TSG-RAN Working Group 3 meeting #7
France, Sofia Antipolis, 20th-24th September

TSGW3#7(99)B63

Agenda Item: **16.3/16.4**

Source: **Ericsson**

Title: **Transport of System information over Iub**

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1. INTRODUCTION

Currently, it is assumed that the termination point for the RRC protocol used over the BCH is in the Node-B. Ref [1] defines a "System Information Update" procedure which the CRNC can use to provide the Node-B with the necessary information.

Since the CRNC is providing (almost) all of the information that has to be broadcasted on the BCCH, this contribution proposes to shift the RRC termination point almost completely to the CRNC. Given the wide range of functionality that the RRC layer is providing when used over the BCH, a small part of the RRC functionality will remain in the Node-B.

Before discussing the WG3 related proposal, first an overview is presented on the latest WG2 status, since not all latest WG2 decisions have been reflected in specification updates.

2. BACKGROUND INFORMATION: WG-2 STATUS

From approved WG2-contribution ref. [2], the following description was taken:

1. Overall Structure

The system information elements are broadcast in *system information blocks*. Different system information blocks may have different characteristics, e.g. regarding their repetition rate and the requirements on UEs to update the system information blocks. A *master information block* is used to specify what system information blocks are in use in a cell, and how they are scheduled. The *system information blocks* may also contain scheduling information for other *system information blocks* in a lower hierarchy.

Each system information block has a specific characteristic regarding when it is needed by the UE, its repetition period, its update frequency and its scope (cell/PLMN).

2. Scheduling

The scheduling of the broadcast channel is done in such way that the UE knows exactly when the needed information can be found.

The scheduling information for a system information block (SIB) consists of the following parameters:

- actual broadcast channel (if more than one exists)[1]
- the repetition period (SIB_REP)
- the position (phase) within the repetition period (SIB_POS).

The scheduling is based on the Cell System Frame Number (SFN). The frame at which a particular *system information block* occurs is defined as follows:

[1] WG3 editor note: this is no longer relevant since WG2 has decided to only have one BCCH on a BCH.

SFN mod SIB_REP = SIB_POS

It is proposed that SIB_REP be defined as a power of 2. Thus a big range for SIB_REP can be achieved with only a few bits. This will also simplify the scheduling of various *system information blocks* with different repetition periods on the same channel. In that case two *system information blocks* with a low repetition rate can be multiplexed to give the next higher repetition rate, which can be multiplexed with a *system information block* with that repetition rate etc. This is illustrated in the figure below, where four different *system information blocks* are multiplexed on one channel. The SIBs have the following parameters:

SIB1: SIB_REP = 8 SIB_POS = 0
SIB2: SIB_REP = 8 SIB_POS = 4
SIB3: SIB_REP = 4 SIB_POS = 2
SIB4: SIB_REP = 2. SIB_POS = 1

SFN:	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14
	SIB1	SIB4	SIB3	SIB4	SIB2	SIB4	SIB3	SIB4	SIB1	SIB4	SIB3	SIB4	SIB2	SIB4	SIB3

Note that the scheduling shown in the figure above may not be optimal. It does not even comply with the range proposed below. It is only shown to highlight the scheduling principles.

A suitable range for SIB_REP would be 16 to 2048 (3 bits required) corresponding to 0.16 to 20.48 seconds. SIB_POS must always be less than SIB_REP. The number of bits used to code SIB_POS can therefore be SIB_REP dependent (4 to 11). This will save bits and avoid an error case.

The *master information block* will be scheduled in the same way but the parameters will be specified (FFS). SIB_REP might be less than 16 if that is considered suitable.

The example above is for the simple case where the system information blocks exactly fits one transport block. However, since it is expected that the system information will evolve and more elements will be added, it is important that a given system information block can be extended with more information elements when needed. Also, especially for the measurement control information, the number of elements of a given type (e..g. the measurement objects) can vary a lot. Therefore it is very important that segmentation of system information blocks into transport blocks (e.g. 160 bits) is supported.

Ref [2] continues on the segmentation and the following L3 scheduling was accepted by WG2:

3. L3 Segmentation

In this solution, the RRC layer always passes down pieces that fits into one transport block. On the BCH only one BCCH is mapped in this solution, since the multiplexing is done in RRC. The simplest example can be found in GSM. One RRC message type is specified for each segment. If a system information block needs to be segmented, each part becomes a separate RRC message with an upper maximum length with is the transport block size.
The RRC layer performs the scheduling, multiplexing and passes down the segments in the order they shall be transmitted.
The scheduling information for a system information block should include where each segment of the SIB (SIB1a, SIB1b etc) can be found, so the UE easily can locate the different segments.

SFN:	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14
BCCH	SIB1a	SIB1b	SIB3a	SIB2	SIB3b		SIB3a	SIB3b	SIB1a	SIB1b	SIB3a	SIB2	SIB3b		SIB3a

Although the copied text itself was not agreed in WG2 (not proposed to be included in any specification), the indicated concept was agreed including MIB, SIB and RRC segmentation and scheduling. More detailed contributions (e.g. ref [5]) also describing the contents of the SIB's are submitted to the coming WG2 meeting (ref [3], submitted for the previous WG2 meeting, proposes detailed SIB contents but was not discussed yet).

3. RATIONALE

3.1. Protocol architecture

Considering the following:

- So far no parameters have been identified which have to originate from (to be measured by) the Node-B and updated in the RRC/BCH very frequently. The only broadcasted parameters, possibly based on node-B measurements, currently under consideration are UL interference and RACH/CPCH persistency. For these parameters it is expected that the required updated period will be around 10 seconds or longer. In addition it is expected that the broadcasted values are not directly the measured values but the measured values after some filtering.
- Some system information can be sent also on FACH. For instance, the contents of the master information block sent on FACH to notify UEs in CELL_FACH state on an update of system information, needs to be co-ordinated with that sent on BCH.

Therefore it is proposed to move the termination point for the RRC protocol over the BCH from the node-B to the CRNC, however with one exception.

When the RRC protocol is used over the BCH, the RRC protocol layer takes care of a lot of functionality:

1. Format MIB/SIB
2. Segment MIB/SIB into segments which fit in BCH TB's
3. Determine scheduling of segments (= BCH TB's)
4. Perform repetitive transmission of segments according the determined schedule

In order to avoid that the CRNC has to send segments constantly to the node-B although they are not updated, it is proposed to leave the repetitive transmission in the node-B.

The resulting protocol architecture is shown in figure 1.

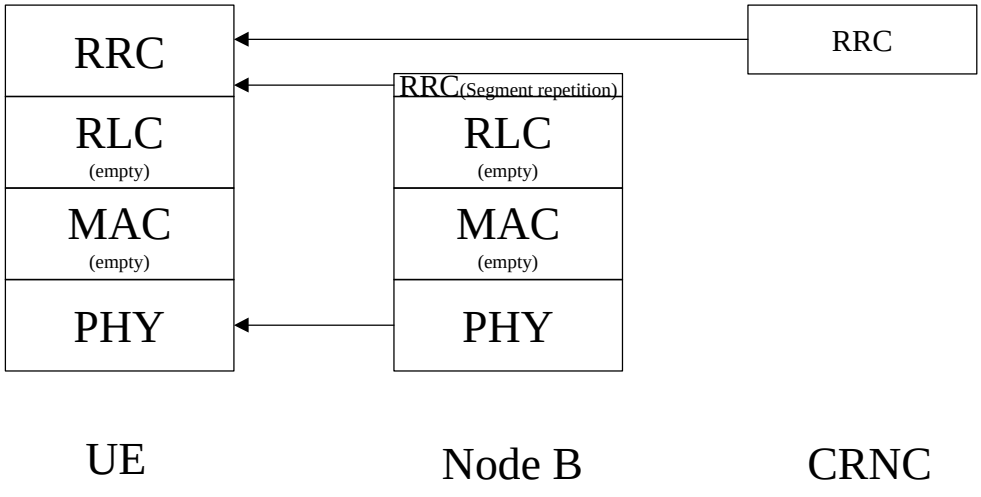


Figure 1: Protocol architecture

3.2. Detailed consequences

It is proposed that the CRNC will send segments to the Node-B. Only the CRNC will have to execute the segmentation of the MIB/SIBs.

The Node-B receiving the segments should take care of the scheduling of the segments based on the SG_REP and the SG_POS and does not have to be aware of the detailed contents of the different segments.

Often several information blocks will have to updated at the same time. E.g. the CRNC will have to provide an updated MIB every time a SIB change requires update of the value tag in the MIB. Even in the case when only one SIB needs to be updated, still this could mean an update of several segments. Therefore it is proposed that multiple segments can be updated in one NBAP procedure.

If multiple information blocks are updated in one procedure, the MIB segments shall always be updated last: when the tag value in the MIB is updated, the information in the other SIB's should already have been updated. This means that the Node-B has to know which segments belong to the MIB.

Further assumptions:

- The SG_POS will be equal to the SIB_POS, unless the SIB is segmented in multiple segments. In this case, an offset will have to be added: SG_POS = SIB_POS + x.
- The SG_REP will always be equal to the SIB_REP.

4. PROPOSAL

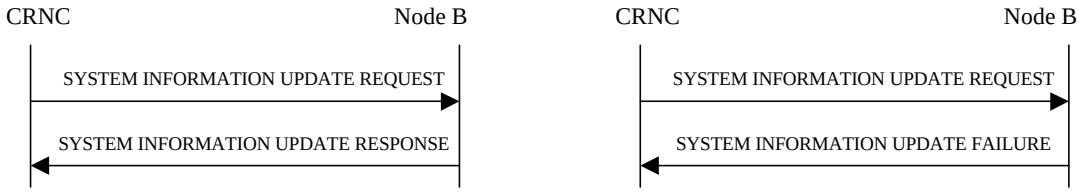
Based on reasoning stated in chapter 3, the following detailed modifications are proposed to [1].

4.1. Procedure text

The following changes are proposed to the current procedure text in [1] chapter 8.1.7.:

8.1.7. System Information Update Procedure

This NBAP common procedure is used by the CRNC to send system information to its Node B, which broadcasts them on the logical channel BCCH. The procedure is triggered when CRNC sets the system information at start/restart and when the system information needs to be modified.



Sys~~y~~tem Information Update Procedure

The SYSTEM INFORMATION UPDATE REQUEST message contains Master Information Block (MIB)- and/or System Information Block (SIB) segments which have to be broadcasted on the primary-CCPCH, together with scheduling information for each segment. The Node B is responsible for transmitting the received segments according the scheduling parameters provided by the CRNC. Based on the received segment position (SG_POS) and segment repetition (SG_REP), the Node B shall transmit the corresponding segment in frames with :

SFN mode SG_REP = SG_POS

If the SYSTEM INFORMATION UPDATE REQUEST message contains MIB segments in addition to SIB segments, the MIB segments shall be updated last in the BCH scheduling cycle.

~~new information to be broadcast on the BCCH.~~

The Node B shall either reply with a SYSTEM INFORMATION UPDATE RESPONSE message, or a SYSTEM INFORMATION UPDATE FAILURE message.

The SYSTEM INFORMATION UPDATE RESPONSE message indicates successful completion of the update procedure meaning that all the new segments are inserted in BCH scheduling cycle.

Note: This does not necessarily mean that the information is already broadcasted on the Uu.

The ~~while~~ SYSTEM INFORMATION UPDATE FAILURE message indicates unsuccessful completion of the BCH update. In this case the complete update has failed; no new segment will have been inserted in the BCH scheduling cycle. ~~. When the SYSTEM INFORMATION UPDATE RESPONSE message indicates successful procedure completion, the information broadcast on the BCCH is updated successfully with the newly received information.~~

(Editors note: the assumption that no SIB is originating from the Node B still needs to be confirmed by WG2).

4.2. Message layout

The following message layout is proposed to be included in chapter 9.1.x (no message layout is currently specified):

9.1.x System Information Update Request

Information Element	Reference	Type
Message Discriminator		M
Message Type		M
Transaction ID		M
MIB Segment Information		C1
MIB SG REP		M
MIB SG POS		M
MIB SG		M
SIB Segment Information		C1
SIB SG REP		M
SIB SG POS		M
SIB SG		M

C1: At least one of the information element groups shall be present.

9.1.x. System Information Update Response

Information Element	Reference	Type
Message Discriminator		M
Message Type		M
Transaction ID		M

9.1.x. System Information Update Failure

Information Element	Reference	Type
Message Discriminator		M
Message Type		M
Transaction ID		M

In addition, the following parameter descriptions are proposed to be included in chapter 9.2.1:

9.2.1.x MIB_SG

Segment which is part of the Master Information Block.

9.2.1.x MIB_SG_POS

First position of the Master Information Block segment in the SFN cycle (MIB_SG_POS < MIB_SG_REP)

9.2.1.x MIB_SG_REP

Repetition distance for a Master Information Block segment. The segment shall be transmitted when SFN mod MIB_SG_REP = MIB_SG_POS.

9.2.1.x SIB_SG

Segment which is part of a System Information Block.

9.2.1.x SIB_SG_POS

First position of the System Information Block segment in the SFN cycle (SIB_SG_POS < SIB_SG_REP).

9.2.1.x SIB_SG_REP

Repetition distance for a System Information Block segment. The segment shall be transmitted when SFN mod SIB_SG_REP = SIB_SG_POS.

4.3. Liaison

It is proposed to sent a liaison to WG2 asking for a confirmation on the assumption that no SIBs need to originate from the Node B.

5. REFERENCES

[1]: TS 25.433 v.1.2.0 “NBAP specification”

[2]: TSGR2#6(99)944: “Scheduling of system information”

[3]: TSGR2#6(99)817: “System Information Blocks”

[4]: TSGR2#6(99)584: “Mechanisms to transfer and update system information”

[5]: TSGR2#7(99)xxx: “Change of termination point for BCH”