TSG-RAN Working Group 1 meeting #14 **_R1-00-0890_**
Oulu, Finland
July 4th to July 7th , 2000

Agenda item: Release 2000 issues
Source: Nokia
Title: Remarks on the proposal for the improved cell RACH/FACH state
Document for: Discussion (RAN WG1), Information (RAN WG2)

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1. Introduction

In the last TSG RAN WG1 meeting Tdoc 678 (WG1 number) was submitted to TSG RAN WG1 and WG2 to clarify the issues. As the document was not covered in the actual meeting but still answered via the WG1 reflector, this provides an update of the documents with remaining issues that would need to discuss. The original questions and their answers are provided in Annex as it is felt that reviewing them will give some more insight what is the proposed method actually..
(The part with the revision marks is the answers provided by GBT to the issues via the reflector)

Some new items or issues needing clarification are pointed out in this paper.

1. The simulation cases:

As discussed in the reflector, for the downlink simulations TX power should be used instead of RX power. Preferable similar assumptions should be used than with TX diversity work to allow cross-checking of the results and later potential comparison with other proposed methods (if such methods emerge).

The large interleaving lengths as 80 ms are not going to be very practical as they basically mean that the FACH is reserved for 80 ms for a single UE only (otherwise TPC can not be applied)

Interesting comparison case is the overhead in the uplink with current RACH/FACH state, assuming e.g. a single acknowledgement in the uplink after each packet (stream) in the downlink.

2. Delay with the operation assuming a single retransmission.

With the TCP/IP traffic model it is worth noting what is the delay for operation before TCP level retransmission is initiated. If the TCP timer value is exceeded then (IP) core network will assume that packet was lost and will resent the packet. If the timers are set very long on the otherhand will deteriorate the end user quality of service. The TCP timers are adaptive and will slowly adopt to the radio characteristics, thus the protocol will work but relative delay is interesting to account in the comparison.

What is then worth comparing is the delay with a single retransmission with the proposed scheme for a small amount of packets that could be sent during a few frames.

The delay will consist then of the following issues:
a) RNC scheduling delay
b) FACH procedure delay (including UE processing and CPCH set up etc.)
c) These both for the retransmission
d) Additionally the Iub delay and BS processing

Lets compare the delay elements between the current FACH/RACH and the proposed FACH/RACH with "FACH paging"

Delay "element"	Current	Proposed
RNC scheduling	Traffic dependant, zero if no other traffic	Requires considering the traffic that has been scheduled a priori with two step FACH procedure. Let's assume the same value added as is needed for FACH procedure (Advance in the scheduling required)
FACH procedure delay (from the start of the FACH message to the start of the acknowledgement transmission in the uplink)	FACH message duration plus processing at UE	First FACH message duration and UE processing + second FACH message duration + UE processing
Retransmission	As above	As Above
BS processing	Not considered at this point	Not considered at this point (additional memory and processing needed though if Iub delay is not constant)
Iub Delay	Assume 100 ms roundtrip	The currently

With the above table the value for the current method for s single retransmission becomes:

0 ms (assumed traffic equal to the FACH capability, excluding processing)
160 ms (FACH decoding, protocol processing, start up of RACH TX+ RACH procedure)
160 ms (retransmission procedure as above)
100 ms Iub delay (roundtrip) for first TX
100 ms Iub delay for second TX
+--------------------
Total of approximately 500 ms

With the above table the value for the proposed method for s single retransmission becomes:

160 ms (assumed traffic equal to the FACH capability, + 160 ms advance scheduling to compensate the UE processing delay, RNC processing excluded)
160 ms (assumed traffic equal to the FACH capability, + 160 ms advance scheduling to compensate the UE processing delay) for scheduling of second retransmission
320 ms (1st FACH decoding, protocol processing, start up of CPCH TX+ procedure, 2nd FACH decoding, protocol processing, RACH or CPCH procedure for acknowledgement)
320 ms (retransmission procedure as above)
100 ms Iub delay (roundtrip) for first TX
100 ms Iub delay for second TX
+--------------------
Total of approximately 1200 ms

With the mentioned assumptions the QoS with proposed method is reduced due to the increased delay. Further if IP based transport is used on the Iub, the delay jitters needs to be compensated with additional buffer for the proposed method since the scheduling message on FACH is tied to the particular SFN.

The resulting delay values are not the full story as the IP network itself has varying delay characteristics that add to the total delay in addition to the one generated by the radio interface operation.

Thus if there is gain it comes at cost as well. It is then worth noting that Release –99 terminals will have better QoS in cell RACH/FACH state compared to Release 2000 terminals having support for this feature.

Interesting comparison aspect is then what is the difference to a dedicated channel set up delay when comparing to this and then what are the achieved benefits actually when compared to the dedicated channel operation.

Conclusions:

Conclusions are to be drawn of ther the discussion of this and other items raised on the reflector. It is woth noting that some decision is needed at the WG1 meeting #15 at the latest. It is to be noted that TSG RAN WG2 is also the leaving WG on the issue and outcome needs to be coordinated together with TSG RAN WG2.

Annex 1: The Comments to the Questions in R1-00-0678 (Comments from GBT are indicated with revision marks)

2. Comments on the fast power control benefits and simulation results.

a) Fast power control seems to be evaluated against non-power controlled case with continuous operation. As this is not the case with FACH, the results as such are of no relevance.

(1) The new results with bursty case are presented in this meeting. Note that using CPCH, there is a 5 ms power control preamble that helps with the convergence as well.

For a single packet (frame) on FACH, comparison needs to be made with total required signalling with and without fast power control, In this case single packet is better without fast power control as with fast power control there needs first to be a transmission with "paging" type of information (without fast power control to initiate CPCH operation in the uplink. For this:

- What is the interference generated in the uplink only for this? (as only downlink is simulated)

(2) One reserved PCPCH channel operating at the lowest SF [256 or possibly 512]. So the total generated interference is either 16 kbps or 8 kbps for a FACH operating at a very high rate. In the downlink ,there is an 8 kbps DL-DPCCH associated with uplink PCPCH.

The key is that the PCPCH will only last during the FACH downlink transmission.

- What is the cut of "difference" for total number of frames on FACH before closed loop power control bring gains? It should be obvious that a single frame FACH is better without power control when considering all the overhead coming from: FACH "paging", CPCH (both uplink and downlink), channels needed to support extra CPCHs (CSICH etc,)

(3) The gain for 10 ms, 20 ms, 40 ms and 80 ms bursts are shown in a GBT contribution. Even at 10 ms and 64 kbps, there is a close to 2 dB gain at BER of .005. Again, the CPCH overhead in DL and UL is only 8 kbps (DL) and 16/8 kbps? (UL).

The paging can be done at the lowest possible rate [SF=256] on FACH. Support for TFCI is required to support CLPC FACH.

Given the above, there should be a 64 kbps cut-off for clpc on FACH. Since going to lower rates and 10 ms will mean a comparable size uplink and downlink overhead.

It is also worth noting as mentioned in last WG1 that some generic assumption like power control dynamic range correspond (60 dB?) to the uplink case rather than the downlink case.

(4) The new results for 40 dB and 20 dB dynamic ranges are presented in this meeting.

3. Questions on the proposal itself:

b) What is the minimum and max delay required between FACH "paging" and actual packet on the FACH? What does the calculated delay consist of (UE processing, CPCH procedure, Node B-RNC delay etc.)? Are CPCH procedure error events included?

(5) The scheduling delay is deterministic and includes the:

1. UE processing
2. CPCH Access Ramp up
3. CD phase
4. pre-data power control

Note that 1 or more PCPCH channels are reserved for this purpose and there is no contention in this phase.

Also the scheduling time, the UE id, and the pcpch access preamble are sent on the scheduling message.

τ_{CLPC} = (Nap_retrans_max + 1)τ_{next_slot} + 5.28msec,
where τ_{next_slot} = Time to next available access slot, between Access Preambles.
= 3.75ms + 1.25ms X Tcpch (CPCH timing parameter)

Note that this is equivalent to:
τ_{CLPC} = [max period from first AP to start of PCP] + [8 slot length PCP]

Figure 1 below shows an overview of the CLPC FACH timing between the Node B and the UEs.

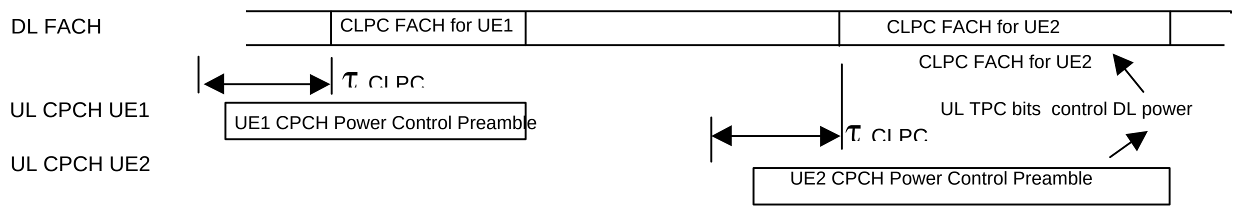

FIGURE 1. CLPC FACH Timing.

c) Where are the packets buffered in the meantime and what is the buffer size needed?

(6) Controlling RNC allocates the capacity, i.e, the power. However, the delay on the Iur-Iub interface Node B-RNC is statistical specially at higher loading condition. So it is proposed to buffer the packets in Node B.

Once the Node B, responds to the pcpch access preamble, it has received the confirmation that the UE has successfully established the PCPCH in UL and DL for the FACH transmission.

Buffer size TBD

d) If in the RNC, is then the uplink CPCH maintained over (100 ms?) just for a single 10 ms packet?

NA

e) What is the amount of bits needed to tell UE the necessary parameters for closed loop FACH reception?

(7) The UE scheduling message includes the following:

1) the UE ID (e.g. CRNTI) addressed in this segment of the CLPC FACH,
2) the SFN# for the beginning of the CLPC FACH segment,
3) the duration of the CLPC FACH segment in frames.
4) Identification of the PCPCH to be used for this segment

4. Questions on System issues:

a) Is there a need to be PCPCH always reserved for FACH with closed loop power control? Or multiple ones? If more than one then how many? How many extra receivers are needed for CPCH in Node B for a single FACH with CPCH? (With and without existing CPCH traffic)?

(8) It is required to have a minimum of one PCPCH transceiver in the Base Node for this purpose ONLY (with or without CPCH traffic) which is reserved for the Downlink FACH transmission. It is worthwhile to do so if the capacity gain in the downlink is by a factor of 1.4-2 and the FACH transmission is rates 64 kbps or higher. At the lower rates the gain diminishes.

If the CLPC FACH traffic in interleaved with normal FACH, then only one code
UTRAN schedules the CLPC portions of the FACH with the constraint that each CLPC FACH segment must be separated by a minimum period equal to τ CLPC if there is only one associated PCPCH. This period permits the UE which is to receive the following segment to access the associated CPCH channel in order to establish closed loop power control with the Node B. If there are more than one associated PCPCH, then UTRAN alternates use of these PCPCHs so that CLPC FACH segments may be transmitted contiguously.

b) If uplink is congested, does this prevent FACH transmission on the downlink (when CPCH procedure fails due to a interference peak in the uplink)

(9) As mentioned above one PCPCH access resource is reserved for this purpose only. So, there is no contention.

If the uplink interference is so high that the access preamble is not heard at all after maximum number of ramp-ups, then the cell is overloaded.

In that case the FACH transmission should continue even if the Base Node has not heard the preamble [confirmation from the UE].

c) Are there impacts for the functional split between RNC and Node B? The earlier raised issue was where are the packets stored before CPCH procedure has success?

See above.

d) If RNC controls the FACH usage (message contents), how does RNC know when CPCH has been released or whether it was free when FACH message was generated in RNC? (if the same CPCH resource pool is shared for CPCH operation)

(10) NA. The resource should be reserved for this purpose.

e) What is the impact for PCH/FACH scheduling?

(11) Need further clarification on this question.

For UEs in the PCH state, UTRAN shall transmit paging messages to alert UEs of forthcoming DL FACH messages which may use CLPC FACH. Upon receipt of an alert for a forthcoming DL FACH message, the UE shall transition to Cell-FACH state and use the procedure described here for receipt of CLPC FACH. The UTRAN must schedule the paging alert for CLPC FACH sufficiently early to permit the UE time to transition to Cell-FACH state, receive the CLPC FACH schedule, and access the associated PCPCH channel before the beginning of the scheduled CLPC FACH segment.

If the FACH is interleaved for usage of PCH traffic and CLPC FACH traffic then, there should be a coordination in assigning the specific SFNs for either purpose.

5. **Conclusions:**

This contribution is intended to point out the issues where further clarifications would be needed before some evaluation of the benefits of the proposed modification for UTRA FDD cell RACH/FACH state could be done. It is to be noted that most of the issues are of the responsibility of RAN WG1 but it was felt useful to have visibility of the raised questions to RAN WG2 as well. Thus this paper is submitted to both RAN WG1 and RAN WG2 with the expectation that (most of) the discussion is to take place in RAN WG1.