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Agenda Item: **7.1**

Source: Alcatel

Title: **Usage of CCCH, DCCH or DTCH for Cell/URA Update; Consequences on UL & DL signalling Transfer RNSAP messages**

Document for: Decision

Usage of CCCH, DCCH or DTCH for Cell/URA Update;
Consequences on UL & DL signalling Transfer RNSAP messages

1 Introduction

Contributions [1] (Nokia) and [2] (Nortel Networks) discuss the advantages/drawbacks of using DCCH, CCCH or DTCH for initial messages (e.g. Cell Update Request, URA Update Request, RRC Connection re-establishment). They do not consider the way these messages are transferred from C-RNC to S-RNC, nor the functional split between Control Plane, User Plane and Radio Network Control plane.

The present contribution tries to study the different solutions as regards to different aspects:

- Split between Control Plane, User Plane and Radio Network Control plane,
- RRC connection,
- Reliability.
- Ciphering

It proposes to use DCCH transport channel, and consequently to remove the RNSAP messages that have been introduced for the transport of RRC signalling on CCCH transport channel.

2 Functional split

The functional split in the Serving RNC can be represented as shown in the following figure. Four clear functional splits can be stressed: the user data plane, the user signalling plane (RRC messages), the Transport Control plane and the Radio Network Control Plane (RNSAP messages). This split has been made at the interfaces and it is necessary that there is no mixing of the planes in order to have a good basis for further feature extensions.

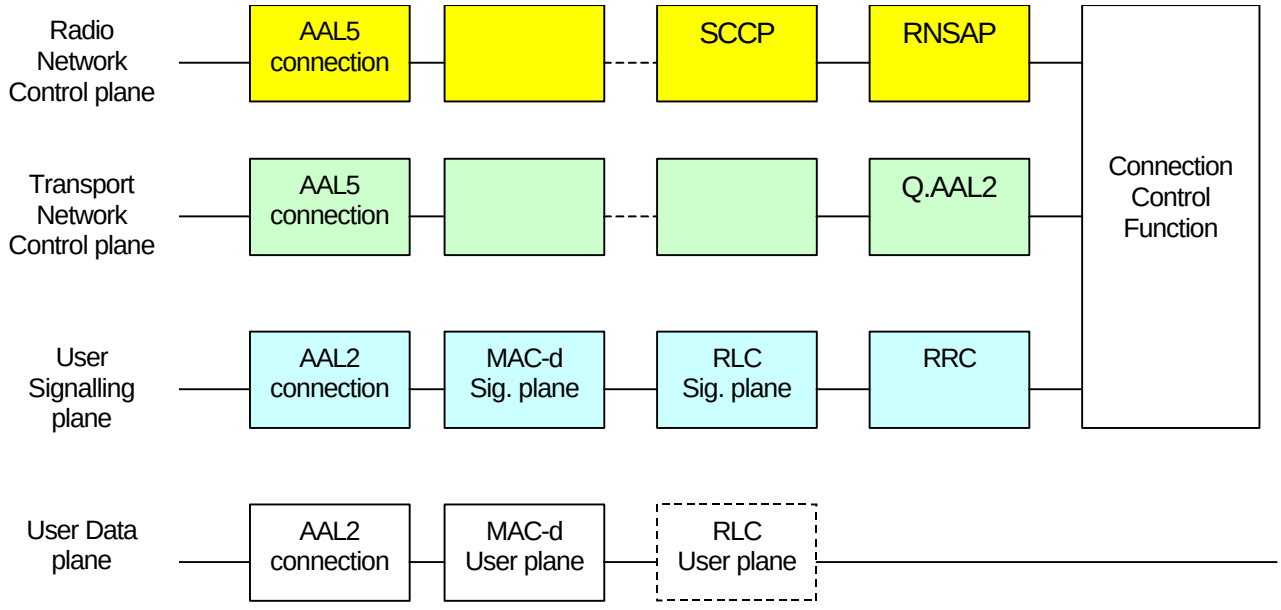

Figure 1: Functional split of protocols in the S-RNC

3 Discussion

Regarding RRC connection, it is clear that the UE has an RRC connection when it initiates e.g. a Cell Update Request or URA Update Request towards a new cell. The RRC function for that UE is

located in the Serving RNC. There is no need to re-establish a new RRC connection, but the C-RNC that receives the RRC Cell/URA Update Request message has to route it to the S-RNC, and to the right UE context within the S-RNC.
Therefore, the Cell/URA Update Request message must contain the SRNC-id and the S-RNTI. Furthermore, a new C-RNTI has to be allocated in the C-RNC and transferred to the S-RNC together with the Cell/URA Update Request message because it is required in the Cell/URA Update Confirm message back to the UE, and it is used by S-RNC to address the right MAC-c context in the C-RNC.

The Cell/URA Update Request message can be transferred over the radio

- Either via CCCH (as proposed by Nokia),
- Or via DCCH (as proposed by Nortel),
- Or via DTCH (as proposed by Nortel as well).

3.1 Via DTCH

If the Cell/URA Update Request is transferred over the radio via the DTCH, this message will be transferred together with the user data to the MAC-d-user, and should be transferred to the RRC which is in the Control Plane.
So, there is a mixing between user plane and control plane: MAC-d-user and RRC are linked functionally. This is never a good approach for the implementation because it would force user plane and control plane to communicate. Furthermore, it is contrary to the basic principles adopted in 3GPP where Radio Network Control plane, Transport Network Control plane and User plane are clearly separate.

In addition, there is a possibility to "lose" the mobile:
If the new location (cell, CRNC) of the mobile is deduced from the origin of the user data message, it is always possible that user frames received at the old cell arrive at S-RNC later than the first user frames received at the new cell as shown in the following figure: UE moves from cell 1 to cell 2 and sends Frame N and Frame N+1 towards cell 1, then Frame N+2 towards cell 2, but the waiting time in ATM queues between Node B1 and S-RNC is longer than between Node B2 and S-RNC; therefore Frame N+1 may arrive at S-RNC after Frame N+2, and the S-RNC believes that the UE is back under … cell 1.

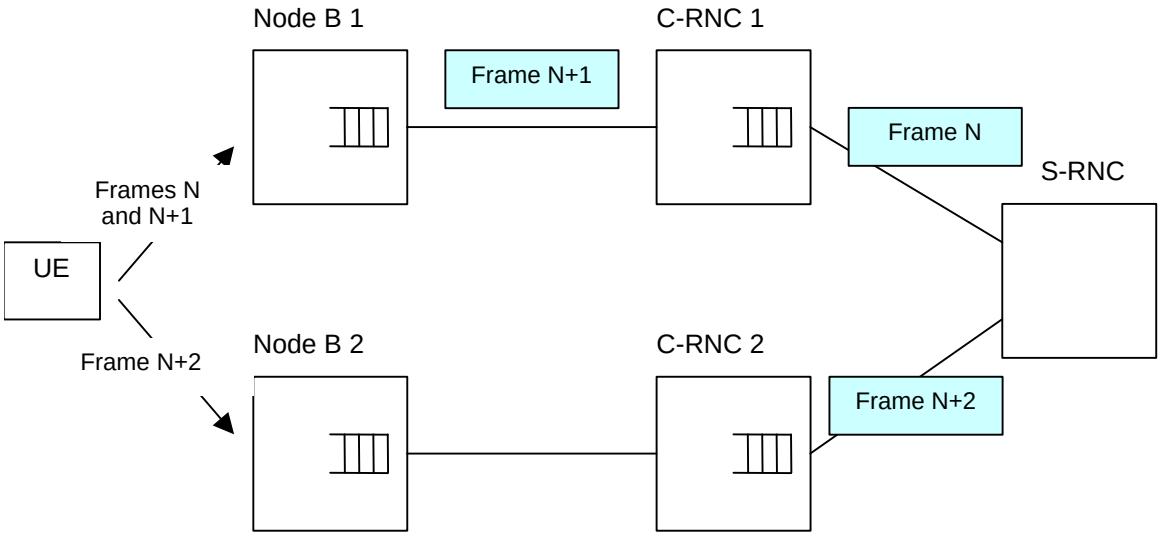

Figure 2: Losing a mobile when user data & signalling are mixed

Therefore, the RRC messages must be separate from the user data.

3.2 Via CCCH

Normally, CCCH is a channel used when the UE has not a RRC connection yet. This is not the case. When a UE has a RRC connection, all the RRC messages should use the DCCH transport channel; then the RRC messages go to MAC-d(sig), RLC and RRC via an AAL2 connection.

However, if CCCH is used, it is necessary to transfer the RRC message via a new RNSAP message that could carry them transparently. One message have been created for that: Uplink Signalling Transfer (Downlink Signalling Transfer for the downlink direction).

RNSAP messages are carried over SCCP. SCCP can be used in connectionless mode (class 0) or in connection-oriented mode (class 2 or 4). Since the C-RNTI is required for the Cell/URA Update Confirm, a C-RNTI context has to be created in the C-RNC before transferring Cell/URA Update Request to the S-RNC. The C-RNTI context should be retrieved when the S-RNC replies. Therefore, SCCP must be established in connection-oriented mode.

On a functional aspect, there is a need to link RNSAP function with RRC function to deliver Cell/URA Update Request message from RNSAP to RRC – and Cell/URA Update Confirm message from RRC to RNSAP. This does not lead to a clean separation of the functional planes.

Furthermore, RNSAP messages using AAL5/ATM connection may have globally a lower priority than the DCCH messages using AAL2 connection. This can be an issue for transactions such as Cell Update that have to be processed very quickly.

In addition, the Cell/URA Update Request message is not secured at layer 2 between UE and S-RNC by RLC function since RLC is by-passed (it is only secured at Iur interfaces by SAAL sublayer used by RNSAP, but not between UE and S-RNC). Only securization at application level could be done (re-transmission at application level), but this is not homogeneous with other procedures when a RNTI is already allocated.

Last, the use of CCCH forbid the ciphering since MAC-d and RLC are by-passed. That is not safe since Cell/URA Update messages can occur frequently and they give a sensitive information on the location of the mobile.

3.3 Via DCCH

As said in the previous section, this is the most appropriate way for transferring RRC messages when the UE already has a RRC connection. All the RRC messages go to MAC-d(sig), RLC and RRC via an AAL2 connection as in current transactions.
The AAL2 connection is already established over Iur, since all the signalling messages to/from the different UEs on FACH/RACH are multiplexed on one single AAL2 connection.

In addition, there is no need to establish a SCCP connection to transfer RNSAP messages. So, it is quicker than via CCCH.

Furthermore, there is no need to create these "Uplink Signalling Transfer" and "Downlink Signalling Transfer" RNSAP messages.

Last, the Cell/URA Update Request message is secured at layer 2 by RLC function (ARQ).

3.4 Conclusion

Regarding RRC connection, CCCH is not adapted since CCCH is used for UE that have not a RRC connection yet.

Regarding functional split, DTCH mixes user data plane with user signalling plane (RRC), CCCH mixes Radio Network Control plane (RNSAP) with User Signalling plane (RRC).

Regarding reliability, the use of CCCH and DTCH by-pass the RLC function and Cell Update Request, URA Update Request and RRC Connection re-establishment messages are not secured.

Regarding Ciphering, Cell/URA update convey sensitive information. This information can be ciphered with DTCH and DCCH, but not with CCCH.

Therefore, only the use of DCCH is acceptable.

4 Proposal

It is proposed to use DCCH as the transport channel for the support of RRC Cell Update Request, URA Update Request and RRC Connection re-establishment messages.

It is also proposed that, more generally, the CCCH is used only for RRC connection establishment and that the further transactions with the UE shall be made on dedicated channels since it has a SRNC-ID and a S-RNTI.

As a consequence, it is proposed to remove "Uplink Signalling Transfer" and "Downlink Signalling Transfer" RNSAP messages in [3] chapters 7, 8.1 and 8.1.2.

It is proposed to modify following sections of [4] :
1. Section 9.14.1 Inter-RNS cell update with switching in the CN
2. Section 9.14.2 Inter-RNS cell update via Iur
3. Section 9.15.1 Inter-RNS URA update with switching in the CN
4. Section 9.15.2 Inter-RNS URA update via Iur

as follows:

- Replace CCCH into DCCH in all texts and figures,
- Replace RNSAP messages "Uplink Signalling Transfer (new Cell/URA update indication)" and "Downlink Signalling Transfer (new Cell/URA update confirm)" by RRC message on top of AAL2 connection (going from "MAC-c" box to "MAC-d" box in the SRNC instead of the RNSAP box).

5 References

[1] TSGR2#3(99)308, Identifier and logical channel for Cell Update (etc.) procedures, Nokia
[2] TSGR2#3(99)277, Usage of DCCH vs CCCH on common channels, Nortel Networks
[3] TS 25.423 v1.0.2, UTRAN Iur interface RNSAP signalling.
[4] TS 25.931 v1.0.0, UTRAN functions, examples on signalling procedures.