3GPP TSG GERAN #36 **Tdoc GP-071743**
Vancouver, CA, 12-16 November, 2007 **Agenda 7.1.5.4**

Source: **Motorola, RIM, Samsung, Panasonic, Freescale**
Title: **On RED HOT B USF Detection by RED HOT A Mobiles**
Document for: **Discussion**

1. Introduction

It has been accepted as a working assumption in [1] that the RED HOT A mobile will be required to extract the USF from RED HOT B blocks, if feasible, in order to simplify USF multiplexing of RED HOT A and RED HOT B mobiles. Towards this end, a method has been proposed in [2] for the demodulation and decoding of the RED HOT B USF by the RED HOT A mobile. Simulation results indicate that this method will meet the USF performance specification for MCS 5-9. However, significant concerns remain with respect to the proposed requirement and solution, including the following:

i) the correctness of using the MCS 5-9 USF performance specification for RED HOT B USF detection by RED HOT A mobiles;

ii) the compatibility of the proposal with receive diversity capable (DARP Phase 2) RED HOT A mobiles;

iii) the lack of demonstrated need for such a requirement;

iv) the complexity associated with this requirement.

Overall, it is believed that the impact of this requirement on the RED HOT A mobile is not fully understood, nor has the need for such a requirement been established. Given the above concerns, the complexity associated with the proposal in [2] is not justified.

2. Performance Specification for RED HOT B USF Detection by RED HOT A Mobiles

Though never formally a working assumption, until recently it has been assumed that it would be sufficient if the same USF performance targets were used for RED HOT A and RED HOT B as were previously defined for MCS 5-9. However, in reviewing the current specification, the basis for such an assumption is unclear.

Currently, there are four types of USF transmissions used in GPRS/EGPRS. A separate USF encoding method is defined for each of the subsets CS 2-4, MCS 1-4, and MCS 5-9, while a fourth USF encoding method is defined solely for CS-1. The USF performance specification for CS 2-4, MCS 1-4, and MCS 5-9 can be found in Tables 1-5, which correspond to Tables 1a, 1c, 2a, 2c, and 2g in [3]. A few observations can be made with respect to these Tables:

i) In Tables 2, 4, and 5, it can be seen that the performance specification for a USF/MCS 5-9 BLER of 10^{-2} is always tighter than the performance specification for MCS-5 data with a BLER of 10^{-1}. The tables indicate that the USF performance specification is from 2.5 to 10 dB tighter than the performance specification for MCS-5 data.

ii) In Tables 1 and 3, it can be seen that with the exception of the TU1.5 nFH and TU3 nFH tests defined in Table 3, the performance specification for a USF/CS2-4 BLER of 10^{-2} is always at least as tight as the performance specification for CS-2 data with a BLER of 10^{-1}. For these two exceptions (2 out of a total of 20), the CS-2 performance specification for data is 3 dB tighter than the USF/CS2-4 performance specification. Other than these two exceptions, the USF/CS2-4 performance specification is 3 to 6 dB tighter than the performance specification for CS-2 data.

iii) In Tables 1 and 3, it can be seen that with the exception of the TU1.5 nFH, TU1.5 iFH, TU3 nFH, TU3 iFH, and the TU50 nFH (850/900 MHz only) tests defined in Table 3 (5 out of total of 20), the performance specification for a USF/MCS1-4 BLER of 10^{-2} is always at least as tight as the performance specification for MCS-1 data with a BLER of 10^{-1}. For three of these exceptions (TU1.5 iFH, TU3 iFH, and TU50 nFH), the MCS-1 performance specification for data is 0.5 dB tighter than the USF/MCS1-4 performance specification. For the two remaining exceptions (TU1.5 nFH and TU3 nFH), the MCS-1 performance specification for data is 5 dB tighter than the USF/MCS1-4 performance specification. Other than these five exceptions, the USF/MCS1-4 performance specification is 0 to 1.5 dB tighter than the performance specification for MCS-1 data.

Thus, in the current specification, whenever the same USF encoding method is used for multiple modulation and coding schemes, it is almost always true that the USF performance specification is at least as tight as the data performance specification for the lowest rate service using the given USF encoding method. In Tables 1-5, only 7 of the 70 USF performance specification values do not have this property.

The desirability of requiring the USF specification to be tighter than the data specification becomes clear if we consider the case in which the mobile receives its data and USF in the same slot. When the USF performance specification is tighter than the data specification, it will always be true that the USF error probability will be less than 10^{-2} whenever the data BLER is less than 10^{-1}. In the absence of such a requirement, this mobile station may be able to correctly decode the data, but may fail to correctly decode the USF. Thus, in order that the USF be reliably received when the USF and the data are transmitted in the same block, it seems that the USF performance specification should be tighter than the data performance specification. Following this argument, there should then be different USF performance requirements for RED HOT A and RED HOT B mobiles, with each having the requirement that the USF performance specification be tighter than the performance specification of the lowest rate data service using the given USF encoding method.

It has been argued that in the absence of a single “absolute” USF performance specification, a USF performance specification which is good enough for MCS 5-9 should be good enough for RED HOT B. However, the current USF performance specification seems designed to be consistent with an attempt to exceed the performance specification of the lowest rate data service using the given USF encoding method. As noted above, there is a clear advantage with such a requirement. For example, if MCS 5-9 did not satisfy this property, a mobile station capable of supporting MCS-5 with a BLER of less than 10^{-1} might find it necessary to fall back to MCS-4 in order to achieve the USF performance target of 10^{-2} when receiving data and USF in the same time slot.

The purpose of the proposed requirement that RED HOT A mobiles demodulate and decode the RED HOT B USF is to avoid the need to use RED HOT A modulation and coding schemes when simultaneously transmitting data to a RED HOT B mobile and USF to a RED HOT A mobile. With this objective, it can then be argued that it is necessary to define different performance targets for RED HOT A and RED HOT B mobiles when extracting the RED HOT B USF. If so, then it seems that the RED HOT A performance targets for RED HOT B USF detection should be based on the performance specification for the RED HOT A data. Specifically, if the objective is to ensure that there is no need to use RED HOT A modulation and coding schemes when simultaneously transmitting data to a RED HOT B mobile and USF to an RED HOT A mobile, then the RED HOT A performance target for RED HOT B USF detection should be set relative to the performance target for the lowest rate RED HOT A modulation and coding scheme, which is DAS-5. It currently seems that the performance of DAS-5 will be superior to that of MCS-5, though the performance of DAS-5 has not been fully characterized so that the appropriate performance targets are not known. However, if the performance target for RED HOT A extraction of the RED HOT B USF is not at least as tight as the performance specification for DAS-5, then it will be not be possible to use DBS 5-12 when simultaneously transmitting data to a RED HOT B mobile and USF to a RED HOT A mobile that is using DAS-5.

3. RED HOT B USF Detection by RED HOT A Mobiles with Receive Diversity (DARP II)

The method proposed in [2] for the A mobile to extract the USF from the B transmission does not consider diversity, and thus the complexity associated with the diversity implementation is unknown. For reasons which follow, it can be assumed that the complexity of RED HOT B USF detection for a RED HOT A mobile supporting MSRD will exceed the complexity of the method proposed in [2] by a factor of at least 2X, and possibly by as much as 4X. A direct extension of the method in [2] to receive diversity, if such a method were to exist, would result in a doubling of complexity. However, the increase in complexity may be much greater than this if it becomes necessary for the RED HOT A mobile to compute two equalizers for each burst – one for LSR and one for HSR. It should be noted that the method proposed in [2] for RED HOT A does not use an equalizer. However, for the RED HOT A mobile with MSRD, it may become necessary to use equalization in order to adequately detect the RED HOT B USF, and furthermore, it may be necessary to jointly train the equalizer coefficients assigned to the two antenna inputs. If a second equalizer must be jointly trained on each burst solely for the purpose of RED HOT B USF extraction, it seems reasonable to consider the possibility that the resulting complexity would exceed that for the for the proposal in [2] by a factor of 4X.

Alternatively, if the RED HOT A mobile with MSRD does not use both antennas to extract the RED HOT B USF, then the RED HOT A mobile cannot be multiplexed with a RED HOT B mobile. The reasoning behind this assertion can be seen if we recall that:

i) the mobile station signals that it is DARP Phase II capable to the network;

ii) the mobile station’s use of receive diversity is not under network in control, nor does the network know whether or not the mobile is using receive diversity.

Typically, the network determines how to send the USF information to a particular mobile by referencing its current modulation and coding scheme. For example, if a first EGPRS mobile is using MCS-5 for data, the network knows that USF information can be sent to this mobile using any MCS 5-9. If this mobile is subsequently uplink multiplexed with another EGPRS mobile using MCS-5 for data, then MCS-5 can be used to simultaneously send the data to the second mobile and the USF to the first mobile.

However, the situation is changed entirely if the EGPRS mobile were to operate in such a way that diversity is used when demodulating data, but diversity is not used when demodulating the USF. If the mobile were to operate in this way, then the mobile may be using MCS-5 for data, but may completely fail to extract the USF. From Table 2, it can be seen that the single antenna performance specification for MCS-5 data with the TU50 nFH channel at 900 MHz is -93 dBm. However, in Table 6, it can be seen that the comparable DARP Phase II performance specification for MCS-5 is -100 dBm (0 AGI and 0 antenna correlation). If the mobile is using receive diversity for data, its signal level at each antenna may be as low as -100 dBm. In contrast, the single antenna performance specification for USF/MCS5-9 is -97.5 dBm. Thus, while the MCS-5 data can be received if the signal level at each antenna is -100 dBm and receive diversity is used, the USF reliability will be insufficient if a single antenna receiver is used to demodulate and decode the USF because the performance specification is -97.5 dBm. The problem is much more severe in interference limited cases as can by seen by comparing the co-channel single antenna performance specification for TU50 nFH in Table 4 and the DTS-1 performance specification with DARP Phase II in Tables 8 and 9. Note that for MCS-5, the single antenna co-channel performance specification is 15.5 dB (Tu50 nFH, 900 MHz), whereas the performance specification for DTS-1 is -6.5 dB (900 MHz).

It has been noted that during the development of the performance specification for DARP Phase II that it was not deemed necessary to specify the performance of USF detection. However, this is presumably only because it was assumed that any improvement in data performance would be mirrored by a similar improvement in USF performance. Such an assumption is reasonable if the same diversity equalizer is used for the USF as is used for the data. As can be seen above, USF scheduling cannot be guaranteed to work properly if diversity is used for the data but not for the USF.

As the performance of DAS-5 has not been specified with DARP Phase II, it is not possible to set appropriate performance targets for A extraction of the B USF for an A mobile with receive diversity at this time.

4. The Need for USF A/B Multiplexing

In GERAN #35, it was agreed as a working assumption that a single pulse shape would be used for RED HOT B, and that this pulse shape would meet the existing spectral mask with implementation margin. If we refer to Figure 22 in [4] and Figure 6 in [5], the (approximate) throughput values in Tables 10 can be extracted for a TU3 iFH channel at 900 MHz. From Table 10, it is apparent that the throughput of RED HOT A is as good as or better than RED HOT B when Es/N0 is less than 30 dB. For Es/N0 in excess of 30 dB, RED HOT B provides an increase in the peak throughput which can be as large as 20%.

Table 10: Throughput Comparison for RED HOT A and B with aTU3 iFH Channel at 900 MHz (source [4] and [5]).

	Throughput (Kbps)	
Es/N0 (dB)	RED HOT A	RED HOT B (LGMSK)
10	6	5
15	21	20
20	32	30
25	45	42
30	59	63
35	77	99
40	93	115

At least two straightforward solutions exist for addressing for multiplexing RED HOT A and RED HOT B mobiles, and these are:

i) Use RED HOT A modulation and coding schemes to transmit data to the RED HOT B mobile whenever it is USF multiplexed with a RED HOT A mobile. In other words, the RED HOT B mobile operates as a RED HOT A mobile whenever USF multiplexed with a RED HOT A mobile.

ii) Use RED HOT B modulation and coding schemes to transmit data to the RED HOT B mobile except when it is necessary to simultaneously transmit USF information to a RED HOT A mobile. Only at such times will RED HOT A modulation and coding schemes be used to transmit data to the RED HOT B mobile.

Both of these solutions avoid the need for radio resource segregation, thus satisfying the system requirement with considerably lower complexity than the proposal in [2].

The first alternative would have no impact on the throughput of the RED HOT B mobile except when the Es/N0 for the RED HOT B mobile is greater than 30 dB (for the TU3 iFH channel). However, as the throughput of the RED HOT B mobile can exceed that of RED HOT A by as much as 20% when Es/N0 exceeds 35 dB, it is assumed that the second alternative would be the preferred solution. It should be noted that because the same turbo encoder is used for RED HOT A and RED HOT B, *there is no fundamental limitation that would prevent using RED HOT A for the retransmission of RLC blocks initially transmitted using RED HOT B, or vice versa*. With this solution, the RED HOT B modulation and coding schemes would be used for the RED HOT B mobile except when it is necessary to transmit USF information to a RED HOT A mobile. As a result, there would be a reduction in throughput (for the TU3 iFH channel) *only when both*

i) the signal-to-noise ratio Es/N0 of the RED HOT B mobile is in excess of 30 dB;

ii) the RED HOT A mobile is scheduled on the uplink and it is necessary to transmit a block to the RED HOT B mobile using the RED HOT A modulation and coding schemes.

At all other times, the throughput of the RED HOT B mobile is unaffected.

5. The Complexity of RED HOT B USF Detection by the RED HOT A Mobile

The algorithm proposed for detection of the RED HOT B does not have sufficient detail to fully evaluate the associated complexity, nor is any specific complexity estimate provided. However, a cursory review of the algorithm seems to indicate that the complexity of the algorithm would be on the order of 3 Mcps/slot, and thus it seems that the burden could be in excess of 12 Mcps for some multi-slot classes. As noted previously, an algorithm appropriate for use with a mobile station with receive diversity can be expected to increase this complexity by 2X to 4X, so that the complexity for a DARP II mobile would be from 6 to 12 Mcps/slot, and the complexity with multi-slot operation could be on the order of 24 to 48 Mcps. As these estimates are of the average increase in the loading of the DSP, the peak load increase associated with this requirement may be greater than these average estimates. With this additional loading on the DSP, it may become necessary to increase the speed of the DSP by increasing the supply voltage, and this will result in an increase in current drain. A more precise estimate of the complexity associated with the algorithm in [2] would require details such as the length of the channel estimates, the implementation of synchronization, the oversampling ratio, the required numerical precision, the DSP instruction set, and details of the associated memory interface.

The RED HOT B mobile will be highly complex as it must support multiple symbol rates on the downlink (and thus sampling and re-sampling), blind modulation detection over seven combinations of modulations and symbol rate, RED HOT A and RED HOT B modulation and coding schemes, and turbo decoding. In contrast, the RED HOT A mobile is able to exploit the benefits of higher order modulation and turbo codes without incurring the additional complexity associated with the higher symbol rate operation. As there seem to exist straightforward alternatives which will allow the efficient USF multiplexing of RED HOT A and B mobiles, there does not seem to be adequate justification for the addition of very significant complexity to the RED HOT A mobile with the requirement that the RED HOT A mobile demodulate and decode the RED HOT B

USF. As indicated in the figure on page 6 of [2], the complexity associated with this requirement is purely additive for the RED HOT A mobile.

During discussions during the last GERAN Ad Hoc meeting, it was claimed that if the RED HOT A mobile were required to implement the algorithm proposed in [2] there would be no increase on the cost of the mobile, especially since RED HOT A and B were to be implemented only in a new mobile. However, it should be noted that mobile vendors roadmap their hardware/software platforms across the various cost tiers years in advance. Any new mobile to be delivered in the next few years is already on such a roadmap. Presumably, one objective of the standardization process is to get the specification turned into product as soon as possible and at the lowest possible cost. The addition of unnecessary requirements will either result in delay or in an increase in the cost of the platform needed to deliver the required features.

6. Summary and Conclusions

Significant concerns remain with respect to the proposed requirement that the RED HOT A mobile be required to demodulate and decode the RED HOT B USF. At a minimum, these concerns include the following:

i) Appropriate performance targets for the RED HOT A mobile have not been defined (with or without receive diversity).

ii) No diversity algorithm has been proposed for extraction of the RED HOT B USF by the RED HOT A mobile. Without such an algorithm, RED HOT A mobiles with receive diversity cannot be USF multiplexed with RED HOT B mobiles in the proposed manner.

iii) There is currently no demonstrated need for this requirement, since straightforward solutions already exist within the standard for efficiently USF multiplexing RED HOT A and RED HOT B mobiles.

iv) The complexity associated with this requirement is potentially very significant in terms of algorithm development, DSP MIP's, and current drain.

Overall, it is believed that the impact of this requirement on the RED HOT A mobile is not fully understood, nor has the need for such a requirement been established. Given the above concerns, the very significant complexity associated with the proposal in [2] is not justified.

7. References

[1] GP-071048 "Proposed way forward for RED HOT and HUGE Version 2", source Ericsson, Freescale, InterDigital, Marvell, Motorola, Nokia, Nokia Siemens Networks, Samsung, TELECOM ITALIA S.p.A., TeliaSonera AB, 3GPP TSG GERAN#34.

[2] AHG1-070068, "Support of Common USF Multiplexing for RED HOT," source Nokia Siemens Networks and Nokia, GERAN1 RED-HOT HUGE Ad Hoc #2.

[3] 3GPP TS 45.005 V7.11.0.

[4] GP-071242, "Additional simulation results for RED HOT and HUGE," source Ericsson, GERAN #35.

[5] GP-071243, "Spectrum mask design for Higher Symbol Rate," source Ericsson, GERAN #35.

Table 1: (TS 45.005 Table 1a) Input signal level (for normal BTS) at reference performance for GMSK modulated signals

GSM 900 and GSM 850						
Type of channel		**Propagation conditions**				
		static	**TU50 (no FH)**	**TU50 (ideal FH)**	**RA250 (no FH)**	**HT100 (no FH)**
PDTCH/CS-2	dBm	-104(x)	-100	-101	-101	-99
USF/CS-2 to 4	dBm	-104(x)	-103	-104(x)	-104(x)	-104
GSM 900, GSM 850 and MXM 850						
Type of Channel		**Propagation conditions**				
		static	**TU50 (no FH)**	**TU50 (ideal FH)**	**RA250 (no FH)**	**HT100 (no FH)**
PDTCH/MCS-1	dBm	-104(x)	-102.5	-103	-103	-102
USF/MCS-1 to 4	dBm	-104(x)	-102.5	-104	-104(x)	-102,5
DCS 1 800 & PCS 1 900						
Type of channel		**Propagation conditions**				
		static	**TU50 (no FH)**	**TU50 (ideal FH)**	**RA130 (no FH)**	**HT100 (no FH)**
PDTCH/CS-2	dBm	-104(x)	-100	-100	-101	-99
USF/CS-2 to 4	dBm	-104(x)	-104(x)	-104(x)	-104(x)	-103
DCS 1800, PCS 1900 and MXM 1900						
Type of channel		**Propagation conditions**				
		static	**TU50 (no FH)**	**TU50 (ideal FH)**	**RA130 (no FH)**	**HT100 (no FH)**
PDTCH/MCS-1	dBm	-104(x)	-102,5	-103	-103	-101,5
USF/MCS-1 to 4	dBm	-104(x)	-104	-104	-104(x)	-102,5
NOTE 3: PDTCH/CS-4 and PDTCH/MCS-x can not meet the reference performance for some propagation conditions (*). NOTE 4 : The complete conformance should not be restricted to the logical channels and channel models identified with (x)						

Table 2: (TS 45.005 Table 1c) Input signal level (for MS) at reference performance for 8-PSK modulated signals

GSM 900 and GSM 850						
Type of channel		**Propagation conditions**				
		static	**TU50 (no FH)**	**TU50 (ideal FH)**	**RA250 (no FH)**	**HT100 (no FH)**
PDTCH/MCS-5	dBm	-98	-93	-94	-93	-92
USF/MCS-5 to 9	dBm	-102(x)	-97,5	-99	-100	-99
DCS 1 800 and PCS 1900						
Type of channel		**Propagation conditions**				
		static	**TU50 (no FH)**	**TU50 (ideal FH)**	**RA130 (no FH)**	**HT100 (no FH)**
PDTCH/MCS-5	dBm	-98	-93,5	-93,5	-93	-89,5
USF/MCS-5 to 9	dBm	-102(x)	-99	-99	-100	-99
Performance is specified at 30% BLER for those cases identified with mark **. NOTE 2: PDTCH for MCS-x can not meet the reference performance for some propagation conditions (*). NOTE 3: The complete conformance should not be restricted to the logical channels and channel models identified with (x).						

Table 3: (TS 45.005 Table 2a) Interference ratio at reference performance for GMSK modulated signals

GSM 900 and GSM 850						
Type of channel		**Propagation conditions**				
		TU3 (no FH)	**TU3 (ideal FH)**	**TU50 (no FH)**	**TU50 (ideal FH)**	**RA250 (no FH)**
PDTCH/CS-2	dB	15	13	14	13	13
USF/CS-2 to 4	dB	18	9	10	9	8
GSM 850, MXM 850 and GSM 900						
Type of channel		**Propagation conditions**				
		TU3 (no FH)	**TU3 (ideal FH)**	**TU50 (no FH)**	**TU50 (ideal FH)**	**RA250 (no FH)**
PDTCH/MCS-1	dB	13	9.5	10.5	9.5	10
USF/MCS-1 to 4	dB	18	10	11	9.5	9.5
DCS 1 800 & PCS 1 900						
Type of channel		**Propagation conditions**				
		TU1,5 (no FH)	**TU1,5 (ideal FH)**	**TU50 (no FH)**	**TU50 (ideal FH)**	**RA130 (no FH)**
PDTCH/CS-2	dB	15	13	13	13	13
USF/CS-2 to 4	dB	18	9	9	9	7
DCS 1800, PCS 1 900 and MXM 1900						
Type of channel		**Propagation conditions**				
		TU1,5 (no FH)	**TU1,5 (ideal FH)**	**TU50 (no FH)**	**TU50 (ideal FH)**	**RA130 (no FH)**
PDTCH/MCS-1	dB	13	9.5	10	9.5	10
USF/MCS-1 to 4	dB	18	10	9.5	9.5	9.5
Performance is specified at 30% BLER for those cases identified with mark **. NOTE 3: PDTCH/CS-4 and PDTCH/MCS-x cannot meet the reference performance for some propagation conditions (*).						

Table 4: (TS 45.005 Table 2c) Cochannel interference ratio (for MS) at reference performance for 8-PSK modulated signals

GSM 850 and GSM 900						
Type of channel		**Propagation conditions**				
		TU3 (no FH)	**TU3 (ideal FH)**	**TU50 (no FH)**	**TU50 (ideal FH)**	**RA250 (no FH)**
PDTCH/MCS-5	dB	19,5	14,5	15,5	14,5	16,5
USF/MCS-5 to 9	dB	17	10,5	11,5	9	9
DCS 1 800 and PCS 1900						
Type of channel		**Propagation conditions**				
		TU1,5 (no FH)	**TU1,5 (ideal FH)**	**TU50 (no FH)**	**TU50 (ideal FH)**	**RA130 (no FH)**
PDTCH/MCS-5	dB	19,5	14,5	15	15,5	16,5
USF/MCS-5 to 9	dB	17	10,5	10	9	9
Performance is specified at 30% BLER for those cases identified with mark **. NOTE 2: PDTCH for MCS-x can not meet the reference performance for some propagation conditions (*).						

Table 5: (TS 45.005 Table 2g) Adjacent channel interference ratio (for MS) at reference performance for 8-PSK modulated signals

GSM 850 and GSM 900						
Type of channel		Propagation conditions				
		TU3 (no FH)	TU3 (ideal FH)	TU50 (no FH)	TU50 (ideal FH)	RA250 (no FH)
PDTCH/MCS-5	dB	2.5	-2	-1	-2	1
USF/MCS-5 to 9	dB	-1	-8.5	-8	-9.5	-9
DCS 1 800 and PCS 1900						
Type of channel		Propagation conditions				
		TU1,5 (no FH)	TU1,5 (ideal FH)	TU50 (no FH)	TU50 (ideal FH)	RA130 (no FH)
PDTCH/MCS-5	dB	2.5	-2	-2	-1.5	1
USF/MCS-5 to 9	dB	-1	-8.5	-9	-9.5	-9
Performance is specified at 30% BLER for those cases identified with mark **. NOTE 1: NOTE 2: PDTCH for MCS-x can not meet the reference performance for some propagation conditions (*).						

Table 6: (TS 45.005 Table 1j) Input signal level at reference performance for Downlink Advanced Receiver Performance – phase II

GSM 900 and GSM 850					
		Propagation conditions			
		TU50 (noFH)		HT100 (noFH)	
		Corr. = 0; AGI = 0	Corr.=0,7; AGI=-6dB	Corr. = 0; AGI = 0	Corr.=0,7; AGI=-6dB
PDTCH CS-2	BLER (dBm)	-105,0	-101,5	-104,0	-100,0
PDTCH MCS-1	BLER (dBm)	-105,0	-103,0	-105,0	-101,0
PDTCH MCS-5	BLER (dBm)	-100,0	-97,0	-98,5	-94,0
NOTE: Performance is specified at 30% BLER for those cases identified with mark '**' NOTE: Performance is not specified for those cases identified with mark '-'					

Table 7: (Table 1j (Continued)) Input signal level at reference performance for Downlink Advanced Receiver Performance – phase II

DCS 1800 & PCS 1900					
		Propagation conditions			
		TU50 (noFH)		HT100 (noFH)	
		Corr. = 0; AGI = 0	Corr.=0,7; AGI=-6dB	Corr. = 0; AGI = 0	Corr.=0,7; AGI=-6dB
PDTCH CS-2	BLER (dBm)	-105,0	-101,5	-104,0	-100,0
PDTCH MCS-1	BLER (dBm)	-105,0	-103,5	-105,0	-101,0
PDTCH MCS-5	BLER (dBm)	-100,5	-97,5	-98,0	-93,5
NOTE: Performance is specified at 30% BLER for those cases identified with mark '**' NOTE: Performance is not specified for those cases identified with mark '-'					

Table 8: (TS 45.005 Table 2q) C/I1 ratio at reference performance for Downlink Advanced Receiver Performance – phase II

GSM 900 and GSM 850				
		Propagation conditions		
		TU50 (noFH)		
		Correlation=0; AGI=0 dB		
		DTS-1/DTS-1b Note1	**DTS-2**	**DTS-5**
PDTCH CS-2	BLER (dB)	-9,5	3,0	3,5
PDTCH MCS-1	BLER (dB)	-11,5	1,0	1,5
PDTCH MCS-5	BLER (dB)	-6,5	7,0	8,0
NOTE: Performance is specified at 30% BLER for those cases identified with mark '**' NOTE: Performance is not specified for those cases identified with mark '-' NOTE 1: DARP Test Scenario 1 (DTS-1) is similar to testing of co-channel interference for non-DARP receivers with essentially at least as stringent requirements under TU50noFH propagation conditions. DTS-1b utillizes an 8-PSK modulated interferer and is to be applied for MCS5-MCS9.				

Table 9: (TS 45.005 Table 2q (Continued)) C/I1 ratio at reference performance for Downlink Advanced Receiver Performance – phase II

DCS 1800 and PCS 1900				
		Propagation conditions		
		TU50 (noFH)		
		Correlation=0; AGI=0 dB		
		DTS-1/DTS-1b Note1	**DTS-2**	**DTS-5**
PDTCH CS-2	BLER (dB)	-9,0	3,0	3,0
PDTCH MCS-1	BLER (dB)	-10,5	1,0	1,0
PDTCH MCS-5	BLER (dB)	-6,0	6,5	7,5
NOTE: Performance is specified at 30% BLER for those cases identified with mark '**' NOTE: Performance is not specified for those cases identified with mark '-' NOTE 1: DARP Test Scenario 1 (DTS-1) is similar to testing of co-channel interference for non-DARP receivers with essentially at least as stringent requirements under TU50noFH propagation conditions. DTS-1b utillizes an 8-PSK modulated interferer and is to be applied for MCS5-MCS9.				