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Agenda Item:

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Title: Proposal for a modified PCH structure, revised

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Summary

We propose a new physical-channel structure for paging that is more efficient than the current structure in terms of DL code and power usage. Furthermore, it allows for greater flexibility in terms of paging payload. The new structure is split into a Page Indicator part and a Page Message part, transmitted on two separate physical channels. The Page Indicators are time-multiplexed with the Acquisition Indicators and the Page Messages are proposed to be incorporated into the FACH.

1 Introduction

The Paging Channel (PCH) of UTRA/FDD is mapped to a Secondary CCPCH (S-CCPCH) with spreading factor 64 (according to ARIB Vol.3), onto which *Page Indicators* (PI) and *Page Messages* are time-multiplexed in a rather intricate manner [1]. While the sleep mode properties of this structure are very good, the structure is somewhat inefficient in terms of DL power usage. This is due to the fact that the duty-cycle of the PCH is typically very low, while the peak power is rather high. Furthermore, the structure does not allow Page Messages to share the same immediate code-resource (sub-tree) as other messages with similar properties and requirements. This reduces the efficiency of the overall power and code-resource utilization.
Another drawback of the current 3GPP PCH is its limited flexibility. It is anticipated that Page Messages may be of varying sizes. It is not obvious that the current scheme, with its rather intricate structure, supports this in a good way.

2 General Proposal

We propose that paging makes use of two physical channels instead of only one physical channel, which is currently the case. One physical channel is used to carry Page Indicators while a second physical channel is used to carry the Page Messages, see Figure 1.

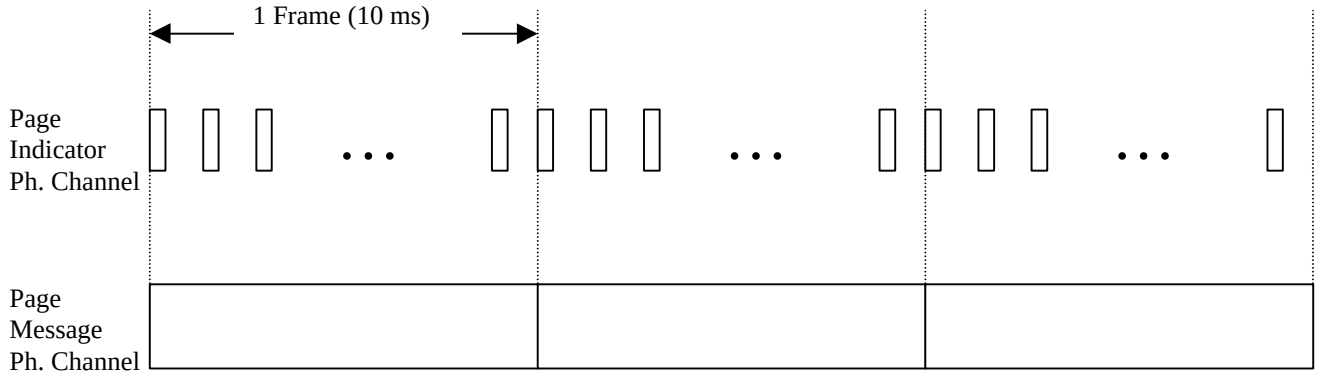

Figure 1 General description of new paging structure

The Page Indicators indicates to an UE that there may be a Page Message intended for it. They thus serve exactly the same function as the PI part of the current paging channel. Normally, a UE only monitors its PIs. Only if a PI is determined to be in the “on” state, does the US read the corresponding Page Message Channel to check the Page Message.

3 The Page Indicators

Currently in UTRA/FDD, the Acqusition Indicators (AI) are transmitted on the Acquisition-Indicator Channel (AICH). Due to processing-time requirements, the AI transmission is discontinuous with “holes” between consecutive AIs, see [1]. The “holes” surrounding the AIs could be filled with PIs. By doing this, the Page Indicators can be transmitted with virtually zero cost in terms of Node B power budget impact and DL channelisation code usage, as both the power and the code is already allocated, but not fully used, for AI transmission.
Consequently, we propose to replace the current AICH with an *Indicator Channel* (ICH) with the same structure as the AICH, but where the “holes” between the AIs are filled with PIs, see Figure 2.

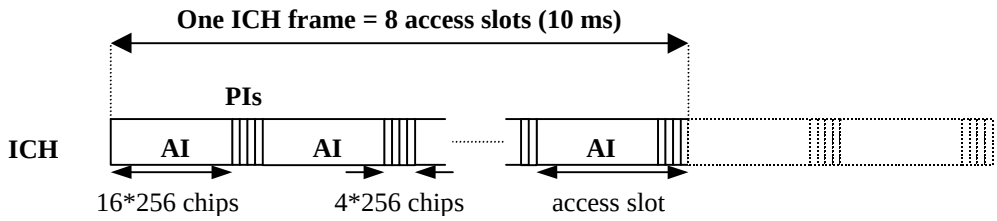

Figure 2 Proposed PI /AI transmission on the ICH

Each PI in a frame is allocated to a (group of) UE(s). For flexibility, we propose that there can be between one and four PI in each access slot i.e. the spreading factor of the PI can range between 256 and 1024[1]. In this way, the network operator can make a trade-off between sleep-mode efficiency (better sleep-mode efficiency with many short page indicators) and power budget allocated to the page indicators. There could also be a possibility to repeat the PI between the access slots (PI in access slot 1 repeated in access slot 5, PI in access slot 2 repeated in access slot 6, etc.) to achieve time diversity. Once again, this allows for a trade-off between sleep-mode efficiency, i.e. the detection performance can be improved at the expense of a reduced number of Page Indicators per frame.

4 The Page Message

The Page Message is a control message requiring in-band identification of the UE. As such, there is no principal difference as compared to any other L3 control message sent on a common TrCH, e.g. an "Access Grant" message. Therefore, we propose that the Page Message is seen as an ordinary FACH message and is sent on a FACH transport channel (Secondary CCPCH physical channel). This will lead to a more efficient use of the code resource, due to trunking effects. Furthermore, the flexibility in terms of payload will increase significantly as compared with the present 3GPP PCH structure. The Page Message may cover only a part of an S-CCPCH frame, e.g. by multiplexing with other FACH messages, or may even be extended over several S-CCPCH frames.

Obviously, there should be a well-defined timing T_{ICH} between the PI of a certain ICH frame and the corresponding Page Message frame. The timing should be chosen such that there is sufficient time for processing of the last group of PIs in a frame before the Page Message is to be received.

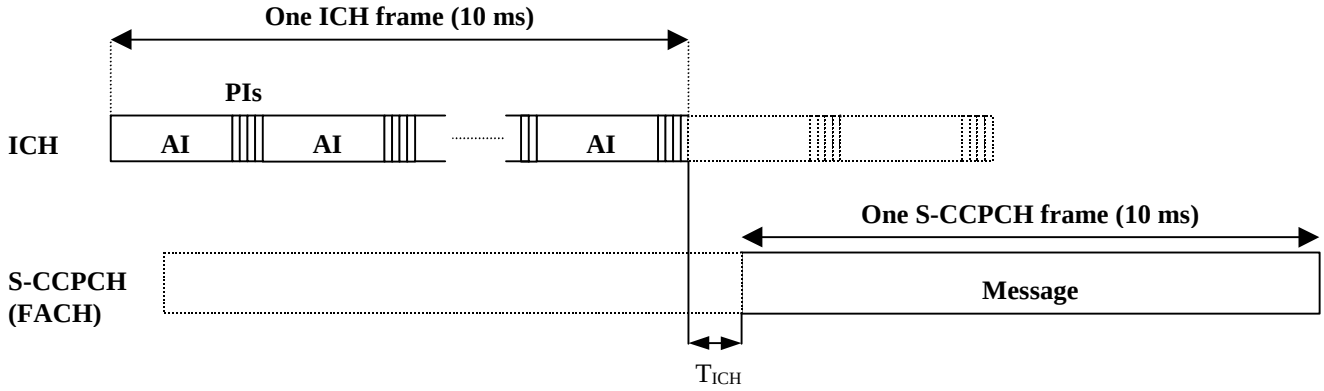

Figure 3 Proposed new paging structure

9 References

[1] 3GPP RAN S1.11 V2.0.0 (1999-04), UTRA FDD Transport Channels and Physical Channels.

[1] An equivalent description is to say that spreading factor of the PI is always 256 but the PI can be repeated 2 or 4 times.