TSG-RAN Meeting #6 ***TSGRP#6(99)628***
Nice, France, 13 – 15 December 1999

Title: **Agreed CRs of category "D" (Editorial) to TS 25.303**

Source: **TSG-RAN WG2**

Agenda item: **5.2.3**

Doc #	Status-	Spec	CR	Rev	Subject	Cat	Versio	Versio
R2-99k68	agreed	25.303	018	2	Corrections to RRC State Names	D	3.1.0	3.2.0
R2-99k12	agreed	25.303	021		Editorial issues	D	3.1.0	3.2.0

3GPP TSG-RAN Meeting #6
Nice, France, 13 - 15 December 1999

Document (R2-99k68)
e.g. for 3GPP use the format TP-99xxx
or for SMG, use the format P-99-xxx

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25.303 CR 018r2 Current Version: 3.1.0

GSM (AA.BB) or 3G (AA.BBB) specification number ↑ *↑ CR number as allocated by MCC support team*

For submission to: TSG-RAN#6	for approval	X	strategic	*(for SMG use only)*
list expected approval meeting # here ↑	for information		non-strategic	

Form: CR cover sheet, version 2 for 3GPP and SMG *The latest version of this form is available from: ftp://ftp.3gpp.org/Information/CR-Form-v2.doc*

Proposed change affects: (U)SIM [ ] ME [X] UTRAN / Radio [X] Core Network [ ]
(at least one should be marked with an X)

Source: TSG-RAN WG2 **Date:** 3.12.1999

Subject: Corrections to RRC State Names

Work item:

Category: *(only one category shall be marked with an X)*

F	Correction		**Release:**	Phase 2	
A	Corresponds to a correction in an earlier release			Release 96	
B	Addition of feature			Release 97	
C	Functional modification of feature			Release 98	
D	Editorial modification	X		Release 99	X
				Release 00	

Reason for change: The RRC state names were previously updated and approved by RAN#5 for TS 25.331. This CR implements the necessary changes to TS 25.303.

Clauses affected: 3, 5.2, 5.3.3, 6.2.3.1, 6.2.3.3, 6.3.1, 6.3.2, 6.3.3

Other specs affected:

Other 3G core specifications		→ List of CRs:
Other GSM core specifications		→ List of CRs:
MS test specifications		→ List of CRs:
BSS test specifications		→ List of CRs:
O&M specifications		→ List of CRs:

Other comments:

help.doc

<--------- double-click here for help and instructions on how to create a CR.

3 Symbols

~~For the purposes of the present document, the following symbols apply:~~

~~+ A "+" in a substate name means that transport channels separated by the symbol can both be used in that substate. The name doesn't define whether simultaneous multicode transmission is allowed on these channels. E.g. in DCH / DCH + DSCH both downlink transport channels can be actively transmitting at the same time, but in RACH + FAUSCH / FACH simultaneous transmission on RACH and FAUSCH requiring multicode transmission should not be necessary.~~No special symbols are defined in this document.

5 Radio Bearer Control – Overview of Procedures

5.1 Configurable parameters

The following layer 1, MAC and RLC parameters should be able to configure by RRC. The list is not complete.

- Radio bearer parameters, e.g.
  - RLC parameters per RLC link (radio bearer), which may include e.g. PDU size and timeout values. Used by RLC.
  - Multiplexing priority per DCCH/DTCH. Used by MAC in case of MAC multiplexing of logical channels.
- Transport channel parameters, e.g.
  - Scheduling priority per transport channel. Used by MAC in case of layer 1multiplexing of transport channels.
  - Transport format set (TFS) per transport channel. Used by MAC and L1.
  - Transport format combination set (TFCS) per UE. Used by MAC and L1.
  - Allowed subset of TFCS per UE. Used by MAC.
  - CPCH access parameters per CPCH channel. [Details are FFS.] Used by MAC and L1.
- Physical channel parameters, which may include e.g. carrier frequency and codes. Used by L1.

5.2 Typical configuration cases

The table below gives a proposal which main combination cases of parameter configuration that shall be supported, in terms of which parameters that shall be able to configure simultaneously (by one procedure). Note that the "Transport channel type switching" is not a parameter as such, it only indicates that switching of transport channel type may take place for that combination case.

Table 1: Typical configuration cases.
An "X" indicates that the parameter can (but need not) be configured

Parameter		Layer	A	B	C	D	E	F
Radio bearer parameters	RLC parameters	RLC	X					
	Logical channel multiplexing priority	MAC	X					
Transport channel parameters	Transport channel scheduling priority	MAC	X					
	TFS	L1+MAC	X	X				
	TFCS	L1+MAC	X	X				
	Subset of TFCS	MAC					X	X
	Transport channel type switching	MAC	X	X	X			
Physical channel parameters		L1	X	X	X	X		

Case A is typically when a radio bearer is established or released, or when the QoS of an existing radio bearer need to be changed (the necessity of change of QoS is FFS).

Case B is when the traffic volume of a radio bearer has changed so the TFS used on the DCH need to be changed, which may in turn affect any assigned set of physical channels. Another example is to make the UE use a new transport channel and at the same time supplying the TFS for that channel.

Case C is when the traffic volume of one radio bearer has changed so that the used transport channel type is changed, e.g. from RACH/CELL_FACH to DCH/CELL_DCH or when the CPCH Set assigned to a UE is switched. This case includes the assignment or release of a set of physical channels.

Case D is e.g. the change of used DL channelization code, when a DCH is currently used. No transport channel type switching take place.

Case E is a temporary restriction and/or a release of restriction for usage of the TFCS by the UE (total uplink rate).

Case F is used to dynamically control the allocation of resources on uplink DCHs in the CRNC, using broadcast information such as transmission probability and maximum bit rate.

5.3 RRC Elementary Procedures

5.3.1 Category 1: Radio Bearer Configuration

The first category of procedures includes Case A and are characterized by:

- Are executed upon request by higher layers and the parameter configuration is based on QoS
- Affects L1, MAC and RLC.

There are three RRC procedures included in this category:

- **Radio Bearer Establishment.** This procedure establishes a new radio bearer. The establishment includes, based on QoS, assignment of RLC parameters, multiplexing priority for the DTCH, CPCH Set assignment, scheduling priority for DCH, TFS for DCH and update of TFCS. It may also include assignment of a physical channel(s) and change of the used transport channel types / RRC state.
- **Radio Bearer Release.** This procedure releases a radio bearer. The RLC entity for the radio bearer is released. The procedure may also release a DCH, which affects the TFCS. It may include release of physical channel(s) and change of the used transport channel types / RRC state.
- **Bearer Reconfiguration.** (NOTE) This procedure reconfigures parameters for a radio bearer (e.g. the signalling link) to reflect a change in QoS. It may include change of RLC parameters, change of multiplexing priority for DTCH/DCCH, CPCH Set assignment, change of DCH scheduling priority, change of TFS for DCH, change of TFCS, assignment or release of physical channel(s) and change of used transport channel types.

NOTE: The necessity of this procedure is FFS.

5.3.2 Category 2: Transport Channel Configuration

The second category of procedures includes Case B and are characterized by:

- Configuration of TFS for a transport channel and reconfiguration of TFCS is done, but sometimes also physical channel parameters.
- Affects L1 and MAC.
- Switching of used transport channel(s) may take place.

There is one RRC procedure included in this category:

- **Transport Channel Reconfiguration.** This procedure reconfigures parameters related to a transport channel such as the TFS. The procedure also assigns a TFCS and may change physical channel parameters to reflect a reconfiguration of a transport channel in use.

NOTE: It is expected that the configuration of TFS/TFCS needs to be done more seldom than the assignment of physical channel. A "pre-configuration" of TFS/TFCS of a transport channel not in use can be done by this procedure, to be used after transport channel type switching when the physical channel is assigned.

5.3.3 Category 3: Physical Channel Configuration

The third category of procedures includes the cases C and D and are characterized by:

- May assign or release a physical channel for the UE (which may result in transport channel type switching)
- May make a combined release and assignment (replacement) of a physical channel in use (which does not result in transport channel type switching / change of RRC state).
- Affects mainly L1, and only the transport channel type switching part of MAC.
- The transport format sets (TFS and TFCS) are not assigned by this type of procedure. However, the UE can be directed to a transport channel, which TFS is already assigned to the UE.

There is one RRC procedure included in this category:

- **Physical Channel Reconfiguration.** This procedure may assign, replace or release a set of physical channels used by an UE. As a result of this, it may also change the used transport channel type (RRC state). For example, when the first physical channel is assigned the UE enters the DCH/DCH state. When the last physical channel is released the UE leaves the DCH/CELL_DCH state and enters a state (and transport channel type) indicated by the network. A special case of using this procedure is to change the DL channelization code of a dedicated physical channel.

NOTE: The procedure does not change the active set, in the downlink the same number of physical channels are added or replaced for each radio link.

5.3.4 Category 4: Transport Format Combination Restriction

The fourth category of procedures includes Case E and are characterized by:

- Does only control MAC by means of the transport format combinations that may be used within the set without affecting L1.

There is one RRC procedure included in this category:

- **Transport format combination control.** The network uses this procedure towards an UE, to control the used transport format combinations in the uplink within the transport format combination set.

5.3.5 Category 5: Uplink Dedicated Channel Control in CRNC

The fifth category of procedures includes Case F and are characterized by:

- Does control UE MAC by means of broadcasting transmission probability and maximum total bit rate that shall be used for uplink DCHs, which are under control by this procedure.

There is one RRC procedure included in this category:

- **Dynamic Resource Allocation Control of Uplink DCHs :** The network uses this procedure towards all UEs, to control the probability of transmission and the maximum total bit rate used by uplink DCHs, which are under control by this procedure.

6.2.3.1 UE-Originated DCH Activation

Figure 14 illustrates an example of a procedure for a switch from common channels (RACH/FACHCELL_FACH) to dedicated (CELL_DCH) channels.

In the UE the traffic volume measurement function decides to send a MEASUREMENT REPORT message to the network. In the network this measurement report could trigger numerous different actions. For example the network could do a change of transport format set, channel type switching or, if the system traffic is high, no action at all. In this case a switch from RACH/CELL_FACH to DCH/CELL_DCH is initiated.

Whether the report should be sent with acknowledged or unacknowledged data transfer or if the network should be able to configure data transfer mode for the report is FFS.

First, the modifications on L1 are requested and confirmed on the network side with CPHY-RL-Setup primitives.

The RRC layer on the network side sends a PHYSICAL CHANNEL RECONFIGURE message to its peer entity in the UE (acknowledged or unacknowledged transmission optional to the network). This message is sent on DCCH mapped to FACH. The message includes information about the new physical channel, such as codes and the period of time for which the DCH is activated (NOTE 1).

NOTE 1: This message does not include new transport formats. If a change of these is required due to the change of transport channel, this is done with the separate procedure Transport Channel Reconfiguration. This procedure only handles the change of transport channel.

When the UE has detected synchronisation on the new dedicated channel L2 is configured on the UE side and a PHYSICAL CHANNEL RECONFIGURE COMPLETE message can be sent on DCCH mapped on DCH to RRC in the network (need FFS). Depending on whether the complete-message is applied, the need for an indication of the synchronisation on the NW side is also FFS. Triggered by either the NW CPHY_sync_ind or the L3 complete message, the RNC-L1 and L2 configuration changes are executed in the NW.

When applying the FAUSCH, the "DCCH: RACH: MEASUREMENT REPORT" is replaced by a "DCCH: FAUSCH: DCH REQUEST" message that is transmitted on the FAUSCH in unacknowledged mode. In this case rather than giving a measurement report for the NW to process, the FAUSCH indicates a request for a DCH of predefined capacity.

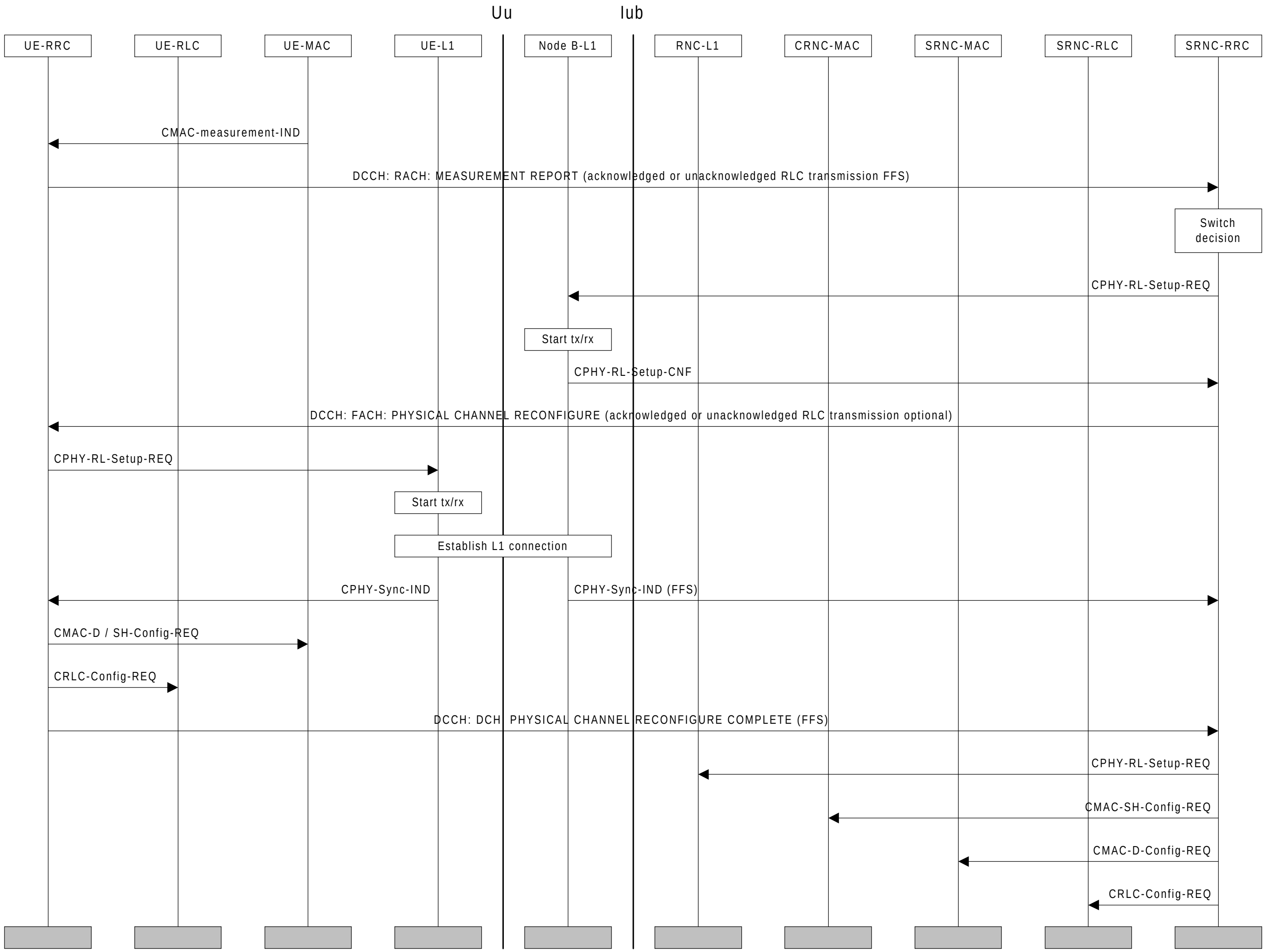

Figure 14: UE-Originated DCH Activation

6.2.3.2 UE-terminated synchronised DCH Modify

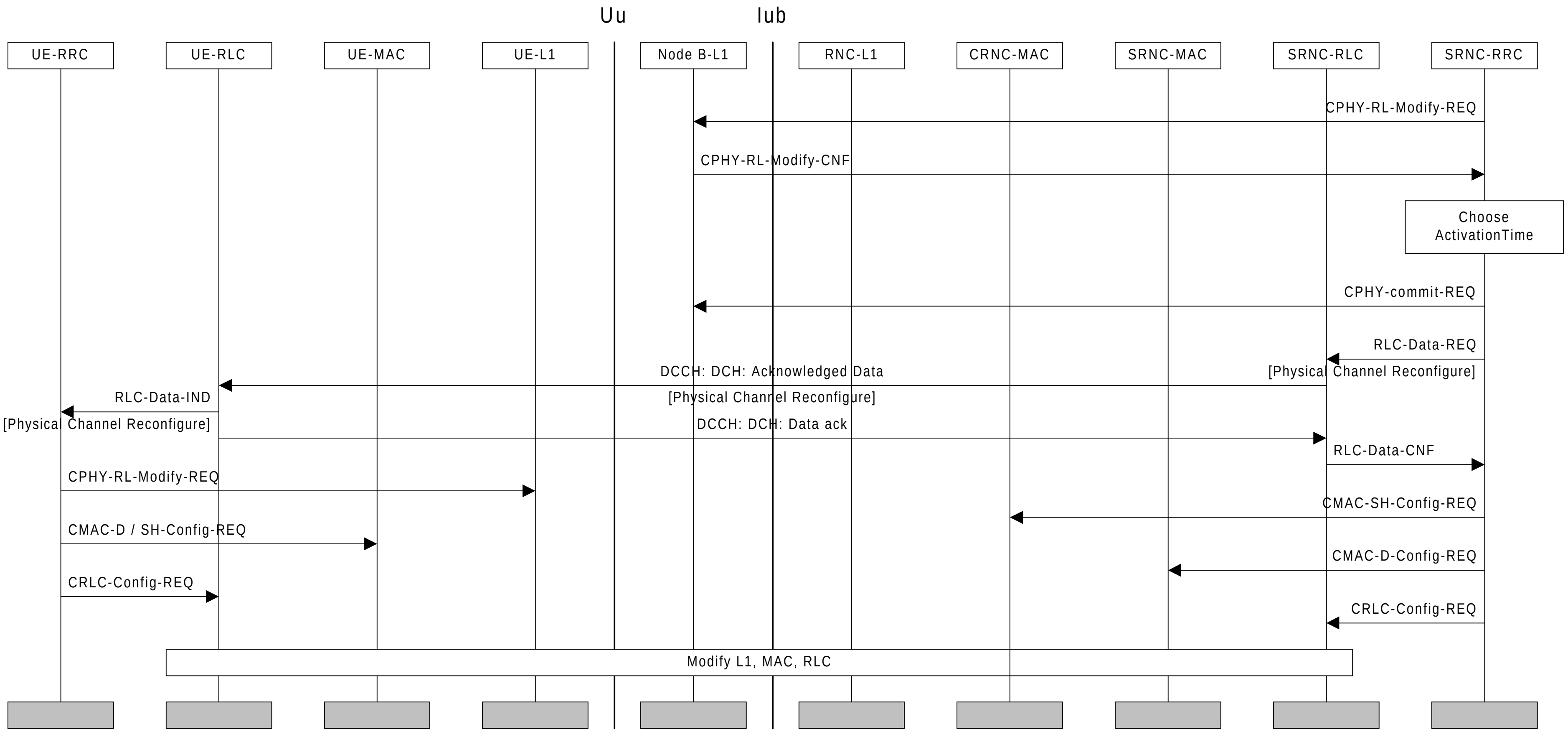

Figure 15: UE-terminated synchronised DCH Modify

Figure 15 illustrates an example of a synchronised procedure for DCH modification. Triggering of this procedure could for example be accomplished by an inactivity timer. The procedure can e.g. release all transport formats of a radio bearer without releasing the DCH, due to another bearer using it. The synchronised procedure is applied in the case when the old and new configurations are not compatible e.g. change of channelization code.

After the CPHY-RL-Modify requests have been confirmed, an activation time is chosen by NW-RRC. After deciding upon the activation time, the NW-RRC sends a PHYSICAL CHANNEL RECONFIGURE message as acknowledged data transfer to the UE. In both uplink and downlink this message is sent on DCCH mapped on DCH.

After reception the UE reconfigures L1 and L2 to DCH resources. The need for a Physical Channel Reconfigure Complete message to the network is FFS (not shown here). If a complete message is used it would be sent on DCCH mapped on DCH. In the unsynchronised case this message could trigger a modification of L1 and L2 resources in the network associated with the dedicated channel.

6.2.3.3 UE-terminated DCH Release

Figure 16 illustrates an example of a procedure for a switch from dedicated (CELL_DCH) to common (~~RACH/~~CELL_FACH) channels. All DCHs used by a UE are released and all dedicated logical channels are transferred to ~~RACH/~~CELL_FACH instead. Triggering of this procedure could for example be an inactivity timer.

A switch from DCH to common channels is decided and a PHYSICAL CHANNEL RECONFIGURE message is sent (acknowledged or unacknowledged data transfer is a network option) from the RRC layer in the network to the UE. This message is sent on DCCH mapped on DCH.

NOTE 1: This message does not include new transport formats. If a change of these is required due to the change of transport channel, this is done with the separate procedure Transport Channel Reconfiguration. This procedure only handles the change of transport channel.

NOTE 2: If the loss of L1 sync is used to detect in the NW that the UE has released the DCH:s, as is one possibility in the figure, then there may be a need to configure the Node B-L1 to a short timeout for detecting loss of sync. This is presented by the CPHY_out_of_sync_configure primitives in the figure. The L23 group is seeking guidance from the L1-group relating to the time required for reliable out-of-sync detection.

After reception the UE reconfigures L1 and L2 to release old DCH resources. The PHYSICAL CHANNEL RECONFIGURE COMPLETE (need FFS) message to the network is here sent on DCCH mapped on RACH (message acknowledgement on FACH). This message triggers a normal release of L1 and L2 resources in the network associated with the dedicated channel. If the L3 COMPLETE message doesn’t exist, the CPHY_out_of_sync_ind from the physical layer must be applied.

NOTE 3: When a Switch to ~~RACH/~~CELL_FACH is done it is important to free the old code as fast as possible so that it can be reused. Therefore instead of waiting for the Physical Channel Reconfigure Complete message the network can reconfigure L1 and L2 when the acknowledged data confirmation arrives and the network is sure that the UE has received the Physical Channel Reconfigure message. To be even more certain that the UE has released the old DCH resources the network can wait until after the Out of sync Indication from L1.
These steps including a timer starting when the Physical Channel Reconfigure is sent, gives the network four different indications that the released DCH is really released, and that resources can be reused.

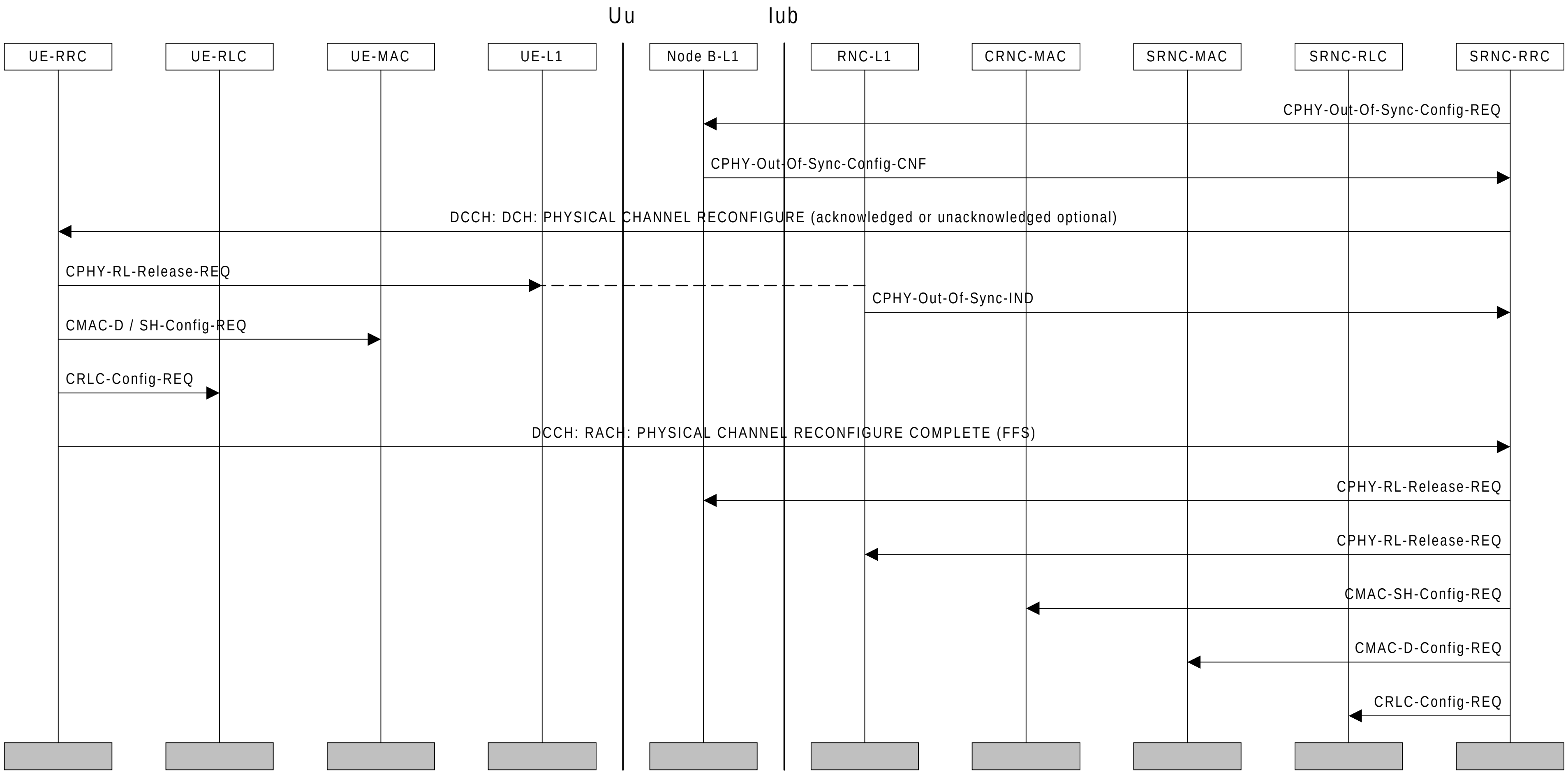

Figure 16: UE-terminated DCH Release

6.3 Data transmission

6.3.1 Acknowledged-mode data transmission ~~in DCH / DCH +~~on DSCH

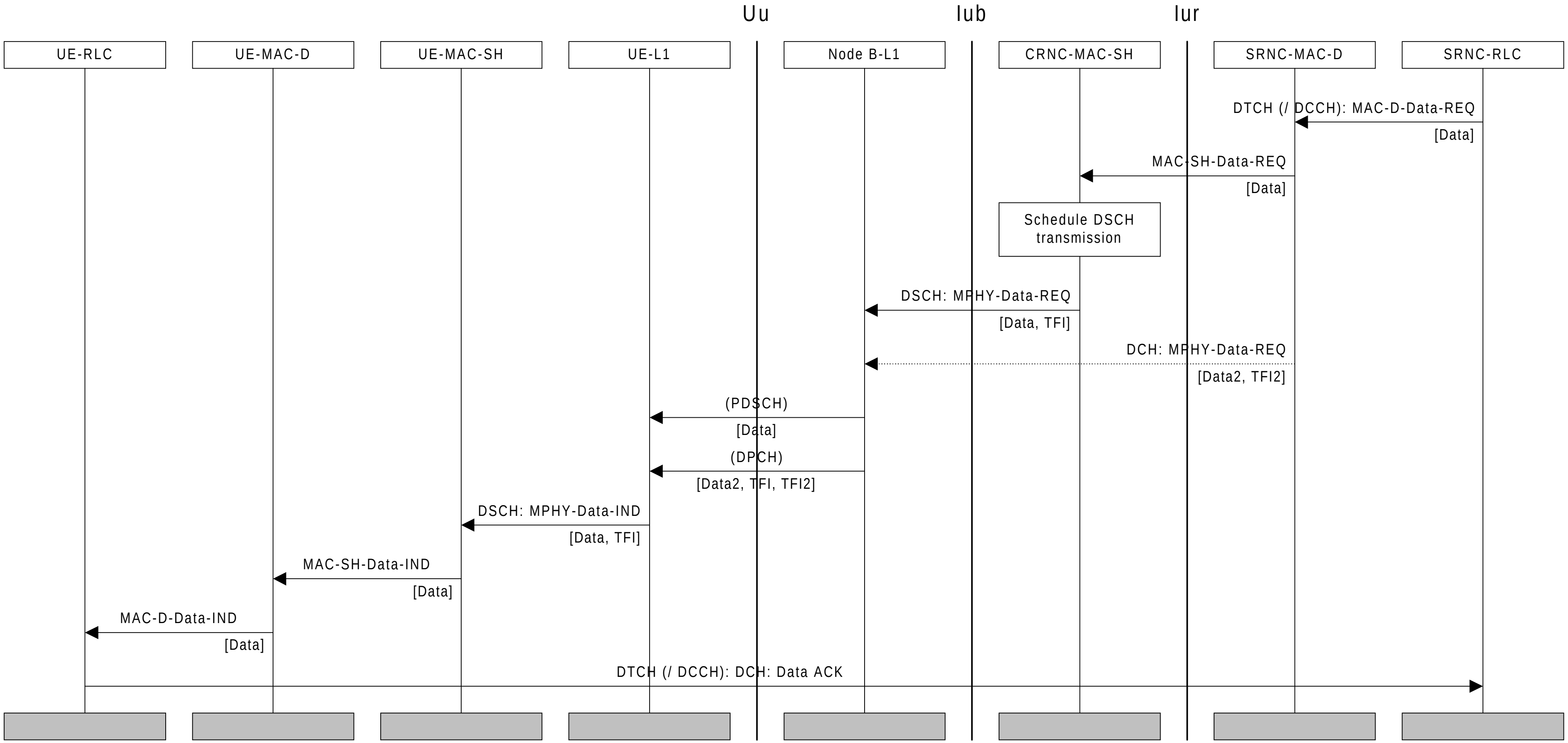

Figure 19: Example of acknowledged-mode data transmission on DSCH

Figure 19 shows an example of acknowledged-mode data transmission on DSCH in the DCH / DCH + DSCH substateassociated with a DCH. First RLC in SRNC requests data transmission locally from MAC-d. MAC-d routes the request either locally or across the Iur to MAC-sh in CRNC, where DSCH transmission scheduling takes place. MAC-SH determines the TFI for the data and requests data transmission across Iub from the physical layer in Node B. At the same time data for an associated dedicated channel may arrive in Node B.

TFI for the DSCH and TFI2 for the DCH are combined in the physical layer and transmitted on the DPCCH (dedicated physical control channel) of the associated DPCH (dedicated physical channel). The DSCH data is transmitted separately on the PDSCH (physical downlink shared channel). TFI is used to decode DSCH data, which is then forwarded through MAC-sh and MAC-d to the receiving RLC. An acknowledgement is eventually sent by the UE-RLC mapped to a DCH, unless the DCH is released before the acknowledgement.

6.3.2 Acknowledged-mode data transmission in DCH / DCH +on DSCH associated to a DCH with using one TFCI-word

NOTE: For release-99 this example is only valid in the case where SRNC = CRNC.

Figure 20 shows an example of acknowledged-mode data transmission on DSCH in the DCH / DCH + DSCH substate. First RLC in SRNC requests data transmission from MAC-d. MAC-d passes the data on to MAC-sh, which schedules the DSCH transmission and determines the TFI for the data. The TFI and CFN (connection frame number) for transmission are given back to MAC-d.

MAC-sh selects the TFI and transmits the data for DSCH while MAC-d transmits the TFI synchronised with the transmission of any DCH data and TFI:s intended for transmission in the same frame. TFI for the DSCH and TFI2 for the DCH are combined into the same TFCI on the physical layer and transmitted on the DPCCH (dedicated physical control channel) of the associated DPCH (dedicated physical channel). The DSCH data is transmitted separately on the PDSCH (physical downlink shared channel). TFI is used to decode DSCH data, which is then forwarded through MAC-sh and MAC-d to the receiving RLC. An acknowledgement is eventually sent by the UE-RLC mapped to a DCH, unless the DCH is released before the acknowledgement.

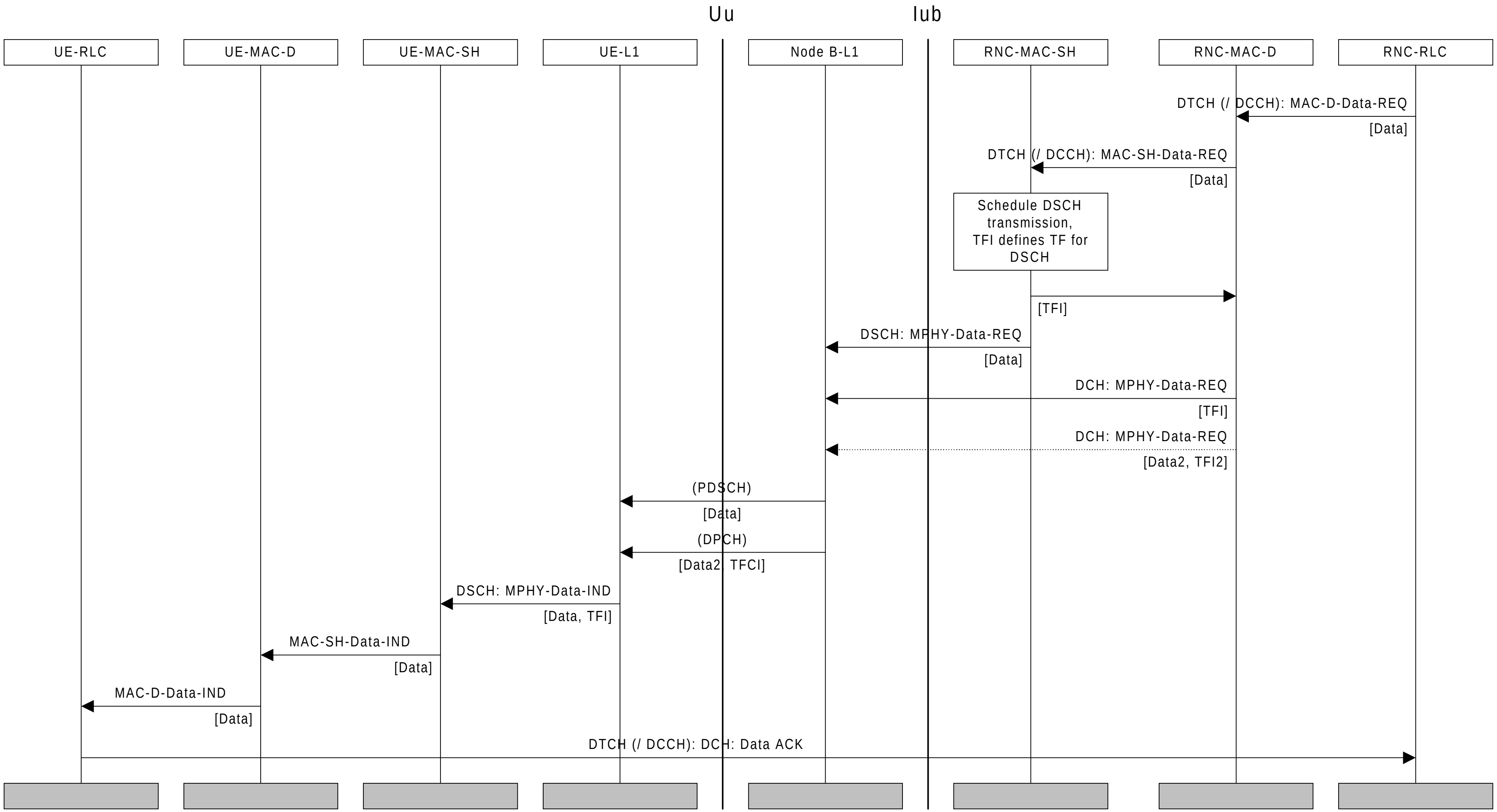

Figure 20: Example of acknowledged-mode data transmission on DSCH

6.3.3 Acknowledged-mode data transmission ~~in~~ on CPCH/~~FACH~~

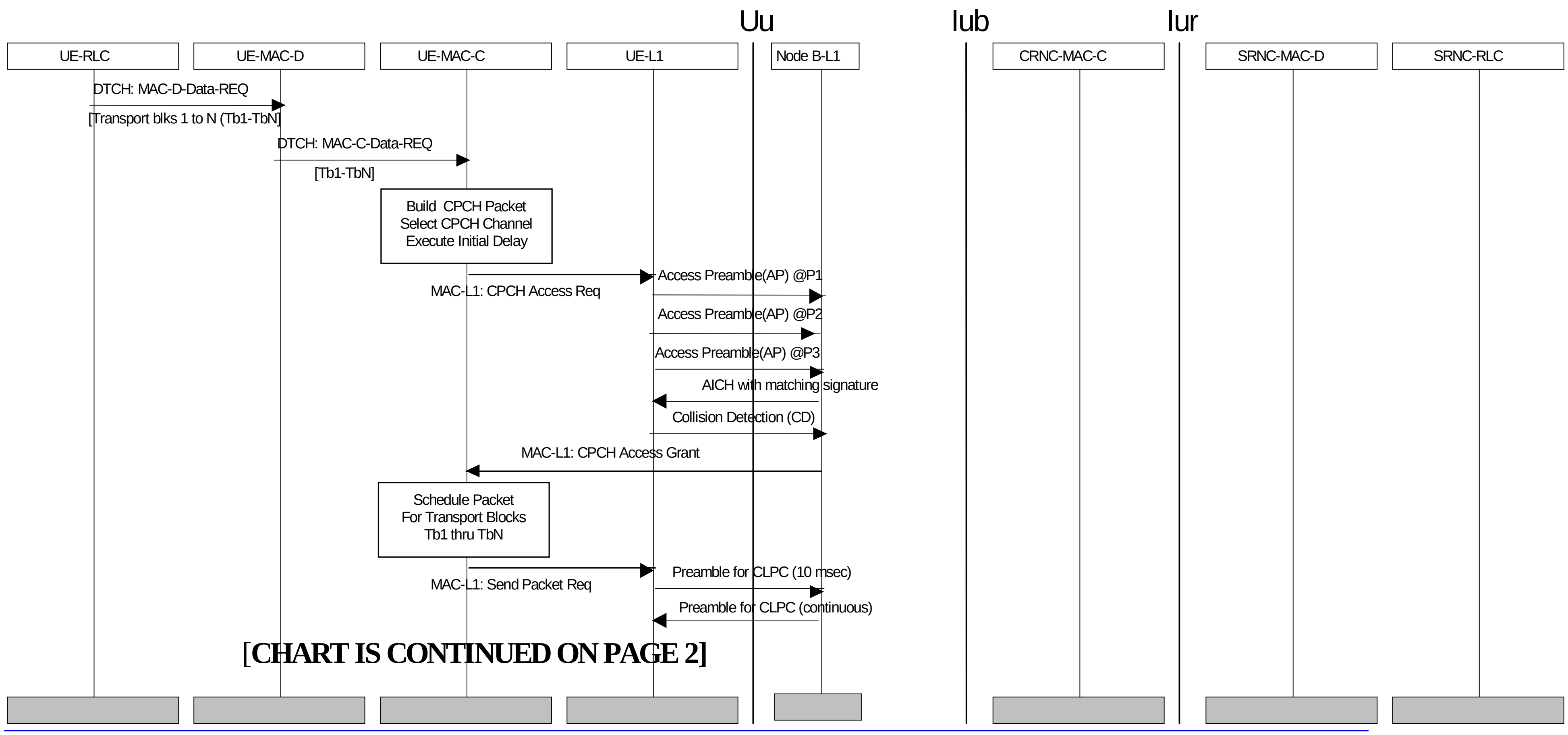

Figure 21: Example of acknowledged-mode data transmission on ~~RACH+~~CPCH/~~FACH~~ (page 1 of 2)

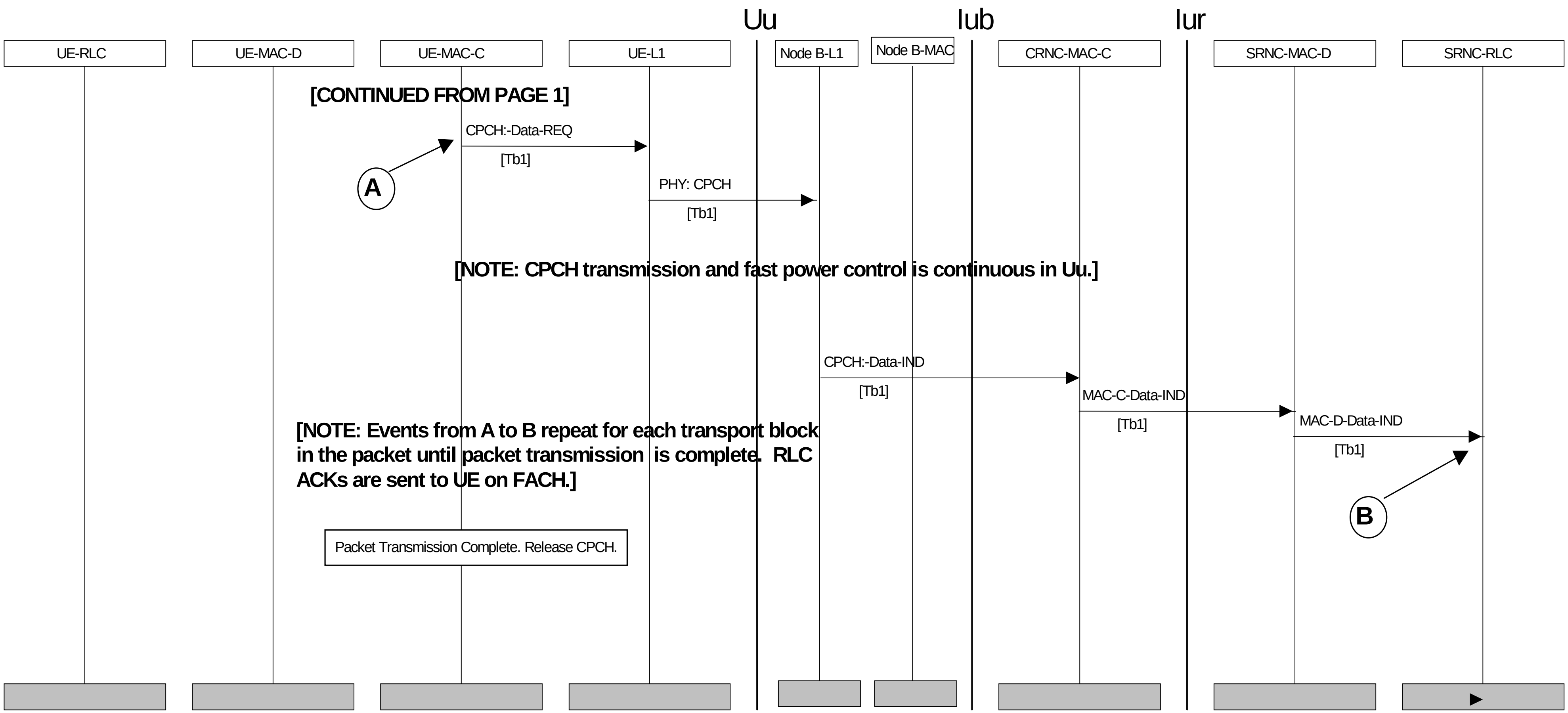

Figure 22: Example of acknowledged-mode data transmission on ~~RACH+~~CPCH~~/FACH~~ (page 2 of 2)

Figure 21 shows an example of acknowledged-mode data transmission on CPCH while in the RRC Connected state, the RACH+CPCH/CELL_FACH substate with CPCH resources assigned to UE (RACH+CPCH/FACH mode). An RB setup has allocated CPCH resources to the logical channel sourcing the data to be transmitted. First RLC in UE requests data transmission locally from MAC-d. MAC-d routes the request to MAC-c, where CPCH packet building is done. When the packet size (bytes in PHY for TFI chosen by MAC-c) is known, MAC-c selects one of the available CPCH channels from the CPCH set it has been assigned to use for this logical channel. Priority access procedure is performed to execute an initial access delay. Then the CPCH access procedure is performed between UE and NB to request and obtain the CPCH for transmission. The CPCH access procedure includes an AP, AICH-ack, CD, and ASSIGN premable messages. When the CPCH channel has been assigned, MAC-c schedules the packet for transmission by L1. [NOTE: if the requested channel could not be assigned, MAC-c may select an alternate CPCH channel which may have lower capacity. If the lower rate CPCH channel were assigned by NB, MAC-c would segment the packet based on the CPCH capacity and schedule only the highest priority packet head. The lower priority packet tail would be saved in a MAC queue for later packet transmission.]

After the 10msec period to close the TPC loops on both the CPCH UL and CPCCH DL, transport blocks are transmitted, frame by frame, unitl all the packet data is sent. SRNC RLC uses the DCCH to send RLC ACKs to the UE RLC using the FACH DL channel.

3GPP TSG-RAN Meeting #6
Nice, France, 13 - 15 December 1999

Document (R2-99k12)
e.g. for 3GPP use the format TP-99xxx
or for SMG, use the format P-99-xxx

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25.303 CR 021 Current Version: 3.1.0

GSM (AA.BB) or 3G (AA.BBB) specification number ↑ *↑ CR number as allocated by MCC support team*

For submission to: TSG-RAN#6 — for approval: X — for information: — strategic: — non-strategic: — *(for SMG use only)*

list expected approval meeting # here ↑

Form: CR cover sheet, version 2 for 3GPP and SMG The latest version of this form is available from: ftp://ftp.3gpp.org/Information/CR-Form-v2.doc

Proposed change affects: (U)SIM [ ] ME [X] UTRAN / Radio [X] Core Network [ ]
(at least one should be marked with an X)

Source: TSG-RAN WG2 **Date:** 3.12.1999

Subject: Editorial issues

Work item:

Category:
(only one category shall be marked with an X)

F	Correction	
A	Corresponds to a correction in an earlier release	
B	Addition of feature	
C	Functional modification of feature	
D	Editorial modification	X

Release:

Phase 2	
Release 96	
Release 97	
Release 98	
Release 99	X
Release 00	

Reason for change: Cleaning of editorial notes and FFS:s from 25.303

Clauses affected: 1, 5.1, 5.2, 5.3.1, 6.1.1, 6.1.2, 6.1.3.1, 6.1.3.2, 6.2.1.1, 6.2.1.1.3, 6.2.3.1, 6.2.3.2, 6.2.3.3, 6.3.3, 6.3.4, 6.4.2, 6.4.6, 6.4.7, 6.5.1, 6.6

Other specs affected:

Other 3G core specifications		→ List of CRs:
Other GSM core specifications		→ List of CRs:
MS test specifications		→ List of CRs:
BSS test specifications		→ List of CRs:
O&M specifications		→ List of CRs:

Other comments:

<--------- double-click here for help and instructions on how to create a CR.

Release 1999 Submission form

<table>
<tr><td>Work Area / Item:</td><td colspan="4">Interlayer procedures in Connected Mode</td></tr>
<tr><td>Affects:</td><td>UE/MS: X</td><td>CN:</td><td>UTRAN: X</td><td>Compatibility Issues: Yes: No:</td></tr>
<tr><td>Expected Completion Date:</td><td colspan="4">3. 12. 1999</td></tr>
<tr><td>Services impacted:</td><td colspan="4">None</td></tr>
<tr><td>Specifications affected:</td><td colspan="4">None</td></tr>
<tr><td colspan="2">Tasks within work which are not complete:</td><td colspan="3">The following items are considered for releases beyond release 99:
• Asymmetric Transport Channel Reconfiguration
• Support of downlink shared channel in FDD-mode using one TFCI-word when SRNC <> CRNC</td></tr>
<tr><td colspan="2">Consequences if not included in Release 1999:</td><td colspan="3">No consequences.</td></tr>
<tr><td colspan="4">Accepted by TSG# for late inclusion in Release 1999:</td><td></td></tr>
</table>

Abstract of document:

The present document describes all procedures that assign, reconfigure and release radio resources. Included are e.g. procedures for transitions between different states and substates, handovers and measurement reports. The emphasis is on showing the combined usage of both peer-to-peer messages and interlayer primitives to illustrate the functional split between the layers, as well as the combination of elementary procedures for selected examples. The peer-to-peer elementary procedure descriptions are described in the related protocol descriptions and they are thus not within the scope of this document.

The interlayer procedures in this document are informative.

Contentious Issues:

Configuration of loss of synchronisation on the physical layer not finalised. Functionality can be incorporated in TS:s 25.302 and 25.331, but the solution may impact descriptions in TS 25.303.

1 Scope

The present document describes all procedures that assign, reconfigure and release radio resources. Included are e.g. procedures for transitions between different states and substates, handovers and measurement reports. The emphasis is on showing the combined usage of both peer-to-peer messages and interlayer primitives to illustrate the functional split between the layers, as well as the combination of elementary procedures for selected examples. The peer-to-peer elementary procedure descriptions are described in the related protocol descriptions /1, 2, 3/ and they are thus not within the scope of this document.

The interlayer procedures in this document are informative.

Following items are considered for releases beyond release 99:

- Asymmetric Transport Channel Reconfiguration
- Support of downlink shared channel in FDD-mode using one TFCI-word when SRNC <> CRNC

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.

[1] 3G TS 25.321: "MAC Protocol Specification"

[2] 3G TS 25.322: "RLC Protocol Specification"

[3] 3G TS 25.331: "RRC Protocol Specification"

[4] 3G TS 25.304: "UE Procedures in Idle Mode"

[5] 3G TS 25.301: "Radio Interface Protocol Architecture"

3 Symbols

For the purposes of the present document, the following symbols apply:

+ A "+" in a substate name means that transport channels separated by the symbol can both be used in that substate. The name doesn’t define whether simultaneous multicode transmission is allowed on these channels. E.g. in DCH / DCH + DSCH both downlink transport channels can be actively transmitting at the same time, but in RACH + FAUSCH / FACH simultaneous transmission on RACH and FAUSCH requiring multicode transmission should not be necessary.

4 General Description of Connected Mode

The connected mode is entered when the RRC connection is established. The UE is assigned a radio network temporary identity (RNTI) to be used as UE identity on common transport channels. Two types of RNTI exist. The Serving RNC allocates an s-RNTI for all UEs having an RRC connection. The combination of s-RNTI and an RNC-ID is unique within a PLMN. c-RNTI is allocated by each Controlling RNC through which UE is able to communicate on DCCH. c-

RNTI is always allocated by UTRAN when a new UE context is created to an RNC, but the UE needs its c-RNTI only for communicating on common transport channels.

The UE leaves the connected mode and returns to idle mode when the RRC connection is released or at RRC connection failure.

Within connected mode the level of UE connection to UTRAN is determined by the quality of service requirements of the active radio bearers and the characteristics of the traffic on those bearers.

The UE-UTRAN interface is designed to support a large number of UE:s using packet data services by providing flexible means to utilize statistical multiplexing. Due to limitations, such as air interface capacity, UE power consumption and network h/w availability, the dedicated resources cannot be allocated to all of the packet service users at all times.

The UE state in the connected mode defines the level of activity associated to the UE. The key parameters of each state are the required activity and resources within the state and the required signalling prior to the data transmission. The state of the UE shall at least be dependent on the application requirement and the period of inactivity.

Common Packet Channel (CPCH) uplink resources are available to UE's with an access protocol similar to the RACH. The CPCH resources support uplink packet communication for numerous UEs with a set of shared, contention-based CPCH channels allocated to the cell.

Packet Services can be supported also using the FAUSCH, by means of which a dedicated transport channel can be allocated for data transmission.

The different levels of UE connection to UTRAN are listed below:

- No signalling connection exists
  The UE is in idle mode and has no relation to UTRAN, only to CN. For data transfer, a signalling connection has to be established.

- Signalling connection exists
  When at least one signalling connection exists, the UE is in connected mode and there is normally an RRC connection between UE and UTRAN. The UE position can be known on different levels:

  - UTRAN Registration Area (URA) level
    The UE position is known on URA level. The URA is a set of cells

  - Cell level
    The UE position is known on cell level. Different transport channel types can be used for data transfer:

  - Common transport channels (RACH / FACH, DSCH, CPCH)

  - Dedicated transport channels (DCH) (FAUSCH can be used to allocate a dedicated transport channel for data transmission.)

Assuming that there exists an RRC connection, there are two basic families of RRC connection mobility procedures, URA updating and handover. Different families of RRC connection mobility procedures are used in different levels of UE connection (cell level and URA level):

- URA updating is a family of procedures that updates the UTRAN registration area of a UE when an RRC connection exists and the position of the UE is known on URA level in the UTRAN.

- Handover is a family of procedures that adds or removes one or several radio links between one UE and UTRAN when an RRC connection exists and the position of the UE is known on cell level in the UTRAN.

5 Radio Bearer Control – Overview of Procedures

5.1 Configurable parameters

The following layer 1, MAC and RLC parameters should be able to configure by RRC. The list is not complete.

- Radio bearer parameters, e.g.

  - RLC parameters per RLC link (radio bearer), which may include e.g. PDU size and timeout values. Used by RLC.
  - Multiplexing priority per DCCH/DTCH. Used by MAC in case of MAC multiplexing of logical channels.
- Transport channel parameters, e.g.
  - Scheduling priority per transport channel. Used by MAC in case of layer 1multiplexing of transport channels.
  - Transport format set (TFS) per transport channel. Used by MAC and L1.
  - Transport format combination set (TFCS) per UE. Used by MAC and L1.
  - Allowed subset of TFCS per UE. Used by MAC.
  - CPCH access parameters per CPCH channel. ~~[Details are FFS.]~~ Used by MAC and L1.
- Physical channel parameters, which may include e.g. carrier frequency and codes. Used by L1.

5.2 Typical configuration cases

The table below gives a proposal which main combination cases of parameter configuration that shall be supported, in terms of which parameters that shall be able to configure simultaneously (by one procedure). Note that the "Transport channel type switching" is not a parameter as such, it only indicates that switching of transport channel type may take place for that combination case.

Table 1: Typical configuration cases.
An "X" indicates that the parameter can (but need not) be configured

Parameter		Layer	A	B	C	D	E	F
Radio bearer parameters	RLC parameters	RLC	X					
	Logical channel multiplexing priority	MAC	X					
Transport channel parameters	Transport channel scheduling priority	MAC	X					
	TFS	L1+MAC	X	X				
	TFCS	L1+MAC	X	X				
	Subset of TFCS	MAC					X	X
	Transport channel type switching	MAC	X	X	X			
Physical channel parameters		L1	X	X	X	X		

Case A is typically when a radio bearer is established or released, or when the QoS of an existing radio bearer need to be changed ~~(the necessity of change of QoS is FFS)~~.

Case B is when the traffic volume of a radio bearer has changed so the TFS used on the DCH need to be changed, which may in turn affect any assigned set of physical channels. Another example is to make the UE use a new transport channel and at the same time supplying the TFS for that channel.

Case C is when the traffic volume of one radio bearer has changed so that the used transport channel type is changed, e.g. from RACH/FACH to DCH/DCH or when the CPCH Set assigned to a UE is switched. This case includes the assignment or release of a set of physical channels.

Case D is e.g. the change of used DL channelization code, when a DCH is currently used. No transport channel type switching take place.

Case E is a temporary restriction and/or a release of restriction for usage of the TFCS by the UE (total uplink rate).

Case F is used to dynamically control the allocation of resources on uplink DCHs in the CRNC, using broadcast information such as transmission probability and maximum bit rate.

5.3 RRC Elementary Procedures

5.3.1 Category 1: Radio Bearer Configuration

The first category of procedures includes Case A and are characterized by:

- Are executed upon request by higher layers and the parameter configuration is based on QoS
- Affects L1, MAC and RLC.

There are three RRC procedures included in this category:

- **Radio Bearer Establishment.** This procedure establishes a new radio bearer. The establishment includes, based on QoS, assignment of RLC parameters, multiplexing priority for the DTCH, CPCH Set assignment, scheduling priority for DCH, TFS for DCH and update of TFCS. It may also include assignment of a physical channel(s) and change of the used transport channel types / RRC state.
- **Radio Bearer Release.** This procedure releases a radio bearer. The RLC entity for the radio bearer is released. The procedure may also release a DCH, which affects the TFCS. It may include release of physical channel(s) and change of the used transport channel types / RRC state.
- **Radio Bearer Reconfiguration.** (NOTE) This procedure reconfigures parameters for a radio bearer (e.g. the signalling link) to reflect a change in QoS. It may include change of RLC parameters, change of multiplexing priority for DTCH/DCCH, CPCH Set assignment, change of DCH scheduling priority, change of TFS for DCH, change of TFCS, assignment or release of physical channel(s) and change of used transport channel types.

NOTE: The necessity of this procedure is FFS.

5.3.2 Category 2: Transport Channel Configuration

The second category of procedures includes Case B and are characterized by:

- Configuration of TFS for a transport channel and reconfiguration of TFCS is done, but sometimes also physical channel parameters.
- Affects L1 and MAC.
- Switching of used transport channel(s) may take place.

There is one RRC procedure included in this category:

- **Transport Channel Reconfiguration.** This procedure reconfigures parameters related to a transport channel such as the TFS. The procedure also assigns a TFCS and may change physical channel parameters to reflect a reconfiguration of a transport channel in use.

NOTE: It is expected that the configuration of TFS/TFCS needs to be done more seldom than the assignment of physical channel. A "pre-configuration" of TFS/TFCS of a transport channel not in use can be done by this procedure, to be used after transport channel type switching when the physical channel is assigned.

5.3.3 Category 3: Physical Channel Configuration

The third category of procedures includes the cases C and D and are characterized by:

- May assign or release a physical channel for the UE (which may result in transport channel type switching)
- May make a combined release and assignment (replacement) of a physical channel in use (which does not result in transport channel type switching / change of RRC state).
- Affects mainly L1, and only the transport channel type switching part of MAC.
- The transport format sets (TFS and TFCS) are not assigned by this type of procedure. However, the UE can be directed to a transport channel, which TFS is already assigned to the UE.

There is one RRC procedure included in this category:

- **Physical Channel Reconfiguration.** This procedure may assign, replace or release a set of physical channels used by an UE. As a result of this, it may also change the used transport channel type (RRC state). For example, when the first physical channel is assigned the UE enters the DCH/DCH state. When the last physical channel is released the UE leaves the DCH/DCH state and enters a state (and transport channel type) indicated by the network. A special case of using this procedure is to change the DL channelization code of a dedicated physical channel.

NOTE: The procedure does not change the active set, in the downlink the same number of physical channels are dded or replaced for each radio link.

5.3.4 Category 4: Transport Format Combination Restriction

The fourth category of procedures includes Case E and are characterized by:

- Does only control MAC by means of the transport format combinations that may be used within the set without affecting L1.

There is one RRC procedure included in this category:

- **Transport format combination control.** The network uses this procedure towards an UE, to control the used transport format combinations in the uplink within the transport format combination set.

5.3.5 Category 5: Uplink Dedicated Channel Control in CRNC

The fifth category of procedures includes Case F and are characterized by:

- Does control UE MAC by means of broadcasting transmission probability and maximum total bit rate that shall be used for uplink DCHs, which are under control by this procedure.

There is one RRC procedure included in this category:

- **Dynamic Resource Allocation Control of Uplink DCHs :** The network uses this procedure towards all UEs, to control the probability of transmission and the maximum total bit rate used by uplink DCHs, which are under control by this procedure.

6 Examples of procedures

These sequences are examples and do not provide a comprehensive set of all different scenarios.

In cases where the logical and / or transport channel for a given message is known, it can be shown in front of the message name (*Logical_Ch: Transport_Ch: Message).* For example: DCCH:RACH:Acknowledged Data indicates a data message on DCCH mapped onto RACH. Either logical or transport channel can be omitted, if it is unspecified for the message.

6.1 RRC Connection Establishment and Release Procedures

6.1.1 RRC connection establishment

RRC connection establishment (see /5/) is shown in Figure 1 (protocol termination for common channels is shown according to former case A, case C can be found for comparison in Annex A). The RRC layer in the UE leaves the idle mode and initiates an RRC connection establishment by sending an RRC Connection Request message using the MAC SAP for the CCCH logical channel. MAC transmits the L3 message on the RACH transport channel.

NOTE: ~~The L23 EG has adopted a working assumption to use an identity from the Non-Access Stratum (such as TMSI+LAI) included in the RRC Connection Request message. A PRACH physical random access channel capable of transmitting 32 kbps is estimated to be suitable for the message, guidance on the preferability of this data rate is sought from the physical layer EG. Other alternatives exist, such as a random number.~~

On the network side, upon the reception of RRC Connection Request, the RRC layer performs admission control, assigns an s-RNTI for the RRC connection and selects radio resource parameters (such as transport channel type, transport format sets etc). If a DCH is to be established, CPHY-RL-Setup and CPHY-TrCH-Config request primitives (transmitted as one RADIO LINK SETUP PDU) are sent to all Node B:s which would be involved in the channel establishment. The physical layer operation is started and confirmation primitives are returned from each Node B. RRC configures parameters on layer 2 to establish the DCCH logical channel locally. The selected parameters including the RNTI, are transmitted to the UE in an RRC Connection Setup message using the MAC SAP for the CCCH logical channel.

Upon reception of the RRC Connection Setup message, the RRC layer in the UE configures the L1 and L2 using these parameters to locally establish the DCCH logical channel. In case of DCH, layer 1 indicates to RRC when it has reached synchronisation. ~~The need for the synchronisation indication on the network side is FFS.~~

The RLC signalling link is locally established on both sides. The establishment can be mapped on either RACH / FACH, RACH+FAUSCH / FACH or DCH by MAC. When the UE has established the RLC signalling link, it transmits an RRC Connection Setup Complete message to the network using acknowledged mode on the DCCH.

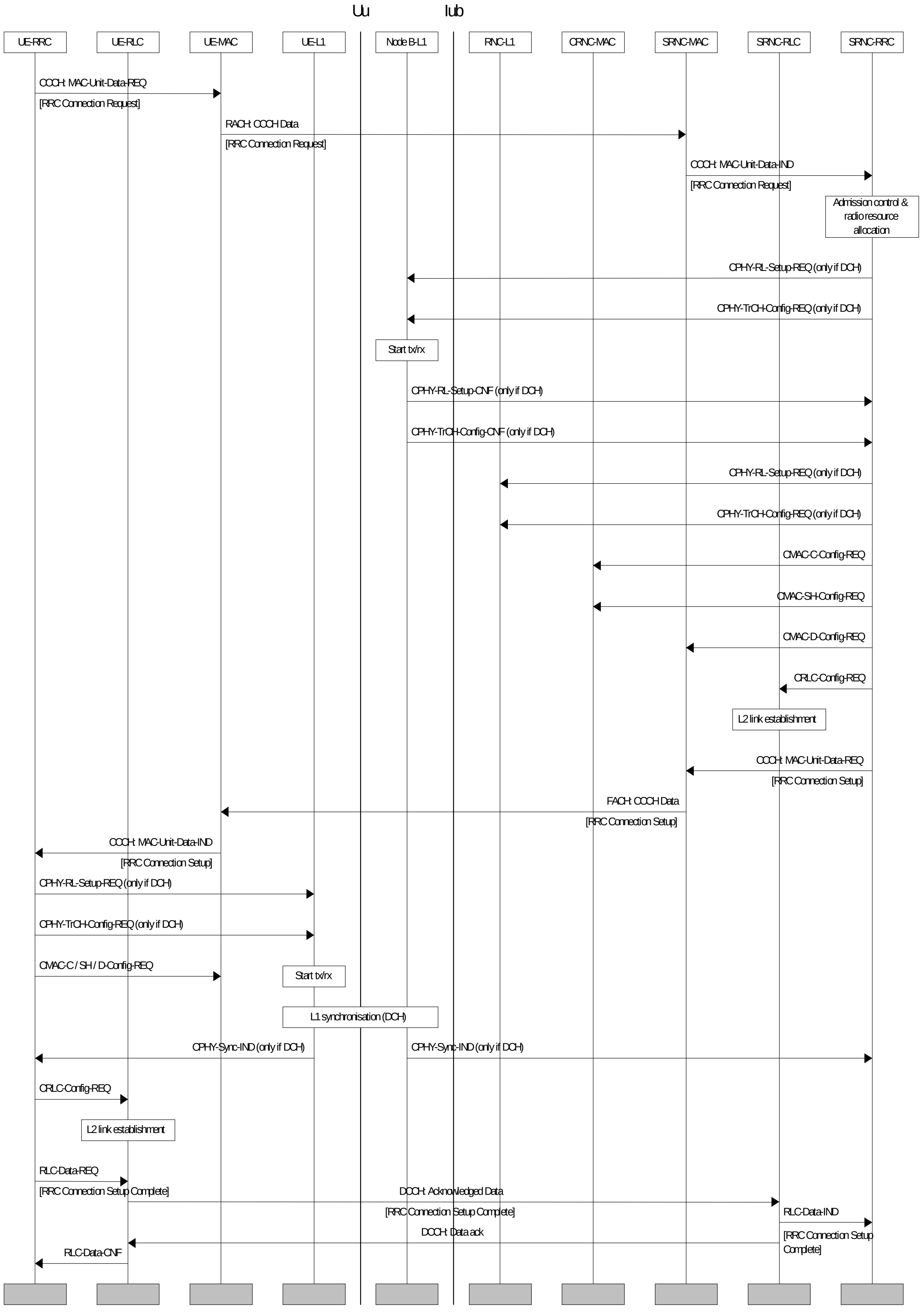


Figure 1: RRC connection establishment (with common channel termination case A)

6.1.2 UE Initiated Signalling Connection Establishment

NOTE 1: In case additional UE capability information is needed at RRC Connection Setup, it is transmitted in the RRC Connection Setup Complete message.

The sequence in Figure 2 shows the establishment of the first Signalling Connection for the UE, initiated by the UE.

RRC Signalling Connection Establishment is requested by the non access stratum in the UE with a primitive over the Dedicated Control (DC) SAP. The primitive contains an initial message to be transferred transparently by RRC to the non-access stratum entity on the network side.

NOTE 2: The initial NAS message could for a GSM based Core Network be e.g. CM Service Request, Location Update Request etc.

If no RRC connection exists, the RRC layer makes an RRC connection establishment, which includes the transmission of UE capability information. When the RRC connection establishment is completed, the signalling connection establishment can be resumed.

The initial message from NAS is transferred in the RRC message "Direct Transfer" using acknowledged mode on the DCCH, to the network, where it is passed on with an RRC Signalling Connection Establish IND primitive over the DC-SAP.

~~NOTE 3: The necessity for a separate RRC message for encapsulating NAS messages is FFS.~~

When the initial NAS message has been transferred successfully, as indicated by the RLC-Data-CNF primitive in the UE, the Signalling Connection Establishment is confirmed by the UE-RRC.

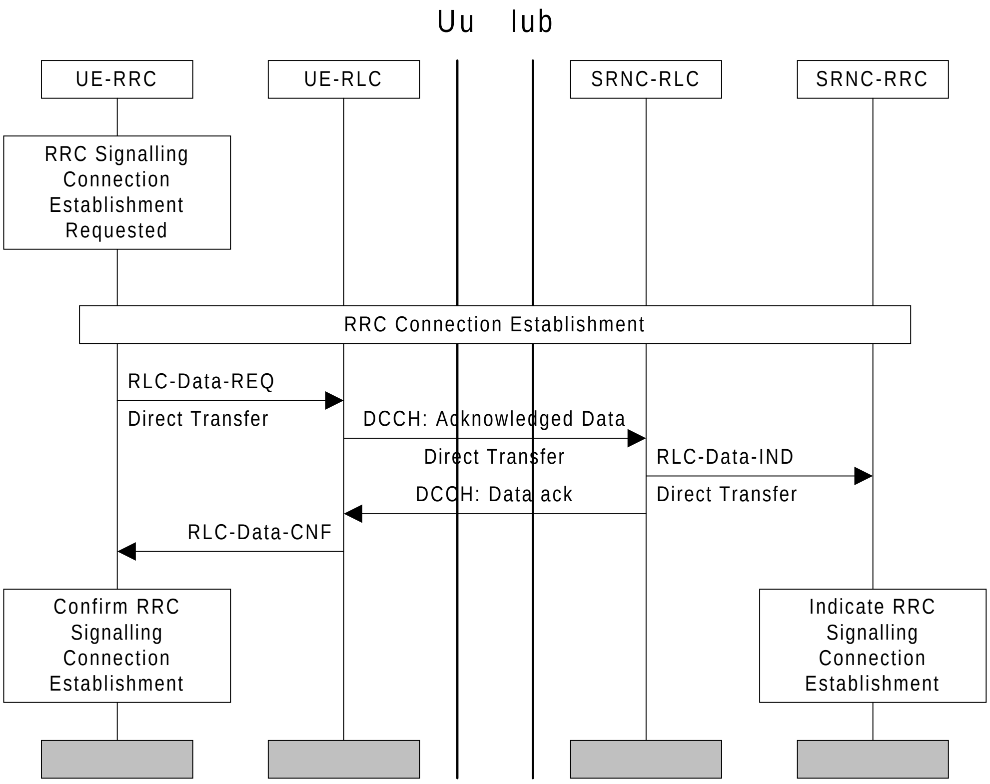


Figure 2: UE initiated Signalling Connection Establishment

6.1.3 Normal RRC Connection Release

A normal RRC Connection Release procedure is initiated on the network side by an RRC Signalling Connection Release request for the last Signalling Connection of a UE. The procedure is slightly different depending on whether the UE has dedicated physical channel(s) allocated.

6.1.3.1 RRC Connection Release from Dedicated Physical Channel

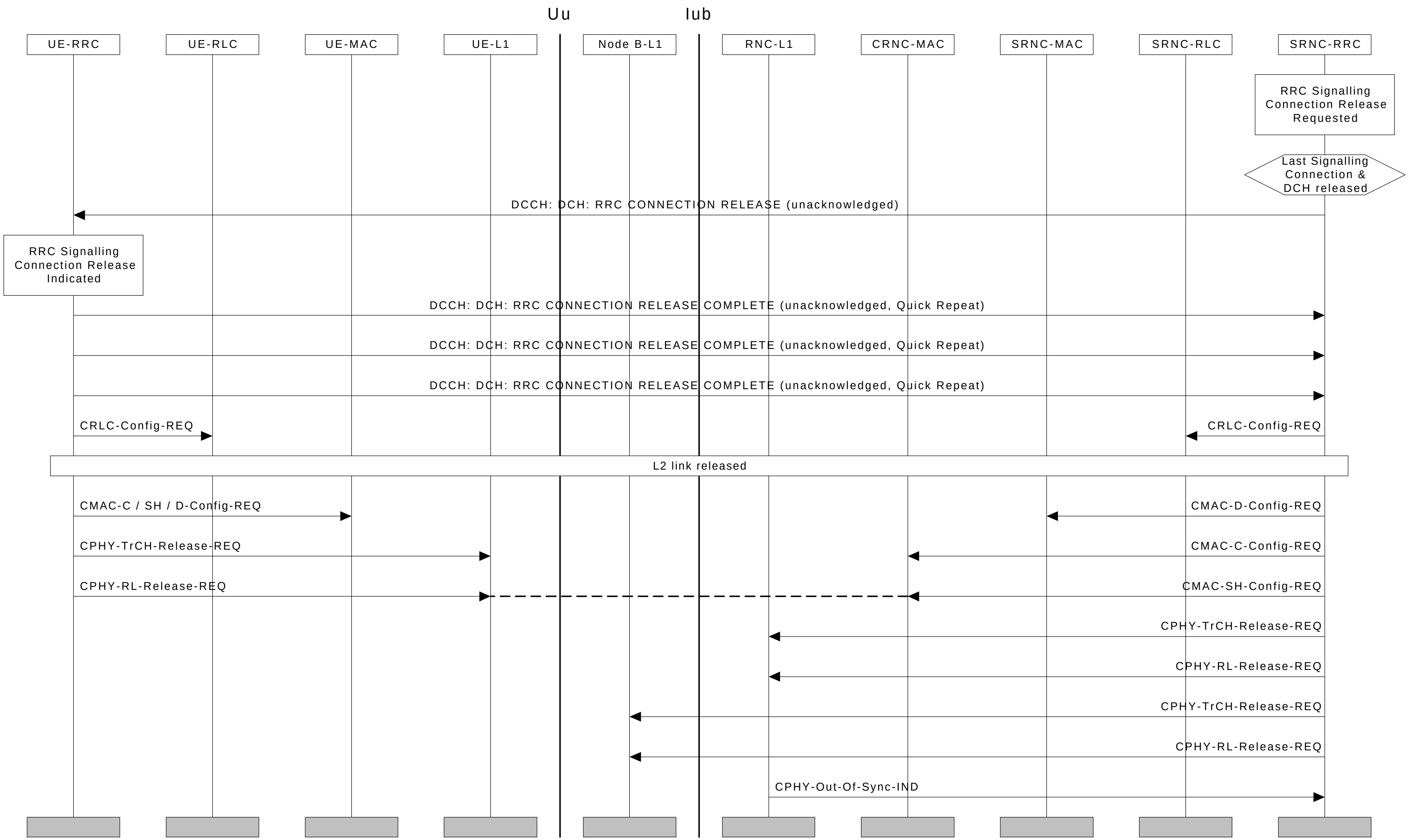


Figure 3: RRC Connection Release from Dedicated Physical Channel

The RRC layer entity in the network issues an RRC CONNECTION RELEASE message using unacknowledged mode on the DCCH. Upon reception of this message the UE-RRC sends an RRC Signalling Connection Release Indication primitive to NAS The UE replies with an RRC CONNECTION RELEASE COMPLETE message, which is sent in unacknowledged-mode on the dedicated channel. To improve the reliability of the message, quick repeat on RRC-level can be used. The UE will then proceed to release RLC(s), MAC and the radio link(s) after which the UE RRC enters Idle Mode.

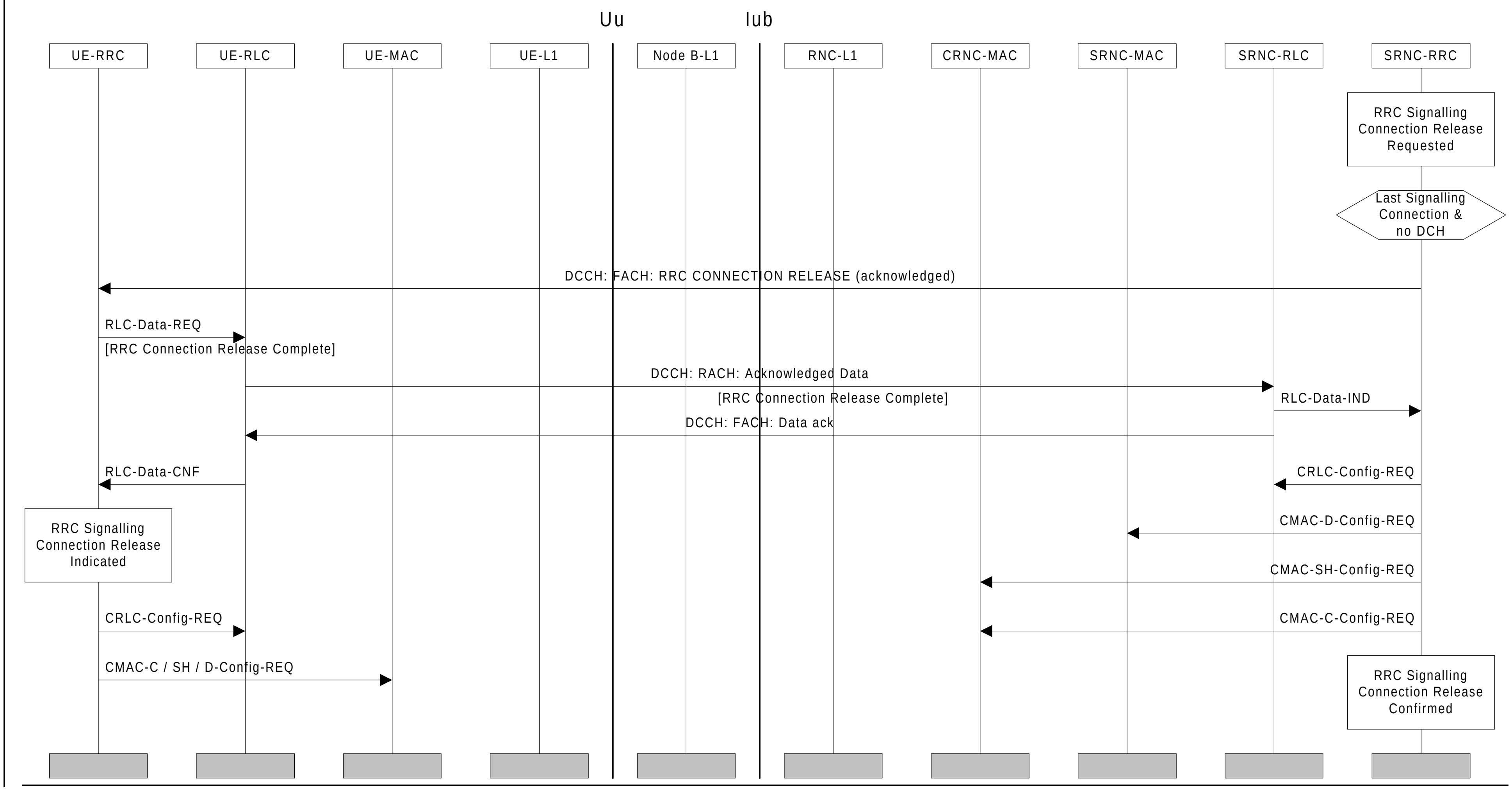
The primary method to detect the release of the signalling link in the NW is the RRC CONNECTION RELEASE COMPLETE-message from the UE. Should the message be lost despite the use of quick repeat, the release of the signalling link is detected by the out-of-sync primitive from either Node-B L1 or RNC-L1 ~~(FFS)~~ to RNC RRC. After receiving this primitive, the RNC-RRC layer releases L2 and L1 resources on the network side and enters the idle mode.

6.1.3.2 RRC Connection Release without Dedicated Physical Channel

The RRC layer entity in the network issues an RRC CONNECTION RELEASE message using unacknowledged or acknowledged mode on the DCCH. Upon reception of this message the UE-RRC sends an RRC Signalling Connection Release Indication primitive to NAS and an RRC CONNECTION RELEASE COMPLETE message to UTRAN using acknowledged mode on the DCCH.

~~NOTE: Depending on RLC design, the acknowledgement to RRC CONNECTION RELEASE could be piggybacked to the RRC CONNECTION RELEASE COMPLETE MESSAGE, resulting in no additional messages. Therefore acked / unacked transmission is considered FFS.~~

After receiving the RRC CONNECTION RELEASE COMPLETE message the network RRC layer releases L2 resources, sends an RRC Signalling Connection Release confirmation to DC-SAP and goes to Idle Mode (more precisely: only the RRC entity dedicated to this UE goes to Idle Mode).


Uu
Iub
UE-RRC
UE-RLC
UE-MAC
UE-L1
Node B-L1
RNC-L1
CRNC-MAC
SRNC-MAC
SRNC-RLC
SRNC-RRC
RRC Signalling Connection Release Requested
Last Signalling Connection & no DCH
DCCH: FACH: RRC CONNECTION RELEASE (acknowledged)
RLC-Data-REQ
[RRC Connection Release Complete]
DCCH: RACH: Acknowledged Data
[RRC Connection Release Complete]
RLC-Data-IND
DCCH: FACH: Data ack
RLC-Data-CNF
CRLC-Config-REQ
RRC Signalling Connection Release Indicated
CMAC-D-Config-REQ
CMAC-SH-Config-REQ
CRLC-Config-REQ
CMAC-C-Config-REQ
CMAC-C / SH / D-Config-REQ
RRC Signalling Connection Release Confirmed

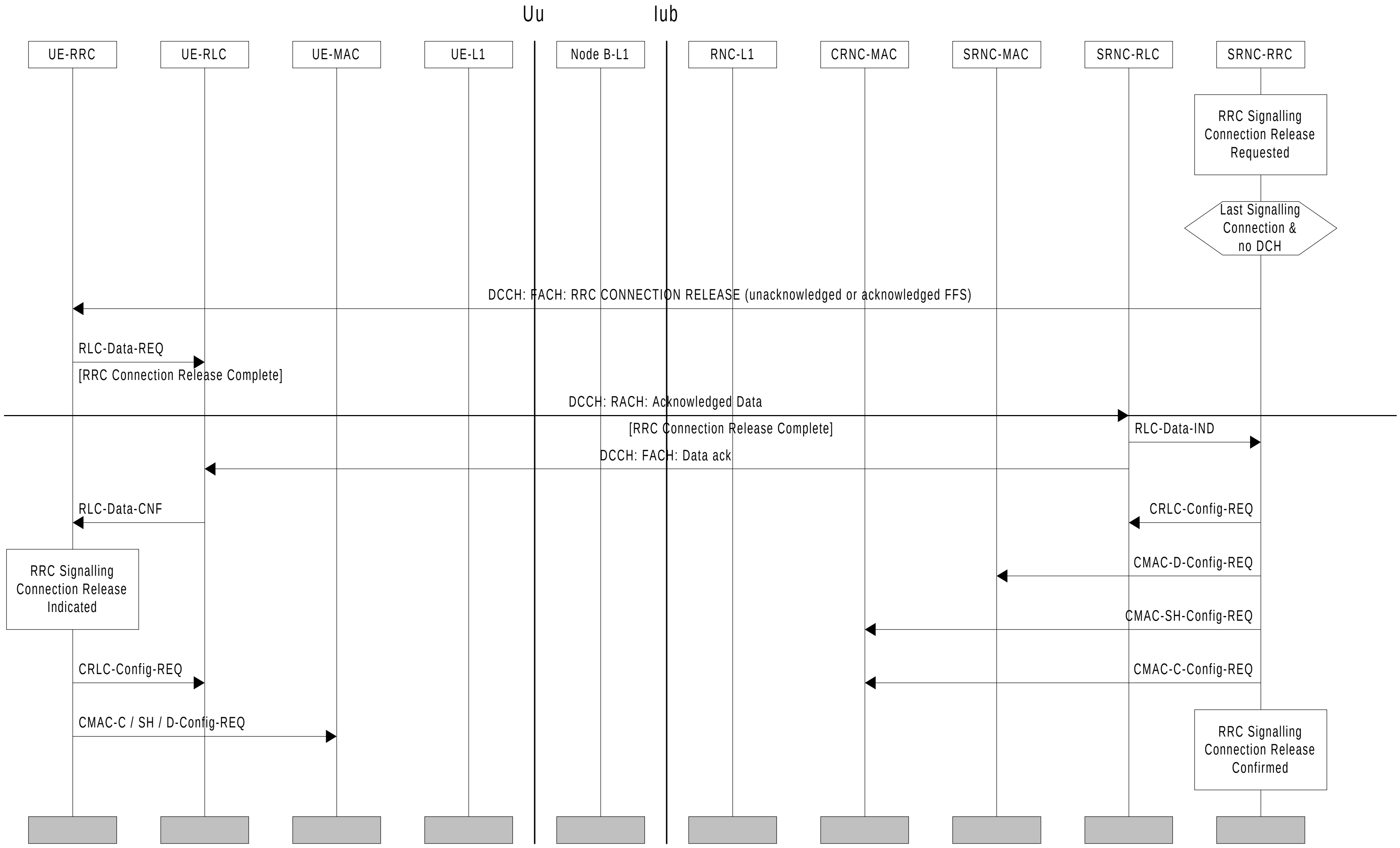


Figure 4: RRC Connection Release without Dedicated Physical Channel

6.2 Radio Bearer Procedures

6.2.1 Radio Bearer Configuration

6.2.1.1 Radio Bearer Establishment

The procedures for establishing radio bearers may vary according to the relation between the radio bearer and a dedicated transport channel. Depending on the QoS parameters, there may or may not be a permanently allocated dedicated channel associated with the RB. Circuit-switched bearers, or bearers classified as real-time services typically need a permanent association to a DCH to meet the delay requirements. Packet-switched bearers, or bearers classified as non-real-time services can in many cases be served as best-effort, requesting capacity from an associated DCH based on need.

When establishing an RB together with a DCH, the DCH may be attached to either a newly activated physical channel or it may be accommodated by modifying an existing physical channel. The modification is further broken down into two different options: synchronised and unsynchronised. If the old and new physical channel settings are compatible (TFCI etc.) in the sense that executing the modification in the NW and the UE with arbitrary timing does not introduce transmission errors, the unsynchronised procedure can be applied. If the old and new settings are incompatible, due to e.g. assignment of the same TFCI value to a new set of physical layer configuration, the synchronised procedure must be used.

6.2.1.1.1 Radio Bearer Establishment with Dedicated Physical Channel Activation

The procedure in Figure 5 is applied when a new physical channel needs to be created for the radio bearer. A Radio Bearer Establishment is initiated when an RB Establish Request primitive is received from the DC-SAP on the network side of the RRC layer. This primitive contains a bearer reference and QoS parameters. Based on these QoS parameters, L1 and L2 parameters are chosen by the RRC entity on the network side.

The physical layer processing on the network side is started with the CPHY-RL-Setup request primitive issued to all applicable Node B:s. If any of the intended recipients is / are unable to provide the service, it will be indicated in the confirmation primitive(s).After setting up L1 including the start of tx / rx in Node B, the NW-RRC sends a RADIO BEARER SETUP message to its peer entity (acknowledged or unacknowledged transmission optional for the NW). This message contains L1, MAC and RLC parameters. After receiving the message, the UE-RRC configures L1 and MAC.

When L1 synchronisation is indicated ~~(NOTE 1)~~, the UE sends a RADIO BEARER SETUP COMPLETE message in acknowledged-mode back to the network. The NW-RRC configures MAC and RLC on the network side.

~~NOTE 1: Need for sync_ind on NW-side FFS~~

After receiving the confirmation for the RADIO BEARER SETUP COMPLETE, the UE-RRC creates a new RLC entity associated with the new radio bearer. The applicable method of RLC establishment may depend on RLC transfer mode. The RLC connection can be either implicitly established, or explicit signalling can be applied. ~~The exact procedure is FFS (NOTE 2).~~

~~NOTE 2: Not needed for transparent mode but may be needed for non- transparent mode.~~

Finally, an RB Establish Indication primitive is sent by UE-RRC and an RB Establish Confirmation primitive is issued by the RNC-RRC.

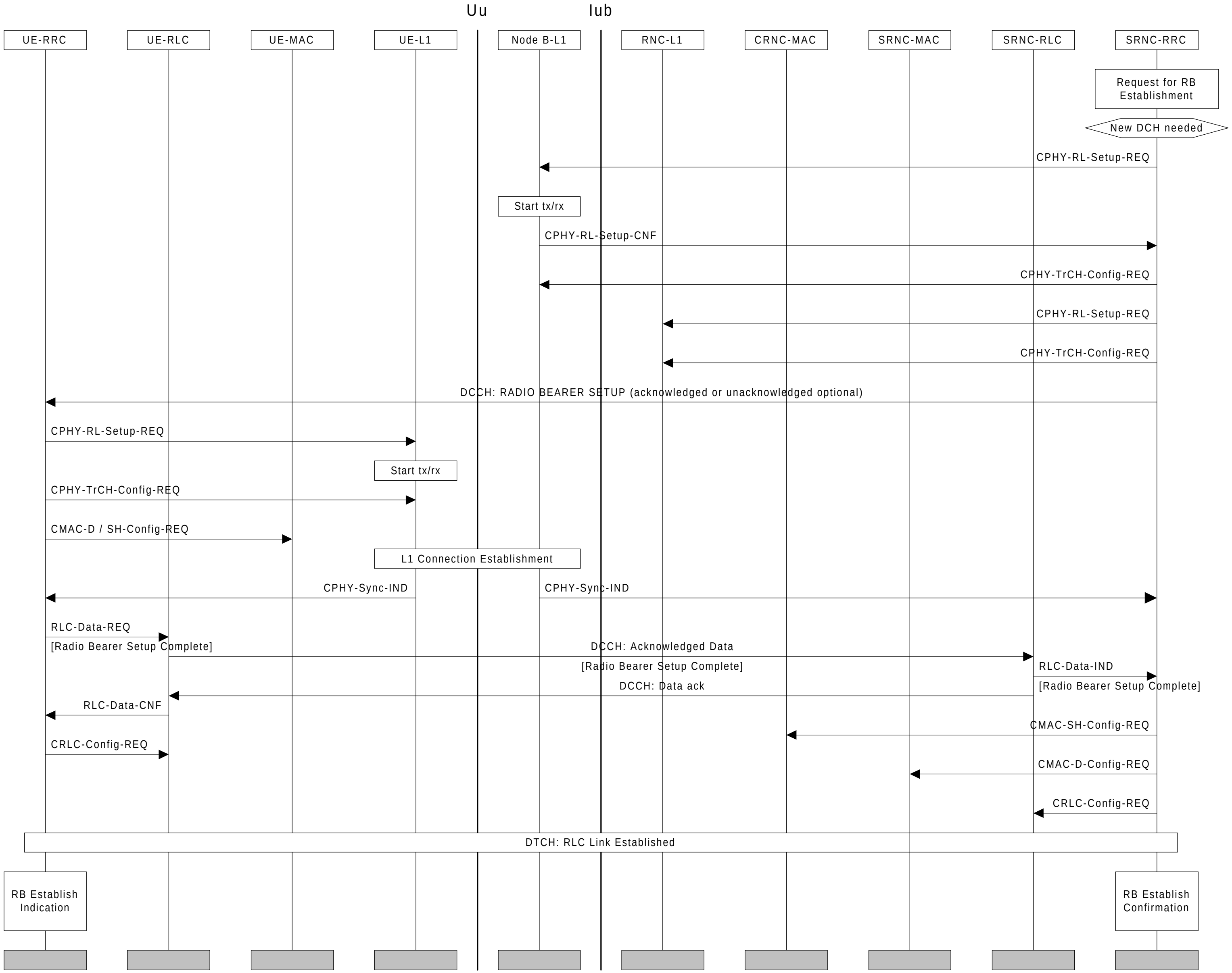

Uu
Iub
UE-RRC
UE-RLC
UE-MAC
UE-L1
Node B-L1
RNC-L1
CRNC-MAC
SRNC-MAC
SRNC-RLC
SRNC-RRC
Request for RB Establishment
New DCH needed
CPHY-RL-Setup-REQ
Start tx/rx
CPHY-RL-Setup-CNF
CPHY-TrCH-Config-REQ
CPHY-RL-Setup-REQ
CPHY-TrCH-Config-REQ
DCCH: RADIO BEARER SETUP (acknowledged or unacknowledged optional)
CPHY-RL-Setup-REQ
Start tx/rx
CPHY-TrCH-Config-REQ
CMAC-D / SH-Config-REQ
L1 Connection Establishment
CPHY-Sync-IND
CPHY-Sync-IND
RLC-Data-REQ
[Radio Bearer Setup Complete]
DCCH: Acknowledged Data
[Radio Bearer Setup Complete]
RLC-Data-IND
DCCH: Data ack
[Radio Bearer Setup Complete]
RLC-Data-CNF
CMAC-SH-Config-REQ
CRLC-Config-REQ
CMAC-D-Config-REQ
CRLC-Config-REQ
DTCH: RLC Link Established
RB Establish Indication
RB Establish Confirmation

Figure 5: Radio Bearer Establishment with Dedicated Physical Channel Activation

6.2.1.1.2 Radio Bearer Establishment with Unsynchronised Dedicated Physical Channel Modification

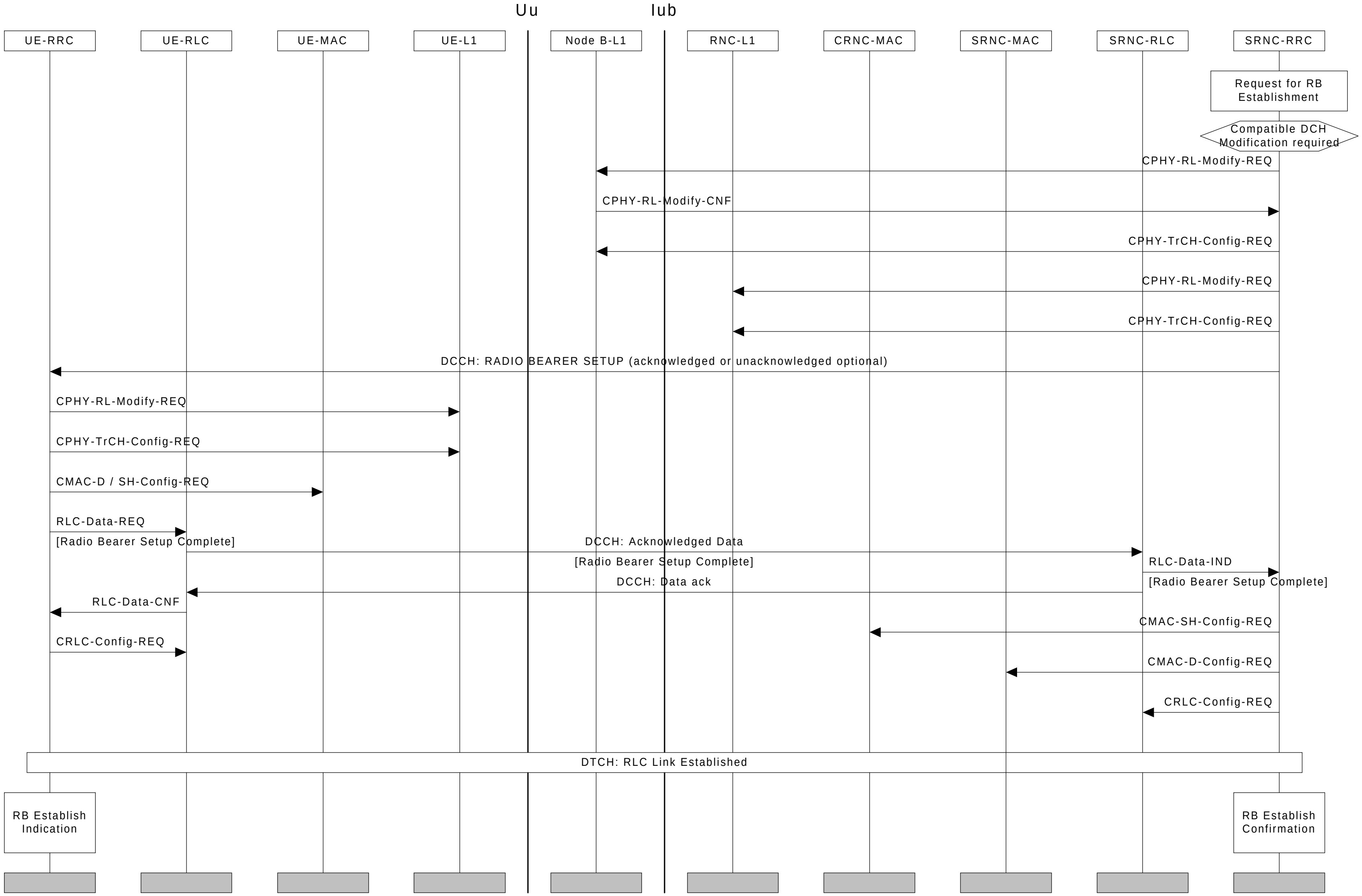


Figure 6: Radio Bearer Establishment with Unsynchronised Dedicated Physical Channel Modification

The establishment of a radio bearer, when unsynchronised physical channel modification is applicable, is shown in Figure 6. If the old and new physical layer configurations are compatible in the sense that they can coexist in the peer entities, an unsynchronised procedure for radio bearer establishment can be applied. In this case no fixed activation time is required.

The modifications on the physical layer in the network are done in response to an CPHY_ modify request. Failure to comply is indicated in the confirmation primitive. In an error-free case the RADIO BEARER SETUP message on L3 is transmitted. Acknowledged or unacknowledged transmission is a network option. Configuration changes on the UE-side proceed after this message has been received. Reception of the RADIO BEARER SETUP COMPLETE message triggers configuration changes in MAC and RLC in the network.

6.2.1.1.3 Radio Bearer Establishment with Synchronised Dedicated Physical Channel Modification

In this case the CPHY-RL-Modify request doesn't immediately cause any changes in the physical layer configuration, it only checks the availability of the requested configuration and makes a "reservation". After the confirmations have been received from all applicable Node B:s, the RRC chooses the appropriate "activation time" when the new configuration can be activated. This information is signalled to MAC, RLC and also the physical layer (CPHY_Commit request primitive).

After the RADIO BEARER SETUP message (acknowledged transmission on L2 required) between peer L3 entities the setup proceeds on the UE-side. The new configuration is now available both on the UE and the network side, and at the scheduled activation time the new configuration is assumed by all applicable peer entities.

~~NOTE: The method of synchronisation is a subject of current study.~~

In case the old and the new physical channel configurations are incompatible with each other (due to different DPCCH format, TFCI patterns or similar differences), the modification on physical layer and L2 require exact synchronisation between the UE and the NW, as shown in Figure 7.

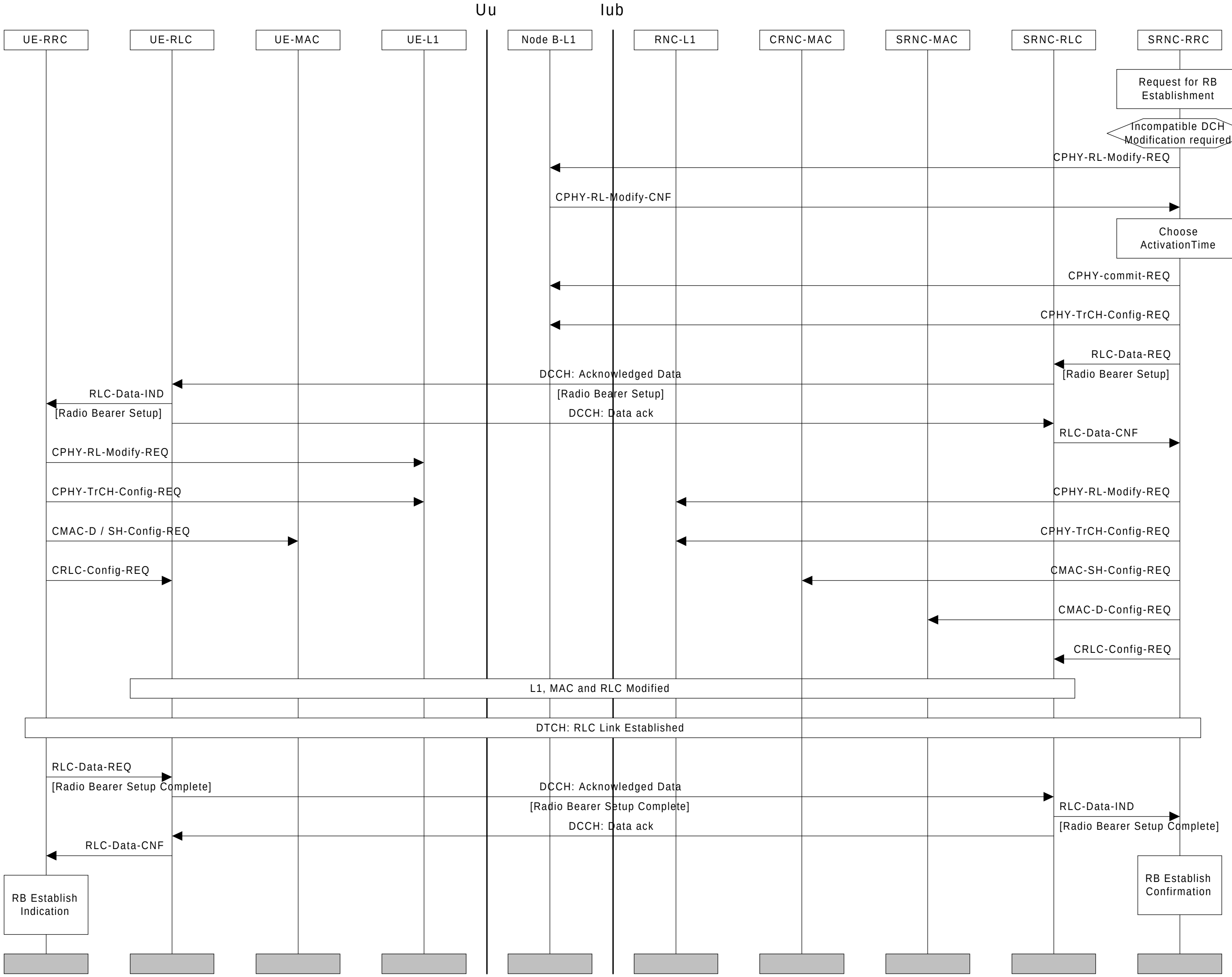


Figure 7: Radio Bearer Establishment with Synchronised Dedicated Physical Channel Modification

6.2.1.1.4 Radio Bearer Establishment without Dedicated Physical Channel

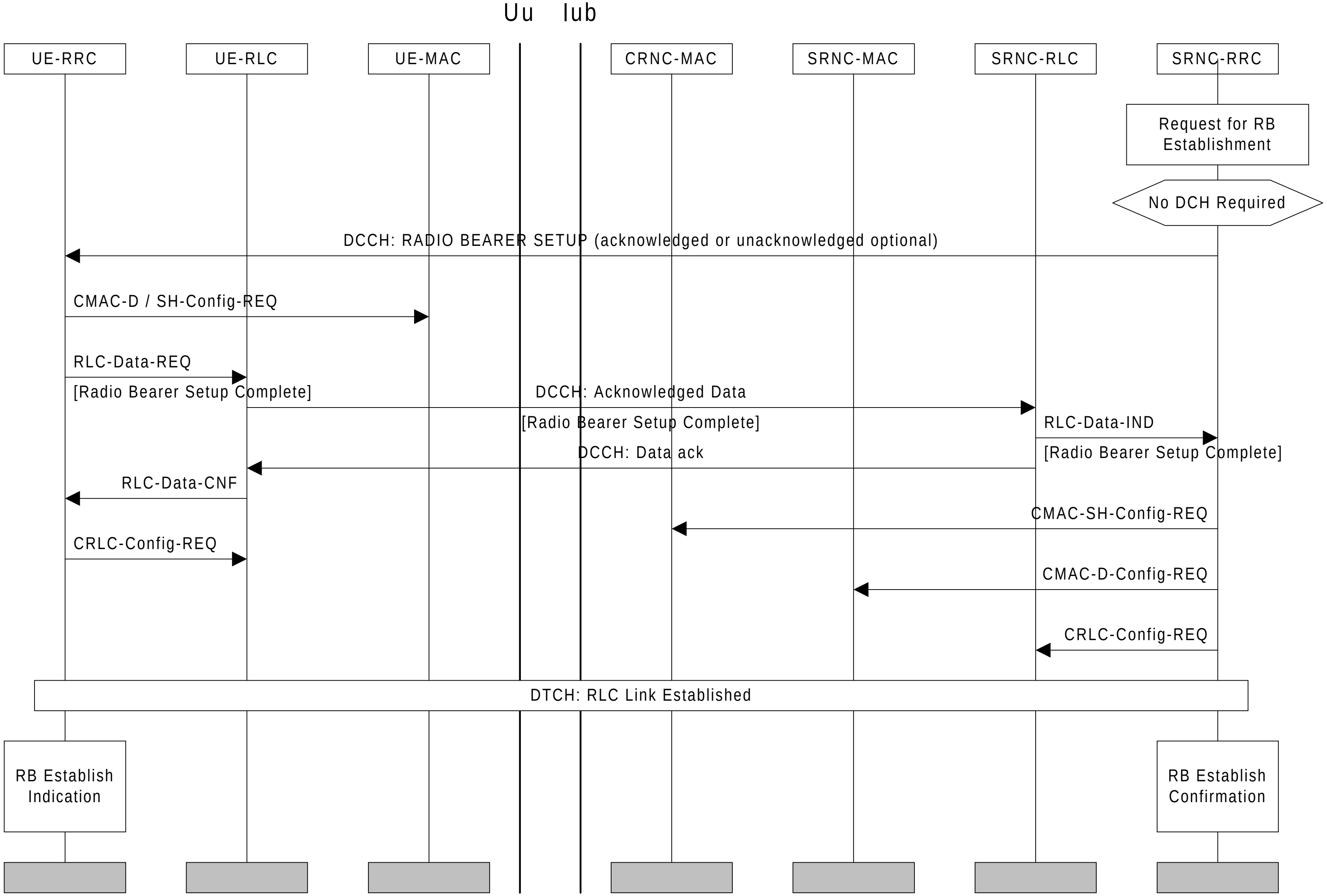


Figure 8: Radio Bearer Establishment without Dedicated Physical Channel

For some radio bearers dedicated radio resources are not permanently associated. Therefore the setting up of the physical resource is separate from the actual radio bearer setup, which involves only RLC and MAC.

MAC can be initially configured to operate either on existing dedicated transport and physical channels or on common channels.

6.2.1.1.5 Radio Bearer Establishment with CPCH Channel Allocation

When the RNC determines the need to assign CPCH UL resources to a UE, the RNC sends an RB Setup message to the UE. Since the CPCH physical parameters are broadcast in the BCCH, the RB Setup message does not include a DPCH part. The Transport Channel information includes the CPCH set (CPCH Set ID#) to which the UE is to be assigned. MAC entities are configured: MAC-D and MAC-C in the UE, MAC-C in the CRNC, and MAC-D in the SRNC. Node B MAC controls access to the individual CPCH channels in the CPCH set. However, Node B MAC does not require configuration, since it was configured to control the CPCH set when the CPCH set was initially allocated to that cell. The Node B MAC can function independently of the number of UEs assigned to the CPCH set. Once the RB setup is complete, the UE may access the CPCH when the logical channel for this RB next presents data to send in the uplink direction.

The message flow diagram for RB setup for CPCH is similar to the RB Setup without Dedicated Physical Channel (cf 7.2.1.1.4).

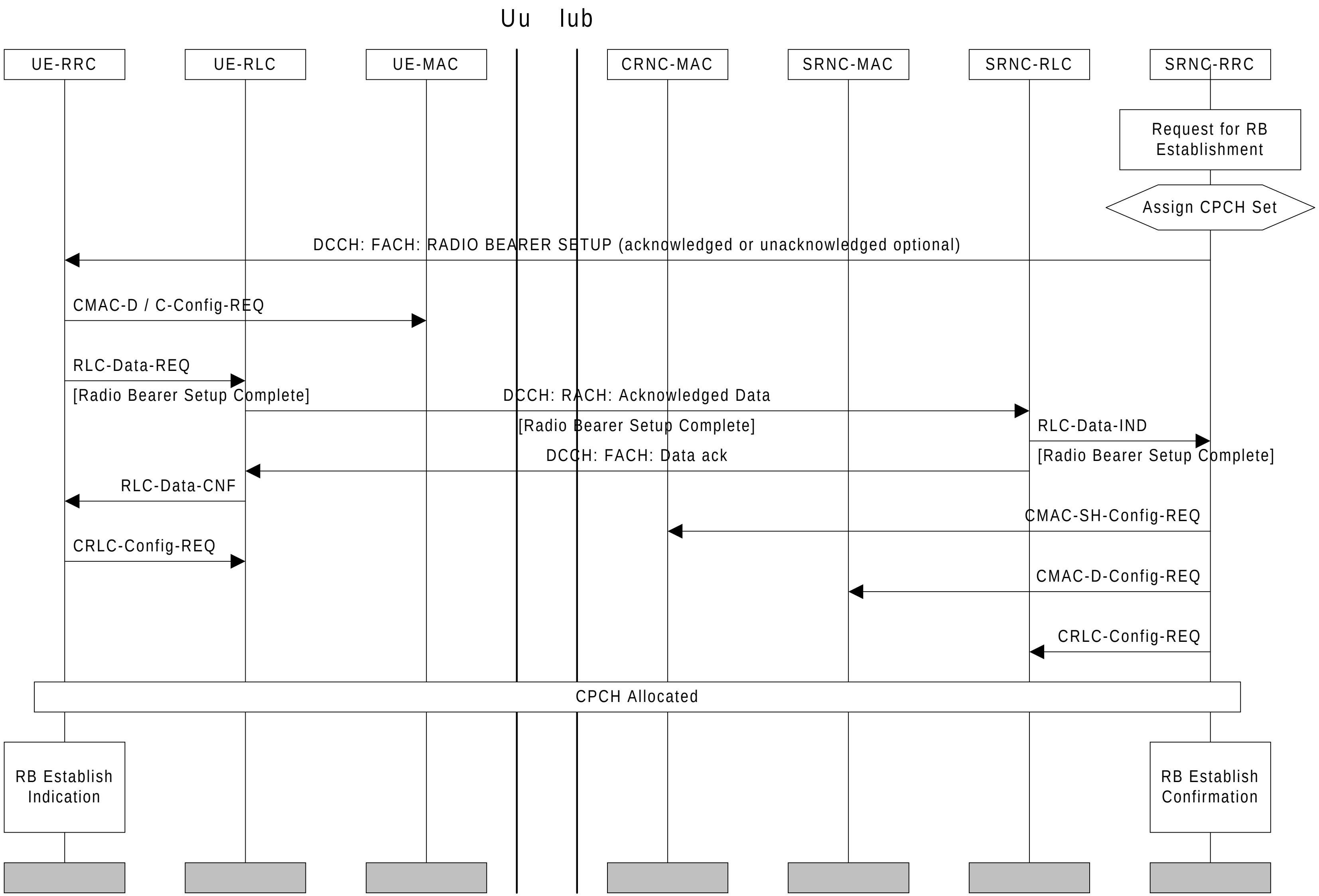


Figure 9: Radio Bearer Establishment with CPCH Channel Allocation

6.2.1.2 Radio Bearer Release

Similar as for Radio Bearer Establishment procedure, the Radio Bearer Release can include physical channel modification or physical channel deactivation depending on the differences between new and old QoS parameters. These can also be both synchronised and unsynchronised.

The Radio Bearer Release procedure is initiated when the release is requested from the RRC layer on the NW side. This request contains a bearer reference, and on retrieval a RB Release Confirm primitive is immediately returned to the Non-Access Stratum.

New L1 and L2 parameters may be chosen for remaining radio bearers if any. A RADIO BEARER RELEASE message is sent from the RRC layer in the network to its peer entity in the UE. This message includes possible new L1, MAC and RLC parameters for remaining radio bearers and indentification of the radio bearer to be released (NOTE 1). An RB Release Indication is sent by the UE-RRC.

NOTE 1: In synchronised case a specific activation time would be needed for the change of L1 and L2 configuration to avoid data loss.

The RRC on the UE side configures L1 and MAC, and releases the RLC entity associated to the released radio bearer. After receiving a RADIO BEARER RELEASE COMPLETE message from the UE, the NW-RRC does a similar reconfiguration also on the network side.

6.2.1.2.1 Radio Bearer Release with Unsynchronised Dedicated Physical Channel Modification

The example in Figure 10 shows the case where release can be executed as an unsychronised physical channel modification, i.e. without physical channel deactivation.

After notifying upper layers of the release, a RADIO BEARER RELEASE message (acknowledged or unacknowledged transmission optional for the network) is sent to the UE triggering the reconfiguration in the UE. When this is finalised the UE sends a RADIO BEARER RELEASE COMPLETE message to the network, after which the reconfiguration is executed in the network.

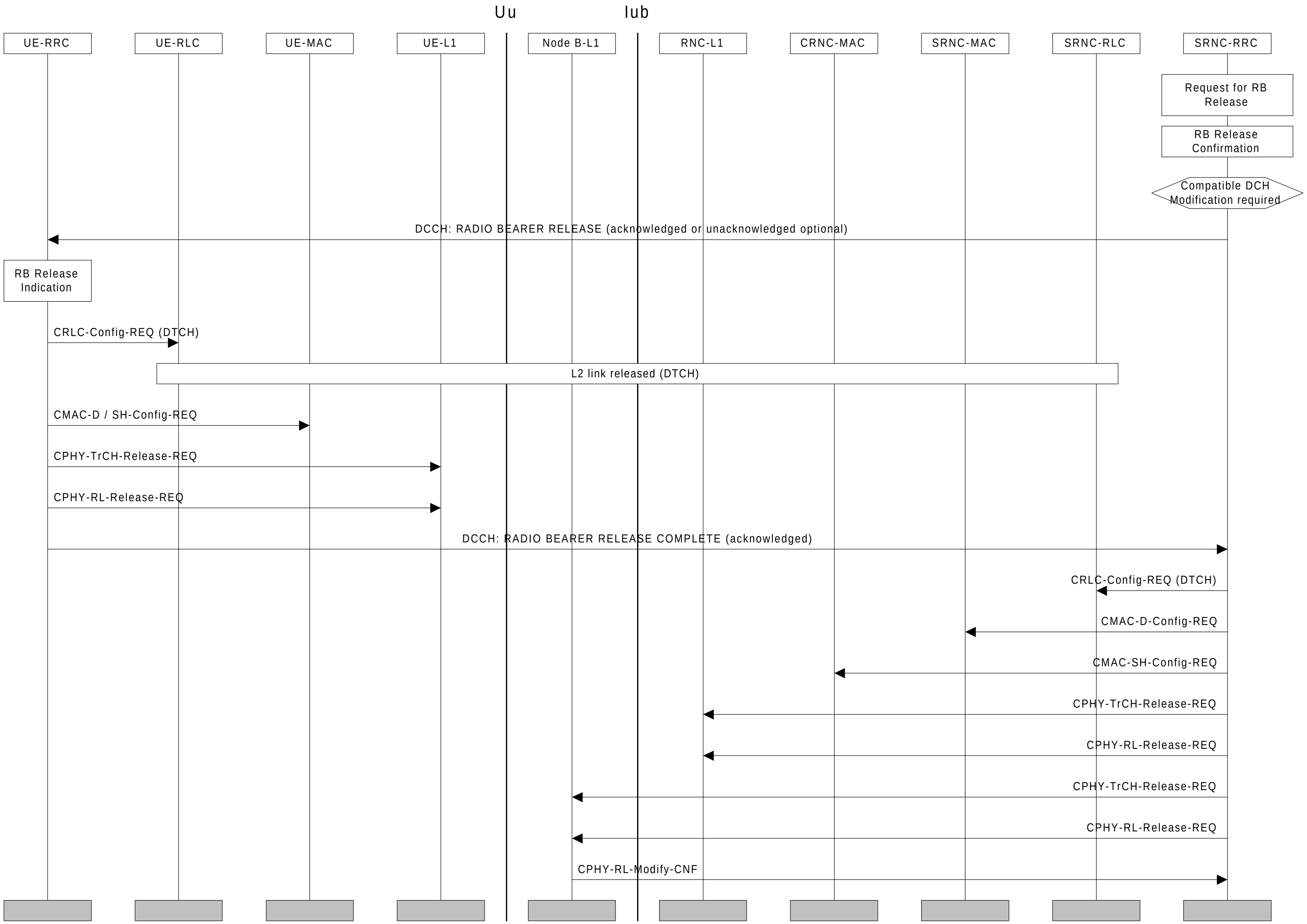


Figure 10: Radio Bearer Release with Unsynchronised Dedicated Physical Channel Modification

6.2.1.3 Bearer Reconfiguration

For Bearer Reconfiguration, both synchronised and unsynchronised procedures are applicable. The unsynchronised procedure is shown as an example.

6.2.1.3.1 Unsynchronised Radio Bearer Reconfiguration

Because of the unsynchronised nature of the procedure in Figure 11, there is no activation time and no separate commit request for the Node B physical layer is needed. The possibility for executing the requested modification will be reported in the confirmation primitives from the physical layer. If the modification involves the release of an old configuration, the release can be postponed to the end of the procedure. After the reception of a RADIO BEARER RECONFIGURATION from the RNC-RRC (acknowledged or unacknowledged transmission optional for the network), the UE executes the modifications on L1 and L2.

Upon reception of a RADIO BEARER RECONFIGURATION COMPLETE message from the UE-RRC, the NW-RRC executes the modifications on L1 and L2. Finally the old configuration, if any, is released from Node B-L1.

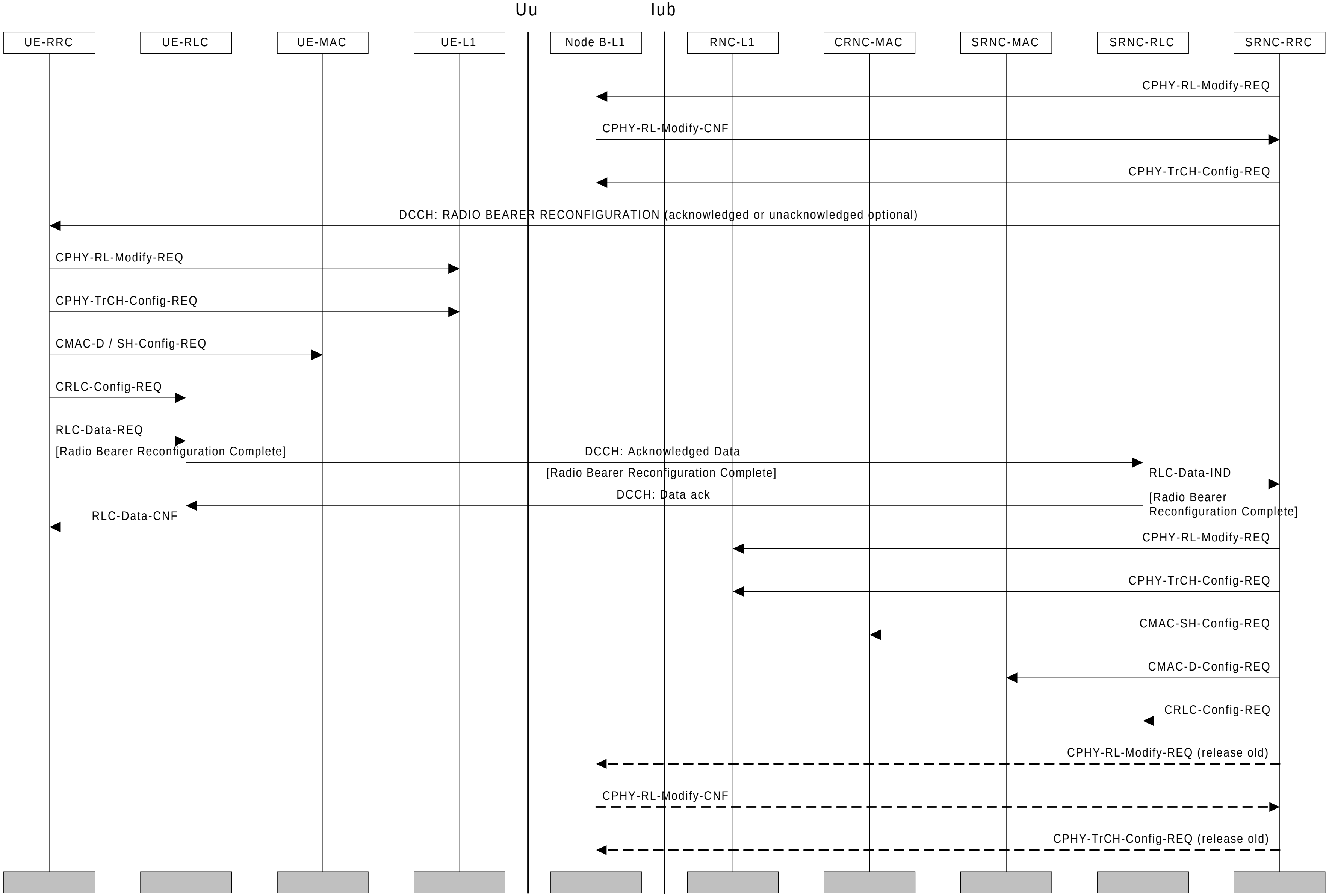


Figure 11: Unsynchronised Radio Bearer Reconfiguration

6.2.2 Transport Channel Reconfiguration

For transport channel reconfiguration, both synchronised and unsynchronised procedures are applicable.

6.2.2.1 Unsynchronised Transport Format Set Reconfiguration

Figure 12 illustrates an example of a procedure for a change of the Transport Format Set for one transport channel. This is done with the Transport Channel Reconfiguration rocedure.

A change of the transport format set for a transport channel is triggered in the RRC layer in the network. A TRANSPORT CHANNEL RECONFIGURE message is sent from the RRC layer in the network to its peer entity (acknowledged or unacknowledged transmission is a network option). This message contains the new transport format set and a new transport format combination Set, i.e. new parameters for L1 and MAC (NOTE 1). When this message is received in the UE a reconfiguration of L1 and MAC is done. A similar reconfiguration is also done on the network side after the reception of a TRANSPORT CHANNEL RECONFIGURE COMPLETE message.

NOTE 1: In a synchronised procedure a specific activation time is needed for the change of L1 and L2 configuration to avoid data loss.

During the reconfiguration of the transport format set for a transport channel, radio traffic on this channel could be halted temporarily since the UE and the network are not necessarily aligned in their configuration. This traffic can resume after the COMPLETE-message.

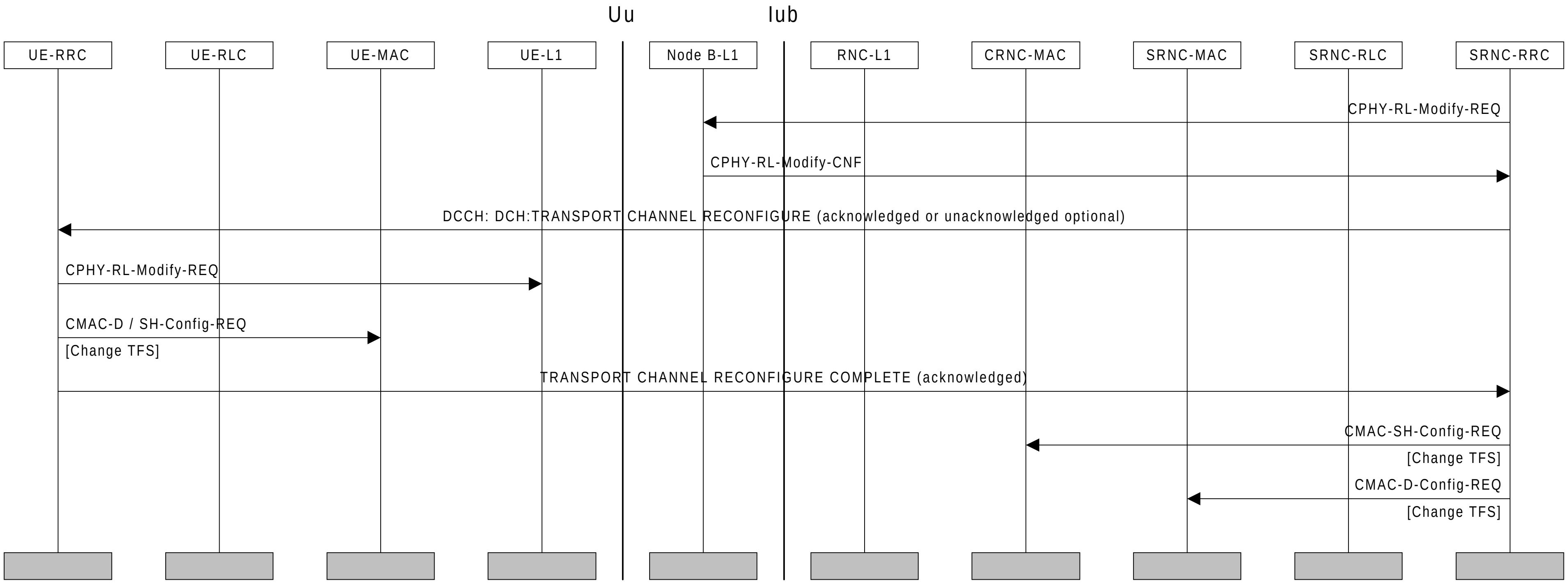


Figure 12: Unsynchronised Transport Format Set Reconfiguration

6.2.2.2 Asymmetric transport channel reconfiguration

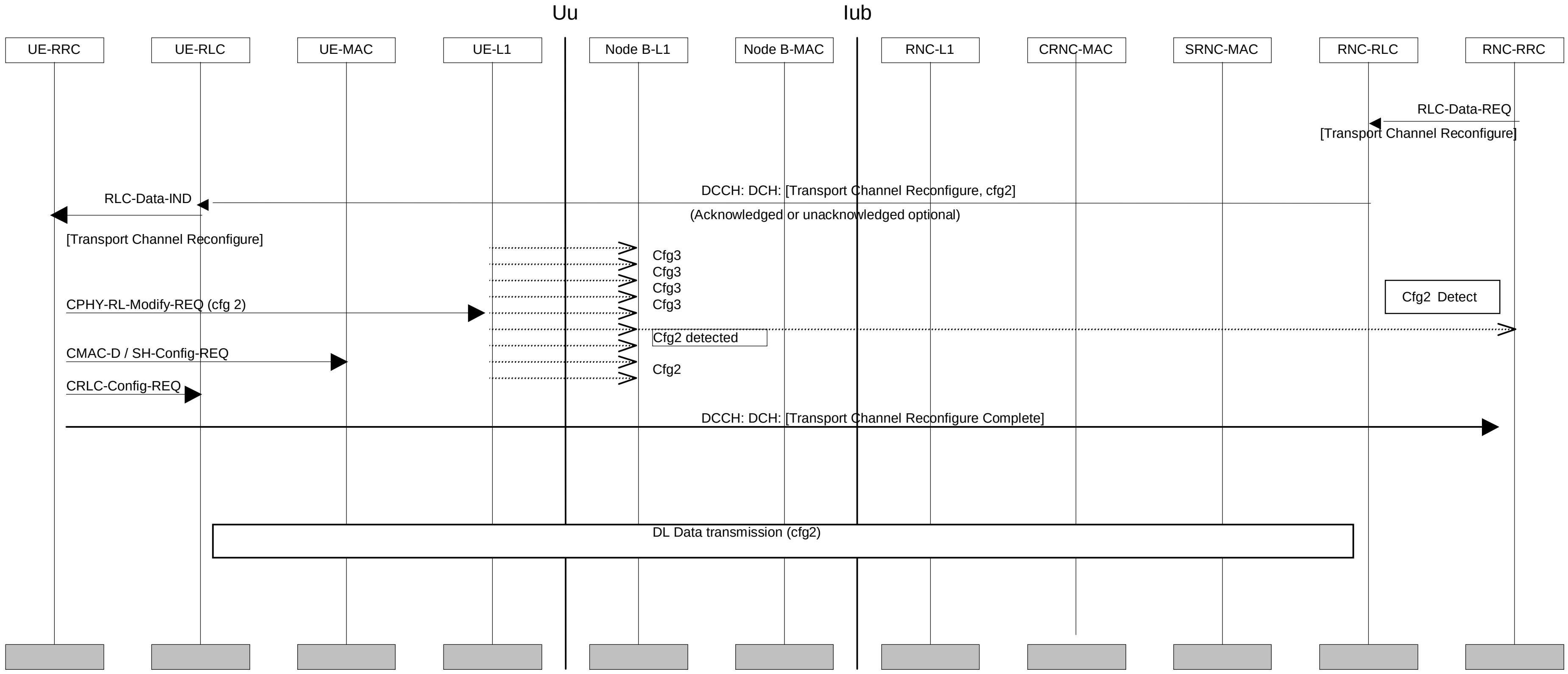


Figure 13: Asymmetric DCH Reconfiguration

NOTE: This procedure is considered for Release 00

The RNC has initially sent one or more channel configurations (cfg1, cfg2, cfg3...) to each Node B and to the UE, e.g. at RB Setup.

When a DCH configuration is to be modified, the RNC sends a TRANSPORT CHANNEL RECONFIGURE message to the UE, indicating the new configuration to be applied (e.g. change from cfg3 to cfg2). Each Node B can then configure its physical layer to receive in the new configuration mode at a given radio frame number.

Upon reception of the TRANSPORT CHANNEL RECONFIGURE message, the UE reconfigures uplink L1 and L2 resources and starts to transmit data with the new configuration. In downlink, the UE can switch to the new configuration after a certain time which corresponds basically to the round trip delay. The UE may also avoid any data loss by temporarily performing double decoding.

When a Node B detects the new configuration at the specified radio frame, this is signalled to the RNC over the Iub. If the expected configuration is not detected, then the Node B can revert back to the old configuration. When the RNC detects, from one or more Node Bs, that the new configuration is applied by the UE on the uplink, it starts sending to every Node B, downlink DCH Iub frames with an indication of the new mode to be applied.

6.2.3 Physical Channel Reconfiguration

For physical channel reconfiguration, both synchronised and unsynchronised procedures are applicable.

6.2.3.1 UE-Originated DCH Activation

Figure 14 illustrates an example of a procedure for a switch from common channels (RACH/FACH) to dedicated (DCH) channels.

In the UE the traffic volume measurement function decides to send a MEASUREMENT REPORT message to the network. In the network this measurement report could trigger numerous different actions. For example the network could do a change of transport format set, channel type switching or, if the system traffic is high, no action at all. In this case a switch from RACH/FACH to DCH/DCH is initiated.

Whether the report should be sent with acknowledged or unacknowledged data ~~transfer or if the network should be able to configure data transfer mode for the report is FFS~~transfer is configured by the network.

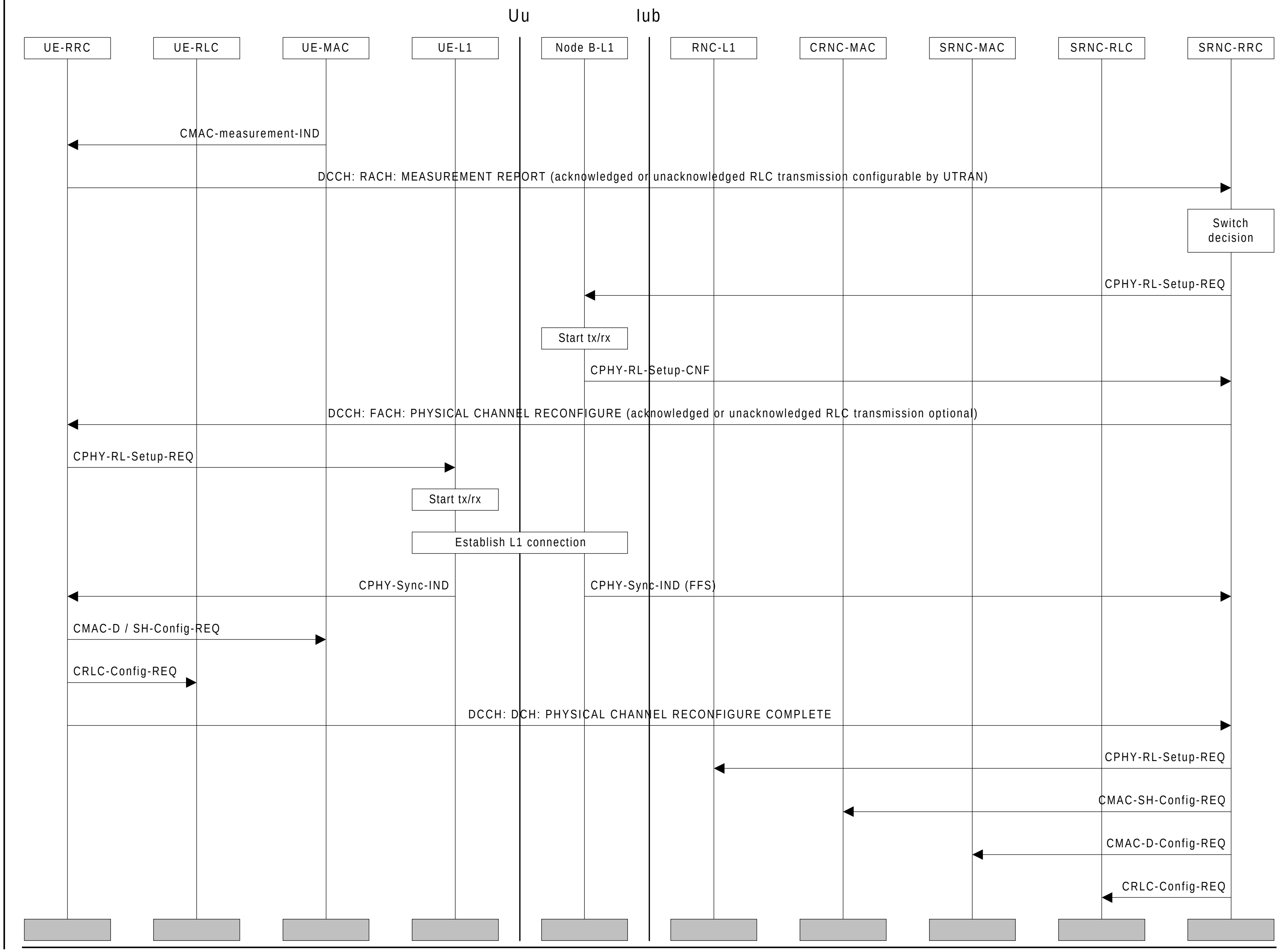
First, the modifications on L1 are requested and confirmed on the network side with CPHY-RL-Setup primitives.

The RRC layer on the network side sends a PHYSICAL CHANNEL RECONFIGURE message to its peer entity in the UE (acknowledged or unacknowledged transmission optional to the network). This message is sent on DCCH mapped to FACH. The message includes information about the new physical channel, such as codes and the period of time for which the DCH is activated (NOTE 1).

NOTE 1: This message does not include new transport formats. If a change of these is required due to the change of transport channel, this is done with the separate procedure Transport Channel Reconfiguration. This procedure only handles the change of transport channel.

When the UE has detected synchronisation on the new dedicated channel L2 is configured on the UE side and a PHYSICAL CHANNEL RECONFIGURE COMPLETE message can be sent on DCCH mapped on DCH to RRC in the network~~ (need FFS)~~. ~~Depending on whether the complete message is applied, the need for an indication of the synchronisation on the NW side is also FFS. ~~Triggered by either the NW CPHY_sync_ind or the L3 complete message, the RNC-L1 and L2 configuration changes are executed in the NW.

When applying the FAUSCH, the "DCCH: RACH: MEASUREMENT REPORT" is replaced by a "DCCH: FAUSCH: DCH REQUEST" message that is transmitted on the FAUSCH in unacknowledged mode. In this case rather than giving a measurement report for the NW to process, the FAUSCH indicates a request for a DCH of predefined capacity.


Uu
Iub
UE-RRC
UE-RLC
UE-MAC
UE-L1
Node B-L1
RNC-L1
CRNC-MAC
SRNC-MAC
SRNC-RLC
SRNC-RRC
CMAC-measurement-IND
DCCH: RACH: MEASUREMENT REPORT (acknowledged or unacknowledged RLC transmission configurable by UTRAN)
Switch decision
CPHY-RL-Setup-REQ
Start tx/rx
CPHY-RL-Setup-CNF
DCCH: FACH: PHYSICAL CHANNEL RECONFIGURE (acknowledged or unacknowledged RLC transmission optional)
CPHY-RL-Setup-REQ
Start tx/rx
Establish L1 connection
CPHY-Sync-IND
CPHY-Sync-IND (FFS)
CMAC-D / SH-Config-REQ
CRLC-Config-REQ
DCCH: DCH: PHYSICAL CHANNEL RECONFIGURE COMPLETE
CPHY-RL-Setup-REQ
CMAC-SH-Config-REQ
CMAC-D-Config-REQ
CRLC-Config-REQ

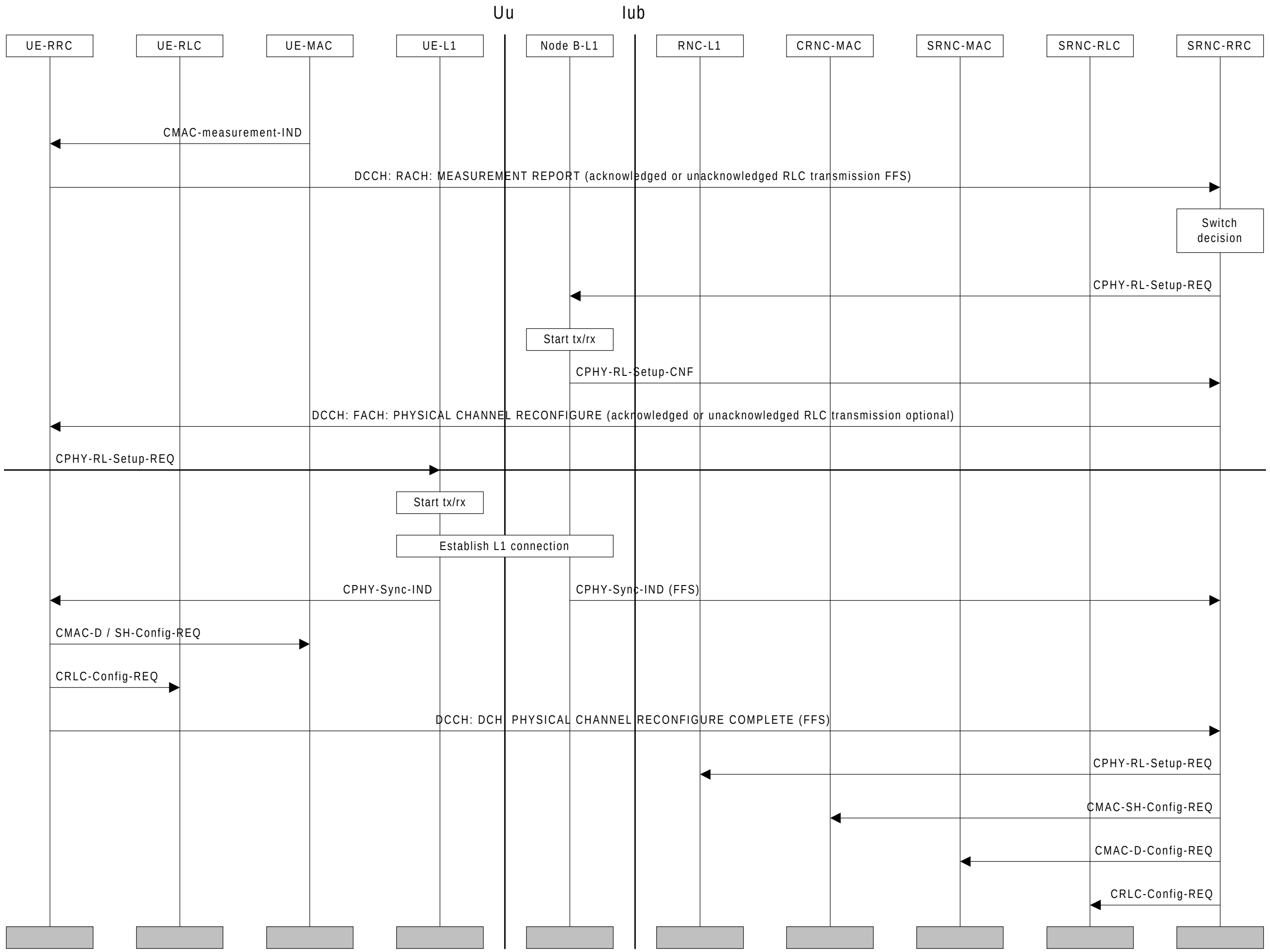


Figure 14: UE-Originated DCH Activation

6.2.3.2 UE-terminated synchronised DCH Modify

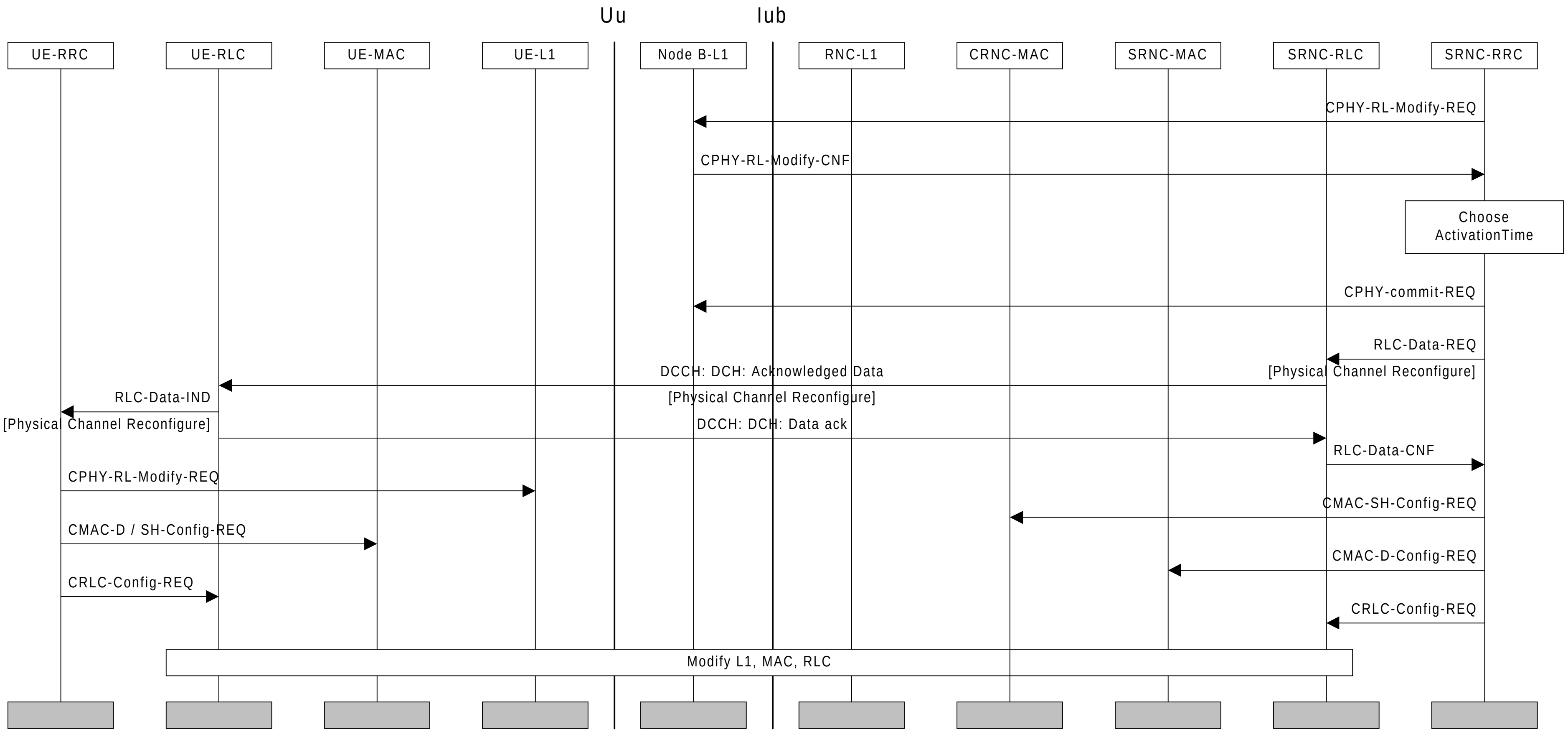


Figure 15: UE-terminated synchronised DCH Modify

Figure 15 illustrates an example of a synchronised procedure for DCH modification. Triggering of this procedure could for example be accomplished by an inactivity timer. The procedure can e.g. release all transport formats of a radio bearer without releasing the DCH, due to another bearer using it. The synchronised procedure is applied in the case when the old and new configurations are not compatible e.g. change of channelization code.

After the CPHY-RL-Modify requests have been confirmed, an activation time is chosen by NW-RRC. After deciding upon the activation time, the NW-RRC sends a PHYSICAL CHANNEL RECONFIGURE message as acknowledged data transfer to the UE. In both uplink and downlink this message is sent on DCCH mapped on DCH.

After reception the UE reconfigures L1 and L2 to DCH resources. The need for a Physical Channel Reconfigure Complete message to the network is FFS (not shown here). If a complete message is used it would be sent on DCCH mapped on DCH. In the unsynchronised case this message could trigger a modification of L1 and L2 resources in the network associated with the dedicated channel.

6.2.3.3 UE-terminated DCH Release

Figure 16 illustrates an example of a procedure for a switch from dedicated (DCH) to common (RACH/FACH) channels. All DCHs used by a UE are released and all dedicated logical channels are transferred to RACH/FACH instead. Triggering of this procedure could for example be an inactivity timer.

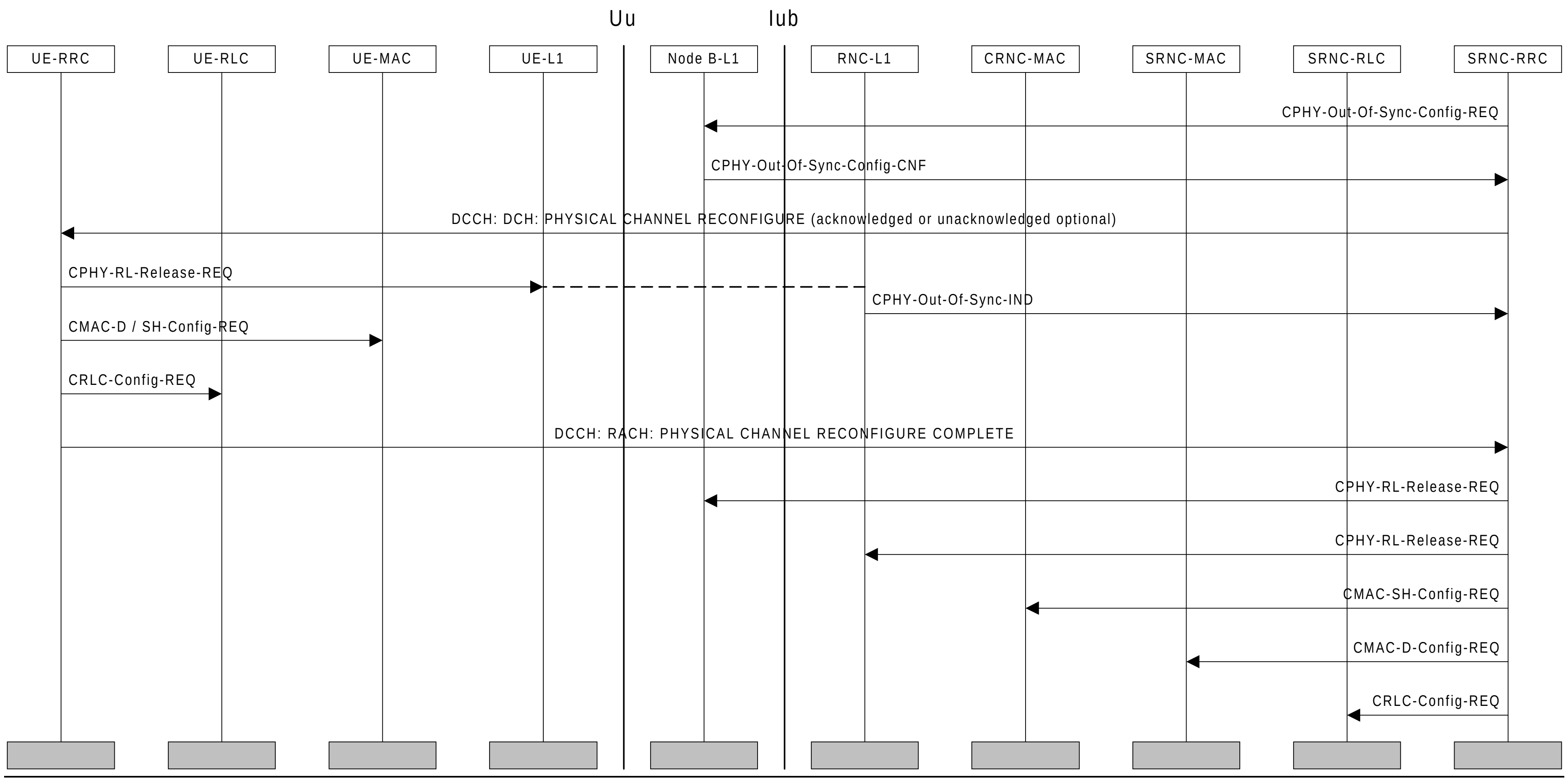
A switch from DCH to common channels is decided and a PHYSICAL CHANNEL RECONFIGURE message is sent (acknowledged or unacknowledged data transfer is a network option) from the RRC layer in the network to the UE. This message is sent on DCCH mapped on DCH.

NOTE 1: This message does not include new transport formats. If a change of these is required due to the change of transport channel, this is done with the separate procedure Transport Channel Reconfiguration. This procedure only handles the change of transport channel.

NOTE 2: If the loss of L1 sync is used to detect in the NW that the UE has released the DCH:s, as is one possibility in the figure, then there may be a need to configure the Node B-L1 to a short timeout for detecting loss of sync. This is presented by the CPHY_out_of_sync_configure primitives in the figure. The L23 groupRAN WG2 is seeking guidance from the L1 groupRAN WG1 relating to the time required for reliable out-of-sync detection.

After reception the UE reconfigures L1 and L2 to release old DCH resources. The PHYSICAL CHANNEL RECONFIGURE COMPLETE (need FFS) message to the network is here sent on DCCH mapped on RACH (message acknowledgement on FACH). This message triggers a normal release of L1 and L2 resources in the network associated with the dedicated channel. If the L3 COMPLETE message doesn't exist, the CPHY-_-outOut-_-ofOf-_-syncSync-_-ind IND from the physical layer must be applied.

NOTE 3: When a Switch to RACH/FACH is done it is important to free the old code as fast as possible so that it can be reused. Therefore instead of waiting for the Physical Channel Reconfigure Complete message the network can reconfigure L1 and L2 when the acknowledged data confirmation arrives and the network is sure that the UE has received the Physical Channel Reconfigure message. To be even more certain that the UE has released the old DCH resources the network can wait until after the Out of sync Indication from L1.
These steps including a timer starting when the Physical Channel Reconfigure is sent, gives the network four different indications that the released DCH is really released, and that resources can be reused.


Uu
Iub
UE-RRC
UE-RLC
UE-MAC
UE-L1
Node B-L1
RNC-L1
CRNC-MAC
SRNC-MAC
SRNC-RLC
SRNC-RRC
CPHY-Out-Of-Sync-Config-REQ
CPHY-Out-Of-Sync-Config-CNF
DCCH: DCH: PHYSICAL CHANNEL RECONFIGURE (acknowledged or unacknowledged optional)
CPHY-RL-Release-REQ
CPHY-Out-Of-Sync-IND
CMAC-D / SH-Config-REQ
CRLC-Config-REQ
DCCH: RACH: PHYSICAL CHANNEL RECONFIGURE COMPLETE
CPHY-RL-Release-REQ
CPHY-RL-Release-REQ
CMAC-SH-Config-REQ
CMAC-D-Config-REQ
CRLC-Config-REQ

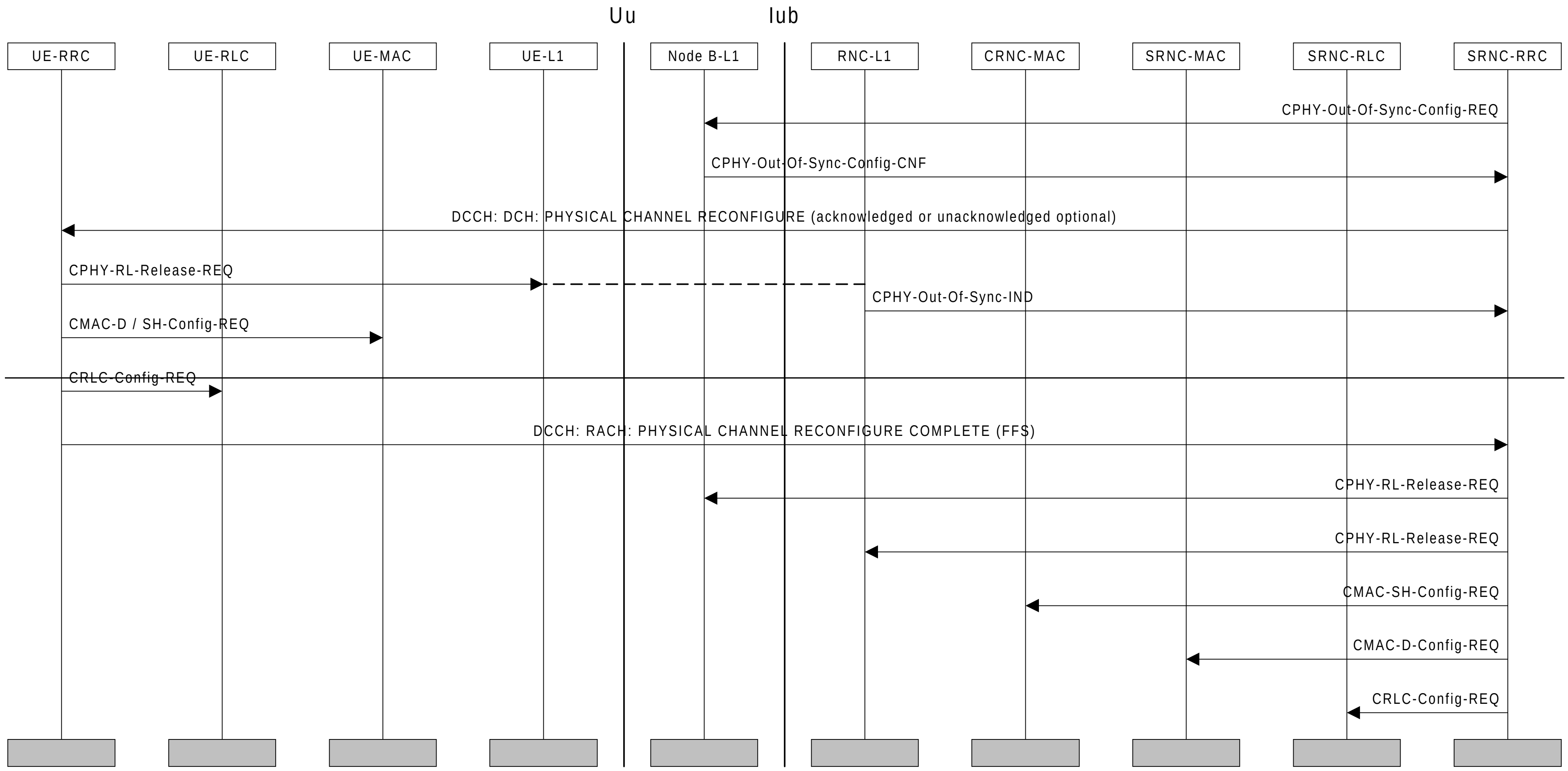


Figure 16: UE-terminated DCH Release

6.2.4 Transport Format Combination Control

6.2.4.1 Transport Format Combination Limitation

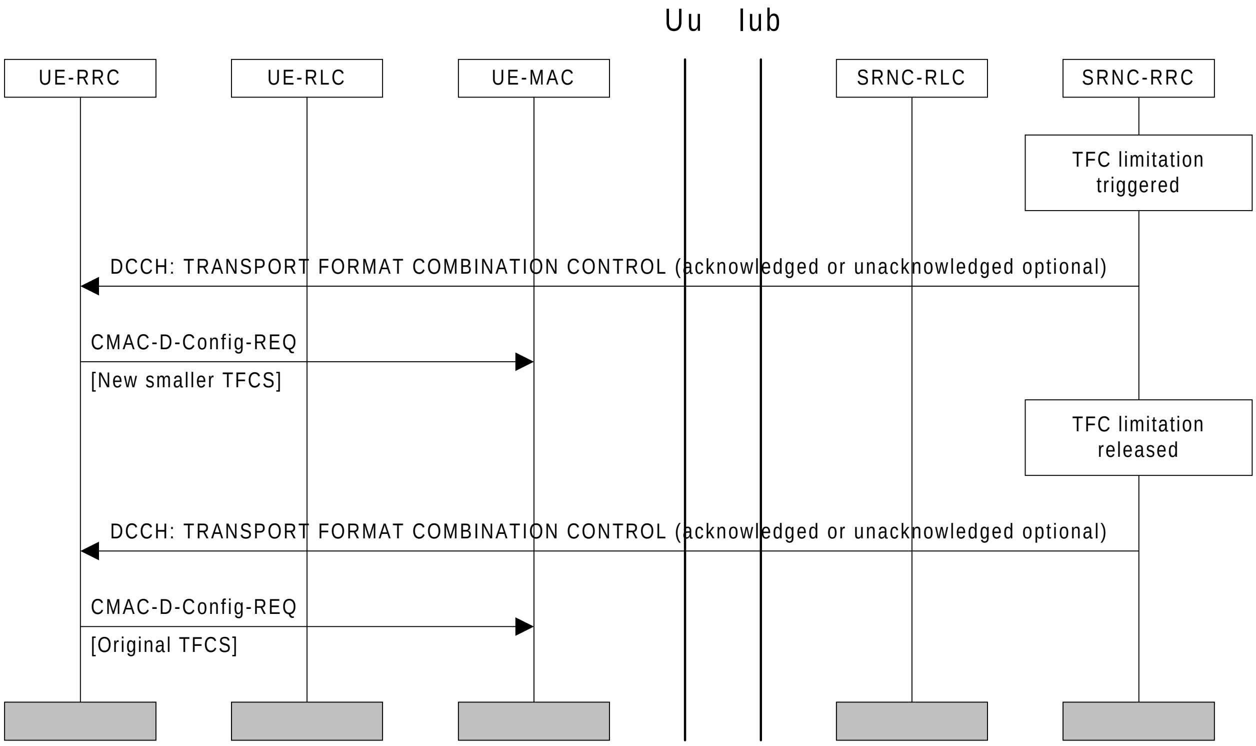


Figure 17: Transport Format Combination Limitation

Figure 17 illustrates an example of a Transport Format Combination Control procedure. A congestion situation occurs and allowed transport format combinations are restricted temporarily. When the congestion is resolved the restriction is removed.

This procedure is initiated with a Transport Format Combination Control message from the network to the UE (acknowledged or unacknowledged transmission optional to the NW). This message contains a subset of the ordinary Transport Format Combination Set. The UE then continues with a reconfiguration of MAC. MAC sees the TFC subset as a completely new set.

Further, after a while when the congestion is resolved a new Transport Format Combination Control message is sent to the UE from the RRC layer in the network. This message contains a subset that is the entire original set. Again, the UE reconfigures the MAC.

6.2.5 Dynamic Resource Allocation Control of Uplink DCH:s

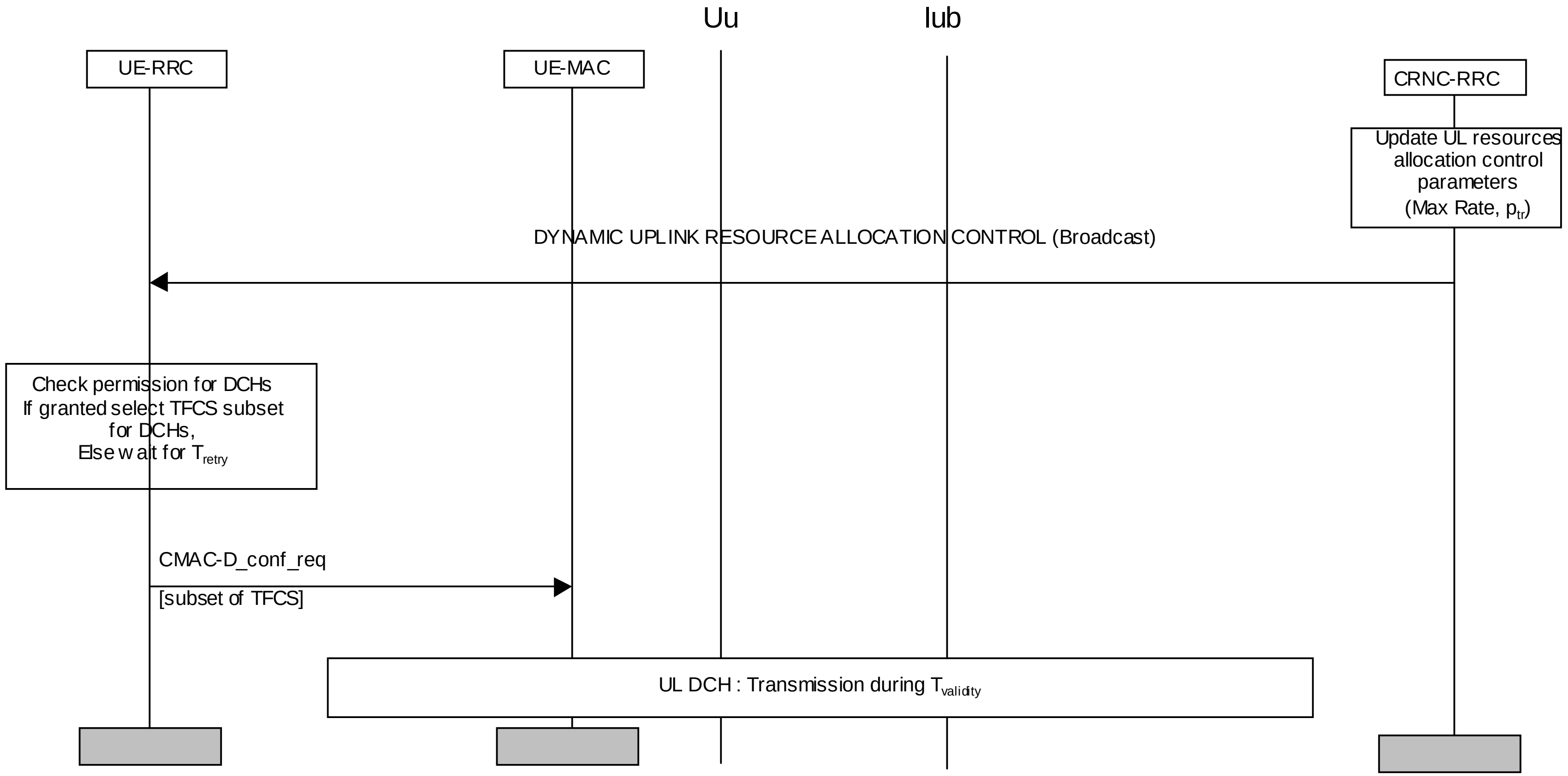


Figure 18: Dynamic Resource Allocation Control of Uplink DCHs

Figure 18 illustrates an example of a Dynamic Resource Allocation Control procedure of uplink DCHs. The CRNC regularly broadcasts the following parameters:

- Transmission probability ptr, which indicates the probability for a UE to be allowed to transmit on its DCHs, which are under control by this procedure, during the next period $T_{validity}$
- Maximum total bit rate allowed to be used by the UE on its DCH which are under controlled by this procedure, during the next allowed period $T_{validity}$

Besides these parameters, the RNC has allocated the following parameters to the UE:

- Transmission time validity, $T_{validity}$, which indicates the time duration for which an access for transmission is granted.
- Reaccess time T_{retry}, which indicates the time duration before retrying to access the resources, in case transmission has not been granted.

This procedure is initiated with a Dynamic Uplink Resource Allocation Control message regularly broadcast by the CRNC. It applies to all UEs having DCHs that can be controlled dynamically. The UEs have to listen to this message prior to transmission on these DCHs. The UE RRC checks whether transmission is allowed, and then reconfigures MAC with a new subset of TFCS derived from the maximum total bit rate parameter. This TFCS subset shall control only the DCHs which are under control by this procedure. The UE RRC procedure shall be mandatory for all UEs supporting high bit rate NRT services.

In case of soft handover on the uplink DCH, The UE is requested either to listen to broadcast information from its primary cell (the one with the lowest pathloss), or from all cells involved in its Active Set, depending on its class. In the latter case, the UE is expected to react according to the stricter control information.

6.3 Data transmission

6.3.1 Acknowledged-mode data transmission in DCH / DCH + DSCH

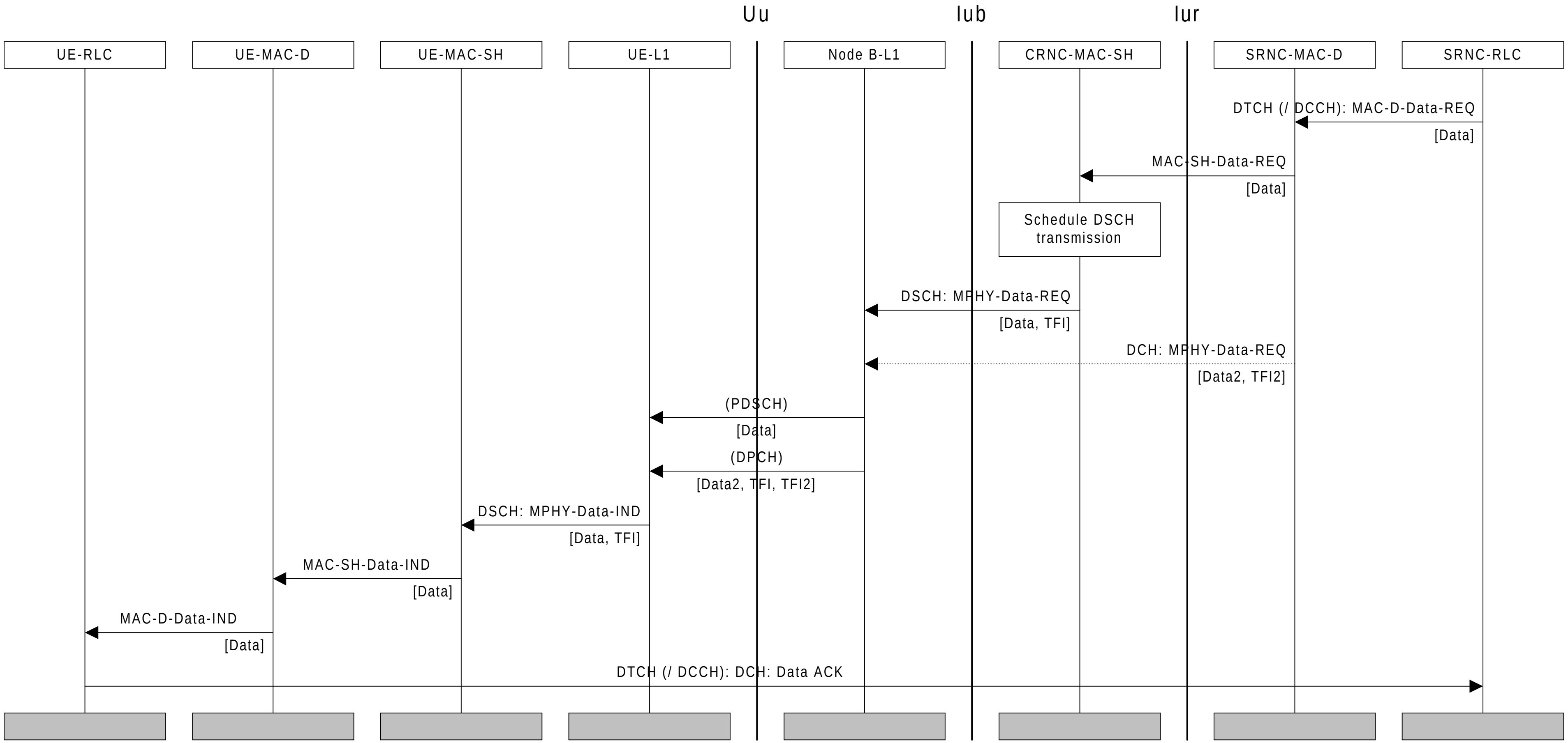


Figure 19: Example of acknowledged-mode data transmission on DSCH

Figure 19 shows an example of acknowledged-mode data transmission on DSCH in the DCH / DCH + DSCH substate. First RLC in SRNC requests data transmission locally from MAC-d. MAC-d routes the request either locally or across the Iur to MAC-sh in CRNC, where DSCH transmission scheduling takes place. MAC-SH determines the TFI for the data and requests data transmission across Iub from the physical layer in Node B. At the same time data for an associated dedicated channel may arrive in Node B.

TFI for the DSCH and TFI2 for the DCH are combined in the physical layer and transmitted on the DPCCH (dedicated physical control channel) of the associated DPCH (dedicated physical channel). The DSCH data is transmitted separately on the PDSCH (physical downlink shared channel). TFI is used to decode DSCH data, which is then forwarded through MAC-sh and MAC-d to the receiving RLC. An acknowledgement is eventually sent by the UE-RLC mapped to a DCH, unless the DCH is released before the acknowledgement.

6.3.2 Acknowledged-mode data transmission in DCH / DCH + DSCH with one TFCI

NOTE: For release-99 this example is only valid in the case where SRNC = CRNC.

Figure 20 shows an example of acknowledged-mode data transmission on DSCH in the DCH / DCH + DSCH substate. First RLC in SRNC requests data transmission from MAC-d. MAC-d passes the data on to MAC-sh, which schedules the DSCH transmission and determines the TFI for the data. The TFI and CFN (connection frame number) for transmission are given back to MAC-d.

MAC-sh selects the TFI and transmits the data for DSCH while MAC-d transmits the TFI synchronised with the transmission of any DCH data and TFI:s intended for transmission in the same frame. TFI for the DSCH and TFI2 for the DCH are combined into the same TFCI on the physical layer and transmitted on the DPCCH (dedicated physical control channel) of the associated DPCH (dedicated physical channel). The DSCH data is transmitted separately on the PDSCH (physical downlink shared channel). TFI is used to decode DSCH data, which is then forwarded through MAC-sh and MAC-d to the receiving RLC. An acknowledgement is eventually sent by the UE-RLC mapped to a DCH, unless the DCH is released before the acknowledgement.

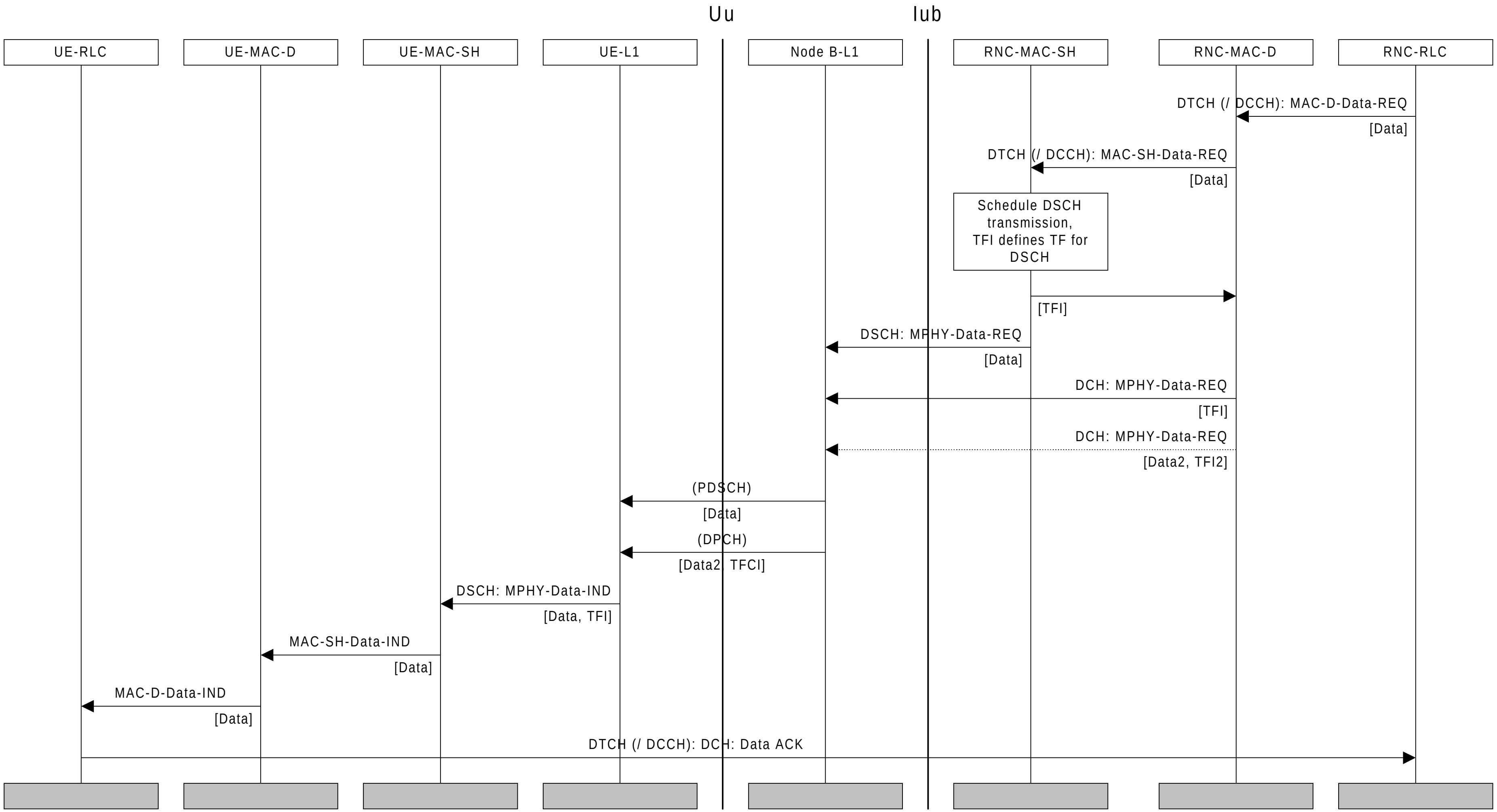


Figure 20: Example of acknowledged-mode data transmission on DSCH

6.3.3 Acknowledged-mode data transmission in CPCH/FACH

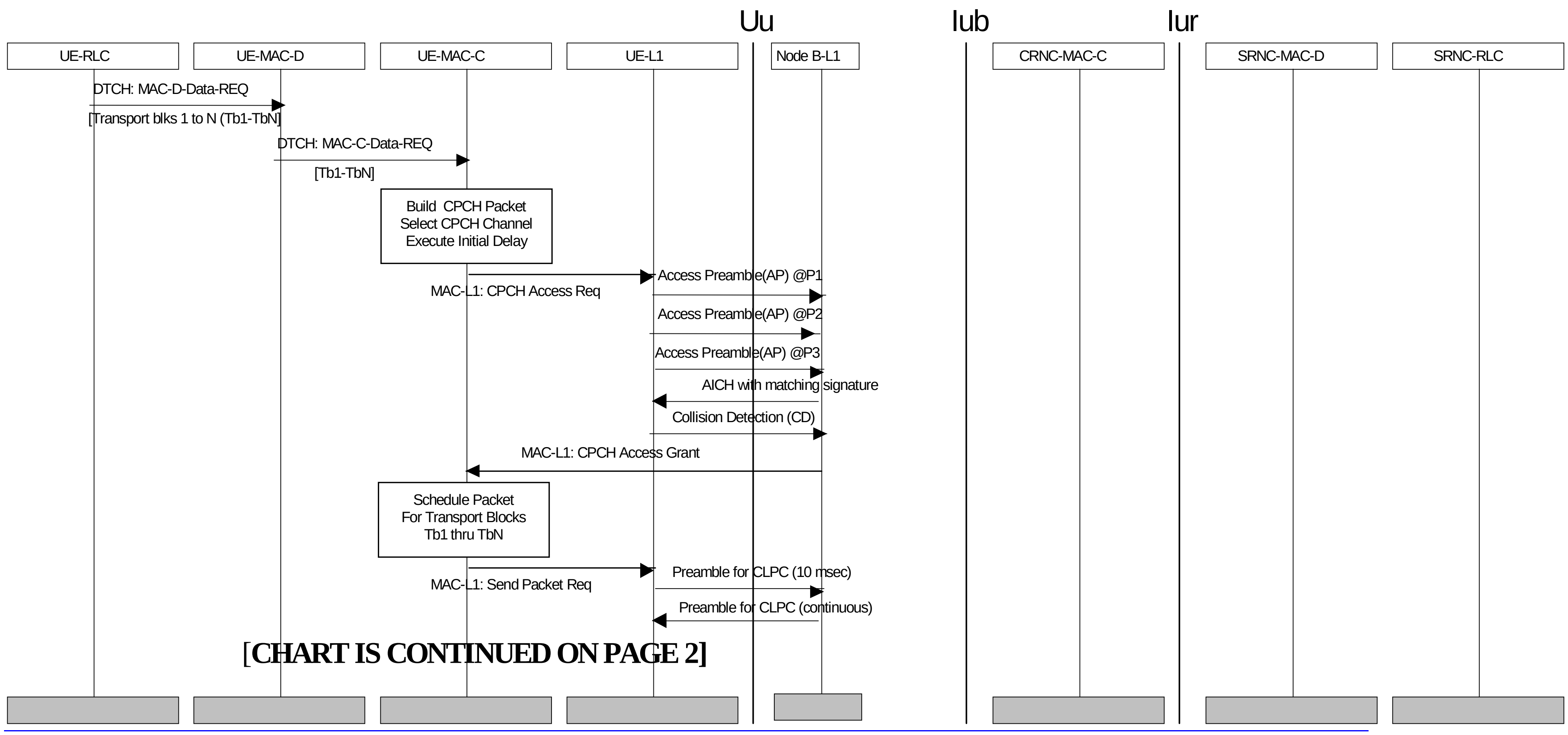


Figure 21: Example of acknowledged-mode data transmission on RACH+CPCH/FACH (page 1 of 2)

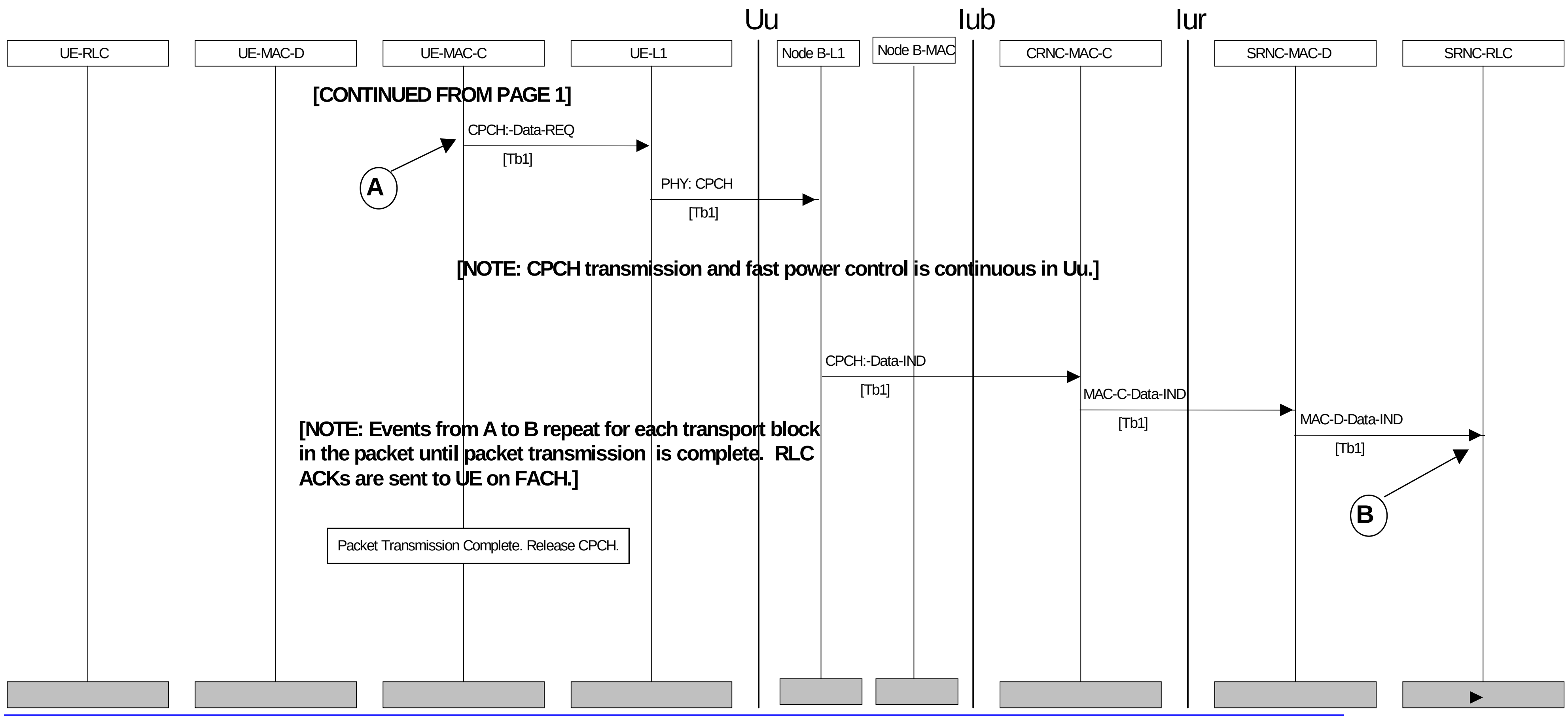


Figure 22: Example of acknowledged-mode data transmission on RACH+CPCH/FACH (page 2 of 2)

Figure 21 shows an example of acknowledged-mode data transmission on CPCH while in the RRC Connected state, the RACH+CPCH/FACH substate with CPCH resources assigned to UE (RACH+CPCH/FACH mode). An RB setup has allocated CPCH resources to the logical channel sourcing the data to be transmitted. First RLC in UE requests data transmission locally from MAC-d. MAC-d routes the request to MAC-c, where CPCH packet building is done. When the packet size (bytes in PHY for TFI chosen by MAC-c) is known, MAC-c selects one of the available CPCH channels from the CPCH set it has been assigned to use for this logical channel. Priority access procedure is performed to execute an initial access delay. Then the CPCH access procedure is performed between UE and NB to request and obtain the CPCH for transmission. The CPCH access procedure includes an AP, AICH-ack, CD, and ASSIGN premable messages. When the CPCH channel has been assigned, MAC-c schedules the packet for transmission by L1. [NOTE: if the requested channel could not be assigned, MAC-c may select an alternate CPCH channel which may have lower capacity. If the lower rate CPCH channel were assigned by NB, MAC-c would segment the packet based on the CPCH capacity and schedule only the highest priority packet head. The lower priority packet tail would be saved in a MAC queue for later packet transmission.]

After the 10msec period to close the TPC loops on both the CPCH UL and CPCCH DL, transport blocks are transmitted, frame by frame, unitl all the packet data is sent. SRNC RLC uses the DCCH to send RLC ACKs to the UE RLC using the FACH DL channel.

6.3.4 Data transfer on USCH/DSCH (TDD only)

In Figure 23 a data transfer procedure on USCH/DSCH is presented. It is assumed that the RAB establishment has been performed for example with the RAB Establishment procedure without Dedicated Physical Channel as illustrated in 7.2.1.1.4 and that the RAB is mapped on the USCH and DSCH transport channels.

In the UE the traffic measurement function decides to send a Capacity Request.to the network using the SHCCH logical channel mapped on the RACH. In the C-RRC the USCH/DSCH scheduling function will decide to allocate physical resources to this logical channel and RRC in C-RNC sends a PhyShChAllocation to its peer entity in the UE. This message specifies the physical resources and the period of time the MAC-sh can transfer the data on the USCH transport channel.

Both RRC in the CRNC and the UE configure their respective Layer 1 and MAC for the data transfer on the USCH and at the specified time MAC-sh in the UE convey the data using the specified PUSCH resources.

This operation may be repeated several times till the RLC buffer is empty.

In the diagram it is assumed that the PhyShChAllocation has allocated additionally to the PUSCH resources some PDSCH resources, so that at the time specified in the allocation message both RRC in the CRNC and the UE configure their respective Layer 1 and MAC for the data transfer on the DSCH and at the specified time MAC-sh in the UE convey the acknowledgement message of the UTRAN RLC to its UE peer entity using the specified PDSCH resources.

NOTE: The exact content of the message PhyShChAllocation is ffs.

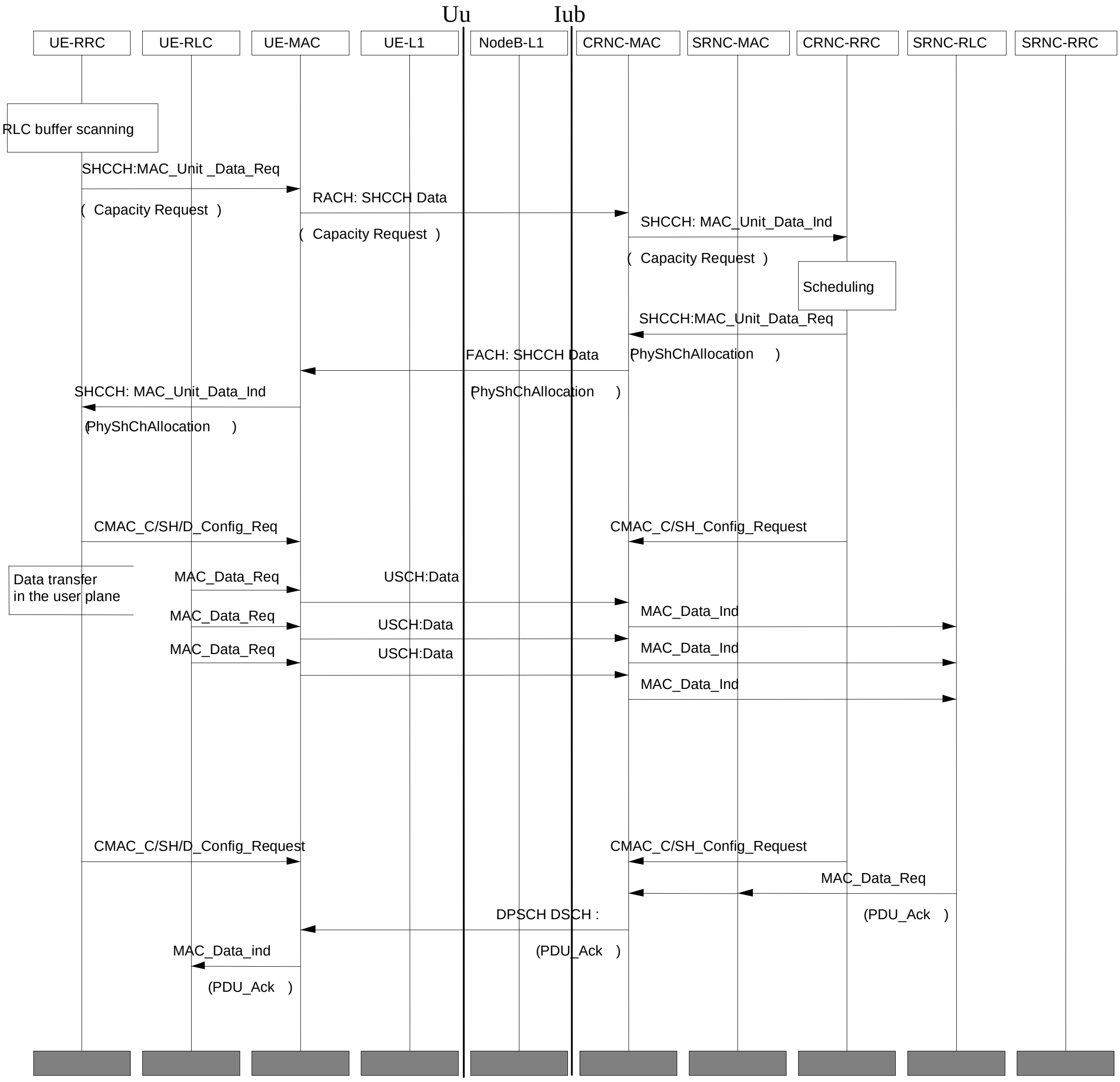


Figure 23: Data transfer on USCH/DSCH

6.4 RRC Connection mobility procedures

The RRC handover protocol must be common for the FDD and TDD modes. This means that the same protocol must support all the following handover procedures

6.4.1 Handover Measurement Reporting

Figure 24 illustrates an example where a measurement control and a measurement report procedure is used for handover measurements. The NW RRC requests the UE to start measurements and reporting with a MEASUREMENT CONTROL message. The message includes an indication of a measurement type (e.g. intra-frequency measurement), the radio links to evaluate, the reporting criteria and a measurement identity number. The UE configures L1 to start measurements. When measurement reporting criteria are fulfilled the UE sends a MEASUREMENT REPORT message.

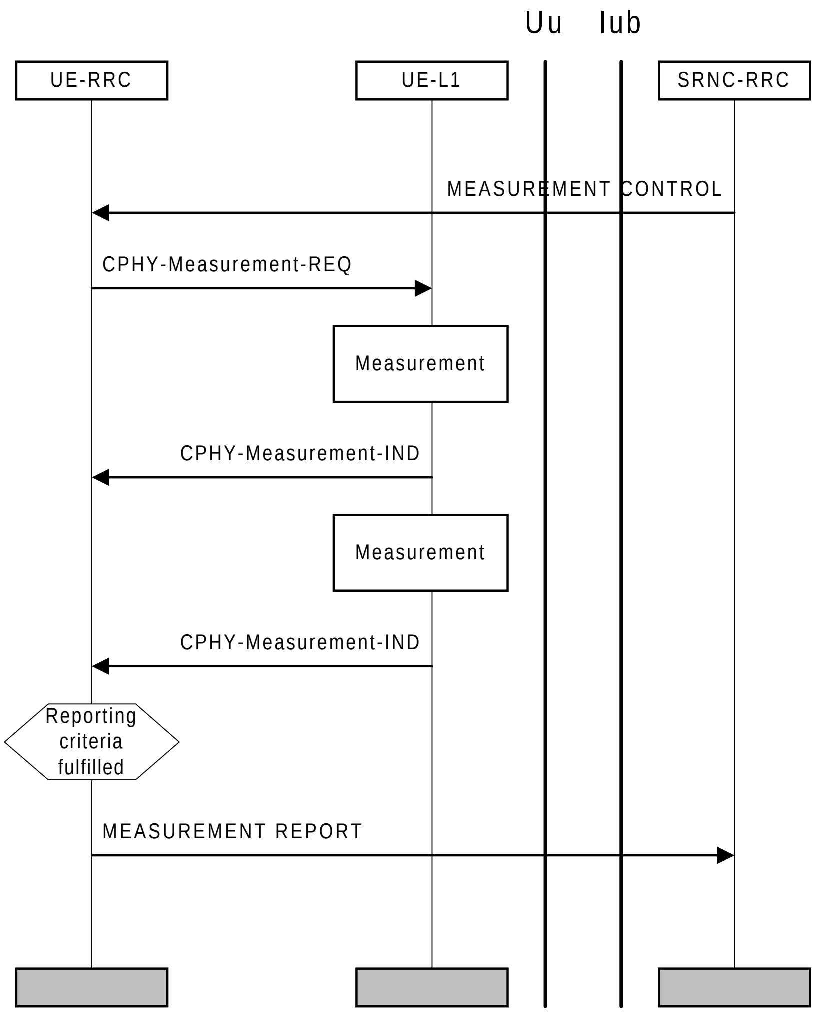


Figure 24: Handover measurement reporting

6.4.2 Cell Update

~~NOTE: This example currently applies only in the case of URA change.~~

Figure 25 illustrates an example of a cell update procedure.

The cell update procedure is triggered by the cell re-selection function in the UE, which notifies which cell the UE should switch to. The UE reads the broadcast information of the new cell. Subsequently, the UE RRC layer sends a CELL UPDATE message to the UTRAN RRC via the CCCH logical channel and the RACH transport channel. The RACH transmission includes the current S-RNTI and the SRNC Identity.

Upon reception of the CELL UPDATE, the UTRAN registers the change of cell. If the registration is successful it replies with a CELL UPDATE CONFIRM message transmitted on the DCCH/FACH to the UE. The message includes the current S-RNTI and SRNC Identities and it may also include new S-RNTI and / or S-RNTI + SRNC Identities. By using DCCH for the confirm message the contents of the message can be ciphered.

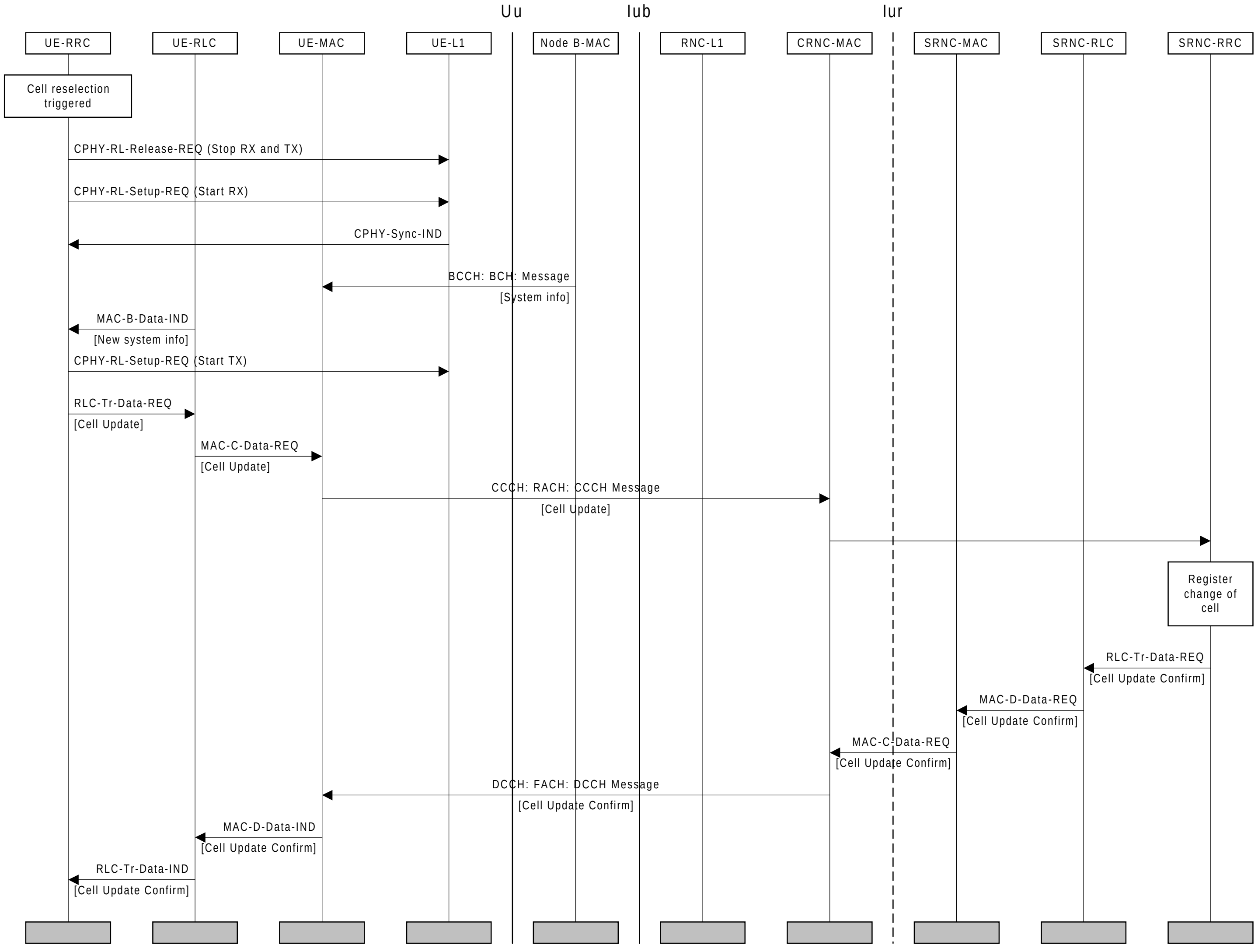


Figure 25: Cell update procedure

6.4.3 URA Update

Figure 26 illustrates an example of a URA Update procedure. For a more detailed figure on the interlayer interaction for CCCH or DCCH transmission please refer to "Cell Update" in the previous section.

When cell re-selection is triggered, the UE abandons the radio link in the old cell and establishes a radio link to the new cell. The URA update procedure is triggered when the UE reads the broadcast information of the new cell and recognises that a URA update is required. After that, the UE RRC layer sends a URA UPDATE on the CCCH to the UE MAC layer, which transfers the message on the RACH to UTRAN. The RACH transmission includes the current S-RNTI and SRNC Identity.

Upon reception of the URA UPDATE, the UTRAN registers the change of URA. Then the CRNC-RRC requests the CRNC-MAC to send a URA UPDATE CONFIRM message on the FACH to the UE. The message includes the current S-RNTI and SRNC Identities and may also include new C-RNTI, S-RNTI and SRNC Identities.

The logical channel used for URA UPDATE CONFIRM depends on the SRNC relocation policy. If SRNC is always relocated before URA UPDATE CONFIRM is sent, a DCCH should be used (to allow ciphering of the message contents). If SRNC is not relocated, the CCCH logical channel should be used to be able to utilize the RNSAP Iur procedures and not being forced to set up user plane on the Iur for this procedure.

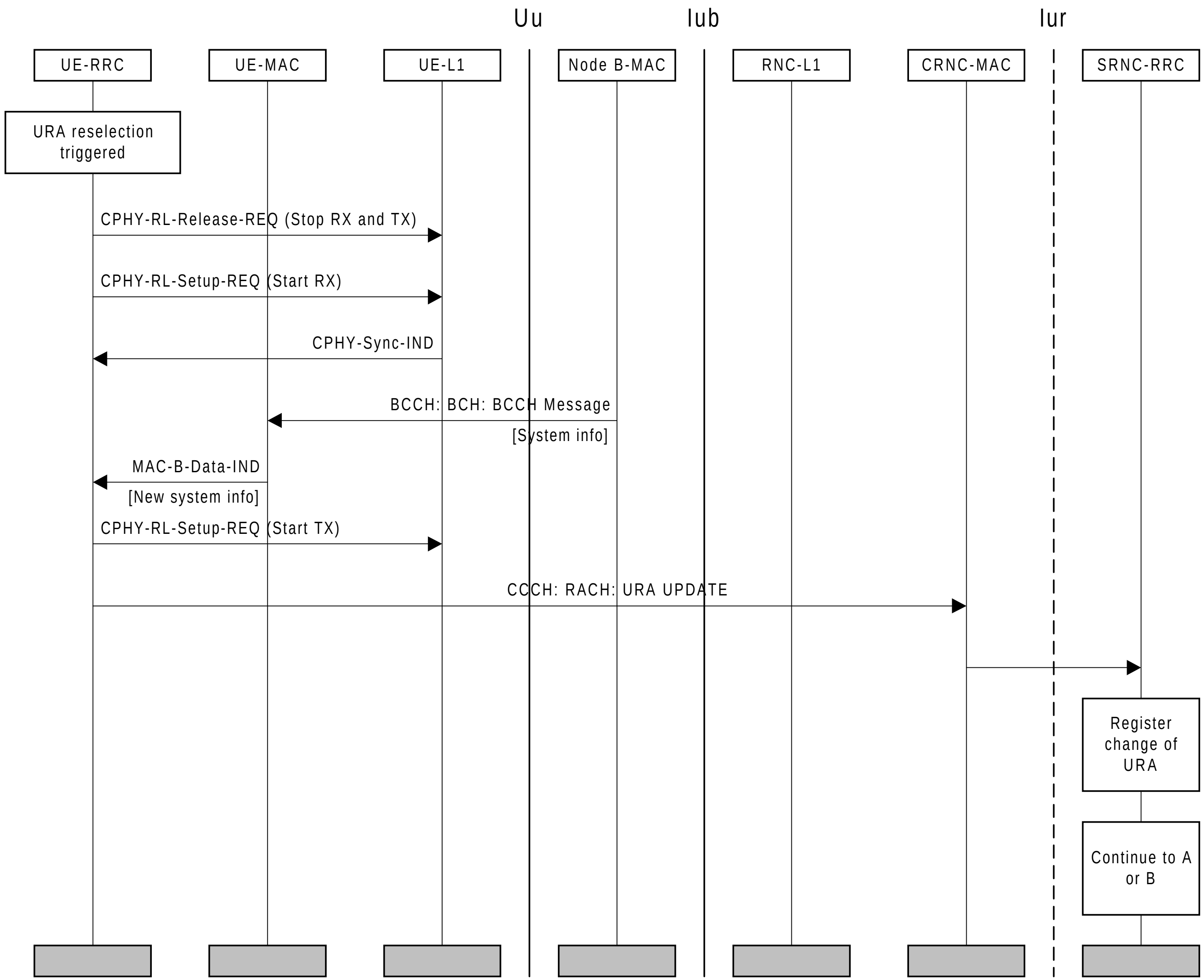


Figure 26: Beginning of the URA update procedure – continue either to case A or case B

Case A: URA UPDATE CONFIRM on DCCH:

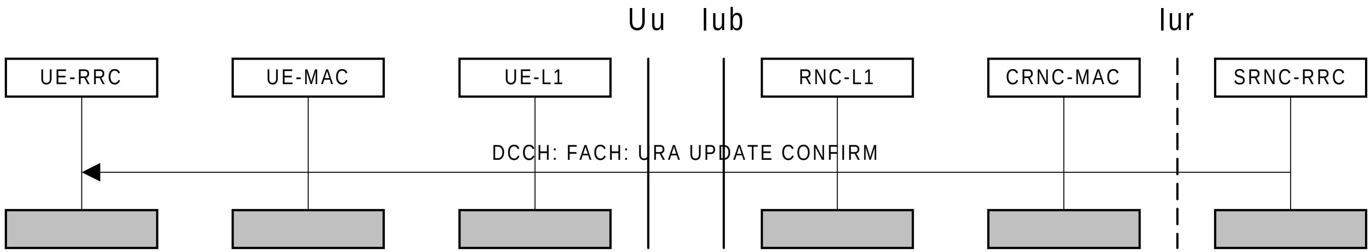


Figure 27: Case A continuation of URA update, CONFIRM message can be ciphered

Case B: URA UPDATE CONFIRM on CCCH:

In this case transmission between SRNC and CRNC takes place on the RNSAP Downlink Signalling Transfer and the CCCH logical channel is used.

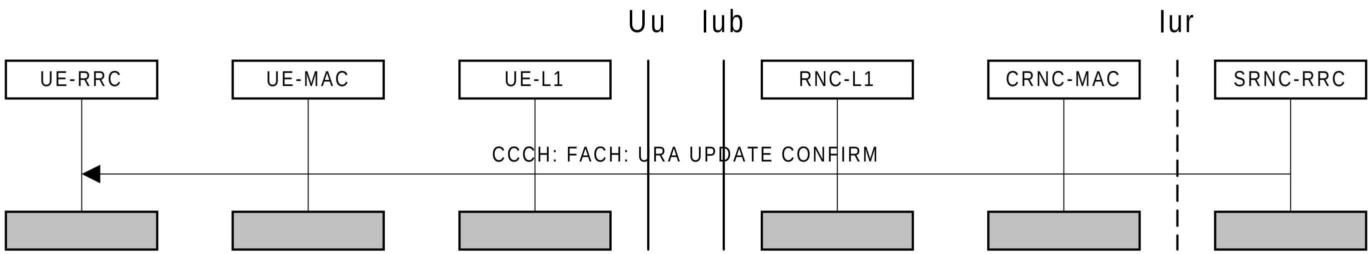


Figure 28: Case B continuation of URA update, CONFIRM message cannot be ciphered

6.4.4 Radio Link Addition (FDD soft-add)

NOTE: TDD soft-add is an option supported on the condition that L1 supports it

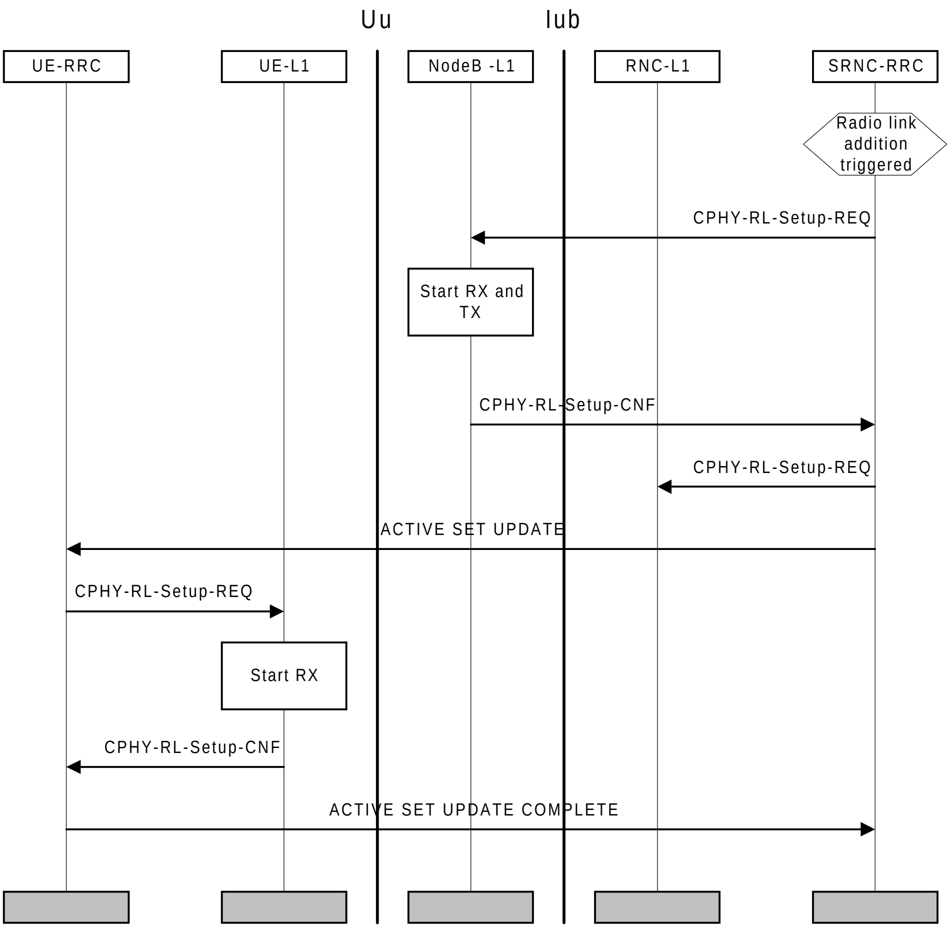


Figure 29: Radio Link Addition

Figure 29 illustrates a radio link addition procedure. Radio link addition is triggered in the network RRC layer by measurement reports sent by the UE. The NW RRC first configures the new radio link on the physical layer in Node B. Transmission and reception begin immediately. The NW RRC then sends an RRC ACTIVE SET UPDATE message to the UE RRC. The UE RRC configures layer 1 to begin reception.

After confirmation from the physical layer in UE an ACTIVE SET UPDATE COMPLETE message is sent to the RNC-RRC.

6.4.5 Radio Link Removal (FDD soft-drop)

NOTE: TDD soft-drop is an option supported on the condition that L1 supports it

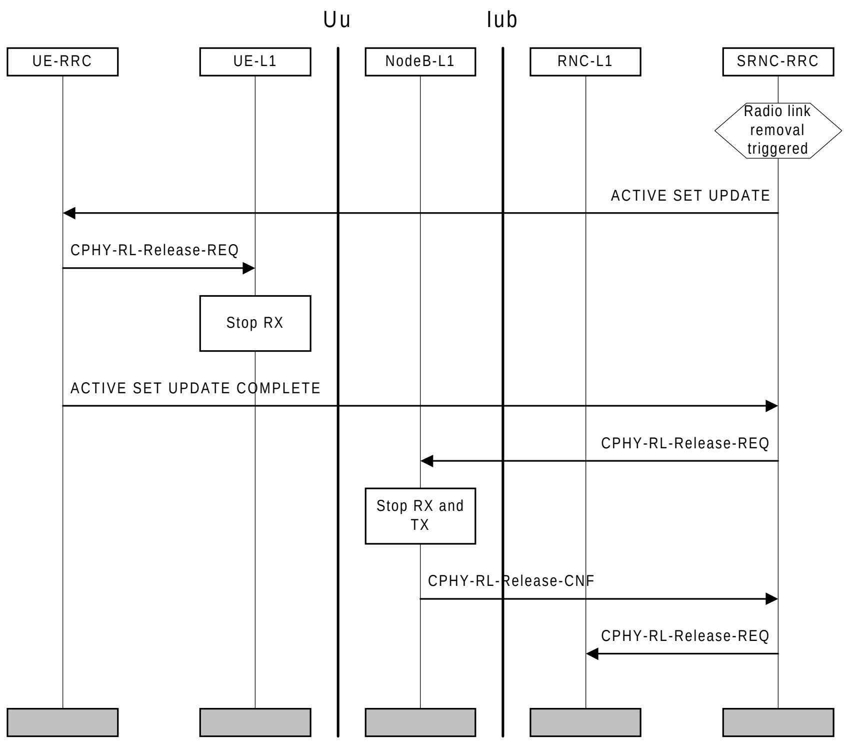


Figure 30: Radio link removal

Figure 30 illustrates a radio link removal procedure. Radio link removal is triggered by an algorithm in the network RRC layer by measurement reports sent by the UE. Radio link removal may also be triggered in the NW due to load control algorithms. The radio link is first deactivated by the UE and then in the NW.

The NW RRC sends an ACTIVE SET UPDATE message to the UE RRC. The UE RRC requests UE L1 to terminate reception of the radio link(s) to be removed. After this the UE RRC acknowledges radio link removal with an ACTIVE SET UPDATE COMPLETE message to the NW RRC. The NW RRC proceeds to request the NW L1 in both Node B and the RNC to release the radio link.

6.4.6 Combined radio link addition and removal

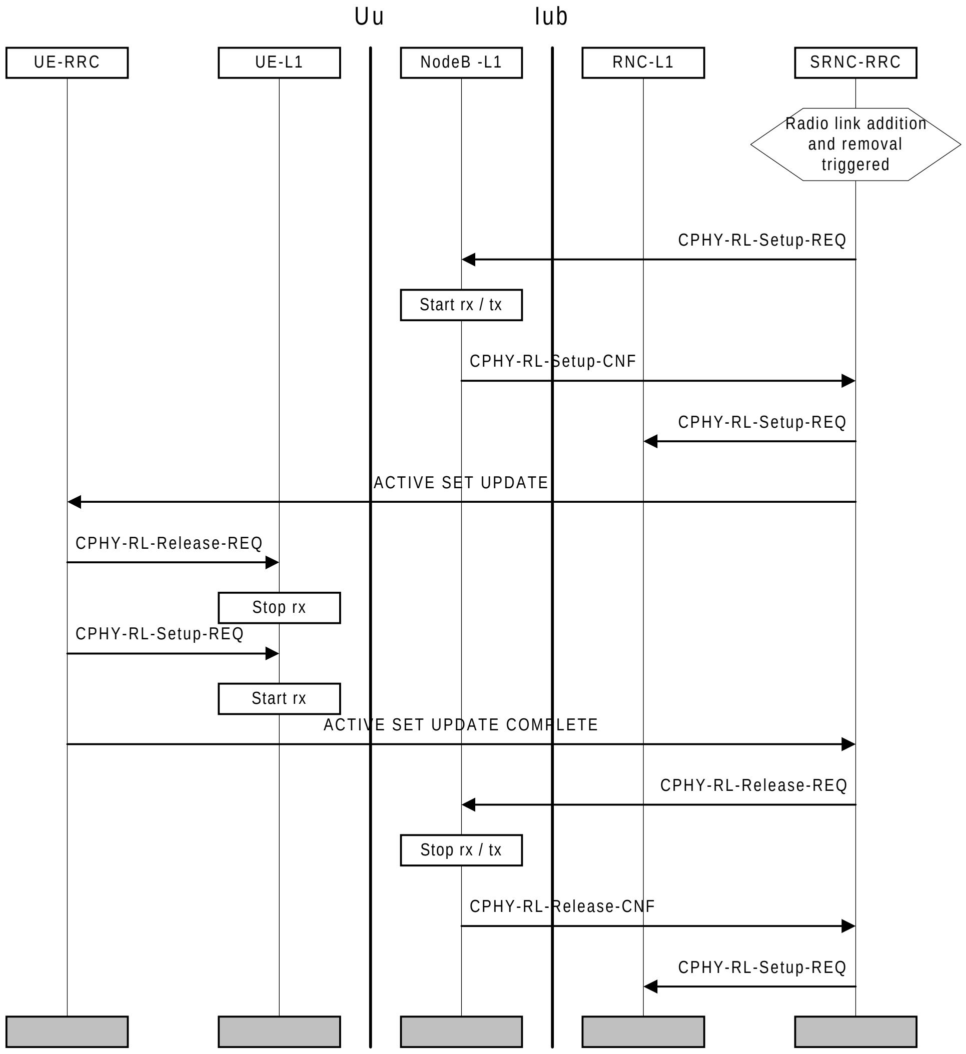


Figure 31: Combined Radio Link Addition And Removal

Figure 31 illustrates a combined radio link addition and removal procedure. The NW RRC determines the need for radio link replacement based on received measurement reports or load control algorithms.

When radio links are to be replaced, the NW RRC first configures the NW L1 to activate the radio link(s) that are being added. The NW RRC then sends an ACTIVE SET UPDATE message to the UE RRC, which configures the UE L1 to terminate reception on the removed radio link(s) and begin reception on the added radio link(s).

If the UE active set is full, the replacement has to be performed in the order defined in Figure 31. If UE has only one radio link, then the replacement must be done in reverse order (first add, then remove).

~~NOTE: The present assumption is that the order of the replacement can be left to the UE.~~

The UE RRC acknowledges the replacement with an ACTIVE SET UPDATE COMPLETE message. The NW RRC then configures the NW L1 to terminate reception and transmission on the removed radio link.

6.4.7 Hard Handover (FDD and TDD hard)

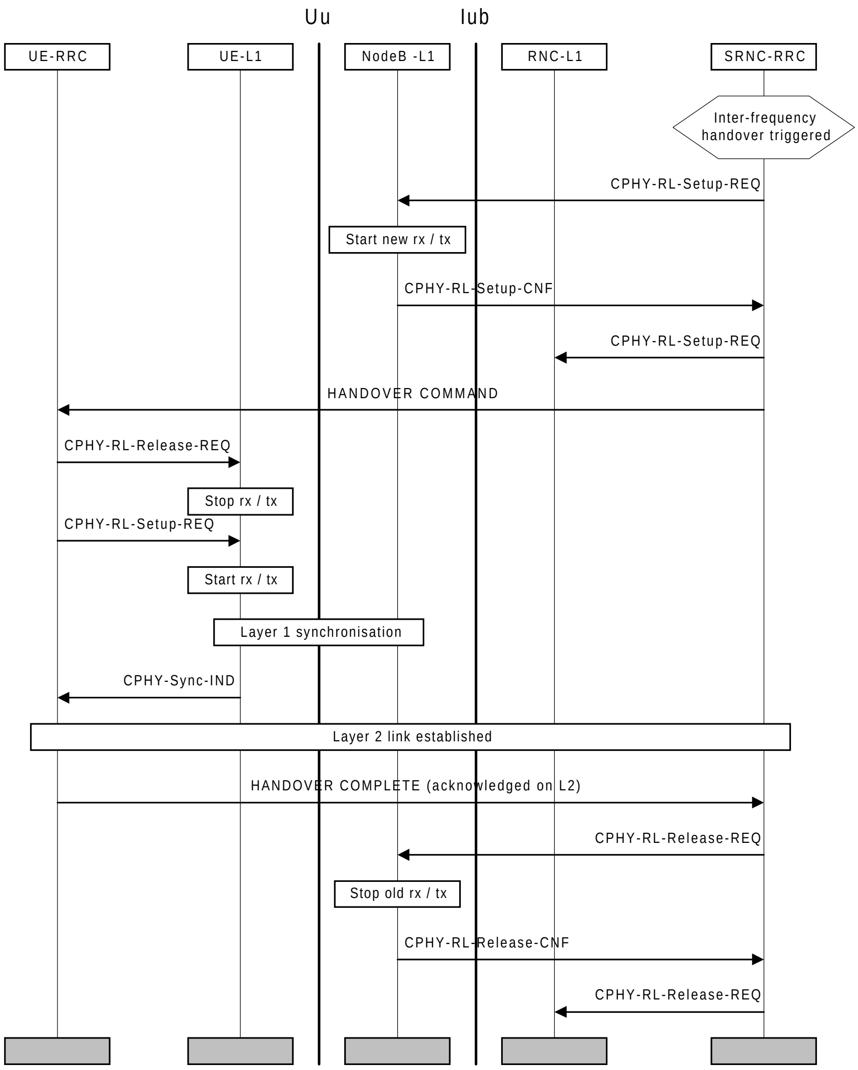


Figure 32: Hard handover

Figure 32 illustrates a hard handover. The NW RRC determines the need for hard handover based on received measurement reports or load control algorithms.

For inter-frequency handover the measurements are assumed to be performed in slotted mode.

The NW RRC first configures the NW L1 to activate the new radio links. The NW L1 begins transmission and reception on the new links immediately. The NW RRC then sends the UE RRC a HANDOVER COMMAND message. The message indicates the radio resources that should be used for the new radio link. The UE RRC configures the UE L1 to terminate reception on the old radio link and begin reception on the new radio link.

After the UE L1 has achieved downlink synchronisation on the new frequency, a L2 link is established and the UE RRC sends a HANDOVER COMPLETE message to the NW RRC. After having received the L3 acknowledgement, the NW RRC configures the NW L1 to terminate reception and transmission on the old radio link.

~~NOTE 1: Whether it should be possible to setup several radio links immediately on the new frequency is FFS.~~

~~NOTE 2: The suspension and resuming of the CC and MM signalling during handover is FFS.~~

6.4.8 RRC Connection re-establishment

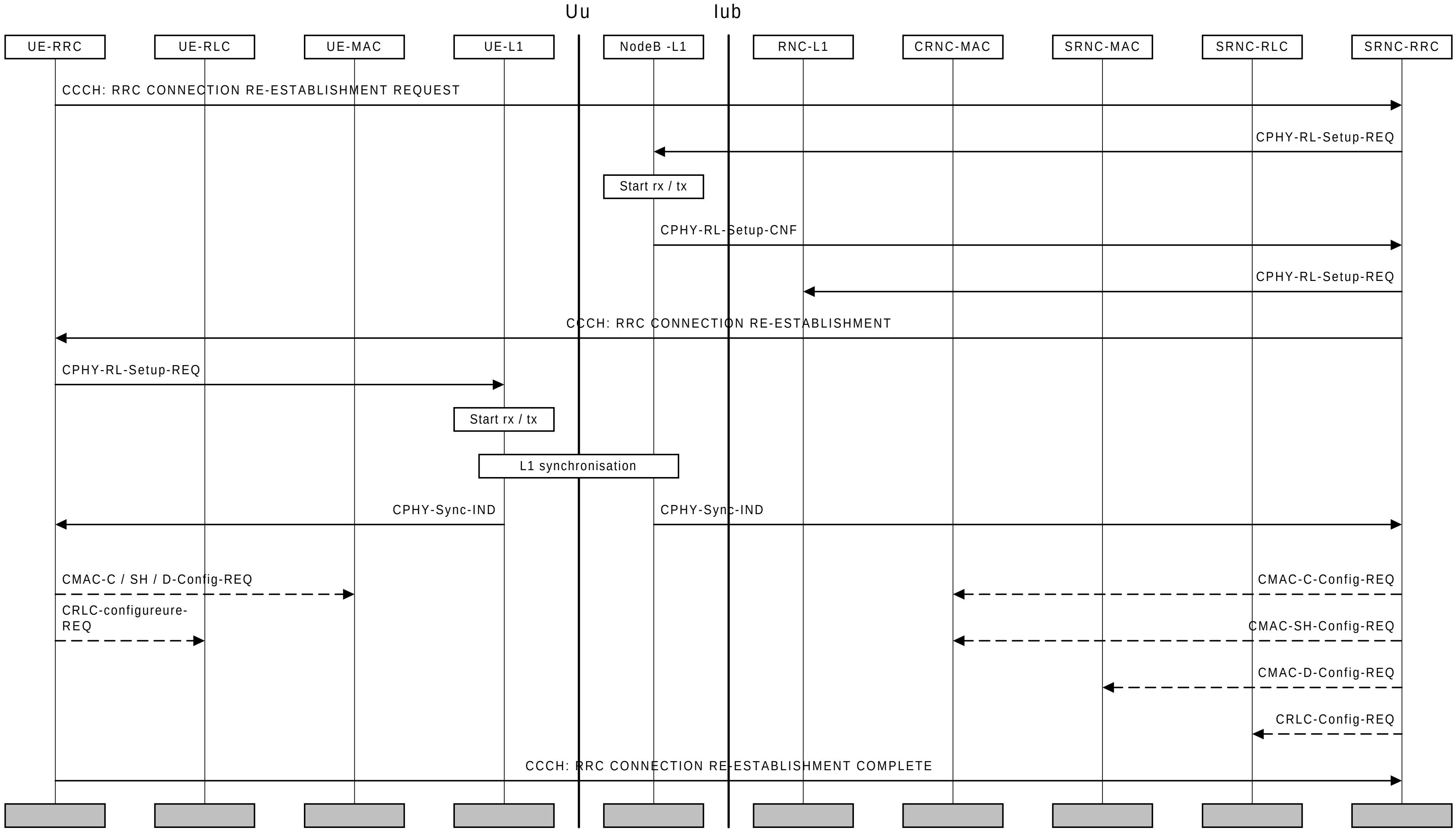


Figure 33: RRC connection re-establishment

Figure 33 shows an example of an RRC connection re-establishment procedure. RRC connection re-establishment is needed, when a UE loses radio connection due to e.g. radio link failure. After having selected a new cell, the UE RRC sends the NW RRC an RRC CONNECTION RE-ESTABLISHMENT REQUEST message. The NW RRC configures the NW and acknowledges the connection re-establishment to the UE RRC with an RRC CONNECTION RE-ESTABLISHMENT message. The UE RRC configures the UE L1 to activate the new radio link(s). After the UE has synchronised to at least one radio link, the MAC and RLC layers can be configured (if necessary).

When the procedure is completed on the UE side, an RRC CONNECTION RE-ESTABLISHMENT COMPLETE message is sent.

6.4.9 Inter-system Handover: GSM/BSS to UTRAN

The handover from GSM/BSS to UTRAN for a dual-mode GSM MS / UMTS UE is illustrated in Figure 34. On the network side, upon the reception of a HARD HANDOVER PROCEED 2 command through the RANAP protocol, the RRC layer performs admission control and radio resource allocation assigning an RNTI for the RRC connection and selecting radio resource parameters (such as transport channel type, transport format sets, etc). RRC configures these parameters on layer 1 and layer 2 to locally establish the DCH logical channel.

The selected parameters including the RNTI, were previously transmitted to UE via RANAP message HARD HANDOVER PROCEED 1 and GSM upgraded message HANDOVER COMMAND.

Upon reception of the HANDOVER COMMAND message, the GSM RR layer transmits the required parameters to the UMTS RRC layer using an RR-Data-IND primitive. UE RRC configures L1 and L2 using these parameters to locally establish the DCH logical channel. Layer 1 indicates to RRC when it has reached synchronisation. An RLC signalling link establishment is then initiated by the UE. A HANDOVER COMPLETE message is finally sent by the UE.

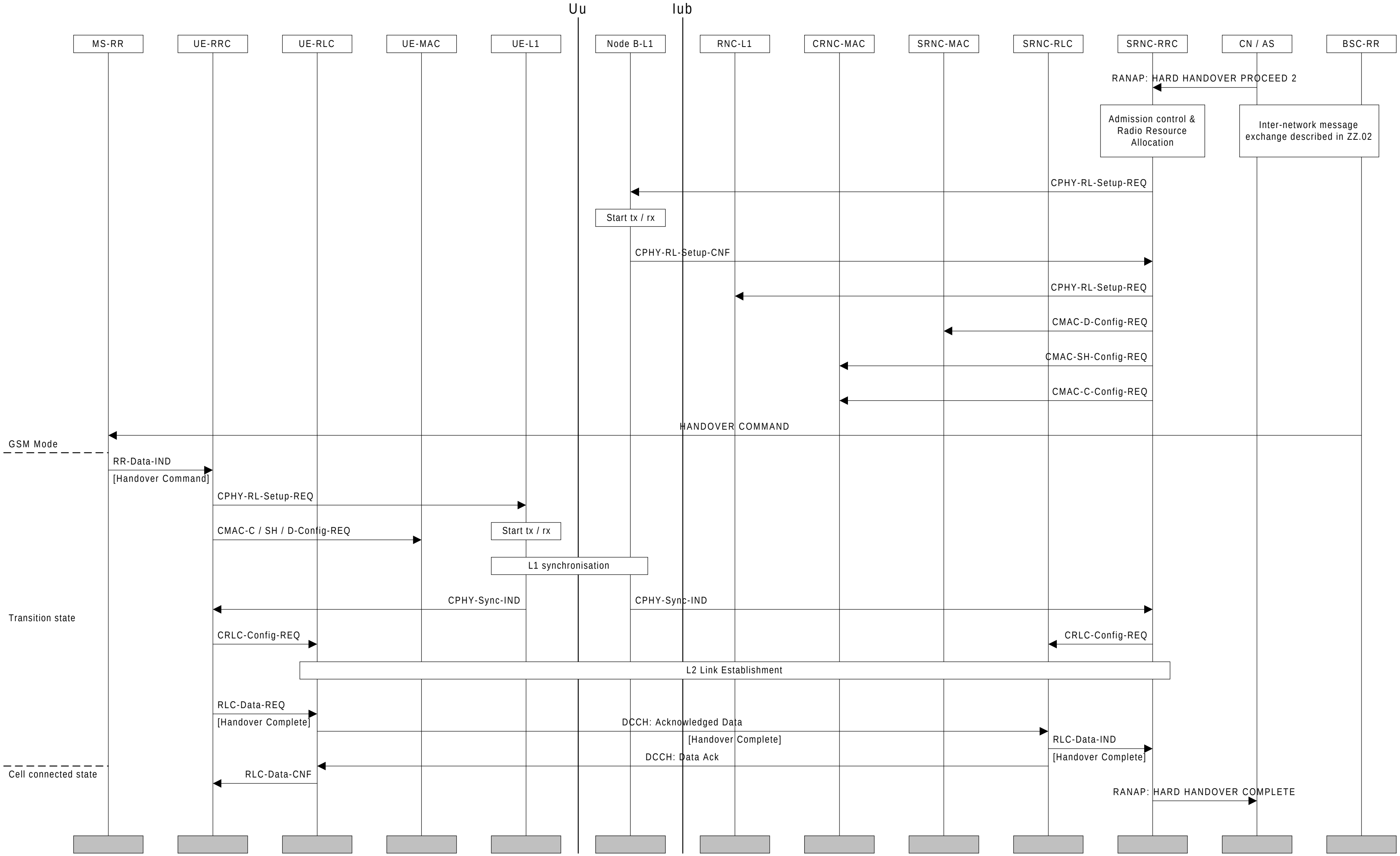


Figure 34: GSM to UMTS inter-system handover

6.4.10 Inter-System Handover: UTRAN to GSM/BSS, PSTN/ISDN domain services

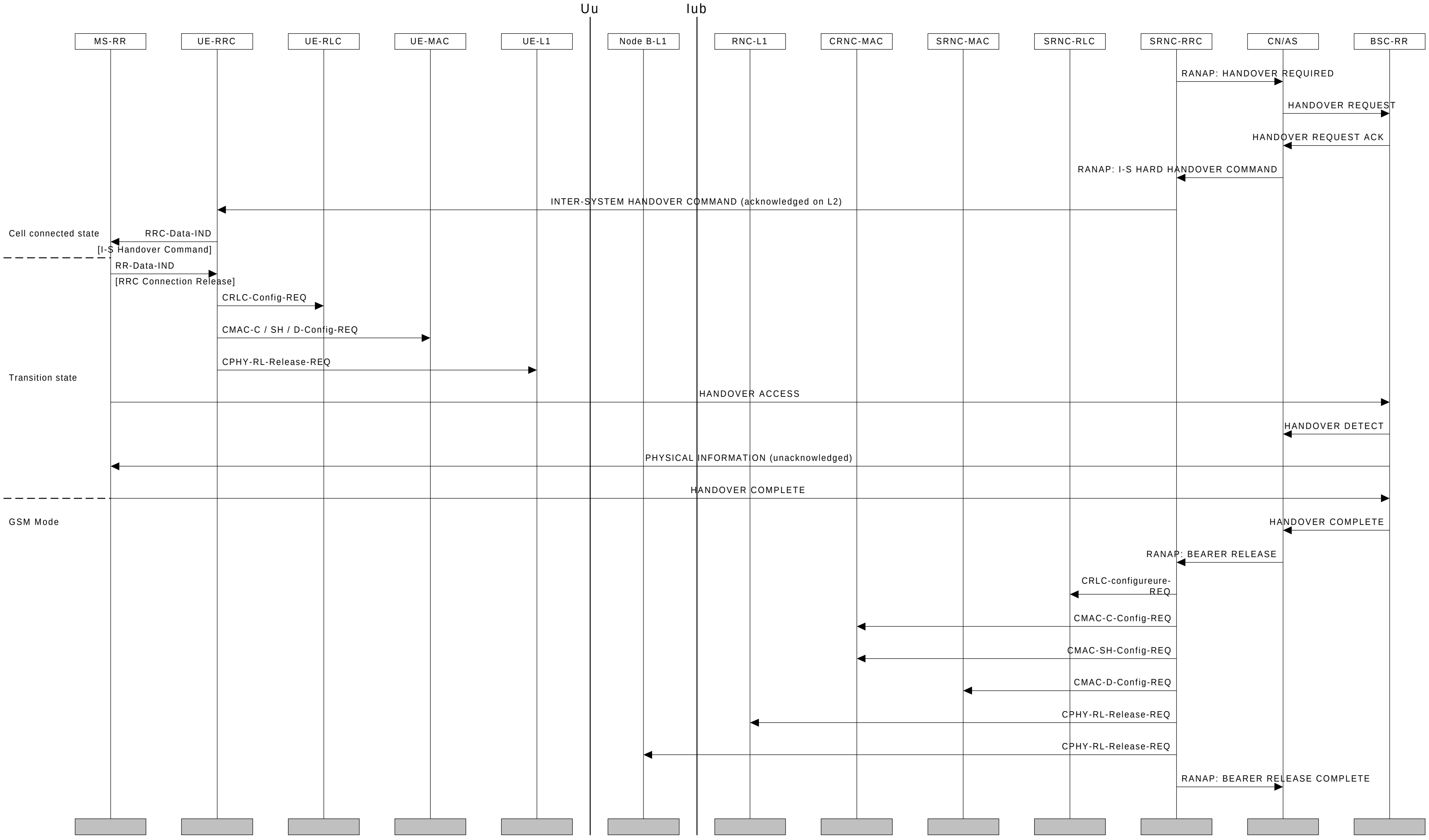


Figure 35: UMTS to GSM inter-system handover

NOTE: The scope of this description is restricted to a UE having a connection only to PSTN/ISDN services, i.e. no simultaneous IP connection

For PSTN/ISDN domain services UTRAN Inter-System Handover procedure is based on measurement reports from the UE but initiated from the UTRAN. INTER-SYSTEM HANDOVER COMMAND is sent using acknowledged data transfer on the DCCH. The UE transition from UTRAN Connected Mode starts when an INTER-SYSTEM HANDOVER COMMAND is received. The transition to GSM Connected mode is finished when HANDOVER COMPLETE message is sent from the UE.

UTRAN sends a HANDOVER REQUIRED to CN/AS. This message contains information needed for the GSM system to be able to perform a handover (e.g. serving cell, target cell). Some parts of this information (e.g. MS classmark) have been obtained at call setup of the UTRAN Connection and are stored in CN.

The CN/AS sends a HANDOVER REQUEST message to BSC-RR allocating the necessary resources to be able to receive the GSM MS and acknowledge this by sending HANDOVER REQUEST ACKNOWLEDGE to CN/AS. The HANDOVER REQUEST ACKNOWLEDGE contains all radio-related information that the UE needs for the handover.

CN/AS sends a INTER-SYSTEM HANDOVER COMMAND (type UTRAN-to-BSS HARD HANDOVER) to the UE to start the execution of the handover. This message contains all the information needed for the UE to be able to switch to the GSM cell and perform a GSM handover.

Upon reception of the HANDOVER COMMAND message, UMTS RRC forwards the handover mparameters to the GSM RR layer using an RRC-Data-IND primitive. To release the resources from UMTS the RR layer transmits to the UMTS RRC an RRC Connection Release message using an RR-Data-IND primitive. The RRC layer can then locally release the resources on the RLC, MAC and physical layers of the UE.

After having switched to the assigned GSM channel received in the INTER-SYSTEM HANDOVER COMMAND, the GSM MS sends HANDOVER ACCESS in successive layer 1 frames, just as it typically would have done for a conventional GSM handover initiation.

When the BSC-RR has received the HANDOVER ACCESS it indicates this to the CN/AS by sending a HANDOVER DETECT message. The BSC-RR sends a PHYSICAL INFORMATION message to the GSM MS in unacknowledged mode that contains various fields of physical layer -related information allowing a proper transmission by the MS.

After layer 1 and 2 connections are successfully established, the GSM MS returns the HANDOVER COMPLETE message.

CN/AS is then able to release the UTRAN resources that were used for the UE in UTRAN Connected Mode. The CN/AS send a BEARER RELEASE command to UTRAN, after which UTRAN can release all NW resources from RLC, MAC and the physical layer. When the release operation is complete, a BEARER RELEASE COMPLETE message is sent to CN / AS.

6.5 CN originated paging request in connected mode

6.5.1 UTRAN coordinated paging using DCCH

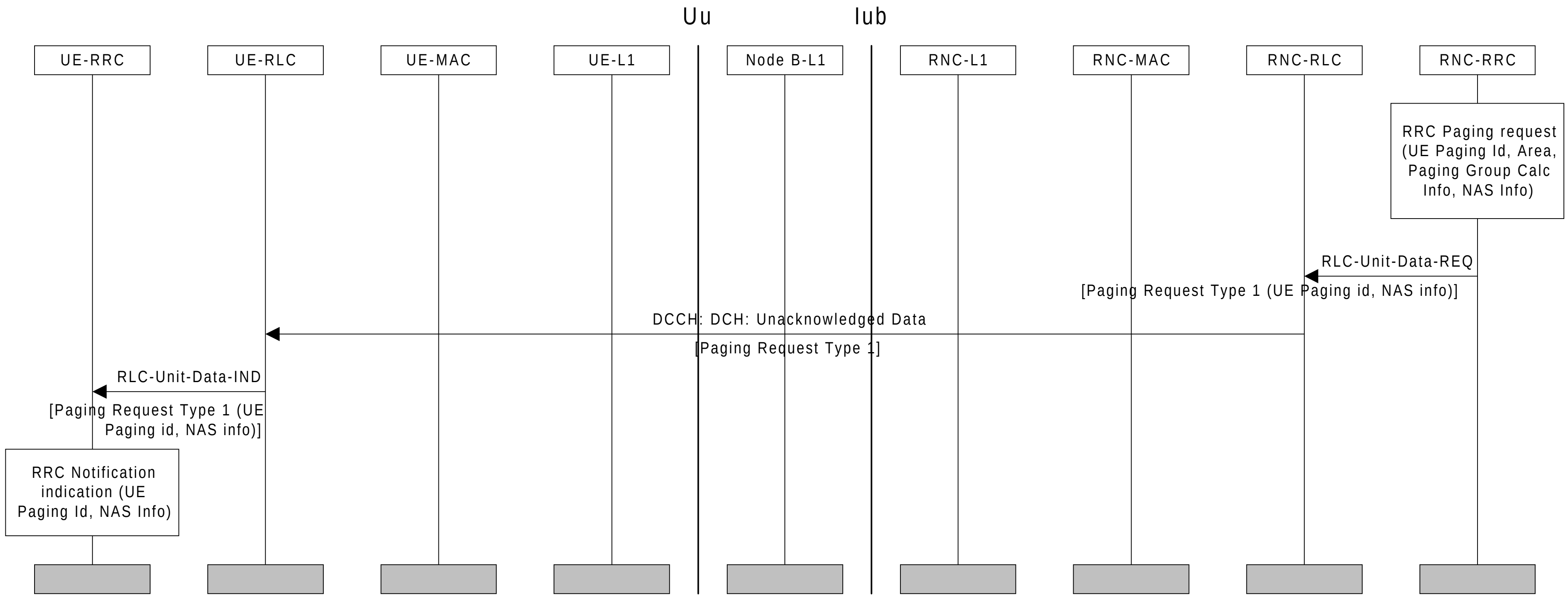


Figure 36. Example sequence of CN initiated paging request using DCCH

The above sequence illustrates a CN originated paging request, when the UE is in connected mode and can be reached on the DCCH. The coordination of the paging request with the existing RRC connection is done in UTRAN.

The entity above RRC on the network side requests paging of a UE over the Nt-SAP. The request contains a UE paging identity, an area where the page request is to be broadcast, information for calculation of the paging group and NAS information to be transparently transmitted to the UE by the paging request.

Since the UE can be reached on the DCCH, the RRC layer formats a Paging Request Type 1 message containing the UE paging identity and the NAS information, and the message is transmitted directly to the UE using unacknowledged data transfer.

~~6.5.2 UTRAN coordinated paging using PCCH~~

~~FFS.~~

~~6.5.3 UE coordinated paging~~

~~FFS.~~

6.6 UTRAN originated paging request and paging response

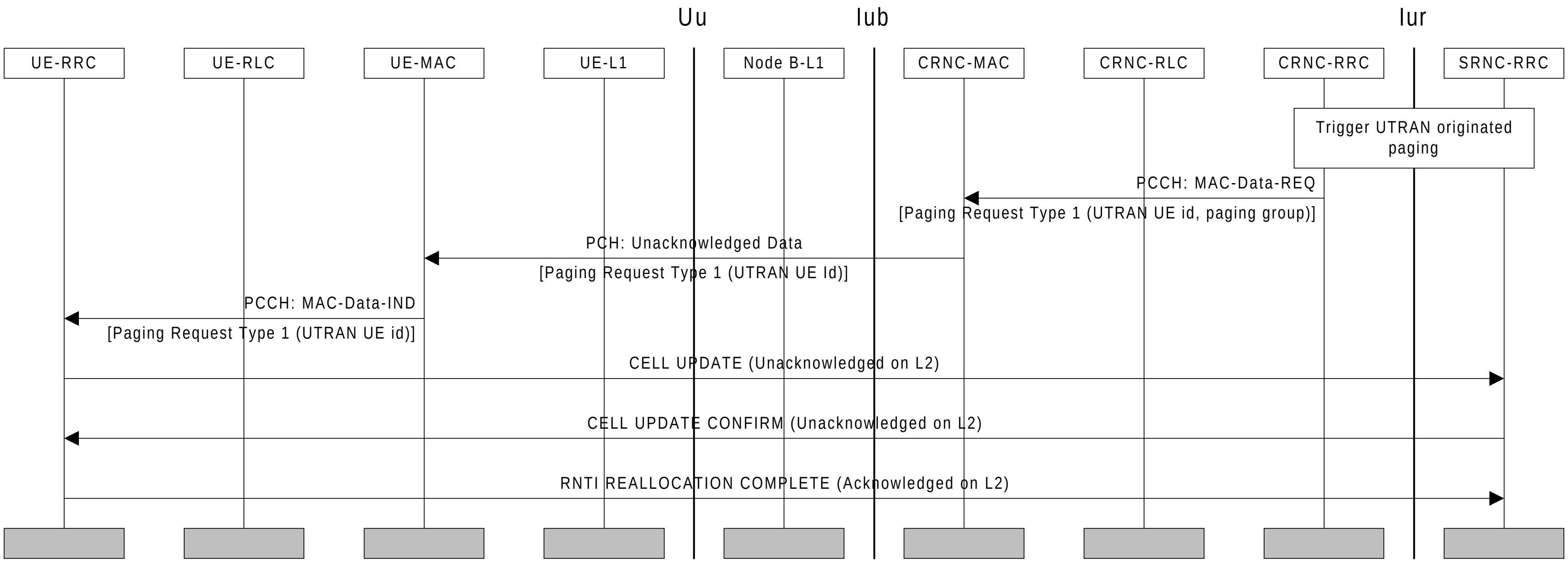


Figure 37: Example sequence for UTRAN initiated paging request with paging response

The RRC layer in the network uses this sequence to trigger a switch to RACH/FACH substate of the cell connected state, when the UE can only be reached on the PCH (the PCH substate of cell connected state or the URA connected state). A Paging Type 1 message is prepared, containing the UTRAN UE identity (s-RNTI + RNC-ID). The RRC requests the transmission of the message by MAC on the PCCH, indicating the paging group.

In the UE, the RRC layer continuously monitors the paging group on the PCH and compares the UE identities in received paging request messages with its own identities. A match occurs, and in this case the RRC layer changes state to RACH/FACH substate within the cell connected mode.

The UE prepares a Cell Update message, which is sent on CCCH~~ or DCCH (FFS)~~.

~~NOTE: The content of the Paging Response Type 2 message is FFS. It could e.g. be measurements.~~

When the network receives the Cell Update message, a c-RNTI is allocated and signalled to UE using the Cell Update Confirm message, which is sent on ~~CCCH or~~ DCCH~~ (FFS)~~ using unacknowledged mode. The latter message also acknowledges the reception of the Cell Update message. The UE configures MAC to use the new c-RNTI and prepares a RNTI Reallocation Complete message. When the network receives the RNTI Reallocation Complete message on DCCH it can delete any old c-RNTI and the DCCH/DTCH logical channels can be used also in the downlink using the new c-RNTI.