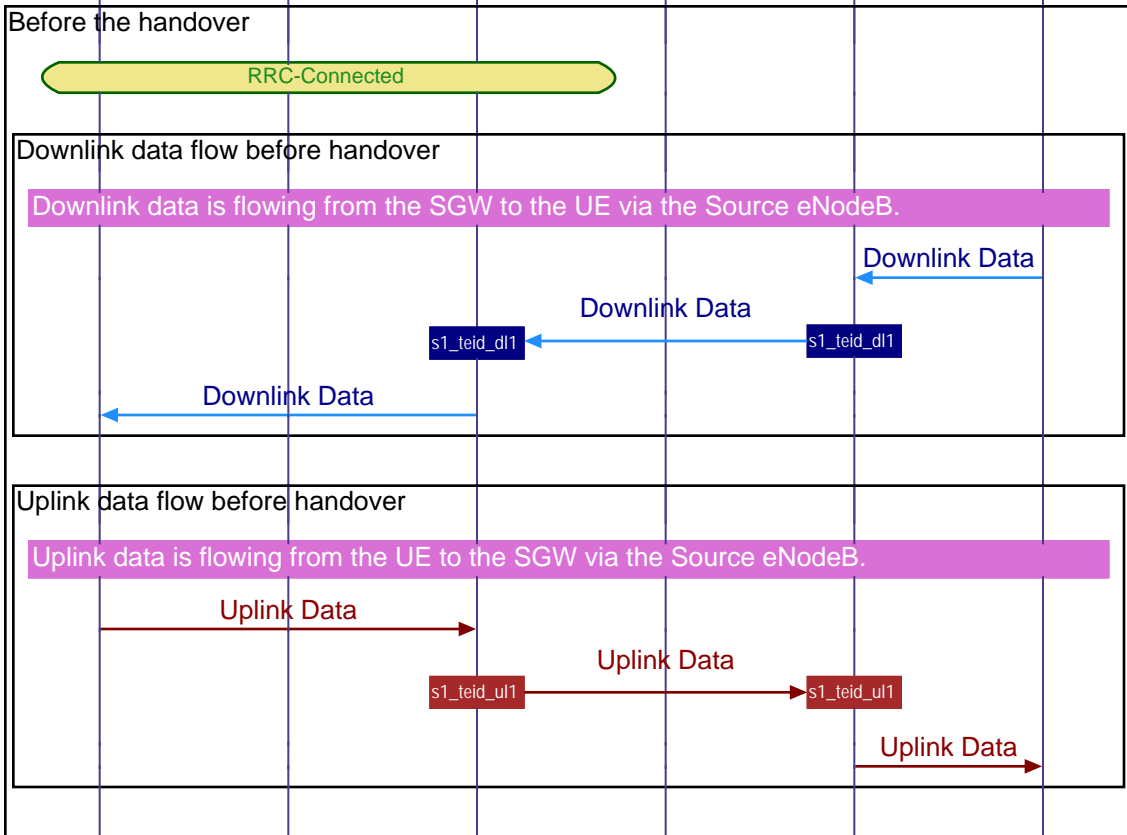


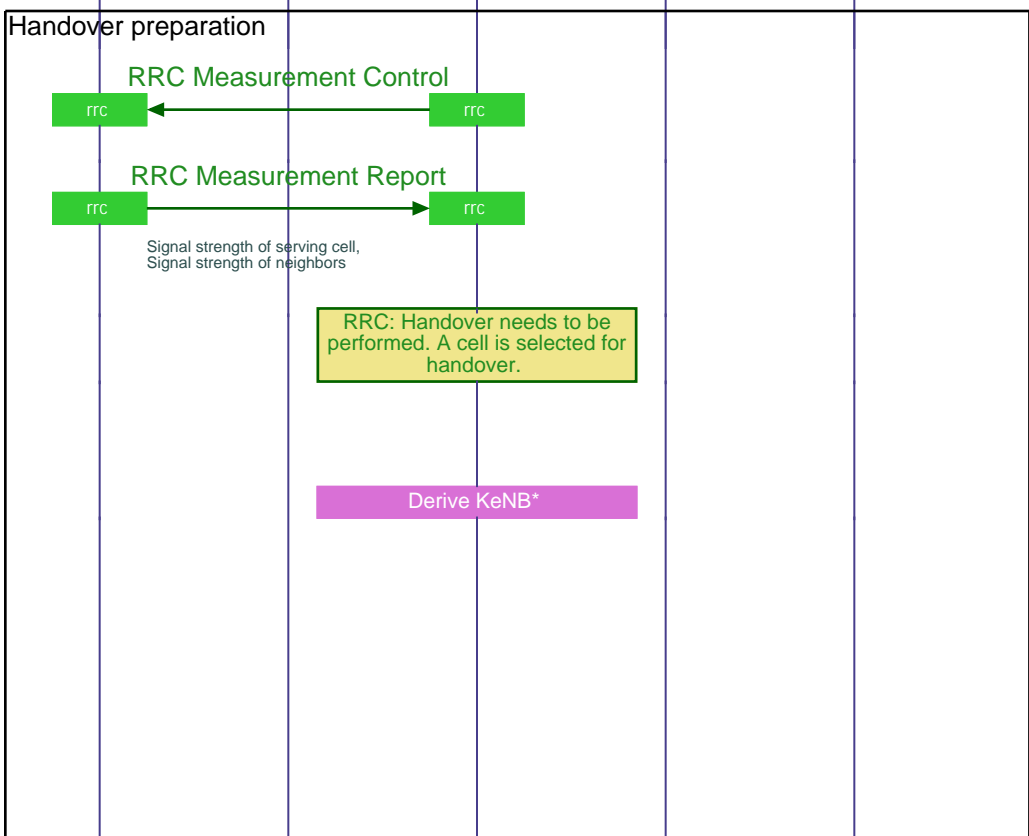
LTE X2 Handover (Successful Handover)						
LTE Mobile	eNodeB Network		Core Network			EventStudio System Designer 6
UE	Target eNodeB	Source eNodeB	MME	SGW	PGW	20-Apr-13 22:03 (Page 1)

This sequence diagram was generated with EventStudio System Designer - <http://www.EventHelix.com/EventStudio/>

eNodeBs in LTE are interconnected with the X2 interface. If two eNodeBs are served by the same MME, handover from the source to the target eNodeB will take place over the X2 interface.



The UE and Source eNodeB are in RRC Connected state.



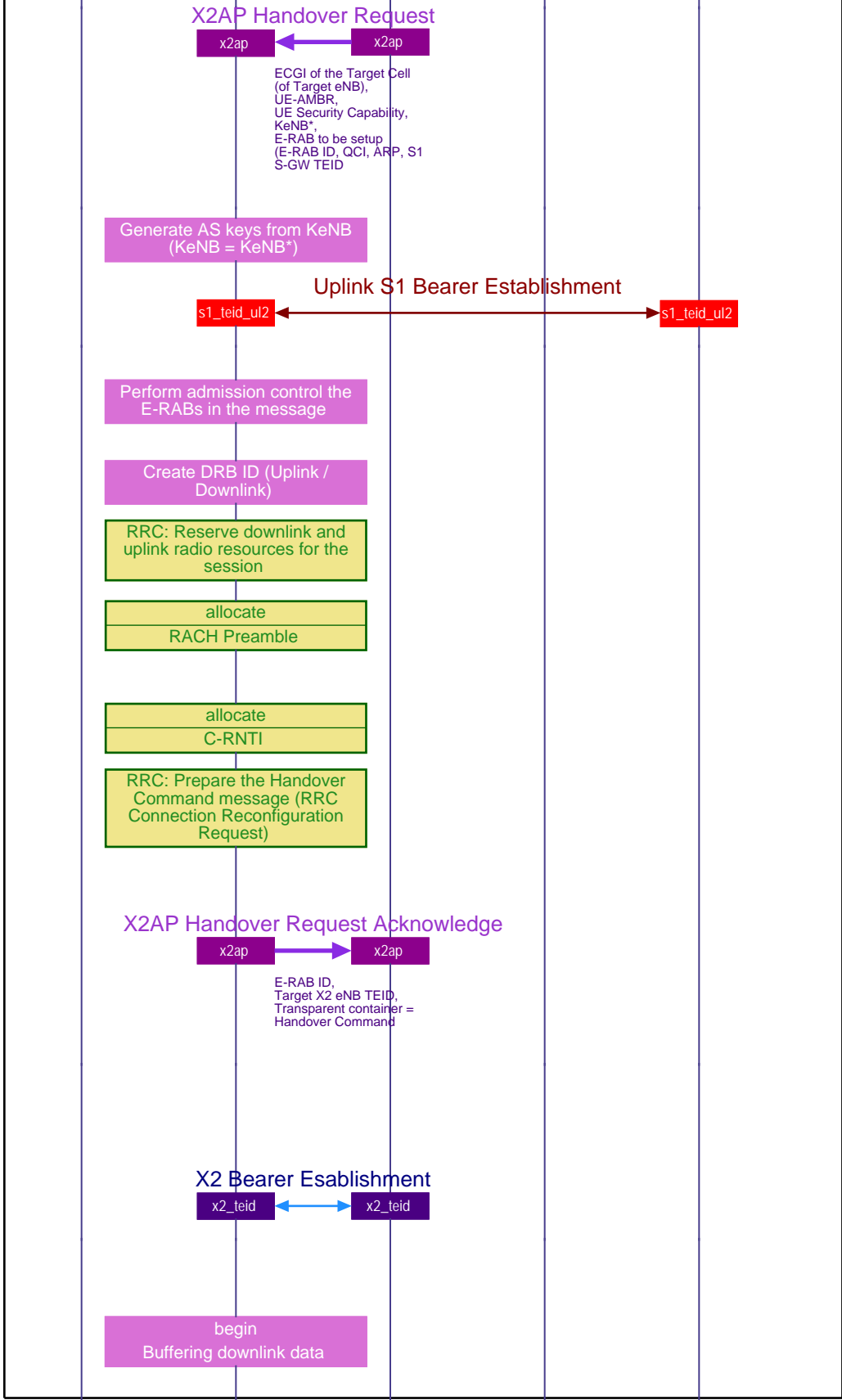
The network sets the measurement thresholds for sending measurement reports.

Neighboring cell signal quality is now better than the serving cell.

The RRC uses the latest measurement to decide if a handover is needed to another cell. The target cell is selected. The eNodeB for the target cell is identified.

# LTE X2 Handover (Successful Handover)

LTE Mobile		eNodeB Network		Core Network			EventStudio System Designer 6 20-Apr-13 22:03 (Page 2)
UE	Target eNodeB	Source eNodeB	MME	SGW	PGW		



The Source eNodeB initiates the handover with the Handover Request message. Information about active E-RABs, security keys is included in the message. (Click on the message name above the arrow to see message details)

GTP connect for the uplink side is established between the Target eNodeB and the serving SGW.

Check if resources are available at the target eNodeB to accept this session.

Assign Dedicated Radio Bearer ids for Uplink and Downlink.

The Target eNodeB allocates radio resources for the UE that will be handed in.

The Target eNodeB allocates a RACH preamble to the UE. The UE will use this preamble to send a contention free RACH.

A new C-RNTI is assigned to the UE.

This message includes the RACH preamble that needs to be sent to the terminal. This message includes information about the assigned radio resources.

The Target eNodeB responds back to the source eNodeB with a Handover Request Acknowledge message. This message carries the Handover Command message (RRC Connection Reconfiguration Request) in a transparent container. (Click on the message name above the arrow to see message details)

An X2 GTP connection is established between the Source and the Target eNodeBs. This channel will carry the user data during the handover.

At this point, the UE is ready to buffer downlink data that will be received during the handover.

Handover execution

# LTE X2 Handover (Successful Handover)

LTE Mobile	eNodeB Network		Core Network			EventStudio System Designer 6
UE	Target eNodeB	Source eNodeB	MME	SGW	PGW	20-Apr-13 22:03 (Page 3)

## RRC Connection Reconfiguration Request



RACH Preamble Assignment,  
Target C-RNTI,  
Target DRB ID (UL/DL),  
Target eNB AS Security Algorithm

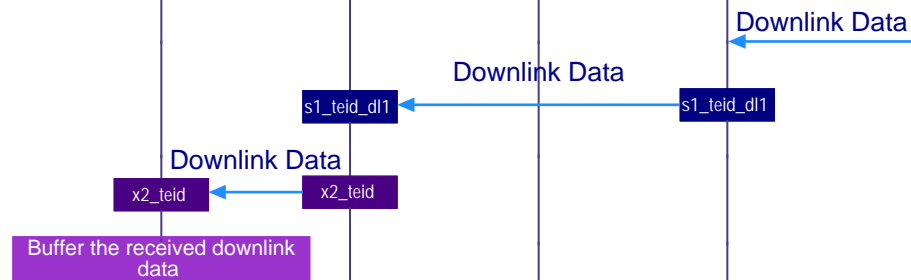
## X2AP SN Transfer Status



Downlink PDCP  
Sequence Number,  
Uplink PDCP Sequence  
Number

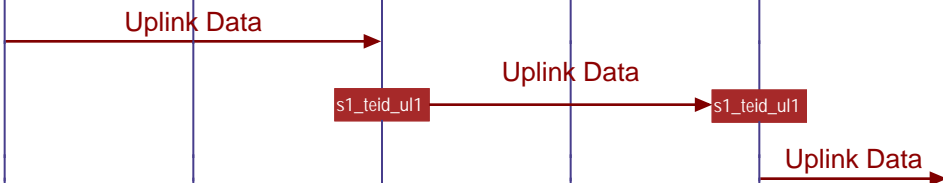
## Downlink data flow during handover preparation

At this point all downlink data is getting rerouted from the source eNodeB to the target eNode. The data is being buffered at the target as the UE is yet to connect to the target.



## Uplink data flow during handover preparation

The uplink data is still being sent from the UE to the SGW via the Source eNodeB.



begin  
Switching to Target eNodeB

Detach from Source eNodeB

Generates KeNB (KeNB = KeNB\*) and AS keys

RRC-Idle

## Synchronizing with target cell



The Source eNodeB sends a handover command to the UE. The message contains a new C-RNTI and new DRB IDs. A RACH preamble is also included for contention free RACH access.

The PDCP sequence numbers are sent from the source to the target eNodeB. (Click on the message name above the arrow to see message details)

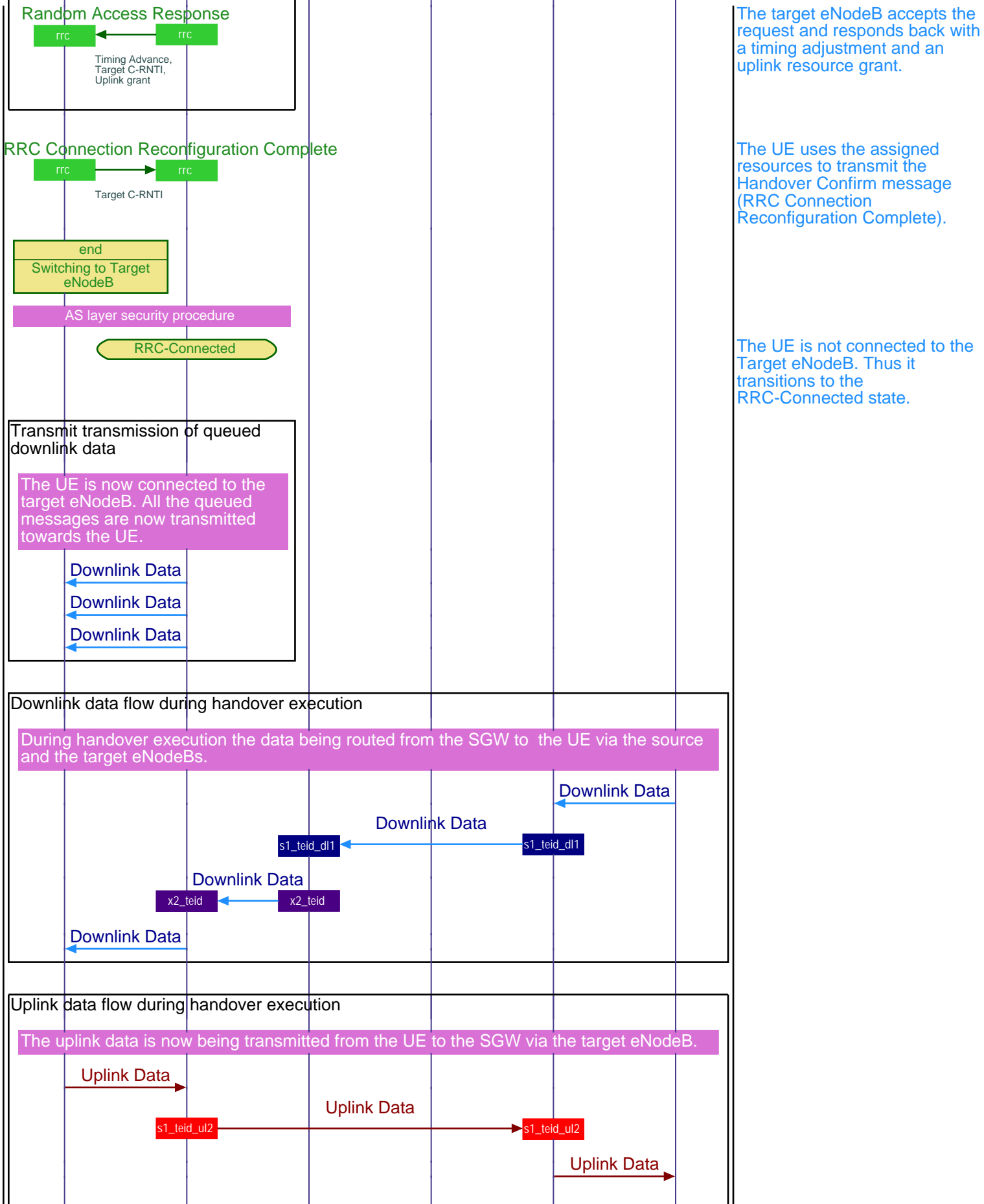
Meanwhile, the UE has received the handover command and it is switching to the new target cell.

At this point, the UE has detached from the source eNodeB but is still not communicating with the target eNodeB. The UE is in the RRC-Idle state.

UE uses the preamble assigned in the handover command to send a RACH to the target eNodeB.

# LTE X2 Handover (Successful Handover)

LTE Mobile	eNodeB Network		Core Network			EventStudio System Designer 6 20-Apr-13 22:03 (Page 4)
UE	Target eNodeB	Source eNodeB	MME	SGW	PGW	



The target eNodeB accepts the request and responds back with a timing adjustment and an uplink resource grant.

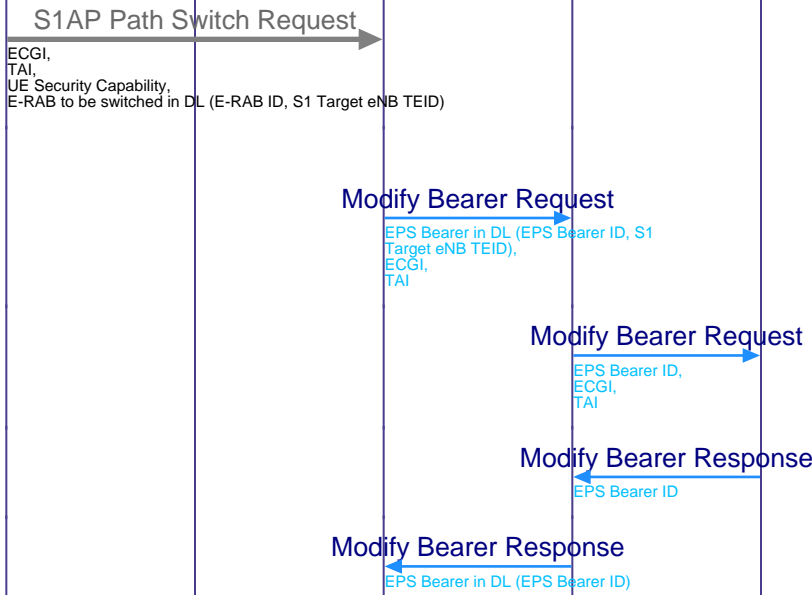
The UE uses the assigned resources to transmit the Handover Confirm message (RRC Connection Reconfiguration Complete).

The UE is not connected to the Target eNodeB. Thus it transitions to the RRC-Connected state.

Handover completion

Switching path

At this point, the UE is receiving and transmitting data. The downlink data transmission towards the terminal is still being routed via the source eNodeB. The path will now be switched to remove the source eNodeB from the path.



The target eNodeB requests the MME to switch the path from the source eNodeB to the target eNodeB. (Click on the message name above the arrow to see message details)

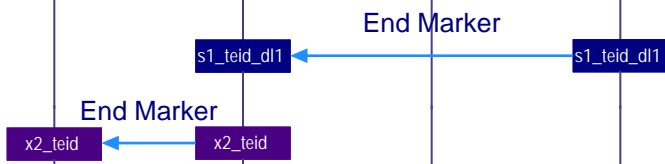
MME requests the SGW to switch the path to the target eNodeB.

The SGW asks the PGW to switch the path.

The SGW responds back to the MME signaling the completion of the path switch.

Send end marker

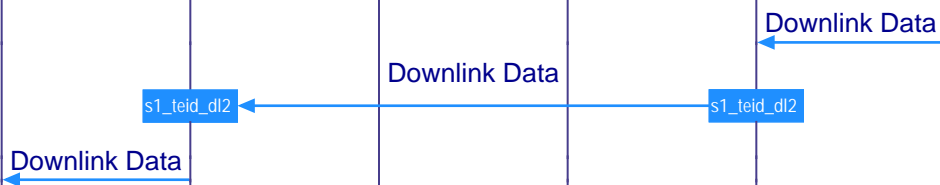
The SGW also inserts an end marker towards the source eNodeB. This marker will be used to sequence the data received from the source eNodeB and the new data received from the target eNodeB.



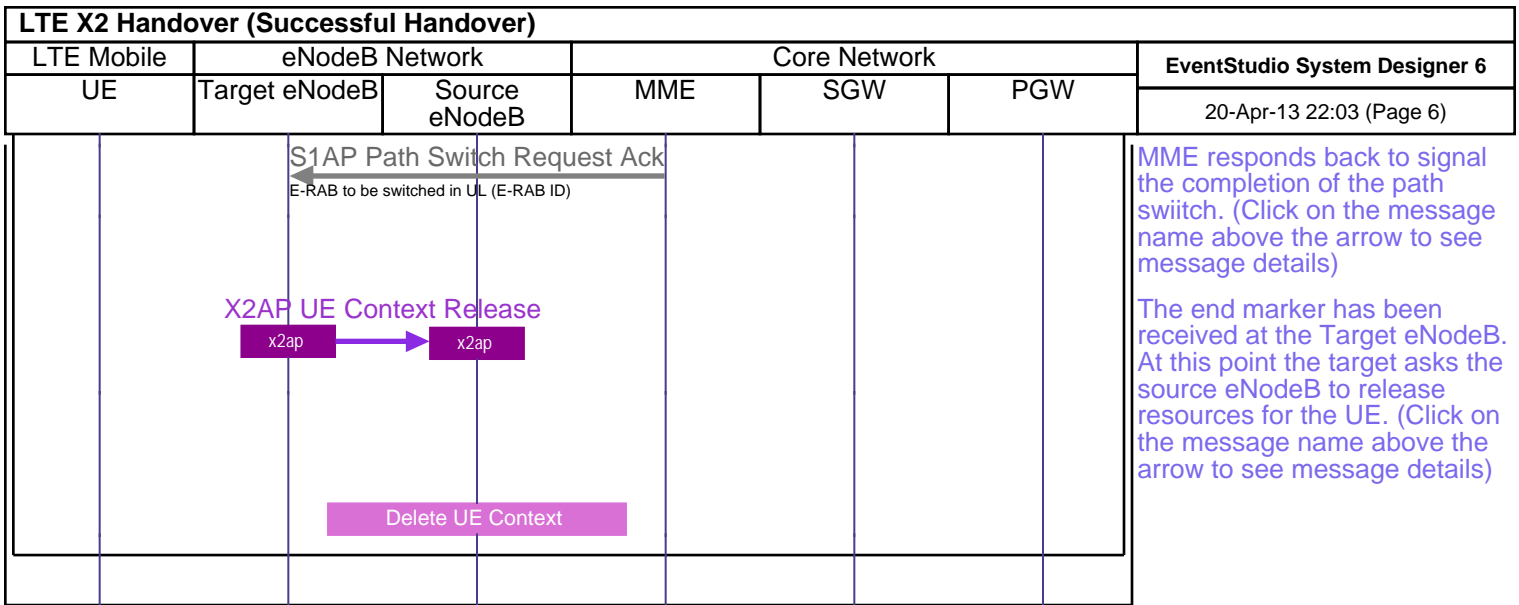
Keep receiving the data from the source eNodeB until the end marker is received

The target eNodeB will buffer data directly received from the SGW until all the data received via the source eNodeB has been transmitted. This is needed to maintain the transmission order.

Downlink data flow after handover



SGW is now sending the data using the target eNodeB TEID.



This sequence diagram was generated with EventStudio System Designer - <http://www.EventHelix.com/EventStudio/>