3GPP RAN1/RAN2 joint meeting on LTE **R2-060988**
Athens, Greece, 27–31 March, 2006

Agenda Item: **3.5**
Source: **CATT**
Title: **PCH mapping and Paging control**
Document for: **Discussion and decision**

Introduction

This document discusses the PCH mapping and paging control in the physical layer. It is proposed that the PCH is mapped on the downlink physical shared channel, and the paging indicating channel is combined with downlink shared control channel. Two methods are presented for indicating the paging indicator in downlink shared control channel.

Discussion

1. The Mapping of PCH

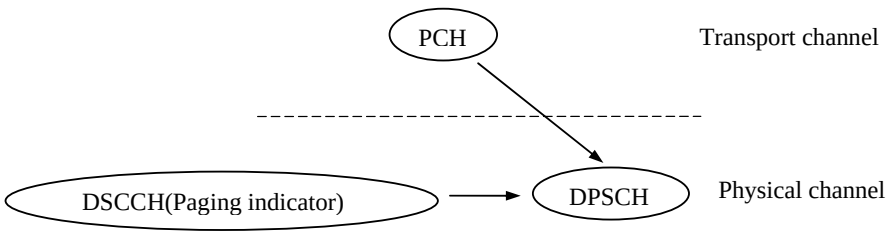
In the TR25.813, the Paging channel is characterised by:

- support of UE power saving (DRX cycle is indicated by the network to the UE);
- requirement to be broadcast in the entire coverage area of the cell;
- mapped to physical resources which can be used dynamically also for traffic/other control channels.

So, PCH can be mapped on the downlink physical shared channel (named as DPSCH for short). While no paging, the DPSCH doesn't carry any content of PCH to save the radio resource. Additionally, the data amount of PCH is much usually, UE will spend more time and power for reading it. For supporting UE power saving, a paging indicating channel in physical layer should be configured to indicate whether having PCH. UEs will listen to the paging indicating signal in DRX mode. As PCH is mapped on DPSCH and the scheduling information of DPSCH is carried on the downlink shared control channel (named as DSCCH for short), we can combined the paging indicating channel into DSCCH. The occasion of paging indicator appears on the DSCCHs with DTX period. Which DSCCH carry the paging indicator and the DTX period is broadcasted on the BCH.

The location of resource using by PCH is fixed with paging indicator, which can be broadcasted in BCH of determined by specification.

An example is shown in the Figure 1.



DPSCH	UE2 Data	UE1 Data	UE2 Data	UE1 Data	UE2 Data	UE1 Data	UE2 Data	UE1 Data	UE2 Data	UE1 Data	PCH Data	UE1 Data

DSCCH	UE1	UE2	UE1	UE2	UE1	UE2	UE1	UE2	UE1	PI	UE1	UE2
SFN	1	2	3	4	5	6	7	8	9	10	11	12

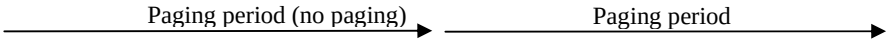


Figure 1: PCH mapping

In Figure 1, SFN #5, 10 in DSCCH are the paging indicator occasion. But in the SFN #5, there is no paging information, so the scheduling information to UE1 is carried on DSCCH, in subsequent SFN, i.e. SFN #6, UE1 transmits/receives data. In the SFN #10, paging indicator is presented on DSCCH, and the PCH information appears in SFN #11.

2. The DSCCH Frame

Two solutions are depicted below for distinguishing the paging indicator and scheduling information on DSCCH.

1). Introducing a PI-ID. This PI-ID equals to C-RNTI in size, and isn't assigned to any UE for ever. When the special PI-ID has been detected, the content carried on DSCCH is a paging indicator. The structure of DSCCH frame is as following:

C-RNTI/PI-ID	……

2). Adopting a paging tag field. This paging tag field is used in DSCCH frames, which indicates whether the content carried on DSCCH is a paging indicator or normal scheduling information. For example, when the paging tag is set to 0, it shows the content is normal scheduling information. By contraries, when the paging tag is set to 1, it shows the content is paging indicators. The structure of DSCCH frame is as following:

Paging tag	……

With one of the solutions above, there is no any paging indicator in the DSCCH even the occasion of paging indicating comes while no PCH information. The corresponding resource can be used for scheduling and transmission. If the paging indictor is presented on DSCCH, the corresponding resource of DPSCH will be utilized to transfer the data of PCH. Other static information, e.g. demodulation and decode parameter, may be broadcasted on the BCH.

3. Paging control procedure

The paging control procedure is depicted as following in detail according to each structure of DSCCH frame:

1). Using a PI-ID

If there is no paging, the eNodeB transfers scheduling information on the DSCCHs with a C-RNTI allocated to a UE, then transfers data on the related DPSCH. If there is paging message coming from aGW, the eNodeB sends paging indicator and resources indicating of DPSCH on DSCCH when the paging occasion comes, and set the PI-ID in the DSCCH frame instead of C-RNTI at the same time.

UEs in LTE-IDLE monitor the DSCCHs that may carry paging indicators with DRX period. UEs will inspect the UE-ID information firstly once receiving the DSCCHs frame. If the UE-ID is not the PI-ID, it means there is no paging information. These UEs will return to dormant state, and monitor paging indicator in the next DRX occasion.

When the UE-ID is PI-ID, UEs will read the paging indicator belonging to themselves. The UE will return to dormant state and monitor DSCCH in next DRX occasion, if no exact paging information associated with it. Otherwise, the UE reads scheduling information; and receives the paging data carried on DPSCH, and then deals with paging message. The procedure depicted above is shown in Figure 2.

UEs in LTE_ACTIVE state decide next execution based on the UE-ID taken on DSCCH like current system.

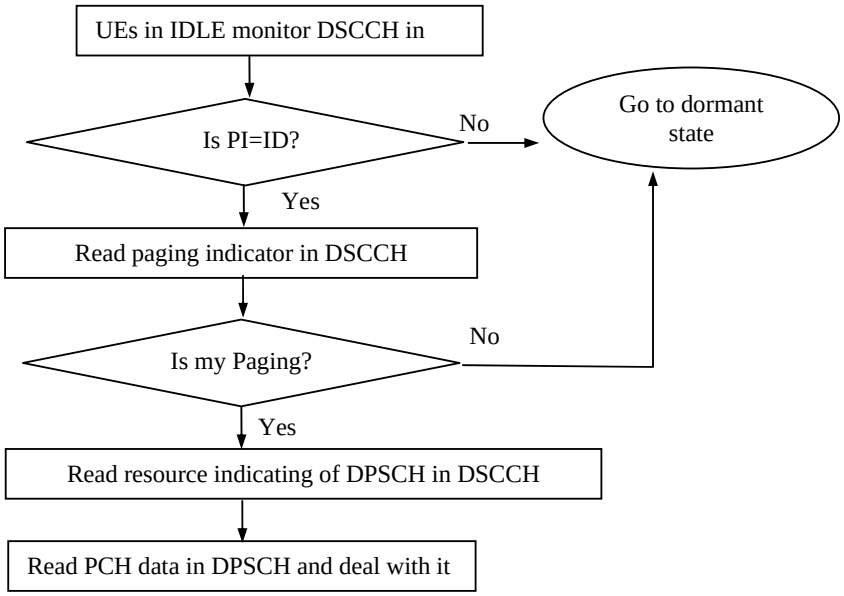


Figure 2: The control procedure of Idle UE

2). Using paging tag.

If there is no paging, the eNodeB transfers scheduling information in which paging tag = 0 on the DSCCHs with the scheduled UE's C-RNTI, and traffic data on the DPSCH. If there is paging message coming from aGW, the eNodeB will transmit the paging indicators and resources indicating on DSCCH in which the paging tag=1 at the paging occasion, then transfer the paging information on DPSCH subsequently.

UEs in LTE_IDLE state receive the cell broadcast and get the information about how to demodulation the paging data. Then UEs will monitor the DSCCHs that may carry paging indicator with DRX period. After receiving the DSCCH frames, UEs will judge the paging tag firstly.

If the paging tag equals to 0, there is no paging information. These UEs return dormant state, and monitor paging indicator in the next paging occasion.

If the paging tag equals to 1, there is paging information. The UE will read the paging indicator belong to itself. These UEs will return to dormant state if there is no paging information associated with them, and monitor paging indicator in the next paging occasion. Otherwise, UEs will read scheduling information, and receive the paging data on DSPCH, then deal with the paging message.

The control procedure of UE in LTE-IDLE is show in figure 3.

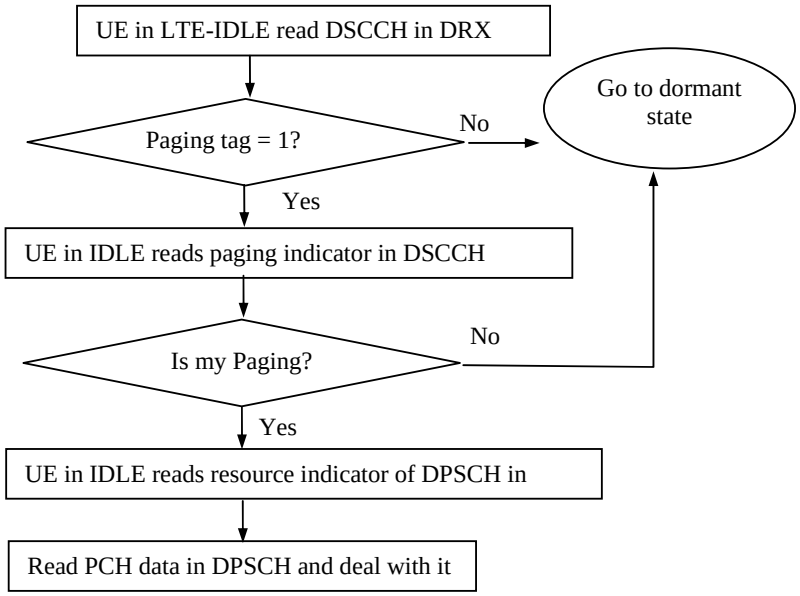


figure 3. The control procedure of Idle UE using paging tag

UEs in LTE_ACTIVE decide next execution according to paging tag. If the paging tag equals 0, the active UEs deal with DSCCHs as normal mode. If the paging tag equals 1, the active UEs don't receive information on DPSCH and monitor other DSCCHs continuely. The control procedure of Active UE using paging tag is show in figure 4.

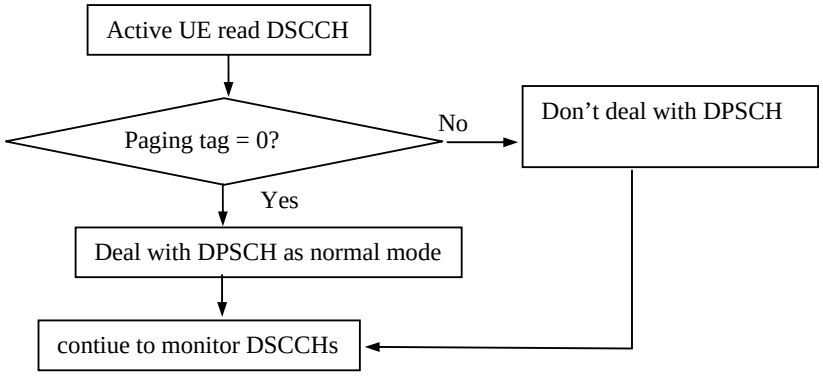


figure 3. The control procedure of Active UE using paging tag

Conclusion

The contribution discusses the paging mapping and paging control procedure. The PCH is mapped on the DPSCH, and the paging indicating channel is combined with DSCCH. The radio resource is saved if the schemes were adopted and the scheduling of radio resouce is very flexible. For these two solutions above that used for distinguishing paging indicator and scheduling information, we prefer to the first one, i.e. using a special PI-ID.

References

[1] TR25.813 “Radio interface protocol aspects”

[2] TR25.814 “Physical Layer Aspects for Evolved UTRA”