TSG-RAN WG#2 Meeting#6 TSGR2#6 (99)841

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Support of Multi-Frame Page Messages

Introduction

In a 3GPP-WCDMA system the Secondary CCPCH is used to carry the FACH and PCH. The Secondary CCPCH can support variable rate with the help of the TFCI field. Although, the Secondary CCPCH channel bit rate can vary from 32 kbps to 2048 kbps, it is highly unlikely that channel bit rates more than 128 kbps will be supported. This is due to the fact that the power requirement for overhead channels should be minimized to maximize the number of users in a WCDMA system.

Currently, the structure of the PICH allows the page messages to be transmitted in one 10 msec frame following the PICH frame. However, extending the paging message over multiple frames will lead to a higher trunking efficiency. As an example, let us assume that 100 bits fit in a 10 msec frame and there are enough pages queued for a first frame to consume 120 message bits and enough pages queued for a second frame to consume 80 message bits. In this case, at least one of the pages from the first frame would need to be delayed to a subsequent paging occasion because there is not sufficient room in the frame. By combining the pages from the first and second frames, this problem could be avoided due to a higher trunking efficiency In this way because of the larger message throughput, use of multi-frame paging messages will also mean that it is possible to achieve a larger DRX cycle duration.

In this contribution, a simple modification is proposed followed by a text proposal for support of multi-frame page messages.

1.0 Current Structure of PICH and Message part

The Page Indication Channel (PICH) is a physical channel used to carry Page Indicators (PI). Figure 1 illustrates the frame structure of the PICH. One PICH frame is of length 10 msecs and consists of 300 bits (150 symbols). Of these, 288 bits are used to carry Page indicators and the remaining 12 bits are not used. The Page Indicators indicates to a UE that there may be a page intended for it. The UE monitors its PI and if it is determined to be in 'on' state, the UE reads the PCH after a predefined time T_{PICH} as shown in Figure 1. With this structure, it is not possible to support multi-frame messages on the PCH since there will be a conflict of the message part in the second frame corresponding to Page Indicators of the second frame.

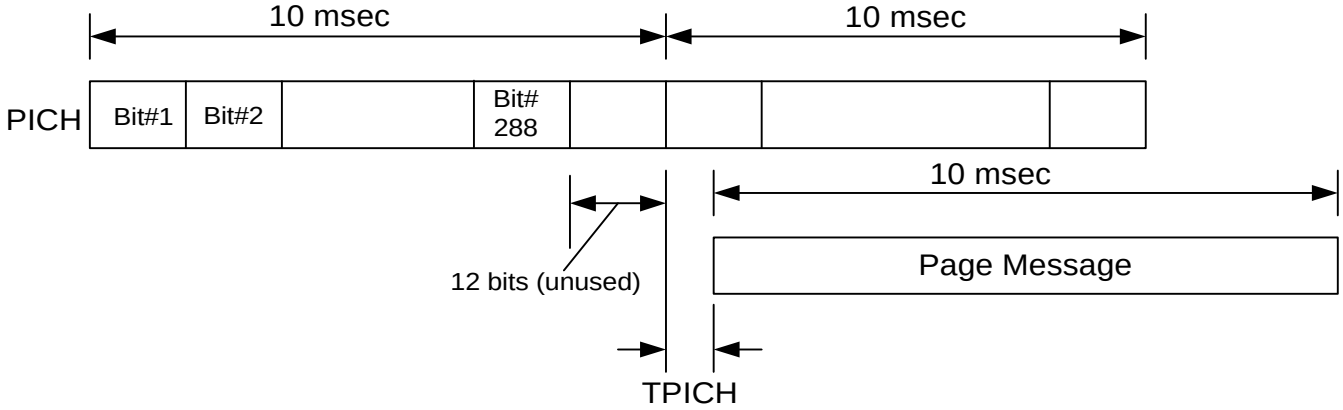

Figure 1

2.0 Proposed Structure of PICH and Message Part

It is proposed to increase the size of the PICH frame from one (1) frame to N_{max} frames where N_{max} is in the range of 1 to 8. The PICH will be followed by a Paging channel Message of length N_{max} frames. Figure 2 shows an example where $N_{max} = 4$. UEs are expected to have a DRX cycle (measured in frames) which specifies how often to wake up to receive Paging Indicators. The DRX cycle would be variable to allow a trade off between delay and sleep mode efficiency. In case N_{max} is set to 8 frames, the minimum value of the DRX cycle should be greater than or equal to $N_{max} = 8$. The parameters N_{max} and bit rate of the paging channel are broadcast on the BCH.

According to the proposed structure, the algorithm for calculating the paging occasions must be changed. The following algorithm is proposed. The Paging Occasions occur at the frame numbers:

Cell SFN = $\lfloor((\text{IMSI mod } M) \text{ mod (DRX cycle length)}) / N_{max}\rfloor \times N_{max} + n \times (\text{DRX cycle length})$ where n = 1,2..

The constant *M* is included to simplify the calculations (FFS). *M* must be significantly greater than the maximum possible DRX cycle length. The formula above indicates the first frame of the group of N_{max} frames which contains the UE's Paging Indicator. The actual Paging Indicator within the group of N_{max} frames has to be determined. This is done in a similar way based upon IMSI and the number of Paging Indicators in the frame.

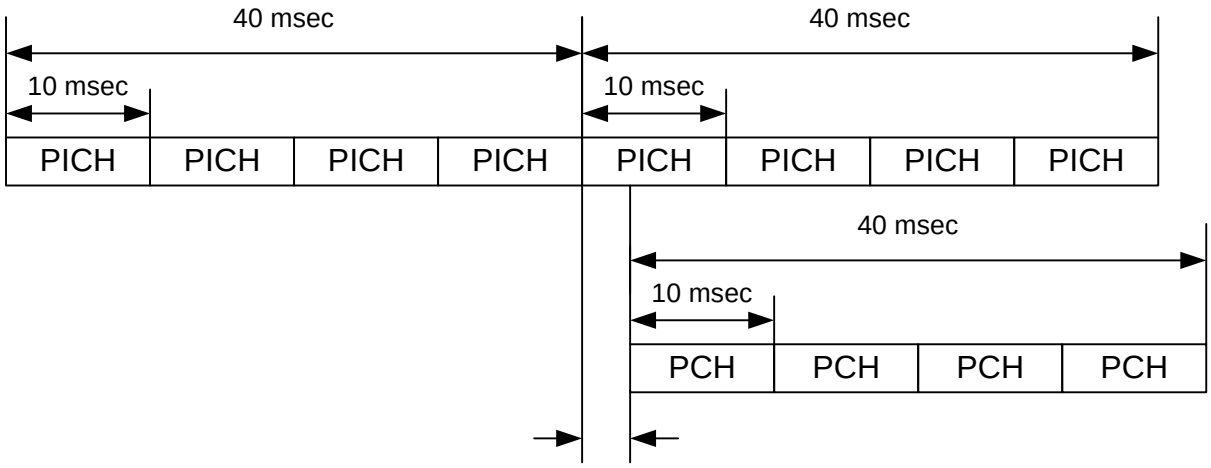

Figure 2

3.0 Conclusion

The modified structure allows UMTS to support multi-frame messaging on the paging channel thus giving the operator the flexibility to control the trunking and sleep mode efficiency. The changes to the RRC message parameters and information elements required to support this functionality are described in a companion paper [1].

4.0 Text Proposal

Section 8 of TS25.304 [2] should be modified as follows:

The UE may use Discontinuous Reception (DRX) in idle mode in order to save power consumption. When DRX is used the UE needs only to monitor at one paging occasion per DRX cycle.

The size of the Page Channel messages can vary from one(1) frame to a maximum of N_{max} frames thereby permitting control of the PCH trunking efficiency.

The DRX cycle length shall be 2^k frames, where k is an integer.

The UE may be attached to different CN domains with different DRX cycle lengths. In this case, the UE shall use the shortest of those DRX cycle lengths. The DRX cycle lengths for each CN domain are broadcast in UTRAN cells. An UE may also be assigned an individual DRX cycle length by a CN.

The UE shall use the IMSI, the Cell System Frame Number, the DRX cycle length and the duration of Paging Channel messages (N_{max} frames) to determine the Paging Occasions. The Paging Occasions occur at the frame numbers:

Cell SFN = $\lfloor ((\text{IMSI mod } M) \bmod (\text{DRX cycle length})) / N_{max} \rfloor \times N_{max} + n \times (\text{DRX cycle length})$ where n = 1,2..

where M is a constant used to simplify the calculations (FFS). M will depend on the coding used for IMSI. M must be significantly greater than the maximum possible DRX cycle length. *n* is a integer counter that is incremented every Paging Occasion and N_{max} (1 to 8) is the number of frames over which Paging Channel messages are transmitted.

The actual Paging Indicator within the frame that the UE shall read is similarly determined based on IMSI. The same applies for the PICH in case more than one exists.

5.0 References

[1] TS 25.304, “UE Procedures in Idle Mode”, v1.3.2

[2] Motorola ' New IE required to support multi-frame page messages', TSR2#6(99)843