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Agenda Item: 7
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Title: Text proposal for gating during compressed mode
Document for: Discussion and decision

Introduction

The current assumption regarding the use of gating and compressed mode is that higher layers would have to disable gating before initiating a compressed mode pattern sequence.

This has an impact on the power saving which can be achieved during gating, since the DPCCH would have to be transmitted continuously between each compressed mode transmission gap in a transmission gap pattern sequence. Thus according to the current assumption there could be a large number of non-compressed frames where gating is prevented.

RAN WG4 has sent a LS [1] to RAN WG1, encouraging the development of solutions which enable gating and compressed mode to be active at the same time.

The attached text proposal for the "Terminal Power Saving Features" technical report [2] shows one way in which gating could be used in conjunction with compressed mode, with consequent improvements in the power saving.

According to this method, the timing of compressed mode transmission gaps would be determined by higher layers in the usual way for compressed mode, enabling measurements to be carried out at the appropriate times.

During gating, compressed frames would be handled in a similar way to Embedded Data Periods. We introduce a new term "Embedded Compressed Mode Frame", to refer to a frame containing all or part of a compressed mode transmission gap, or a frame immediately following a transmission gap. In Embedded Compressed Mode Frames, gating is temporarily suspended by Layer 1, without any higher layer signalling. Inner loop power control is operated normally during Embedded Compressed Mode Frames.

Designating the frame after a transmission gap also as an Embedded Compressed Mode Frame enables the power control loop to converge correctly after each compressed mode transmission gap prior to the resumption of gating.

The operation of compressed mode during gating is shown in Figure 1.

An Embedded Data Period may or may not coincide with an Embedded Compressed Mode Frame.

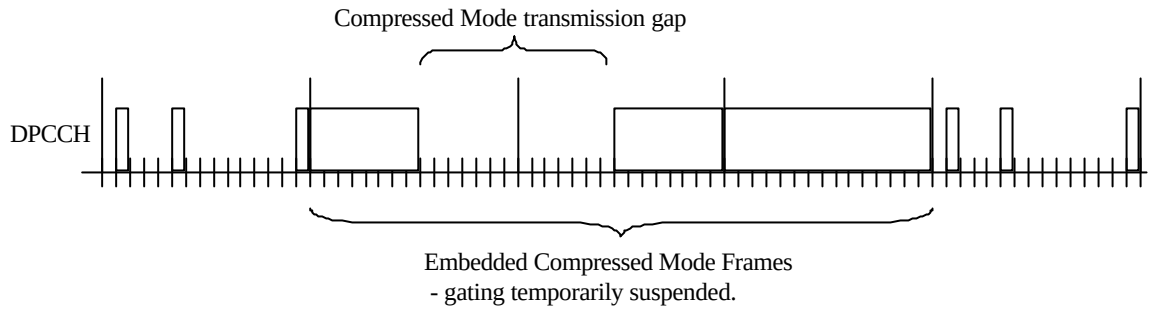

Figure 1: Example of Embedded Compressed Mode Frames during gating of rate 1/5

The power saving benefit of this proposal will obviously depend on how much compressed mode is used. The general advantages of this scheme include the following:

?? Unnecessary signalling to terminate gating before each transmission gap pattern sequence and to re-initiate gating afterwards is avoided;

?? The average duration of gating can be increased and terminal power consumption and interference can be reduced in the non-compressed frames between the transmission gaps in active transmission gap pattern sequences;

?? The timing of inter-frequency and inter-system measurements is not affected.

It might also be beneficial to suspend gating in the frame before each compressed mode transmission gap, in order to ensure that the power control is well converged immediately prior to the gap. However, this is not likely to be necessary even if a compressed mode transmission gap begins in slot #0 of a frame, because the gating reference patterns are arranged such that the DPCCH is always transmitted in the last slot of a frame.

Reference

[1] 3GPP R4-01-0194, “Response to LS (R1-01-0173) on impact of compressed mode on DPCCH gating benefits”, RAN WG4, Jan 2001

[2] 3GPP R1-01-0179, TR25.840v2.1.0 2001-01

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Text Proposal:

6.1.8 Operation with other Features

In this subclause, the required changes in operation of other features when the features are used with gating are investigated.

6.1.8.1 Transmit diversity

6.1.8.1.1 Open Loop Transmit Diversity

Since STTD encoding is performed for each time slot unit, there does not exist the case that four consecutive bits overlap a slot border. Thus, there's no impact by gating. For the convenience, STTD encoding of DL DPCH described in TS 25.211 is summarized as follows:

- The diversity antenna pilot bit pattern is obtained by STTD encoding only the pilot bits except the case that N_{pilot}=2.
- For N_{pilot} = 2, the diversity antenna pilot pattern is obtained by STTD encoding the two pilot bits with the last two bits (data or DTX) of the second data field (data2) of the slot.
- STTD encoding for the DPDCH, TPC, and TFCI fields is done as described in subclause 5.3.1.1.1 of TS 25.211.

The STTD encoding operation described above clearly reveals that there is no impact by gating.

6.1.8.1.2 Closed Loop Transmit Diversity

When the gating is turned on during closed loop transmit diversity, gating impacts uplink feedback signalling. For closed loop transmit diversity Mode 1, it will work without changes. For closed loop transmit diversity Mode 2, one possible solution is that during gating, Mode 1 is used instead of Mode 2 without explicit signalling. If the Mode 1 is used instead of Mode 2 during gating, the Tx diversity mode should return to Mode 2 without explicit signalling when the gating is terminated.

6.1.8.2 Compressed mode

During gating, compressed mode transmission gap pattern sequences may be active, as signalled by higher layers. If this is the case, certain frames are known as Embedded Compressed Mode Frames. An Embedded Compressed Mode Frame is any frame which contains all or part of an uplink or downlink compressed mode transmission gap, and any frame which immediately follows a frame containing all or part of an uplink or downlink compressed mode transmission gap, as shown in the example in Figure3.

The following actions shall be taken in each timeslot in each Embedded Compressed Mode Frame:

?? the UE shall turn on its transmitter except during uplink compressed mode transmission gaps;

?? the UE shall turn on its receiver except during downlink compressed mode transmission gaps;

?? the UTRAN shall turn on its transmitter except during downlink compressed mode transmission gaps;

?? both uplink and downlink TPC fields shall be updated except during uplink or downlink compressed mode transmission gaps.

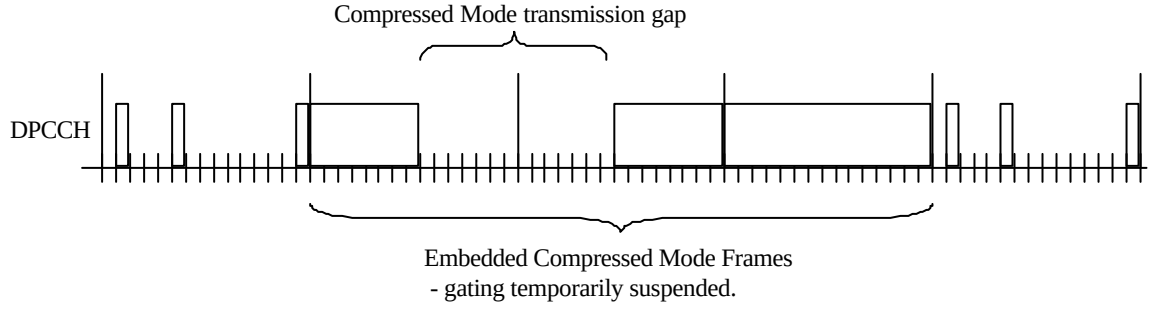

Figure 3: Example of Embedded Compressed Mode Frames during gating of rate 1/5

The UTRAN may therefore use the uplink TFCI to detect the presence of Embedded Data Periods during Embedded Compressed Mode Frames.

It is not necessary for higher layers to terminate gating before the start of a compressed mode transmission gap pattern sequence. The advantages of this are similar to the advantages of the Embedded Data Period which are noted in section 6.1.4.2. Firstly, unnecessary signalling to terminate gating before each transmission gap pattern sequence and to re-initiate gating afterwards is avoided. Secondly, the average duration of gating can be increased and terminal power consumption and interference can be reduced in the non-compressed frames between the transmission gaps in active transmission gap pattern sequences. Thirdly, the timing of inter-frequency and inter-system measurements is not affected.

Embedded Data Periods (see section 6.1.4.2) can be used to transmit reports of the measurements made in compressed mode transmission gaps as required by higher layers. ~~If the compressed mode is initiated during gating, gating shall be disabled by higher layer signaling before the compressed mode is initiated by higher layer signaling. It means that the gating should be terminated before inter-frequency and inter system hard handover. Furthermore, gating is never used during the compressed mode, i.e., during the compressed mode pattern is active.~~

6.1.8.3 Soft Handover

If any of the Node Bs in the Active set do not support gated transmission, gating shall be disabled. In other words, if a new radio link is setup during gating and the Node B of the newly added radio link does not support gating, then the gating shall be terminated.

6.1.8.4 SSDT

Gating shall be disabled by higher layer signaling when the soft handover is initiated with SSDT. The termination of gating and the initiation of SSDT can be performed by a single higher layer signaling message. Thus, no additional signalling is required.