TSG-RAN Meeting #21 **RP-030457**
Frankfurt, Germany, 16 - 19 September 2003

Title: **CRs (Rel-5) to TS 25.213**

Source: **TSG-RAN WG1**

Agenda item: **7.2.5**

TS 25.213 **(RP-030457)**

RP Tdoc #	WG Toc#	Spec	CR	R	Subject	Phase	Cat	Curre	New	WI	Remarks
RP-030457	R1-030689	25.213	062	-	Clarification of 16QAM modulation description	Rel-5	F	5.3.0	5.4.0	HSDPA-Phys	

3GPP TSG-RAN WG1 Meeting #33 *Tdoc R1-030689*
New York, NY, USA, 25-29 August, 2003

CR-Form-v7

CHANGE REQUEST

⌘	25.213	CR	062	⌘ rev	-	⌘	Current version:	5.3.0	⌘

*For **HELP** on using this form, see bottom of this page or look at the pop-up text over the ⌘ symbols.*

Proposed change affects:	UICC apps⌘	[ ]	ME	[X]	Radio Access Network	[X]	Core Network	[ ]

Title:	⌘	Clarification of 16QAM modulation description		
Source:	⌘	TSG RAN WG1		
Work item code:	⌘	HSDPA-Phys	***Date:*** ⌘	2003-08-08
Category:	⌘	**F**	***Release:*** ⌘	Rel-5
		Use one of the following categories: ***F*** *(correction)* ***A*** *(corresponds to a correction in an earlier release)* ***B*** *(addition of feature),* ***C*** *(functional modification of feature)* ***D*** *(editorial modification)* Detailed explanations of the above categories can be found in 3GPP TR 21.900.		*Use one of the following releases:* *2 (GSM Phase 2)* *R96 (Release 1996)* *R97 (Release 1997)* *R98 (Release 1998)* *R99 (Release 1999)* *Rel-4 (Release 4)* *Rel-5 (Release 5)* *Rel-6 (Release 6)*

Reason for change:	⌘	The current description of the 16QAM modulation mapping leaves room for different interpretations of the desired behaviour, e.g. it is not specified how the serial-to-parallel conversion is operating.
Summary of change:	⌘	The description of the 16QAM modulation mapping is rewritten and the serial-to-parallel conversion is specified similar to the way it is specified for QPSK. The updated description does not change the originally intended behaviour.
Consequences if not approved:	⌘	UE/UTRAN implementations might differ in the serial-to-parallel conversion and might also have differing 16QAM modulation mappings leading to compatibility and interoperability problems.

Clauses affected:	⌘	5.1				
		Y	**N**			
Other specs affected:	⌘		X	Other core specifications	⌘	
			X	Test specifications		
			X	O&M Specifications		
Other comments:	⌘	**Isolated impact analysis:** This CR affects only the 16QAM modulation function used for HSDPA. The CR does not have impact on earlier releases than Rel5 or on UE/UTRAN that don't support 16QAM. The CR does have impact on UE/UTRAN implementations of the 16QAM modulation behaving other than specified in this CR.				

How to create CRs using this form:

Comprehensive information and tips about how to create CRs can be found at http://www.3gpp.org/specs/CR.htm. Below is a brief summary:

1) Fill out the above form. The symbols above marked ⌘ contain pop-up help information about the field that they are closest to.

2) Obtain the latest version for the release of the specification to which the change is proposed. Use the MS Word "revision marks" feature (also known as "track changes") when making the changes. All 3GPP specifications can be downloaded from the 3GPP server under ftp://ftp.3gpp.org/specs/ For the latest version, look for the directory name with the latest date e.g. 2001-03 contains the specifications resulting from the March 2001 TSG meetings.

3) With "track changes" disabled, paste the entire CR form (use CTRL-A to select it) into the specification just in front of the clause containing the first piece of changed text. Delete those parts of the specification which are not relevant to the change request.

5 Downlink spreading and modulation

5.1 Spreading

Figure 8 illustrates the spreading operation for the physical channel except SCH. The behaviour of the modulation mapper is different between QPSK and 16QAM. The downlink physical channels using QPSK are P-CCPCH, S-CCPCH, CPICH, AICH, AP-AICH, CSICH, CD/CA-ICH, PICH, PDSCH, HS-SCCH and downlink DPCH. The downlink physical channel using either QPSK or 16 QAM is HS-PDSCH. The non-spread downlink physical channels, except SCH, AICH, AP-ICH and CD/CA-ICH, consist of a sequence of 3-valued digits taking the values 0, 1 and "DTX". Note that "DTX" is only applicable to those downlink physical channels that support DTX transmission. In case of QPSK, these digits are mapped to real-valued symbols as follows: the binary value "0" is mapped to the real value +1, the binary value "1" is mapped to the real value –1 and "DTX" is mapped to the real value 0. For the indicator channels using signatures (AICH, AP-AICH and CD/CA-ICH), the real-valued symbols depend on the exact combination of the indicators to be transmitted, compare [2] sections 5.3.3.7, 5.3.3.8 and 5.3.3.9.

In case of QPSK, each pair of two consecutive real-valued symbols is first serial-to-parallel converted and mapped to an I and Q branch. The definition of the modulation mapper is such that even and odd numbered symbols are mapped to the I and Q branch respectively. In case of QPSK, for all channels except the indicator channels using signatures, symbol number zero is defined as the first symbol in each frame. For the indicator channels using signatures, symbol number zero is defined as the first symbol in each access slot. The I and Q branches are then both spread to the chip rate by the same real-valued channelisation code $C_{ch,SF,m}$. The channelisation code sequence shall be aligned in time with the symbol boundary. The sequences of real-valued chips on the I and Q branch are then treated as a single complex-valued sequence of chips. This sequence of chips is scrambled (complex chip-wise multiplication) by a complex-valued scrambling code $S_{dl,n}$. In case of P-CCPCH, the scrambling code is applied aligned with the P-CCPCH frame boundary, i.e. the first complex chip of the spread P-CCPCH frame is multiplied with chip number zero of the scrambling code. In case of other downlink channels, the scrambling code is applied aligned with the scrambling code applied to the P-CCPCH. In this case, the scrambling code is thus not necessarily applied aligned with the frame boundary of the physical channel to be scrambled.

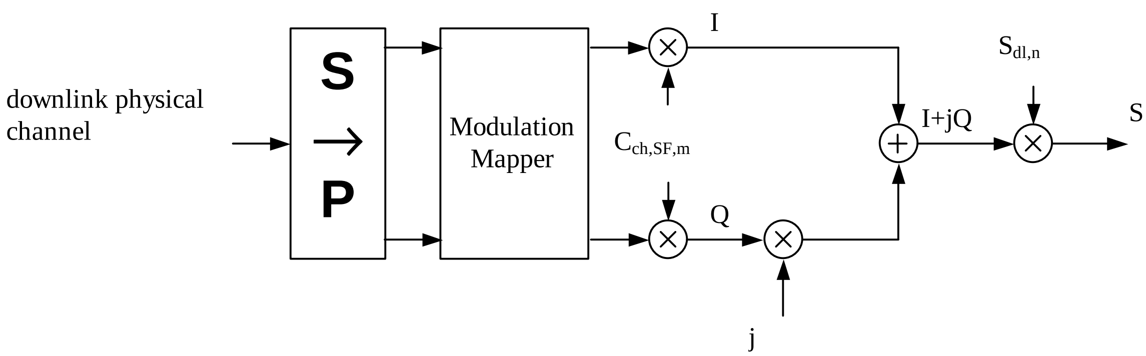


Figure 8: Spreading for all downlink physical channels except SCH

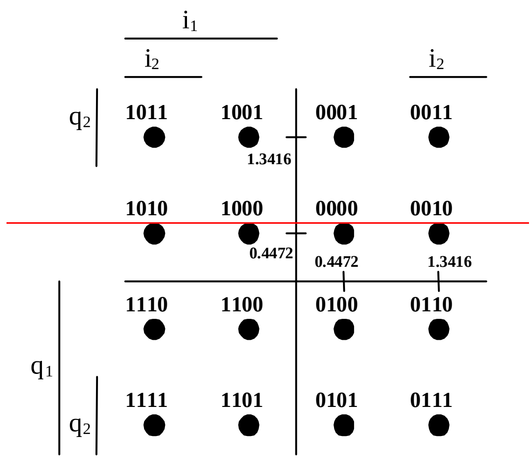
In case of 16QAM, a set of four consecutive binary symbols $n_k, n_{k+1}, n_{k+2}, n_{k+3}$ (with k mod 4 = 0) is serial-to-parallel converted to two consecutive binary symbols ($i_1 = n_k$, $i_2 = n_{k+2}$) on the I branch and two consecutive binary symbols ($q_1 = n_{k+1}$, $q_2 = n_{k+3}$) on the Q branch and then mapped to 16QAM by the modulation mapper as defined in table 3A. The I and Q branches are then both spread to the chip rate by the same real-valued channelisation code $C_{ch,16,m}$. The channelisation code sequence shall be aligned in time with the symbol boundary. The sequences of real-valued chips on the I and Q branch are then treated as a single complex-valued sequence of chips. This sequence of chips from all multi-codes is summed and then scrambled (complex chip-wise multiplication) by a complex-valued scrambling code $S_{dl,n}$. The scrambling code is applied aligned with the scrambling code applied to the P-CCPCH.

~~The serial to parallel conversion uses four bits which result in index bits allocated to I and Q according to table 3A. These index bits are mapped to the modulated constellation symbols as illustrated in figure 8A.~~

Table 3A: 16 QAM ~~index bits~~modulation mapping

$i_1q_1i_2q_2$	I branch	Q branch
0000	0.4472	0.4472
0001	0.4472	1.3416
0010	1.3416	0.4472
0011	1.3416	1.3416
0100	0.4472	-0.4472
0101	0.4472	-1.3416
0110	1.3416	-0.4472
0111	1.3416	-1.3416
1000	-0.4472	0.4472
1001	-0.4472	1.3416
1010	-1.3416	0.4472
1011	-1.3416	1.3416
1100	-0.4472	-0.4472
1101	-0.4472	-1.3416
1110	-1.3416	-0.4472
1111	-1.3416	-1.3416

~~I~~	~~0~~	~~1~~	~~2~~	~~3~~
~~b(i)~~	~~i_1~~	~~q_1~~	~~i_2~~	~~q_2~~



~~**Figure 8A: 16 QAM constellation**~~

Figure 9 illustrates how different downlink channels are combined. Each complex-valued spread channel, corresponding to point S in Figure 8, is separately weighted by a weight factor G_i. The complex-valued P-SCH and S-SCH, as described in [2], section 5.3.3.5, are separately weighted by weight factors G_p and G_s. All downlink physical channels are then combined using complex addition.

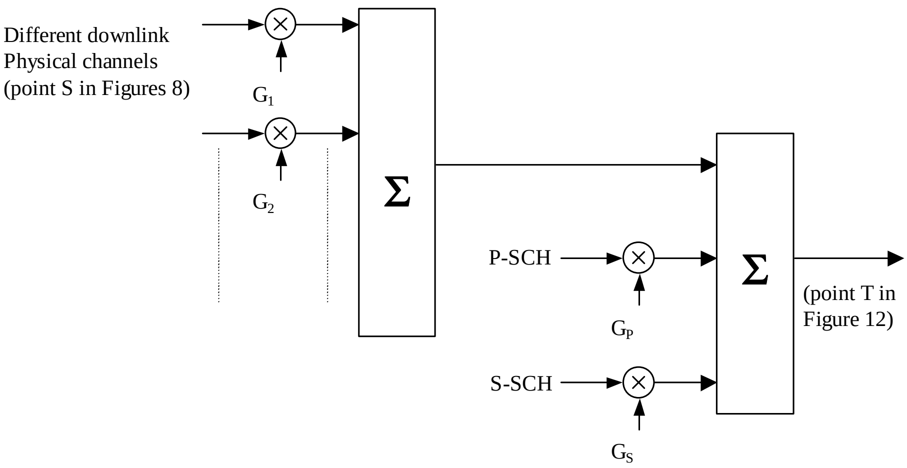


Figure 9: Combining of downlink physical channels