ETSI TR 145 050 V14.0.0 (2017-04)

Digital cellular telecommunications system (Phase 2+) (GSM);
GSM/EDGE Background for
Radio Frequency (RF) requirements
(3GPP TR 45.050 version 14.0.0 Release 14)

3GPP™ A GLOBAL INITIATIVE
GSM® GLOBAL SYSTEM FOR MOBILE COMMUNICATIONS

Reference
RTR/TSGR-0645050ve00

Keywords
GSM

ETSI

650 Route des Lucioles
F-06921 Sophia Antipolis Cedex - FRANCE

Tel.: +33 4 92 94 42 00 Fax: +33 4 93 65 47 16

Siret N° 348 623 562 00017 - NAF 742 C
Association à but non lucratif enregistrée à la
Sous-Préfecture de Grasse (06) N° 7803/88

Important notice

The present document can be downloaded from:
http://www.etsi.org/standards-search

The present document may be made available in electronic versions and/or in print. The content of any electronic and/or print versions of the present document shall not be modified without the prior written authorization of ETSI. In case of any existing or perceived difference in contents between such versions and/or in print, the only prevailing document is the print of the Portable Document Format (PDF) version kept on a specific network drive within ETSI Secretariat.

Users of the present document should be aware that the document may be subject to revision or change of status.
Information on the current status of this and other ETSI documents is available at
https://portal.etsi.org/TB/ETSIDeliverableStatus.aspx

If you find errors in the present document, please send your comment to one of the following services:
https://portal.etsi.org/People/CommiteeSupportStaff.aspx

Copyright Notification

No part may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm except as authorized by written permission of ETSI.
The content of the PDF version shall not be modified without the written authorization of ETSI.
The copyright and the foregoing restriction extend to reproduction in all media.

© European Telecommunications Standards Institute 2017.
All rights reserved.

DECT™, **PLUGTESTS**™, **UMTS**™ and the ETSI logo are Trade Marks of ETSI registered for the benefit of its Members.
3GPP™ and **LTE**™ are Trade Marks of ETSI registered for the benefit of its Members and of the 3GPP Organizational Partners.
GSM® and the GSM logo are Trade Marks registered and owned by the GSM Association.

Intellectual Property Rights

IPRs essential or potentially essential to the present document may have been declared to ETSI. The information pertaining to these essential IPRs, if any, is publicly available for **ETSI members and non-members**, and can be found in ETSI SR 000 314: *"Intellectual Property Rights (IPRs); Essential, or potentially Essential, IPRs notified to ETSI in respect of ETSI standards"*, which is available from the ETSI Secretariat. Latest updates are available on the ETSI Web server (https://ipr.etsi.org/).

Pursuant to the ETSI IPR Policy, no investigation, including IPR searches, has been carried out by ETSI. No guarantee can be given as to the existence of other IPRs not referenced in ETSI SR 000 314 (or the updates on the ETSI Web server) which are, or may be, or may become, essential to the present document.

Foreword

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

The present document may refer to technical specifications or reports using their 3GPP identities, UMTS identities or GSM identities. These should be interpreted as being references to the corresponding ETSI deliverables.

The cross reference between GSM, UMTS, 3GPP and ETSI identities can be found under http://webapp.etsi.org/key/queryform.asp.

Modal verbs terminology

In the present document "**should**", "**should not**", "**may**", "**need not**", "**will**", "**will not**", "**can**" and "**cannot**" are to be interpreted as described in clause 3.2 of the ETSI Drafting Rules (Verbal forms for the expression of provisions).

"**must**" and "**must not**" are **NOT** allowed in ETSI deliverables except when used in direct citation.

Contents

Intellectual Property Rights 2
Foreword 2
Modal verbs terminology 2
Foreword 22
1 Scope 23
1.1 General 23
1.2 References 23
2 Information available 23
3 DCS1800 system scenarios 23
4 GSM900 small cell system scenarios 24
5 GSM900 and DCS1800 microcell system scenarios 24
6 Conversion factors 25
7 Repeaters 26
8 Error Patterns for Speech Coder Developments 26
9 Simulations of Performance 26
10 GSM900 railway system scenarios 26
11 Simulation results for GPRS receiver performance 27
12 Pico BTS RF scenarios 27
13 CTS system scenarios 27
14 GSM400 system scenarios 27
15 MXM system scenarios 28
16 LCS scenarios 28
17 8-PSK Scenarios 28
18 T-GSM 900 System Scenarios 28
19 MBMS System Scenarios 28
20 T-GSM 810 System Scenarios 28
21 Multicarrier BTS Class 28
22 ER-GSM band introduction 28
23 Extended Training Sequence Code Sets 29
23.1 Background 29
23.2 Extended TSC Sets 29
23.2.1 Scope 29
23.2.2 Design criteria 29
23.2.3 Design methodology 29
23.2.4 Evaluation methodology 30
23.2.5 Performance evaluation 30
24 Machine-type-communication (MTC) deployment, including EC-GSM-IoT, in a reduced BCCH spectrum allocation 30
24.1 Introduction 30
24.2 Simulation campaign 31
24.2.1 Introduction 31

24.2.2 Idle mode procedures 32
24.2.2.1 General 32
24.2.2.1.1 Simulator support 32
24.2.2.1.2 Performance metrics 32
24.2.2.1.3 Simulation assumptions 33
24.2.2.2 PLMN selection 33
24.2.2.3 Cell selection 33
24.2.2.3.1 General 33
24.2.2.3.2 GPRS/EGPRS 34
24.2.2.3.3 EC-GSM-IoT 35
24.2.2.4 Cell reconfirmation 35
24.2.2.4.1 GPRS/EGPRS 35
24.2.2.4.2 EC-GSM-IoT 37
24.2.3 Common control channel performance 39
24.2.3.1 General 39
24.2.3.2 GPRS/EGPRS 39
24.2.3.2.1 Resource usage 39
24.2.3.2.2 Common control signaling delay 40
24.2.3.2.3 Failed attempts 40
24.2.3.3 EC-GSM-IoT 40
24.2.3.3.1 Resource usage 40
24.2.3.3.2 Common control signaling delay 41
24.2.3.3.3 Failed attempts 41
24.2.3.3.4 Coverage class distribution 41
24.2.4 Data traffic and control channel performance 42
24.2.4.1 General 42
24.2.4.2 GPRS/EGPRS 42
24.2.4.2.1 PDCH resource usage 42
24.2.4.2.2 Latency 42
24.2.4.2.4 Failed Attempts 43
24.2.4.2.5 Capacity 43
24.2.4.3 EC-GSM-IoT 43
24.2.4.3.1 PDCH resource usage 43
24.2.4.3.2 Latency of MAR periodic reports 44
24.2.4.3.3 Latency of Downlink Application Ack 44
24.2.4.3.3 Failed attempts 44
24.2.4.3.4 Capacity 44
24.2.4.3.5 Coverage Class Distribution 45
24.3 Conclusion 45

Annex A: DCS1800 System scenarios 47

A.0 INTRODUCTION 47

A.1 SCENARIO 1 - SINGLE BTS AND MS 47
A.1.1 Constraints 47
A.1.1.1 Frequency Bands and Channel Arrangement (Clause 2 of GSM 05.05) 47
A.1.1.2 Proximity 48
A.1.1.3 Range 48
A.1.3 Inputs needed 49

A.2 SCENARIO 2 - MULTIPLE MS AND BTS, COORDINATED 49
A.2.1 Constraints 49
A.2.3 Inputs needed 50

A.3 SCENARIO 3 - MULTIPLE MS AND BTS, UNCOORDINATED 51
A.3.1 Constraints 51
A.3.3 Inputs needed 51

A.4 SCENARIO 4 - COLOCATED MS 52
A.4.1 Constraints 52
A.4.3 Inputs needed 53

A.5 SCENARIO 5 - COLOCATED BTS 53

A.5.1 Constraints....53
A.5.3 Inputs needed....53
A.6 SCENARIO 6 - COLOCATION WITH OTHER SYSTEMS....54
A.6.1 Constraints....54
A.6.3 Inputs needed....54
A.7 Title: Justifications for the proposed Rec. 05.05_DCS....55
A.7.1 Transmitter....56
A.7.1.1 Modulation, Spurs and Noise....56
A.7.1.1.1 Co-ordinated, BTS -> MS (Scenario 2, figure 2.1)....56
A.7.1.1.2 Uncoordinated, BTS -> MS (Scenario 3, figure 3.1)....56
A.7.1.1.3 Co-ordinated & Uncoordinated MS -> BTS (Scenarios 2 and 3, figures 2.1 and 3.1)....56
A.7.1.1.4 Co-ordinated & Uncoordinated MS->MS (Scenario 4)....56
A.7.1.1.5 Co-ordinated & Uncoordinated BTS->BTS (Scenario 5)....56
A.7.1.2 Switching Transients....56
A.7.1.2.1 Uncoordinated MS -> BTS (Scenario 3, figure 3.1)....56
A.7.1.2.2 Uncoordinated BTS -> MS (Scenario 3, figure 3.1)....56
A.7.1.3 Intermodulation....57
A.7.1.3.1 Co-ordinated, BTS -> MS (Scenario 2, figures 2.2 and 2.3)....57
A.7.1.3.2 Uncoordinated, BTS ->MS (Scenario 3, figure 3.2 top)....57
A.7.1.3.3 Uncoordinated, MS&MS-> BTS (Scenario 4, figure 4.1 bottom)....57
A.7.1.3.4 Uncoordinated MS&MS-> MS (Scenario 4, figure 4.1 top)....57
A.7.2 Receiver....57
A.7.2.1 Blocking....57
A.7.2.1.1 Co-ordinated & Uncoordinated BTS-> MS (Scenarios 2 and 3, figures 2.1 and 3.1)....57
A.7.2.1.2 Co-ordinated MS-> BTS (Scenario 2, figure 2.1)....57
A.7.2.1.3 Uncoordinated MS-> BTS (Scenario 3, figure 3.1)....57
A.7.2.1.4 Co-ordinated & Uncoordinated MS-> MS (Scenario 4)....57
A.7.2.1.5 Co-ordinated & Uncoordinated BTS-> BTS (Scenario 5)....57
A.7.2.2 Intermodulation....58
A.7.2.2.1 Co-ordinated & Uncoordinated BTS-> MS (Scenarios 2 and 3, figure 3.2 middle)....58
A.7.2.2.2 Co-ordinated MS & MS -> BTS (Scenario 4)....58
A.7.2.2.3 Uncoordinated MS & MS -> BTS (Scenario 4, figure 3.2 lower)....58
A.7.2.3 Maximum level....58
A.7.2.3.1 Co-ordinated MS -> BTS (Scenario 1)....58
A.7.2.3.2 Co-ordinated BTS -> MS (Scenario 1)....58
A.8.1 SCOPE....58
A.8.2 FREQUENCY BANDS AND CHANNEL ARRANGEMENT....58
A.8.3 REFERENCE CONFIGURATION....58
A.8.4 TRANSMITTER CHARACTERISTICS....59
A.8.4.1 Output power....59
A.8.4.1.1 Mobile Station....59
A.8.4.1.2 Base Station....59
A.8.4.2 Output RF spectrum....59
A.8.4.2.1 Spectrum due to the modulation....59
A.8.4.2.2 Spectrum due to switching transients....60
A.8.4.3 Spurious emissions....60
A.8.4.3.1 Principle of the specification....60
A.8.4.3.2 Base Station....60
A.8.4.3.3 Mobile Station....60
A.8.4.4 Radio frequency tolerance....61
A.8.4.5 Output level dynamic operation....61
A.8.4.5.1 Base station....61
A.8.4.5.2 Mobile station:....61
A.8.4.6 Phase accuracy....61
A.8.4.7 Intermodulation attenuation....61
A.8.4.7.1 Base transceiver station....61
A.8.4.7.2 Intra BTS intermodulation attenuation....61
A.8.4.7.3 Intermodulation between MS....61
A.8.5 RECEIVER CHARACTERISTICS....62
A.8.5.1 Blocking characteristics....62

A.8.5.2 Intermodulation characteristics 63
A.8.5.3 Spurious response rejection 63
A.8.5.4 Spurious emissions 63
A.8.6 TRANSMITTER/RECEIVER PERFORMANCE 63
A.8.6.1 Nominal error rates (NER) 63
A.8.6.2 Reference sensitivity level 63
A.8.6.3 Reference interference level 64
A.8.6.4 Erroneous frame indication performance 64

Annex B: GSM900 Small Cell System scenarios 65

B.1 Transmitter 66
B.1.1 Modulation, Spurs and Noise 66
B.1.1.1 Co-ordinated, BTS -> MS 66
B.1.1.2 Uncoordinated, BTS -> MS 66
B.1.1.3 Co-ordinated & Uncoordinated MS -> BTS 66
B.1.1.4 Co-ordinated & Uncoordinated MS -> MS 66
B.1.1.5 Co-ordinated & Uncoordinated BTS -> BTS 67
B.1.2 Switching Transients 67
B.1.2.1 Uncoordinated MS -> BTS 67
B.1.2.2 Uncoordinated BTS -> MS 67
B.1.3 Intermodulation 67
B.1.3.1 Coordinated, BTS -> MS 67
B.1.3.2 Uncoordinated, BTS -> MS 67
B.1.3.3 Uncoordinated, MS&MS -> BTS 67
B.1.3.4 Uncoordinated MS&MS -> MS 67

B.2 Receiver 67
B.2.1 Blocking 67
B.2.1.1 Co-ordinated & Uncoordinated BTS -> MS 67
B.2.1.2 Co-ordinated MS -> BTS 67
B.2.1.3 Uncoordinated MS -> BTS 68
B.2.1.4 Co-ordinated & Uncoordinated MS -> MS 68
B.2.1.5 Co-ordinated and Uncoordinated BTS -> BTS 68
B.2.2 Intermodulation 68
B.2.2.1 Co-ordinated & Uncoordinated BTS -> MS 68
B.2.2.2 Co-ordinated MS & MS -> BTS 68
B.2.2.3 Uncoordinated MS & MS -> BTS 68
B.2.3 Maximum level 68
B.2.3.1 Co-ordinated MS -> BTS 68
B.2.3.2 Co-ordinated BTS -> MS 68
B.3.1 Transmitter 69
B.3.1.1 Modulation, Spurs and Noise 69
B.3.1.1.1 Co-ordinated, BTS -> MS 69
B.3.1.1.2 Uncoordinated, BTS -> MS 69
B.3.1.1.3 Co-ordinated & Uncoordinated MS -> BTS 69
B.3.1.1.4 Co-ordinated & Uncoordinated MS -> MS 69
B.3.1.1.5 Co-ordinated & Uncoordinated BTS -> BTS 69
B.3.1.2 Switching Transients 69
B.3.1.2.1 Uncoordinated MS -> BTS 69
B.3.1.2.2 Uncoordinated BTS -> MS 69
B.3.1.3 Intermodulation 70
B.3.1.3.1 Coordinated, BTS -> MS 70
B.3.1.3.2 Uncoordinated, BTS -> MS 70
B.3.1.3.3 Uncoordinated, MS&MS -> BTS 70
B.3.1.3.4 Uncoordinated MS&MS -> MS 70
B.3.2 Receiver 70
B.3.2.1 Blocking 70
B.3.2.1.1 Co-ordinated & Uncoordinated BTS -> MS 70
B.3.2.1.2 Co-ordinated MS -> BTS 70
B.3.2.1.3 Uncoordinated MS -> BTS 70
B.3.2.1.4 Co-ordinated & Uncoordinated MS -> MS 70
B.3.2.1.5 Co-ordinated and Uncoordinated BTS -> BTS 70

B.3.2.2 Intermodulation 70
B.3.2.2.1 Co-ordinated & Uncoordinated BTS -> MS 70
B.3.2.2.2 Co-ordinated MS & MS -> BTS 71
B.3.2.2.3 Uncoordinated MS & MS -> BTS 71
B.3.2.3 Maximum level 71
B.3.2.3.1 Co-ordinated MS -> BTS 71
B.3.2.3.2 Co-ordinated BTS -> MS 71

Annex C: Microcell System Scenarios 72

Annex D: Conversion factors 85

Annex E: Repeater Scenarios 89

E.1 INTRODUCTION 89

E.2 REPEATER APPLICATIONS - OUTDOOR AND INDOOR 89

E.3 OUTDOOR REPEATER SCENARIO 89

E.4 OUTDOOR REPEATER PERFORMANCE Requirements 90
E.4.1 Wideband Noise 90
E.4.2 Intermodulation Products and Spurious Emissions 91
E.4.3 Output Power 91
E.4.4 Blocking by Uncoordinated BTS 91
E.4.5 Summary of Outdoor Repeater Requirements 92

E.5 INDOOR REPEATER SCENARIO 92

E.6 INDOOR REPEATER PERFORMANCE REQUIREMENTS 92
E.6.1 Wideband Noise 92
E.6.2 Intermodulation Products and Spurious Emissions 93
E.6.3 Output Power 93
E.6.4 Blocking by Uncoordinated BTS 94
E.6.5 Summary of Indoor Repeater Requirements 94

E.7 Title: Repeater Scenarios 95
E.7.1 Introduction 95
E.7.2 Repeater performance 95
E.7.2.1 Link Equations 95
E.7.2.2 Co-ordinated Scenario 96
E.7.2.3 Uncoordinated Scenario 97
E.7.2.4 Wideband Noise 97
E.7.2.5 3rd order Intermodulation (IM3) performance/Spurious emissions: 97
E.7.3 Repeater scenarios 97
E.7.3.1 Rural scenario 98
E.7.3.2 Urban Scenario 98
E.7.4 Summary 99
E.7.4.1 Repeater Specification 99
E.7.4.2 Planning considerations 99
E.7.5 Out of band Gain 100
E.7.6 Planning guidelines for repeaters 100
E.7.7 Indoor Repeater Scenario 100

Annex F: Error Patterns for Speech Coder Development 104

F.0 Introduction 104

F.1 Channel Conditions 104
F.1.1 Simulation Conditions 104
F.1.2 Available Error Patterns 104

F.2 Test Data for the half rate speech coder 105
F.2.1 File description 105
F.2.2 Soft decision values and chip error patterns 105
F.2.3 Error patterns of corresponding TCH/FS 106

Annex G: Simulation of Performance 108

G.1 Implementation Losses and Noise Figure 108
G.1.1 Assumed Equalizer 108
G.1.2 Accuracy of Simulations 108
G.1.3 Simulation Results 108

G.2 Reference Structure 117
G.2.1 Error Concealment 118
G.2.2 Implementation Losses and Noise Figure 118
G.2.3 Assumed Equalizer 118
G.2.4 Simulation Results 118
G.2.5 Proposed Values for Recommendation GSM 05.05 118

G.3 Simulation of performance for AMR 119
G.3.1 System Configuration 119
G.3.2 Error Concealment 119
G.3.3 Implementation Losses and Noise Figure 120
G.3.4 Assumed Equalizer 120
G.3.5 Simulation Methods 120
G.3.5.1 Simulation for speech 120
G.3.5.2 Simulation for DTX 120
G.3.5.3 Simulation for inband channel 120
G.3.6 Remarks to the Data in GSM 05.05 121

Annex H: GSM900 Railway System Scenarios 122

H.1 Scope 122
H.1.1 List of some abbreviations 122

H.2 Constraints 122
H.2.1 GSM based systems in the 900 MHz band 122
H.2.2 Other systems 123
H.2.3 UIC systems outline 123
H.2.4 Fixed UIC RF parameters 123

H.3 Methodology 123
H.3.1 Scenarios 124
H.3.2 Format of calculations 125
H.3.3 GSM900 systems parameters 125
H.3.4 Minimum Coupling Loss 126
H.3.5 Interference margins 127
H.3.6 Differences between E- and P-GSM 127

H4 Transmitter requirements 127
H.4.1 Transmitter requirements summary 128

H.5 Receiver requirements 128
H.5.1 Receiver requirements summary 129

H.6 Wanted signals levels 129
H.6.1 Maximum wanted signal level 130
H.6.2 Dynamic range of wanted signals 130

Annex I: Void 131

Annex J: GSM900 Railway System Scenarios 132

J.1 Introduction 132

J.2 Basic considerations 132
J.2.1 Types of equipment and frequency ranges 132

J.3 Discussion of the individual sections in GSM 05.05 133
J.3.1 Scope 133
J.3.2 Frequency bands and channel arrangement 133

J.3.3 Reference configuration 134
J.3.4 Transmitter characteristics....134
J.3.4.1 Output power 134
J.3.4.2 Void 134
J.3.4.2.1 Spectrum due to the modulation and wide band noise 134
J.3.4.2.2a MS spectrum due to switching transients....134
J.3.4.2.2b BTS spectrum due to switching transients 135
J.3.4.3.1 Spurious emissions....135
J.3.4.3.2 BTS spurious emissions 136
J.3.4.3.3 MS spurious emissions....136
J.3.4.3.4 MS spurious emissions onto downlinks 137
J.3.4.4 Radio frequency tolerance 138
J.3.4.5 Output level dynamic operation....138
J.3.4.5.1 BTS output level dynamic operation....138
J.3.4.5.2 MS output level dynamic operation 139
J.3.4.6 Phase accuracy....139
J.3.4.7.1 Intra BTS intermod attenuation....139
J.3.4.7.2 Intermodulation between MS (DCS1800 only)....139
J.3.4.7.3 Mobile PBX 139
J.3.5 Receiver characteristics....140
J.3.5.1 Blocking characteristics....140
J.3.5.2 Blocking characteristics (in-band) 140
J.3.5.3 Blocking characteristics (out-of-band)....141
J.3.5.4 AM suppresion characteristics....141
J.3.5.5 Intermodulation characteristics....141
J.3.5.6 Spurious emissions 141
J.3.6 Transmitter/receiver performance 141
J.3.6.1 Nominal error rates....141
J.3.6.2 Reference sensitivity level 141

Annex K: Block Erasure Rate Performance for GPRS 143

K.1 Introduction 143

K.2 Simulation Model....143

K.3 Results 143

K.4 Conclusions 144

Annex L: Proposal on how to report GPRS performance into GSM 05.05....145

L.1 Introduction 145

L.2 GPRS BLER performance....145

L.3 GPRS throughput analyses....146
L.3.1 TU50 ideal FH....147
L.3.2 TU3 no FH 148

L.4 Proposals for GPRS performance in GSM 05.05....148
L.4.1 TU50 ideal FH....148
L.4.2 TU3 no FH 149

L.5 Conclusions 149

Annex M: GPRS simulation results in TU 3 and TU 50 no FH....150

M.1 Introduction 150

M.2 Simulation Model....150

M.3 Maximum GPRS throughput....152

M.4 Conclusion....153

M.5 References 153

Annex N: C/I_c and E_b/N_o Radio Performance for the GPRS Coding Schemes 154
N.1 Introduction 154
N.2 C/I simulation results 154
N.3 E_b/N_0 performance 156
N.4 Conclusions 158
N.5 References 158
Annex O: Void 159
Annex P: Block Error Rate and USF Error Rate for GPRS 160
P.1 Introduction 160
P.2 Simulation Assumptions 160
P.3 Simulation Results 161
P.3.1 Interference Simulations 161
P.3.1.1 TU50 Ideal Frequency Hopping 161
P.3.1.2 TU50 No Frequency Hopping 162
P.3.1.3 TU3 Ideal Frequency Hopping 163
P.3.1.4 TU3 No Frequency Hopping 164
P.3.1.5 RA250 No Frequency Hopping 165
P.3.2 Sensitivity Simulations 166
P.3.2.1 TU50 Ideal Frequency Hopping 166
P.3.2.2 TU50 No Frequency Hopping 167
P.3.2.3 HT100 No Frequency Hopping 168
P.3.2.4 RA250 No Frequency Hopping 169
P.3.2.5 Static Channel 170
Annex Q: Block Error Rate and USF Error Rate for GPRS, 1800 MHz 171
Q.1 Introduction 171
Q.2 Simulation Assumptions 171
Q.3 Simulation Results 172
Q.3.1 Interference Simulations, 1 800 MHz 172
Q.3.1.2 TU50, Ideal Frequency Hopping 172
Q.3.1.3 TU50 No Frequency Hopping 173
Q.3.2 Sensitivity Simulations, 1800 MHz 174
Q.3.2.1 TU50 Ideal Frequency Hopping 174
Q.3.2.2 TU50 No Frequency Hopping 175
Q.3.2.3 HT100 No Frequency Hopping 176
Annex R: Pico BTS RF Scenarios 177
R.1 Introduction 177
R.2 Fixed parameters 177
R.3 Maximum BTS Output Power 178
R.4 BTS Receiver Sensitivity 179
R.4.1 Balanced link (zero interference scenario) 179
R.4.2 Interferer at MCL scenario 179
R.4.3 Power control (zero interference scenario) 180
R.4.4 Sensitivity overview 180
R.5 BTS Power Control Range 180
R.6 BTS Spectrum due to modulation and wideband noise 180
R.7 Spurious Emissions 181

R.8 Radio Frequency Tolerance....181
R.9 Blocking Characteristics....182
R.10 pico- BTS AM suppression characteristics....183
R.10.1 Modulation sidebands....184
R.10.1.1 Uncoordinated BTS->MS....184
R.10.1.2 Uncoordinated MS->BTS....184
R.10.2 Switching transients....184
R.10.2.1 Uncoordinated BTS->MS....184
R.10.2.2 Uncoordinated MS->BTS....184
R.10.3 Blocking....185
R.10.3.1 Uncoordinated BTS->MS....185
R.10.3.2 Uncoordinated MS->BTS....185
R.10.4 The AM suppression requirement....185
R.10.4.1 Downlink, BTS->MS....185
R.10.4.2 Uplink, MS->BTS....185
R.10.4.3 Interference levels....186
R.11 intermodulation....186
R.11.1 co-ordinated and uncoordinated BTS -> MS (scenarios 2 & 3, figure 3.2 middle)....186
R.11.2 coordinated MS&MS -> BTS (scenario 4)....186
R.11.3 uncoordinated MS&MS -> BTS (scenario 4, figure 3.2 lower)....186
R.11.4 MCL relaxation....187
R.12 Pico BTS TI1.5 performance requirements....187
R.12.1 Nominal Error Rates for Pico-BTS....187
R.13 timing and synchronisation....188
R.13.1 Steady state timing advance error....188
R.13.2 Conventional BTS....189
R.13.3 Pico-BTS....189
R.13.3.1 Pico-BTS relaxation....189
R.13.3.2 MS impact of Pico-BTS relaxation....189
Annex S: CTS system scenarios....191
S.1 Introduction....191
S.1.1 Parameter Set....191
S.1.1.1 Transmitter Parameter....191
S.1.1.2 Receiver Parameter....192
S.1.1.3 Minimum coupling loss values....192
S.1.1.4 Path loss models....192
S.1.1.5 Margins....193
S.2 Transmitter characteristics....193
S.2.1 Maximum CTS-FP Transmit Power limited by MS blocking....193
S.2.2 Maximum CTS-FP Transmit Power limited by Spectrum due to Modulation and WBN....194
S.2.3 Specification of max. CTS-FP Transmit Power and CTS-FP Spectrum due to modulation and wide band noise....195
S.2.3.1 Maximum CTS-FP transmit power....195
S.2.3.2 Spectrum due to modulation and wide band noise....196
S.2.4 Balanced link for zero interference scenario (Interferer at MCL scenario)....197
S.2.5 Range of Coverage for CTS:....197
S.2.6 Minimum CTS-FP transmit power....198
S.2.7 Power Level Distribution....199
S.2.8 Spurious Emission....199
S.3 Receiver characteristics....200
S.3.1 Blocking....200
S.3.2 AM suppression....201
S.3.2.1 Spectrum due to modulation....201
S.3.2.2 Switching transients....202
S.3.2.3 Blocking....203
S.3.2.4 Specification of AM Suppression....203

S.3.3 Intermodulation 204
S.3.3.1 uncoordinated CTS-MSs -> GSM-BTS 204
S.3.3.2 uncoordinated CTS-FPs -> MS 204
S.3.3.3 uncoordinated GSM-MSs -> CTS-FP 205
S.4 CTS-FP TI5 performance requirements 205
S.4.1 Nominal Error Rates for the CTS-FP 205
S.5 Conclusion 206
Annex T: GSM400 system scenarios 207
T.0 Introduction 207
T.1 Frequency bands and channel arrangement 207
T.2 System Scenario Calculations for GSM400 systems 208
T.2.1 Worst case proximity scenarios 208
T.3 Worst Case Scenario Requirements 210
T.3.1 Transmitter 210
T.3.1.1 Modulation, Spurs and noise 210
T.3.1.1.1 Co-ordinated BTS -> MS 210
T.3.1.1.2 Uncoordinated BTS -> MS 210
T.3.1.1.3 Coordinated & Uncoordinated MS -> BTS 210
T.3.1.1.4 Coordinated & Uncoordinated MS -> MS 210
T.3.1.1.5 Coordinated & Uncoordinated BTS -> BTS 210
T.3.1.2 Switching transients 210
T.3.1.2.1 Uncoordinated MS -> BTS 210
T.3.1.2.2 Uncoordinated BTS -> MS 210
T.3.1.3 Intermodulation 211
T.3.1.3.1 Coordinated BTS -> MS 211
T.3.1.3.2 Uncoordinated BTS -> MS 211
T.3.1.3.3 Uncoordinated MSs -> BTS 211
T.3.1.3.4 Uncoordinated MS & MS -> MS 211
T.3.2 Receiver 211
T.3.2.1 Blocking 211
T.3.2.1.1 Coordinated & Uncoordinated BTS -> MS 211
T.3.2.1.2 Coordinated MS -> BTS 211
T.3.2.1.3 Uncoordinated MS -> BTS 211
T.3.2.1.4 Coordinated & Uncoordinated MS -> MS 211
T.3.2.1.5 Coordinated & Uncoordinated BTS -> BTS 211
T.3.2.2 Intermodulation 211
T.3.2.2.1 Coordinated & Uncoordinated BTS -> MS 211
T.3.2.2.2 Coordinated MS -> BTS 212
T.3.2.2.3 Uncoordinated MS -> BTS 212
T.3.2.3 Maximum level 212
T.3.2.3.1 Coordinated MS -> BTS 212
T.3.2.3.2 Coordinated BTS -> MS 212
T.4 Transmitter characteristics 212
T.4.1 Output power 212
T.4.1.1 Mobile Station 212
T.4.1.2 Base Station 212
T.4.2 Output RF Spectrum 212
T.4.2.1 Spectrum due to the modulation and wideband noise 212
T.4.2.2 Spectrum due to switching transients 213
T.4.3 Spurious emissions 213
T.4.3.1 Principle of the specification 213
T.4.3.2 Base transceiver station 214
T.4.3.3 Mobile station 214
T.4.4 Radio frequency tolerance 214
T.4.5 Output level dynamic operation 214
T.4.5.1 Base station 214

T.4.5.2 Mobile station 215
T.4.6 Phase accuracy 215
T.4.7 Intermodulation attenuation 215

T.5 Receiver characteristics 215
T.5.1 Blocking characteristics 215
T.5.2 AM suppression characteristics 217
T.5.3 Intermodulation Characteristics 218
T.5.4 Spurious emissions 218

T.6 Receiver performance 218

Annex U: 850 MHz and 1 900 MHz Mixed-Mode Scenarios 219

U.1 Introduction 219

U.2 BTS Wide Band Noise and Intra BTS Intermodulation Attenuation 219
U.2.1 Overview 219
U.2.1.1 TIA/EIA-136 219
U.2.1.2 ETSI GSM 220
U.2.2 Scenario - Mixed-Mode Multi-Carrier BTS in FCC Regulated Environment 220
U.2.3 BTS Wide Band Noise and Intra BTS Intermodulation Attenuation Analysis 221

U.3 BTS Blocking and AM Suppression Characteristics 223
U.3.1 Overview 223
U.3.1.1 TIA/EIA-136 223
U.3.1.2 ETSI GSM 223
U.3.2 Scenario - Mixed-Mode Multiple MS and BTS, Uncoordinated Close Proximity 223
U.3.3 Blocking Analysis 224
U.3.3.1 Definition 224
U.3.3.2 Calculation 224
U.3.4 AM Suppression Analysis 225

Annex V: LCS scenarios 226

V.1 Introduction 226

V.2 TOA Type A LMU in a Co-Located Deployment 226
V.2.1 Constraints 226
V.2.2 Frequency Bands and Channel Arrangement (clause 2 of GSM 05.05) 226
V.2.3 Proximity for DCS1800/PCS1900 226
V.2.4 Inputs needed 227
V.2.5 Conclusion 227

V.3 Discussion of TOA LMU RF Specification 227
V.3.1 Introduction 227
V.3.2 Analysis Model 228
V.3.3 Results 228
V.3.4 Conclusions 229

V.4 Simulation results for TOA–LMU performance 229
V.4.1 Introduction and requirements 229
V.4.2 Simulation model 232
V.4.3 Assumed TOA estimation algorithm 232
V.4.4 Simulation results 233
V.4.4.1 Sensitivity performance 233
V.4.4.2 Interference performance 233
V.4.4.3 Multipath performance 234
V.4.4.4 Positioning Performance 235

V.5 Discussion of RIT measurement performance of TOA LMU 236

V.6 Simulations Results for E-OTD LMUs and E-OTD Capable MSs 237
V.6.1 Introduction 237
V.6.2 E-OTD Measurement Accuracy 237
V.6.2.1 Sensitivity Performance 237

V.6.2.2 Interference Performance 238
V.6.2.3 Multipath performance 240
V.6.3 Location accuracy 241
V.6.3.1 Network parameters 241
V.6.3.2 Simulation results 241

V.7 BTS Frequency Source Stability, E-OTD reporting periods and E-OTD Location Accuracy 242
V.7.1 Factors determining E-OTD stability 242
V.7.2 Relationship between range errors and location error 243

Annex V.A: Evaluation of Positioning Measurement Systems 244

1 Introduction 244

2 Positioning Simulator 244

3 System Simulator 245
3.1 Initiation 246
3.2 Path loss calculations 246
3.3 Channel allocation 246
3.4 C and I calculations 246
3.5 Dropping calls with too low C/I 247
3.6 System simulator parameters 247

4 Radio Link Level Simulator 248

5 Channel Model 248
5.1 Channel model requirements 248
5.2 Channel model 248
5.3 Delay spread 249
5.4 Average power delay profile 250
5.5 Matching the delay spread of the channel model to the delay spread model 250
5.6 Short-term fading 250
5.7 Diversity 251
5.8 Limitations 251
5.9 Summary of the channel model 251

6 GSM Adaptation 252
6.1 FIR Filter Implementation 252
6.2 Sampling in Time Domain 253
6.3 Frequency Hopping 253

7 Position Calculation and Statistical Evaluation 253

8 References 254

Annex V.B: Simulations on Co-Existence of EDGE and GSM Modulated Signals 255

1 Introduction 255

2 Simulations 256

3 Simulation Results 257

4 Conclusions 259

Annex W: Update of GPRS background information 260

W.1 Introduction 260

W.2 References 260

W.3 Simulation assumptions 260

W.4 Co-channel interference simulations with varying C/I 261

W.5 Co-channel interference simulations with varying Eb/N0 262

W.6 Effect on the MS receiver Noise Factor 264

W.7 Conclusion 265

Annex X: 8-PSK Scenarios 266

X.1 Assumptions 266

X.2 Closest Approach 266
X.2.1 Closest Approach, Coordinated 266
X.2.1.1 Closest Approach BTS Transmitting, Coordinated 266
X.2.1.1.1 Nominal Error Rate Requirement at High Input Levels 266
X.2.1.1.2 MS Receiver Intermodulation Characteristics 266
X.2.1.2 Closest Approach MS Transmitting, Coordinated 267
X.2.1.2.1 Nominal Error Rate at High Input Levels 267
X.2.1.2.1.1 GSM900 BTS 267
X.2.1.2.1.2 DCS1800 BTS 268
X.2.1.2.2 BTS Receiver Intermodulation Characteristics 268
X.2.1.3 Minimum Coupling for Coordinated Case 269
X.2.1.3.1 Downlink Power Control Enabled 269
X.2.1.3.2 No Downlink Power Control 269
X.2.2 Closest Approach, Uncoordinated 269
X.2.2.1 Closest Approach BTS Transmitting, Uncoordinated 269
X.2.2.1.1 Noise Masking 269
X.2.2.1.2 MS Receiver Intermodulation Characteristics 269
X.2.2.1.3 BTS Tx Inter/Intra Modulation Masking 270
X.2.2.2 Minimum Coupling for Uncoordinated Case 270

X.3 Analysis of Specifications 270
X.3.1 Scenario 1: Single BTS and MS 270
X.3.1.1 Specifications Affected (GSM 05.05) 270
X.3.1.2 Maximum Receiver Levels 270
X.3.1.3 Reference Sensitivity Level 270
X.3.1.3.1 Coverage Limit 270
X.3.1.3.2 Link Balance 271
X.3.2 Scenario 2: Multiple MS and BTS, Coordinated 271
X.3.2.1 Specifications Affected (GSM 05.05) 272
X.3.2.2 Adaptive Power Control (GSM 05.05, subclause 4.1) 272
X.3.2.3 Output RF Spectrum (GSM 05.05, subclause 4.1) 272
X.3.2.4 Inter/Intra Modulation Attenuation, BTS (GSM 05.05, subclauses 4.7.1 and 4.7.2) 273
X.3.2.5 Blocking (GSM 05.05, subclause 5.1) 273
X.3.2.6 Reference Interference Level 273
X.3.3 Scenario 3: Multiple MS and BTS, Uncoordinated 274
X.3.3.1 Specifications Affected (GSM 05.05) 274
X.3.3.2 Output RF Spectrum (GSM 05.05, subclause 4.2) 274
X.3.3.3 Transmit Intermodulation (GSM 05.05, subclause 4.7) 275
X.3.3.4 Blocking, In-Band Up and Down Links (GSM 05.05, subclause 5.1) 275
X.3.3.5 BTS Receiver Intermodulation (GSM 05.05, subclause 5.3) 276

X.4 C/I Limited Coordinated MS and BTS 276
X.4.1 N=4/12 Reuse Pattern, Geometric C/I 276
X.4.2 N=4/12 Reuse Pattern, C/I CDF 277
X.4.3 Adjacent Channel Interference 278

X.5 BTS Inter and Intra Modulation 278
X.5.1 Simplified Analysis 278
X.5.2 Normal BTS to Normal BTS (Same EIRP) 280
X.5.3 Normal to Micro (Micro BTS EIRP is 20 dB less than Normal BTS) 282

Annex Y: T-GSM 900 system scenarios 285

Y.0 Introduction 285

Y.1 Frequency bands and channel arrangement 285

Y.2 System Scenario Calculations for T-GSM 900 systems 285
Y.2.1 Worst case proximity scenarios 285

Y.3 Worst Case Scenario Requirements 287
Y.3.1 Transmitter 287
Y.3.1.1 Modulation, Spurs and noise 287
Y.3.1.1.1 Co-ordinated BTS -> MS 287
Y.3.1.1.2 Uncoordinated BTS -> MS 287
Y.3.1.1.3 Coordinated & Uncoordinated MS -> BTS 288
Y.3.1.1.4 Coordinated & Uncoordinated MS -> MS 288
Y.3.1.1.5 Coordinated & Uncoordinated BTS -> BTS 288
Y.3.1.2 Switching transients 288
Y.3.1.2.1 Uncoordinated MS -> BTS 288
Y.3.1.2.2 Uncoordinated BTS -> MS 288
Y.3.1.3 Intermodulation 288
Y.3.1.3.1 Coordinated BTS -> MS 288
Y.3.1.3.2 Uncoordinated BTS -> MS 288
Y.3.1.3.3 Uncoordinated MSs -> BTS 288
Y.3.1.3.4 Uncoordinated MS & MS -> MS 288
Y.3.2 Receiver 289
Y.3.2.1 Blocking 289
Y.3.2.1.1 Coordinated & Uncoordinated BTS -> MS 289
Y.3.2.1.2 Coordinated MS -> BTS 289
Y.3.2.1.3 Uncoordinated MS -> BTS 289
Y.3.2.1.4 Coordinated & Uncoordinated MS -> MS 289
Y.3.2.1.5 Coordinated & Uncoordinated BTS -> BTS 289
Y.3.2.2 Intermodulation 289
Y.3.2.2.1 Coordinated & Uncoordinated BTS -> MS 289
Y.3.2.2.2 Coordinated MS -> BTS 289
Y.3.2.2.3 Uncoordinated MS -> BTS 289
Y.3.2.3 Maximum level 290
Y.3.2.3.1 Coordinated MS -> BTS 290
Y.3.2.3.2 Coordinated BTS -> MS 290

Y.4 Transmitter characteristics 290
Y.4.1 Output power 290
Y.4.1.1 Mobile Station 290
Y.4.1.2 Base Station 290
Y.4.2 Output RF Spectrum 290
Y.4.2.1 Spectrum due to the modulation and wideband noise 290
Y.4.2.2 Spectrum due to switching transients 291
Y.4.3 Spurious emissions 291
Y.4.3.1 Principle of the specification 291
Y.4.3.2 Base transceiver station 291
Y.4.3.3 Mobile station 292
Y.4.4 Radio frequency tolerance 292
Y.4.5 Output level dynamic operation 292
Y.4.5.1 Base station 292
Y.4.5.2 Mobile station 292
Y.4.6 Phase accuracy 292
Y.4.7 Intermodulation attenuation 292

Y.5 Receiver characteristics 293
Y.5.1 Blocking characteristics 293
Y.5.2 AM suppression characteristics 294
Y.5.3 Intermodulation Characteristics 294
Y.5.4 Spurious emissions 294

Y.6 Receiver performance 294

Annex Z: MBMS system scenarios 295

Annex ZA: T-GSM 810 system scenarios 301

ZA.1 Introduction 301

ZA.2 Coexistence scenario study 301

ZA.2.1 T-GSM 810-iDEN™ 302
ZA.2.1.1 Downlink study 302
ZA.2.1.2 Uplink study 302
ZA.2.2 T-GSM 810-TETRA 303
ZA.2.2.1 Downlink study 303
ZA.2.2.2 Uplink study 303
ZA.2.3 T-GSM 810-T-CDMA 304
ZA.2.3.1 Downlink study 304
ZA.2.3.2 Uplink study 305
ZA.3 Conclusion 305
ZA.4 System parameters 305
ZA.5 References 306
Annex ZB: Introduction of multicarrier BTS class 307
ZB.1 Introduction 307
ZB.2 Transmitter 307
ZB.2.1 Introduction 307
ZB.2.2 Proposal for relaxation and change 308
ZB.2.2.1 Introduction of MCBTS class 1 and class 2 308
ZB.2.2.2 Spectrum due to modulation and wideband noise 308
ZB.2.2.3 Spurious emission 308
ZB.2.2.4 BSS Intermodulation attenuation 309
ZB.2.3 Simulation results 309
ZB.2.4 Impact to GSM-R due to relaxation 317
ZB.3 Receiver 317
ZB.3.1 Proposal for the relaxation 317
ZB.3.2 Treatment of receive levels exceeding the new blocking limit 318
ZB.3.2.1 Simulation results 318
ZB.3.2.2 Conclusion 320
ZB.3.2.3 Discussion 321
Annex ZC: Introduction of Medium Range and Local Area multicarrier BTS classes 322
ZC.1 Introduction 322
ZC.2 Transmitter 322
ZC.3 Receiver 322
ZC.4 References 323
Annex ZD: ER-GSM band introduction 324
ZD.1 Introduction 324
ZD.2 Generalities on Working assumption and methodology 324
ZD.2.1 Evaluation on impacted requirements 324
ZD.2.2 Assumptions 325
ZD.2.2.1 RF performances 325
ZD.2.2.2 Blocker rejection by victim public base station 325
ZD.2.2.3 Blocking and Intermodulation reminders 326
ZD.2.2.4 Desensitization computing method 326
ZD.2.2.5 Coordinated and uncoordinated deployment 327
ZD.2.2.6 Exception to blocking requirement for ER-GSM mobiles 327
ZD.3 Victim receiver performance for lowest frequency offset of ER-GSM interferer 327
ZD.3.1 GSM BTS as victim receiver 327
ZD.3.2 UTRA/E-UTRA BS as victim receiver 328
ZD.4 Victim receiver performance in the ER-GSM frequency range 328
ZD.4.1 GSM BTS as victim receiver 329

ZD.4.2 UTRA/E-UTRA BS as victim receiver 329
ZD.5 Specified requirement based on co-existence analysis 329
ZD.5.1 Uncoordinated deployment 330
ZD.5.2 Coordinated deployment 330
ZD.6 References 330
Annex ZE: Extended TSC Sets 331
ZE.1 Extended TSC Sets Design 331
ZE.1.1 Introduction 331
ZE.1.2 Training Sequence Design 331
ZE.1.2.1 Initial Search 331
ZE.1.2.2 Building the Cost Function 332
ZE.1.2.2.1 Auto Correlation Cost 332
ZE.1.2.2.2 Cross Correlation Cost 333
ZE.1.2.2.2.1 Basic Principle 333
ZE.1.2.2.2.2 Used Model 334
ZE.1.2.3 Performing the search 337
ZE.1.3 Proposed Training Sequence Code Set 337
ZE.1.4 Equivalence of rotational approaches 338
ZE.2 Performance framework for design of Extended TSC Sets 340
ZE.2.1 Working Assumptions for performance framework 340
ZE.3 Delay statistics for design of Extended TSC Sets 342
ZE.3.1 Background 342
ZE.3.2 Simulations 343
ZE.3.2.1 Simulation assumptions 343
ZE.3.2.2 Non-ideal network synchronization 343
ZE.3.2.3 Collection of results 344
ZE.3.2.4 Delay distribution 344
ZE.4 NewToN – Performance evaluation 344
ZE.4.1 Introduction 345
ZE.4.2 Impact of co-TSC interference 345
ZE.4.2.1 Introduction 345
ZE.4.2.2 System model of co-TSC interference 346
ZE.4.2.2.1 Network configuration 346
ZE.4.2.2.2 Interferer strength 347
ZE.4.2.2.3 Co-TSC probability 348
ZE.4.2.3 Link level simulations 349
ZE.4.2.3.1 Interference model 349
ZE.4.2.3.2 Other simulation parameters 350
ZE.4.2.3.3 Results and discussion 350
ZE.4.3 System level simulations 350
ZE.4.3.1 Introduction 350
ZE.4.3.2 Simulation assumptions 351
ZE.4.3.3 Results – non-VAMOS 351
ZE.4.3.4 Results – VAMOS 352
ZE.4.4 Performance comparison according to NewToN framework 353
ZE.4.5 Conclusions 354
ZE.4.6: Performance comparison according to NewToN performance framework 355
ZE.4.7 Detailed link level performance 356
Annex ZF: Machine-type-communication (MTC) deployment, including EC-GSM-IoT, in a reduced BCCH spectrum allocation 357
ZF.1 Common simulation assumption framework 357
ZF.1.1 Tdoc reference 357
ZF.1.2 Working assumptions for network simulations 358
ZF.2 Simulator for Network synchronization evaluation 360
ZF.2.1 Tdoc reference 360

ZF.2.2 Introduction 360
ZF.2.3 Simulator description 360
ZF.2.3.1 General 360
ZF.2.3.2 Network configuration and plan 361
ZF.2.3.3 Mapping and timing of logical channels 361
ZF.2.3.4 Relevant range of coupling loss 362
ZF.2.3.5 Realistic interference model 362
ZF.2.3.6 Receiver model 364
ZF.2.4 Discussion and conclusions 365

ZF.3 Simulator for Common control channel evaluation 365
ZF.3.1 Tdoc reference 365
ZF.3.2 General 366
ZF.3.3 Minimizing execution time 366
ZF.3.3.1 General 366
ZF.3.3.2 Interferers 366
ZF.3.3.2.1 Interferer types 366
ZF.3.3.2.2 Minimum number of interferers 366
ZF.3.3.2.3 Requirement on modeled energy level 367
ZF.3.3.2.4 Conservation of energy 367
ZF.3.3.3 Oversampling 367
ZF.3.3.4 Pre-generation of bursts 367
ZF.3.3.5 Verification 367
ZF.3.3.5.1 General 367
ZF.3.3.5.2 Sensitivity limited performance 368
ZF.3.3.5.3 Interference limited performance 368

ZF.4 Simulator for Data traffic and control channel performance 369
ZF.4.1 Tdoc reference 369
ZF.4.2 Model 369
ZF.4.2.1 General 369
ZF.4.2.2 Mapping tables 370
ZF.4.2.2.1 First stage mapping (SINR → BER) 370
ZF.4.2.2.2 Second stage mapping (BER → BLEP) 370
ZF.4.2.2.3 Mapping choice 370
ZF.4.2.3 SINR handling 371
ZF.4.2.3.1 Blind repetition 371
ZF.4.2.3.2 MRC (uplink only) 372
ZF.4.3 Verification 372
ZF.4.3.1 Sensitivity 372
ZF.4.3.2 Multi-interference (DTS-2) 373

ZF.5 Results for Network synchronization evaluation 373
ZF.5.1 GPRS/EGPRS 373
ZF.5.1.0 Tdoc reference 373
ZF.5.1.1 Simulator configuration 374
ZF.5.1.2 Results 374
ZF.5.1.3 Discussion and conclusions 377
ZF.5.2 EC-GSM-IoT 377
ZF.5.2.1 Tdoc reference 377
ZF.5.2.2 Simulator configuration 377
ZF.5.2.3 Results 377
ZF.5.2.4 Conclusions 380

ZF.6 Results for Common control channel evaluation 380
ZF.6.1 GPRS/EGPRS 380
ZF.6.1.1 Tdoc reference 380
ZF.6.1.2 Assumptions 380
ZF.6.1.2.1 General 380
ZF.6.1.2.2 Network synchronization 380
ZF.6.1.2.3 BCCH Power Savings 380
ZF.6.1.3.4 Frequency planning 380
ZF.6.1.4 Simulations 381

ZF.6.1.4.1 Simulation assumptions 381
ZF.6.1.4.1.1 System parameters 381
ZF.6.1.5 Results 381
ZF.6.1.5.1 Resource Usage 381
ZF.6.1.5.2 Common control channel delay 382
ZF.6.1.5.3 Failed Attempts 382
ZF.6.1.6 Discussion 382
ZF.6.1.7 Conclusions 382
ZF.6.2 EC-GSM-IoT 382
ZF.6.2.1 Tdoc reference 382
ZF.6.2.2 Assumptions 383
ZF.6.2.2.1 Link model 383
ZF.6.2.2.2 Blind transmissions 383
ZF.6.2.2.3 Network synchronization 383
ZF.6.2.2.4 Coverage class adaptation 383
ZF.6.2.2.5 BCCH Power Savings 383
ZF.6.2.2.6 Frequency planning 383
ZF.6.2.3 Simulations 383
ZF.6.2.3.1 Simulation assumptions 383
ZF.6.2.3.2 System parameters 384
ZF.6.2.4 Results 384
ZF.6.2.4.1 General 384
ZF.6.2.4.2 Resource Usage 384
ZF.6.2.4.3 Common control channel delay 386
ZF.6.2.4.4 Failed Attempts 386
ZF.6.2.4.5 Coverage class distribution 386
ZF.6.2.5 Discussion 387
ZF.6.2.6 Conclusions 387

ZF.7 Results for Data traffic and control channel evaluation 387
ZF.7.1 GPRS/EGPRS 387
ZF.7.1.1 Tdoc reference 387
ZF.7.1.2 Assumptions 387
ZF.7.1.2.1 Traffic generation 387
ZF.7.1.2.2 RACH interference 387
ZF.7.1.2.3 BCCH Power Savings 388
ZF.7.1.3 Simulations 388
ZF.7.1.3.1 Simulation assumptions 388
ZF.7.1.3.1.1 System parameters 389
ZF.7.1.3.1.2 Cell selection and coding scheme selection 389
ZF.7.1.3.1.3 Control signaling 389
ZF.7.1.3.1.4 Simulated scenarios 390
ZF.7.1.3.2 Results 390
ZF.7.1.3.2.1 Time Slot Usage 390
ZF.7.1.3.2.2 Latency of Uplink Transmissions 391
ZF.7.1.3.2.3 Latency of Downlink Transmissions 391
ZF.7.1.3.2.4 Failed Attempts 392
ZF.7.1.3.2.5 Capacity 392
ZF.7.1.4 Discussion and conclusions 392
ZF.7.2 EC-GSM-IoT 392
ZF.7.2.1 Assumptions 392
ZF.7.2.1.1 Traffic generation 392
ZF.7.2.1.2 EC-RACH interference 393
ZF.7.2.1.3 BCCH Power Savings 393
ZF.7.2.1.4 Uplink Power Backoff 393
ZF.7.2.2 Simulations 393
ZF.7.2.2.1 Simulation assumptions 393
ZF.7.2.2.1.1 System parameters 394
ZF.7.2.2.1.2 Cell selection and uplink coverage class selection 394
ZF.7.2.2.1.3 Downlink coverage class selection and coding scheme selection 395
ZF.7.2.2.1.4 Control signaling 395
ZF.7.2.2.1.5 Simulated scenarios 395

ZF.7.2.2.2 Results 395
ZF.7.2.2.2.1 TS Usage 396
ZF.7.2.2.2.2 Latency of MAR periodic reports 397
ZF.7.2.2.2.3 Latency of Downlink Application Ack 397
ZF.7.2.2.2.4 Failed Attempts 397
ZF.7.2.2.2.5 Capacity 397
ZF.7.2.2.3 DL and UL Coverage Class Distribution 398
ZF.7.2.3 Discussion and conclusions 399
ZF.7.2.3.1 Impact from frequency re-use 399
ZF.7.2.3.2 SINR vs carrier based measurements 399
ZF.7.2.3.2.1 General 399
ZF.7.2.3.2.2 Coverage class distribution 399
ZF.7.2.3.2.3 BLER 400
ZF.7.2.4 Conclusion 401

ZF.8 Traffic model for legacy GPRS MTC 401
ZF.8.1 Tdoc reference 401
ZF.8.2 Legacy GRPS MTC uses cases and scenarios 401
ZF.8.3 Aggregated traffic model of MTC over Legacy GPRS 402

ZF.9 Simulator model for wanted signal level and SINR estimation error 403
ZF.9.1 Tdoc reference 403
ZF.9.2 Model 403
ZF.9.3 Noise-limited case 404
ZF.9.4 Interference-limited case 405
ZF.9.5 Discussion and conclusions 406

Annex ZG: Change history 407

History 408

Foreword

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

The contents of the present document are subject to continuing work within the TSG and may change following formal TSG approval. Should the TSG modify the contents of the present document, it will be re-released by the TSG with an identifying change of release date and an increase in version number as follows:

Version x.y.z

where:

- x the first digit:
  - 1 presented to TSG for information;
  - 2 presented to TSG for approval;
  - 3 or greater indicates TSG approved document under change control.
- y the second digit is incremented for all changes of substance, i.e. technical enhancements, corrections, updates, etc.
- z the third digit is incremented when editorial only changes have been incorporated in the document.

1 Scope

1.1 General

The present document gives background information on how the RF requirements of GSM400, GSM900 and DCS 1800 systems have been derived.

1.2 References

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

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

[1] 3GPP TR 45.820, “Cellular System Support for Ultra Low Complexity and Low Throughput Internet of Things”

[2] 3GPP TS 45.001, “Physical layer on the radio path;General description”

[3] 3GPP TS 45.003, “Channel coding”

[4] 3GPP TS 45.004, “Modulation”

2 Information available

The present document collects together temporary documents of ETSI SMG and STC SMG2 and 3GPP GERAN which can be seen as base line material for the RF requirements in GSM 05.05. The documents are divided into several clauses

In each clause there is a short description of the documents. The documents themselves are annexed to this report.

A list of phase 2 change requests to SMG2 related documents are annexed to the SMG meeting reports.

3 DCS1800 system scenarios

There are two documents describing the basis of the DCS1800 RF requirements. They are:

- DCS1800 System scenarios (TDoc SMG 259/90, reproduced as TDoc SMG 60/91).
- Justifications for the DCS1800 05.05 (TDoc SMG 260/90, revised as TDoc SMG 60/91)).

These documents have been derived first by the UK PCN operators and later by GSM2 ad hoc group working on DCS 1800 requirements during 1990. The documents were presented to TC SMG in October 1990.

DCS1800 System Scenarios describes six scenarios which are considered to be the relevant cases for DCS1800. The six scenarios described are:

- Single MS - Single BTS.
- Multiple MSs - Multiple co-ordinated BTSs.
- Multiple MSs - Multiple uncoordinated BTSs.