TSG-RAN Working Group 3 ***TSGR3#6(99) 849***
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Agenda Item: 14.1

Source: Alcatel

Title: Proposal to remove the silence detection procedure in the user plane DCH FP (TS 25.427)

Document for: Decision

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1 Introduction

This document addresses the need for the silence detection procedure described in TS25.427 for the user plane DCH FP. This procedure has been included under the assumption that it would be useful for synchronisation purposes, and also in order to prevent errors in TFCI decoding in case of soft handover. The implementation of this procedure is quite complex, especially when several Iub transport bearers are multiplexed on the same physical channel, and also when the Iur is involved. Furthermore , it is explained below that there is no real need for this procedure in order to handle the synchronisation, and that this would also not always help solving errors in TFCI decoding.

Therefore it is proposed to remove this procedure, and alternative text is proposed in the data transfer procedure, to explain how the DCH FP shall cope with discontinuous data transmission.

2 Discussion

In Tdoc R3-518/99, the need for the silence detection procedure in downlink has been justified by the fact that, in case of soft handover, a Node B which would not receive correctly a data frame on the Iub would have a different TFCI value than the one(s) which have correctly received it. The UE could then not apply soft combining on TFCI. This argument is valid, but the alternative proposal that can be used with the silence detection does not solve this problem, and may even worsen it. Indeed, when the Node B knows that it has not received a valid data frame, it is proposed in Tdoc R3 518/99 that Node B suspends the transmission of the complete radio frame, which should be in fact the complete TTI. If the Node B does not transmit any DPCCH (no TPC bits), this may lead to an unacceptable degradation of uplink power control, so this is not recommended. If the Node B sends only the DPCCH, the UE will perform downlink power control with all the links involved in soft handover, thus requiring only the minimum transmitter power from each link to satisfy the QoS requirement, taking into account soft combining in the UE. If the radio link that has not sent the data actively contributes to the Active Set, the UE may then not be able to decode data contained in the other links.

In case several DCH with different QoS are multiplexed on the same CCTrCH, but are sent on separate AAL2 connections, if only one data frame is lost or delayed on the Iub, it is proposed in Tdoc 518/99 that the complete radio frame is not transmitted. If the UE is in soft handover, this may help, but it is not proved that it will be sufficient (see above). However if the UE is not in soft handover, the proposal from Tdoc 518/99 would imply that the data from other DCH are not transmitted, whereas nothing would have prevented their good reception in the UE.

As a conclusion, it is believed that the silence detection procedure would not permit to completely solve the issue mentioned in Tdoc 518/99, and is not worth being implemented only to solve it in a few cases. An alternative solution to handle the issue of having different TFCI values in soft handover is proposed : in case the Node B does not receive any transport block from the Iub, or does receive an incompatible combination of transport blocks (unknown TFC), it only transmits the DPCCH without TFCI bits. When the UE performs soft combining on TFCI bits from all radio links of its Active Set, it will automatically ignore the radio link which has not transmitted any TFCI. It is recognised that this proposal does also not solve the issues mentioned above in case the radio link without TFCI is a major one of the Active Set, but it is not worse than the proposal using silence detection, and has the merits to be far more simple.

The silence detection procedure is also supposed to help the synchronisation and timing adjustment procedures, as stated in TS 25.427. However, as it is currently defined in TS 25.427, the timing adjustment procedure requires the Node B to send a timing adjustment control frame, in case a data frame arrives outside the arrival window. If no data frame arrives, the Node B shall not send any timing adjustment control frame. Therefore the fact that data frames may not be sent at each transmission time interval shall not disturb the timing adjustment procedure.

However, there may still be a need to maintain some synchronisation frames between RNC and Node B in case of long silence period, so that timing alignment is not lost. This shall be handled through the sending of DL synchronisation frames, at the initiative of the RNC, according to the synchronisation accuracy requirements. On reception of these synchronisation frames, the Node B shall respond with an UL synchronisation frame.

Note that these synchronisation frames may also be used as keep alive frames on downlink, which permit the Node B and RNC to detect a link failure. A maximum keep alive timer shall be defined, and the RNC shall send at least one DL synchronisation frame before the expiration of this silence timer. If the Node B does not receive any frame (data or control) at the expiry of a corresponding timer, it shall perform a radio link failure procedure.

On the uplink, a similar mechanism shall be applied to detect radio link failure. However, the Node B is currently not allowed to send on its own some control frame for timing adjustment or synchronisation. Therefore, it is proposed to define a new control frame, called UL Keep Alive, that shall be sent each time the Node B has not sent any data or control frame at the expiry of a keep alive timer.

3 Change proposal to TS 25.427

Changes are proposed in sections 7.2, 7.2.1 and 8.

7.2 Control frame structure

…/…

DL synchronisation: DL synchronisation control frames are used to achieve and maintain the synchronisation of the DCH user plane accordingly to the synchronisation procedure. DL synchronisation control frames are also used as keep alive frames, in order to maintain activity on the radio link, as described in the data transfer procedure below.

Table below shows the structure of the payload when control frame is used for the user plane synchronisation. This control information is sent in DL only

NAME	DL Synchronisation
Parameters	CFN

7.2.1 Uplink control frame

UL Keep Alive : UL Keep Alive control frames are used to maintain some activity on the radio link in uplink, when any data or control frame has been sent during a given period. UL Keep Alive frames are sent in uplink only.

NAME	UL Keep Alive
Parameters	CFN : Indicates the frame number when the Node B has sent this control frame.

8 DCH FP procedures

8.1 Data transfer

Editor's Note: this chapter describes when and how often a DCH data frame is transferred. Handling of DTX and loss of synchronisation in Node B is described as well.

When there is some data to be transmitted, DCH data frames are transferred every transmission time interval between the SRNC and the Node B for downlink transfer, and between Node B and SRNC for uplink transfer.

At each frame, the Node B shall build the TFCI value of each CCTrCH, according to the TFI of the DCH data frames multiplexed on this CCTrCH and scheduled for that frame. In case the Node B does not have any data to transmit at one frame, or receives an unknown combination of DCH data frames, it shall transmit only the DPCCH without TFCI bits.

The SRNC may send DL synchronisation control frames to the Node B, in order to maintain the synchronisation. On reception of the DL synchronisation control frame, the Node B shall reply with a UL synchronisation frame, as described in the synchronisation procedure below.

The SRNC shall send at least one data frame or one DL synchronisation frame every $T_{KeepAliveTransmit}$. If the Node B does not receive any data frame or control frame at the expiry of $T_{KeepAliveReceive}$, it shall detect a radio link failure and perform a Radio Link Failure Indication procedure.

When the Node B does not have any data to transmit to SRNC, and has not sent any UL synchronisation control frame or Timing adjustment control frame at the expiry of $T_{KeepAliveTransmit}$, it shall send a UL Keep Alive control frame. If the SRNC does not receive any data or control frame from the Node B at the expiry of $T_{KeepAliveReceive}$, it shall detect a link failure.

8.2 Synchronisation

In synchronisation procedure the SRNC sends a DL SYNCHRONISATION control frame towards Node B. This message indicates the target CFN.

Upon reception of the DL SYNCHRONISATION control frame, Node B shall immediately respond with UL SYNCHRONISATION control frame indicating the ToA for the DL synchronisation frame and the CFN indicated in the received DL SYNCHRONISATION message.

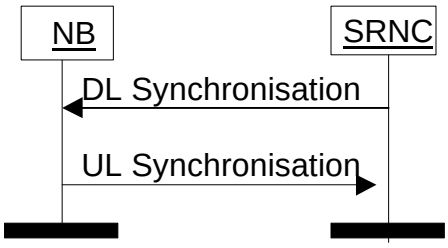

Figure 1. DCH Synchronisation procedure.

8.3 Timing adjustment

To keep the synchronisation of a DCH data stream SRNC includes a Connection Frame Number (CFN) to all DL DCH FP frames
If DL frame arrives outside the determined arrival window, node B should evaluate the time difference between the optimal arrival time for the DL DCH FP frame to be transmitted in the indicated CFN and the actual measured arrival time of the DL DCH FP frame (ToA: time of arrival).

Node B reports the measured ToA and the indicated CFN in one UL DCH FP control frame.

The arrival window and the time of arrival are defined as follows:

Time of Arrival Window Endpoint (ToAWE) : ToAWE represents the time point by which the DL data shall arrive to the node B from Iub. The ToAWE is defined as the amount of milliseconds before the last time point from which a timely DL transmission for the identified CFN would still be possible taking into account the node B internal delays.

(If data does not arrive before ToAWE a Timing Adjustment Control Frame shall be sent by node B.)

Time of Arrival Window Startpoint (ToAWS): ToAWS represents the time after which the DL data shall arrive to the node B from Iub. The ToAWE is defined as the amount of milliseconds from the ToAWE

(If data arrives before ToAWS a Timing Adjustment Control Frame shall be sent by node B.)

Time of Arrival (ToA) : ToA is the time difference between the end point of the DL arrival window (ToAWE) and the actual arrival time of DL frame for a specific CFN.

8.4 Outer loop PC information transfer

Editor's Note: this chapter describes when and how often an the outer loop power control information is transferred in a DCH frame, considering also the case when multiple DCH are associated to one UE.

SRNC modifies the Eb/No setpoint used by the Node B by including the absolute value of the new Eb/No setpoint in one control frame sent to the Node B's. This control frame can be sent via any of the transport connections dedicated to one UE.

~~**8.5 Silence detection**~~

~~For the DCHs characterised by discontinuous transmission, the Iub/Iur FP shall prevent the sending of unnecessary empty FP frames (frame with TFI indication zero bits in the TBS), but it must be ensured that the receiving end does not consider the missed reception of the frame as an transport error, resulting e.g. to incorrect timing adjustments in Iub/Iur DCH FP.~~

~~To handle these requirements, two different modes are defined in the receiving side of one FP connection (I.e. in node B for DL Iub/Iur DCH FP and in SRNC for UL Iub/Iur DCH FP):~~

~~1.N*ormal* mode~~
~~2.*Silent* mode.~~

~~If a FP frame containing a TBS is not received during a transmission time interval, the receiver shall act according to its mode:~~

~~**Normal mode:** If the receiver in *normal mode* does not receive an expected FP frame, it considers this as a transmission failure. As consequence, the TX-side – when the RX side is not known to be in silent mode – is mandated to send an FP frame for every Transmission time interval, even if the frames do not contain data (empty frame).~~

~~**Silent Mode:** If the RX side in *silent mode* does not receive an expected FP frame, it considers it as an empty frame. Thus the TX-side, when the RX side is known to be in *silent mode*, is not mandated to send empty FP frames.~~

~~All kind of frames can be sent both in normal and silent mode.~~
~~The FP provides the receiver side a mechanism to signal to the transmitting side the transition between modes as described in the following chapter.~~

~~8.5.1 Transitions between modes~~

~~Each DL /UL DCH FP frame contains silence indications, TRANSMIT SILENCE and RECEPTION SILENCE. The former indication is for transmitting direction and the latter for the receiving direction.~~

~~When silence detection is not used, both TRANSMIT SILENCE and RECEPTION SILENCE indications are off.~~

~~When transmitter (SRNC or Node B) wants to suspend the transmission of empty frames, it sets first the TRANSMIT SILENCE indication ON in all the transmitted frames (empty or non empty frames). When receiver (node B or SRNC) notices that the indication is set ON then it switches into the silent mode and notify this to transmitter setting the RECEPTION SILENCE indication ON in the frames going to the other direction (empty of non empty frames).~~

~~When transmitter notices that the receiver has reacted to the mode change (receives frame(s) with RECEPTION SILENCE indication on), it is not anymore forced to send empty frames.~~

~~When the transmitter decides to restore the normal mode (i.e. always transmit a frame in one transmission time interval), it switches the TRANSMIT SILENCE indication off in the transmitted frames. When the receiver in silent mode receives the first frame with TRANSMIT SILENCE indication off, it switches to normal mode, and sets its RECEPTION SILENCE indication off.~~

~~Note that:~~

- ~~The use of the silence detection for the DL need to be verified~~
- ~~The use of the silence detection in UL is FFS~~
- ~~Working assumption is that the TRANSMIT SILENCE and RECEPTION SILENCE bits are carried only by separate control frames, and the use of data frame is FFS.~~
- ~~In silence mode there shall be some keep alive frames (empty frames sent with a certain periodicity)~~

4 Conclusion

It is proposed to include changes proposed in section 3 of this document into TS 25.427.

5 References

[1] TS 25.427 version 0.3.1, July 1999