TSG RAN WG 1#14 **TSGR1#14(00)916**
Oulou, Finland
4-7 July, 2000

Agenda item: **?**
Source: **Golden Bridge Technology**
Title: **CLPC on FACH: Responses to Nokia Questions**

Document for: **Discussion**

GBT responses are shaded in yellow below

TSG-RAN Working Group 2 meeting #13 ***R2-001100***
Oahu, Hawaii, USA
May 22nd – 26th, 2000

Agenda item: Release 2000 issues
Source: Nokia
Title: Questions and comments on the proposed Improved Common DL Channel for Cell FACH State
Document for: Discussion (RAN WG1), Information (RAN WG2)

---

1. Introduction

In the last WG1 meeting the proposal of the improved FACH/RACH state operation was made with the intention to enable fast power control with FACH operation. In order to properly judge the proposal and the implication for UTRAN, several open items are noted in this paper. Furthermore the motivation with the simulation results shown in RAN WG1 or RAN WG2 is not necessary presenting the actual solution proposed.

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 more correct model for analysing benefits on the FACH is a bursty model, with radio frames addressed to different UE's multiplexed and broadcast on a continuous FACH channel. The new results with bursty case are presented in R1-00625. Note that using CPCH for CLPC, provides a 5 ms power control preamble that provides closed loop power level convergence before the beginning of the FACH frame which is to use CLPC.

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]. So the total generated interference is either 15 kbps for a FACH operating at a very high rate. This uplink CPCH is used only during those FACH segments selected for CLPC.

If, for instance an average FACH would have 20% of its downlink traffic addressed to individual UEs and selected for CLPC, then the UL interference for the CPCH providing CLPC would be 15 kbps x .2 = 3 kbps average. The PCPCH only lasts during the FACH CLPC segment 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 R1-00625. 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 15 kbps (DL) and 15 kbps? (UL) used only during transmission of the CLPC FACH.

The downlink scheduling for CLPC FACH would require approximately 20 bits for each message which schedules a single CLPC FACH segment. Each CLPC FACH segment may use multiple contiguous frames, but the worst case for overhead computation is to assume a CLPC page message for each frame. In this case the CLPC paging messages will require 2kbps.   So the total overhead can be calculated:

DL: 15 kbps (CPCH) + 2 kbps (paging) = 17 kbps
UL: 15 kbps (CPCH)

These figures would be multiplied by the percentage of the FACH channel which would use CLPC. For example:

10% of FACH using CLPC:
1.7 kbps overhead in DL, 1.5 kbps overhead in UL.

100% of FACH using CLPC:
17kbps overhead in DL, 15 kbps overhead in UL.

The DL capacity gain for continuous operation depends on FACH channel rate. For a 2 db capacity gain (20 msec, 5 Hz), the increased DL capacity is:

30 kbps FACH: 27 kbps (data) x 2 db = 15.8 kbps increased capacity
(assuming TFCI)
60 kbps FACH: 57 kbps x 2 db = 33.3 kbps increased capacity
120 kbps FACH: 108 kbps x 2 db = 63.2 kbps increased capacity
240 kbps FACH: 228 kbps x 2 db = 133.4 kbps increased capacity
…..etc…

Thus for 30 kbps FACH the overhead to support CLPC exceeds the capacity gain. For 60 kbps FACH the net gain is marginal. For FACH rates at 120 kbps or higher, there are clearly large net capacity gains.

Given the above, there should be a 64 kbps cut-off for CLPC on FACH.

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 R1-00625.

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, $\tau_{CLPC,}$ is deterministic and includes

1. UE processing (fixed)
2. CPCH Access Ramp up (variable, Nap_retrans_max dependant)
3. CD phase (fixed)
4. pre-data power control (fixed)

Note that 1 or two PCPCH channels are reserved for CLPC and there is no contention for this PCPCH. CPCH procedure errors events are considered in this protocol and if they occur, OLPC of FACH (normal operation) is used on the FACH segment. See answer (9), below.

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.

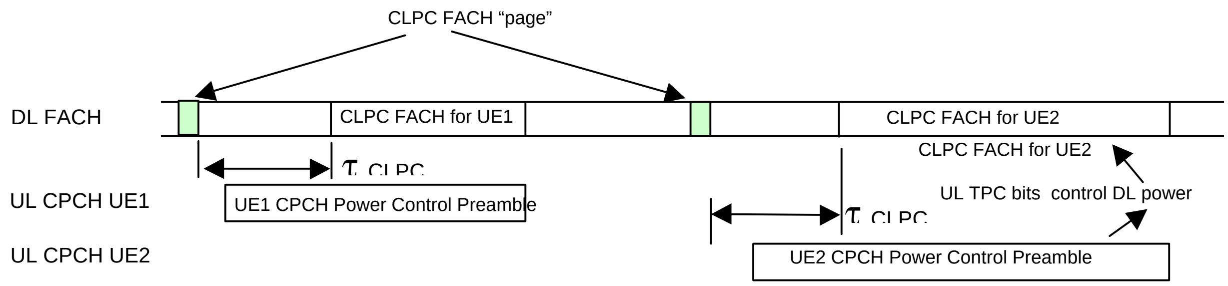

FIGURE 1. CLPC FACH Timing.

For example if Tnext slot = 3.75 msec, and if Nap_retrans_max= 10,
τ_{CLPC} = (10 + 1)*3.75 + 5.28 msec = 46.5 msec (approximately 5 frames).

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

(6) It is proposed to buffer the packets in Node B.
Buffer size is dependant on τ_{CLPC}, as shown above. If τ_{CLPC} is 5 frames, as shown in the above example, then the required buffer is approximately 200 bytes for 60 kbps FACH, 400 bytes for 120 kbps FACH, etc.

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) to use the next CLPC FACH, e.g.16 bits
2) Identification of the PCPCH to be used for the next segment 4bits

Upon receipt of the CLPC scheduling message, the addressed UE begins to access the reserved PCPCH channel indicated in the message, while continuing to monitor the FACH DL. When the CLPC FACH segment begins, the UE maintains the PCPCH channel. If no FACH segment is addressed to the UE within τ_{CLPC} of initial access attempt, the UE releases the reserved PCPCH. The UE maintains the reserved PCPCH channel until the first frame in which there is no FACH message directed to that UE. At that point the UE releases the PCPCH used for CLPC. In this way the protocol does not require explicit signalling of SFN number for onset of CLPC segment or signalling of CLPC segment length.

4. Questions on System issues:

a) Does there 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 CLPC of 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 60 kbps or higher. At the lower rates there is no net gain.

If the CLPC FACH traffic is interleaved with normal FACH, then only one PCPCH is needed. 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 is 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) interference peak in the uplink)

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

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 would continue normally using OLPC methods. If the Base Node does not hear the preamble [confirmation from the UE],or if, for any reason, the reserved PCPCH DPCCHs for CLPC are not established at the time the CLPC FACH segment is to begin, Node B will not attempt CLPC and will revert to normal FACH broadcast for that segment. Access error events cause the Node B to abort CLPC protocol for that FACH segment. The FACH segment is still transmitted and received, but at the higher broadcast power level.

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) May 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.

f) Release –99 UE expects FACH to be non-power controlled. When on the RACH/FACH state, does the power controlling of FACH cause problems for their quality monitoring of FACH reception and in-band identification of UEs ? Mainly are there impacts to WG4 requirements due (to) this change?

(12) Preliminary comments:

1. It is our understanding that currently slow power control and OLPC on FACH is possible. So this should not be a new issue.
2. It is also our understanding that several S-CCPCH could be used in a single cell, so segregation of UEs by capability (UE release) is possible.
3. Even if the R'99 UE is not power-controlled, there is a possibility of error on FACH reception, possible errors induced by CLPC would be no different than other errors handled in R'99.
4. It is also possible not to interleave the packet data traffic on FACH#1 and open another FACH #2 for the downlink packet data ONLY.

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.