

Agenda item:

Source: Ericsson

Title: CR 25.214-033: Uplink TX timing adjustment

Document for: Decision

1 Introduction

It was concluded at WG1#7, that there should be two methods to cope with timing adjustments due to UE movement, clock drift, etc:

1. Adjusting the TX timing in the UE. This has so far only been accepted for the case when the UE is not in soft handover or in soft handover with cells that all are known to have the same timing reference.
2. Adjustment of TX timing in the Node B. This should be based on feedback from the UE when such adjustment is needed.

However, the two methods are still not fully specified as will be shown in the following sections.

2 Adjusting the TX timing in the UE

We believe that the UE shall always be allowed to change its TX timing, i.e. also in the normal soft handover case, where no common timing reference is used for the cells.

The reason is that if the UE gets problems with its TPC loop because the links' timing is drifting, then it has to drop the link that gives the UE the problem. That link may very well be the best (strongest) link. If the UE instead was allowed to shift its TX timing so that the best link was kept at all times, then the quality the UE sees will be better. Of course, the shifting of timing might force another link out of the receiving window, but that link should then be the weakest one.

Also, to our understanding, the WG4 discussions have not been limited to the non-soft handover case.

Finally, the UE clock has much worse stability than the network's clock. In general, one should avoid using the system's worst clock to control the data transport in the network, since this will lead to increased number of frame slips. The UE shall, in all cases, adjust its timing to that of the network. In effect, this means that the UE shall try to cope with the receive timing to as large extent as possible (by shifting its uplink TX timing), and to only order adjustments of downlink timing when really needed. If the UE in soft handover is not allowed to shift its TX timing, this will lead to increased need of shifting the downlink timing instead. This is a much more complicated procedure, and costs signalling capacity.

3 Adjustment of TX timing in the Node B

Adjustment of TX timing in Node B of the downlink shall be triggered by a UE report that it has problems with the received timing. While WG1 agreed to use this technique at WG1#7, up to now there has been no text proposed for the specifications that indicate that this signalling from the UE to network exist.

Although the signalling message itself of course is outside the scope of WG1, it would be good to have some mentioning in the WG1 specifications that L1 shall detect when radio links are drifting too far away from the

optimum reception time. It is up to WG4 to define exactly the criteria when such a message shall be sent to the network.

4.3.3 With existing uplink dedicated channel

The assumption for this case is that there already exist DPCCH/DPDCHs in the uplink, and a corresponding dedicated physical channel shall be set up in the downlink. This corresponds to the case when a new cell has been added to the active set in soft handover and shall begin its downlink transmission.

At the start of soft handover, the uplink dedicated physical channel transmitted by the UE, and the downlink dedicated physical channel transmitted by the soft handover source cell continues transmitting as usual.

The synchronisation establishment flow upon intra/inter-cell soft handover is described in figure 2.

- a) The UE starts the chip synchronisation establishment process of downlink channels from the handover destination. The uplink channels being transmitted shall continue transmission as before.
- b) UTRAN starts the transmission of the downlink DPCCH/DPDCH at a frame timing such that the frame timing received at the UE will be within $T_0 \pm [148]$ chips prior to the frame timing of the uplink DPCCH/DPDCH at the UE. UTRAN then starts the synchronization establishment process of the uplink DPCCH/DPDCH transmitted by the UE. Frame synchronization can be confirmed using the Frame Synchronization Word. Successful frame synchronization is confirmed and reported to the higher layers when S_R successive frames have been confirmed to be frame synchronized. Otherwise, frame synchronization failure is reported to the higher layers.
- c) Based on the handover destination CPICH reception timing, the UE establishes chip synchronisation of downlink channels from handover destination cell. Frame synchronization can be confirmed using the Frame Synchronization Word. Successful frame synchronization is confirmed and reported to the higher layers when S_R successive frames have been confirmed to be frame synchronized. Otherwise, frame synchronization failure is reported to the higher layers.

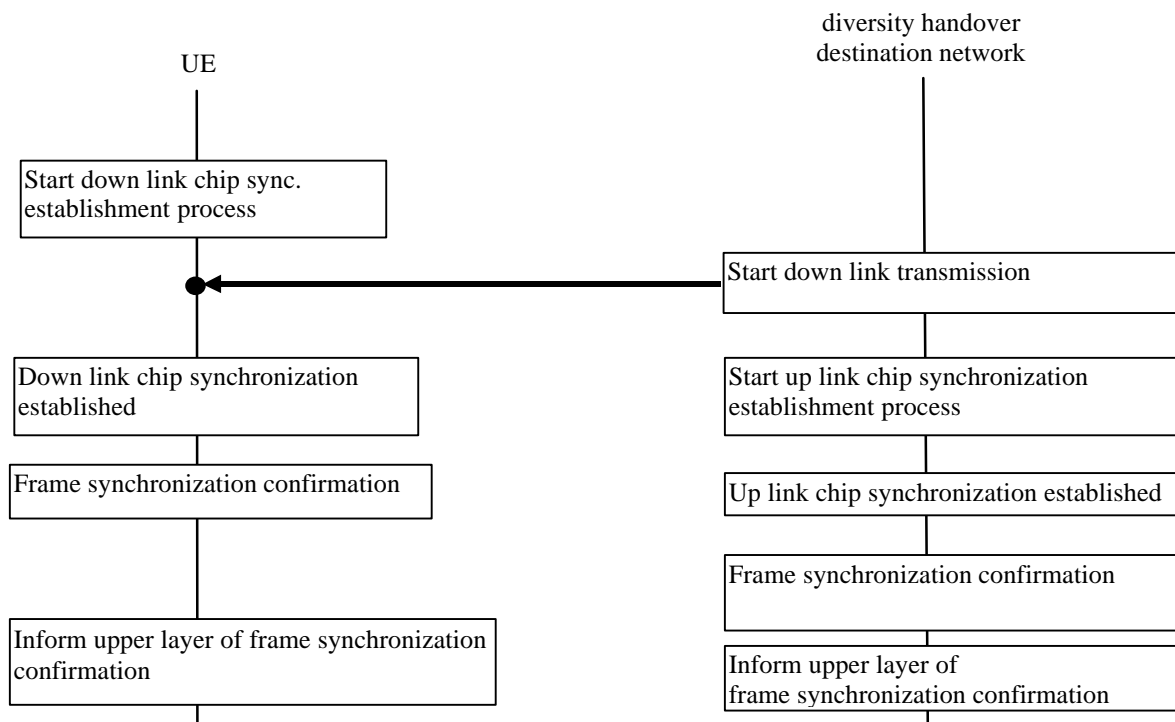


Figure 2: Synchronization establishment flow upon intra/inter-cell soft handover

4.3.4 Transmission timing adjustments

During a connection, ~~in some cases the UE is allowed to change its transmission timing. When the UE is not in soft handover or in soft handover with cells that all are known to have the same timing reference, the UE may adjust its DPDCH/DPCCH transmission time instant. <Note: maximum rate of the adjustment should be specified in R4> Otherwise, the UE may not adjust its DPDCH/DPCCH transmission time instant.~~

If the receive timing for any downlink DPCCH/DPDCH in the current active set has drifted, so the time between reception of the downlink DPCCH/DPDCH in question and transmission of uplink DPCCH/DPDCH lies outside the valid range, L1 shall inform higher layers of this, so that the network can be informed of this and downlink timing can be adjusted by the network.

Note: The maximum rate of uplink TX time adjustment, and the valid range for the time between downlink DPCCH/DPDCH reception and uplink DPCCH/DPDCH transmission in the UE is to be specified by RAN WG4.