Technical Document - Confidential

GSM FAX & DATA SERVICES

OVERVIEW

DATA SERVICES

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2. Handshaking for data transfer, Reset of RLP connection
3. Collisions added
4. New primitives: RA_ACTIVATE_CNF, L2R_ACTIVATE_CNF, L2RUART_REQ, L2R_UART_CNF, RLP_DETACH_CNF, L2R_DEACTIVATE_CNF,

The data transfer part 3.9/3.10 is not up to date

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List of References

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1.1 References

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telephone network;
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(ITU-T.31, 1995)

[4] ITU-T Recommendation T.32; Terminals for telematic services;
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[29] Service Access Point FAD
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[30] Service Access Point T30
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[32] Message Sequence Charts RLP
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[40] Test Specification FAD
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[41] Test Specification T30
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[42] Test Specification ACI
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1.2 Abbreviations

ACI	AT Command Interpreter
AGCH	Access Grant Channel
AT	Attention sequence "AT" to indicate valid commands of the ACI
BCCH	Broadcast Control Channel
BCS	Binary Coded Signals
BS	Base Station
BSIC	Base Station Identification Code
C/R	Command/Response
C1	Path Loss Criterion
C2	Reselection Criterion
CBCH	Cell Broadcast Channel
CBQ	Cell Bar Qualify
CC	Call Control
CCCH	Common Control Channel
CCD	Condat Coder Decoder
CKSN	Ciphering Key Sequence Number
CRC	Cyclic Redundancy Check
DCCH	Dedicated Control Channel
DISC	Disconnect Frame
DL	Data Link Layer
DM	Disconnected Mode Frame
DTX	Discontinuous Transmission
EA	Extension Bit Address Field
EL	Extension Bit Length Field
EMMI	Electrical Man Machine Interface
EOL	End Of Line
F	Final Bit
F&D	Fax and Data Protocol Stack
FACCH	Fast Associated Control Channel
FHO	Forced Handover
GP	Guard Period
GSM	Global System for Mobile Communication
HDLC	High level Data Link Control
HISR	High level Interrupt Service Routine
HPLMN	Home Public Land Mobile Network
I	Information Frame
IMEI	International Mobile Equipment Identity
IMSI	International Mobile Subscriber Identity
ITU	International Telecommunication Union
IWF	Interworking Function
Kc	Authentication Key
L	Length Indicator
LAI	Location Area Information
LISR	Low level Interrupt Service Routine
LPD	Link Protocol Discriminator
M	More Data Bit
MCC	Mobile Country Code
MM	Mobility Management
MMI	Man Machine Interface
MNC	Mobile Network Code

MS	Mobile Station
MSG	Message phase in the GSM 3.45 protocol
N(R)	Receive Number
N(S)	Send Number
NCC	National Colour Code
NECI	New Establishment Causes included
OTD	Observed Time Difference
P	Poll Bit
P/F	Poll/Final Bit
PCH	Paging Channel
PCO	Point of Control and Observation
PDU	Protocol Description Unit
PL	Physical Layer
PLMN	Public Land Mobile Network
RACH	Random Access Channel
REJ	Reject Frame
RNR	Receive Not Ready Frame
RR	Radio Resource Management
RR	Receive Ready Frame
RTD	Real Time Difference
RTOS	Real Time Operating System
SABM	Set Asynchronous Balanced Mode
SACCH	Slow Associated Control Channel
SAP	Service Access Point
SAPI	Service Access Point Identifier
SDCCH	Slow Dedicated Control Channel
SIM	Subscriber Identity Module
SMS	Short Message Service
SMSCB	Short Message Service Cell Broadcast
SS	Supplementary Services
T.4	CCITT Standardisation for Document coding of Group 3 Facsimile Apparatus
TAP	Test Application Program
TCH	Traffic Channel
TCH/F	Traffic Channel Full Rate
TCH/H	Traffic Channel Half Rate
TDMA	Time Division Multiple Access
TE	Terminal Equipment - e. g. a PC
TMSI	Temporary Mobile Subscriber Identity
UA	Unnumbered Acknowledgement Frame
UI	Unnumbered Information Frame
V(A)	Acknowledgement State Variable
V(R)	Receive State Variable
V(S)	Send State Variable
VPLMN	Visiting Public Land Mobile Network

1.3 Terms

Entity:	Program which executes the functions of a layer
Message:	A message is a data unit which is transferred between the entities of the same layer (peer-to-peer) of the mobile and infrastructure side. Message is used as a synonym to protocol data unit (PDU). A message may contain several information elements.
Primitive:	A primitive is a data unit which is transferred between layers on one component (mobile station or infrastructure). The primitive has an operation code which identifies the primitive and its parameters.
Service Access Point:	A Service Access Point is a data interface between two layers on one component (mobile station or infrastructure).

2 Overview

The Protocol Stacks are used to define the functionality of the GSM protocols for interfaces. The GSM specifications are normative when used to describe the functionality of interfaces, but the stacks and the subdivision of protocol layers does not imply or restrict any implementation.

The protocol stack for fax and data transmission consists of several entities. Each entity has one ore more service access points, over which the entity provides a service for the upper entity. The entity, which is described in this document, is coloured grey in the following figure :

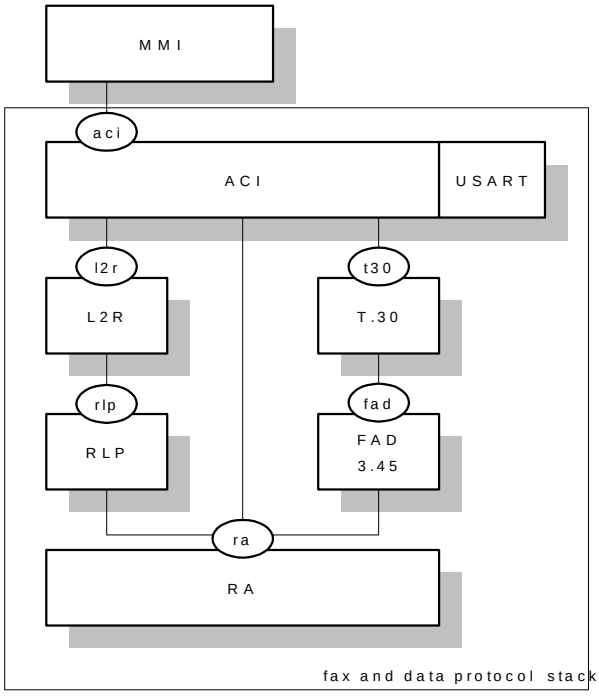


Figure 2-1: Architecture of the fax and data protocol stack

The information units passed via the SAPs are called primitives and consists of an operation code and several parameters. See the Users Guide for details.

The entities of the fax and data protocol stack are:

2.1 RA - Rate Adaptation

This entity performs an adaptation between an asynchronous or synchronous data stream with several bit rates on to the fixed bit rate used at the TCH. This is performed by the rate adaptation functions RA1' and RA0 described in GSM 04.21.

2.2 RLP - Radio Link Protocol

This entity provides a Layer 2 protocol for asynchronous reliable data transfer as specified in GSM 04.22. It includes error correction, sequence numbers and a mechanism for repeating corrupted and lost messages.

2.3 L2R - Layer 2 Relay Functionality

The L2R provides relay functions in order to adapt the character-oriented data received from the TE via USART to the bit-oriented RLP protocol.

2.4 FAD 03.45 - Fax Adaptation Protocol

The fax adaptation protocol, as specified in GSM 03.45, provides synchronisation with the BCS and MSG modems of the peer entity. It uses byte repetition in conjunction with a voting algorithm to handle corruption on the TCH data stream. The non-transparent fax protocol in accordance with GSM 03.46 is not part of this implementation.

The fax adapter enables T.30 to send BCS at 300 BPS and T.4 MSG in 2400, 4800, 7200 and 9600 BPS.

2.5 T.30 - Fax Protocol Entity

The protocol uses binary coded signals packed in HDLC frames to set up and release a connection in the message phase of the FAX transmission. This entity is specified in the ITU-T.30. The main tasks of this unit are:

- Building the HDLC frames with CRC.
- Performing bit stuffing/de-stuffing.
- Executing a sequence of 5 phases: 1.) set up, 2.) pre-message procedures, 3.) transmission/reception, 4.) post message procedures, 5.) waiting for call release.

2.6 ACI - AT Command Interpreter

The ACI is specified in GSM 07.07. It is responsible for call establishment via the GSM voice protocol stack and terminal adaptation for asynchronous transparent character-oriented data transmission. The ACI is able to receive AT commands and send the replies over the USART driver to a remote PC. This makes it possible to control the voice and data protocol stack from a remote application running on a PC. The ACI also provides a unique interface for an internal MMI in the MS.

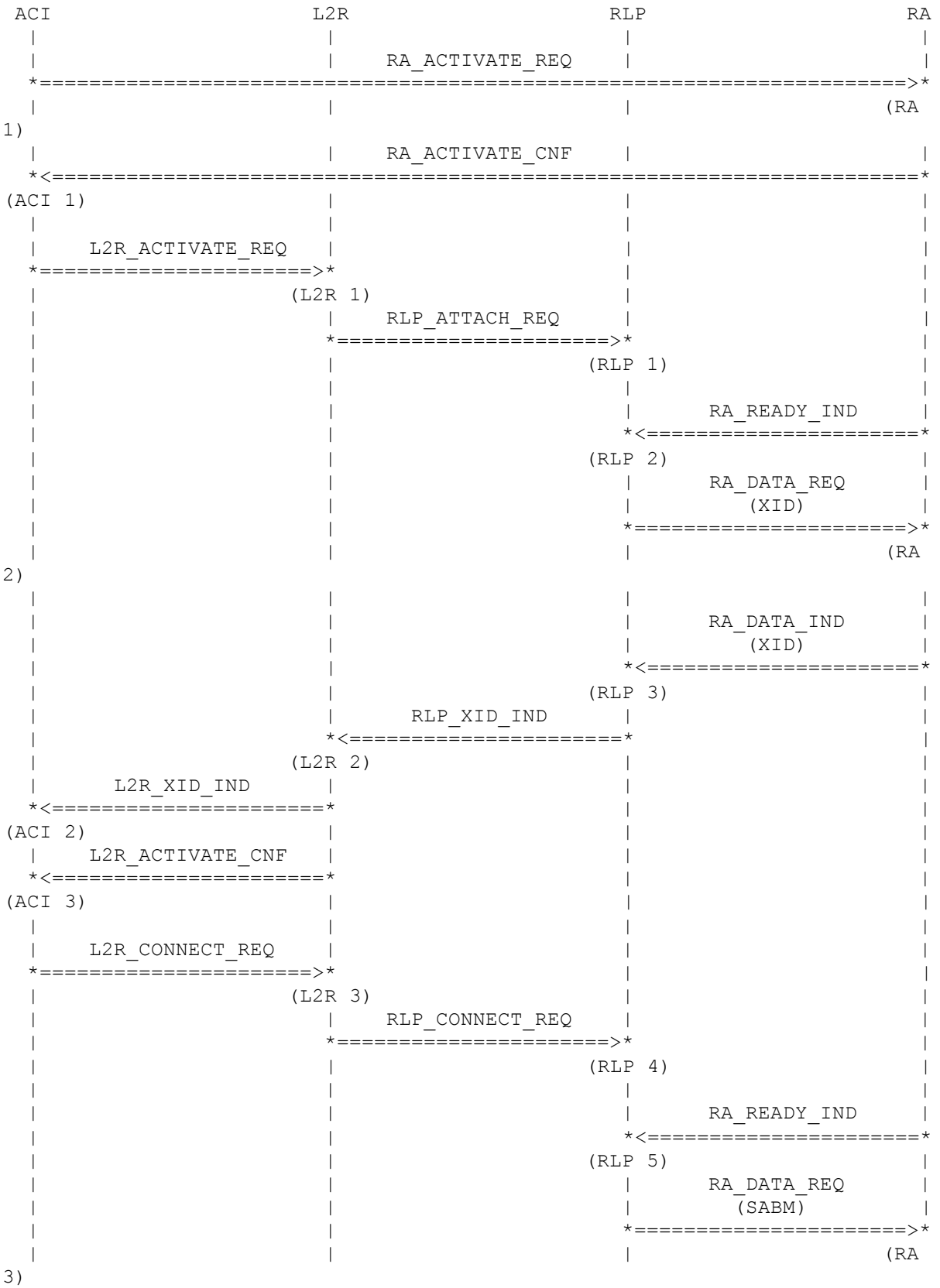
2.7 USART - Universal Synchronous Asynchronous Receiver Transmitter Driver

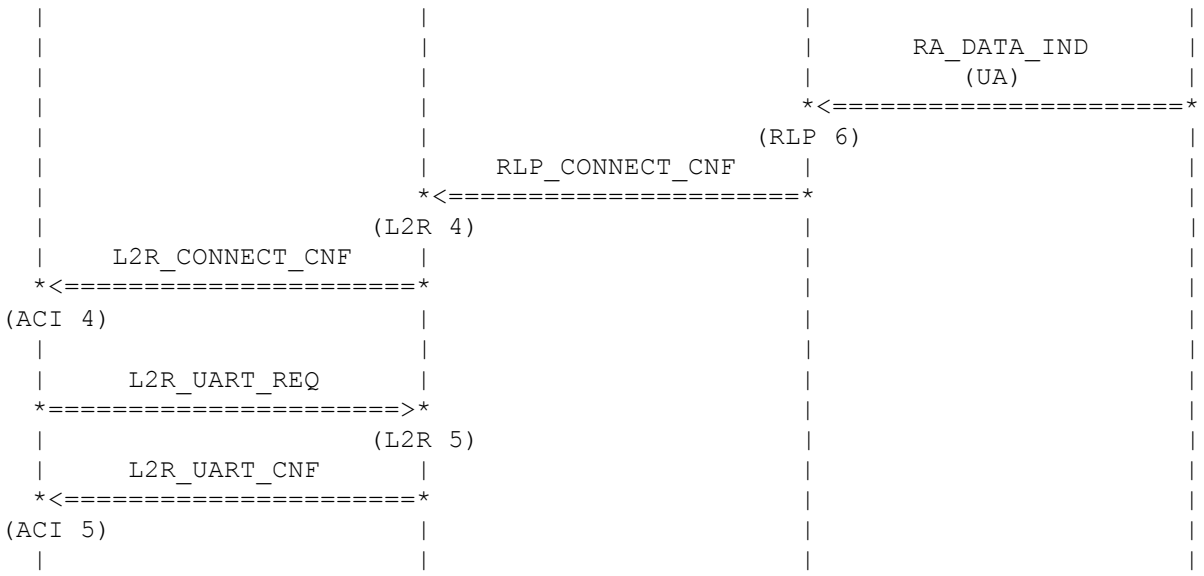
The USART is a hardware component that facilitates a connection between the mobile station and terminal equipment (e.g. a PC). This interface uses some of the circuits described in V.24.

The data exchange provided by this unit is serial and asynchronous (synchronous communication is not in the scope of this document). A driver that uses interrupts to manage a circular buffer for the sending and receiving direction is necessary in order to use this component in the F&D. The driver has to be able to perform flow control.

3 Message Sequence Charts

3.1 Mobile Originated Activate and Connect





(RA 1)
ACI initialises and activates RA. This must always be the first step before using Fax & Data Services.

(ACI 1)
RA acknowledges the RA_ACTIVATE_REQ by a RA_ACTIVATE_CNF.

(L2R 1)
ACI initialises and activates L2R.

(RLP 1)
RLP is initialised and switched into the ADM and attached mode.

(RLP 2)
RLP receives the indication, that a frame can be sent.

(RA 2)
RLP sends the Parameter, which shall be negotiated.

(RLP 3)
RLP receives the response of the base station containing the negotiated parameters.

(L2R 2)
L2R receives the parameters. The data compression parameters are further used for the data compression function.

(ACI 2)
The negotiated Parameters are passed to ACI, where they may be made available for the user.

(ACI 3)
The L2R_ACTIVATE_CNF is an acknowledgement for the previous L2R_ACTIVATE_REQ. ACI should wait for this reply before connecting with a L2R_CONNECT_REQ. A timeout is not required, since a timeout is implemented in RLP already, which generates an error indication, when no response of the base station is received.

(L2R 3)
After receiving the L2R_ACTIVATE_CNF ACI requests L2R to connect to its peer entity.

(RLP 4)
Now RLP in turn is requested to connect to its peer.

(RLP 5)
RLP receives the indication, that a frame can be sent.

(RA 3)
RLP sends a SABM command, by which it wants to switch the layer into ABM mode.

(RLP 6)
The base station sends an UA command, which is an acknowledgement for the SABM command.

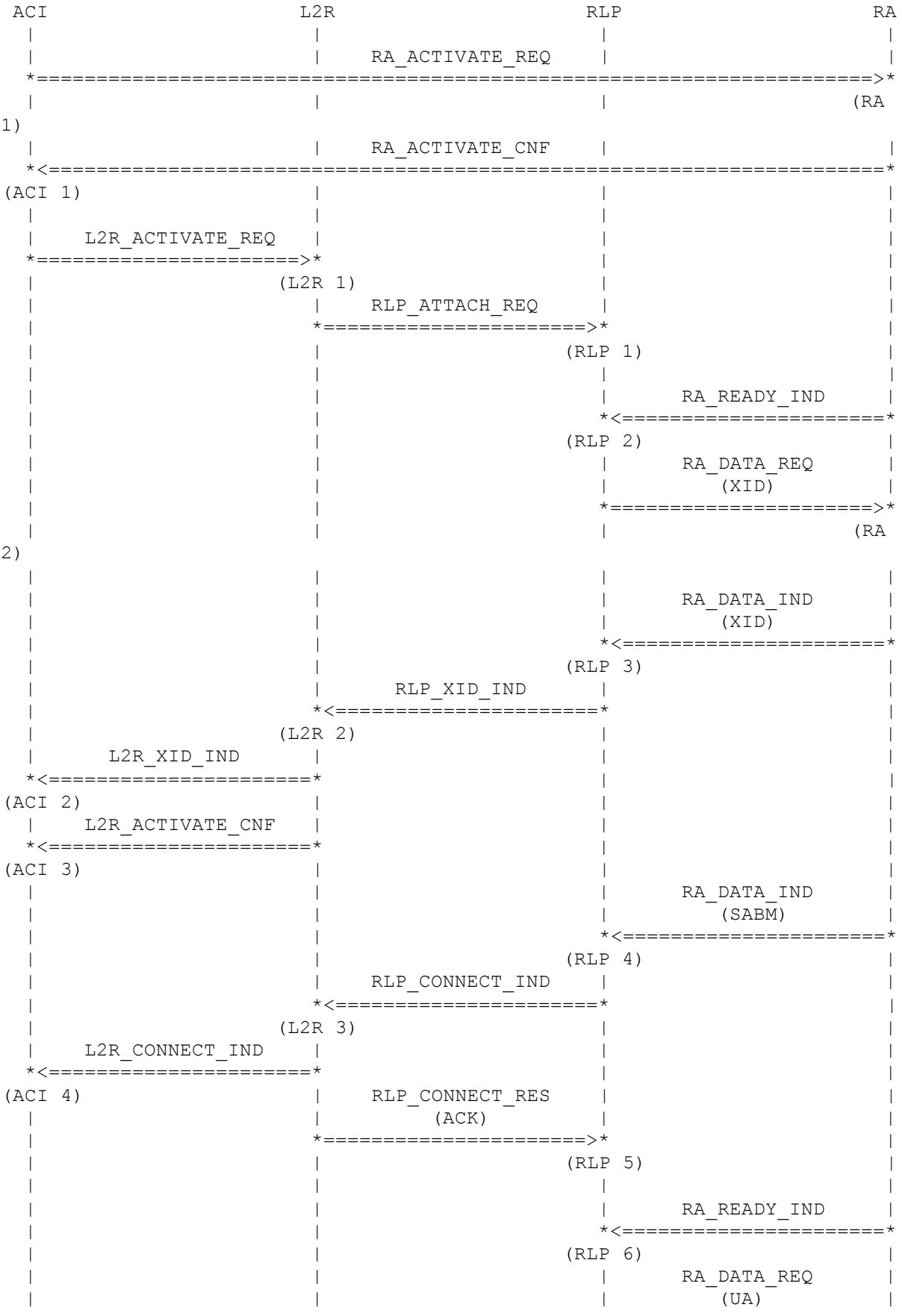
(L2R 4)
RLP confirms the RLP_CONNECT_REQ to L2R.

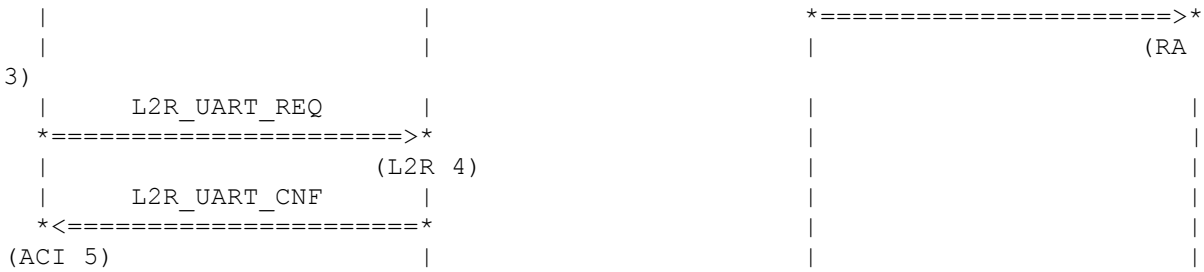
(ACI 4)
L2R in turn confirms the connection establishment to ACI.

(L2R 5)
ACI passes the control of the UART to L2R by a L2R_UART_REQ.

(ACI 5)
L2R acknowledges the L2R_UART_REQ by a L2R_UART_CNF and confirms, that now data can be sent and received via the UART.

3.2 Mobile Terminated Connect





(RA 1)
ACI initialises and activates RA. This must always be the first step before using Fax & Data Services.

(ACI 1)
RA acknowledges the RA_ACTIVATE_REQ by a RA_ACTIVATE_CNF.

(L2R 1)
ACI initialises and activates L2R.

(RLP 1)
RLP is initialised and switched into the ADM and attached mode.

(RLP 2)
RLP receives the indication, that a frame can be sent.

(RA 2)
RLP sends the Parameter, which shall be negotiated.

(RLP 3)
RLP receives the response of the base station containing the negotiated parameters.

(L2R 2)
L2R receives the parameters. The data compression parameters are further used for the data compression function.

(ACI 2)
The negotiated Parameters are passed to ACI, where they may be made available for the user.

(ACI 3)
The L2R_ACTIVATE_CNF is an acknowledgement for the previous L2R_ACTIVATE_REQ.

(RLP 4)
RLP receives a SABM command from the base station.

(L2R 3)
RLP indicates to L2R, that the base station wants to connect. If RLP is not attached (i.e. it is in the ADM and detached mode), it would just ignore the SABM command.

(ACI 4)
L2R in turn indicates to ACI that the base station wants to connect.

(RLP 5)
L2R acknowledges the RLP_CONNECT_IND by a RLP_CONNECT_RES.

(RLP 6)
RLP receives the indication, that a frame can be sent.

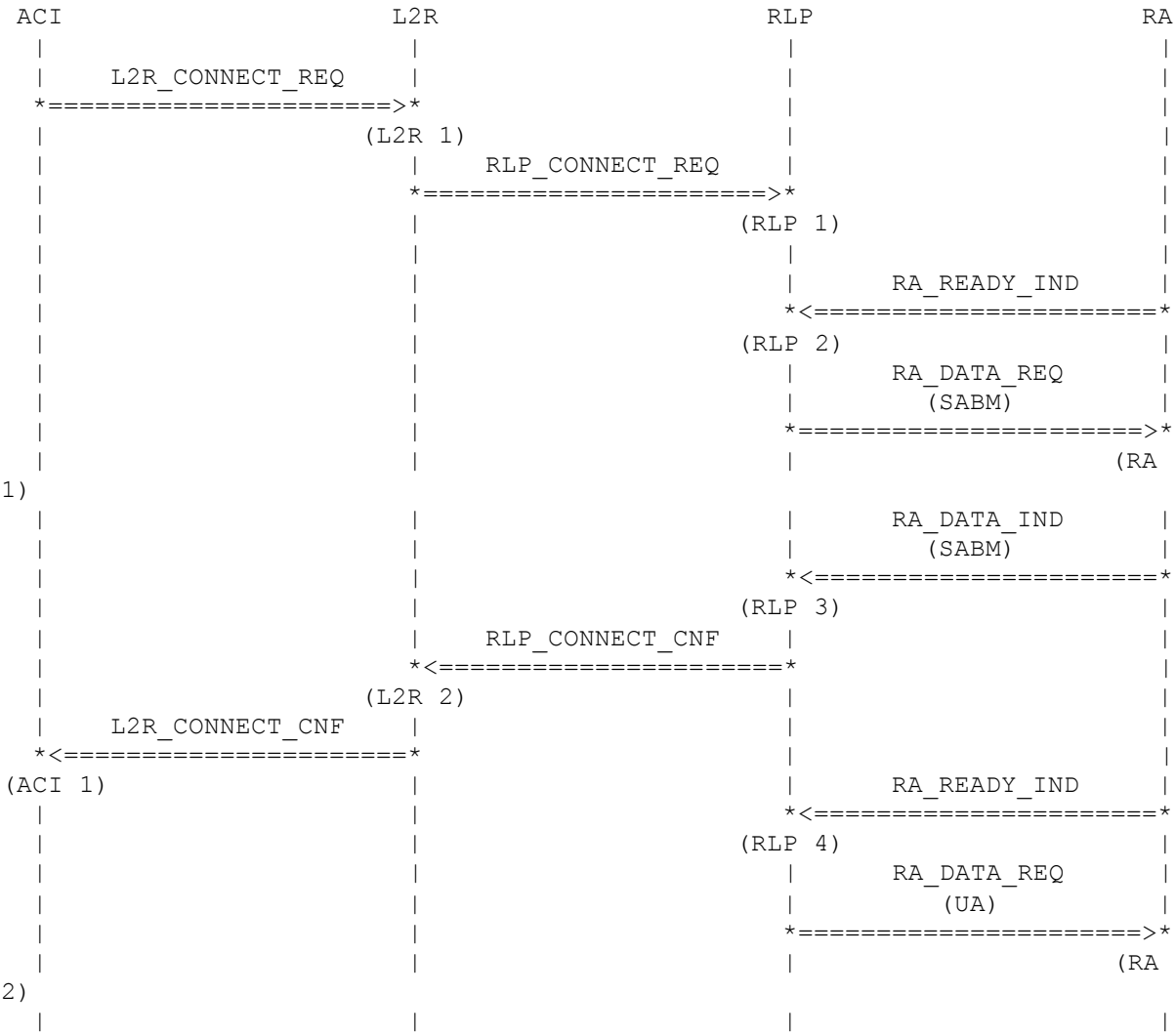
(RA 3)
RLP acknowledges the SABM command by a UA response to the base station.

(L2R 4)
ACI passes the control of the UART to L2R by a L2R_UART_REQ.

(ACI 5)
L2R acknowledges the L2R_UART_REQ by a L2R_UART_CNF and confirms, that now data can be sent and received via the UART.

3.3 Collisions of both sides connection establishment

3.3.1 Case 1: Collision on physical layer



(L2R 1)
ACI requests L2R to connect to its peer.

(RLP 1)
RLP in turn is requested to connect to its peer.

(RLP 2)
RLP receives the indication, that a frame can be sent.

(RA 1)
RLP sends a SABM command, by which it wants to switch the layer into ABM mode.

(RLP 3)
The base station has sent a SABM command already on its own. In fact this message has been sent by the base station before receiving the SABM of the mobile.

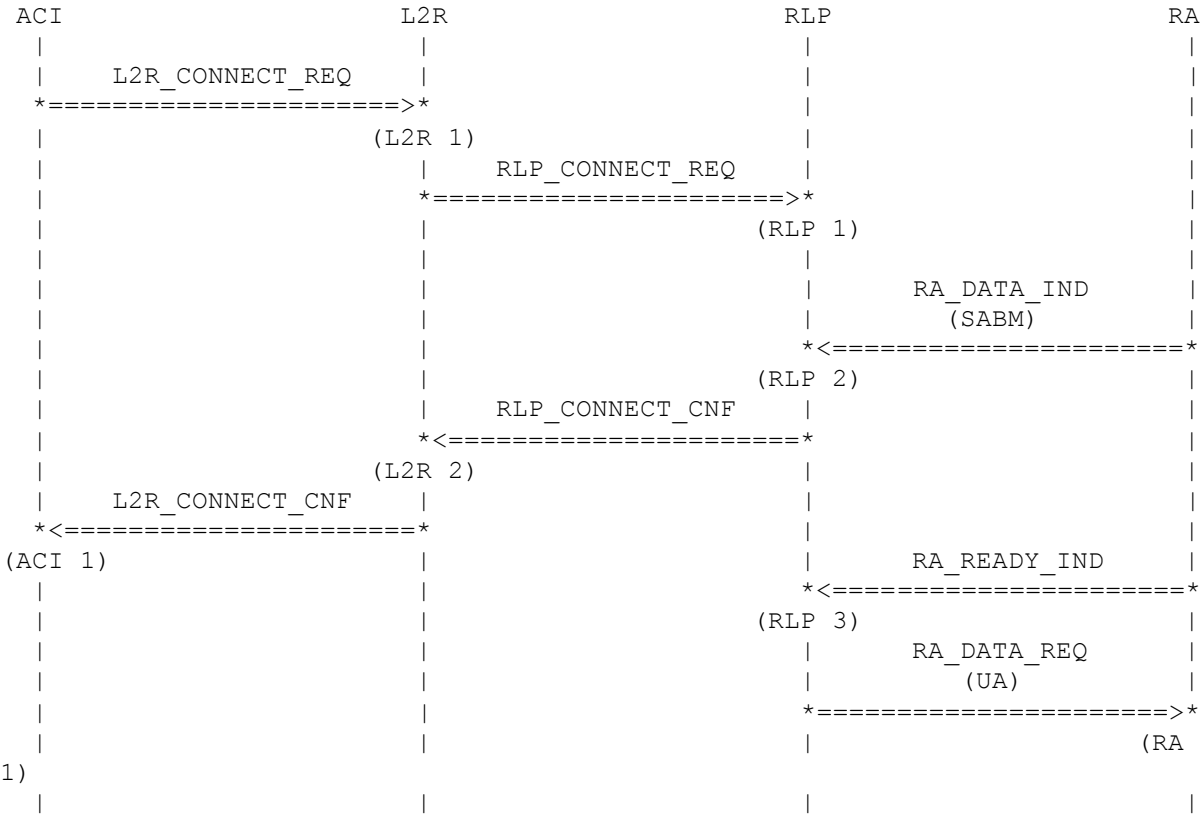
(L2R 2)
RLP confirms the RLP_CONNECT_REQ to L2R.

(ACI 1)
L2R in turn confirms the connection establishment to ACI.

(RLP 4)
RLP receives the indication, that a frame can be sent.

(RA 2)
RLP acknowledges the SABM command of the base station by a UA response.

3.3.2 Case 2: Collision in RLP



(L2R 1)
ACI requests L2R to connect to its peer.

(RLP 1)
RLP in turn is requested to connect to its peer.

(RLP 2)
The base station has sent a SABM command already on its own.

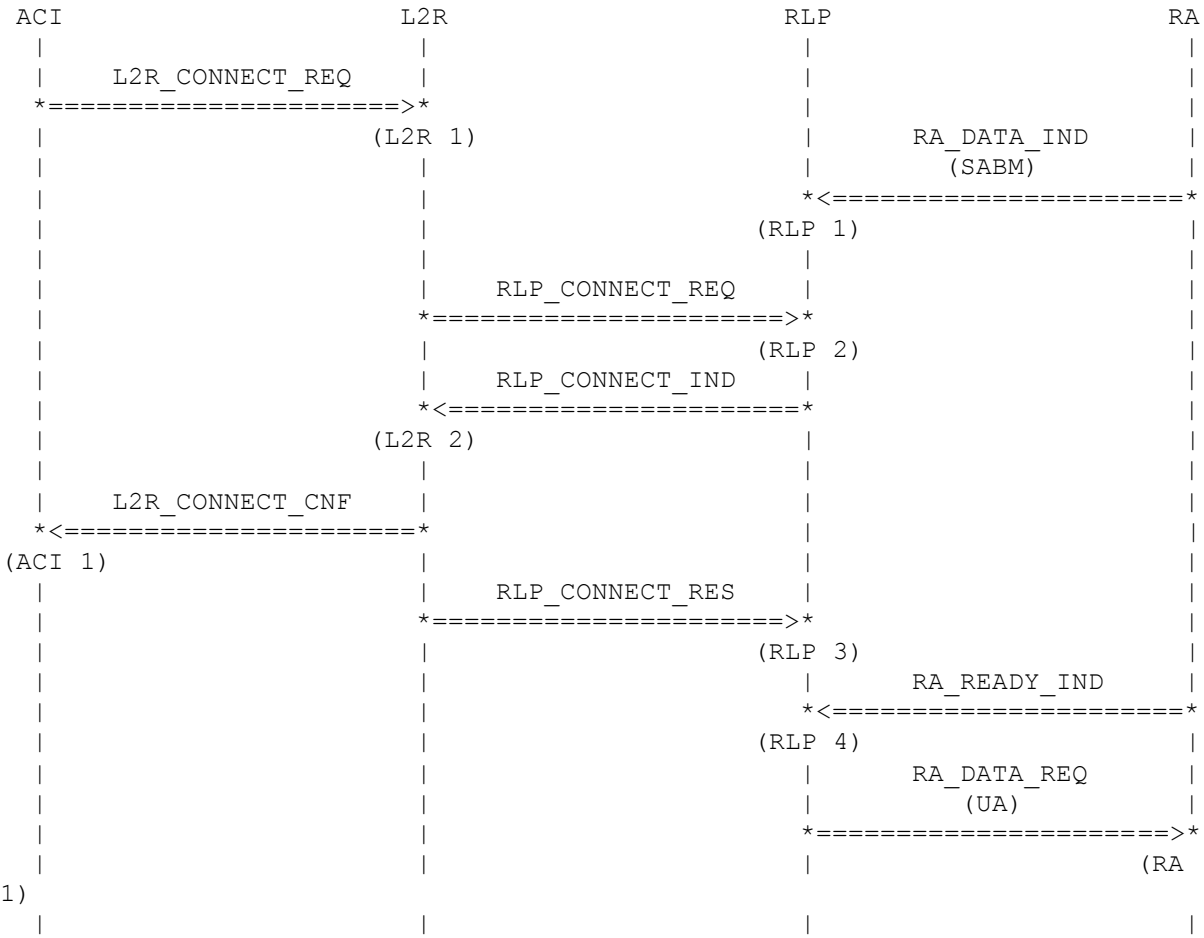
(L2R 2)
RLP confirms the RLP_CONNECT_REQ to L2R.

(ACI 1)
L2R in turn confirms the connection establishment to ACI.

(RLP 3)
RLP receives the indication, that a frame can be sent.

(RA 1)
RLP acknowledges the SABM command of the base station by a UA response.

3.3.3 Case 3: Collision between L2R and RLP



(L2R 1)
ACI requests L2R to connect to its peer.

(RLP 1)
The base station sends a SABM command on its own.

(RLP 2)
RLP is requested to connect to its peer.

(L2R 2)
RLP indicates that the base station wants to connect. In fact this message is sent before the RLP_CONNECT_REQ is received by RLP

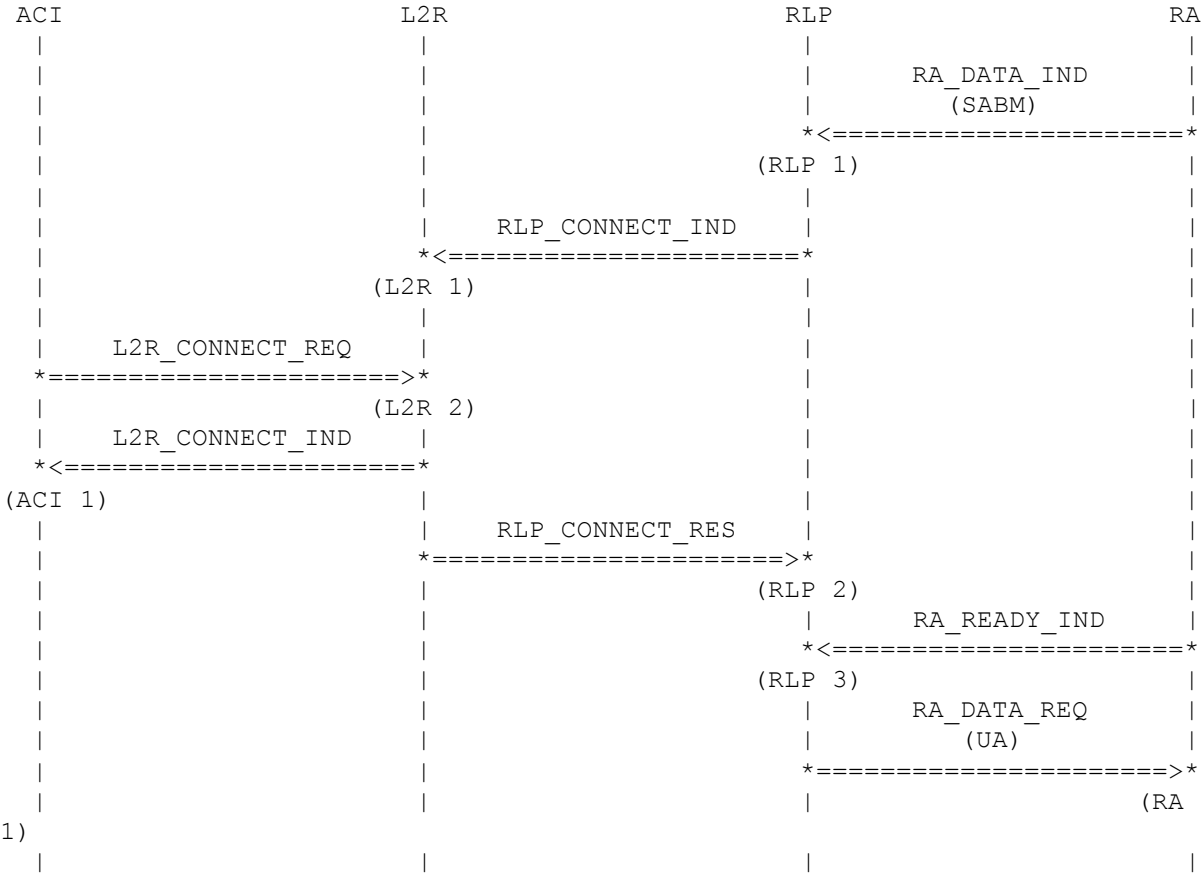
(ACI 1)
L2R confirms the connection establishment to ACI.

(RLP 3)
L2R acknowledges the RLP_CONNECT_REQ.

(RLP 4)
RLP receives the indication, that a frame can be sent.

(RA 1)
RLP acknowledges the SABM command of the base station by a UA response.

3.3.4 Case 4: Collision between ACI and L2R



(RLP 1)
The base station sends a SABM command.

(L2R 1)
RLP indicates that the base station wants to connect.

(L2R 2)
ACI requests L2R to connect to its peer.

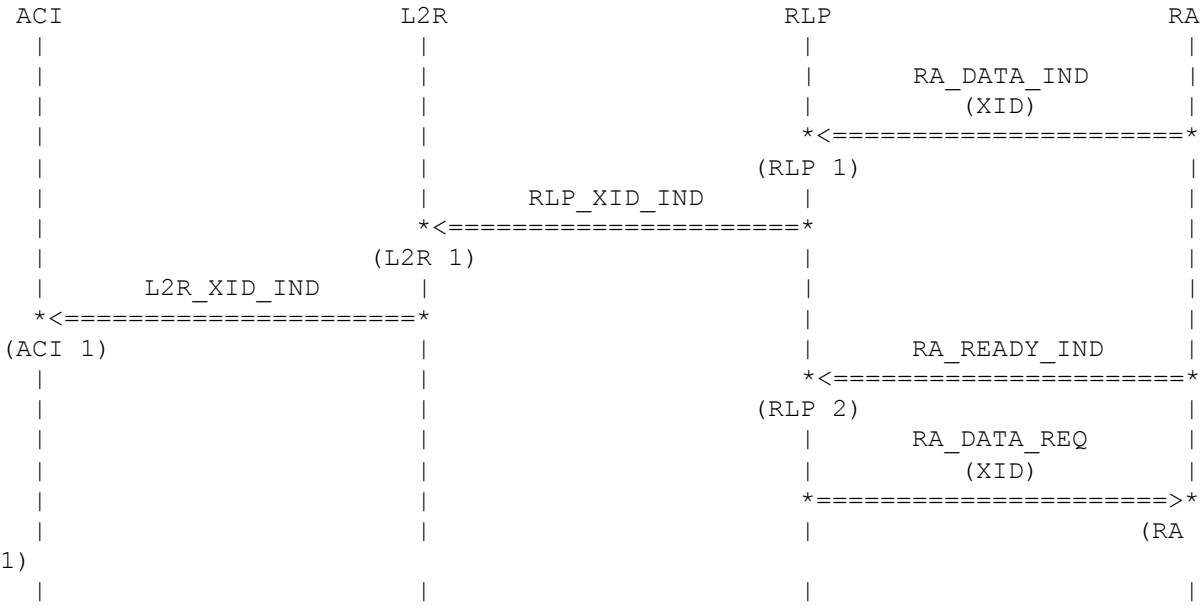
(ACI 1)
L2R indicates, that the base station wants to connect. In fact this message is sent before the L2R_CONNECT_REQ is received by L2R.

(RLP 2)
L2R acknowledges the RLP_CONNECT_REQ.

(RLP 3)
RLP receives the indication, that a frame can be sent.

(RA 1)
RLP acknowledges the SABM command of the base station by a UA response.

3.4 Mobile Terminated Parameter Negotiation



(RLP 1)
RLP receives a XID command

(L2R 1)
RLP determines the resulting parameter values and passes them to L2R. L2R uses the data compression parameters.

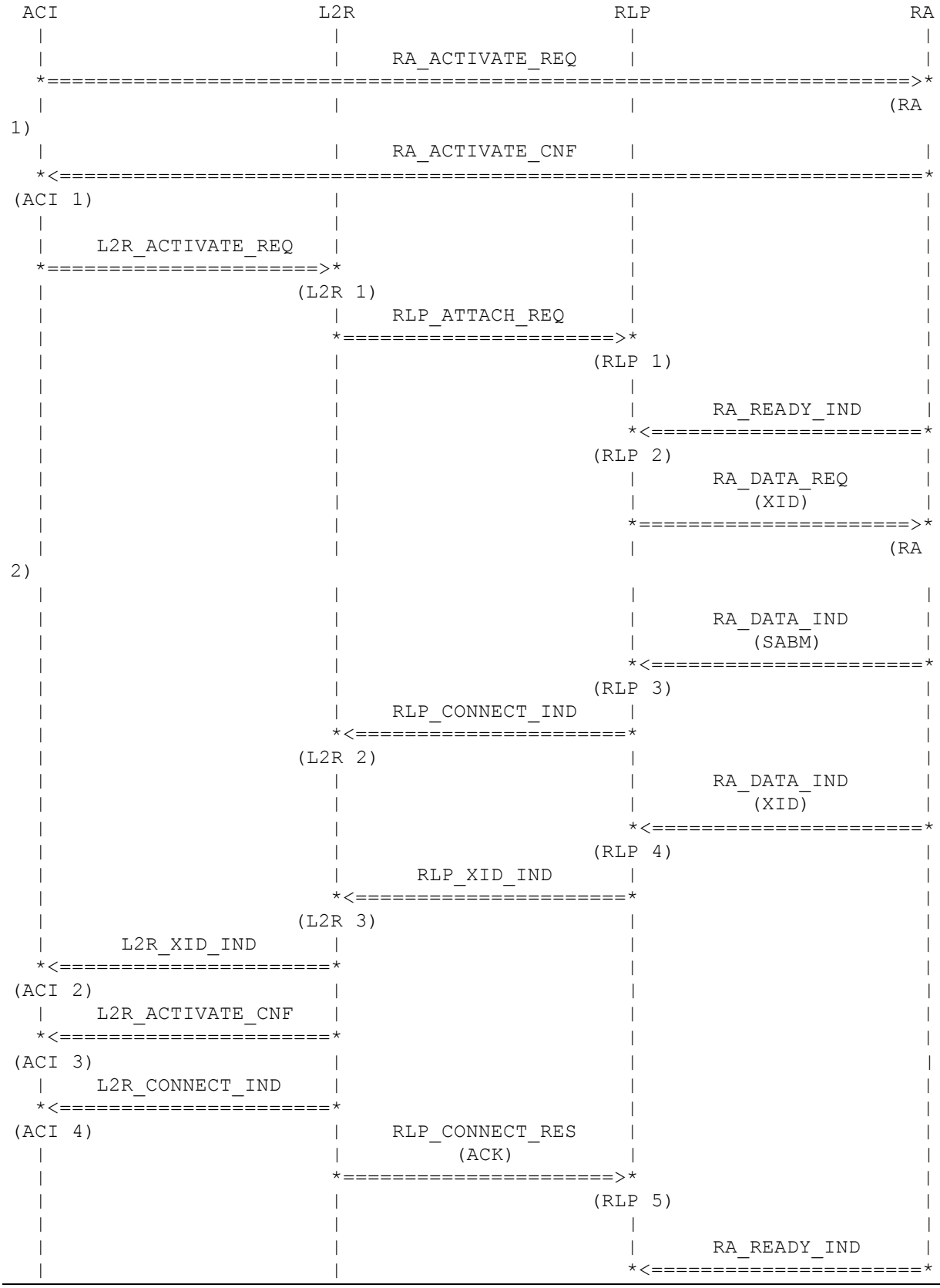
(ACI 1)
L2R passes the negotiated parameters to ACI, where they may be made available for the user.

(RLP 2)
RLP receives the indication, that a frame can be sent.

(RA 1)
RLP sends an XID response, by which the resulting negotiated parameters are passed to the base station.

3.5 Collisions of parameter negotiation and connection establishment

3.5.1 Case 1: SABM is received after sending XID



(RA 1)
ACI initialises and activates RA.

(ACI 1)
RA acknowledges the RA_ACTIVATE_REQ by a RA_ACTIVATE_CNF.

(L2R 1)
ACI initialises and activates L2R.

(RLP 1)
RLP is initialised and switched into the ADM and attached mode.

(RLP 2)
RLP receives the indication, that a frame can be sent.

(RA 2)
RLP sends the Parameter, which shall be negotiated.

(RLP 3)
Instead of the negotiated parameters RLP receives a SABM command from the base station.

(L2R 2)
RLP indicates to L2R, that the base station wants to connect. But L2R delays the corresponding L2R_CONNECT_IND until the parameter negotiation has been finished.

(RLP 4)
RLP receives the negotiated parameters from the base station.

(L2R 3)
The parameters are handed over to L2R.

(ACI 2)
The negotiated Parameters are passed to ACI.

(ACI 3)
The L2R_ACTIVATE_CNF is an acknowledgement for the previous L2R_ACTIVATE_REQ.

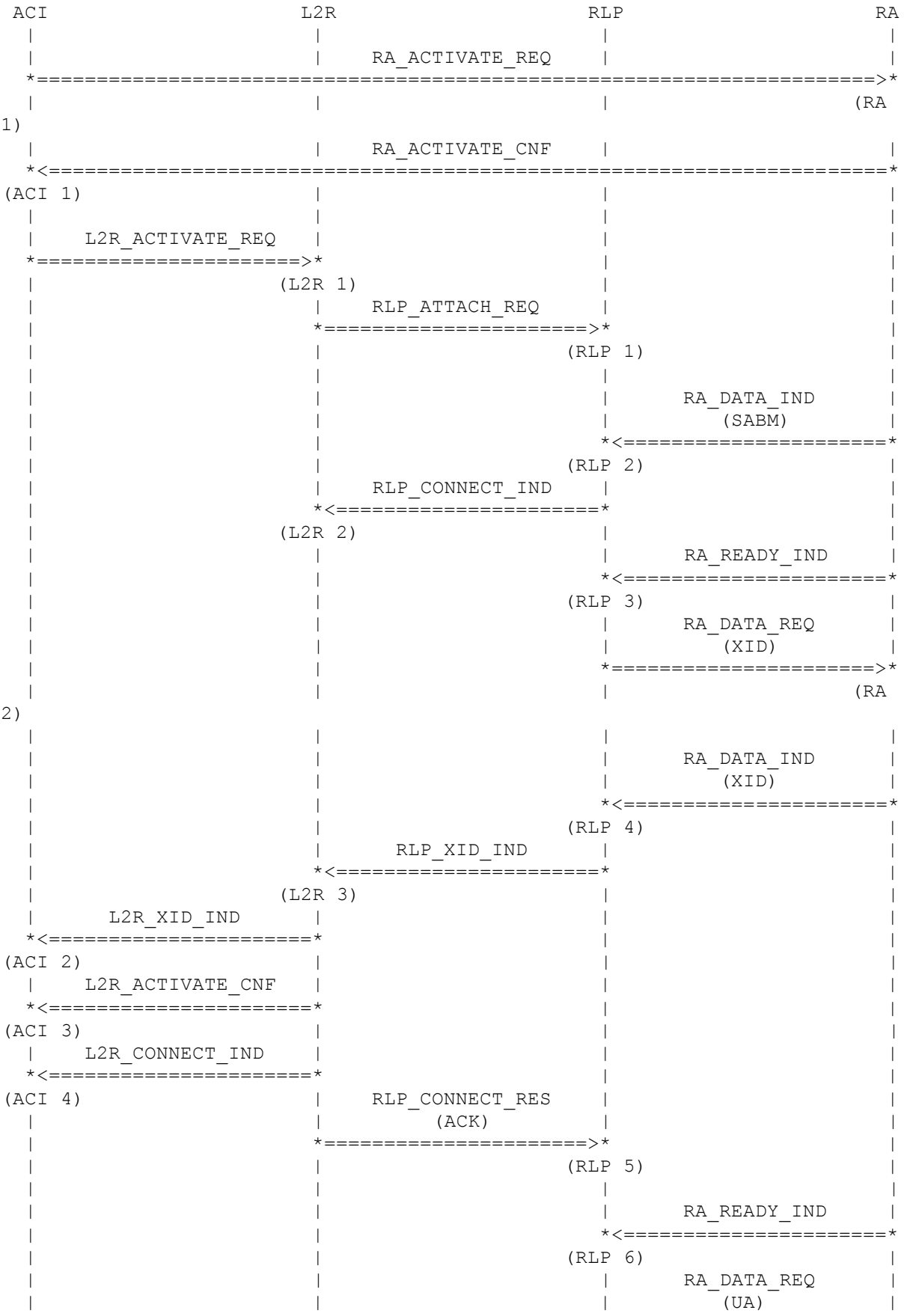
(ACI 4)
Now L2R indicates to ACI that the base station wants to connect.

(RLP 5)
L2R acknowledges the previous RLP_CONNECT_IND by a RLP_CONNECT_RES.

(RLP 6)
RLP receives the indication, that a frame can be sent.

(RA 3)
RLP acknowledges the SABM command by a UA response to the base station.

3.5.2 Case 2: SABM is received before sending XID



```
   |                          |                          *======================>*
   |                          |                          |                    (RA
3)
```

(RA 1)
ACI initialises and activates RA.

(ACI 1)
RA acknowledges the RA_ACTIVATE_REQ by a RA_ACTIVATE_CNF.

(L2R 1)
ACI initialises and activates L2R.

(RLP 1)
RLP is initialised and switched into the ADM and attached mode.

(RLP 2)
RLP receives a SABM command from the base station before it can send the XID command.

(L2R 2)
RLP indicates to L2R, that the base station wants to connect. But L2R delays the corresponding L2R_CONNECT_IND until the parameter negotiation has been finished.

(RLP 3)
RLP receives the indication, that a frame can be sent.

(RA 2)
RLP sends the Parameter, which shall be negotiated.

(RLP 4)
RLP receives the negotiated parameters from the base station.

(L2R 3)
The parameters are handed over to L2R.

(ACI 2)
The negotiated Parameters are passed to ACI.

(ACI 3)
The L2R_ACTIVATE_CNF is an acknowledgement for the previous L2R_ACTIVATE_REQ.

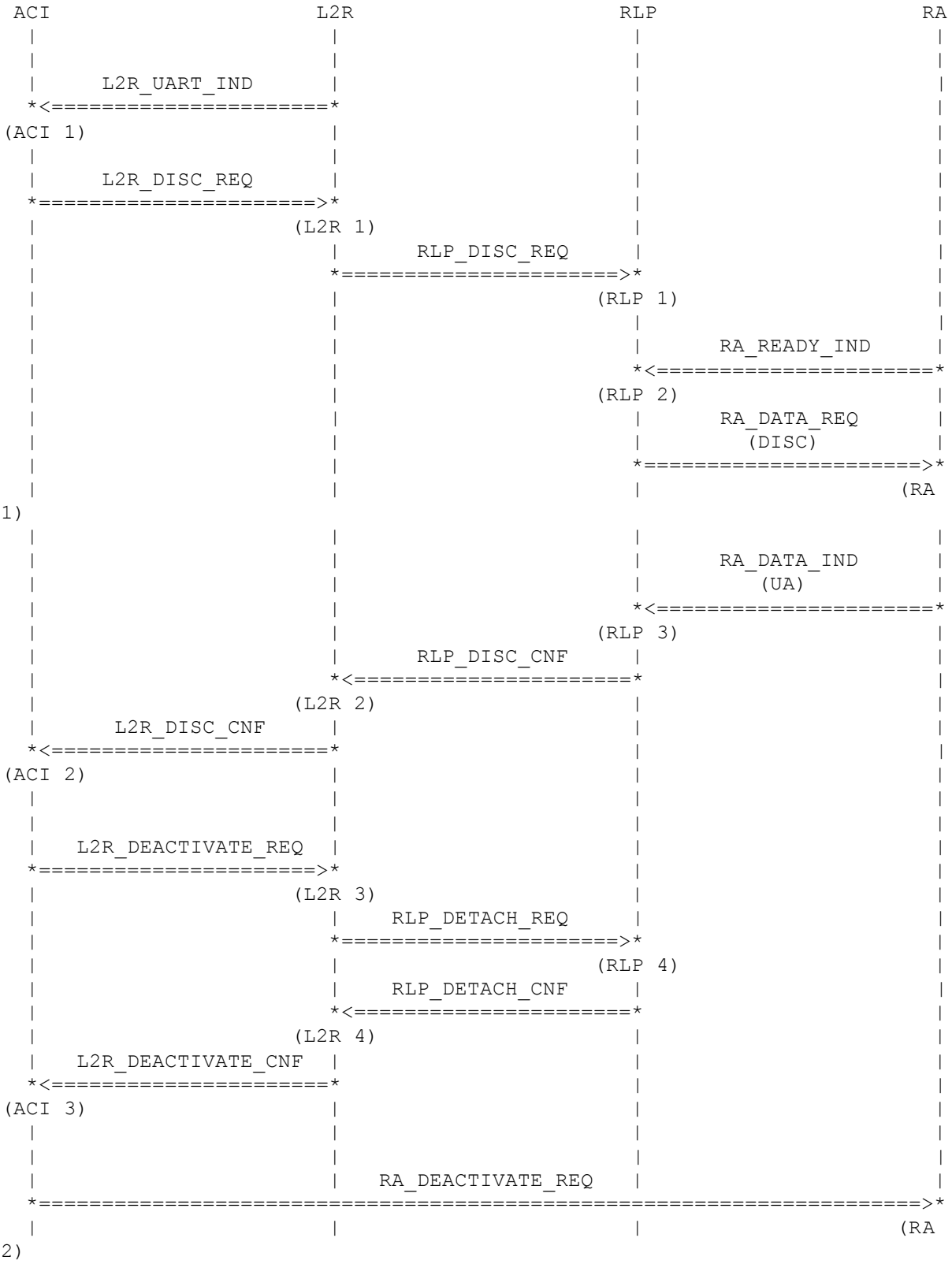
(ACI 4)
Now L2R indicates to ACI that the base station wants to connect.

(RLP 5)
L2R acknowledges the previous RLP_CONNECT_IND by a RLP_CONNECT_RES.

(RLP 6)
RLP receives the indication, that a frame can be sent.

(RA 3)
RLP acknowledges the SABM command by a UA response to the base station.

3.6 Mobile Originated Disconnect and Detach



(ACI 1)
L2R indicates that the user has entered the ESCAPE seqeunce ('+++'). The control of the UART is passed back to the ACI

(L2R 1)
ACI requests L2R to disconnect. This occurs usually, when the user has entered the 'ATH' command.

(RLP 1)
L2R in turn requests RLP to disconnect from its peer.

(RLP 2)
RLP receives the indication, that a frame can be sent.

(RA 1)
RLP sends a DISC command.

(RLP 3)
RLP receives an UA response as an acknowledgement from its peer.

(L2R 2)
RLP confirms to L2R the release of the connection.

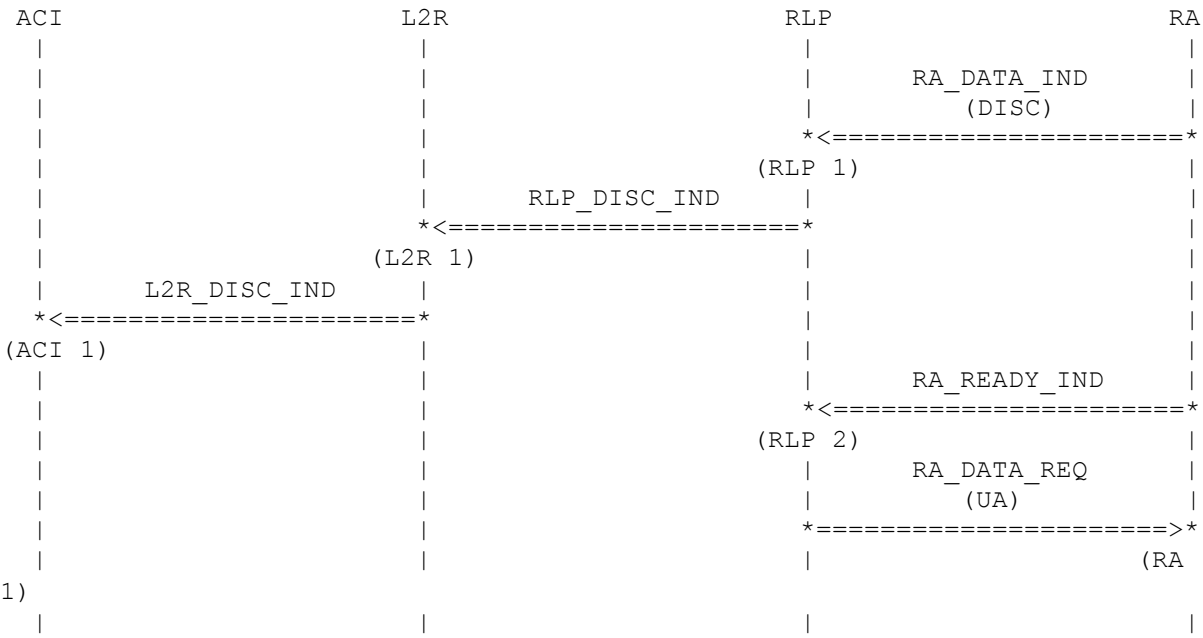
(ACI 1)
L2R in turn confirms to ACI the release of the connection. This is the acknowledgement for the previous L2R_DISC_REQ. ACI should wait for this reply before deactivating L2R and RLP with a L2R_DEACTIVATE_REQ. A timeout is not required, since a timeout is implemented in RLP already, which generates an error indication, when no response of the base station is received.

(L2R 3)
After receiving the L2R_DISC_CNF ACI deactivates L2R.

(RLP 4)
L2R in turn deactivates RLP with a RLP_DETACH_REQ. No acknowledgement is required for this primitive, since detaching is always possible without fail.

(RA 2)
ACI deactivates the RA entity. Now the traffic channel can be used by the voice stack if required.

3.7 Mobile Terminated Disconnect and Detach



(RLP 1)
RLP receives a DISC command.

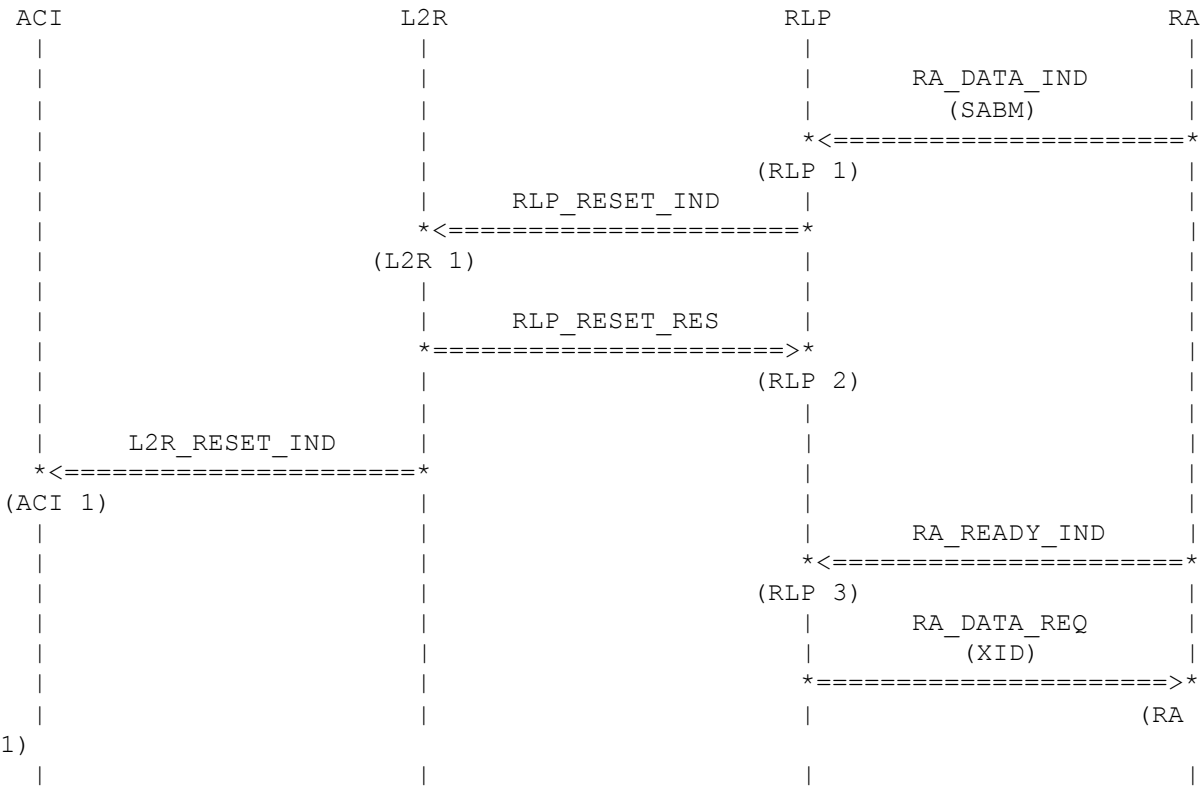
(L2R 1)
RLP indicates to L2R, that the connection will be released.

(ACI 1)
L2R in turn indicates to ACI that the connection will be released. The control of the UART is also passed to ACI, if L2R has the control. No extra L2R_UART_IND is sent in this case.

(RLP 2)
RLP receives the indication, that a frame can be sent.

(RA 1)
RLP sends an UA response, by which the DISC command is acknowledged.

3.8 Mobile Terminated Reset



(RLP 1)
The RLP receives a SABM command.

(L2R 1)
RLP indicates the request to reset to L2R.

(RLP 2)
L2R acknowledges the reset to RLP.

(ACI 1)
L2R in turn indicates to ACI that the RLP connection is reset.

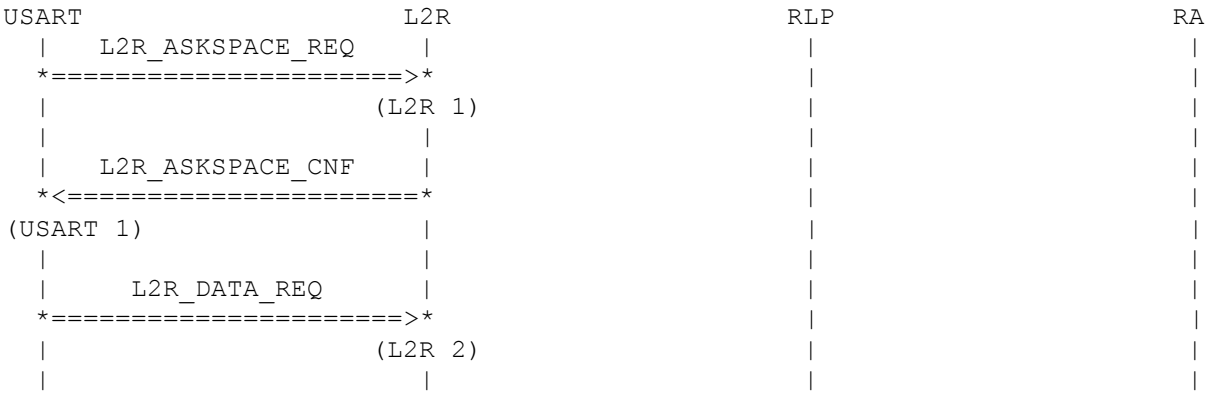
(RLP 3)
RLP receives the indication, that a frame can be sent.

(RA 1)
RLP sends an UA response. RLP resets its internal variables and is in the ABM state.

3.9 Mobile Sends Data

3.9.1 Reception of data from USART

All the primitives in this MSC are implemented as a single function call, which runs in the context of the L2R relay entity and copies data into the TX buffer of the L2R entity. Therefore these three primitives can not be interrupted by any other primitives.

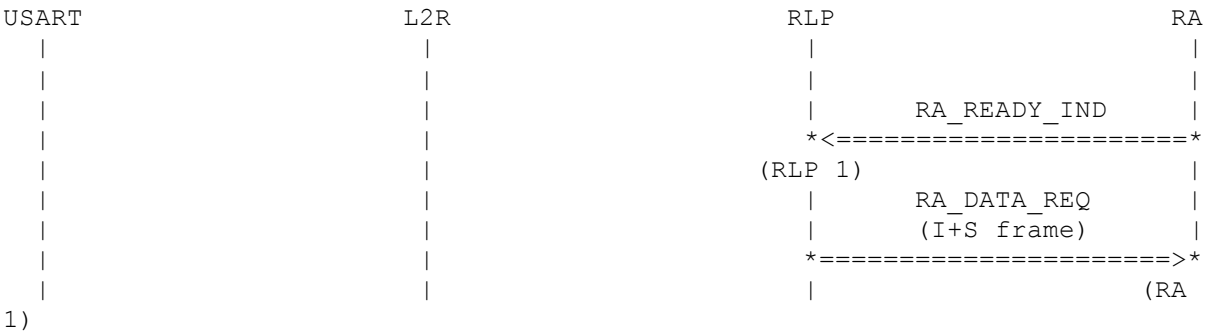


(L2R 1)
The USART asks L2R, how much space is available in the TX buffer.

(USART 1)
L2R returns the number of bytes, that may be written into the TX buffer.

(L2R 2)
The USART transfers the data to L2R.

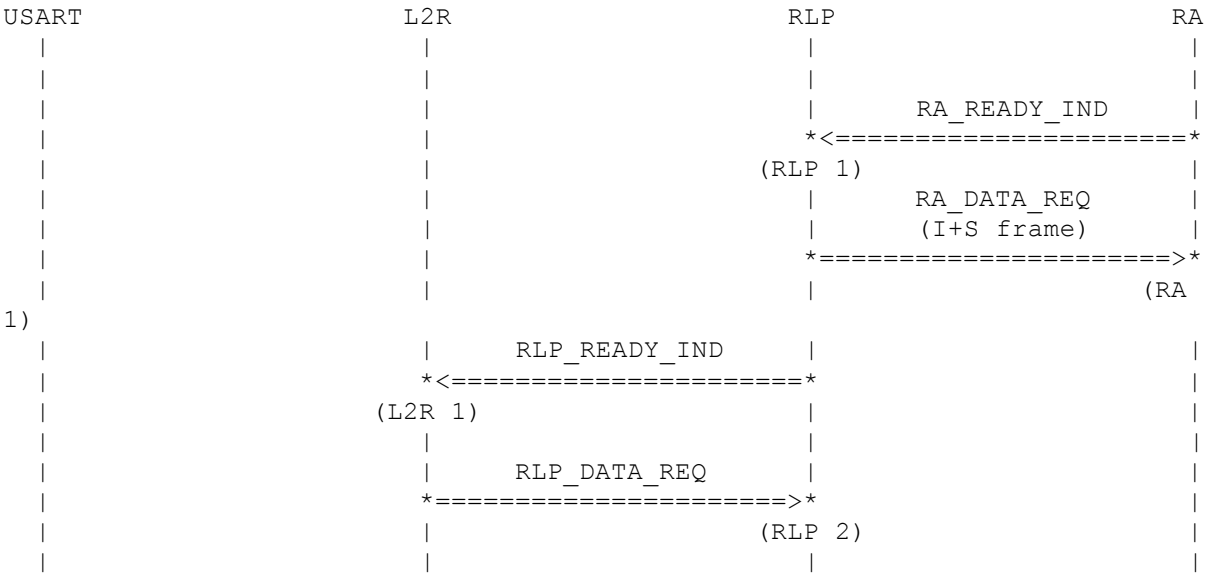
3.9.2 Data are sent by RLP, low water mark of RLP buffer is not reached



(RLP 1)
RLP receives the indication, that a frame can be sent.

(RA 1)
RLP sends one RLP frame out of the internal RLP buffer to RA. The low water mark of the RLP buffer is not reached. Therefore no indication is given to L2R.

3.9.3 Data are sent by RLP, low water mark of RLP buffer is reached, data are available in L2R TX buffer



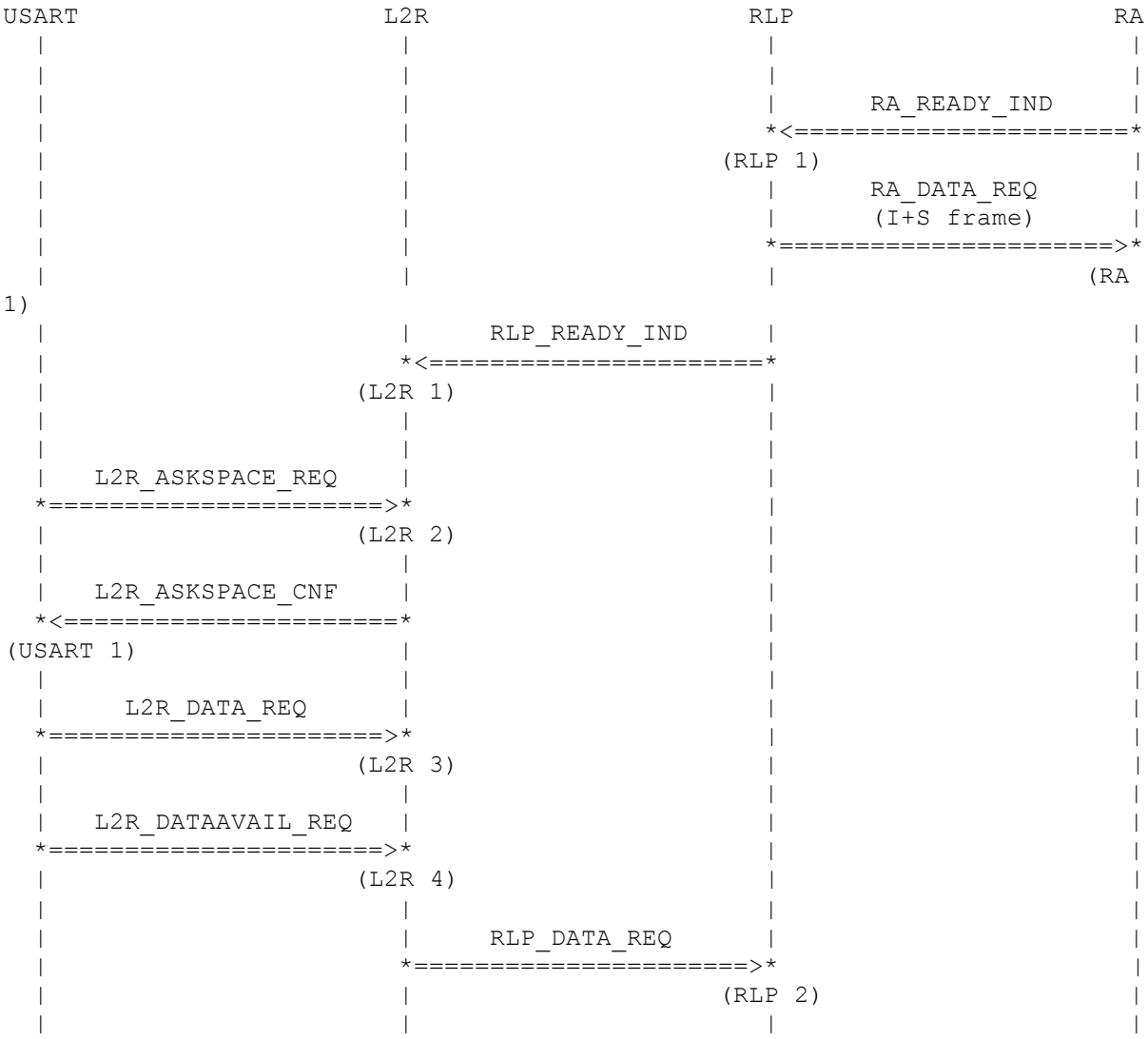
(RLP 1)
RLP receives the indication, that a frame can be sent.

(RA 1)
RLP sends one RLP frame out of the internal RLP buffer to RA. The low water mark of the RLP buffer is reached.

(L2R 1)
RLP indicates to L2R, that it is ready to receive more data from L2R. This primitive contains also the number of L2R frames that can be accepted by RLP.

(RLP 2)
There are enough data available in the TX buffer. L2R sends these data to RLP.

3.9.4 Data are sent by RLP, low water mark of RLP buffer is reached, data are available with delay



(RLP 1)
RLP receives the indication, that a frame can be sent.

(RA 1)
RLP sends one RLP frame out of the internal RLP buffer to RA. The low water mark of the RLP buffer is reached.

(L2R 1)
RLP indicates to L2R, that it is ready to receive more data from L2R. This primitive contains also the number of L2R frames that can be accepted by RLP.

(L2R 2)
The next three primitives are already covered in 3.9.1. The USART asks L2R, how much space is available in the TX buffer.

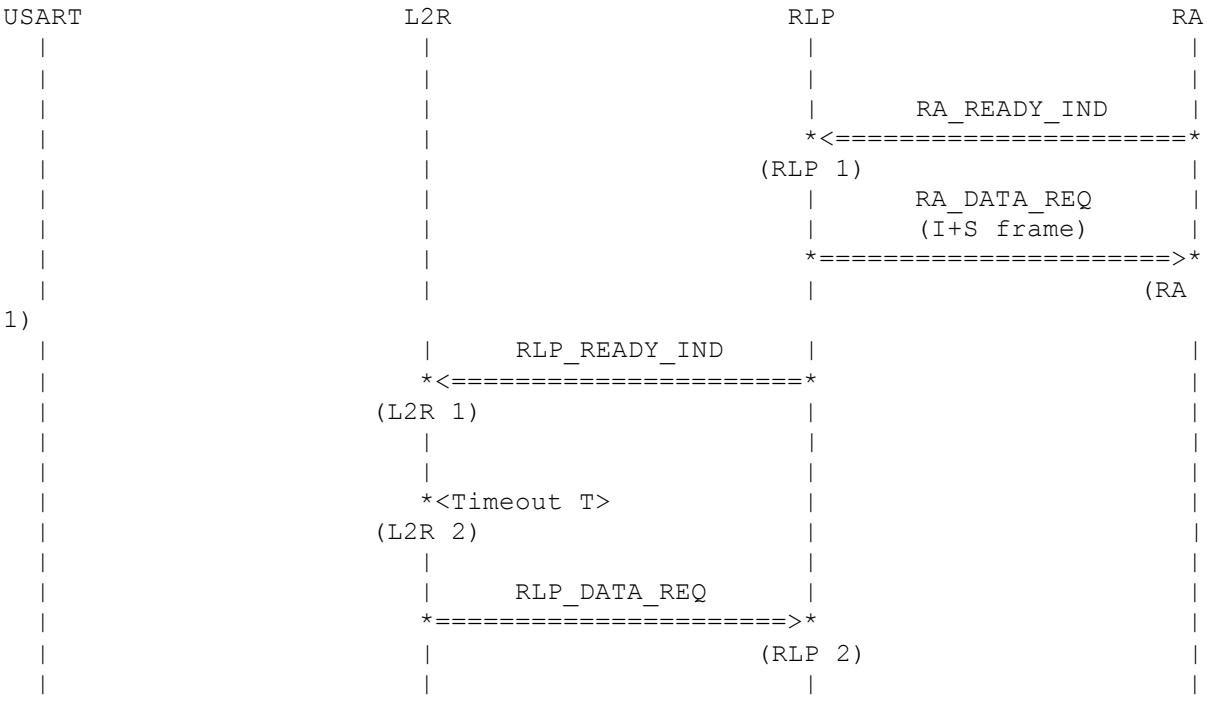
(USART 1)
L2R returns the number of bytes, that may be written into the TX buffer.

(L2R 3)
The USART transfers the data to L2R.

(L2R 4)
The USART indicates, that data are now available in the TX buffer.

(RLP 2)
L2R sends the data to RLP.

3.9.5 Data are sent by RLP, low water mark of RLP buffer is reached, data are not available in L2R TX buffer



(RLP 1)
RLP receives the indication, that a frame can be sent.

(RA 1)
RLP sends one RLP frame out of the internal RLP buffer to RA. The low water mark of the RLP buffer is reached.

(L2R 1)
RLP indicates to L2R, that it is ready to receive more data from L2R. This primitive contains also the number of L2R frames that can be accepted by RLP.

(L2R 2)
Timer T expires.

(RLP 2)
L2R sends all data, that are available, to RLP. If no data are available, an empty frame is sent.

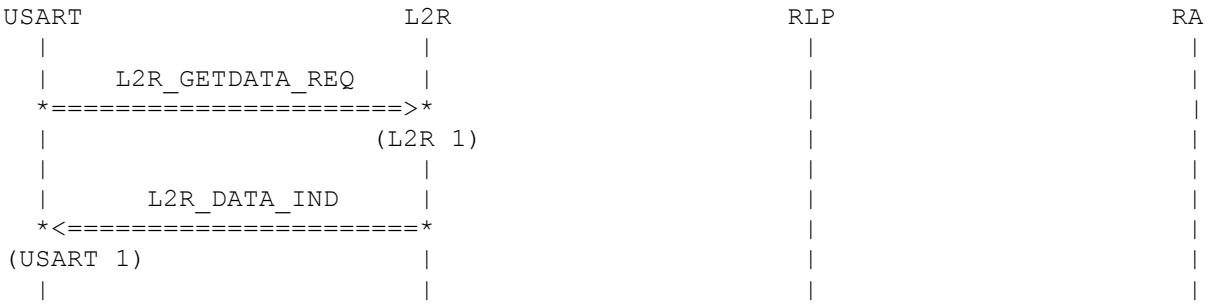
3.10 Mobile Receives Data

In all MSCs the primitives L2R_GETDATA_REQ and L2R_DATA_IND are implemented as a single function call, which runs in the context of the L2R relay entity and copies data from the TX buffer of the L2R entity. Therefore these two primitives can not be interrupted by any other primitives.

3.10.1 Data are received by RLP

(RLP 1)
RLP receives a frame from RA. The frame is stored in the receive buffer of the RLP entity. It will be delivered to L2R on request. Receiving data and reading them out of the buffer are completely independent processes.

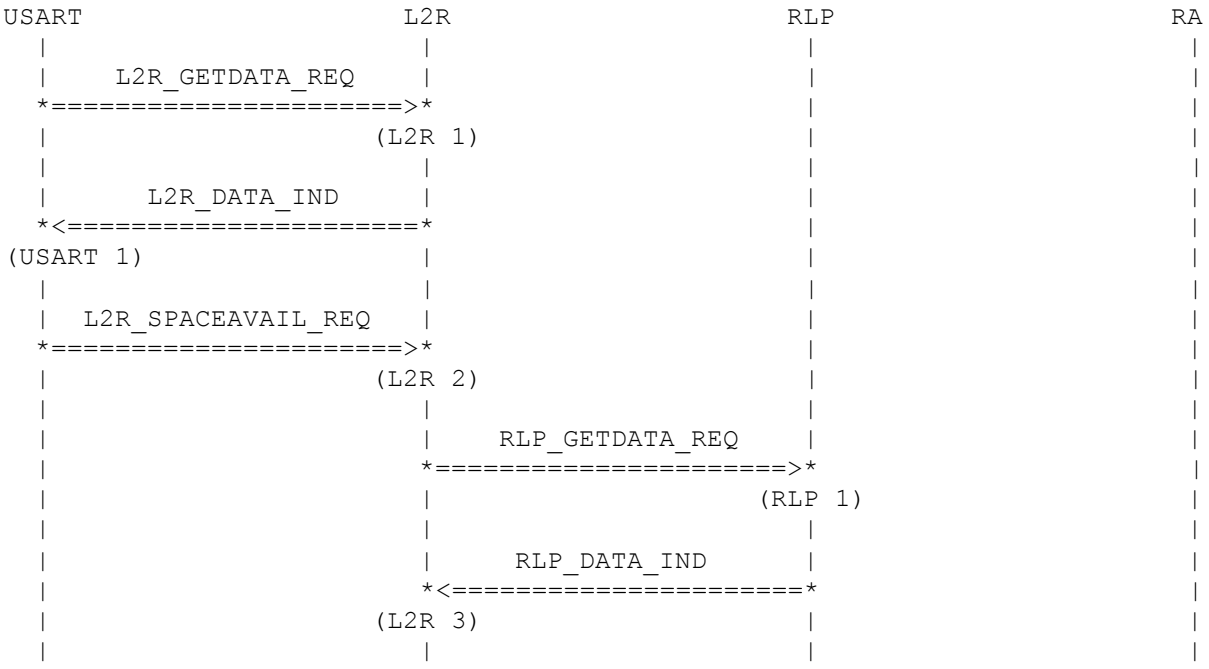
3.10.2 Data are collected by USART, low water mark of L2R RX buffer not reached



(L2R 1)
The USART requests L2R to pass data to the USART.

(USART 1)
L2R sends data to the USART. The low water mark of the L2R RX buffer has not been reached or L2R has requested RLP already to send data with a RLP_GETDATA_REQ. Therefore a L2R_SPACEAVAIL_REQ is not sent.

3.10.3 Data are collected by USART, low water mark of L2R RX buffer is reached, data are available



(L2R 1)
The USART requests L2R to pass data to the USART.

(USART 1)
L2R sends data to the USART.

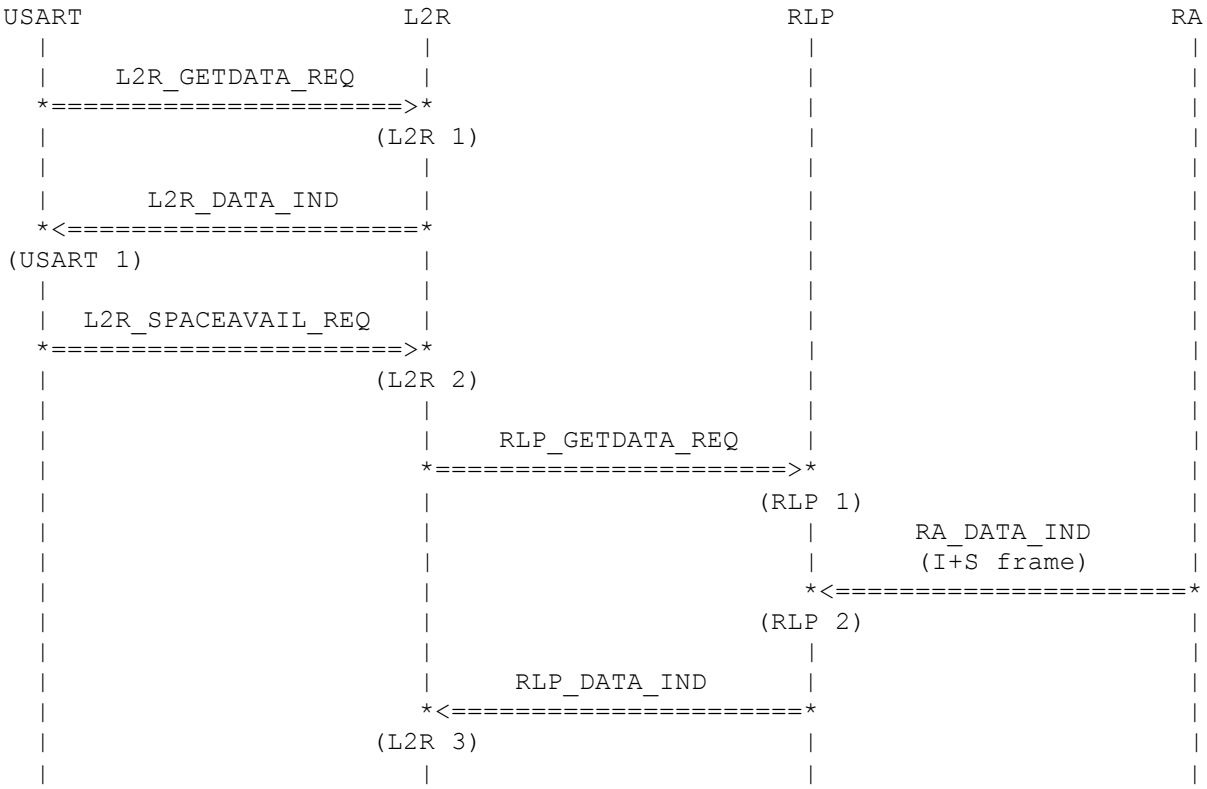
(L2R 2)
The low water mark of the L2R RX buffer is reached and L2R has not previously sent a RLP_GETDATA_REQ to RLP, which has not been answered yet by a RLP_DATA_IND. Therefore L2R is waked up by a L2R_SPACEAVAIL_REQ.

(RLP 1)
L2R sends a RLP_GETDATA_REQ to RLP to request data from RLP.

(L2R 3)
RLP sends data to L2R. If there is more space in the L2R RX buffer, the L2R entity repeats step (RLP 1) and sends another RLP_GETDATA_REQ, which in turn will be answered by a RLP_DATA_IND. This continues until no more space is available

in the RX buffer. In this case the L2R entity has to wait for a L2R_SPACEAVAIL_REQ. The exchange of the primitives RLP_GETDATA_REQ and RLP_DATA_IND may also be as depicted in 3.10.4 and 0.

3.10.4 Data are collected by USART, low water mark of L2R RX buffer is reached, data are available with delay



(L2R 1)
The USART requests L2R to pass data to the USART.

(USART 1)
L2R sends data to the USART.

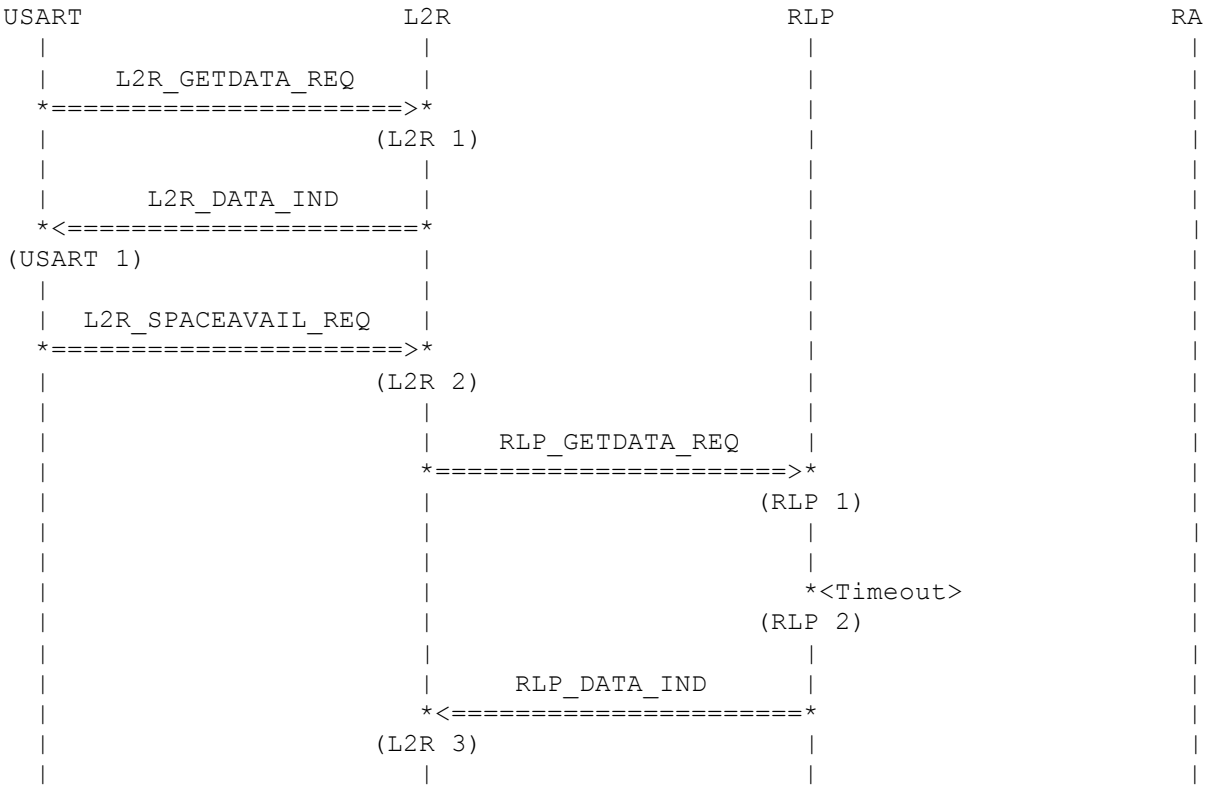
(L2R 2)
The low water mark of the L2R RX buffer is reached and L2R has not previously sent a RLP_GETDATA_REQ to RLP, which has not been answered yet by a RLP_DATA_IND. Therefore L2R is waked up by a L2R_SPACEAVAIL_REQ.

(RLP 1)
L2R sends a RLP_GETDATA_REQ to RLP to request data from RLP. Currently there are not enough data available.

(RLP 2)
RLP receives data from RA. It is assumed that now the requested amount of data is available.

(L2R 3)
RLP sends the data to L2R. If there is more space in the L2R RX buffer, the L2R entity repeats step RLP 1 and sends another RLP_GETDATA_REQ, which in turn will be answered by a RLP_DATA_IND. This continues until no more space is available in the RX buffer. In this case the L2R entity has to wait for a L2R_SPACEAVAIL_REQ. The exchange of the primitives RLP_GETDATA_REQ and RLP_DATA_IND may also be as depicted in 3.10.3 and 0.

3.10.5 Data are collected by USART, low water mark of L2R RX buffer is reached, no data are available



(L2R 1)
The USART requests L2R to pass data to the USART.

(USART 1)
L2R sends data to the USART.

(L2R 2)
The low water mark of the L2R RX buffer is reached and L2R has not previously sent a RLP_GETDATA_REQ to RLP, which has not been answered yet by a RLP_DATA_IND. Therefore L2R is waked up by a L2R_SPACEAVAIL_REQ.

(RLP 1)
L2R sends a RLP_GETDATA_REQ to RLP to request data from RLP.

(RLP 2)
The timer expires. RLP could not collect the requested amount of data. Whatever data are available now, will be send in the next step to L2R.

(L2R 3)

RLP sends the data to L2R. If there is more space in the L2R RX buffer, the L2R entity repeats step (RLP 1) and sends another RLP_GETDATA_REQ, which in turn will be answered by a RLP_DATA_IND. This continues until no more space is available in the RX buffer. In this case the L2R entity has to wait for a L2R_SPACEAVAIL_REQ. The exchange of the primitives RLP_GETDATA_REQ and RLP_DATA_IND may also be as depicted in 3.10.3 and 3.10.4.

Appendices

A. Acronyms

DS-WCDMA Direct Sequence/Spread Wideband Code Division Multiple Access

B. Glossary

International Mobile Telecommunication 2000 (IMT-2000/ITU-2000) Formerly referred to as FPLMTS (Future Public Land-Mobile Telephone System), this is the ITU's specification/family of standards for 3G. This initiative provides a global infrastructure through both satellite and terrestrial systems, for fixed and mobile phone users. The family of standards is a framework comprising a mix/blend of systems providing global roaming. <URL: http://www.imt-2000.org/>