3GPP TSG-RAN2 Meeting #57bis
St. Julian's, Malta, 26ᵗʰ-30ᵗʰ March 2007

Tdoc ⌘*R2-071337*

Agenda Item:	**5.3**
Souce:	**Samsung**
Title:	**System information scheduling and change notification**
Document for:	**Discussion and decision**

1 Introduction

During the previous RAN2 meeting the following was agreed:

Scheduling information (indicating starting times) is provided for a group of system information blocks (SIBs) that have the same scheduling requirements (i.e. periodicity). Such a group of SIBs is referred to as a Scheduling Unit (SU). BCH incudes 'Scheduling information of the most frequently repeated Scheduling Unit (SU-1)', while SU-1 includes the 'Scheduling information of the other Scheduling Units (other than SU-1)'.

This paper mainly discusses the further details of the scheduling information including what information is provided via the PDCCH. Furthermore, this paper analyses the different options for indicating system information changes.

2 Discussion

2.1 Scheduling information

This section discusses the further details of the scheduling information as included in BCH and SU-1 including the use of PDCCH.

BCCH mapped to BCH

The scheduling is fixed in all details i.e. PDCCH is not used.

BCCH mapped to DL-SCH

In order to limit its size, our proposal is that the Scheduling information indicates the Radio Frame (RF) in which the transmission of the concerned SU starts i.e. the UE starts reading the PDCCH control channel from the first sub-frame of the indicated RF (i.e. UTRAN has some scheduling flexibility, but this comes at the cost of decreased UE battery lifetime).

Note   In the back of this document (see 5.1), we have shown that use of a common offset can help to reduce the scheduling information (resulting in 9b of scheduling info on BCH and 10b + N_{SU} * 4b of scheduling info within SU-1, with N_{SU} being the number of SUs that are scheduled and assuming the standard allows up to 16 SU).

It is assumed that roughly 10 bits of the PDCCH are not relevant for the case of BCCH mapped to DL-SCH. Our proposal is to introduce a special format, including a field for indicating the SU.

Especially for low bandwith systems, it seems desirable to introduce some scheduling flexibility. Hence, it is proposed that the UE only considers that transmission of an SU is finised when detecting the absence of the SU on PDCCH for N consecutive subframes. Considering that the eNB has the option to use a reduced number of resources for BCH, the value of N could probably be low (and fixed in the standard).

Summary of proposals

- 'Scheduling information' indicates the Radio Frame (RF) in which the transmission of the concerned SU starts

- PDCCH control channel is used to indicate the SU and the corresponding detailed time/ frequency resource allocation

- UEs only consider transmission of an SU to be finised when detecting the absence of the SU on PDCCH for N consequtive subframes

2.2 Indication of system information change

2.2.1 Use of paging/ notification and value tags

UMTS includes the following mechanism to indicate a system information change

- UTRAN can notify UEs by signalling the "BCCH modification info" (MIB Value tag & BCCH modification time), using the PAGING TYPE1 message (UEs in IDLE & _PCH) and the SYSTEM INFORMATION CHANGE INDICATION message (CELL_FACH)

- The MIB includes a general 4b value tag. For all other SIBs a value tag is provided together with the scheduling information (i.e. within the MIB or one of the Scheduling blocks). For most SIBs a 2b cell value tag is used

Most system information changes rather infrequently, say once per day (the only exception may be UL interference info i.e. SIB7 alike). Hence, a 'paging/ notification mechanism' is much 'cheaper' than transmitting value tags every few radio frames (RF). Hence our proposal is to indicate System information changes by means of a 'paging/ notification mechanism'.

Nearly all system information is cell specific. Consequently, if a paging/ notification mechanism is used, the main remaining purpose of using value tags on BCCH is to avoid BCH acquisition upon return from a temporary Out Of Service (OOS). For this case, the value tags help not only to improve UE battery lifetime but more importantly to reduce the 'service interruption' (related to acquisition of SIBs including the common channel configurations e.g. paging, aRACH). Although OOS should be infrequent, our assumption is that value tags are probably needed for this purpose. Our proposal is that BCH does not include an overall value tag (indicating changes in all system information). Instead, it is proposed that the most frequently repeated Scheduling Unit (SU-1) includes a value tag for each of the SUs. This means that upon returning from OOS the UE acquires SU-1 and, depending on the value tags, other SUs

SUs should be designed to include a limited number of SIBs corresponding with independent functionality. Considering the infrequent changes, the additional 'cost' of acquiring the entire SU is marginal especially when concentrated transmission is used for D-BCH. Hence our proposal is that if one System Information Block changes, the UE acquires the entire Scheduling Unit in which it is contained (implying that changes are indicated at the level of an SU)

Summary of main proposals

- System information changes are indicated by means of a 'paging/ notification mechanism'

- BCH does not include an overall value tag (indicating changes in all system information). The most frequently repeated Scheduling Unit (SU-1) includes a value tag for each of the SUs

    o Upon returning from OOS the UE acquires SU-1 and, depending on the value tags, other SUs

- If one System Information Block changes, the UE acquires the entire Scheduling Unit in which it is contained (implying that changes are indicated at the level of an SU)

2.2.2 Paging/ notification information

BCCH modification time

Optional, needed to support synchronous reconfiguration of e.g. common channel information

The modification time needs to cover a range corresponding with the longest Paging/ DRX cycle. It does not seem essential to use all frames as possible start of a BCCH modification i.e. to save bits we could limit the

modification time to frames corresponding with SFN MOD 16, in which case 6b would be needed for a range of 60s.

Note 1   In UMTS, there does not seem to be an explicit statement that the UE shall refrain from using the 'old configuration' after the modification time

Overall value tag

Inclusion of a value tag allows time flexibility between the paging/ notification and the (asynchronous) BCCH modification i.e. if the MIB value tag is not set to the indicated value, the UE knows the modification has not occurred yet and will re-read BCH at the next 'value tag occurance'.

Time flexibility is not needed to accommodate varying transport network delays (since BCCH and PCCH are terminated in the eNB). Time flexibility could be desirable since UEs in DRX receive the notification at different points in time (due to different paging cycles and occasions). However, it seems preferable to perform (asynchronous) BCCH moficication prior to the paging/ notification to avoid that UEs have to acquire system information multiple times. In such a case, the only purpose of the value tag information is to avoid multiple BCH reading due to repeatition of the paging/ notification (as well as the useless BCH reading for UEs that have already aquired the new BCH information). This purpose could equally well be achieved by a 2b 'Transaction identity'.

Based on the above, there does not seem to be a strong need for including value tag information in the BCCH modification information.

Scheduling information of changed SU

One could consider including the scheduling information of the changed SUs. However, it is assumed that the scheduling information is quite stable and normally does not change even if there is a change in SU-2, SU-3 or SU-4. Hence, there does not seem to be a strong need for including this in the BCCH modification information.

Further signalling aspects

The paging/ notification can be provided in a number of ways:

1: *PDCCH only*: A special RNTI value is used for the PDCCH CRC, indicating 'BCCH Modification'. The BCCH modification information is carried on PDDCH, using a special format.

2: *PDCCH+PCH*: The 'paging RNTI' is used for the PDCCH CRC. The BCCH modification information is carried on PCH i.e. using an optional BCCH Modification IE within the Paging message

3: *BCH*: The UE is required to verify the value tag of each SU periodically e.g. at least once per 5s

Approach 3 is bad for the UE battery lifetime unless there is system information that the UE anyhow needs to acquire frequently. Considering the conclusion of the UTRA SIB7 discussions (the information is not very dynamic i.e. may be valid for 40s), this does not seem the way to go.

Approach 1 implies that at every Paging/ DRX wakeup the UE has to verify an additional C-RNTI value which may somewhat affect UE battery lifetime as well as UE complexity. This approach also implies that the BCCH modification info has to be limited to around 10 bits.

Approach 2 means that there will be an additional overhead in every 'Paging' message (i.e. a 'presence' bit for the IE BCCH Modification info). Moreover, this approach probably implies that some kind of 'Paging/ notification' message has to be introduced for connected mode (i.e. separate, somewhat different, mechanisms for idle and connected). On the positive, there is only additional UE processing in the infrequent case of a BCCH mofication.

We request RAN2 to consider approach 1 and 2. Both approaches are able to provide the essential BCCH modification information i.e. the modification time and a 'transaction identity'. In case approach 2 is adopted, some more information may be included e.g. an indication of the changed SU, possibly including the value tag.

In case there is no significant difference in UE power consumption between approach 1 and 2 i.e. between

1: Checking PDCCH with an additional RNTI, at every paging cycle/ DRX wakeup and

2: Reading an additional Paging message when detecting "PCH RNTI" on PDCCH, due to a BCCH modification (occurring once a day)

then approach 1 seems most attractive, since it can be used for both modes. Then, to avoid the continuous additional RNTI-processing for active connected mode UEs, it seems attractive to adopt a scheme in which:

- Idle mode and 'inactive' connected mode UEs (DRX above a threshold) apply approach 1, while

- 'Active' connected UEs periodically verify if 'BCCH modification' is indicated on PDCCH i.e. apply approach 1 e.g. once every 2s.

This seems an acceptable mechanism, but it may be appropriate to ask RAN1 for confirmation.

Note 2   As mentioned before, most system information changes infrequently i.e. once per day. Hence, a 2 bit value tag as used in UTRA would seem sufficient.

Summary of main proposals

- RAN2 is requested to first decide how the BCCH modification is provided i.e. either:

    o 1: PDCCH only: Using a special RNTI value and a special PDCCH format

    o 2: PDCCH+PCH: The 'paging RNTI' and the Paging message is used. If needed, a similar mechanism can be developed for connected mode UEs

- The BCCH modification information is decided depending on the above:

    o Approach 1: Modification time and the transaction identity

    o Approach 2: Modification time and transaction identity. In this case additional information could be considered e.g. an indication of the changed SU, possibly including the value tag.

        ▪ These additions are not considered to be really needed

2.2.3 Dynamic system information i.e. SIB-7

In UTRA, there is one rather dynamic SIB, namely SIB 7. This SIB includes the UL interference level and the dynamic persistence information, both of which are relevant for initial RACH access. UTRA SIB 7 applies an expiry timer. In our understanding, the latest discussions on SIB-7 concluded that the information is less dynamic than earlier anticipated i.e. the final recommendation was to repeat the information regularly i.e. every 160ms and to set the expiration time to 256 repetitions i.e. 40s.

The previous suggests that it may be possible to apply a value tag for this type of information also i.e. it could be specifed that the UE re-reads the SIB after having been OOS for a period typically corresponding with the value tag wrap around. However, it is not attractive to perform a paging/ notification frequently e.g. every 5 sec. Hence, our proposal is to apply an expiration time for system information that changes frequently.

Summary of main proposals

- Apply an expiration time for system information that is changing frequently

3   Conclusion & recommendation

In this contribution we have discussed the further details of the scheduling information including what information is provided via the PDCCH. Furthermore, this paper analysed the different options for indicating system information changes. Based on our analysis, RAN2 is requested to consider the following proposals:

- 'Scheduling information' indicates the Radio Frame (RF) in which the transmission of the concerned SU starts

- PDCCH control channel is used to indicate the SU and the corresponding detailed time/ frequency resource allocation

- UEs only consider transmission of an SU to be finised when detecting the absence of the SU on PDCCH for N consequtive subframes

- System information changes are indicated by means of a 'paging/ notification mechanism'

- BCH does not include an overall value tag (indicating changes in all system information). The most frequently repeated Scheduling Unit (SU-1) includes a value tag for each of the SUs

    o Upon returning from OOS the UE acquires SU-1 and, depending on the value tags, other SUs

- If one System Information Block changes, the UE acquires the entire Scheduling Unit in which it is contained (implying that changes are indicated at the level of an SU)

- RAN2 is requested to first decide how the BCCH modification is provided i.e. either:

    o 1: PDCCH only: Using a special RNTI value and a special PDCCH format

    o 2: PDCCH+PCH: The 'paging RNTI' and the Paging message is used. If needed, a similar mechanism can be developed for connected mode UEs

- The BCCH modification information is decided depending on the above:

    o Approach 1: Modification time and the transaction identity

    o Approach 2: Modification time and transaction identity or further detailed information e.g. an indication of the changed SU, possibly including the value tag

- Apply an expiration time for system information that is changing frequently

4 References

[1] RP-070136 TS 36.300 E-UTRA and E-UTRAN Overall description; Stage 2 (Release 8)

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