TSG-RAN Working Group 1 meeting #20 ***TSGR1#20 0490***
Busan, South Korea, 21 ~ 25 May 2001

Agenda Item **11 (Gating Adhoc)**
Source: **Samsung Electronics and Nokia**
Title: **Short Overview on Gated DPCCH Transmission**
Document for: **Discussion**

1. Introduction

Gating was proposed as a technique for terminal power saving and interference reduction. In the last RAN#11 meeting, WI "Terminal Power saving features" was renamed to "Gated DPCCH Transmission". In this document we will have a short overview.

2. Discussion

Gating was originally proposed for the DCH/DCH states. However, due to issues related to connection release time it was later proposed for the DSCH/DCH states [1] [3]. UTRAN schedules the gating of the DPCCH on those intervals that in the DSCH there is no downlink activity for the corresponding (to that DPCCH) UE. Figure 1 presents the Gating / non-Gating cases.

Figure 1.1 shows the typical packet transmission on DSCH/DCH states. During the "reading time", the DPCCH is transmitted although no actual data is sent through the DSCH. Thus, for reasons of UE power consumption and interference reduction, DPCCH Gating was introduced. Two timers were introduced. T_{pre_gating}, which is the time elapsed before applying Gating after the last DL packet transmission and T_{cr_dsch}, the time elapsed after the last DL packet Tx, before we release resources and move to CELL_FACH, after applying Gating.
Two cases are identified as shown in Figure 1.2 and 1.3 respectively:

- Case A: $T_{pre\_gating}.<T_{reading\ time}<T_{cr\_dsch}$: Apply gating and then terminate gating to send the next packet.
- Case B: $T_{pre\_gating}.<T_{cr\_dsch}<T_{reading\ time}$: Apply gating and then switch to CELL_FACH state.

Note: Treading time is the reading time which is the time interval between consecutive packet transmissions.

3. Main Discussion

WG1 worked on the above cases where $T_{pre\_gating}<T_{reading\ time}$ and identified gains of gating compared to the non-gating mode from the Physical layer point of view.

Another alternative was proposed in WG2. Instead of applying Gating, to switch to CELL_FACH state until the required transmission of the next packet. At that point we switch again to CELL_DCH. This is presented in Figure 1.4. Another timer is introduced $T_{rach/fach.}$ which can be equal to T_{pre_gating}.

In general for packet transmission several points must be taken into account

- Packet model that "simulates" and models the characteristics of application/service we are running. (The main parameter for the model is the reading time between packet transmission.)
- Selection of transport and physical channels for packet transmission e.g. CPCH, DSCH, FACH, DCH
- RRC states for packet transmission in DL/UL: e.g. CELL_DCH, CELL_FACH.

All the above along with the T_{pre_gating} and T_{cr_dsch}, $T_{rach/fach}$ must be configured in that way to

- Minimise interference →maximise capacity
- Minimise additional signalling
- Minimise impact on resources management
- Minimise impact on other techniques e.g. compressed mode
- Minimise delay in packet transmission
- Maximise gains in battery saving

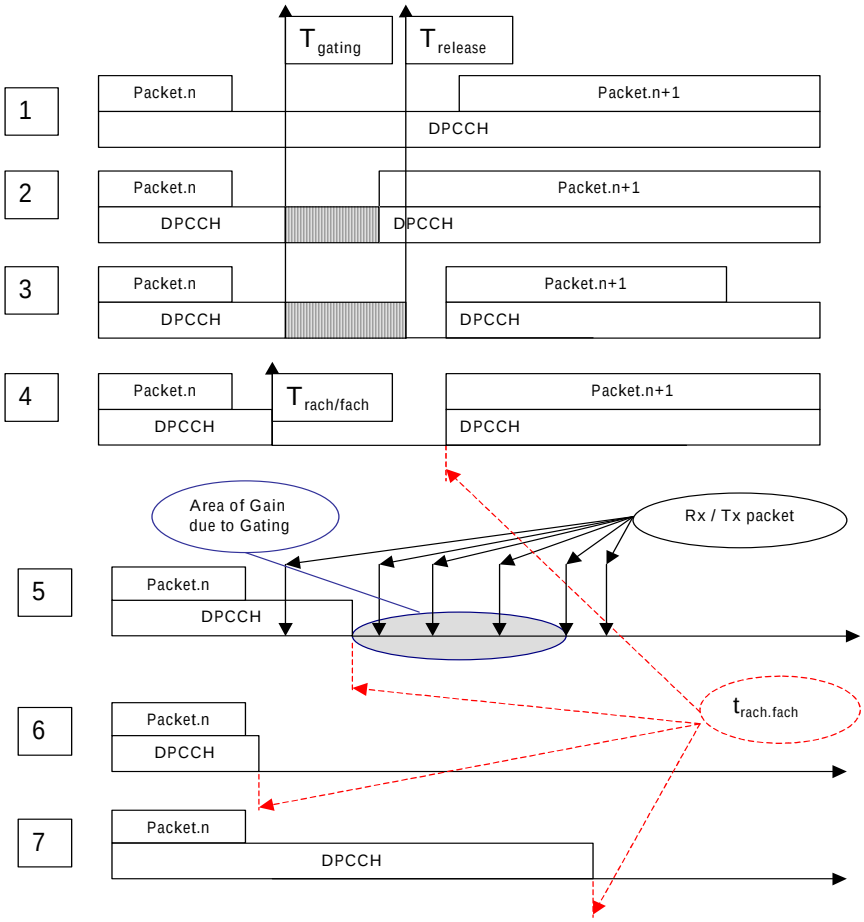

Figure 1 Cases

As can be shown in Figure 1.5, there are several possible cases for reception/transmission of packets through DSCH. With the theory of limits the following can be identified

$T_{reading\ time}$ very long > 15 sec
Preferred solution for packet Tx: Switch to CELL_FACH state (RACH/FACH).
Comments:

- Time frame is very long and this means we have substantial gain in reducing interference. The only PHY Channels are the infrequently transmitted S-CCPCH/PRACH (FACH/RACH TrCh).
- The longer the reading time the more the gain in interference reduction

$T_{reading\ time}$ very short < 0.5sec
Preferred solution for packet Tx: Remain in CELL_DCH
Comments:

- If RACH/FACH is applied:
  - Introduction of long delays
    - Long delay is required for transition between CELL_DCH and CELL_FACH states.
    - Strong impact on other processes
      - Especially if large number of UEs are under the transition process.
    - Restriction in time imposed in subsequent packet transmission.
- If Gating is applied:
  - May not have time to initiate/terminate gating.
  - Even in those cases that we do initiate gating, the gain in power saving/interference reduction is extremely short.

The main point in the above two cases is that it is clear which approach should be implemented, due to the substantial and clear gains of one with respect to the another.

$T_{reading\ time}$ of intermediate values 0.5 < $T_{reading\ time}$ < 15 sec
Preferred solution:?
Comments:

- The solution should be seen in a more holistic approach considering interference, signalling, complexity, delays and etc. [4].
- As it is shown in Figure 1.5/1.6/1.7, the further we move to intermediate cases, the more we have to think about trade off among the proposed solutions[4]. The shorter the reading time, the more important is the delay factor due to signalling. The longer the reading time the more important is the gain in interference aspect. In this case, switching to CELL_FACH state and remaining in CELL_DCH state cannot have clear advantages over each other.
- Gating is proposed as an intermediate solution for this case, that can "enable" a smooth transition between CELL_DCH and CELL_FACH.
- RAN2/3 have studied and have shown that signalling can be heavier in switching to CELL_FACH state than Gating [2]. It is pointed that depending on implementation there are cases that signalling for Gating is substantially less than signalling for switching to CELL_FACH state.

Note 2: The values of $T_{reading\ time}$ 0.5, 15 secs are merely for the sake of the discussion and are not results of simulation evaluation or investigation.

3. Conclusion

The main points are the following

- There are some kinds of packet models (possibly also for future applications) that Gating can be applied as an intermediate solution between switching to CELL_FACH state and remaining in CELL-DCH state.
- The actual configuration of e.g. parameters, timers is an implementation issue and not of our interest at this point.
- Gating is proposed as an optional feature and we should give the opportunity to operators to implement it and configure the parameters the way they want to "extract" the gains that have been identified for certain scenarios.

For the above reasons we propose that gating be accepted as an optional feature for Rel5.

4. References

[1] 3G TR 25.840 Terminal Power Saving Features.
[2] R1-010491, Clarification on Comparison between Gated DPCCH Transmission and Using CELL_FACH Samsung Electronics.
[3] TSG R1#13(00) 0686, "Discussion paper on DPCCH gating benefits", NOKIA.
[4] TSG R1#3(99) 0191, "Detail description of transmission stop and resumption control", NTT DoCoMo.