**TSG-RAN Working Group 1 meeting #20** ***TSGR2#21(01)-0491***
**Busan, Korea, 21 ~ 25 May 2001**

**Agenda Item** **11 (Gating Ad hoc)**
**Source:** **Samsung Electronics and Nokia**
**Title:** **Clarification on Comparison between Gated DPCCH Transmission and Using CELL_FACH**
**Document for:** **Discussion and Decision**

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# 1. Introduction

Gated DPCCH Transmission (hereinafter gating is used interchangeably) was proposed as a technique for terminal power saving. It was commented that earlier switching to CELL_FACH (hereinafter CELL_FACH switching will be used)could save more terminal power than Gating. However it was also noted that gating could have more benefit in signaling delay and overhead aspect compared to CELL_FACH switching. Accepting the comment on comparison with CELL_FACH switching, the WI "Terminal Power Saving Features" was renamed by "Gated DPCCH Transmission" at the previous RAN#11 plenary meeting.

The original purpose of Gating is to save terminal power when DSCH channel is being used. When DSCH is used, the associated DPCH can be sustained for a while even though there are no data transmitted on DSCH. Gating can be applied to the DPCCH during there are no data transmitted but the dedicated channel is sustained.

It was commented in the previous RAN2 meetings that CELL_FACH switching can be used for the same purpose and could save more terminal power than Gating. However, Gating can also save terminal power if compared to continuous transmission of DPCCH when there is no DSCH data. Moreover, from the viewpoint of signalling load and delay, Gating seems to have more benefit than CELL_FACH switching. If that is the case, both the two techniques, Gating and CELL_FACH switching, could be alternative and it is totally up to operator's decision to determine the technique to be used.

In this contribution, a discussion is presented on the comparison of Gating with CELL_FACH switching in terms of delay and signalling load.

# 2. Delay Comparison between Gating and CELL_FACH

In the previous RAN2 meetings, there was some concern that instead of using gating, during the reading time UE can release the dedicated channels and move to CELL_FACH state.
In this section, the signalling delay aspect of Gating and CELL_FACH is compared.

## 2.1. Signalling delay aspect of gating

Figure 1 shows the flow of signalling for gating initiation or termination as described in TR25.938.

The followings are the needed signalling delay in the Figure 1.

1. NBAP message (Radio Link Reconfiguration Prepare) transmission delay from RNC to Node B: (A)
2. Node B processing delay for Radio Link reconfiguration : (B)
3. NBAP message (Radio Link Reconfiguration Ready) transmission delay from Node B to RNC: (C)
4. SRNC processing delay for Radio Link reconfiguration: (D)
5. NBAP message (RADIO LINK RECONFIGURATION COMMIT) transmission delay from RNC to Node B: (A)
6. RRC message (TRANSPORT CHANNEL RECONFIGURATION) transmission delay in DL: (E)
7. UE processing delay for Transport channel Reconfiguration: (F)
8. RRC message (TRANSPORT CHANNEL RECONFIGURATION COMPLETE) transmission delay in UL: (G)

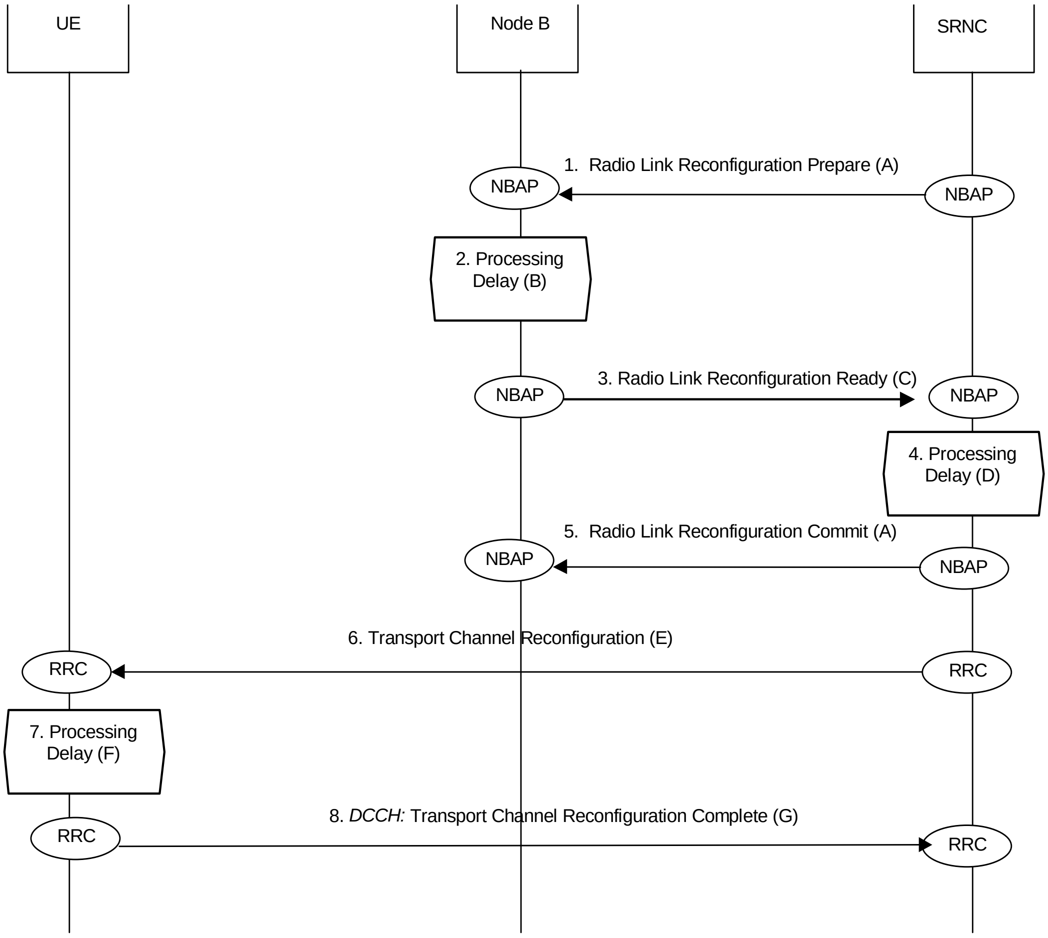


Figure 1. Signalling for Gating Initiation or Termination when SRNC=CRNC

The total needed delay to initiate/terminate gating is as follow:

Total delay = A + B + C + D + Max(A, E + F + G, CFN margin)

**2.2 Signalling delay aspect of Cell_FACH switching**

Figure 2 shows the flow of signalling for Cell_FACH switching.

The followings are the needed additional delay in the Figure 2 compared to the case of Figure 1.

1. Node B processing delay for Radio Link setup : (B')
2. ALCAP Iub Data Transport Bearer Setup delay: (K)
3. FACH Scheduling time: (L)
4. Uu Synchronization delay: (M)
5. User plane Synchronization delay : (N)

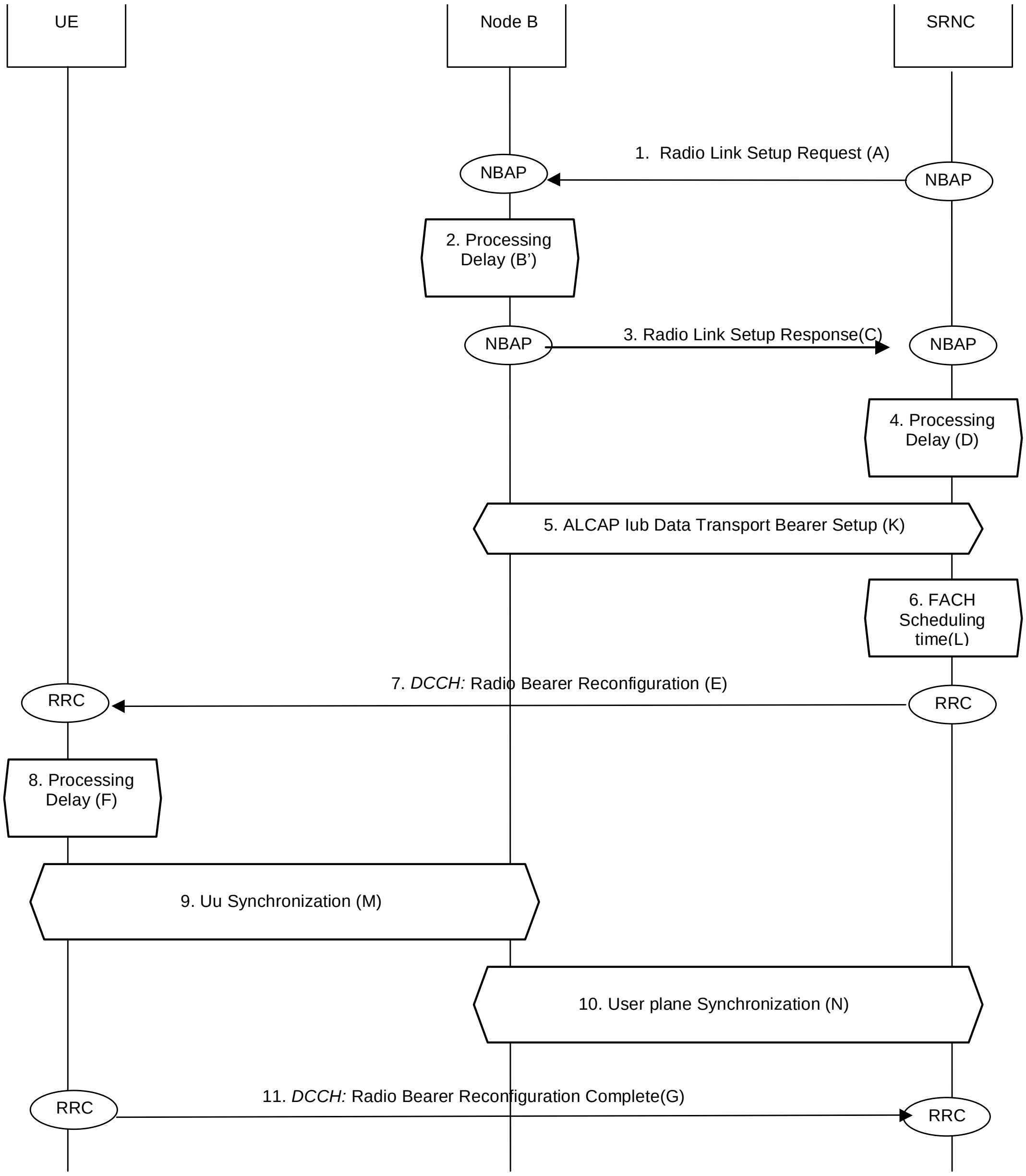


Figure 2. Signalling for transition from CELL_FACH to CELL_DCH

The total needed delay for transition from CELL_FACH state to CELL_DCH state is as follow:

Total delay = A + B' + C + D + K + Max(L + E + F + M + G, N)

**2.3 Differential delay components between Gating and CELL_FACH**

B' : Node B processing delay for Radio Link setup is defined as the time from when Node B receives the

Radio Link Setup Request message from SRNC, until Node B successfully has performed actions according to the Request message and starts to transmit Radio Link Setup Response message to the SRNC. When Node B receives the Request message from SRNC, Node B should check its resource in order to allocate the resources (DCH and DSCH) which are requested by SRNC. When it is possible to allocate the resources, Node B sends Response message to SRNC. There is some possibility that the request is rejected. It is reasonable to assume that the delay B' is larger than the delay B.

K : ALCAP Iub Data Transport Bearer Setup delay is the time for setting up the Iub Data transport bearer in user plane. It consists of several protocol steps, which requires some delay.

L : FACH Scheduling time is the delay in the CRNC for scheduling the transmission of FACH data. Since the RRC message should be transmitted using the common channel (FACH), it can have additional delay for scheduling. If CELL_FACH switching is used for terminal power saving purpose, the load on FACH can be increased and therefore, the FACH scheduling delay can be larger.

M : Uu Synchronization delay is the needed time for UE and Node B to get synchronization. The Uu synchronization is described as DL synchronisation plus UL synchronisation delay

Total delay for gating termination is equal to A + B + C + D + Max(A, E + F + G, CFN margin). Total delay for switching from CELL_FACH state to CELL_DCH state is equal to A + B' + C + D + K + Max(L + E + F + M + G, N). If the common part is removed, then the differences are:

- Gating: B + Max(A, E + F + G, CFN margin)
- CELL_FACH: B' + K + Max(L + E + F + M + G, N).

We can note that B<= B' and we can assume that A <= CFN margin <=E+F+G and N<=L+E+F+M+G.

Then we can conclude that CELL_FACH switching has additional delay such as (B'-B) + K + L + M. That is, CELL_FACH switching has additional delays for processing for channel allocation (B'-B), ALCAP Iub Data Transport Bearer Setup (K), FACH Scheduling (L) and Uu Synchronization(M).

### 2.4. Conclusion on the delay comparison

The estimated additional delay for CELL_FACH switching will be heavily dependent on implementation and therefore some system can give small delay while some system needs relatively large delay. But it seems obvious that Gating has shorter delay than CELL_FACH switching. Furthermore signalling delay for Gating initiation/termination can be decreased if signalling information for gating is transferred in User Plane using Frame Protocol [4].

# 3. Signalling Load Comparison between Gating and CELL_FACH

CELL_FACH switching requires much more information to be processed on UTRAN than Gating. The amount of information for CELL_FACH switching is almost 8 times larger than for Gating, as shown in Table 1 for RRC messages and Table 2 for NBAP messages. The larger information bits means more system-processing loads (for radio resource scheduling, resetting up of radio bearers between RNC and Node B, physical channel synchronisation, etc) and also means that CELL_FACH switching requires more information which should be transferred over radio channel than Gating although all the information in the Table 1 is not necessarily required to be sent over radio channel because some information can be stored and used.

Table 1: Required processing information entities in number of bits for Gating and CELL_FACH switching in RRC messages [5]

| | CELL_FACH switching | Gating |
|---|---|---|
| Total bits | 295 bits | 32 bits |
| Message name | CELL_FACH → CELL_DCH (RB or Transport Ch. or Physical Ch. Reconfiguration) | End of Gating<br>(RB or Transport Ch. or Physical Ch. Reconfiguration) |
| Required processing IEs | -RRC transaction Identifier<br>-Message type field<br>-RRC state indicator<br>-UL Transport channel information common for all transport channels<br>-Added or Reconfigured UL TrCH information<br>-DL Transport channel information common for all transport channels<br>-Added or Reconfigured DL TrCH information<br>-Uplink DPCH info<br>-Downlink PDSCH information | -RRC state indicator<br>-RRC transaction identifier<br>-Message type field<br>-Activation time<br>-Gated DPCCH Transmission Control info (gating rate)<br>-UL Transport channel information common for all transport channels |
| Message name | CELL_FACH → CELL_DCH (RB or Transport Ch. or Physical Ch. Reconfiguration Complete) | End of Gating<br>(RB or Transport Ch. or Physical Ch. Reconfiguration Complete) |
| Required processing IEs | -RRC state indicator<br>-RRC transaction identifier | -RRC state indicator<br>-RRC transaction identifier |

Table 2: Required processing information entities in number of bits for Gating and CELL_FACH switching in NBAP messages [6]

| | CELL_FACH switching | Gating |
|---|---|---|
| Total bits | 964 bits | 135 bits |
| Message name | RADIO LINK SETUP REQUEST MESSAGE | RADIO LINK RECONFIGURATION PREPARE |

| | | |
|---|---|---|
| Required processing IEs | -Message Discriminator + Message Type<br>-CRNC Communication Context ID<br>-Transaction ID<br>-UL Scrambling Code<br>-Min UL Channelisation Code Length<br>-Max Number of UL DPDCHs<br>-Puncture Limit<br>-UL DPCCH Slot Format<br>-UL TFCS<br>-UL SIR Target<br>-DL TFCS<br>-DL DPCCH Slot Format<br>-TFCI signalling mode<br>-Multiplexing Position<br>-PDSCH RL ID<br>-PDSCH code mapping<br>-Power Offset information<br>-TPC DL step size, Limited Power Increase, Limited DL PC Status<br>-DCH information common for all DCHs<br>-DCH ID<br>-UL TFS<br>-DL TFS<br>-Allocation/Retention Priority<br>-Frame Handling Priority<br>-QE-Selector<br>-DSCH ID<br>-TFS<br>-Allocation/Retention Priority<br>-Frame Handling Priority<br>-ToAWS, ToAWE<br>-RL Information<br>-RL ID<br>-C-ID<br>-First RLS indicator<br>-Frame Offset<br>-Chip Offset<br>-DL Code Information : 14 bit<br>-Initial DL Tx Power, Maximum DL Power, Minimum DL Power | -Message Discriminator + Message Type<br>-Node B Communication Context ID<br>-Transaction ID<br>-RL ID<br>- Gating parameters |
| Messages name | RADIO LINK SETUP RESPONSE MESSAGE.: | RADIO LINK RECONFIGURATION READY |

| | | |
|---|---|---|
| Required processing IEs | -Message Discriminator + Message Type<br>-CRNC Communication Context ID<br>-Transaction ID<br>-Node B Communication Context ID<br>-Communication Control Port ID<br>-RL Information<br>-RL ID<br>-RL set ID<br>-Received total wide band power | -Message Discriminator + Message Type<br>-CRNC Communication Context ID<br>-Transaction ID<br>-RL ID |
| Message name | | RADIO LINK RECONFIGURATION COMMIT |
| Required processing IEs | | -Message Discriminator + Message Type<br>-Node B Communication Context ID<br>-Transaction ID<br>-CFN |

## 4. Conclusion

There has been long discussion on gating in WG1 and they concluded that gating is feasible [7]. There has been also long discussion on signalling support for gating in WG3 from RAN3#10[8] and agreed to RNSAP/NBAP support for gating [9]. Since gating is optional feature, it is totally dependent on operation choice whether gating is used during reading time between packet call.
At the RAN2 meeting, there has been some concern that CELL_FACH switching can give more terminal power saving gain than gating. As described in this contribution, CELL_FACH switching gives more delay on packet service and needs more information bits in signalling message to set up each radio link than gating. Furthermore, if there are several UEs that uses CELL_FACH switching for terminal power saving, system should exchanges signalling messages to release and setup dedicated channels and SRNC should release and allocate resources too frequently, which gives too much overhead to system.

It is concluded that it is totally the matter of operator choice to apply gating and even to use CELL_FACH switching based on their system implementation capability. There is no reason not to allow operator to choose gating since some benefits can be obtained using gating in some implementation platform.

It is proposed that gating be accepted as a feasible Rel5 feature and detailed normative works to support gating be continued in each WG.

## References


[1] R1-00-0686, “Discussion paper on DPCCH gating benefits”, Nokia

[2] 3G TR 25.932 Delay Budget within the Access Stratum

[3] 3G TS 25.133 Requirements for Support of Radio Resource Management

[4] R1-010489, “User Plane Signalling for Gating”, Samsung Electronics

[5] 3GPP TSG RAN TS 25.331, RRC Protocol Specification (Release 99), V3.6.0, March 2001

[6] 3GPP TSG RAN TS 25.433, UTRAN Iub Interface NBAP Signalling (Release 99), V3.5.0, March 2001

[7] 3G TR 25.840 Terminal Power Saving Features

[8] R3-000206 “Iur/Iub aspect of gated DPCCH transmission”, Samsung Electronics

[9] 3G TR 25.938 Terminal Power Saving Feature (Iur/Iub aspects) v2.0.0