TSG RAN Meeting #22 **RP-030681**
Maui, USA, 9 - 12 December 2003

Title **CR (Rel-5 only) to TS 25.933 on Correction of PE-node as an ATM switch Solution**

Source **TSG RAN WG3**

Agenda Item **7.4.5**

RAN3 Tdoc	Spec	curr. Vers.	new Vers.	REL	CR	Rev	Cat	Title	Work item
R3-031539	25.933	5.3.0	5.4.0	REL-5	005	-	F	Correction of PE-node as an ATM switch Solution	ETRAN-IPtrans

3GPP TSG-RAN WG3 Meeting #39 ***R3-031539***
San Diego, USA, 17-21 November 2003

CR-Form-v7

CHANGE REQUEST

⌘	**25.933**	**CR**	**005**	⌘ **rev**	**-**	⌘	Current version:	**5.3.0**	⌘

For ***HELP*** *on using this form, see bottom of this page or look at the pop-up text over the ⌘ symbols.*

Proposed change affects: UICC apps⌘ [ ] ME [ ] Radio Access Network [X] Core Network [X]

Title: ⌘	Correction of PE-node as an ATM Switch Solution	
Source: ⌘	RAN3	
Work item code: ⌘	ETRAN-IPtrans	***Date:*** ⌘ 17/11/2003
Category: ⌘	**F**	***Release:*** ⌘ *Rel-5*
	Use one of the following categories: ***F*** *(correction)* ***A*** *(corresponds to a correction in an earlier release)* ***B*** *(addition of feature),* ***C*** *(functional modification of feature)* ***D*** *(editorial modification)* Detailed explanations of the above categories can be found in 3GPP TR 21.900.	*Use one of the following releases:* *2 (GSM Phase 2)* *R96 (Release 1996)* *R97 (Release 1997)* *R98 (Release 1998)* *R99 (Release 1999)* *Rel-4 (Release 4)* *Rel-5 (Release 5)* *Rel-6 (Release 6)*

Reason for change: ⌘	The Aal layer is not terminated in the PE-node in the PWE3 solution. The TNL box in the PWE3 solution is inaccurately named PWE router whereas from an end to end perspective it is an ATM switch. The signalling flows are also missing for this inter-working solution.
Summary of change: ⌘	The Aal termination in the PWE-capable ATM switch is taken off. The PWE3 solution is updated from an end to end perspective and renaming to avoid confusion that it is not a TNL IWU nor a router for the ATM-IP interworking. The signalling sequence flow for this solution is given in section 6.10.5.5. Impact Analysis Impact assessment towards the previous version of the specification (same release): this CR has isolated impact on the previous version of the specification (same release) because only one function is impacted. This CR has an impact under the protocol point of view. The impact can be considered as isolated as it affects only one function, namely IP-ATM interworking.
Consequences if not approved: ⌘	The PWE3 based solution is erroneously described in the study area of the TR25.933 which can lead to a wrong definition, evaluation and implementation of this solution for the ATM-IP inter-working.

Clauses affected: ⌘	6.10.2			
	Y	**N**		
Other specs affected: ⌘		X	Other core specifications	⌘
		X	Test specifications	
		X	O&M Specifications	

Other comments: ⌘	

How to create CRs using this form:

Comprehensive information and tips about how to create CRs can be found at http://www.3gpp.org/specs/CR.htm. Below is a brief summary:

1) Fill out the above form. The symbols above marked ⌘ contain pop-up help information about the field that they are closest to.

2) Obtain the latest version for the release of the specification to which the change is proposed. Use the MS Word "revision marks" feature (also known as "track changes") when making the changes. All 3GPP specifications can be downloaded from the 3GPP server under ftp://ftp.3gpp.org/specs/ For the latest version, look for the directory name with the latest date e.g. 2001-03 contains the specifications resulting from the March 2001 TSG meetings.

3) With "track changes" disabled, paste the entire CR form (use CTRL-A to select it) into the specification just in front of the clause containing the first piece of changed text. Delete those parts of the specification which are not relevant to the change request.

6.10.2 Interworking Options

A design goal for the IP transport option within Rel.5 is to minimize the effects on the RNL ([1], clause 5.2). The fact that an Release 99 / Release 4 node can be connected without having been upgraded to Rel.5 must be taken into account.

In the following three potential interworking options (dual stack operation, and TNL IWU) should be considered:

6.10.2.1 Dual Stack operation within Rel.5 RNCs

Within the dual stack option a Rel.5 RNC must provide both stacks. Generally, it is assumed that only RNCs should provide both types of interfaces, so that Node Bs are either IP or ATM nodes. Nevertheless, for interworking case 3, where an IP based Node B is connected with a Release 99 / Release 4 RNC, also an interworking on Iub would be necessary. Within a pure IP or ATM environment the RNC must only provide one type of interface.

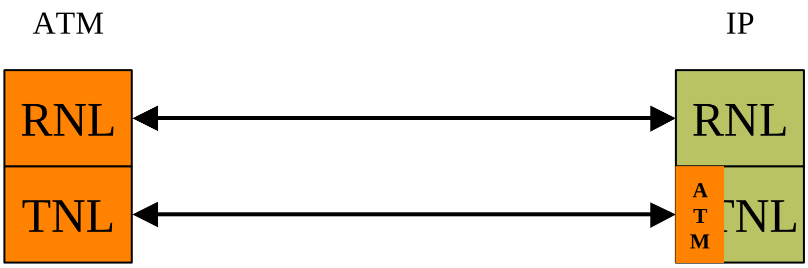


Figure 6-31: Dual Stack operation within Rel.5 RNCs

A Rel.5 IP node that needs to communicate with a pure ATM node (R99 or later) requires the complete ATM/AAL2 protocol stack. Beneficial of such an dual stack solution is, that it does not require a TNL control protocol on IP side.

On Iub this solution would be quit sufficient, but on Iur there may be certain cases where a simple IWF or dual stack operation are not sufficient and an interworking unit (IWU) will be needed. (If interworking case 3 and 4 should be supported, also on Iub an IWU would be needed.)

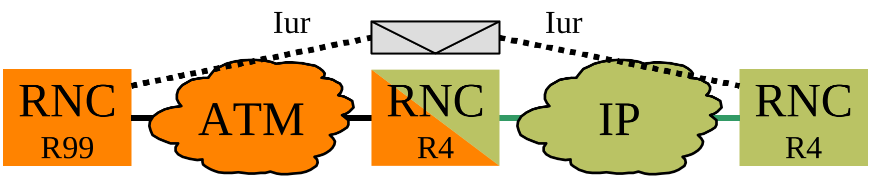


Figure 6-32: Full Meshed Iur

In the network, that is shown in figure 6-32, are some RNCs pure IP based, some RNCs are pure ATM based and some RNCs are dual stacked. Assuming a network configuration where a pure IP based RNS borders on a pure ATM based RNS, the Iur interface between both RNSs must be supported.

A dual stacked RNC with an IWF in the middle would be able to communicate on both networks but would not be able to combine both parts of the network. In that case either an interworking unit is needed or a solution to transport ATM-traffic through the IP-backbone. Such a solution, based on Pseudo-Wire Emulation Edge to Edge (PWE3) [70] [71], is provided in the next paragraph.

6.10.2.1.1 Interworking with PWE3-capable ATM Switchseudo-Wire Emulation

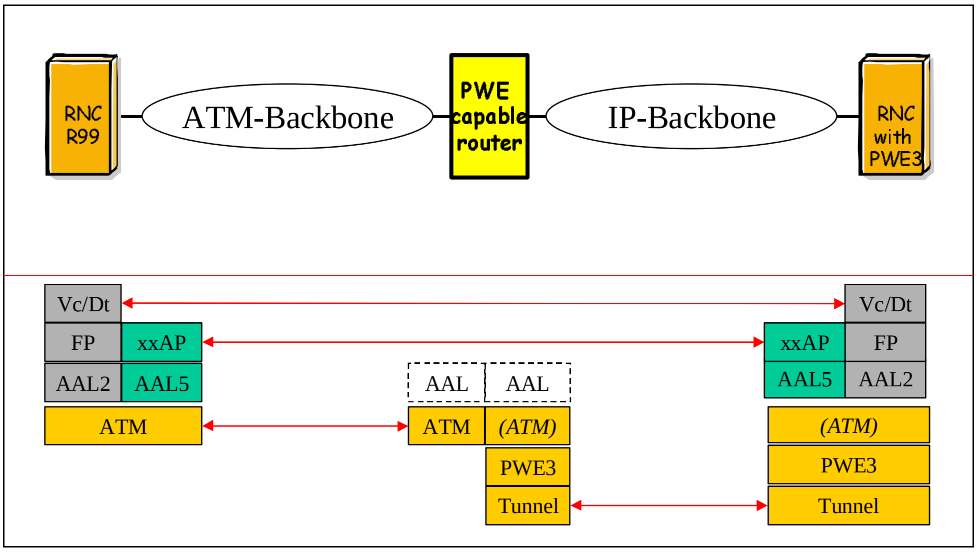


Figure 6-33: Interworking with Pseudo-Wire Emulation

A PE node as defined in [71], WE-capable router, an ATM switch equipped with interfaces to both the ATM and the IP network, connects the ATM and the IP-backbone. The ThroughPE-node acts as a PWE-capable node towards the IP-backbone and establishes a tunnel withbetween the RNC-with PWE3 and the PWE-router, a tunnel is established for interconnection with the RNC-R99.

RNC-with PWE3 communicates with RNC-R99 via its AAL2/AAL5 protocol stackon top of PWE3 layer over the PWE3 tunnel through the IP-backbone. The PWE3 tunnel terminates in the PE-nodeWE-router, from where plain ATM-traffic is forwarded to RNC-R99 over the ATM-backbone w/o termination of the Adaptation Layer. All planes (Control plane designated as xxAP in the figure, Transport Network cControl pPlane (Q2630) and user plane (designated as Vc/Dt in the figure) shall be carried over PWE3.

The TNL Control Plane protocol used in this solution is thus the ALCAP Q2630 tunnelled over PWE3 used as layer 1. A PE-node relays the Q2630 messages encapsulated in SS7/AAL5 like any other ATM switch that is potentially placed in the transport network between the PWE-capable RNC and the next adjacent node terminating the Q2630 stack.

Similarly, a PE-node relays the User Plane messages encapsulated in AAL2/ATM like any other ATM switch that is potentially placed in the transport network between the PWE-capable RNC and the next adjacent node terminating the Q2630 stack.

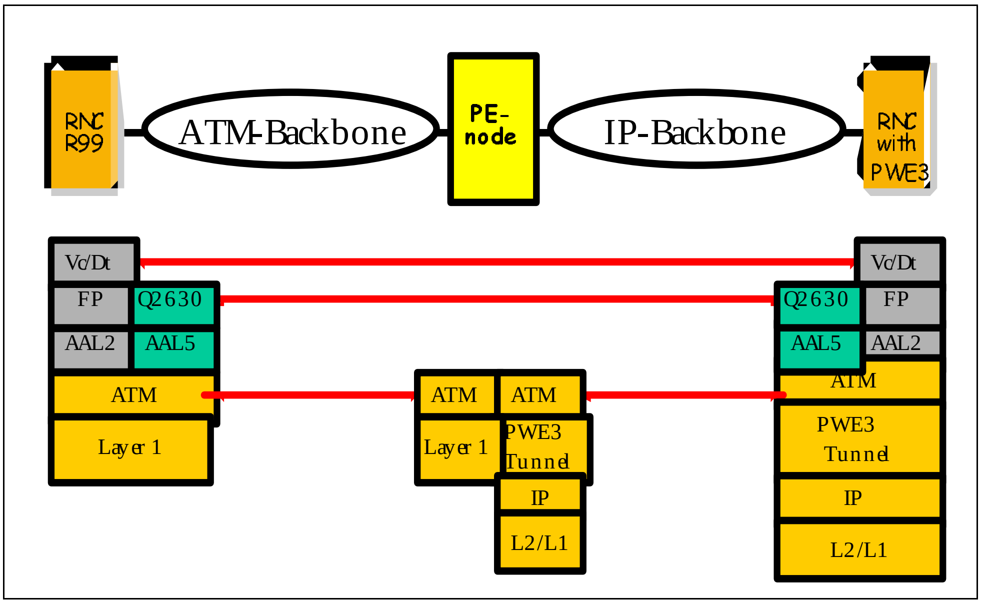


Figure 6-33: Interworking with a PWE3-capable ATM Switch

A PE-node relays also the xxAP Control Plane messages encapsulated in AAL5/ATM like any other ATM switch that is potentially placed in the transport network between the PWE-capable RNC and the ATM RNC.

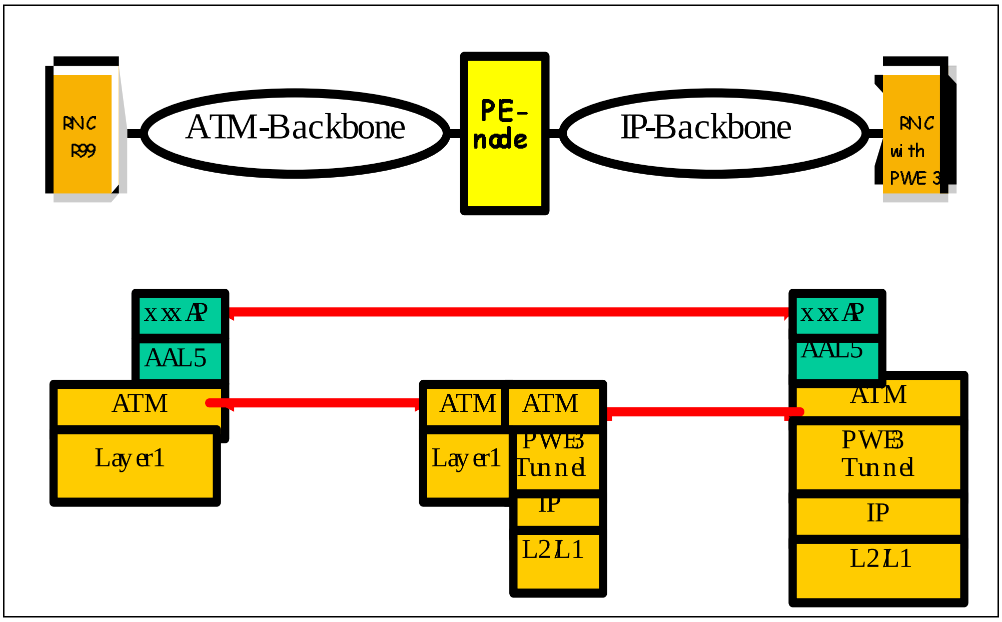
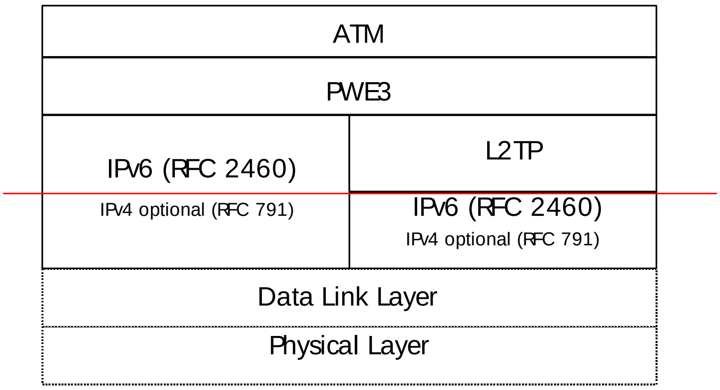


Figure 6-33A: Interworking with a PWE3-capable ATM Switch

The t~~wo~~hree options of PWE3 tunneling protocol [71] over IP networks can be done either directly over IP layer or over L2TP [38] or MPLS.

The following figure shows the protocol stack ~~for PWE3 protocol~~ at the RNC/CN-node, in the case the RNC/CN-node ~~supporting PWE~~ cannot be connected to the ATM backbone and implements PWE3.



~~**Figure 6-34: Bearer for Control plane (RANAP), Transport Network control plane (ALCAP) and user plane with PWE3 tunneling protocol.**~~

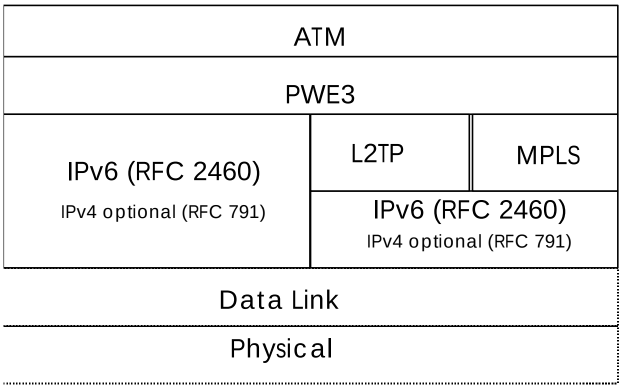


Figure 6-34: Bearer for Control plane (RANAP), Transport Network control plane (ALCAP) and user plane with PWE3 tunneling protocol.

The method(s) to be used for encapsulation of ATM cells, namely, One-to-one mode and N-to-one mode, is(are) FFS. The transport service to be used, namely the ATM VCC Cell Transport Service or the ATM VPC Cell Transport Service, is FFS.

The use of the ATM AAL5 CPCS-SDU and AAL5 PDU frame modes is not required.

The signalling flows corresponding to this ATM-IP interworking method are presented in section 6.10.5.5.

6.10.2.2 Transport Network Layer IWU

Also an TNL IWU can either be placed somewhere between the connecting nodes or can be integrated within one node.

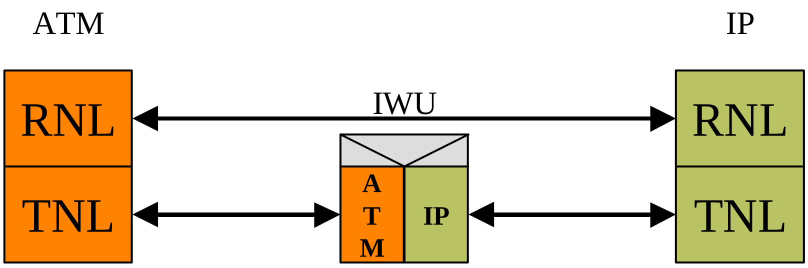


Figure 6-33: Transport Network Layer IWU

On transport network layer the IWU must support the translation between ATM and IP transport formats and QoS requirements. It must hold all states of active connections.

Although it is conceivable that a pure IP TNL could work without a TNL control protocol a simple TNL IWU would probably require a TNL control protocol. At least this depends on the agreed addressing scheme for the IP transport.

6.10.2.2.1 Issue on TNL IWU control protocol

The following two figures show an example of a radio link setup request on Iur between an Release 99 / Release 4 and Rel.5 IP RNC. The first example, where the SRNC is a Release 99 / Release 4 and the DRNC is a Rel.5 IP RNC, avoids the usage of an TNL control protocol due to an appropriate choice of the binding ID and transport layer address within the RNSAP messages. In the second example, where the SRNC is a Rel.5 IP and the DRNC is a Release 99 / Release 4 RNC, the usage of a TNL control protocol is unavoidable.

Figures 6-34 and 6-35 show the relevant information exchange on RNSAP and the involved primitives and messages of the AAL2 signalling protocol regarding [2] for each example.

In the first example the Release 99 / Release 4 SRNC requests a radio link setup. The Rel.5 DRNC RNL requests from its TNL resources for the new connection and receives an appropriate transport layer address and a binding ID. For example, the BID would be the UDP port, where the TNL is waiting for the new connection, and the transport layer address (TLA) would be a the code point (CP) that terminates at the IWU and identifies the DRNC. Therefore the Rel.5 TNL must have the knowledge that it is communicating with an ATM node. It provides an CP instead of an IP address and encodes the necessary information in a way that allows the IWU to establish the IP path later on. Within the radio link setup response message the UDP port number can be transported within the binding ID. Both information's, TLA and BID, are transmitted via ALCAP to the IWU. The IWU maps code points to IP addresses and extracts the port number out of served user generated reference (SUGR). The mapping between code points and IP addresses must be configured by O&M within the IWU and within the TNL of the IP node. The IWU is than able to establish a UDP connection and to complete the ALCAP connection setup. Some ATM specific information's like the link characteristics get either lost or translated into an IP equivalent IE.

Failure behaviour is FFS.

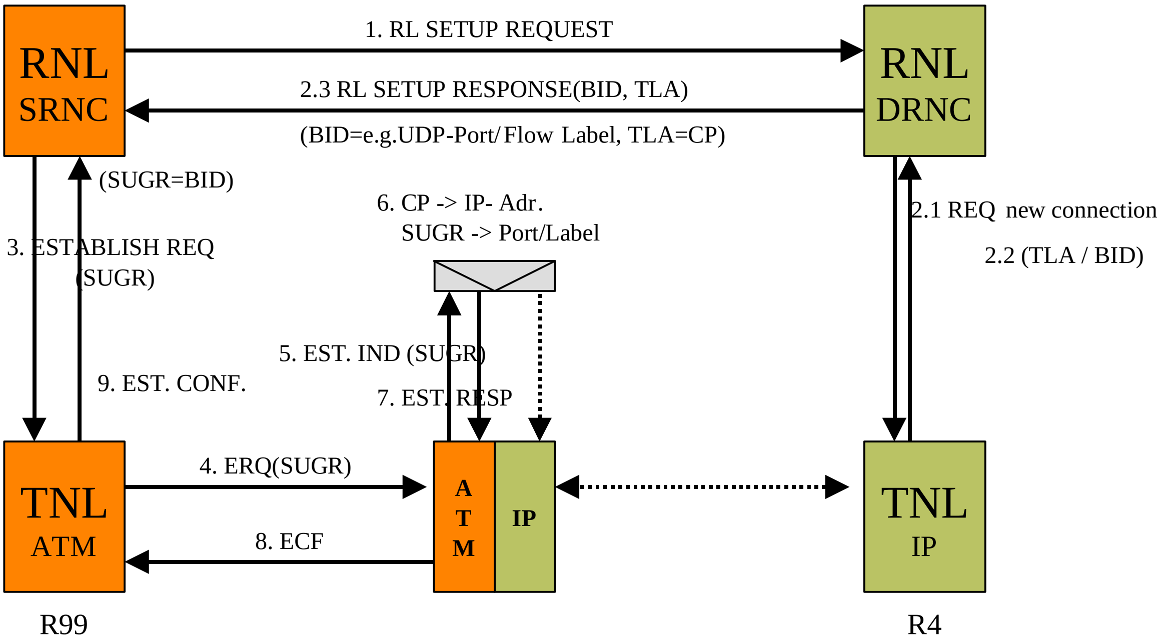


Figure 6-34: Example 1: RNSAP: DCH RL Setup, SRNC = R99/R4; DRNC = Rel.5

NOTE: In this case the IWU must always send data to the DRNC before the DRNC can transmit data towards the SRNC because the DRNC does not know to which IP address/UDP port to send data before receiving this first data.

In the case where the Rel.5 IP RNC requests a radio link setup from the Release 99 / Release 4 RNC, the Release 99 / Release 4 RNC is not aware of the fact that it is communicating with an IP node. Beside, it must choose the binding ID completely free (e.g. without the knowledge what ports are free on the IWU or the IP RNC). The Rel.5 SRNC can map the TLA to an appropriate IP address but it can not map the binding ID to an appropriate UDP port number. Trying to map the binding ID to the port numbers results either in assigning a large number of IP addresses to both, the IP RNC and the IWU, or restricting the binding ID space within the Release 99 / Release 4 RNCs. Even if a trade off between numbers of needed IP addresses and restrictions of the binding ID space could be found, information like the link characteristics that can't be generated within the IWU itself must be transmitted somehow to the IWU. For that purpose a TNL control protocol also on the IP side of the connection is necessary.

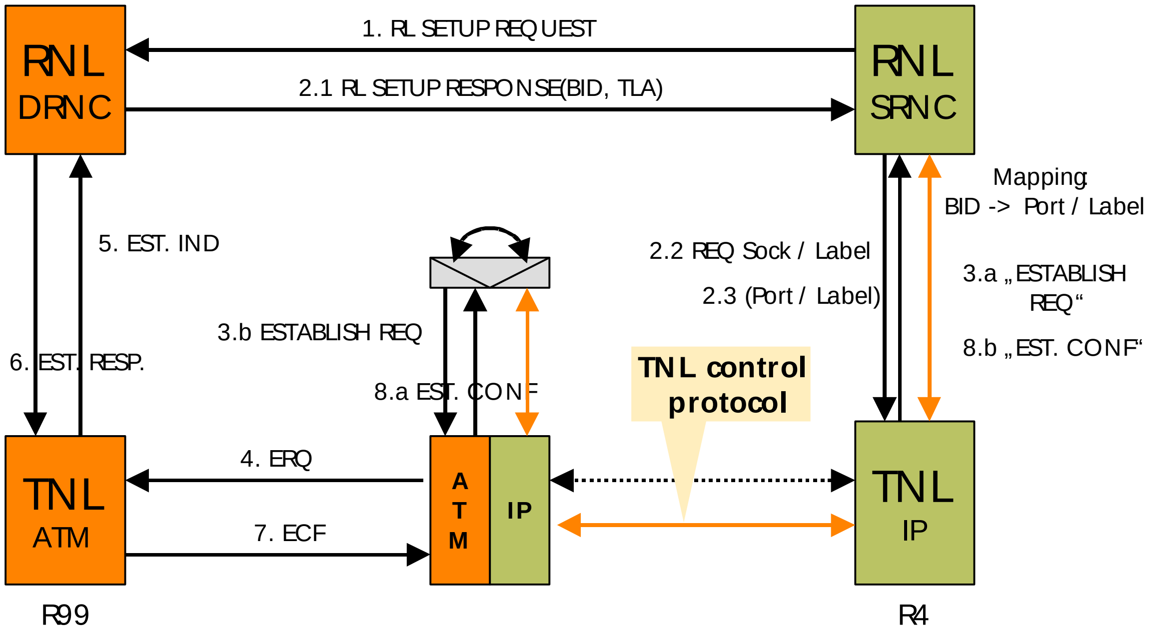


Figure 6-35: Example 2: RNSAP: DCH RL Setup, DRNC = R99/R4; SRNC = Rel.5

Candidates for this IP -based TNL control protocol (IP-ALCAP) are described in sections 6.10.5.1 to 6.10.5.4.

6.10.3 Conclusion

It must be clarified if an interworking on Iub (interworking case 3 and 4) should be supported or if an dual stack operation is sufficient for the Iub interface.

For the Iur interface, when the IP RNC has no access to the ATM network, either:

- an IWU is needed, which is either integrated within the IP RNC~~an UTRAN node~~ or in an independent box
- or alternatively, a PWE3 tunnel protocol can be used between the IP RNC and an ATM switch used in the transport network to make a tunnel towards the ATM RNC.

An IWU that works only on TNL requires a TNL control protocol that must be specified within the standard. The solutions using such an independent IWU and a dedicated IP-based TNL Control Protocol are presented in section 6.10.5.1 to 6.10.5.4. The solution using the ATM switch with the PWE3 tunnel protocol is presented in 6.10.5.5.

6.10.5 ATM/IP Interworking solution proposals.

This section describes the signalling flow for several candidate solutions enabling an IP node to interwork with a legacy ATM node.

It first describes in subsections 6.10.5.1 to 6.10.5.4 the signalling flow for the candidate solutions based on the third interworking option i.e. solutions using a TNL IWU as presented in section 6.10.2.2.

Then in section 6.10.5.5, it presents the signalling flow for the interworking solution based on a PWE3-capable ATM switch that fulfils the same requirement.

6.10.5.1 Bearer control proposal using IETF SIP/SDP

For exchanging transport layer information between IP UTRAN nodes, the RNL signalling should be used (RANAP, RNSAP, NBAP) without a Transport Network Control Protocol.

For establishing transport connections between an IP UTRAN node and an ATM UTRAN node, a Transport Network Layer interworking function should be used in the transport network. This function would be implemented in a third node (such as an RNC) that has both ATM and IP interfaces.

In order to interwork with the q.aal2 signalling used by the AAL2/ATM node, an IP ALCAP will be used.

6.10.5.1.1 Description

It is proposed to use Session Initiation Protocol (SIP) signalling with Session Description Protocol (SDP) parameters. SDP [58] supports both IP and ATM parameters. SIP [57] is proposed since it is an IETF signalling protocol and is used to carry SDP.

Since a node must know what type of interface to communicate with, a Network Type parameter should be added to the RNL signalling. The following table shows how the Network Type parameter is used.

R99/R4	R5 IP	R5 ATM	Action
SRNC	DRNC		**R5** DRNC knows the SRNC is Release 99 / Release 4 because of missing transport parameters in RL setup req. **R5** IP RNC does interworking steps.
DRNC	SRNC		SRNC sends IP transport parameters that Release 99 / Release 4 DRNC will ignore. SRNC must know that it is receiving ATM parameters. Absence of network type in response will indicate that it is Release 99 / Release 4. **R5** IP RNC does interworking steps.
SRNC		DRNC	R5 DRNC knows SRNC is Release 99 / Release 4 because of missing transport parameters in RL setup req.
DRNC		SRNC	SRNC sends ATM network type parameter that Release 99 / Release 4 DRNC will ignore. SRNC must know that it is receiving ATM parameters from DRNC. Absence of network type will indicate that it is Release 99 / Release 4.
	SRNC	DRNC	SRNC sends IP transport parameters. SRNC must know that it is receiving ATM parameters. It can know this from the network type parameter in DRNC response. SRNC then performs interworking steps.
	DRNC	SRNC	SRNC sends ATM network type. R5 DRNC knows its ATM from the network type and performs interworking steps.

6.10.5.1.2 Bearer control between IP and ATM nodes signalling examples

The following figures provide signalling diagrams that show how the interworking can be achieved with this proposal. The Iur is shown as an example. UDP ports are shown for connection identifiers as an example.

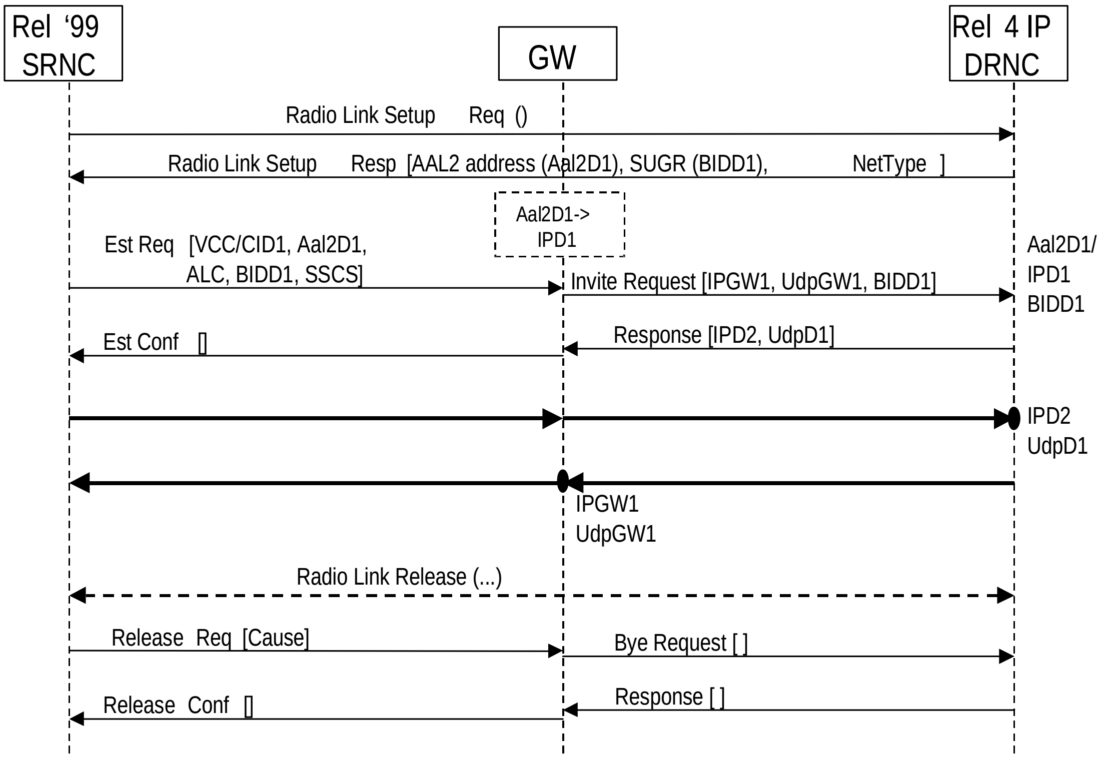


Figure 6-38: Interworking between an AA2/ATM SRNC and an IP DRNC

NOTE 1: The Release 99 / Release 4 SRNC sends radio link setup. There is an SCTP Signalling Gateway for interworking the SCTP/IP signalling to ATM signalling.

NOTE 2: The IP DRNC node responds with ATM transport parameters. The IP DRNC must have both ATM and IP addresses assigned to it.

NOTE 3: The SRNC uses q.aal2 signalling to establish a connection towards the DRNC based on the address received in the RL Setup Response. The TNL IW node is along the route to the DRNC.

NOTE 4: When the TNL IW function receives the q.aal2 set up message it determines that the destination node is an IP node.

NOTE 5: The TNL IW function translates the ATM address to the IP address for the DRNC and sends a SIP Invite message to the IP DRNC. The Invite message includes the IP address and UDP port for traffic toward the TNL IW node. Also included is the binding ID so that the DRNC can correlate the transport signalling with the RNL signalling.

NOTE 6: The IP DRNC responds to the Invite message. Included in the response message is the IP address and UDP port for traffic towards the IP DRNC.

NOTE 7: When the TNL IW node receives the Response message it sends the q.aal2 confirmation message to the ATM SRNC.

NOTE 8: To release the connection, the SRNC sends a q.aal2 Release Request.

NOTE 9: When the TNL IW function receives the request it sends a SIP Bye Request to the IP DRNC.

NOTE 10: The IP DRNC responds to the Bye Request and when the TNL IW function receives it, it sends the q.aal2 Release Confirm.

6.10.5.5 Inter-working with a PWE3-Capable ATM Switch

The signalling flow for the ATM-IP interworking solution based on a PWE-capable ATM switch as defined in section 6.10.2.1.1 is presented in this section.

Protocol Stack

As interworking between IP and ATM based RNCs appears only during the migration phase from an ATM based network to an IP based network and only at the border between the two network types, the interworking solution – and therefore the selected signalling protocol stack – should be straight-forward and not entail new develoment effort.

The reuse of Q2630 meets this straightforward consideration as it is simply needed to define a new layer-1 to reuse this existing TNL CP protocol on the IP part. The overview of the protocol stacks used is presented hereafter with the new part in red.

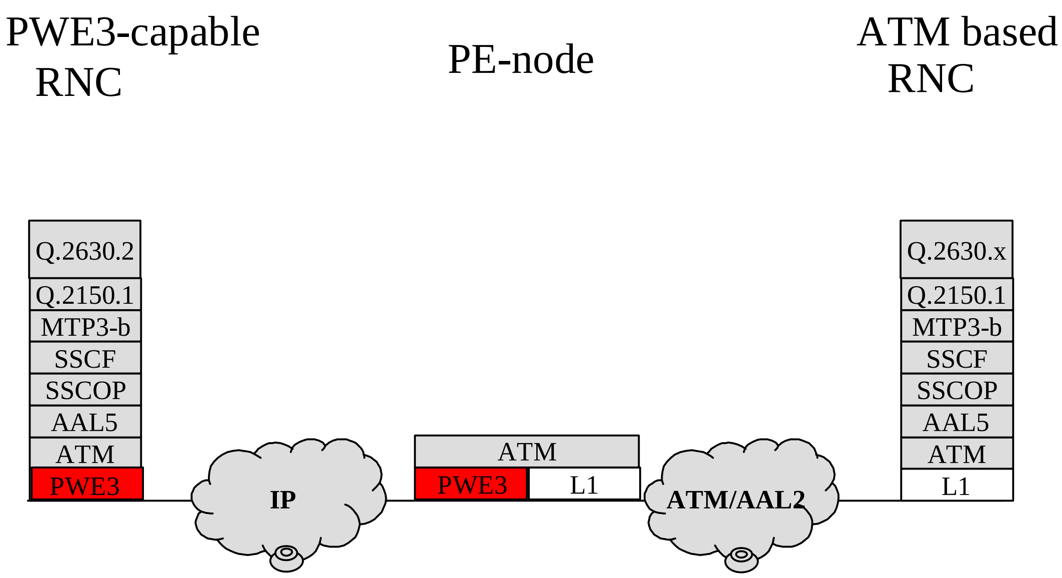


Figure 6-42: Protocol Stack for Transport Network Control Plane Interworking

Benefits of this Protocol Stack

The benefit of that protocol stack is, that most employed protocols are already in use inside the RAN and the additional specification work is low. Therefore a standardized interworking functionality can be easily introduced into the RAN with only the necessity of a new PWE3 tunnelling layer. Services provided by AAL2 signalling entities are unchanged. The interworking unit is straighforward as it is an ATM switch equipped with a specific layer-1 and transparent to the signalling flows. Minimum operation effort is needed to operate and maintain this ATM switch.

Example: Connection Establishment on Iur

This example shows transport bearer establishment and data on Iur. This shows the case where the legacy RAN is the drift RNS.

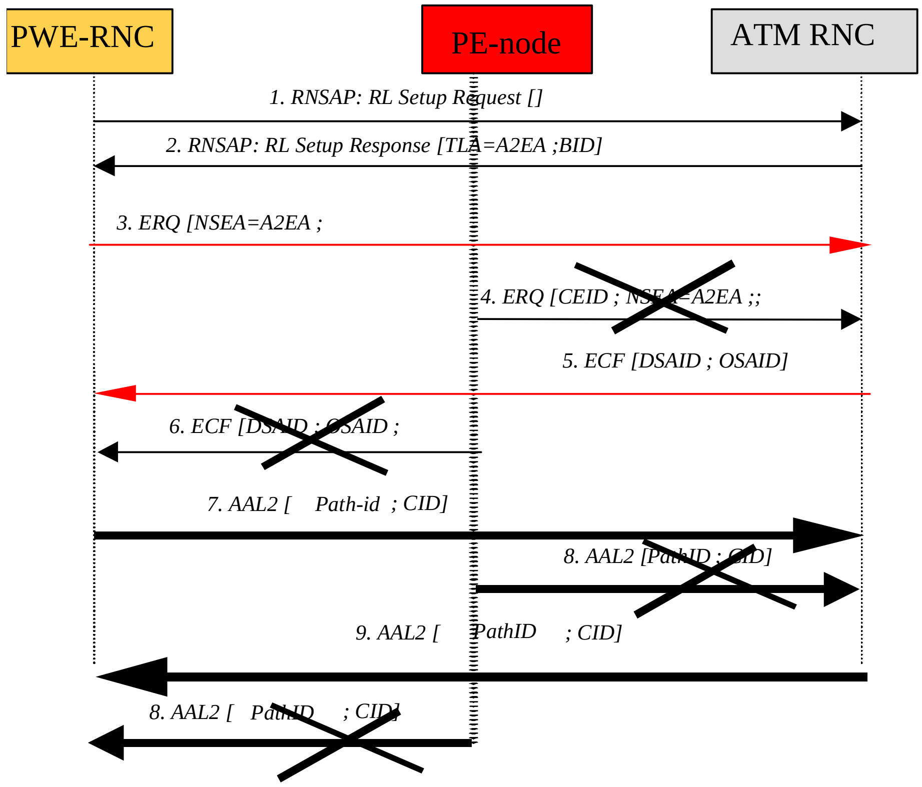


Figure 6-43: Connection Establishment on Iur

1) The PWE3- RNC (serving RNS) initiates establishment of the radio link with RNSAP message Radio Link Setup Request.
2) The legacy RNC node sends RNSAP message Radio Link Setup Response to the IP based RNC containing TLA and a binding ID. TLA contains the ATM endpoint identifier of the ATM based RNC.
3) The PWE3-RNC selects a signalling Vp/Vc according to the received AESA address and sends a Q2630 establishment request message (ERQ) tunnelled over PWE3. The ERQ message contains the Path-id to be used for the user plane.
4) The PE-node is **transparent** for the ERQ message and may simply switch the Vp/Vc (act as an ATM switch) towards the next ATM switch or next aal2 switch or terminating UTRAN node. Step 4 is starighforward.
5) The legacy RNC node sends the connection confirm message (ECF) in reply.
6) The PE-node is **transparent** for the ECF message and may simply switch the Vp/Vc (act as an ATM switch) towards the next ATM switch or next aal2 switch or originating UTRAN node. Step 6 is starighforward.
7) The PWE3- RNC sends data to the legacy RNC node which is also **transparently** carried over the PWE3-tunnel.
8) Only switching at ATM level if needed.
9) The ATM based RNC node sends data to the PWE3 RNC which is also **transparently** carried over the PWE3-tunnel.

Connection release is simply the same as specified in [52]. Connection establishment initiated by the ATM based RNC works respectively.

This sequence flow shows that this solution is the same as currently used but simply provides an adaptation of layer 1.