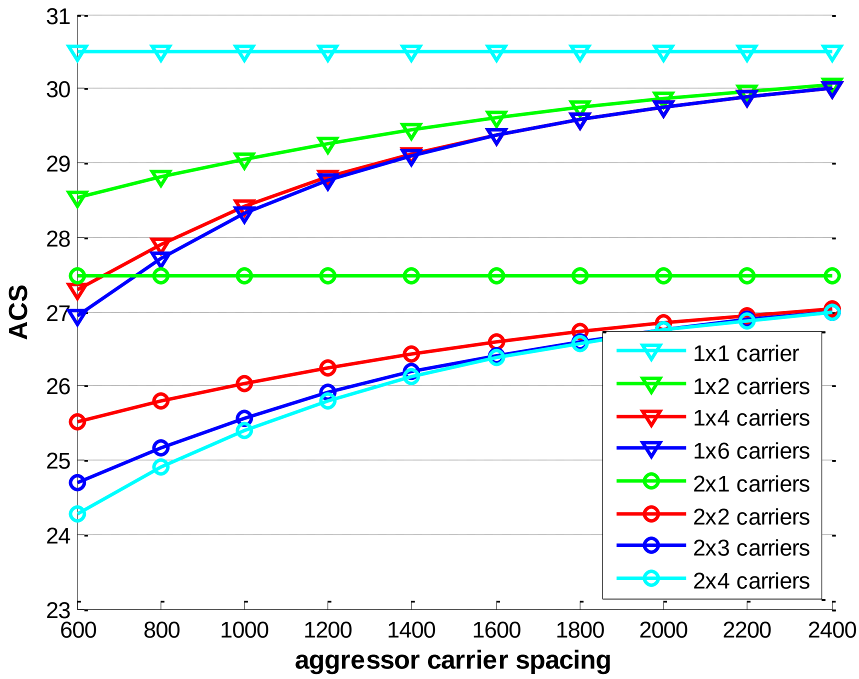

Figure 35D: ACS for several carrier configurations, single- and double-sided

Figure 35F shows the combined UMTS UE ACS for the different carrier configurations that are calculated according the formula above. It can be seen that the sandwiched configuration leads to lower ACS performance than single-sided configuration.

To estimate the corresponding ACIR values, it can be noted when comparing figure 35B and 35C with figure 35D that the ACS values are about 20 dB lower than the ACLR values. This means that ACS dominates ACIR and while ACLR still has an effect on the results, it is not by much. Thus, the lowest ACIR values occur when GSM carrier spacing is small. Table 31A shows ACIR for 600 kHz GSM carrier separation.

Table 31A: ACIR performance for GSM carriers allocated adjacent to UMTS channel. Smallest carrier separation between GSM and UMTS 2.8 MHz. 600 kHz GSM carrier spacing.

	ACIR [dB]							
	Single-sided scenario				Double-sided scenario			
GSM BTS type	1x1 carriers	1x2 carrier	1x4 carriers	1x6 carriers	2x1 carriers	2x2 carriers	2x3 carriers	2x4 carriers
SCBTS	30.50	28.52	27.28	26.94	27.49	25.51	24.68	24.27
MCBTS class 1	30.50	28.52	27.28	26.94	27.49	25.51	24.68	24.27
MCBTS class 2	30.50	28.52	27.27	26.92	27.49	25.51	24.68	24.26

It can be seen in the table that when replacing a SCBTS with a MCBTS, the impact on ACIR is very small, class 1 less than 0.01 dB and class 2 less than 0.02 dB. If the more realistic IM emission levels are used, the degradation is even smaller. The degradation is insignificant in the double-sided scenario due to low combined ACS. Some of the carrier configurations, e.g. 2x2 carriers, do not give any IM3 products in the UMTS receiver filter, which is why is there is no degradation.

A more realistic, though still pessimistic, frequency re-use is 1200 kHz carrier spacing. The corresponding ACIR values can be seen in table 31B. The table shows similar amounts of degradation as in the 600 kHz carrier spacing scenario.

Table 31B: ACIR performance for GSM carriers allocated adjacent to UMTS channel. Smallest carrier separation between GSM and UMTS 2.8 MHz. 1200 kHz GSM carrier spacing.

	ACIR [dB]							
	Single-sided scenario				Double-sided scenario			
GSM BTS type	1x1 carrier	1x2 carrier	1x4 carriers	1x6 carriers	2x1 carriers	2x2 carriers	2x3 carriers	2x4 carriers
SCBTS	30.50	29.26	28.80	28.76	27.49	26.25	25.90	25.79
MCBTS class 1 spec.	30.50	29.25	28.80	28.75	27.49	26.24	25.90	25.79
MCBTS class 2 spec.	30.50	29.25	28.78	28.74	27.49	26.24	25.89	25.78

In both cases above the separation between the last GSM carrier and UMTS 900 centre frequency is 2.8 MHz. If 2.6 MHz is assumed, as recommended in [36] for coordinated case, there will be a small difference for smaller carrier spacing due to higher wideband noise from closest GSM carriers. This is exemplified in figure 35E and 35F.

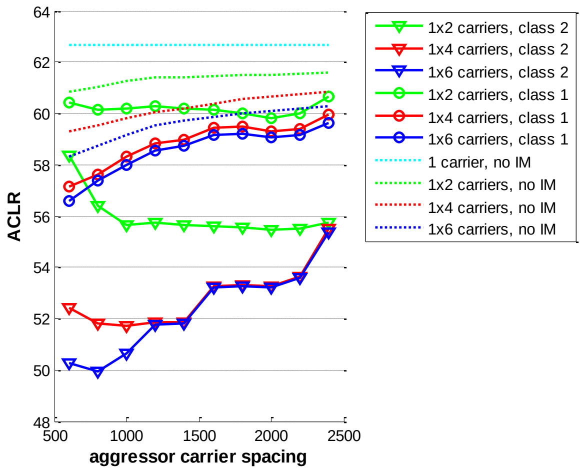

Figure 35E: ACLR for single-sided carrier configurations. IM levels according to specification. Smallest carrier separation between GSM and UMTS 2.6 MHz.

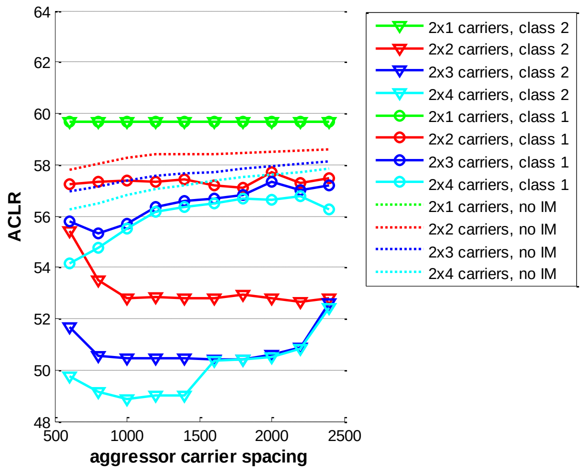

Figure 35F: ACLR for double-sided carrier configurations. IM levels according to specification. Smallest carrier separation between GSM and UMTS 2.6 MHz.

The corresponding ACIR table for 2.6 MHz carrier separation and 600 kHz carrier spacing can be seen in table 31C. ACS has been calculated with the same (log-) linear formula as before, with the addition of 30.5-0.8 dB ACS for separation 2.6 MHz. It can be noticed that when comparing table 31C to table 31A, that all ACIR values has been decreased by 0.8 dB which reflects the fact that all ACS values was decreased by 0.8. This scenario is very similar to 2.8 MHz in terms of degradation.

Table 31C: ACIR performance for GSM carriers allocated adjacent to UMTS channel. Smallest carrier separation between GSM and UMTS 2.6 MHz. 600 kHz GSM carrier spacing.

	ACIR [dB]							
	Single-sided scenario				Double-sided scenario			
GSM BTS type	1x1 carrier	1x2 carrier	1x4 carriers	1x6 carriers	2x1 carriers	2x2 carriers	2x3 carriers	2x4 carriers
SC-BTS	29.70	27.72	26.48	26.14	26.69	24.71	23.89	23.47
MCBTS class 1 spec.	29.70	27.72	26.48	26.14	26.69	24.71	23.88	23.47
MCBTS class 2 spec.	29.70	27.72	26.47	26.12	26.69	24.71	23.88	23.46

GSM spurious emissions have been omitted so far in the results above. A simple, but very pessimistic approach would be to apply a minimum noise level corresponding to the spurious emission levels. The resulting ACLR for the 2.8 MHz minimum carrier separation can be seen in figures 35G and 35H. When comparing these figures to previous results in figures 2 and 3, it can be seen that it is only the configurations with few carriers and small IM levels that are affected and not more than 2 dB (for the single-carrier case). This has minimal impact on ACIR.

The reason for this is that although spurious emissions requirements are slightly relaxed (by changing the measurement method), they only exceed the single-carrier wideband noise level by less than 4 dB for the output power used in this analysis. This is a relatively small contribution of additional interference, when IM is present or in the case of multiple GSM carriers.

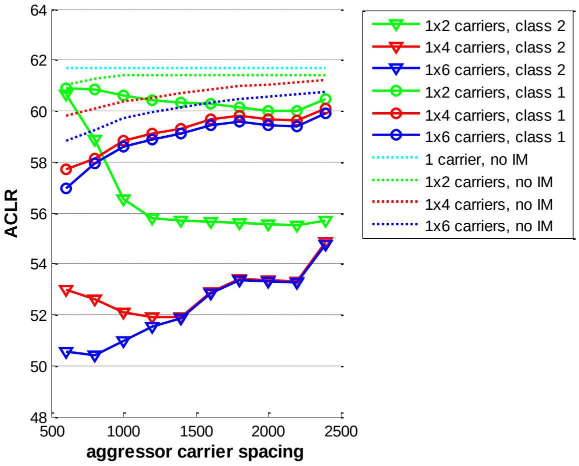

Figure 35G: ACLR for single-sided carrier configurations. IM levels according to specification with spurious emissions. Smallest carrier separation between GSM and UMTS 2.8 MHz

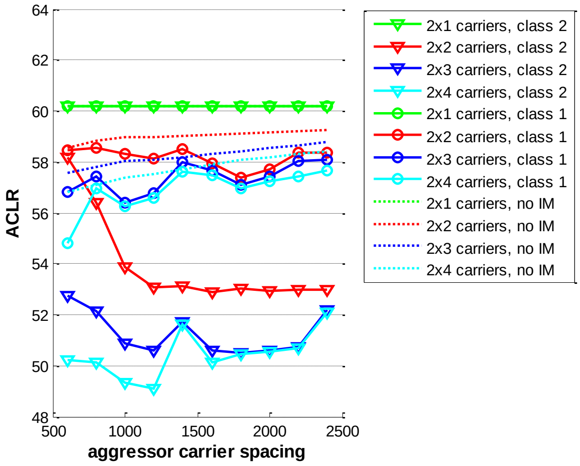

Figure 35H: ACLR for double-sided carrier configurations. IM levels according to specification with spurious emissions. Smallest carrier separation between GSM and UMTS 2.8 MHz.

In summary, considering the effect of the relaxed inband spurious emissions is so small, the conclusion will still remain the same.

4.2.7.2.3 Conclusion for MCBTS downlink

A heavily loaded MCBTS (class 1 or 2) would be very similar to a SCBTS, in terms of interference to an adjacent UMTS system. This is because that the unwanted emissions from MCBTS are orders of magnitude lower than the interference generated in the UMTS UE, which is the same for both MCBTS and SCBTS.

4.2.7.3 Impact on MCBTS uplink from UMTS 900

The impact from UMTS UL on GSM UL has been investigated in 3GPP in the present document and in [3], and also in ECC PT1 [36]. The conclusion from these investigations is that the impact on GSM UL from UMTS UL is negligible for the recommended minimum frequency separation distance between GSM carriers and UMTS centre frequency for uncoordinated case (2.8 MHz). The critical impact seems to be from the unwanted emissions from UMTS UE as the simulated UE TX power is low. An example of power distribution in 900 MHz band from subclause 4.2.6.2.1 of the present document is shown in the figure below

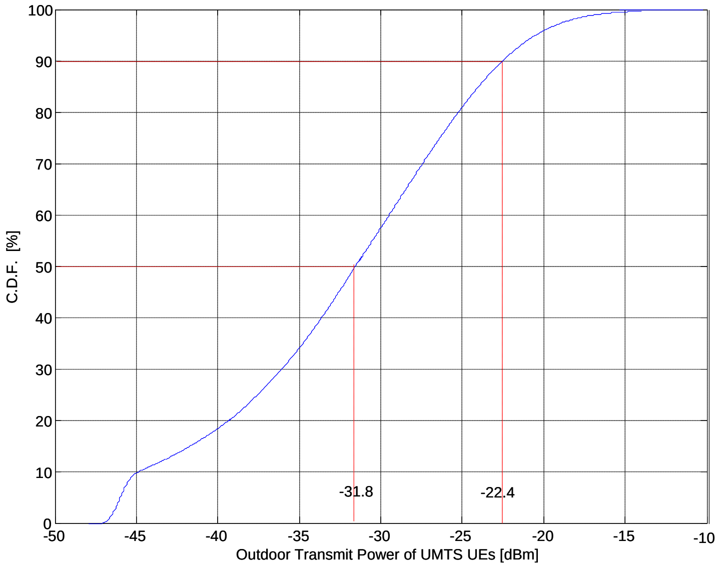

Figure 35J: Power distribution of an UMTS terminal transmit power [dBm]

The curve is slightly adjusted compared to corresponding curve in subclause 4.2.6.2.1 to show the agreed average values at 50% and 90% percentiles.

Another way to describe the scenario situation is to calculate the probability that there is a WCDMA terminal, operating near maximum power output, within the MCL radius of the GSM BS communicating with a GSM UE at the cell boundary is low. This is shown in [3] see figure below:

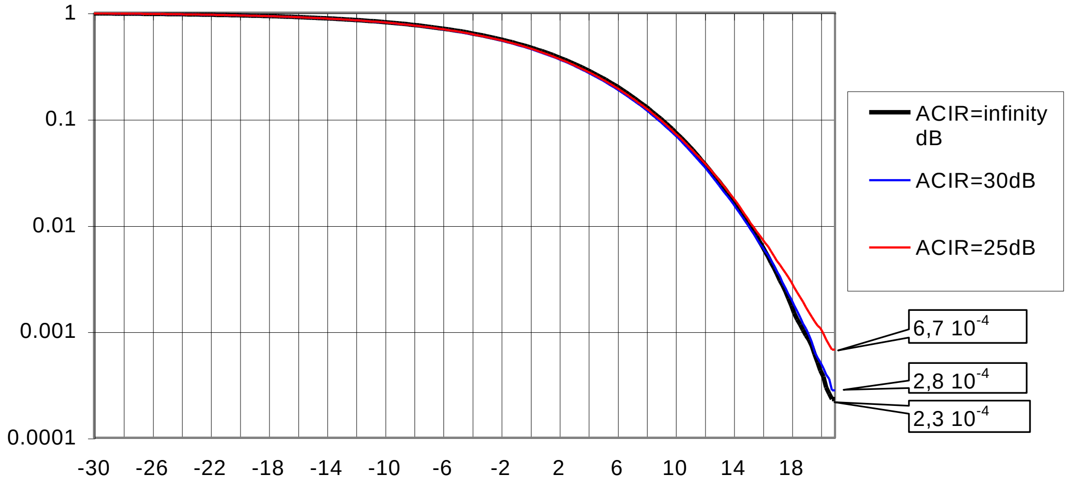

Figure 35K: Probability that an UMTS terminal transmit power is greater than x [dBm]

The above graphs are both assuming 21 dBm UE power which is the minimum allowed for class 3 UE. Maximum UMTS UE TX power at 900 and 1800 is nominally 24 dBm for class 3.

In 3GPP RAN4 [2] the distribution of the input signals to the BS receivers in mixed speech and data systems show the highest input signal levels. This is shown for a large cell system (5 km cell radius) in the graphs below:

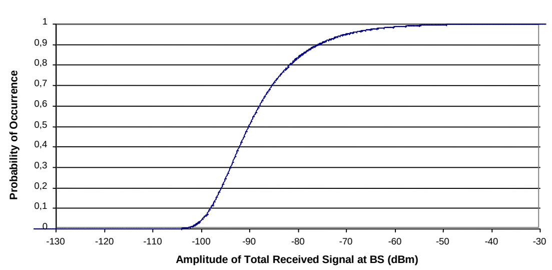

Figure 35L: CDF of Total Signal for Mixed Speech and Data System with 5 km Cells and Worst Case Geographic Offset

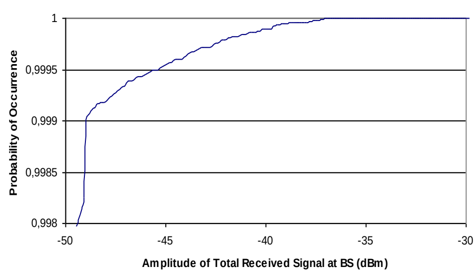

Figure 35M: CDF of Total Signal for Mixed Speech and Data System with 5 km Cells and Worst Case Geographic Offset

These indicate that 99,99 % of occurrences of the input signals to the receivers are about –40 dBm or less. Of course, with this large of a cell, the absolute maximum signal is dictated by MCL also. Note that this analysis assumes co-location of the UMTS base station and the MC BTS.

However, one may perform a simple analysis also for the scenario without co-location. Even with the pessimistic assumption of 59 dB MCL (as defined in 45.050 for small-cell scenarios at 900 MHz) the maximum UE power reaching the MCBTS receiver is less than -35 dBm. To this there is a very low probability (< 0.05%) that this level occurs at all. If a multiple margin of 6 dB (4 UE at MCL) is added, the maximum value is still below the specified inband blocking requirement for MCBTS, -25 dBm.

4.2.7.3.1 Conclusion for MCBTS uplink

Based on the calculation of receiver input signal under MCL assumption according to GSM small cell scenarios and the specified limits of UMTS 900 UE TX power, it is found that the input signal is well below the inband blocking requirements at relevant frequency separation between the systems. It is also shown that the probability that this maximum value occurs is very small.

4.2.7.4 Conclusion

The performance of the UMTS downlink, operating at recommended frequency separation in ECC report 082 [36] to GSM and UMTS respectively, will be very similar when GSM multicarrier BTS (MCBTS class 1 or 2) operates in the adjacent frequency band as when GSM single carrier BTS system operates in the same adjacent band.

Regarding the susceptibility of MCBTS receiver to UMTS UL emissions, it is found that the input signal is well below the inband blocking requirements for MCBTS at relevant frequency separation between the systems. It is also shown that the probability that this maximum value occurs is very small.

4.3 Channel Raster

The fundamental channel raster for all bands is fixed as 200 kHz. In order to be in consistence with UMTS2100 (Band I) and UMTS1800 (Band III), it was agreed to specify UMTS900 (Band VIII) with the standard channel raster of 200 kHz in the same way as for UMTS in 2 GHz band (Band I) and in 1.8 GHz band (Band III).

4.4 Specific Node B requirements for UMTS900

4.4.1 Proposed Transmitter Characteristics

Based on the co-existence studies between UMTS and UMTS operating in 900 MHz band and the co-existence studies between UMTS and GSM operating in 900 MHz band described in section 4, the analysis of the simulation results for the defined co-existence scenarios indicate that there is no need to define more severe or additional requirements (Spectrum mask, ACLR) for the UMTS900 BS transmitter characteristics.

Spectrum emission mask

The proposed RF output spectrum mask for the band VIII (900 MHz) is the same as for other frequency bands (I, II, III, IV, V, VII).

Adjacent Channel Leakage power Ratio (ACLR)

The proposed ACLR for UMTS900 is also the same as for other frequency bands, the ACLR values are given in the table 6.7 of TS25.104 as minimum requirement.

Table 6.7: BS ACLR

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

Spurious emissions

Spurious emissions (category B) for the frequency band VIII (900 MHz) is defined in accordance with ITU-R SM.329 in the table 6.9F below.

Table 6.9F: BS Mandatory spurious emissions limits, operating band VIII, Category B

Band	Maximum Level	Measurement Bandwidth	Note
9kHz ↔ 150kHz	-36 dBm	1 kHz	Note 1
150kHz ↔ 30MHz	- 36 dBm	10 kHz	Note 1
30MHz ↔ 915 MHz	-36 dBm	100 kHz	Note 1
915 MHz ↔ Fc1 - 20 MHz or 915 MHz *whichever is the higher*	-26 dBm	100 kHz	Note 2
Fc1 - 20 MHz or 915 MHz *whichever is the higher* ↔ Fc2 + 20 MHz or 970 MHz *whichever is the lower*	-16 dBm	100 kHz	Note 2
Fc2 + 20 MHz or 970 MHz *whichever is the lower* ↔ 970 MHz	-26 dBm	100 kHz	Note 2
970 MHz ↔ 1 GHz	-36 dBm	100 kHz	Note 3
1GHz ↔ 12.75GHz	-30 dBm	1 MHz	Note 3
NOTE 1: Bandwidth as in ITU-R SM.329 [1], s4.1 NOTE 2: Specification in accordance with ITU-R SM.329 [1], s4.3 and Annex 7 NOTE 3: Bandwidth as in ITU-R SM.329 [1], s4.1. Upper frequency as in ITU-R SM.329 [1], s2.5 table 1			

Spurious emissions for the protection of its own receiver or co-located BS receiver are specified in the same way as for other bands.

Table 6.10: Wide Area BS Spurious emissions limits for protection of the BS receiver

Operating Band	Band	Maximum Level	Measurement Bandwidth	Note
I	1920 - 1980MHz	-96 dBm	100 kHz	
II	1850-1910 MHz	-96 dBm	100 kHz	
III	1710-1785 MHz	-96 dBm	100 kHz	
IV	1710-1755 MHz	-96 dBm	100 kHz	
V	824-849 MHz	-96 dBm	100 kHz	
VI	815-850 MHz	-96 dBm	100 kHz	
VII	2500-2570 MHz	-96 dBm	100 kHz	
VIII	880-915 MHz	-96 dBm	100 kHz	

Table 6.10A: Medium Range BS Spurious emissions limits for protection of the BS receiver

Operating Band	Band	Maximum Level	Measurement Bandwidth	Note
I	1920 - 1980MHz	-86 dBm	100 kHz	
II	1850-1910 MHz	-86 dBm	100 kHz	
III	1710-1785 MHz	-86 dBm	100 kHz	
IV	1710-1755 MHz	-86 dBm	100 kHz	
V	824-849 MHz	-86 dBm	100 kHz	
VI	815-850 MHz	-86 dBm	100 kHz	
VII	2500-2570 MHz	-86 dBm	100 kHz	
VIII	880-915 MHz	-86 dBm	100 kHz	

Table 6.10B: Local Area BS Spurious emissions limits for protection of the BS receiver

Operating Band	Band	Maximum Level	Measurement Bandwidth	Note
I	1920 - 1980MHz	-82 dBm	100 kHz	
II	1850-1910 MHz	-82 dBm	100 kHz	
III	1710-1785 MHz	-82 dBm	100 kHz	
IV	1710-1755 MHz	-82 dBm	100 kHz	
V	824-849 MHz	-82 dBm	100 kHz	
VI	815-850 MHz	-82 dBm	100 kHz	
VII	2500-2570 MHz	-82 dBm	100 kHz	
VIII	880-915 MHz	-82 dBm	100 kHz	

Addition of the frequency band VIII in the table 6.11 of TS25.104 as minimum requirements for co-existence with other systems in the same geographical area.

It should be noted that

i) Concerning the requirement for the protection of GSM900 BS in the frequency range 880-915 MHz, this requirement does not apply to UTRA FDD operating in band VIII, since it is already covered by the requirement in sub-clause 6.6.3.2 of TS25.104.

ii) Concerning the requirement for the protection of GSM900 MS in the frequency range 925-960 MHz, this requirement does not apply to UTRA FDD operating in band VIII.

Table 6.11: BS Spurious emissions limits for UTRA FDD BS in geographic coverage area of systems operating in other frequency bands

System type operating in the same geographical area	Band for co-existence requirement	Maximum Level	Measurement Bandwidth	Note
GSM900	876 – 915 MHz	-61 dBm	100 kHz	For the frequency range 880-915 MHz, this requirement does not apply to UTRA FDD operating in band VIII, since it is already covered by the requirement in sub-clause 6.6.3.2.
	921 - 960 MHz	-57 dBm	100 kHz	For the frequency range 925-960 MHz, this requirement does not apply to UTRA FDD operating in band VIII
DCS1800	1805 - 1880 MHz	-47 dBm	100 kHz	This requirement does not apply to UTRA FDD operating in band III
	1710 – 1785 MHz	-61 dBm	100 kHz	This requirement does not apply to UTRA FDD operating in band III, since it is already covered by the requirement in sub-clause 6.6.3.2.
PCS1900	1930 - 1990 MHz	-47 dBm	100 kHz	This requirement does not apply to UTRA FDD BS operating in frequency band II
	1850 - 1910 MHz	-61 dBm	100 kHz	This requirement does not apply to UTRA FDD BS operating in frequency band II, since it is already covered by the requirement in sub-clause 6.6.3.2.
GSM850	824 - 849 MHz	-61 dBm	100 kHz	This requirement does not apply to UTRA FDD BS operating in frequency band V
	869 – 894 MHz	-57 dBm	100 kHz	This requirement does not apply to UTRA FDD BS operating in frequency band V, since it is already covered by the requirement in sub-clause 6.6.3.2.
FDD Band I	2110 – 2170 MHz	-52 dBm	1 MHz	This requirement does not apply to UTRA FDD BS operating in band I,
	1920 – 1980 MHz	-49 dBm	1 MHz	This requirement does not apply to UTRA FDD BS operating in band I, since it is already covered by the requirement in sub-clause 6.6.3.2.
FDD Band II	1930 – 1990 MHz	-52 dBm	1 MHz	This requirement does not apply to UTRA FDD BS operating in band II
	1850 – 1910 MHz	-49 dBm	1 MHz	This requirement does not apply to UTRA FDD BS operating in band II, since it is already covered by the requirement in sub-clause 6.6.3.2.
FDD Band III	1805 – 1880 MHz	-52 dBm	1 MHz	This requirement does not apply to UTRA FDD BS operating in band III
	1710 – 1785 MHz	-49 dBm	1 MHz	This requirement does not apply to UTRA FDD BS operating in band III, since it is already covered by the requirement in sub-clause 6.6.3.2.
FDD Band IV	2110 – 2155 MHz	-52 dBm	1 MHz	This requirement does not apply to UTRA FDD BS operating in band IV
	1710 – 1755 MHz	-49 dBm	1 MHz	This requirement does not apply to UTRA FDD BS operating in band IV, since it is already covered by the requirement in sub-clause 6.6.3.2.
FDD Band V	869 – 894 MHz	-52 dBm	1 MHz	This requirement does not apply to UTRA FDD BS operating in band V
	824 – 849 MHz	-49 dBm	1 MHz	This requirement does not apply to UTRA FDD BS operating in band V, since it is already covered by the requirement in sub-clause 6.6.3.2.
FDD Band VI	860 - 895 MHz	-52 dBm	1 MHz	This requirement does not apply to UTRA FDD BS operating in band VI

	815 - 850 MHz	-49 dBm	1 MHz	This requirement does not apply to UTRA FDD BS operating in band VI, since it is already covered by the requirement in sub-clause 6.6.3.2.
FDD Band VII	2620 – 2690 MHz	-52 dBm	1 MHz	This requirement does not apply to UTRA FDD BS operating in band VII,
	2500 – 2570 MHz	-49 dBm	1 MHz	This requirement does not apply to UTRA FDD BS operating in band VII, since it is already covered by the requirement in sub-clause 6.6.3.2.
FDD Band VIII	925 – 960 MHz	-52 dBm	1 MHz	This requirement does not apply to UTRA FDD BS operating in band VIII,
	880 – 915 MHz	-49 dBm	1 MHz	This requirement does not apply to UTRA FDD BS operating in band VIII, since it is already covered by the requirement in sub-clause 6.6.3.2.

The spurious emissions for the protection of co-located and co-sited base station for the frequency band VIII (900 MHz) are added in the tables 6.12, 6.13, 6.14 of TS25.104 respectively for WA, MR, and LA BS.

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

Type of co-located BS	Band for co-location requirement	Maximum Level	Measurement Bandwidth	Note
Macro GSM900	876-915 MHz	-98 dBm	100 kHz	
Macro DCS1800	1710 - 1785 MHz	-98 dBm	100 kHz	
Macro PCS1900	1850 – 1910 MHz	-98 dBm	100 kHz	
Macro GSM850	824 - 849 MHz	-98 dBm	100 kHz	
WA UTRA FDD Band I	1920 - 1980 MHz	-96 dBm	100 kHz	
WA UTRA FDD Band II	1850 – 1910 MHz	-96 dBm	100 kHz	
WA UTRA FDD Band III	1710 – 1785 MHz	-96 dBm	100 kHz	
WA UTRA FDD Band IV	1710 – 1755 MHz	-96 dBm	100 kHz	
WA UTRA FDD Band V	824 – 849 MHz	-96 dBm	100 kHz	
WA UTRA FDD Band VI	815 - 850 MHz	-96 dBm	100 kHz	
WA UTRA FDD Band VII	2500 – 2570 MHz	-96 dBm	100 KHz	
WA UTRA FDD Band VIII	880 – 915 MHz	-96 dBm	100 KHz	

Table 6.13: BS Spurious emissions limits for Medium Range BS co-located with another BS

Type of co-located BS	Band for co-location requirement	Maximum Level	Measurement Bandwidth	Note
Micro GSM900	876-915 MHz	-91 dBm	100 kHz	
Micro DCS1800	1710 - 1785 MHz	-96 dBm	100 kHz	
Micro PCS1900	1850 – 1910 MHz	-96 dBm	100 kHz	
Micro GSM850	824 - 849 MHz	-91 dBm	100 kHz	
MR UTRA FDD Band I	1920 - 1980 MHz	-86 dBm	100 kHz	
MR UTRA FDD Band II	1850 – 1910 MHz	-86 dBm	100 kHz	
MR UTRA FDD Band III	1710 – 1785 MHz	-86 dBm	100 kHz	
MR UTRA FDD Band IV	1710 – 1755 MHz	-86 dBm	100 kHz	
MR UTRA FDD Band V	824 – 849 MHz	-86 dBm	100 kHz	
MR UTRA FDD Band VI	815 - 850 MHz	-86 dBm	100 kHz	
MR UTRA FDD Band VII	2500 – 2570 MHz	-86 dBm	100 KHz	
MR UTRA FDD Band VIII	880 – 915 MHz	-86 dBm	100 KHz	

Table 6.14: BS Spurious emissions limits for Local Area BS co-located with another BS

Type of co-located BS	Band for co-location requirement	Maximum Level	Measurement Bandwidth	Note
Pico GSM900	876-915 MHz	-70 dBm	100 kHz	
Pico DCS1800	1710 - 1785 MHz	-80 dBm	100 kHz	
Pico PCS1900	1850 – 1910 MHz	-80 dBm	100 kHz	
Pico GSM850	824 - 849 MHz	-70 dBm	100 kHz	
LA UTRA FDD Band I	1920 - 1980 MHz	-82 dBm	100 kHz	
LA UTRA FDD Band II	1850 – 1910 MHz	-82 dBm	100 kHz	
LA UTRA FDD Band III	1710 – 1785 MHz	-82 dBm	100 kHz	
LA UTRA FDD Band IV	1710 – 1755 MHz	-82 dBm	100 kHz	
LA UTRA FDD Band V	824 – 849 MHz	-82 dBm	100 kHz	
LA UTRA FDD Band VI	815 - 850 MHz	-82 dBm	100 kHz	
LA UTRA FDD Band VII	2500 – 2570 MHz	-82 dBm	100 KHz	
LA UTRA FDD Band VIII	880 – 915 MHz	-82 dBm	100 KHz	

4.4.2 Proposed Receiver Characteristics

The simulation results described in the section 4.2 show that the band III receiver characteristics (ACS, receiver blocking, narrow band blocking) are sufficient for UMTS900 BS being in co-existence with UMTS and GSM operating in 900 MHz band in the same geographical area.

The following receiver characteristics should be defined for UMTS900 BS, and related changes will be made in the TS25.104.

Receiver reference sensitivity

As described in the section 1 of this report, the duplex distance is 45 MHz, and the minimum gap between uplink and downlink frequency blocks is only 10 MHz. The duplexer insertion loss for UMTS900 BS will be bigger than that for the band I.

By considering that UMTS900 will be deployed by operators for offering UMTS coverage in rural area or for indoor coverage in urban area, a good BS receiver sensitivity is fundamentally important. So the defined UMTS900 BS receiver reference sensitivity is defined as the same as for other band: -121 dBm. But it is clear that the technical difficulty is much higher for developing UMTS900 BS with this required reference sensitivity.

Receiver blocking requirements

UMTS900 BS receiver blocking requirements are defined in the similar way as for other bands. They are defined for Wide Area BS, Medium Range BS, and Local Area BS.

Table 7.4: Blocking performance requirement for Wide Area BS

Operating Band	Center Frequency of Interfering Signal	Interfering Signal mean power	Wanted Signal mean power	Minimum Offset of Interfering Signal	Type of Interfering Signal
I	1920 - 1980 MHz	-40 dBm	-115 dBm	10 MHz	WCDMA signal *
	1900 - 1920 MHz 1980 - 2000 MHz	-40 dBm	-115 dBm	10 MHz	WCDMA signal *
	1 MHz -1900 MHz 2000 MHz - 12750 MHz	-15 dBm	-115 dBm	—	CW carrier
II	1850 - 1910 MHz	-40 dBm	-115 dBm	10 MHz	WCDMA signal *
	1830 - 1850 MHz 1910 - 1930 MHz	-40 dBm	-115 dBm	10 MHz	WCDMA signal *
	1 MHz - 1830 MHz 1930 MHz - 12750 MHz	-15 dBm	-115 dBm	—	CW carrier
III	1710 – 1785 MHz	-40 dBm	-115 dBm	10 MHz	WCDMA signal *
	1690 - 1710 MHz 1785 – 1805 MHz	-40 dBm	-115 dBm	10 MHz	WCDMA signal *
	1 MHz - 1690 MHz 1805 MHz - 12750 MHz	-15 dBm	-115 dBm	—	CW carrier
IV	1710 – 1755 MHz	-40 dBm	-115 dBm	10 MHz	WCDMA signal *
	1690 - 1710 MHz 1755 – 1775 MHz	-40 dBm	-115 dBm	10 MHz	WCDMA signal *
	1 MHz - 1690 MHz 1775 MHz - 12750 MHz	-15 dBm	-115 dBm	—	CW carrier
V	824-849 MHz	-40 dBm	-115 dBm	10 MHz	WCDMA signal *
	804-824 MHz 849-869 MHz	-40 dBm	-115 dBm	10 MHz	WCDMA signal *
	1 MHz – 804 MHz 869 MHz - 12750 MHz	-15 dBm	-115 dBm	—	CW carrier
VI	810 – 830 MHz 840 – 860 MHz	-40 dBm	-115 dBm	10 MHz	WCDMA signal *
	1 MHz – 810 MHz 860 MHz – 12750 MHz	-15 dBm	-115 dBm	—	CW carrier
VII	2500 - 2570 MHz	-40 dBm	-115 dBm	10 MHz	WCDMA signal *
	2480 - 2500 MHz 2570 - 2590 MHz	-40 dBm	-115 dBm	10 MHz	WCDMA signal *
	1 MHz -2480 MHz 2590 MHz - 12750 MHz	-15 dBm	-115 dBm	—	CW carrier
VIII	880 - 915 MHz	-40 dBm	-115 dBm	10 MHz	WCDMA signal *
	860 - 880 MHz 915 – 925 MHz	-40 dBm	-115 dBm	10 MHz	WCDMA signal *
	1 MHz -860 MHz 925 MHz - 12750 MHz	-15 dBm	-115 dBm	—	CW carrier
Note*: The characteristics of the W-CDMA interference signal are specified in Annex C					

Table 7.4A: Blocking performance requirement for Medium range BS

Operating Band	Center Frequency of Interfering Signal	Interfering Signal mean power	Wanted Signal mean power	Minimum Offset of Interfering Signal	Type of Interfering Signal
I	1920 - 1980 MHz	-35 dBm	-105 dBm	10 MHz	WCDMA signal *
	1900 - 1920 MHz 1980 - 2000 MHz	-35 dBm	-105 dBm	10 MHz	WCDMA signal *
	1 MHz -1900 MHz 2000 MHz - 12750 MHz	-15 dBm	-105 dBm	—	CW carrier
II	1850 - 1910 MHz	-35 dBm	-105 dBm	10 MHz	WCDMA signal *
	1830 - 1850 MHz 1910 - 1930 MHz	-35 dBm	-105 dBm	10 MHz	WCDMA signal *
	1 MHz - 1830 MHz 1930 MHz - 12750 MHz	-15 dBm	-105 dBm	—	CW carrier
III	1710 – 1785 MHz	-35 dBm	-105 dBm	10 MHz	WCDMA signal *
	1690 - 1710 MHz 1785 – 1805 MHz	-35 dBm	-105 dBm	10 MHz	WCDMA signal *
	1 MHz - 1690 MHz 1805 MHz - 12750 MHz	-15 dBm	-105 dBm	—	CW carrier
IV	1710 – 1755 MHz	-35 dBm	-105 dBm	10 MHz	WCDMA signal *
	1690 - 1710 MHz 1755 – 1775 MHz	-35 dBm	-105 dBm	10 MHz	WCDMA signal *
	1 MHz - 1690 MHz 1775 MHz - 12750 MHz	-15 dBm	-105 dBm	—	CW carrier
V	824-849 MHz	-35 dBm	-105 dBm	10 MHz	WCDMA signal *
	804-824 MHz 849-869 MHz	-35 dBm	-105 dBm	10 MHz	WCDMA signal *
	1 MHz – 804 MHz 869 MHz - 12750 MHz	-15 dBm	-105 dBm	—	CW carrier
VI	810 – 830 MHz 840 – 860 MHz	-35 dBm	-105 dBm	10 MHz	WCDMA signal *
	1 MHz – 810 MHz 860 MHz – 12750 MHz	-15 dBm	-105 dBm	—	CW carrier
VII	2500 - 2570 MHz	-35 dBm	-105 dBm	10 MHz	WCDMA signal *
	2480 - 2500 MHz 2570 - 2590 MHz	-35 dBm	-105 dBm	10 MHz	WCDMA signal *
	1 MHz -2480 MHz 2590 MHz - 12750 MHz	-15 dBm	-105 dBm	—	CW carrier
VIII	880 - 915 MHz	-35 dBm	-105 dBm	10 MHz	WCDMA signal *
	860 - 880 MHz 915 – 925 MHz	-35 dBm	-105 dBm	10 MHz	WCDMA signal *
	1 MHz -860 MHz 925 MHz - 12750 MHz	-15 dBm	-105 dBm	—	CW carrier
Note*: The characteristics of the W-CDMA interference signal are specified in Annex C					

Table 7.4B: Blocking performance requirement for Local Area BS

Operating Band	Center Frequency of Interfering Signal	Interfering Signal mean power	Wanted Signal mean power	Minimum Offset of Interfering Signal	Type of Interfering Signal
I	1920 - 1980 MHz	-30 dBm	-101 dBm	10 MHz	WCDMA signal *
	1900 - 1920 MHz 1980 - 2000 MHz	-30 dBm	-101 dBm	10 MHz	WCDMA signal *
	1 MHz -1900 MHz 2000 MHz - 12750 MHz	-15 dBm	-101 dBm	—	CW carrier
II	1850 - 1910 MHz	-30 dBm	-101 dBm	10 MHz	WCDMA signal *
	1830 - 1850 MHz 1910 - 1930 MHz	-30 dBm	-101 dBm	10 MHz	WCDMA signal *
	1 MHz - 1830 MHz 1930 MHz - 12750 MHz	-15 dBm	-101 dBm	—	CW carrier
III	1710 – 1785 MHz	-30 dBm	-101 dBm	10 MHz	WCDMA signal *
	1690 - 1710 MHz 1785 – 1805 MHz	-30 dBm	-101 dBm	10 MHz	WCDMA signal *
	1 MHz - 1690 MHz 1805 MHz - 12750 MHz	-15 dBm	-101 dBm	—	CW carrier
IV	1710 – 1755 MHz	-30 dBm	-101 dBm	10 MHz	WCDMA signal *
	1690 - 1710 MHz 1755 – 1775 MHz	-30 dBm	-101 dBm	10 MHz	WCDMA signal *
	1 MHz - 1690 MHz 1775 MHz - 12750 MHz	-15 dBm	-101 dBm	—	CW carrier
V	824-849 MHz	-30 dBm	-101 dBm	10 MHz	WCDMA signal *
	804-824 MHz 849-869 MHz	-30 dBm	-101 dBm	10 MHz	WCDMA signal *
	1 MHz – 804 MHz 869 MHz - 12750 MHz	-15 dBm	-101 dBm	—	CW carrier
VI	810 – 830 MHz 840 – 860 MHz	-30 dBm	-101 dBm	10 MHz	WCDMA signal *
	1 MHz – 810 MHz 860 MHz – 12750 MHz	-15 dBm	-101 dBm	—	CW carrier
VII	2500 - 2570 MHz	-30 dBm	-101 dBm	10 MHz	WCDMA signal *
	2480 - 2500 MHz 2570 - 2590 MHz	-30 dBm	-101 dBm	10 MHz	WCDMA signal *
	1 MHz -2480 MHz 2590 MHz - 12750 MHz	-15 dBm	-101 dBm	—	CW carrier
VIII	880 - 915 MHz	-30 dBm	-101 dBm	10 MHz	WCDMA signal *
	860 - 880 MHz 915 – 925 MHz	-30 dBm	-101 dBm	10 MHz	WCDMA signal *
	1 MHz -860 MHz 925 MHz - 12750 MHz	-15 dBm	-101 dBm	—	CW carrier
Note*: The characteristics of the W-CDMA interference signal are specified in Annex C					

Narrow band blocking

The simulation results for the several additional co-existence scenarios between UMTS and GSM operating in 900 MHz band in urban and rural environment with different cell ranges have shown that the same narrow band blocking characteristics as for the band III (UMTS1800) will be sufficient for ensuring the good co-existence between UMTS900 and GMS900 in co-existence in the same geographical area.

In consequence, the proposed narrow band blocking requirements for UMTS900 BS are the same as that for UMTS1800.

Table 7.5: Blocking performance requirement (narrowband) for Wide Area BS

Operating Band	Center Frequency of Interfering Signal	Interfering Signal mean power	Wanted Signal mean power	Minimum Offset of Interfering Signal	Type of Interfering Signal
II	1850 - 1910 MHz	- 47 dBm	-115 dBm	2.7 MHz	GMSK modulated*
III	1710 – 1785 MHz	- 47 dBm	-115 dBm	2.8 MHz	GMSK modulated*
IV	1710 – 1755 MHz	- 47 dBm	-115 dBm	2.7 MHz	GMSK modulated*
V	824 – 849 MHz	- 47 dBm	-115 dBm	2.7 MHz	GMSK modulated*
VIII	880 – 915 MHz	- 47 dBm	-115 dBm	2.8 MHz	GMSK modulated*
* GMSK modulation as defined in TS 45.004 [5].					

Table 7.5A: Blocking performance requirement (narrowband) for Medium Range BS

Operating Band	Center Frequency of Interfering Signal	Interfering Signal mean power	Wanted Signal mean power	Minimum Offset of Interfering Signal	Type of Interfering Signal
II	1850 - 1910 MHz	- 42 dBm	-105 dBm	2.7 MHz	GMSK modulated*
III	1710 – 1785 MHz	- 42 dBm	-105 dBm	2.8 MHz	GMSK modulated*
IV	1710 – 1755 MHz	- 42 dBm	-105 dBm	2.7 MHz	GMSK modulated*
V	824 – 849 MHz	- 42 dBm	-105 dBm	2.7 MHz	GMSK modulated*
VIII	880 – 915 MHz	- 42 dBm	-105 dBm	2.8 MHz	GMSK modulated*
* GMSK modulation as defined in TS 45.004 [5].					

Table 7.5B: Blocking performance requirement (narrowband) for Local Area BS

Operating Band	Center Frequency of Interfering Signal	Interfering Signal mean power	Wanted Signal mean power	Minimum Offset of Interfering Signal	Type of Interfering Signal
II	1850 - 1910 MHz	- 37 dBm	-101 dBm	2.7 MHz	GMSK modulated*
III	1710 – 1785 MHz	- 37 dBm	-101 dBm	2.8 MHz	GMSK modulated*
IV	1710 – 1755 MHz	- 37 dBm	-101 dBm	2.7 MHz	GMSK modulated*
V	824 – 849 MHz	- 37 dBm	-101 dBm	2.7 MHz	GMSK modulated*
VIII	880 – 915 MHz	- 37 dBm	-101 dBm	2.8 MHz	GMSK modulated*
* GMSK modulation as defined in TS 45.004 [5].					

Out of band blocking requirements

Out of band blocking requirements for UMTS900 in co-location with other radio systems are defined in the same way as for other frequency bands (UMTS850, UMTS1800). The out of band blocking requirements for the band VIII for WA, MR, LA BS are added to in the three tables 7.5C, 7.5D, and 7.5E of TS25.104.

Table 7.5C: Blocking performance requirement for Wide Area BS when co-located with BS in other bands.

Co-located BS type	Center Frequency of Interfering Signal	Interfering Signal mean power	Wanted Signal mean power	Type of Interfering Signal
Macro GSM900	921 – 960 MHz	+16 dBm	-115 dBm	CW carrier
Macro DCS1800	1805 – 1880 MHz	+16 dBm	-115 dBm	CW carrier
Macro PCS1900	1930 – 1990 MHz	+16 dBm	-115 dBm	CW carrier
Macro GSM850	869 – 894 MHz	+16 dBm	-115 dBm	CW carrier
WA UTRA-FDD Band I	2110 – 2170 MHz	+16 dBm	-115 dBm	CW carrier
WA UTRA-FDD Band II	1930 – 1990 MHz	+16 dBm	-115 dBm	CW carrier
WA UTRA-FDD Band III	1805 – 1880 MHz	+16 dBm	-115 dBm	CW carrier
WA UTRA-FDD Band IV	2110 – 2155 MHz	+16 dBm	-115 dBm	CW carrier
WA UTRA-FDD Band V	869 – 894 MHz	+16 dBm	-115 dBm	CW carrier
WA UTRA-FDD Band VI	875 – 885 MHz	+16 dBm	-115 dBm	CW carrier
WA UTRA-FDD Band VII	2620 – 2690 MHz	+16 dBm	-115 dBm	CW carrier
WA UTRA-FDD Band VIII	925 – 960 MHz	+16 dBm	-115 dBm	CW carrier

Table 7.5D: Blocking performance requirement for Medium Range BS when co-located with BS in other bands.

Co-located BS type	Center Frequency of Interfering Signal	Interfering Signal mean power	Wanted Signal mean power	Type of Interfering Signal
Micro GSM900	921 – 960 MHz	-3 dBm	-105 dBm	CW carrier
Micro DCS1800	1805 – 1880 MHz	+5 dBm	-105 dBm	CW carrier
Micro PCS1900	1930 – 1990 MHz	+5 dBm	-105 dBm	CW carrier
Micro GSM850	869 – 894 MHz	-3 dBm	-105 dBm	CW carrier
MR UTRA-FDD Band I	2110 – 2170 MHz	+8 dBm	-105 dBm	CW carrier
MR UTRA-FDD Band II	1930 – 1990 MHz	+8 dBm	-105 dBm	CW carrier
MR UTRA-FDD Band III	1805 – 1880 MHz	+8 dBm	-105 dBm	CW carrier
MR UTRA-FDD Band IV	2110 – 2155 MHz	+8 dBm	-105 dBm	CW carrier
MR UTRA-FDD Band V	869 – 894 MHz	+8 dBm	-105 dBm	CW carrier
MR UTRA-FDD Band VI	875 – 885 MHz	+8 dBm	-105 dBm	CW carrier
MR UTRA-FDD Band VII	2620 – 2690 MHz	+8 dBm	-105 dBm	CW carrier
MR UTRA-FDD Band VIII	925 – 960 MHz	+8 dBm	-105 dBm	CW carrier

Table 7.5E: Blocking performance requirement for Local Area BS when co-located with BS in other bands.

Co-located BS type	Center Frequency of Interfering Signal	Interfering Signal mean power	Wanted Signal mean power	Type of Interfering Signal
Pico GSM900	921 – 960 MHz	-7 dBm	-101 dBm	CW carrier
Pico DCS1800	1805 – 1880 MHz	-4 dBm	-101 dBm	CW carrier
Pico PCS1900	1930 – 1990 MHz	-4 dBm	-101 dBm	CW carrier
Pico GSM850	869 – 894 MHz	-7dBm	-101 dBm	CW carrier
LA UTRA-FDD Band I	2110 – 2170 MHz	-6 dBm	-101 dBm	CW carrier
LA UTRA-FDD Band II	1930 – 1990 MHz	-6 dBm	-101 dBm	CW carrier
LA UTRA-FDD Band III	1805 – 1880 MHz	-6 dBm	-101 dBm	CW carrier
LA UTRA-FDD Band IV	2110 – 2155 MHz	-6 dBm	-101 dBm	CW carrier
LA UTRA-FDD Band V	869 – 894 MHz	-6 dBm	-101 dBm	CW carrier
LA UTRA-FDD Band VI	875 – 885 MHz	-6 dBm	-101 dBm	CW carrier
LA UTRA-FDD Band VII	2620 – 2690 MHz	-6 dBm	-101 dBm	CW carrier
LA UTRA-FDD Band VIII	925 – 960 MHz	-6 dBm	-101 dBm	CW carrier

Intermodulation and narrow band intermodulations

Intermodulation requirements and the narrow band intermodulation requirements for UMTS900 BS are defined in the same way as for other bands. The intermodulation and narrow band intermodulation requirements in tables 7.6, 7.6A, 7.6B, 7.6C, 7.6D, 7.6E for Wide Area BS, Medium Range BS, and Local Area BS should be extended to the band VIII.

Table 7.6: Intermodulation performance requirement (Wide Area BS)

Operating band	Interfering Signal mean power	Offset	Type of Interfering Signal
All bands	- 48 dBm	10 MHz	CW signal
	- 48 dBm	20 MHz	WCDMA signal *
Note*: The characteristics of the W-CDMA interference signal are specified in Annex C			

Table 7.6A: Narrowband intermodulation performance requirement (Wide Area BS)

Operating band	Interfering Signal mean power	Offset	Type of Interfering Signal
II, III, IV, V, VIII	- 47 dBm	3.5 MHz	CW signal
	- 47 dBm	5.9 MHz	GMSK modulated*
* GMSK as defined in TS45.004			

Table 7.6B: Intermodulation performance requirement (Medium Range BS)

Operating band	Interfering Signal mean power	Offset	Type of Interfering Signal
All bands	- 44 dBm	10 MHz	CW signal
	- 44 dBm	20 MHz	WCDMA signal *
Note*: The characteristics of the W-CDMA interference signal are specified in Annex C			

Table 7.6C: Narrowband intermodulation performance requirement (Medium Range BS)

Operating band	Interfering Signal mean power	Offset	Type of Interfering Signal
II, III, IV, V, VIII	- 43 dBm	3.5 MHz	CW signal
	- 43 dBm	5.9 MHz	GMSK modulated*
* GMSK as defined in TS45.004			

Table 7.6D: Intermodulation performance requirement (Local Area BS)

Operating band	Interfering Signal mean power	Offset	Type of Interfering Signal
All bands	-38 dBm	10 MHz	CW signal
	-38 dBm	20 MHz	WCDMA signal *
Note*: The characteristics of the W-CDMA interference signal are specified in Annex C			

Table 7.6E: Narrowband intermodulation performance requirement (Local Area BS)

Operating band	Interfering Signal mean power	Offset	Type of Interfering Signal
II, III, IV, V, VIII	-37 dBm	3.5 MHz	CW signal
	-37 dBm	5.9 MHz	GMSK modulated*
* GMSK as defined in TS45.004			

Receiver spurious emissions

The additional receiver spurious emission requirements for the band VIII are added to the table 7.7A, they are defined in the same way as for other bands.

Table 7.7A: Additional spurious emission requirements

Operating Band	Band	Maximum level	Measurement Bandwidth	Note
I	1920 – 1980 MHz	-78 dBm	3.84 MHz	
II	1850 – 1910 MHz	-78 dBm	3.84 MHz	
III	1710 – 1785 MHz	-78 dBm	3.84 MHz	
IV	1710 – 1755 MHz	-78 dBm	3.84 MHz	
V	824 – 849 MHz	-78 dBm	3.84 MHz	
VI	815 – 850 MHz	-78 dBm	3.84 MHz	
VII	2500 – 2570 MHz	-78 dBm	3.84 MHz	
VIII	880 – 915 MHz	-78 dBm	3.84 MHz	

Receiver demodulation performance

Receiver demodulation performance requirements for UMTS900 BS are defined by means of velocity scaling. Since the receiver demodulation performance requirements in the chapter 8 of TS25.104 are not frequency band dependent, they are applicable to the band VIII without needing any changes in the specification.

Propagation profile

By considering the small difference between the band V/VI and VIII, the speed for band V, VI will be applied to band VIII.

Table B.1: Propagation Conditions for Multi path Fading Environments

Case 1		Case 2		Case 3		Case 4	
Speed for Band I, II, III, IV 3 km/h		Speed for Band I, II, III, IV 3 km/h		Speed for Band I, II, III, IV 120 km/h		Speed for Band I, II, III, IV 250 km/h	
Speed for Band V, VI, VIII 7 km/h		Speed for Band V, VI, VIII 7 km/h		Speed for Band V, VI, VIII 280 km/h		Speed for Band V, VI, VIII 583 km/h (Note 1)	
Speed for Band VII 2.3 km/h		Speed for Band VII 2.3 km/h		Speed for Band VII 92 km/h		Speed for Band VII 192 km/h	
Relative Delay [ns]	**Average Power [dB]**	**Relative Delay [ns]**	**Average Power [dB]**	**Relative Delay [ns]**	**Average Power [dB]**	**Relative Delay [ns]**	**Average Power [dB]**
0	0	0	0	0	0	0	0
976	-10	976	0	260	-3	260	-3
		20000	0	521	-6	521	-6
				781	-9	781	-9

Table B.3: Propagation Conditions for Multipath Fading Environments for E-DPDCH and E-DPCCH Performance Requirements

ITU Pedestrian A Speed 3km/h (PA3)		ITU Pedestrian B Speed 3km/h (PB3)		ITU vehicular A Speed 30km/h (VA30)		ITU vehicular A Speed 120km/h (VA120)	
Speed for Band I, II, III and IV 3 km/h		Speed for Band I, II, III and IV 3 km/h		Speed for Band I, II, III and IV 30 km/h		Speed for Band I, II, III and IV 120 km/h	
Speed for Band V, VI, VIII 7 km/h		Speed for Band V, VI, VIII 7 km/h		Speed for Band V, VI, VIII 71 km/h		Speed for Band V, VI, VIII 282 km/h (Note 1)	
Relative Delay [ns]	**Relative Mean Power [dB]**	**Relative Delay [ns]**	**Relative Mean Power [dB]**	**Relative Delay [ns]**	**Relative Mean Power [dB]**	**Relative Delay [ns]**	**Relative Mean Power [dB]**
0	0	0	0	0	0	0	0
110	-9.7	200	-0.9	310	-1.0	310	-1.0
190	-19.2	800	-4.9	710	-9.0	710	-9.0
410	-22.8	1200	-8.0	1090	-10.0	1090	-10.0
		2300	-7.8	1730	-15.0	1730	-15.0
		3700	-23.9	2510	-20.0	2510	-20.0

4.5 UE Rx sensitivity and possible impact on network coverage & capacity

4.5.1 UE Rx sensitivity

4.5.1.1 Issues for consideration

In this section we look at the impact of

- Rx Filter losses
- Filter temperature shift
- Filter flatness and impact on EVM / ISI
- Available filter performance

4.5.1.2 Rx Filter losses

Filter losses are dependant on the required pass band bandwidth and stop band frequency. As the stop band frequency offset decreases, the insertion losses will increase. Similarly as the pass band bandwidths decrease, the filter losses will also increase for the same filter technology. In the case when the filter is implemented as part of a duplexer increasing the pass band will also impact the filter losses.

The impact of filter losses and resultant impact on Rx sensitivity can be seen in TS 25.101 for the different operating bands as shown below

Table 31A

Operating Band	UL Frequencies UE Tx Node Rx (MHz)	DL Frequencies UE Rx, Node Tx (MHz)	UE Rx sensitivity (dBm)	Rx bandwidth (MHz)	Min Tx/Rx Spacing (MHz)
I	1920 – 1980	2110 – 2170	-117	60	130
II	1850 – 1910	1930 – 1990	-115	60	20
III	1710 - 1785	1805 - 1880	-114	75	20
IV	1710 - 1755	2110 - 2155	-117	45	355
VI	830 - 840	875 - 885	-117	10	35
V	824 - 849	869 - 894	-115	25	20
VIII	880-915	925-960	-114	35	10

1) With a smaller Tx to Rx spacing the filter losses increase and we see this impact in the minimum sensitivity requirements for similar WCDMA operating bands in the 3GPP specifications {Band VI, V}. In the case of Band VIII the minimum Tx to Rx spacing has further decreased by 100% so we would expects a sensitivity figure lower than Band V {i.e. > 2 dB}

2) If we now consider Band III and assuming simple frequency scaling we can consider the filter losses for the equivalent Band VIII (as the pass band and Tx-Rx gap have a similar value after scaling) the sensitivity of WCDMA in the Band VIII (UMTS 900) would be similar to Band III which is a 3dB delta compared to Band I (UMTS 2100)

4.5.1.3 Filter temperature shift

Filter temperature shift introduces a loss for the lower Rx band edge and the upper Tx band edge. This is show below in figure 36.

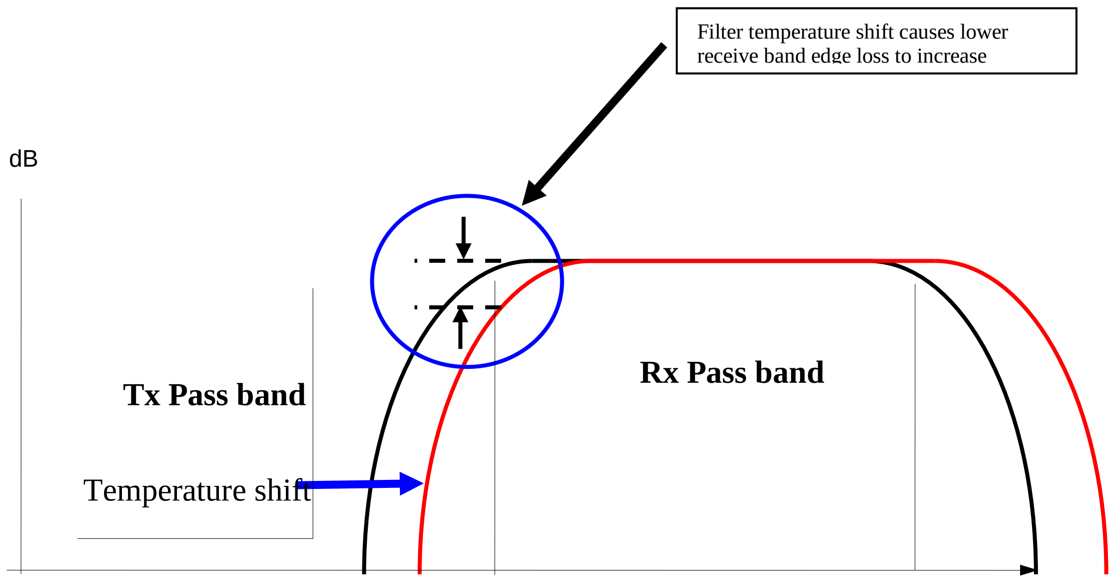

Figure 36: Filter temperature Shift

Rx sensitivity performance has to be met for all operating frequencies; in this case the sensitivity requirements must account for the effect of temperature for the lowest and highest operating channels

4.5.1.4 Filter flatness and impact on EVM / ISI

EVM is a measure of the difference between the reference waveform and measured waveform. The measured waveform will be distorted due to any errors in frequency, phase, amplitude and timing. As WCDMA is a wideband system the RF channel filter distortion has to be maintained over a larger bandwidth. High EVM in the Rx filter (ripple and group delay) will increase the Inter Symbol Interference (ISI) and degrades the receiver sensitivity performance for those 5 MHz channels at the band edges.

For Band VIII a larger allocation of the ISI budget would be needed to be allocated for the RF filter impact due to the smaller Tx – Rx spacing. Impact of temperature will also need to be accounted for in the ISI budget as it is difficult to maintain this linearity for the band edge channels without increasing the pass-band attenuation (Note similar issue for Tx EVM path). These issues are captured in figure 37 below.

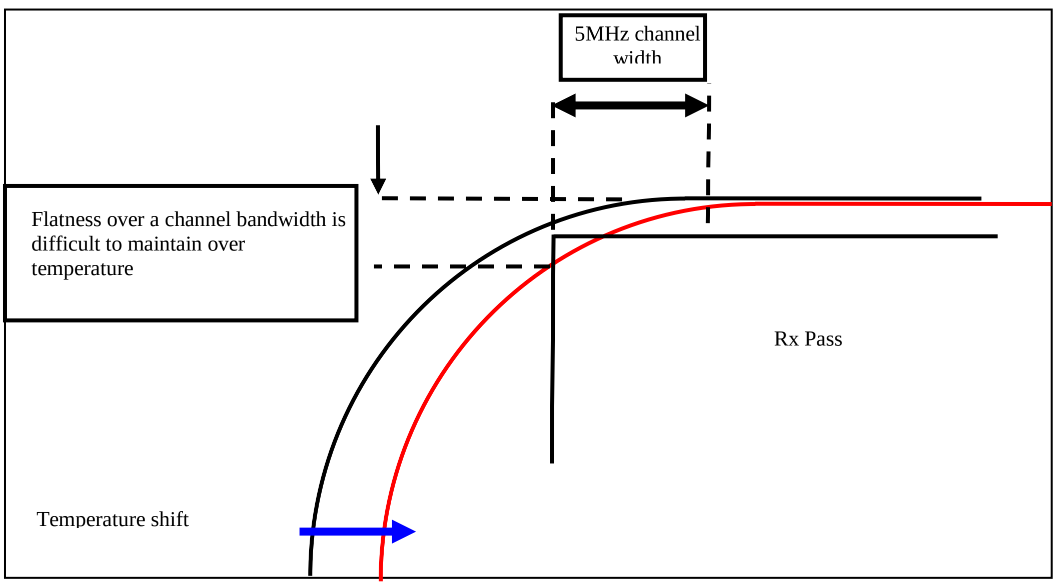

Figure 37: Temperature Shift

4.5.1.5 Available Filter performance

The sensitivity of a receiver is directly proportional to the insertion loss in front of the LNA. The insertion loss is predominated by the receive filter. Generally state of the art filter performance is determined by component vendors. In this case requirements are usually a trade –off between parameters for example

- Rx pass band attenuation {impacts sensitivity}
- Tx pass band attenuation [impact Tx power, battery life}
- Tx/Rx pass band ripple {impact EVM / ISI - sensitivity}
- Tx/ Rx out of band attenuation {impact spurious emission, blocking spec , etc}
- Filter return loss {impacts antenna matching , radiated performance}
- Tx/ Rx filter temperature performance {impacts all parameters}

So filter which provide state of the art performance from one vendor in one area may not necessarily provide a matching performance in other areas. Additional losses also need to be factored in to account for other system components such as isolator and switching devices needed for single and multi-band terminal + RF components. Filter losses for the band I and VIII s are captured below.

Table 31B

Operating Band	UL Frequencies UE Tx Node B Rx (MHz)	DL Frequencies UE Rx, Node B Tx (MHz)	UE Rx sensitivity (dBm)	Rx Losses (dB)
I	1920 – 1980	2110 – 2170	-117	2.0 – 2.4
VIII	880 – 915	925-960	-114	4.5 – 5.0

4.5.1.6 Conclusion

Based on the issues raised in this document on the impact of

- Rx Filter losses
- Filter temperature shift
- Filter flatness and impact on EVM /ISI
- Available Filter performance

We propose the UE sensitivity requirements for Band VIII should be set at -114 dBm.

4.5.2 Impact on network coverage/capacity due to UE sensitivity degradation

Two different approaches on the analysis of the possible impact on network coverage/capacity are presented here. Due to the fact the analysis approaches are different, the obtained results can be different as well. These two analysis approaches can help operators to further analyse the possible impact on UMTS900 network coverage/Capacity when planning the network.

The first analysis is based on static system simulation for a network consisting of several cells and can be found in section 4.5.2.1, The second analysis is based on link budget analysis of a single cell and can be found in section 4.5.2.2.

4.5.2.1 Analysis of UE reference sensitivity impact on system capacity

This section is dedicated to the analysis of the impact of UE reference sensitivity to the WCDMA900 network coverage and capacity in the rural scenario 4.

Scenario 4: UMTS macro vs UMTS macro, in rural environment, uncoordinated

4.5.2.1.1 Analysis

In order to understand the impact of UE reference sensitivity to the system coverage/capacity the Scenario 4 simulation was done with single operator only, which represents the most critical scenario from the UE reference sensitivity point of view as the amount of interference is the lowest. UE reference sensitivity of -114dBm DPCH_Ec was used and the system was loaded to the full capacity and after that the CPICH power of the each user was recorded. Note that the number of users in the system does not have any impact on the common channel received signal power but the users were introduced into the simulation to monitor the signal levels in the network. The more users there are the more reliable are the results as the statistics cover the whole network area. The CPICH_RSCP distribution is shown below:

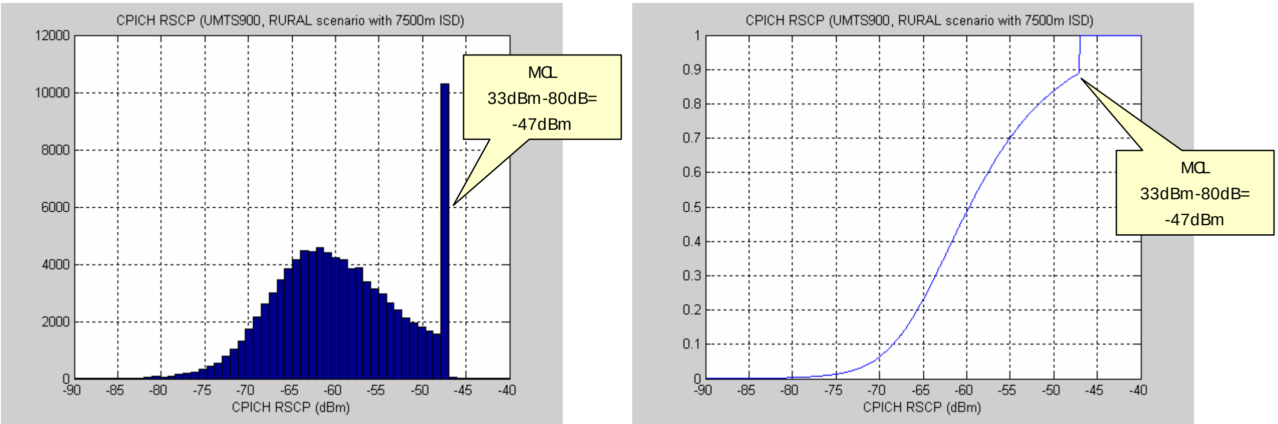

Figure 38 CPICH_RSCP in rural scenario 4, PDF and CDF

As can be seen from the figure 38 the probability that the CPICH_RSCP is below -75dBm is 1%.

In order to understand the signal powers for the UEs that are located indoors an IPF of 15dB can be used as agreed in scenario 6 assumptions [3]. The probability that the CPICH_RSCP for an indoor user is lower than -75dBm-15dB= -90dBm is hence 1%. The CPICH_RSCP power in the UE reference sensitivity requirement is 7dB above the DPCH_Ec hence if DPCH_Ec is -114dBm the CPICH_RSCP is -107dBm that is 17dB lower than the lowest CPICH_RSCP power seen by any user in the scenario 4 even if 15dB IPF is assumed.

Table 32: Parameters for 12.2kbps DL reference channel, 25.101 Table C2

	Relative to DPCH (dB)	Channel Power (dBm)
P-CPICH	7	-107
P-CCPCH	5	-109
SCH	5	-109
PICH	2	-112
DPCH		-114
		TOTAL
Ior (dBm)		-103.68

In order to quantify the impact of UE noise figure to the system performance the level of other cell pilots was also recorded. The other-cell pilot power distribution is shown below:

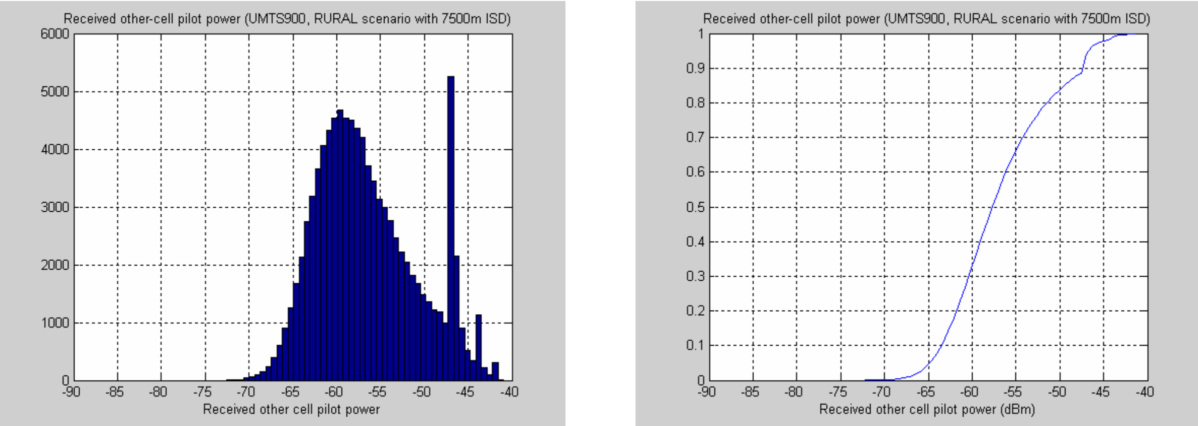

Figure 39: Received other cell pilot power in rural scenario 4, PDF and CDF

The other-cell pilot powers are in 99% of cases above -70dBm. The received other-cell pilot powers were recorded in order to understand the signal powers in the empty system as a fully loaded system is in most cases interference limited, however in this case the other-cell interference of the pilots alone is significantly higher than UE noise floor. Assuming 15dB IPF the other-cell pilot power for user located indoors is in 99% of cases above -70dBm-15dB= -85dBm.

The total interference in the UE receiver is the sum of the intra-frequency interference, inter-frequency/system interference (here equal to zero) and UE noise floor. The total interference power in the 99% point with UE reference sensitivity of -117dBm DPCH_Ec and -114dBm DPCH_Ec is calculated below:

Thermal noise floor	-108 dBm
UE NF (worst case)	9 dB
UE noise floor	**-99 dBm**
Other cell interference	-85 dBm
TOTAL	**-84.83 dBm**
Thermal noise floor	-108 dBm
UE NF (worst case)	12 dB
UE noise floor	**-96 dBm**
Other cell interference	-85 dBm
TOTAL	**-84.67 dBm**

Difference **-0.16 dB**

Figure 39B

As can be seen from the calculation above the impact of 3dB higher UE noise figure is only 0.2dB hence the UE reference sensitivity of -114dBm has negligible impact on the system coverage/capacity or HSDPA bit rates in the analyzed scenario.

4.5.2.1.2 Discussion

In this section the impact of UE reference sensitivity of -114dBm DPCH_Ec to the system coverage/capacity in rural scenario 4 has been analyzed. As the other-cell pilot powers in the system are high also indoors the 3dB higher UE NF, when compared to core band, has negligible impact on the system capacity.

4.5.2.2 Possible impact on network coverage/capacity due to UE sensitivity degradation

4.5.2.2.1 UE sensitivity and downlink noise floor

Due to the small minimum gap of 10 MHz between uplink and downlink blocks, the duplexer filter loss is more important, UMTS900 UE sensitivity has to be degraded compared to the band I (2 GHz) UE sensitivity.

The impact of UE sensitivity degradation on UMTS900 network coverage and capacity should be analyzed. The table 33 below gives the UE sensitivity levels and the related downlink noise floor.

Table 33: UE sensitivity and downlink noise floor

UE sensitivity (dBm)	Noise figure including duplexer loss (dB)	Downlink noise floor (dBm)
-117	9	-99
-116	10	-98
-115	11	-97
-114	12	-96

4.5.2.2.2 Analysis of impact on UMTS900 network coverage

UMTS is a WCDMA multi-service (multiple data rates) system. Two important characteristics of the WCDMA system are

i) Coverage and capacity are closely correlated

ii) Uplink and downlink coverage/capacity can be different.

For a given service (data rate), uplink coverage is dependent of UE Tx power and BS sensitivity, uplink capacity is function of BS receiver performance (Noise figure, Eb/No). Downlink coverage is usually defined as the downlink pilot target Ec/I_0., the pilot power allocation is a parameter to set. Downlink coverage depends BS Tx power and UE sensitivity, when UE sensitivity is degraded, for keeping the same downlink pilot coverage, more power should be allocated to pilot and other common channels. In consequence, less BS Tx power will be available to traffic channel, also the downlink traffic power consuming for a UE with degraded sensitivity will be higher, that means downlink capacity becomes smaller when UE sensitivity is degraded.

Usually a WCDMA network is designed with a 50% cell loading. The coverage and capacity at such cell loading are considered as the nominal network coverage and capacity. It is well known that WCDMA network is uplink limited in coverage, and downlink limited in capacity. It can be reasonably considered that downlink noise floor increase will not affect the uplink coverage. The impact on downlink coverage can be adjusted by power allocation parameter setting, the impact of downlink noise floor increase (UE sensitivity degradation) will affect only downlink capacity (throughput).

4.5.2.2.3 Analysis of impact on UMTS900 network capacity

4.5.2.2.3.1 Rural area large cell size

As stated in section 3, UMTS cell size is uplink limited, it is determined on uplink calculation. The cell size calculation depend many parameters, for a given cell reliability and a given set of system and network parameters, the cell sizes for different services (uplink data rates) are different. A typical cell size is calculated for CS64 service with 90% of cell area reliability, in rural area with BS antenna height of 40 m, with a 10 dB indoor penetration loss, the uplink allowable pathloss is estimated with a uplink link budget tool as 136.5 dB, the uplink cell range is estimated as 5 km.

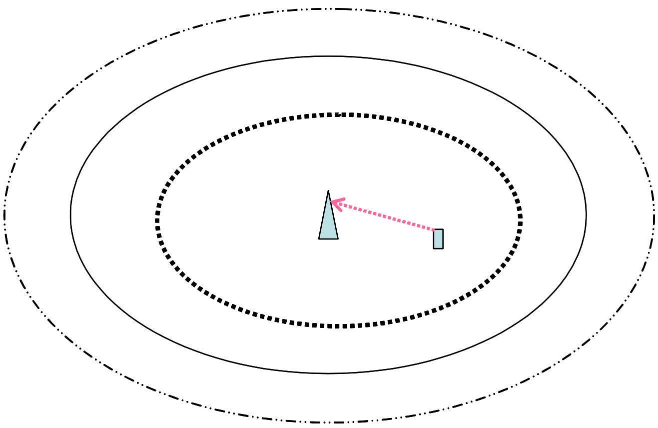

Figure 40: Cell size is determined by uplink allowable pathloss

In order to maintain the same cell size in downlink, the downlink pathloss is related to the uplink pathloss,

$$\text{DL Pathloss} = \text{UL Pathloss} + df \qquad (1)$$

Where df is the additional downlink pathloss, such as propagation loss difference due to the difference of downlink and uplink frequencies, insertion loss, etc.

When downlink noise floor is higher, the power allocated to common channels (Pilot, P-CCPCH, S-CCPCH, PICH, etc) should be increased, the available power for traffic channel becomes less, and the power consummation per traffic channel is also higher, the consequence is that the downlink capacity (throughput) will be reduced.

Under the assumption of a BS Tx power = 43 dBm, the calculated downlink PS384 capacity (throughput in kbps) losses for several pathloss values as function of downlink noise floor (dBm) are plotted in figure 41. It can be seen that

a) For pathloss = 140 dB, downlink PS384 capacity (averaged cell throughput in kbps) loss increases about 5% with 1 dB downlink noise floor increase, the downlink PS384 capacity (averaged cell throughput in kbps) loss is 17.5% for 3 dB downlink noise floor increase.

b) For pathloss = 136.5 dB (5 km cell range), downlink PS384 capacity (averaged cell throughput in kbps) loss increases about 2.5% with 1 dB downlink noise floor increase, the downlink PS384 capacity (averaged cell throughput in kbps) loss is 9% for 3 dB downlink noise floor increase.

c) For pathloss = 130 dB, downlink PS384 capacity (averaged cell throughput in kbps) loss increases about 0.7% with 1 dB downlink noise floor increase, the downlink PS384 capacity (averaged cell throughput in kbps) loss is 2.2% for 3 dB downlink noise floor increase.

d) For pathloss = 120 dB, downlink PS384 capacity (averaged cell throughput in kbps) loss increases 0.1% with 1 dB downlink noise floor increase, the downlink PS384 capacity (averaged cell throughput in kbps) loss is 0.2% for 3 dB downlink noise floor increase.

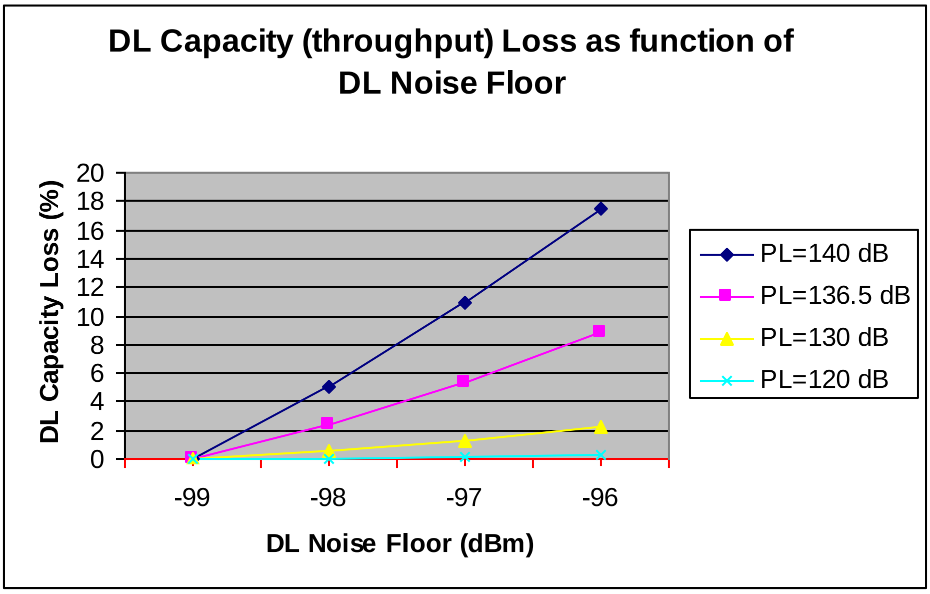

Figure 41: DL capacity (throughput in kbps) loss (%) in function of DL noise floor (Rural area)

4.5.2.2.3.2 Urban area small cell size with indoor mobiles

In urban area, UMTS900 can be deployed for offering deep indoor coverage. The impact on UMTS900 downlink capacity loss in urban area can be estimated in the similar way. Under the assumption of dense urban environment, with BS antenna height of 30m, BS antenna gain of 15 dBi, 21 dB indoor penetration factor (IPF), the uplink budget gives a allowable pathloss of 123 dB for the service CS64, the cell range is estimated as 816 m.

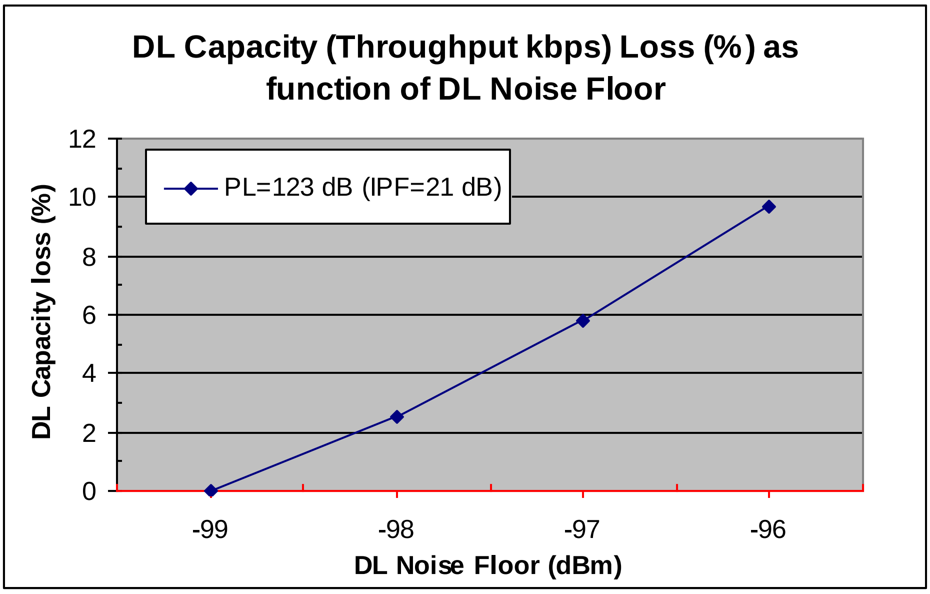

Figure 42: DL capacity (throughput in kbps) loss (%) in function of DL noise floor (Urban area)

For maintaining the same cell range on downlink, under the assumption of a BS Tx power = 43 dBm, the calculated downlink PS384 capacity (throughput in kbps) losses for the pathloss of 123 dB with IPF=21 dB as function of downlink noise floor (dBm) are plotted in figure 42. It can be seen that for this indoor coverage case with pathloss of 123 dB, indoor penetration factor of 21 dB, downlink PS384 capacity (averaged cell throughput in kbps) loss increases about 3% with 1 dB downlink noise floor increase, the downlink PS384 capacity (averaged cell throughput in kbps) loss is 9.7% for 3 dB downlink noise floor increase.

4.5.2.2.4 Discussion

UMTS900 UE sensitivity degradation will impact more network downlink capacity (throughput) rather than network coverage, since WCDMA network coverage limiting factor is uplink. Downlink common channel coverage is adjusted by the Tx power setting.

Cell average downlink capacity loss due to downlink noise floor (UE sensitivity) increase depends allowable pathloss, plus indoor penetration factor, that means cell size in rural area, and indoor penetration factor in urban area. For large cell size in rural area or large indoor penetration factor in urban area, the cell average downlink capacity loss becomes more important than that for small cell size in rural area or small indoor penetration factor in urban area.

Similar to PS384 service, when HSDPA is implemented in the network, the impact on HSDPA coverage/capacity could be

a) Due to UE sensitivity degradation, for maintaining the same coverage, the power allocated to common channels has to be increased, this will makes less power for HSDPA data traffic channel, the downlink throughput will be reduced accordingly.

b) Increase of HS-SCCH part will also reduce in consequence the power for HS-DSCH.

c) At cell border, when noise becomes comparable to extra-cell interferences, the downlink throughput will be reduced.

4.6 Specific UE requirements for UMTS900

4.6.1 Proposed Transmitter Characteristics

Based on the co-existence studies between UMTS and UMTS operating in 900 MHz band and the co-existence studies between UMTS and GSM operating in 900 MHz band described in section 4.2, the analysis of the simulation results for the defined co-existence scenarios indicate that there is no need to define more severe or additional requirements for the UMTS900 UE transmitter characteristics in terms of spectrum mask and ALCR.

UE Tx power classes

By considering that

i) The duplex distance between uplink block and downlink block is only 45 MHz;

ii) Minimum gap between uplink block and downlink block is only 10 MHz;

iii) The UMTS900 UE could be multi-mode (UMTS and GSM) or multi-band UE

It is considered as useful and necessary to define an additional UE Tx Power class 3bis at Tx power at + 23 dBm with measurement tolerance +2/-2 dB. Three UE Tx power classes are defined for UMTS900 UE: Power Class 3, Power Class 3bis, and Power Class 4.

Table 6.1: UE Power Classes

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

Spectrum emission mask

The proposed RF output spectrum mask for the band VIII (900 MHz) is the same as for other frequency bands (I, II, III, IV, V, VII).

Adjacent Channel Leakage power Ratio (ACLR)

The proposed ACLR for UMTS900 UE is also the same as for other frequency bands, the ACLR values are given in the table 6.11 of TS25.101 as minimum requirement.

Table 6.11: UE ACLR

Power Class	Adjacent channel frequency relative to assigned channel frequency	ACLR limit
3	+ 5 MHz or – 5 MHz	33 dB
3	+ 10 MHz or – 10 MHz	43 dB
4	+ 5 MHz or – 5 MHz	33 dB
4	+ 10 MHz or –10 MHz	43 dB

Spurious emissions

The general spurious emission requirements for the band VIII UE are the same as for other bands.

The additional spurious emissions levels are defined in the table 6.13 of TS25.101, these additional spurious emission levels are defined for the protection of the BS and UE of other radio systems. By considering that there will be both GSM and UMTS systems operating in this 900 MHz band, the protection for GSM BS and MS and for UMTS BS and UE are not the same. The measurement bandwidth for the additional spurious emissions for the protection of GSM and UMTS are not the same either. For the frequency range 925-935 MHz, the required spurious emission level for the protection of GSM downlink was defined as -67 dBm/100 kHz, the required spurious emission level for the protection of UMTS downlink is defined as -60 dBm/3.84 MHz. These requirements need to be added to the frequency band I (2100 MHz) and III (1800 MHz). Both requirements should be fulfilled. These two requirements for the frequency range 925-935 MHz are also defined for the band VIII (900 MHz). In addition, spurious requirements for the protection of the downlink of GSM900, UMTS900, GSM1800, UMTS1800, UMTS2100, UMTS2600 are defined and added to the table 6.13.

Table 6.13: Additional spurious emissions requirements

Operating Band	Frequency Bandwidth	Measurement Bandwidth	Minimum requirement
I	875 MHz ≤ f ≤ 885 MHz	3.84 MHz	-60 dBm
	921 MHz ≤ f < 925 MHz	100 kHz	-60 dBm *
	925 MHz ≤ f ≤ 935 MHz	100 kHz 3.84MHz	-67 dBm * -60 dBm **
	935 MHz < f ≤ 960 MHz	100 kHz	-79 dBm *
	1805 MHz ≤ f ≤ 1880 MHz	100 kHz	-71 dBm *
	1884.5 MHz <f<1919.6 MHz	300 kHz	-41 dBm
	2110 MHz ≤ f ≤ 2170 MHz	3.84 MHz	-60 dBm
II	869 MHz ≤ f ≤ 894 MHz	3.84 MHz	-60 dBm
	1930 MHz ≤ f ≤ 1990 MHz	3.84 MHz	-60 dBm
	2110 MHz ≤ f ≤ 2155 MHz	3.84 MHz	-60 dBm
III	921 MHz ≤ f < 925 MHz	100 kHz	-60 dBm *
	925 MHz ≤ f ≤ 935 MHz	100 kHz 3.84 MHz	-67 dBm * -60 dBm **
	935 MHz < f ≤ 960 MHz	100 kHz	-79 dBm *
	1805 MHz ≤ f ≤ 1880 MHz	3.84 MHz	-60 dBm
	2110 MHz ≤ f ≤ 2170 MHz	3.84 MHz	-60 dBm
IV	869 MHz ≤ f ≤ 894 MHz	3.84 MHz	-60 dBm
	1930 MHz ≤ f ≤ 1990 MHz	3.84 MHz	-60 dBm
	2110 MHz ≤ f ≤ 2155 MHz	3.84 MHz	-60 dBm
V	869 MHz ≤ f ≤ 894 MHz	3.84 MHz	-60 dBm
	1930 MHz ≤ f ≤ 1990 MHz	3.84 MHz	-60 dBm
	2110 MHz ≤ f ≤ 2155 MHz	3.84 MHz	-60 dBm
VI	875 MHz ≤ f ≤ 885 MHz	3.84 MHz	-60 dBm
	1884.5 MHz ≤ f ≤1919.6 MHz	300 kHz	-41 dBm
	2110 MHz ≤ f ≤ 2170 MHz	3.84 MHz	-60 dBm
VII	921 MHz ≤ f < 925 MHz	100 kHz	-60 dBm *
	925 MHz ≤ f ≤ 935 MHz	100 kHz 3.84 MHz	-67 dBm * -60 dBm**
	935 MHz < f ≤ 960 MHz	100 kHz	-79 dBm *
	1805 MHz ≤ f ≤ 1880 MHz	100 kHz	-71 dBm *
	2110 MHz ≤ f ≤ 2170 MHz	3.84 MHz	-60 dBm
	2620 MHz ≤ f ≤ 2690 MHz	3.84 MHz	-60 dBm
	2590 MHz ≤ f ≤ 2620 MHz	3.84 MHz	-50 dBm
VIII	921 MHz ≤ f < 925 MHz	100 kHz	- 47 dBm *
	925 MHz ≤ f ≤ 935 MHz	TBD	TBD
	935 MHz < f ≤ 960 MHz	TBD	TBD
	1805 MHz < f ≤ 1880 MHz	TBD	TBD
	2110 MHz ≤ f ≤ 2170 MHz	3.84 MHz	-60 dBm
	2620 MHz ≤ f ≤ 2690 MHz	TBD	TBD
Note * The measurements are made on frequencies which are integer multiples of 200 kHz. As exceptions, up to five measurements with a level up to the applicable requirements defined in Table 6.12 are permitted for each UARFCN used in the measurement Note** Both 100 kHz and 3.84 MHz requirements shall be fulfilled.			

4.6.2 Proposed Receiver Characteristics

The simulation results given in section 4.2 have also indicate that UE receiver RF requirements, ACS, receiver blocking characteristics, narrow band blocking, specified for band III are sufficient for UMTS900 UE being in co-existence with UMTS and GSM operating in 900 MHz band..

The following receiver characteristics are defined for UMTS900 UE, and related changes should be made in the technical specification TS25.101.

Receiver reference sensitivity

As described in the section 1 of this report, the duplex distance is 45 MHz, and the minimum gap between uplink and downlink frequency blocks is only 10 MHz. The duplexer insertion loss for UMTS900 MHz will be bigger than that in the core band, even bigger than that of UMTS1800. By considering the small duplex distance (45 MHz) and very small minimum duplex gap (10 MHz), the duplexer insertion loss is more important, the filter performance with temperature variation is more difficult to maintain. As proposed in the section 4.5, UE reference sensitivity is degraded of 3 dB compared to that of the core band (band I) UE.

Table 7.2: Test parameters for reference sensitivity

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

Receiver blocking requirements

UMTS900 UE receiver in-band blocking and out of band blocking requirements are defined in the similar way as for other bands. The band VIII is to be added to the tables 7.6 and 7.7 of TS25.101.

Table 7.6: In-band blocking

Parameter	Unit	Level	
DPCH_Ec	dBm/3.84 MHz	<REFSENS>+3 dB	
$\hat{I}_{or}$	dBm/3.84 MHz	<REF$\hat{I}_{or}$> + 3 dB	
$I_{blocking}$ mean power (modulated)	dBm	-56	-44
F_{uw} offset		=±10 MHz	≤-15 MHz & ≥15 MHz
F_{uw} (Band I operation)	MHz	2102.4≤ f ≤2177.6 (Note 2)	2095≤ f ≤2185
F_{uw} (Band II operation)	MHz	1922.4≤ f ≤1997.6 (Note 2)	1915≤ f ≤2005
F_{uw} (Band III operation)	MHz	1797.4≤ f ≤1887.6 (Note 2)	1790≤ f ≤1895
F_{uw} (Band IV operation)	MHz	2102.4≤ f ≤2162.6 (Note 2)	2095≤ f ≤2170
F_{uw} (Band V operation)	MHz	861.4≤ f ≤901.6 (Note 2)	854≤ f ≤909
F_{uw} (Band VI operation)	MHz	867.4≤ f ≤892.6 (Note 2 and 3)	860≤ f ≤900 (Note 3)
F_{uw} (Band VII operation)	MHz	2612.4≤ f ≤2697.6 (Note 2)	2605 ≤ f ≤ 2705
Fuw (Band VIII operation)	MHz	917.4≤ f ≤967.6 (Note 2)	910 ≤ f ≤ 975
UE transmitted mean power	dBm	20 (for Power class 3) 18 (for Power class 4)	

Table 7.7: Out of band blocking

Parameter	Unit	Frequency range 1	Frequency range 2	Frequency range 3	Frequency range 4
DPCH_Ec	dBm/3.84 MHz	<REFSENS>+3 dB	<REFSENS>+3 dB	<REFSENS>+3 dB	<REFSENS> +3 dB
$\hat{I}_{or}$	dBm/3.84 MHz	<REF$\hat{I}_{or}$> + 3 dB	<REF$\hat{I}_{or}$> + 3 dB	<REF$\hat{I}_{or}$> + 3 dB	<REF$\hat{I}_{or}$> + 3 dB
$I_{blocking}$ (CW)	dBm	-44	-30	-15	-15
F_{uw} (Band I operation)	MHz	2050<f <2095 2185<f <2230	2025 <f ≤2050 2230 ≤f <2255	1< f ≤2025 2255≤f<12750	-
F_{uw} (Band II operation)	MHz	1870<f <1915 2005<f <2050	1845 <f ≤1870 2050 ≤f <2075	1< f ≤1845 2075≤f<12750	1850 ≤ f ≤ 1910
F_{uw} (Band III operation)	MHz	1745 <f <1790 1895<f <1940	1720 <f ≤ 1745 1940≤f < 1965	1< f ≤1720 1965≤f<12750	-
F_{uw} (Band IV operation)	MHz	2050< f <2095 2170< f <2215	2025< f ≤2050 2215≤ f < 2240	1< f ≤2025 2240≤f<12750	-
F_{uw} (Band V operation)	MHz	809< f <854 909< f <954	784< f ≤809 954≤ f < 979	1< f ≤784 979≤f<12750	824 ≤ f ≤ 849
F_{uw} (Band VI operation)	MHz	815 < f < 860 900 < f < 945	790 < f ≤ 815 945 ≤ f < 970	1 < f ≤ 790 970 ≤ f < 12750	-
F_{uw} (Band VII operation)	MHz	2570 < f < 2605 2705 < f < 2750	na 2750 ≤ f < 2775	1 < f ≤ 2570 2775 ≤ f < 12750	-
Fuw (Band VIII operation)	MHz	865 < f < 910 975 < f < 1020	840 < f < 865 1020 ≤ f < 1045	1 < f ≤ 840 1045 ≤ f < 12750	-
UE transmitted mean power	dBm	20 (for Power class 3) 18 (for Power class 4)			
Band I operation	For 2095≤f ≤2185 MHz, the appropriate in-band blocking or adjacent channel selectivity in subclause 7.5.1 and subclause 7.6.1 shall be applied.				
Band II operation	For 1915≤f ≤2005 MHz, the appropriate in-band blocking or adjacent channel selectivity in subclause 7.5.1 and subclause 7.6.1 shall be applied				
Band III operation	For 1790≤f ≤1895 MHz, the appropriate in-band blocking or adjacent channel selectivity in subclause 7.5.1 and subclause 7.6.1 shall be applied.				
Band IV operation	For 2095≤f≤2170 MHz, the appropriate in-band blocking or adjacent channel selectivity in subclause 7.5.1 and subclause 7.6.1 shall be applied.				
Band V operation	For 854≤f≤909 MHz, the appropriate in-band blocking or adjacent channel selectivity in subclause 7.5.1 and subclause 7.6.1 shall be applied.				
Band VI operation	For 860≤f≤900 MHz, the appropriate in-band blocking or adjacent channel selectivity in subclause 7.5.1 and subclause 7.6.1 shall be applied.				
Band VII operation	For 2605 ≤ f ≤ 2705 MHz, the appropriate in-band blocking or adjacent channel selectivity in subclause 7.5.1 and subclause 7.6.1 shall be applied.				
Band VIII operation	For 910 ≤ f ≤ 975 MHz, the appropriate in-band blocking or adjacent channel selectivity in subclause 7.5.1 and subclause 7.6.1 shall be applied.				

Narrow band blocking

The simulation results for the several additional co-existence scenarios between UMTS and GSM operating in 900 MHz band in urban and rural environment with different cell ranges have shown that the same narrow band blocking characteristics as for the band III (UMTS1800) will be sufficient for ensuring the good co-existence between UMTS900 and GMS900 in co-existence in the same geographical area.

In consequence, the proposed narrow band blocking requirements for UMTS900 UE are the same as that for the band III(UMTS1800).

Table 7.7A: Narrow band blocking characteristics

Parameter	Unit	Band II, Band IV and Band V	Band III, VIII
DPCH_Ec	dBm/3.84 MHz	<REFSENS> + 10 dB	<REFSENS> + 10 dB
$\hat{I}_{or}$	dBm/3.84 MHz	<REF$\hat{I}_{or}$> + 10 dB	<REF$\hat{I}_{or}$> + 10 dB
$I_{blocking}$ (GMSK)	dBm	-57	-56
F_{uw} (offset)	MHz	2.7	2.8
UE transmitted mean power	dBm	20 (for Power class 3) 18 (for Power class 4)	

Intermodulation and narrow band intermodulations

Intermodulation requirements for UMTS900 are defined as the same as for other bands.

The narrow band intermodulation requirements for UMTS900 are defined as the same as for the band III.

Table 7.9A: Receive intermodulation characteristics

Parameter	Unit	Band II, Band IV and Band V		Band III, VIII	
DPCH_Ec	dBm/3.84 MHz	<REFSENS>+ 10 dB		<REFSENS>+ 10 dB	
$\hat{I}_{or}$	dBm/3.84 MHz	<REF$\hat{I}_{or}$> + 10 dB		<REF$\hat{I}_{or}$> +10 dB	
I_{ouw1} (CW)	dBm	-44		-43	
I_{ouw2} (GMSK)	dBm	-44		-43	
F_{uw1} (offset)	MHz	3.5	-3.5	3.6	-3.6
F_{uw2} (offset)	MHz	5.9	-5.9	6.0	-6.0
UE transmitted mean power	dBm	20 (for Power class 3) 18 (for Power class 4)			

Receiver spurious emissions

The additional receiver spurious emission requirements for the band VIII are the same as for transmitter additional spurious emissions.

Table 7.11: Additional receiver spurious emission requirements

Band	Frequency Band	Measurement Bandwidth	Maximum level	Note
I	860 MHz ≤ f ≤ 895 MHz	3.84 MHz	-60 dBm	
	921 MHz ≤ f < 925 MHz	100 kHz	-60 dBm *	
	925 MHz ≤ f ≤ 935 MHz	100 kHz 3.84 MHz	-67 dBm * -60 dBm **	
	935 MHz < f ≤ 960 MHz	100 kHz	-79 dBm *	
	1805 MHz ≤ f ≤ 1880 MHz	100 kHz	-71 dBm *	
	1920 MHz ≤ f ≤ 1980 MHz	3.84 MHz	-60 dBm	UE transmit band in URA_PCH, Cell_PCH and idle state
	2110 MHz ≤ f ≤ 2170 MHz	3.84 MHz	-60 dBm	UE receive band
II	869 MHz ≤ f ≤ 894 MHz	3.84 MHz	-60 dBm	
	1850 MHz ≤ f ≤ 1910 MHz	3.84 MHz	-60 dBm	UE transmit band in URA_PCH, Cell_PCH and idle state
	1930 MHz ≤ f ≤ 1990 MHz	3.84 MHz	-60 dBm	UE receive band
	2110 MHz ≤ f ≤ 2155 MHz	3.84 MHz	-60 dBm	
III	921 MHz ≤ f < 925 MHz	100 kHz	-60 dBm*	
	925 MHz ≤ f ≤ 935 MHz	100 kHz 3.84 MHz	-67 dBm* -60 dBm **	
	935 MHz < f ≤ 960 MHz	100 kHz	-79 dBm*	
	1710 MHz ≤ f ≤ 1785 MHz	3.84 MHz	-60 dBm	UE transmit band in URA_PCH, Cell_PCH and idle state
	1805 MHz ≤ f ≤ 1880 MHz	3.84 MHz	-60 dBm	UE receive band
	2110 MHz ≤ f ≤ 2170 MHz	3.84 MHz	-60 dBm	
IV	869 MHz ≤ f < 894 MHz	3.84 MHz	-60 dBm	
	1710 MHz ≤ f < 1755 MHz	3.84 MHz	-60 dBm	UE transmit band in URA_PCH, Cell_PCH and idle state
	1930 MHz ≤ f ≤ 1990 MHz	3.84 MHz	-60 dBm	
	2110 MHz≤ f ≤ 2155 MHz	3.84 MHz	-60 dBm	UE receive band
V	824 MHz ≤ f ≤ 849 MHz	3.84 MHz	-60 dBm	UE transmit band in URA_PCH, Cell_PCH and idle state
	869 MHz ≤ f < 894 MHz	3.84 MHz	-60 dBm	UE receive band
	1930 MHz ≤ f ≤ 1990 MHz	3.84 MHz	-60 dBm	
	2110 MHz ≤ f ≤ 2155 MHz	3.84 MHz	-60 dBm	
VI	815 MHz ≤ f ≤ 850 MHz	3.84 MHz	-60 dBm	UE in URA_PCH, Cell_PCH and idle state
	860 MHz ≤ f ≤ 895 MHz	3.84 MHz	-60 dBm	UE in URA_PCH, Cell_PCH and idle state
	2110 MHz ≤ f ≤ 2170 MHz	3.84 MHz	-60 dBm	
VII	921 MHz ≤ f < 925 MHz	100 kHz	-60 dBm *	
	925 MHz ≤ f ≤ 935 MHz	100 kHz 3.84 MHz	-67 dBm * -60 dBm **	
	935 MHz < f ≤ 960 MHz	100 kHz	-79 dBm *	
	1805 MHz ≤ f ≤ 1880 MHz	100 kHz	-71 dBm *	
	2110 MHz ≤ f ≤ 2170 MHz	3.84 MHz	-60 dBm	
	2500 MHz ≤ f ≤ 2570 MHz	3.84 MHz	-60 dBm	UE transmit band in URA_PCH, Cell_PCH and idle state
	2620 MHz ≤ f ≤ 2690 MHz	3.84 MHz	-60 dBm	UE receive band
VIII	880 MHz ≤ f ≤ 915 MHz	3.84 MHz	-60 dBm	UE in URA_PCH, Cell_PCH and idle state
	921 MHz ≤ f < 925 MHz	100 kHz	-60 dBm *	
	925 MHz ≤ f ≤ 935 MHz	100 kHz 3.84 MHz	-67 dBm * -60 dBm**	
	935 MHz < f ≤ 960 MHz	100 kHz	-79 dBm *	
	1805 MHz < f ≤ 1880 MHz	3.84 MHz	-60 dBm	
	2110 MHz ≤ f ≤ 2170 MHz	3.84 MHz	-60 dBm	
	2620 MHz ≤ f ≤ 2690 MHz	3.84 MHz	-60 dBm	
Note *	The measurements are made on frequencies which are integer multiples of 200 kHz. As exceptions, up to five measurements with a level up to the applicable requirements defined in Table 7.10 are permitted for each UARFCN used in the measurement			
Note**	Both 100 kHz and 3.84 MHz requirements shall be fulfilled.			

Receiver demodulation performance

Receiver demodulation performance requirements for UMTS900 UE are defined by means velocity scaling. Since the receiver demodulation performance requirements are not defined in TS25.101 as frequency band dependent, there is no need to add the band VIII. By default, the receiver demodulation performance requirements defined in the TS25.101 is applicable to the band VIII UE.

Propagation conditions

By considering the small difference between the band V/VI and VIII, the speed for band V, VI will be applied to band VIII.

Table B.1: Propagation Conditions for Multi path Fading Environments (Cases 1 to 6)

Case 1		Case 2		Case 3		Case 4		Case 5 (Note 1)		Case 6	
Speed for Band I, II, III and IV: 3 km/h		Speed for Band I, II, III and IV: 3 km/h		Speed for Band I, II, III and IV: 120 km/h		Speed for Band I, II, III and IV: 3 km/h		Speed for Band I, II, III and IV: 50 km/h		Speed for Band I, II, III and IV: 250 km/h	
Speed for Band V, VI and VIII: 7 km/h		Speed for Band V, VI and VIII: 7 km/h		Speed for Band V, VI and VIII: 282 km/h (Note 2)		Speed for Band V, VI and VIII: 7 km/h		Speed for Band V, VI and VIII: 118 km/h		Speed for Band V, VI and VIII: 583 km/h (Note 2)	
Speed for Band VII: 2.3 km/h		Speed for Band VII: 2.3 km/h		Speed for Band VII: 92 km/h		Speed for Band VII: 2.3 km/h		Speed for Band VII: 38 km/h		Speed for Band VII: 192 km/h	
Relative Delay [ns]	Relative mean Power [dB]	Relative Delay [ns]	Relative mean Power [dB]	Relative Delay [ns]	Relative mean Power [dB]	Relative Delay [ns]	Relative mean Power [dB]	Relative Delay [ns]	Relative mean Power [dB]	Relative Delay [ns]	Relative mean Power [dB]
0	0	0	0	0	0	0	0	0	0	0	0
976	-10	976	0	260	-3	976	0	976	-10	260	-3
		20000	0	521	-6					521	-6
				781	-9					781	-9

Table B.1B: Propagation Conditions for Multi-Path Fading Environments for HSDPA Performance Requirements

ITU Pedestrian A Speed 3km/h (PA3)		**ITU Pedestrian B Speed 3km/h (PB3)**		**ITU vehicular A Speed 30km/h (VA30)**		**ITU vehicular A Speed 120km/h (VA120)**	
Speed for Band I, II, III and IV 3 km/h		Speed for Band I, II, III and IV 3 km/h		Speed for Band I, II, III and IV 30 km/h		Speed for Band I, II, III and IV 120 km/h	
Speed for Band V, VI, VIII 7 km/h		Speed for Band V, VI, VIII 7 km/h		Speed for Band V, VI, VIII 71 km/h		Speed for Band V, VI, VIII 282 km/h (Note 1)	
Speed for Band VII 2.3 km/h		Speed for Band VII 2.3 km/h		Speed for Band VII 23 km/h		Speed for Band VII 92 km/h	
Relative Delay [ns]	**Relative Mean Power [dB]**	**Relative Delay [ns]**	**Relative Mean Power [dB]**	**Relative Delay [ns]**	**Relative Mean Power [dB]**	**Relative Delay [ns]**	**Relative Mean Power [dB]**
0	0	0	0	0	0	0	0
110	-9.7	200	-0.9	310	-1.0	310	-1.0
190	-19.2	800	-4.9	710	-9.0	710	-9.0
410	-22.8	1200	-8.0	1090	-10.0	1090	-10.0
		2300	-7.8	1730	-15.0	1730	-15.0
		3700	-23.9	2510	-20.0	2510	-20.0

Table B.1C: Propagation Conditions for CQI test in multi-path fading

Case 8, Speed for Band I, II, III and IV 30km/h Speed for Band V, VI and VIII 71km/h Speed for Band VII 23km/h	
Relative Delay [ns]	Relative mean Power [dB]
0	0
976	-10

5 Required changes to the Specifications

Editor' s note : This part will include the Text proposals to update the TS

5.1 Required changes to TS 25.104

Required changes in specification TS 25.104 are summarized in Table 34. Requirements which are not shown are applicable to the band VIII (UMTS900) GHz without any modifications from the existing specification TS25.104.

Table 34: Required Changes to TS 25.104

Section	Requirement	Discussion / Required Changes in TS 25.104
5.2	Frequency bands	Add UMTS900 frequency band as Band VIII. - 880 – 915 MHz: Up-link (UE transmit, Node B receive) - 925 – 960 MHz: Down-link (Node B transmit, UE receive)
5.3	TX-RX frequency separation	Add TX-RX frequency separation of 45 MHz for the band VIII.
5.4.3	Channel number	Existing UARFCN definitions in Table 5.1 can be used for Band VIII. There is no need to add additional "odd" channel number (UARFCN) for the band VIII.
6.6.2.1	Spectrum emission mask	Add requirements for band VIII, Same values as for other bands (I, III)
6.6.3.1.2	Spurious emissions (Category B)	Add a new table (6.9F) appropriate for band VIII, the Category B spurious emissions levels and measurement bandwidths are determined based on ITU-R SM.329.
6.6.3.2	Spurious emissions – Protection of the BS Receiver of own or different BS	Add requirements for uplink of band VIII (880-915 MHz) with same level as for band I to band VII.
6.6.3.3	Spurious emissions – Co-existence with other systems in the same geographic area	Add requirements for band VIII with same figures as band I to band VII. Additional notes are added in the GSM900 part, since the added requirements for UTRA-FDD band VIII are more constraints than that for GSM900 in the frequency ranges of the band VIII.
6.6.3.4	Spurious emissions – Co-existence with co-located and co-sited base stations	Add requirements for band VIII with same figures as band I to band VII.
7.5.1	Blocking characteristics	Add blocking requirements and narrow band blocking requirements for Band VIII. Follow the same pattern as for Band III
7.5.2	Blocking/Co-location	Add requirements for Band VIII by following the same pattern as for other bands. Extend the scope of these requirements from Band I to VIII.
7.6	Intermodulation characteristics	Add intermodulation and narrow band intermodulation requirements for Band VIII. Narrow band intermodulation requirement is set following the pattern for band III.
7.7	RX Spurious emissions	Add requirements for Band VIII.
Annex B	Multi-path fading propagation conditions	Add velocity scaled speeds for Band VIII. The speed for the band VIII is the same as for band V and VI.

5.2 Required changes to TS 25.101

Required changes in specification TS 25.101 are summarized in Table 35. Requirements which are not shown are applicable to the band VIII (UMTS900) without any modifications from the existing specification TS25.101.

Table 35: Required Changes to TS 25.101

Section	Requirement	Discussion / Required Changes in TS 25.101
5.2	Frequency bands	New operating band needs to be added as Band VIII. 880 – 915 MHz: Up-link (UE transmit, Node B receive) 925 – 960 MHz: Down-link (Node B transmit, UE receive)
5.3	TX-RX frequency separation	Add this requirement for Band VIII. 45 MHz
5.4.3	Channel number	Existing UARFCN definitions in Table 5.1 can be used for Band VIII. There is no need to add additional “odd” channel number (UARFCN) for the band VIII.
5.4.4	UARFCN	Define UARFCN range for band VIII. 4412 to 4563 for UL, 4637 to 4788 for DL
6.2.1	UE maximum output power	Add UE power classes for band VIII. +24dBm +1/-3dB: Power class 3 +23dBm +2/-2dB Power class 3bis +21dBm +2/-2dB: Power class 4 Because of reduced duplex distance and the minimum duplex gap between uplink and downlink, the duplexer insertion loss is increased, the Tx power class 3bis is added : [+23dBm +2/-2dB]: Power class 3bis
6.6.2.1	Spectrum emission mask	Extend the spectrum emission mask requirements to Band VIII.
6.6.3	TX spurious emissions	Add additional TX spurious emissions requirements for Band VIII. Requirements can be set according to the patterns used in the existing specifications. In 900 MHz band, the requirements for the protection of UMTS900 downlink in the frequency range 925-935 MHz is of -60 dBm/3.84 MHz, for the protection of GSM900 downlink in the frequency range 925-935 MHz is of -67dBm/100 kHz. These two requirements are added to the band I, III, VII, VIII, both of these two requirements need to be fulfilled. The additional requirements for the abnd VIII (UMTS900) UE should be added for the protection of the downlinks of GSM900, UMTS900, GSM1800, UMTS1800, UMTS2000 and UMTS2600.
7.3	Reference sensitivity level	Add reference sensitivity level requirement for band VIII. Existing REFSENS (-114 dBm) definitions for Band III could be used for Band VIII. Note: Due to reduced duplex distance and the minimum gap between uplink and downlink, the abnd VIII UE reference sensitivity is degradated of 3 dB compared to that of the band I.
7.6.1	Minimum requirement (In-band blocking)	Add in-band blocking requirements for band VIII. Requirements can be set according to the patterns used in the existing specifications
7.6.2	Minimum requirement (Out of-band blocking)	Add out-of-band blocking requirements for band VIII. Requirements can be set according to the patterns used in the existing specification
7.6.3	Minimum requirement (Narrow band blocking)	Add narrow band blocking requirements for band VIII. Requirements can be set according to the patterns of band III used in the existing specification.
7.8.2	Minimum requirement (Narrow band receive intermodulation)	Add narrow band receiver intermodulation requirements for band VIII. Requirements can be set according to the patterns of band III used in the existing specification
7.9	RX spurious emissions	Add additional receiver spurious emission requirements for band VIII. Rx spurious emissions are defined following the same rule as for Tx spurious emissions (Table 6.13)
Annex B	Propagation conditions	Add velocity scaled speeds for Band VIII

5.3 Required changes to TS 25.141

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

Changes made in TS25.141 are summarized in the table below.

Table 36: Required Changes to TS 25.141

Section	Requirement	Discussion / Required Changes in TS 25.141
3.4.1	Frequency bands	Add UMTS900 frequency band as Band VIII. 880 – 915 MHz: Up-link (UE transmit, Node B receive) 925 – 960 MHz: Down-link (Node B transmit, UE receive)
3.4.2	TX-RX frequency separation	Add TX-RX frequency separation 45 MHz for the band VIII.
3.5.3	Channel number	Existing UARFCN definitions in Table 3.1 can be used for Band VIII. There is no need to add additional "odd" channel number (UARFCN) for the band VIII.
6.5.2.1	Spectrum emission mask	Add test requirements for band VIII, Same values as for other bands (I, III)
6.5.3.4.2 6.5.3.7	Spurious emissions (Category B)	Add a new table (6.25F, 6.36F) appropriate for band VIII, the Category B spurious emissions levels and measurement bandwidths are determined based on ITU-R SM.329 for minimum requirements and test requirements.
6.5.3.4.3 6.5.3.7.3	Spurious emissions – Protection of the BS Receiver of own or different BS	Add requirements for uplink of band VIII (880-915 MHz) with same level as for band I to band VII.
6.5.3.4.4 6.5.3.7.4	Spurious emissions – Co-existence with other systems in the same geographic area	Add requirements for band VIII with same figures as band I to band VII. Additional notes are added in the GSM900 part, since the added requirements for UTRA-FDD band VIII are more constraints than that for GSM900 in the frequency ranges of the band VIII.
6.5.3.4.5 6.5.3.7.5	Spurious emissions – Co-existence with co-located and co-sited base stations	Add requirements for band VIII with same figures as band I to band VII.
7.5	Blocking characteristics	Add blocking requirements, blocking for co-location, and narrow band blocking requirements for Band VIII. Follow the same pattern as for Band III
7.6	Intermodulation characteristics	Add intermodulation and narrow band intermodulation requirements for Band VIII.
7.7	RX Spurious emissions	Add requirements for Band VIII.
Annex D	Propagation conditions	Add velocity scaled speeds for Band VIII. The speed for the band VIII is the same as for band V and VI.

5.4 Required changes to TS 25.133

Required changes in specification TS 25.133 are summarized in Table 37. Requirements which are not shown are applicable to the band VIII (UMTS900) without any modifications from the existing specification.

Table 37: Required Changes to TS 25.133

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

5.5 Required changes to TS 25.113

Required changes in specification TS 25.113 are summarized in Table 38. Requirements which are not shown are applicable to the band VIII (UMTS900) without any modifications from the existing specification.

Table 38: Required Changes to TS 25.113

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

5.6 Required changes to TS 34.124

Required changes in specification TS 34.124 are summarized in Table 39. Requirements which are not shown are applicable to the band VIII (UMTS900) without any modifications from the existing specification.

Table 39: Required Changes to TS 34.124

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

5.7 Required changes to TS 25.461

Required changes in specification TS 25.461 are summarized in Table 40. Requirements which are not shown are applicable to the band VIII (UMTS900) without any modifications from the existing specification.

Table 40:. Required Changes to TS 25.461

Section	Requirement	Discussion / Required Changes in TS 25.461
4.3.7	Operating bands	Add frequency band VIII.

5.8 Required changes to other specs

For the introduction of the frequency band VIII (UMTS900), changes are also needed to three other specifications:

i) TS25.463

ii) TS25. 307

iii) TS25.331

TS25.463 is under the responsibility of RAN WG3, TS25.307 and TS25.331 are under the responsibility of RAN WG 2.

6 Conclusion

In this UMTS900 work item technical report TR25.816, all of the work related to the development of UMTS900 technical specifications is described.

Chapter 4 has been dedicated to the studies of the RF requirements, the UMTS900 network deployment and the co-existence simulations scenarios were listed, the simulation assumptions and simulation results for each of the defined co-existence scenarios were described. Based on the analysis of simulation results, the RF requirements were derived.

The changes to different technical specifications (TS25.104, TS25.101, TS25.141, TS25.133, TS25.113, TS34.124, TS25.461) have be summarized in the Chapter 5.

Annex A (informative): Intermodulation characteristics

A.1 Intermodulation Attenuation physics

Due to non-linearity in the transmitter, intermodulation products are generated when several signals are processed in a common active element. For MCBTS the Multi-Carrier Power Amplifier is the dominating source of IM products. The transfer function for n signals can in general be presented by a series of powers, i.e. for n input signals

$$S_{out} = \Sigma\{a_k \cdot (S_1+S_2....S_n)^k\}$$

The value of k represents the order of intermodulation as this describes the number of signals involved in the process. In this calculation multiples of the same carrier signals are included as well. For GSM only odd orders (3rd, 5th, 7th etc) may fall inside GSM transmit or receive bands. Normally the factor a_k is decreasing rapidly with the IM order. Thus the most important IM products to consider are 3rd, 5th and 7th order.

Third order IM products from n carriers may be found at

$|2 \cdot f_i - f_j|$, $|2 \cdot f_j - f_i|$ but also on $|f_i+f_j-f_k|$, $|f_i+f_k-f_j|$ etc

for any combination of i, j and k in the range 1 to n and where f_i is the centre frequency for carrier i.

These products can be found for offsets up to $|f_1-f_n|$ outside the group of carriers. Another characteristic for these products is the broadening of spectrum. Assuming GMSK signals and 200 kHz channels, the IM products will occur at the adjacent channels as well, it can be shown theoretically that in these channels the power will be 3 dB lower. Other modulation methods used by GSM systems will result in further attenuation at adjacent channels.

Similarly, the 5th order IM products may be found at

$|3 \cdot f_i - 2 \cdot f_j|$, $|3 \cdot f_j - 2 \cdot f_i|$ but also on $|f_i+f_j+f_k-(f_a+f_b)|$, $|f_i+f_a+f_k-(f_j+f_b)|$ etc

for any combination of i, j, k, a and b in the range 1 to n and where f_i is the centre frequency for carrier i.

These products may be found for offsets up to $2 \cdot |f_1-f_n|$ outside the group of carriers. For this case the spectrum broadening is higher; the power is 2 – 2.5 dB lower in the adjacent channels.

It should be noted that if the carriers are equally spaced in frequency several IM3 and several IM5 (or higher order) products will coincide on the same frequencies and add up, thus creating the maximum amplitude of the IM products. This means that the IM products with highest amplitude are closest to the carriers and that the others are decreasing by increasing offset.

An example of IM spectrum with 3 equally spaced carriers with equal power is shown in Figure A.1.

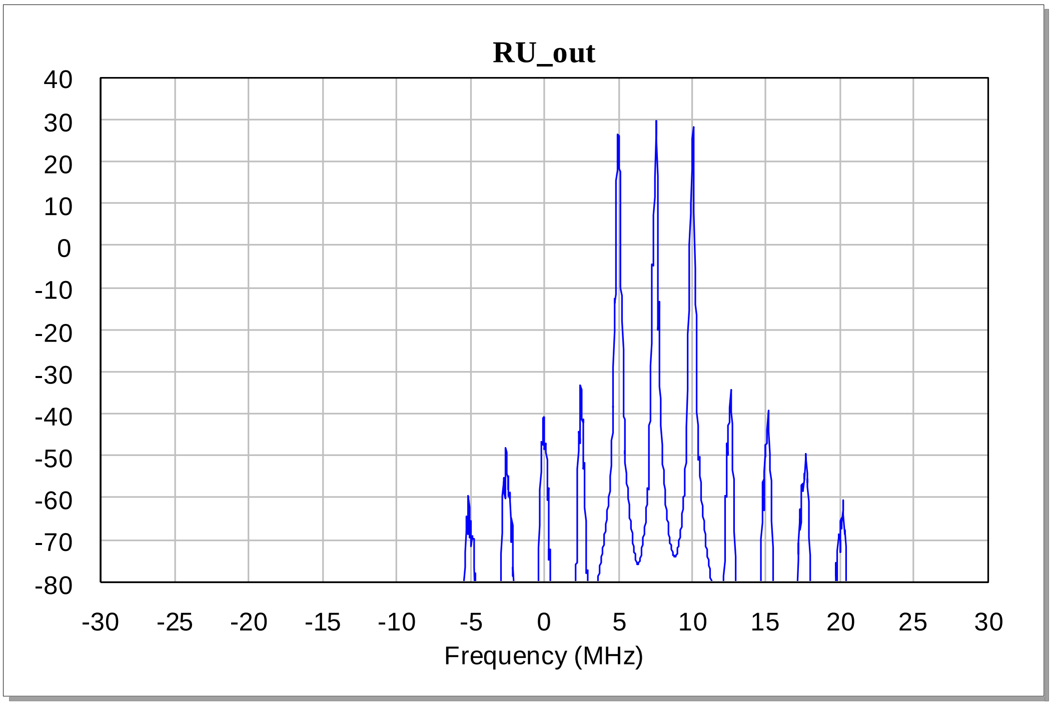

Figure A.1 Example of IM spectrum for 3 GSM carriers

In this figure the 3rd order intermodulation products are found between 0 and 15 MHz, i.e. at 2.5 and 5 MHz offsets on both sides of the outermost carriers. The IM products outside this range are primarily related to 5th order intermodulation.

Reduction of the number of active carriers, while keeping the same output power for the active ones, thus means that the IM3 is reduced rapidly as the factor a_3 is the same and fewer products add up.

How these different products are defined and adding up in different allocations are described in [37]. This is pure theoretical analysis of a power amplifier with low non-linearity. No specific implementation is assumed.

A.2 Application to MCBTS

In the 3GPP specification the requirements are defined at equal frequency spacing and equal power, thus limiting the IM products with highest amplitude to a specified value:

MCBTS class 1: -70 dBc relative the carrier power for any intermodulation product.

MCBTS class 2: same as class 1 but allow for -60 dBc at frequencies where third order intermodulation products can be expected.

For the present analysis of the impact due to MCBTS unwanted emissions the IM performance requirements according to 3GPP TS 45.005, as depicted above, have been assumed as this represents a worst case assumption.

The methodology in [37] may be useful to further estimate the impact from IM products especially when the frequency allocation changes dynamically and the carriers are no longer equally spaced.

Annex B (informative): Change history

Table A.1: Change history

Change history							
Date	**TSG #**	**TSG Doc.**	**CR**	**Rev**	**Subject/Comment**	**Old**	**New**
2005-05	WG4#35	R4-050365			Technical Report UMTS 900 v0.0.1		0.0.1
2005-09	WG4#36	R4-050937			Text proposal for the UMTS900 WI TR25.816, Section 4.1	0.0.1	0.1.0
2005-09	WG4#36	R4-050975			Text proposal for the UMTS900 WI TR25.816, Section 4.2.1 ~4.2.4	0.0.1	0.1.0
2005-09	WG4#36	R4-050939			Text proposal for the UMTS900 WI TR25.816, Section 4.2.5	0.0.1	0.1.0
2005-09	WG4#36	R4-050996			Text proposal for the UMTS900 WI TR25.816, Section 4.2.6	0.0.1	0.1.0
2005-09	WG4#36	R4-050995			Text proposal for the UMTS900 WI TR25.816, Section 4.3	0.0.1	0.1.0
2005-11	WG4#37	R4-051186			Text proposal for the UMTS900 WI TR25.816, Section 2	0.1.0	0.2.0
2005-11	WG4#37	R4-051187			Text proposal for the UMTS900 WI TR25.816, Section 4.2.1	0.1.0	0.2.0
2005-11	WG4#37	R4-051188			Text proposal for the UMTS900 WI TR25.816, Section 4.2.2	0.1.0	0.2.0
2005-11	WG4#37	R4-051189			Text proposal for the UMTS900 WI TR25.816, Section 4.2.3	0.1.0	0.2.0
2005-11	WG4#37	R4-051190			Text proposal for the UMTS900 WI TR25.816, Section 4.2.4	0.1.0	0.2.0
2005-11	WG4#37	R4-051381			Text proposal for the UMTS900 WI TR25.816, Section 4.2.5	0.1.0	0.2.0
2005-11	WG4#37	R4-051435			Text proposal for the UMTS900 WI TR25.816, Section 4.2.6	0.1.0	0.2.0
2005-11	WG4#37	R4-051192			Text proposal for the UMTS900 WI TR25.816, Section 4.4	0.1.0	0.2.0
2005-11	WG4#37	R4-051431			Text proposal for the UMTS900 WI TR25.816, Section 4.5	0.1.0	0.2.0
2005-11	WG4#37	R4-051383			Text proposal for the UMTS900 WI TR25.816, Section 4.6	0.1.0	0.2.0
2005-11	WG4#37	R4-051194			Text proposal for the UMTS900 WI TR25.816, Section 5.1	0.1.0	0.2.0
2005-11					Editorial clean up	0.2.0	0.2.1
2005-11	RAN#30	RP-050808			Presentation for approval	0.2.1	2.0.0
2005-11	RAN#30	RP-050808			Approved and put under change control	2.0.0	7.0.0
2009-09	RAN#45	RP-090825	1		Compatibility between GSM MCBTS and UMTS 900 systems	7.0.0	8.0.0