3GPP TSG RAN WG1 Meeting #7 *TSGR1#7(99)b99*
August 30- September 3 1999, Hannover, Germany

Source: **Mitsubishi Electric**

Title: **Compressed mode function in multiplexing chain**

Agenda item: **11**

Document for: **Discussion and decision**

1. Introduction

In Adhoc4 there were many e-mail discussion about coding and multiplexing chain for compressed mode, but current specification [1] does not include clear description. We think it is important that Adhoc8 also discusses on this issue in order to have common understanding with Adhoc4.

This document discusses where compressed mode function should be placed in coding and multiplexing chain. We propose to ask Adhoc4 for making clear description in TS25.212 considering the result of this discussion. We also propose to revise [1] related to compressed mode parameter considering current scheme of rate matching.

Because the frame formats for uplink compressed mode is under discussion, this contribution discusses mainly on downlink. This discussion would be useful when we consider on up link case.

2. Discussion

We should consider various kind of transmission types (fixed rate, variable rate with flexible position, with fixed position (BRD), etc.), and compress method (puncturing or SF reduction).

In normal mode, when TrCH combination is given, (semi-static) rate matching ratio is decided in order to realize mutual relationship of QOS required for every TrCH. Practically this rate matching is processed for every TTI (downlink) or every 10ms (uplink). (See Figure1 and Figure 2 of [1])

When compressed mode parameter (TGL, TGD, TGP, or pattern) is given, compress method (puncturing or SF reduction by 2) will be selected. In our understanding, this selection is decided by TGL and rate matching ratio corresponding to the maximum data rate of TrCH to be compressed. It should be noted that sometimes SF reduction by 2 would be used even TGL per frame is less than 4 or 3. So, if our understanding is correct, we should revise the table 7 in [1].

2.1 Fixed rate transmission

The rate matching block in coding chain could make additional rate matching for compressed mode. Because each (semi-static) rate matching ratio and data rate of TrCH is already fixed. This discussion would be Adhoc4 matter.

2.2 Variable rate transmission with fixed positions of service

For variable rate transmission, in addition to semi-static rate matching, additional processing is done according to data rate of each TrCH. DTX is applied for downlink with keeping semi-static rate matching. For uplink, dynamic rate matching by symbol repetition is applied for avoiding DTX transmission. If we try to compress by rate matching function, we should know all rate of TrCH to be compressed, with different TTI, or QoS and this would raise complexity.

2.2.1 Variable rate transmission with flexible positions service

The number of DTX bits is obtained at the receiver by detecting TFCI. So, we can use DTX bits of normal frame to make TG (Transmission Gap) for compressed frame. From this point of view, it would be reasonable way to consider the data compression function around 2nd interleaver.

(Puncturing):

Reference [2] discusses about DTX indication bit insertion after 2^{nd} interleaver. But output from 2^{nd} interleaver sometimes includes DTX indication bits for normal mode. So, we should distinguish data and DTX indication bits when we need puncturing. Consequently, it is reasonable to make puncturing before 2^{nd} interleaver.

For example,

Denote number of DTX insertion bits for normal mode by $NDTX_N$.

Denote number of DTX insertion bits required for compressed mode by $NDTX_C$

If $NDTX_N \geq NDTX_C$:
Without making additional puncturing, we can use DTX indication bits for TG of compressed frame. Remaining DTX indication bits are allocated at the end part of transmitted slots (fig.1). The number of this bits is approximately $(NDTX_N\text{-}NDTX_C)$/[15-TGL (per frame)]

If $NDTX_N < NDTX_C$:
Puncturing of transmitted bits by $(NDTX_C - NDTX_N)$ bits is needed. And there is no DTX bit in the transmitted slots (fig.2). Puncturing method is almost the same as section 4.2.6.3 in TS 25.212[1]

In order to make TG, we should gather DTX indication bits together within the TG. It is easy to realize this DTX gathering (or transmission symbol mapping into slot) function after 2^{nd} interleaver.

(SF reduction by 2):

We only need DTX gathering (or transmission symbol mapping into slot) function after 2^{nd} interleaver. It will include additional DTX at the end part of transmitted slot, because maximum TDL is 7slot, less than 7.5 slot.

2.3 Variable rate transmission with fixed position (BRD)

Without TFCI information, it is very difficult to use DTX indication bits of normal mode for TG of compressed frame. Because use of DTX indication bits for TG means to change the position of TrCH blocks depending on their dynamic rate.

The simple way to make puncture is not to treat DTX indication bits as the transmission bits. On the other hand, we can not use DTX bits of normal frame for TG of compressed frame. The Rate matching in each TrCH is parameterised according to the maximum bit rate case. So, we should use the SF reduction method to generate TG in almost all cases. Otherwise, we would have to keep margin when combination of TrCH and semi-static rate matching is used.

3. Proposal

Our proposal for compressed mode function in Multiplexing and coding chain is,

- To have two functions before and after 2^{nd} interleaver, as described below.
- Immediately before the 2^{nd} interleaver, there is a puncturing function to reserve DTX indication bit useful for TG of compressed mode. In case of SF reduction, this function will not be used. It would be possible that "insertion of DTX indication with flexible position" blocks in Figure 2 of [1] have additional function for compressed mode.
- Immediately after the 2^{nd} interleaver, there is a DTX gathering function to make TG (or function of transmit symbol mapping into transmitted slot) function. It would be possible that "Physical channel mapping" blocks in Figure 2 of [1] also have additional function for compressed mode.

4. Text proposal for 25.212(Section 4.4.2.1 and Table 7 in 4.4.3.2)

4.4.2 Transmission time reduction method

When in compressed mode, the information normally transmitted during a 10 ms frame is compressed in time. The mechanism provided for achieving this is either changing the code rate, which means puncturing in practice, or the reduction of the spreading factor by a factor of two.-The maximum idle length is defined to be 5 ms per one 10 ms frame.

4.4.2.1 Method A1: By puncturing, basic case

During compressed mode, rate matching (puncturing) is applied for making short transmission gap length in one frame. Algorithm of rate matching (puncturing) described in Section **Error! Reference source not found.** is used. The maximum transmission gap length allowed to be achieved with this method is the case where the code rate is increased from 1/3 to 1/2 by puncturing~~, which corresponds to 2 - 5 time slots per 10 ms frame~~, depending on the rate matching conditions that would be used in the non-compressed frame case. The explanation of the rate matching conditions are given below:

Example 1: If rate matching conditions in the non-compressed frame case would be such that maximum puncturing =0.2 would be used, then during compressed mode further puncturing of 1-(2/(3*(1-0.2))) =0.17 is allowed which corresponds to 0.17*16=2.7 => 2 time slots.

Example 2: If rate matching conditions in the non-compressed frame case would be such that no puncturing would be used, then during compressed mode puncturing of 1-(2/3)=0.33 is allowed which corresponds to 0.33*16=5.3 => 5 time slots.

4.4.3.3 Parameters for compressed mode

< Editor's note: WG1 suggestion is that there is need for further clarifications in Table 1 (e.g. rationales between change of coding rate/puncturing/change of spreading factor and idle time size, spreading factor range for different modes, etc.).>

Table 1 shows the detailed parameters for each number of idle slots. This is an example for the 10ms interleaving depth. Application of compressed mode for interleaving depths other than 10ms are for further study. Each number of idle slots are classified for three cases:

Case 1 - Power measurement : Number of idle slots = 3, 4, 5, 6.

Case 2 - Acquisition of control channels : Number of idle slots = 3, 4, 5, 6, 8, 10.

Case 3 - Actual handover operation : Number of idle slots = 10, 16.

Table 1: Parameters for compressed mode

<Editors note: Smallest spreading factor used in FDD is 4, thus modification needed for the table below>

Number of idle slots	Mode	Spreading Factor	Idle length [ms]	Transmission time reduction method	Idle frame combining
3	A	512 - 256	1.63 - 1.63	Puncturing Spreading facter reduction by 2	(S)/(D)
	B	128 - 4~~1~~	1.63 - 1.75		
4	A	512 - 256	2.25 - 2.25	Puncturing (D)/(S) ~~Coding rate reduction:R=1/3->1/2 (S)~~ Spreading facter reduction by 2(D)/(S)	
	B	128 - 4~~1~~	2.25 - 2.37		
5	A	512 - 256	2.87 - 2.87		
	B	128 - 4~~1~~	2.87 -2.99		
6	A	512 - 256	3.50 - 3.50	Puncturing (D)/(S) Spreading factor reduction by 2 (S)/(D)	
	B	128 - 4~~2/1~~	3.50 - 3.62		
7~~8~~	A	512 - 256	4.75 - 4.75	~~R=1/3->1/2(D)~~ Spreading factor reduction by 2 (S)	
	B	128 - 4~~2/1~~	4.75 - 4.87		
10	A	512 - 256	6.00 - 6.00	~~Coding rate reduction: R=1/3->1/2~~ Puncturing Spreading factor reduction by 2	(D)

	B	128 - 41	6.00 - 6.12		
1614	A	512 - 256	9.75 - 9.75	Puncturing Spreading factor reduction by 2	
	B	128 - 42	9.75 - 9.87		

(S): Single-frame method as shown in **Error! Reference source not found.** (1).

(D): Double-frame method as shown in **Error! Reference source not found.** (2).

SF=2/1:"2" is for (S) and "1" is for (D).

References

[1] 3GPP RAN 25.212 V2.0.1, Source: Editor

[2] 3GPP TSG R1#6(99) 878, "Insertion of DTX indication bits in downlink," Source: Nokia