TSG-RAN Working Group 3 meeting #6
Sophia Antipolis, France, August 23-27, 1999

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Agenda Item: **6.3**

Source: **Alcatel**

Title: **Synchronization of UTRAN nodes by AAL0/ATM cells**

Document for: **Approval**

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1 Introduction

At Helsinki meting, two different methods have been proposed for the synchronization of UTRAN nodes. The first one, supported by Nokia, proposes to use AAL2 mini-cells, carried by the existing AAL2 connections used by FACH transport channels. The second one, supported by NTT DoCoMo [1], proposed to use AAL0/ATM cells over a high priority ATM connection.

2 Discussion

The discussion is related to two subjects: the synchronisation frames bearer (AAL2 or ATM), and the synchronisation mechanism.

2.1 Synchronisation frame bearer

1. Delay Variation

The delay variation is a key parameter since it corresponds to the accuracy of the transfer delay measurements. Using AAL2 leads to less accuracy than using ATM cells since an AAL2 mini-cell will be transmitted when the ATM cell will be full. Furthermore, according to I.363.2, an AAL2 mini-cell can be transmitted over two ATM cells. And this is completely unpredictable.
Therefore, AAL2 introduces a delay variation that is approximately twice the transmission time of an ATM cell. AAL2 is not an appropriate solution regarding delay variation.

2. Functional split

The solution proposed by Nokia in which synchronisation of Nodes B may be achieved via FACH/RACH AAL2 connection mixes two different functions that are not linked together: synchronisation mechanisms between nodes should not depend on a type of transport channel. Furthermore, there are two additional issues with that solution:

- FACH/RACH AAL2 connection has not a high priority compared to AAL2 connections supporting real-time data since FACH data, and especially RACH data, are non real-time.
- In the case of several FACH, which one should be used?

3. Future safe aspects

The solution reusing FACH/RACH AAL2 solution cannot be extended to the synchronisation of RNCs whereas the solution using AAL0/ATM cells allows it.

2.2 Synchronisation mechanism

NTT DoCoMo contribution [1] proposed to use a procedure equivalent to the Network Time Protocol (NTP, RFC1305), used to synchronise the time in LANs/WANs.

The synchronisation procedure is based on the same principles as IETF RFC 1305.

Figure 1 shows the case of CRNC / Node B synchronisation.
CRNC sends a SYNC REQUEST Control Frame to Node B. This message contains the time of transmission (t1). Upon the reception of SYNC REQUEST, Node B responds with SYNC RESPONSE which contains the time of SYNC REQUEST transmission (t1), the time of the arrival (t2) and the time of the response (t3). CRNC, using the three values together with the time of the arrival of the response (t4), calculates the timing difference as follows.

- Transmission delay T = {(t4 - t1) - (t3 - t2)} / 2
- Timing difference X = t2 - t1 - T

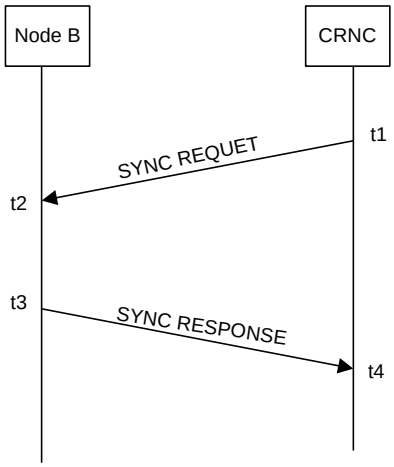

Figure 1: Node Synchronisation procedure

Since the AAL0/ATM synchronisation cells have the highest priority, the transfer delays can be considered in both directions as equivalent with the error of the delay variation. And the delay variation should be very low since it is the highest priority.

Furthermore, using the RFC 1305 mechanism is very beneficial for the future if the UTRAN is based on a full IP transport network.
Therefore, the above mechanism is proposed for the synchronisation of Nodes B under a CRNC, and, optionally, between RNCs in the UTRAN.

3 Proposal

3.1 Proposed modifications to TS 25.401

1) It is proposed to modify the existing text of section 9.3 of TS 25.401 v1.2.1 [1] as follows:

9.3 Node Synchronisation

Node Synchronisation describes how a common timing reference can be achieved between the UTRAN nodes.
Since it is desired to avoid dependence to an external system to provide Node Synchronisation, a specific solutions for UTRAN is needed. If the Network Synchronisation is very good, the drift between different nodes is slow, but will occur. Therefore, some kind of protocols over Iur and Iub need to be specified to detect and correct a possible misalignment of the Node Synchronisation.
The needed accuracy need to be identified.
The architecture may have several solutions: separate synchronisation node, hierarchical synchronisation relation between RNCs and RNC-Node B, mutual synchronisation between RNCs etc.
The RNC / Node B synchronisation and the RNC/RNC synchronisation shall be possible by using a dedicated AAL0/ATM VC with the highest priority. A single synchronisation procedure based on IETF RFC 1305 is defined for the sake of compatibility between UTRAN elements. This procedure

is defined in TS 25.433.

Positioning / Localisation functions may also set requirements on this Node Synchronisation.
[TDD - Node Synchronisation and Frame synchronisation are used within neighbouring cells to minimise cross-interference (Node B-Node B, UE-UE, Node B-UE cross-interferences)].

3.2 Proposed modifications to TS 25.433

It is proposed to include the proposed node synchronisation procedure (Figure 1 and explanatory text) in a new section of TS 25.433 [3].

3.3 Proposed new text in TS 25.430 [4]

1) Add a new section 4.4.6

4.4.6. Iub node synchronisation signalling

The Iub interface provides the means for the node synchronisation between an RNC and its Nodes B. The Iub node synchronisation signalling is carried over a predefined ATM connection, which has the highest ATM priority.

2) Add a new section 5.2.11

5.2.11 Node synchronisation

The controlling RNC memorises the timing information of each node B based on the result of node synchronisation signalling procedure. The RNC adjusts the information if, e.g., a Node B synchronisation shift is detected.

The Node B only handles node synchronisation signalling and does not need to adjust its timing since the controlling RNC adjusts the timing information of the Node B.

3) Add a new section 6.2.2.9

6.2.2.9 Iub Node Synchronisation Signalling Port

A single Iub node synchronisation signalling port shall be used for the RNC - Node B synchronisation procedure.

4) Modify section 7 "Iub Interface Protocol Structure"
It is proposed that the Iub interface protocol structure should include “Node Synchronisation Plane” with Physical layer and ATM layer for transport and node synchronisation protocol for Radio Network Layer.
It is proposed to add a bullet 3 after the numbered bullet 2 with the text:
"Node synchronisation layer, defines procedures for establishing node synchronisation".
And add the Node synchronisation layer in the figure, supported by AAL0/ATM.

4 References

[1] R3-99688 Proposed Iub node synchronisation procedure, DoCoMo contribution.
[2] TS 25.401 UTRAN Overall Description V1.2.1
[3] TS 25.433 UTRAN NBAP specification
[4] TS 25.430 UTRAN I_{ub} Interface: General Aspects and Principles V0.1.4