TSG-RAN Meeting #16 ***RP-020452***

Marco Island, FL, USA, 4 - 7 June 2002

Agenda Item:	**8.9.5**
Source:	**Rapporteur (Ericsson)**
Title:	**TR for SI: DIRECT TRANSPORT BEARERS BETWEEN SRNC AND NODE-B V2.0.1**
Document for:	**Approval**

This document contains the v2.0.1 of TR 25.883 related to direct transport bearers between SRNC and Node-B. The V2.0.1 is intended for submission to RAN#16 for approval to conclude on the study item.

3GPP TR 25.883 V2.0.1 (2002-05)

Technical Report

3rd Generation Partnership Project (3GPP);
Technical Specification Group (TSG) RAN 3;

Direct Transport bearers between SRNC and Node-B (Release 5)

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Contents

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Foreword

This Technical Report (TR) has been produced by the 3rd Generation Partnership Project (3GPP), Technical Specification Group RAN.
The contents of this TR are subject to continuing work within 3GPP and may change following formal TSG approval. Should the TSG modify the contents of this TR, it will be re-released with an identifying change of release date and an increase in version number as follows:

Version m.t.e
where:

- m indicates [major version number]
- x the second digit is incremented for all changes of substance, i.e. technical enhancements, corrections, updates, etc.
- y the third digit is incremented when editorial only changes have been incorporated into the specification.

1 Scope

The purpose of the present document is to help the TSG RAN WG3 group to study aspects of the direct Node-B to SRNC transport bearers in preparation for a WI on this topic, as proposed in [1].
As requested by TSG-RAN, the document describes the identified consequences of the direct transport bearers, and classifies these main consequences as benefits or drawbacks.
Since the consequences might be different for an ATM and IP TNL, these different TNL's are handled separately.
This document is a 'living' document, i.e. it is permanently updated and presented to all TSG-RAN meetings.

2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies.
- A non-specific reference to an ETS shall also be taken to refer to later versions published as an EN with the same number.

[1.] Study Item Description: " Direct transport bearers between SRNC and Node-B " RP-010492, approved at TSG RAN#12
[2.] "PPP over AAL2 and AAL5"; R3-012037
[3.]

3 Definitions, symbols and abbreviations

3.1 Definitions

For the purposes of the present document, the following terms and definitions apply.

3.2 Symbols

3.3 Abbreviations

For the purposes of the present document, the following abbreviations apply:
TNL: Transport Network Layer

4 Introduction

As indicated in [1], in Rel99/Rel4, all Iub/Iur transport bearers used for the transport of Dedicated Transport Channels need to be terminated at the DRNC. However it should be studied if, these transport bearers can go directly from SRNC to Node-B.
The study should investigate possible benefits like decreasing the processing required by the DRNC and decreasing the delay of UTRAN internal transport and investigate any resulting limitations.

The objective of this study is to identify consequences of changing the current specifications that require transport bearers to be terminated at the DRNC.
This Study Item shall take into account the Release-5 SI "SRNS relocation enhancement" and the Release-5 SI "Separation of Resource Reservation and Radio Link activation".

5 Requirements

The following requirements for the study are identified:

1) The study shall investigate if possible benefits like e.g. UTRAN internal transport delay decrease can be obtained by using direct transport bearers between SRNC and Node-B;
2) The study shall identify consequences of changing the current specifications which currently requires transport bearers to be terminated at the DRNC. Consequences in the following areas shall be investigated:
   A) RL combining in DRNC
   B) SRNS relocation
   C) Impact on Iub/Iur user plane and control plane specifications
   D) Impact on UTRAN architecture regarding node functionality

In addition, the following requirements are identified for any solution:

- Changes to Iu & Core Network shall be minimised;
- Changes to Uu & UE shall be minimised;
- The solution shall be backward compatible;
- The solution shall be an optional feature for Rel-5;
- The solution shall allow negotiation of this capability between impacted nodes (e.g. SRNC, DRNC, Node-B)

6 RAN3 Study areas

6.1 General

Any new functionality introduced in R5 should be introduced with the least possible impact to the existing R99/R4 specifications.

6.2 Description of proposed changes

When a RL is established, currently, the DRNC receives a TNL-address and Binding Id from the Node-B which enables it to establish an Transport bearer between the Node-B and the DRNC. Similarly, the SRNC receives a TNL-address and Binding Id from the DRNC which it uses to establish an Transport bearer between the DRNC and the SRNC.
In the proposed solution, the DRNC decides if it wants to allow the usage of direct bearers between Node-B and SRNC. If so, the DRNC will pass the TNL-address and Binding Id received from the Node-B to the SRNC, which will enable the SRNC to establish a direct bearer between the Node-B and the SRNC. The obtained solution is shown in figure 1.

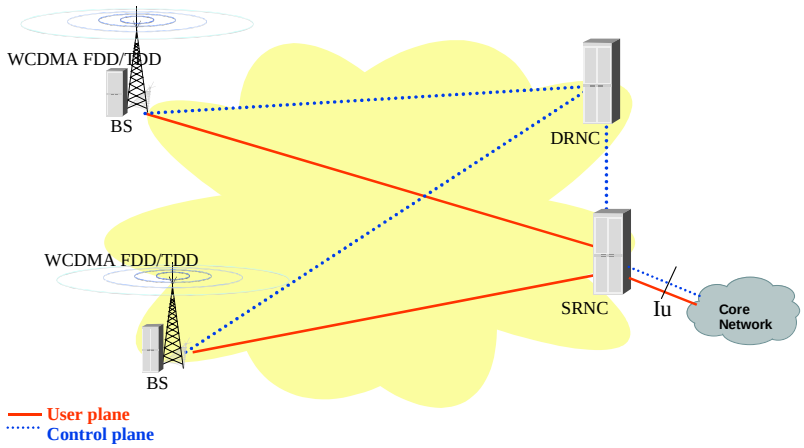

Figure 1: Control/Userplane architecture for Dedicated RL's

In this solution, both the Node-B and the SRNC will not be aware of the fact that they are using a direct transport bearer. This is possible since the solution fully reuses Rel99 protocols with no changes and requires no modifications to a Rel99 SRNC or Node B.

6.3 Consequences with ATM TNL

In this section, the identified consequences of having direct bearers when using an ATM TNL are described.

Editors Note: all indicated benefits need to be further studied.

6.3.1 No Frame Protocol termination in DRNC

Currently the Iub and Iur interfaces need to be terminated in the DRNC. The consequences for the DCH Frame Protocol are shown in figure 2:

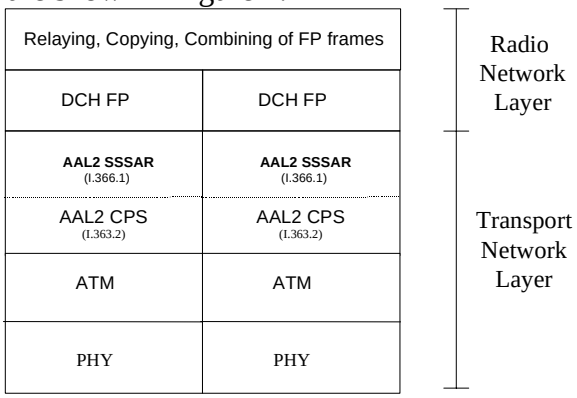

Figure 2: ATM-based DRNC DCH FP stack in R99/Rel-4

The functions of the CPS and SSSAR layer are shown in figure 3 (based on [2]). As can be seen in figure 3, a large FP frame will be segmented by the SSCS layer, and then multiplexed in ATM cells by the CPS layer. When receiving an FP frame, the reverse will take place: demultiplexing in CPS layer and re-assembly of the FP frame in the SSCS layer.

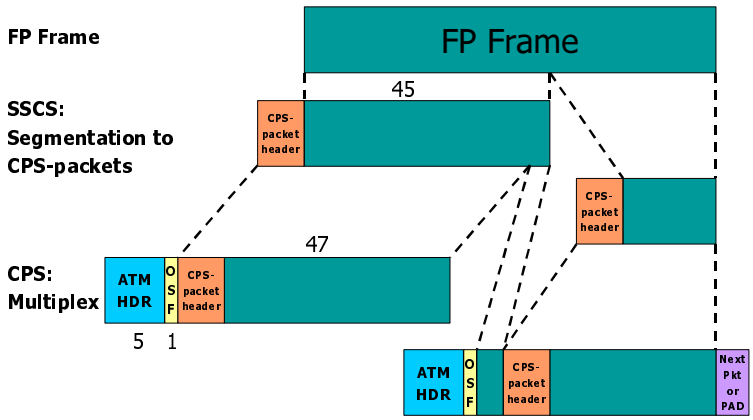

Figure 3: Example of CPS/SSCS functionality

In the DRNS, a complete FP frame will have to be re-assembled before it can be forwarded on the next interface. Especially in the case of low/average speeds on both Iub and Iur this will generate considerable additional delay. E.g. if both Iub and Iur are a 2Mbps interface, for a 384kbps transport channel with a 40ms TTI, an additional minimum delay of 7.68ms[1] will be inserted.

Note this figure does not include any processing delay in the DRNC. Any reduction in delay due to the absence of the RNL application results in an additional gain.

6.3.2 More optimal routing

As is shown in figure 1, when the user plane no longer needs to go via the DRNC, there may be a more optimal routing possible in the TNL between the Node-B and the SRNC.

Allthough it should be obvious that a delay decrease can be obtained due to this more optimal routing, the extend of the delay decrease will depend largely on the network topology that is deployed.

More optimal routing will normally also result in TNL resource savings.

6.3.3 DRNC load

By enabling the direct transport bearers, the Node-B <-> SRNC communication no longer mandatory loads the DRNC user plane resources. The relative load decrease will depend on the fraction of the total DRNS traffic that is caused by Iur traffic.

6.3.4 RL combining in DRNC

RL combining requires RNL involvement. Since there is no RNL functionality present inbetween the SRNC and Node-B in the proposed solution, no RNL combining can take place inbetween SRNC and Node-B. As a result, additional user plane resources might be required. Several comments can be made about the severity of such a limitation:

- RL combining is still possible in the Node-B and SRNC;
- In R99/Rel-4, it is not required for a DRNC to support RL combining;

In the proposed solution, it is the DRNC that decides if the direct transport bearer should be used or not. When making this decision, the DRNC can take into account its own capabilities, possible problems when performing RL combining in the DRNC and estimated delay gain when using direct bearers.

[1] 48x320/2*10^6= 7.68ms (see [5])

6.3.5 SRNS relocation

Current situation

The situations before and after the Serving SRNS relocation are shown in figure 4, which is taken from [4].

In accordance with figure 4, 3GPP Rel99/Rel4 specifications require the Iub and Iur interfaces to be terminated at the DRNC. For the DCH FP a concatenation of two separate transport bearers is used: one between SRNC and DRNC and one between DRNC and Node-B.

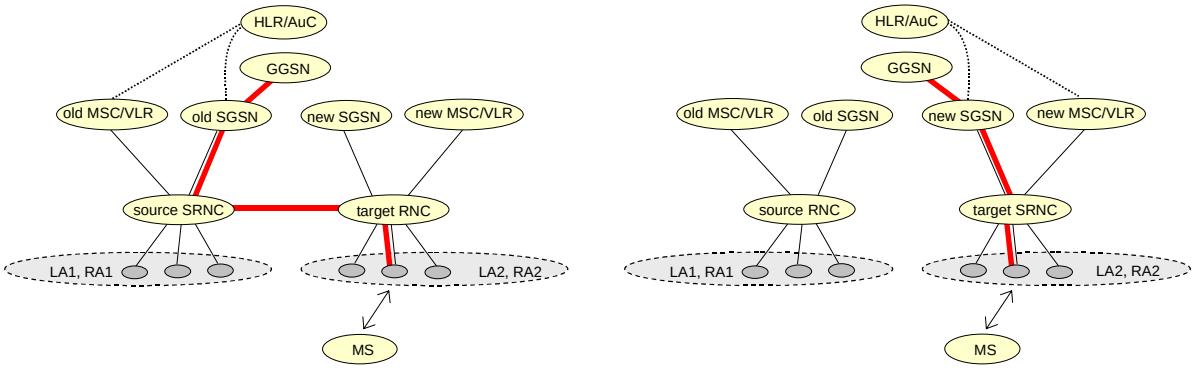

Figure 4: Situation before/after Serving SRNS Relocation

The message sequence for supporting this SRNS relocation is shown in figure 5., which is largely based on figure 39 in [4]. See [4] for a detailed description of this message sequence. As can be seen in figure 5, it is assumed that the Node-B (under the target SRNC) is not aware of the executed Serving SRNS relocation. The Node-B is communicating with the DRNC before and after the SRNS relocation.

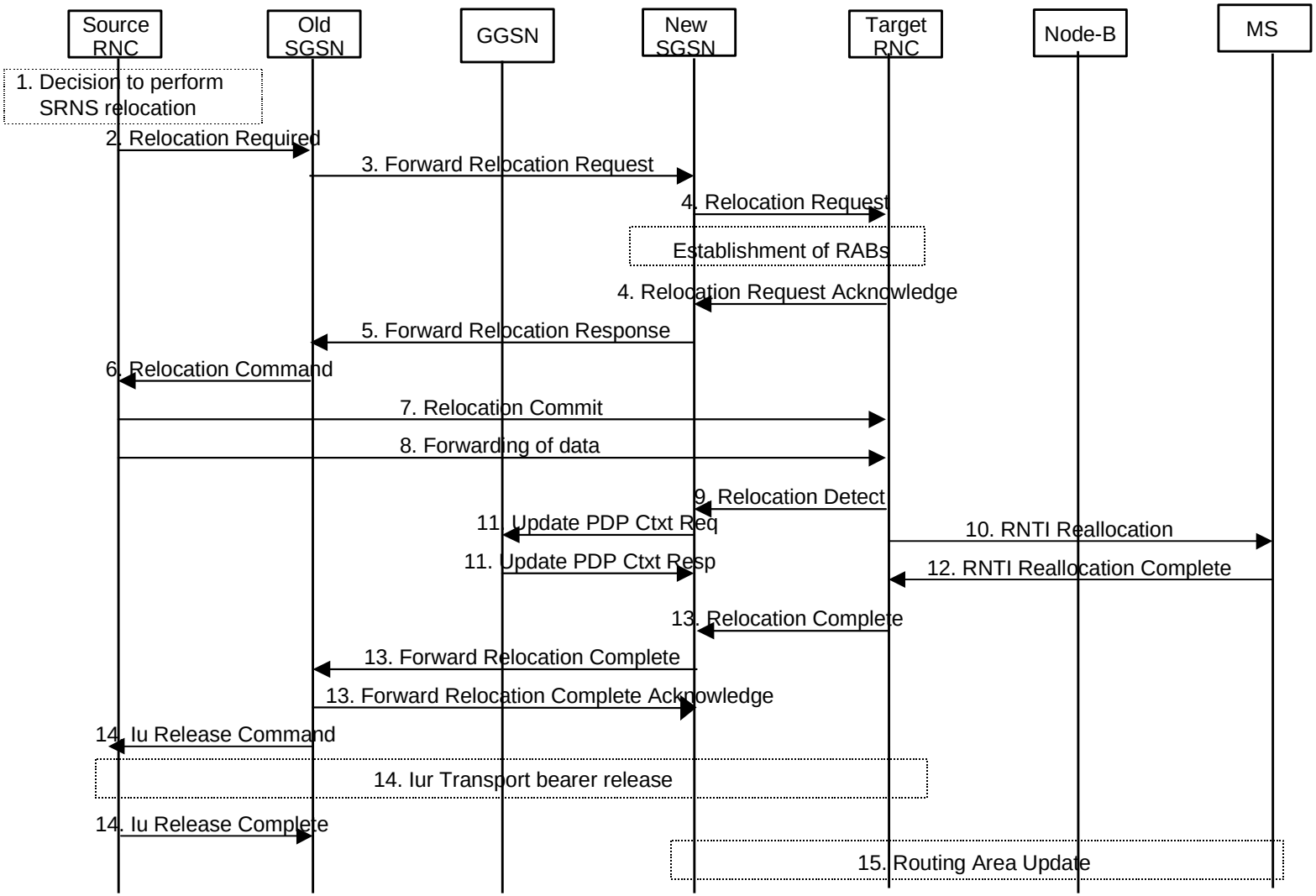

Figure 5: Serving SRNS relocation message sequence (main messages)

Serving SRNS relocation and Direct transport bearers

An example of a situation with a direct transport bearer between SRNC and Node-B is shown in figure 6.

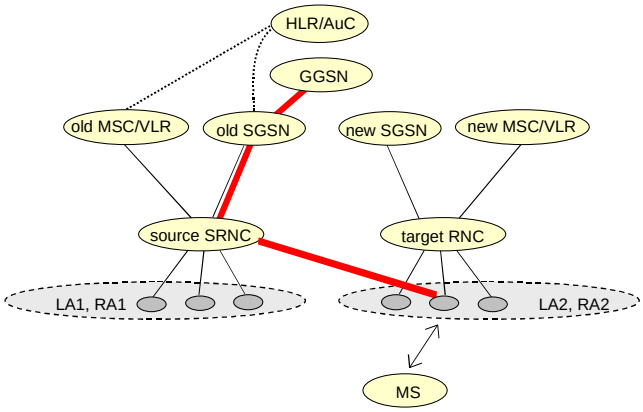

Figure 6: Direct SRNC – Node-B transport bearer example

The NBAP RL-Reconfiguration procedure can be used during Serving SRNS relocation in order to support Serving SRNS relocation even in the case where the SRNC is using direct bearers to the concerning Node-B. The detailed flow is shown in figure 7.

If we compare figure 7 with figure 5, in 3 places an update is made to the message sequence (the updated/new steps are tagged with "n"):

Step 4n

In Step 4n, the target RNC attempts to reserve the UTRAN resource required after the SRNS relocation. As part of this step, new transport bearers are established towards the Node-B.

Note 1: The Node-B will not be aware that these new transport bearers are established from another RNC than the transport bearers they replace. The only thing that the Node-B can detect is that another transport layer address for the RNC is used, but this could also be the result of one RNC using multiple transport layer addresses.

Note 2: If the transport layer makes use of resource reservations in the TNL on Iub, a temporary double reservation on the Iub TNL might occur.

When the UTRAN resources are successfully reserved, both on the transport and radio network layer, the target RNC will transmit the Relocation Request Acknowledge to the new SGSN.

Step 7n

When the target RNC receives the relocation execution trigger, which is in this case the RNSAP Relocation Commit message, the target RNC executes the synchronised RL-reconfiguration commit procedure to make the Node-B switch over to the new transport bearers.

When the transport bearer replacement is executed successfully, the target RNC sends a Relocation Detect message to the new SGSN.

Note 2: When the RL was originally established, the target RNC was informed about the frame- and chip-offset of the CFN towards the SFN of the concerning cell. By remembering these offsets, and keeping track of the SFN of the cell (which the RNC will normally do for transmission on e.g. PCH/FACH channels), the target RNC will be able to determine a CFN value which will take place in the near future and use this CFN value in the RL-Reconfiguration-Commit message, thereby enabling a quick execution of the reconfiguration.

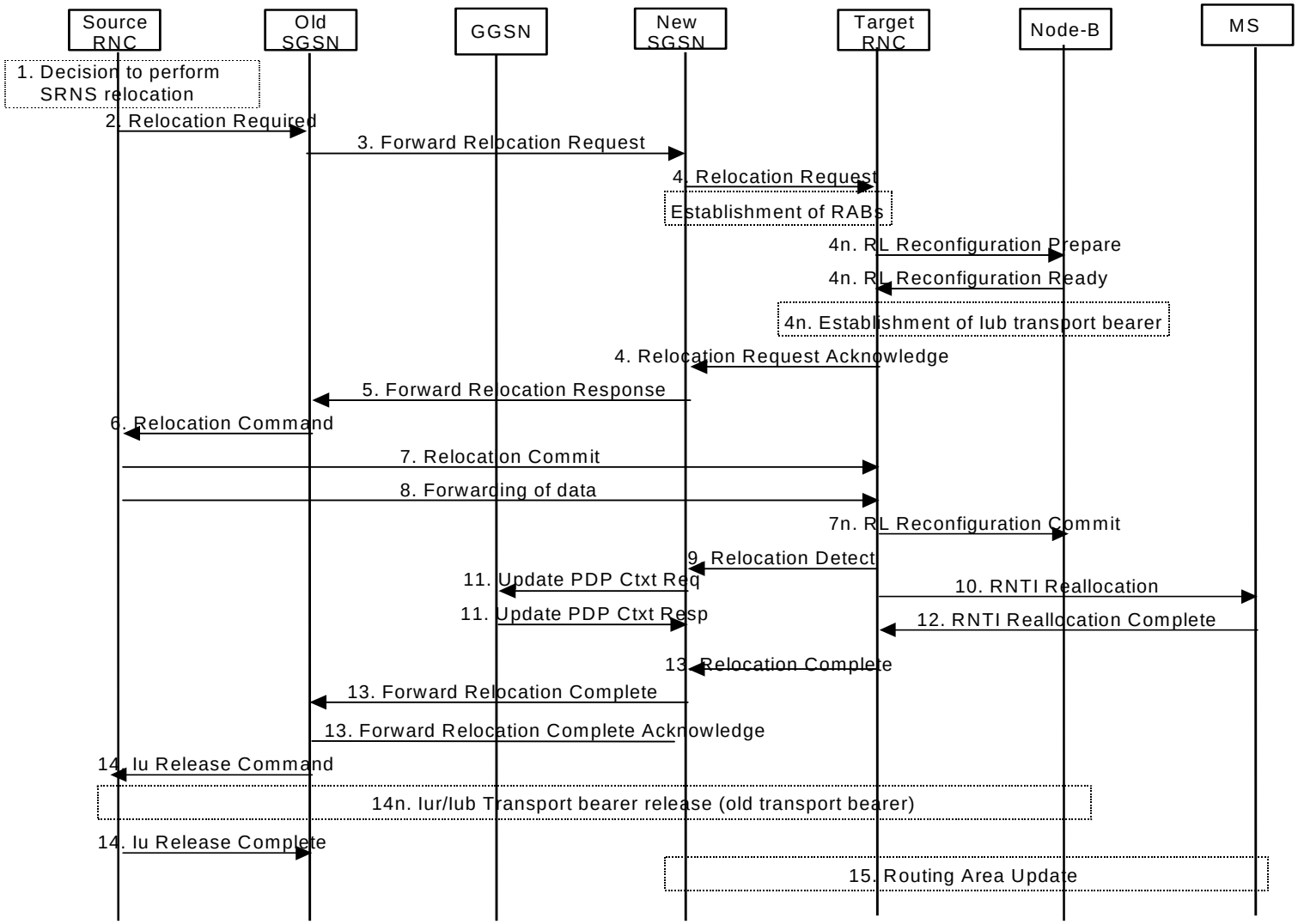

Figure 7 : New SRNS relocation message sequence (main messages)

Step 14n

In step 14n, the source RNC will release the old transport bearer. Was this a transport bearer between source- and target RNC in figure 5, now this is a transport bearer between source RNC and Node-B. The source RNC will not be aware of this difference.

Note that the described scenario is not the only possible solution for supporting the SRNS relocation. Other solutions include using the unsynchronised RL-reconfiguration procedure, and executing the different NBAP procedures at different moments in time in the overall scenario. Similar sequences can be drawn for the CS domain.

Conclusion

SRNS relocation with the CS/PS-domain is fully supported when using direct SRNS<->Node-B transport bearers. Based on existing procedures, several sequences are possible for executing the relocation.

If the transport layer makes use of resource reservations in the TNL on Iub, a temporary double reservation on the Iub TNL during the the relocation can be considered a drawback of this solution.

6.3.6 Impact on Iub/Iur user plane and control plane specifications

No impact.

6.3.7 Impact on UTRAN architecture regarding node functionality

Apart from the difference between “an RNL null function in the DRNC” and “no RNL function in the DRNC” for the DCH FP UP, no impact regarding any node functionality is introduced.

6.3.8 Impact on ATM / IP interworking

Consequences still need to be investigated.

6.3.9 Impact on other Release 5 Study Items

Two other Release 5 Study Items are defined which do have some relation to RL establishment: ”SRNS relocation enhancement” and “Separation of Resource Reservation and Radio Link activation”.

Allthough both these SI’s have not been finalised, no interaction with these SI’s has been identified so far.

6.3.10 Use of VC- and AAL2 switches

With ATM transport, there are two possibilities for establishing the direct bearer between the Node B and the SRNC: VC switching and AAL2 switching.

Full direct bearer connectivity between SRNC and Node-B based on VC switching, requires the establishment of a permanent virtual path between each Node B and each RNC (full mesh). An example is shown in figure x.x.

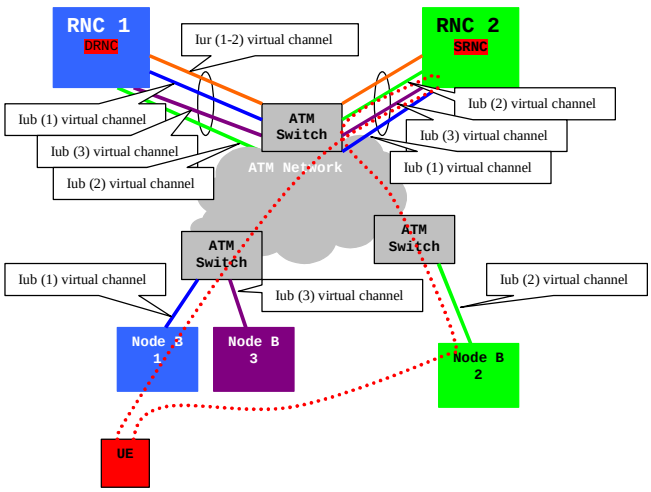

Figure 8: Direct SRNC- Node-B Transport Bearer: VC switching

Having a full meshed VC network multiplies by several times the number of virtual channels needed between the RNC and the ATM Switch, making this solution impractical, and the network configuration more complex.
For example, for an RNC (1) with 300 Nodes B and an RNC (2) with 200 Nodes B:

- RNC (1) needs 500 virtual channels (160% of the previous connections)
- RNC (2) needs 500 virtual channels (250% of the previous connections)

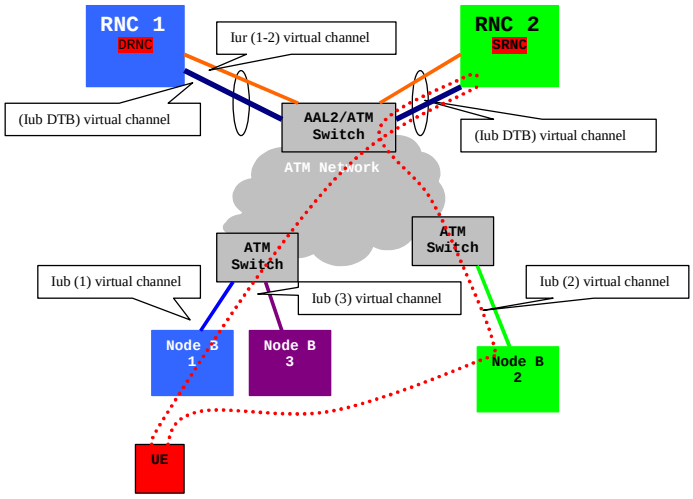

Figure 9: Direct SRNC- Node-B Transport Bearer: AAL2 switching

An example of full direct bearer connectivity between SRNC and Node-B based on AAL2 switching is shown in figure 2. With this solution only one AAL2 path is needed between each RNC and the AAL2 switch. However:

- The user plane transport network will no longer be an ATM but an AAL2 switched network.
- Depending on the network configuration, configuration and planning of the network may become more complex

Full connectivity with direct transport bearers based on PVC (O&M and bandwidth reservation) or SVC (no standardisation) is less practical than full connectivity based on AAL2 switching.

6.4 Consequences with IP TNL

In this section, the identified consequences of having direct bearers when using an IP TNL are described.

6.4.1 No Frame Protocol termination in DRNC

To be completed.

6.4.2 More optimal routing

See section 6.3.2.

6.4.3 DRNC load

See section 6.3.3.

6.4.4 RL combining in DRNC

See section 6.3.4.

6.4.5 SRNS relocation

See section 6.3.5.

6.4.6 Impact on Iub/Iur user plane and control plane specifications

See section 6.3.6.

6.4.7 Impact on UTRAN architecture regarding node functionality

See section 6.3.7.

6.4.8 Impact on ATM / IP interworking

See section 6.3.8.

6.4.9 Impact on other Release 5 Study Items

See section 6.3.9.

6.5 Drawbacks <-> Benefits summary

To be completed.

6.6 Open issues

The following open issues are identified:

1. Establishment delay: Does the use of an AAL2 switch provides an additional gain in delay if this implies the same two-step ALCAP establishment as it is done in the current approach (DRNC involved)?
2. Reliability: What happened if an AAL2 switch fails? Is it still possible to perform ATM Path Switching? Is it then needed a redundant AAL2 switch?
3. How does the RNC know if it supports a functionality that completely depends on the transport network configuration? For example, what happened if a Node supports the feature but there is not an AAL2 switch in the path?

7 Agreements

The following conclusions were agreed:

RAN3 has concluded that there is no clear benefits on supporting Direct transport bearers between SRNC and Node-B.
Furthermore, RAN3 has concluded that there is very limited impact to the RAN3 protocol specifications for supporting Direct transport bearers between SRNC and Node-B. The impact is due to support of the Bearer re-arrangement functionality (which was introduced in Rel-5 for Iub) combined with the Direct transport bearer functionality, for which the Bearer re-arrangement procedure will have to be extended to the Iur interface.

RAN3 could not agree to which extend the direct bearer feature should be introduced in the specifications:

- Five companies have indicated that they consider the benefits of the direct bearer feature only significant for the IP transport option and thus would like to see this feature only introduced for the IP transport option and not for the ATM transport option.

One company has indicated that due to the architecture split between Radio Network Layer (RNL) and Transport Network Layer (TNL), there is no reason to introduce this feature for only a subset of the supported TNL's. Therefore this feature should be introduced in a TNL independent way.

8 Project Plan

8.1 Schedule

Date	Meeting	Scope	[expected] Input	[expected]Output
Aug 2001	TSG RAN #13	RAN Approval		- TR approved

9 History

Document history		
V0.0.1	2001-06	First proposed version
V0.0.2	2001-07	Second proposed version, intended to reflect the discussions/decisions made during Wednesday R3#22.
V0.0.3	2001-07	This version is intended to reflect the discussions/decisions made during RAN#22, except for the discussion on Tdoc 011976 which is reflected in v0.0.4
V0.0.4	2001-07	This version is intended to reflect the discussions/decisions made during RAN#22 including the discussions/decisions on Tdoc 011976.
V0.1.0	2001-09	Approved V0.0.4. (no comments)
V0.1.1	2001-10	Rapporteurs proposal for reflecting decisions RAN3#24.
V0.2.0	2001-11	Approved V0.1.1 (no comments)
V0.2.1	2002-05	This version is intended to reflect the agreement made during RAN3#28.
V0.3.0	2002-05	Approved V0.2.1.
V1.0.0	2002-05	Identical to V0.3.0. Intended for RAN#16 submission for Information.
V2.0.0	2002-05	Identical to V1.0.0. Intended for RAN#16 submission for Approval.
V2.0.1	2002-05	Conclusion from RP-020391 added to V2.0.0
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