

Agenda Item: 12.3.6
Source: Philips
Title: Evolved Paging for LTE
Document for: Discussion, Decision

This document is an update of R2-060015 presented at RAN2#50, which addresses some questions raised and extends our proposal in light of the agreements at RAN2#50.

1. Introduction

At RAN2#50 meeting the description of logical and transport channels for LTE was revised in [1], detailing some of the characteristics of the Paging Channel that were previously FFS.

In conjunction with [2] (which considers the RACH), this contribution looks at the benefit that could be gained from the agreement in [1] for faster initial access both for Network-Initiated and for UE-Initiated calls or service requests.

2. Discussion

We provide in this part an analysis of some of the points relating to the Paging Channel in [1] in order to extend the model for the Paging Channel in the E-UTRAN.

The following description for the Paging Channel as a transport channel is included in [1]:

3. Paging Channel (PCH) 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.

It was decided that the PCH will be a separate transport channel from the Downlink Shared Channel (DL-SCH), while being mapped to physical resources that can be shared with other traffic or control channels such as the DL-SCH.

In our original proposals [3, 4] we advocated the merging of the PCH together with the DL-SCH as transport channels for a simplification of the number of transport channels and for a reduction in start-up delay by associated signalling; that proposal is now superseded by the decision reported in [1].

However, the proposal in [1] that both the PCH and the DL-SCH may share physical resources, and that the PCH is broadcast in the entire cell, now allows us to revise our proposals so that similar benefits are gained.

We therefore renew our proposal [4] that the PCH carries broadcast data of Paging Information, and that the UE listens to the PCH in either continuous or DRX mode depending on their state for power-saving purposes.

In this updated proposal, a UE would listen to the Paging Information in the following way:

- In LTE RRC Active mode, a UE may monitor the PCH in continuous mode or in DRX mode (in LTE-MAC level)
- In LTE Idle mode, a UE may monitor the PCH in DRX mode

This is our first proposal for a model for the PCH in the E-UTRAN:

Proposal 1: The PCH is configured to carry Paging Information that is monitored in either continuous mode or in DRX mode depending on the LTE RRC and/or LTE-MAC state of the UE

This proposal 1 is the basis on which we propose to extend the functionality of the PCH in order to provide scheduling and data allocation on the DL-SCH: we propose that no separate Scheduling Control Channel be needed for monitoring by the UE, and that the PCH be used as a minimal scheduling indicator for data scheduled on the DL-SCH.

This aims to give the network the flexibility to assign the physical resources for the service that a UE may be paged to receive, through a range of configurable settings included in the Paging Information, dependent for instance on the type of connection, application-specific Quality of Service parameters suitable for the specific service that the UE is to receive, or radio channel conditions.

This minimal scheduling information may be seen as a service-scheduling indicator indicating the scheduling and availability on the DL-SCH of the service that a UE is being paged to receive.

This is therefore our second proposal for a model for the Paging Channel in the E-UTRAN:

Proposal 2: The PCH is used both for sending Paging Information and a service-scheduling indicator for physical resource allocation of data scheduled on the DL-SCH

For details of the service-scheduling parameters included in the indicator, we should consider the use of default and/or stored configurations, which have already been discussed at length and are proposed in [5] for implementation in Release 7.

With the use of default or stored configurations, the network would signal which configuration a UE is to use, together with the physical resource allocation, as part of the Paging Information, hence allowing faster set-up of Radio Bearers and reducing delays for first packet transmissions.

This could include not only downlink configurations, but also uplink configurations for initial access to the network.

This is consequently our third proposal for the PCH in the E-UTRAN:

Proposal 3: The Paging Information transmitted on the PCH contains an indication for the default/stored configuration to be used for initial access to the network

Our proposals for initial access using the RACH are set out in detail in [2].

Proposals 1-3 present our model for the Paging Channel in the E-UTRAN. To highlight the extended functionality that this new Paging Channel introduces, we propose to include these features under the description of the PCH in TR25.813 [1], using the terminology “Evolved Paging Indicators”.

3. Proposal

We have made a series of proposals for the Paging Channel in the E-UTRAN, with the aim to provide flexible configurations and faster initial cell access.

The proposals are recapitulated below:

Proposal 1: The PCH is configured to carry Paging Information that is monitored in either continuous mode or in DRX mode depending on the LTE RRC and/or LTE-MAC state of the UE

Proposal 2: The PCH is used both for sending Paging Information and a service-scheduling indicator for physical resource allocation of data scheduled on the DL-SCH

Proposal 3: The Paging Information transmitted on the PCH contains an indication for the default/stored configuration to be used for initial access to the network

The model presented is one where an association has emerged between Paging and RACH operation, where the symmetrical use of default/stored configurations and the exchange of dynamic RACH system information will result in simpler resource allocation and faster initial cell access both for network-initiated and for UE-initiated access requests.

4. Conclusion

In this paper we have proposed to extend the functionality of the Paging Channel, by using it as a means of scheduling physical resource allocation for data transmitted on the DL-SCH and of enabling faster Radio Bearer configuration.

We propose that this approach be selected as a basis for further work on the transport channels in the general radio interface architecture.

A text proposal is appended to this document. We propose capturing this in the TR25.813. Note that this text proposal overlaps with the text proposal provided in [2] in relation to the RACH.

5. References

- [1] TR 25.813, Evolved Universal Terrestrial Radio Access (UTRA) and Universal Terrestrial Radio Access Network (UTRAN); Radio interface protocol aspects (Release 7), V0.3.0, 2006-01
- [2] R2-060430, Signalling for Random Access for LTE, Philips
- [3] R2-052444, Transport Channels & States for the E-UTRAN, Philips
- [4] R2-060015, Evolved Paging for LTE, Philips
- [5] TR 25.815, Signalling enhancements for Circuit-Switched (CS) and Packet-Switched (PS) Connections; Analyses and Recommendations, V0.4.2 (2005-11)

6. Text Proposal for TR 25.813

-- Start of Text Proposal --

5.2.2 Transport channels

Downlink transport channel types are:

1. **Broadcast Channel (BCH)** characterised by:
 - low fixed bit rate;
 - requirement to be broadcast in the entire coverage area of the cell.
2. **Downlink Shared Channel (DL-SCH)** characterised by:
 - possibility to use HARQ;
 - possibility of applying link adaptation by varying the modulation, coding and transmit power;
 - possibility to be broadcast in the entire cell;
 - possibility to use beamforming;
 - dynamic or semi-static resource allocation;
 - possibility of CQI reporting;
 - different levels of UE activity so as to achieve UE power saving.

NOTE: the possibility to use slow power control depends on the physical layer.

3. **Paging Channel (PCH)** 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;
 - the PCH carries Evolved Paging Indicators that contains:
 - o a service-scheduling indicator for physical resource allocation of data transmitted on the DL-SCH that the UE is being paged for;
 - o an indication for the default/stored configuration to be used for initial access to the network.

4. **Notification Channel (NCH) FFS** characterised by:
 - support of UE power saving;
 - requirement to be broadcast in the entire coverage area of the cell.

It is FFS whether a separate **Multicast Channel (MCH)** would exist or if additional attributes will be added to the SCH.

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-- *End of Text Proposal* --

