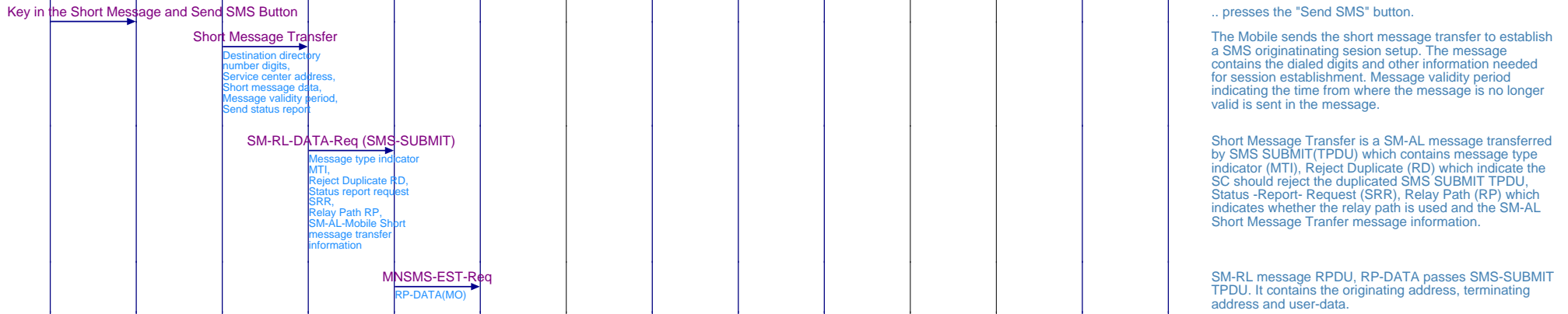| | | Cell | | | | Mobile Network | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Mobile Station | | | | Base Stations | | Mobile Switching Center | | VLR | SMS-IWMSC | Service Center | |
| User | | GSM Mobile | | | | BSS | | | | | | NSS | |
| SMS User | Mobile | SM-AL-Mobile | SM-TL-Mobile | SM-RL-Mobile | CM-Sub-Mobile | BSS | MSC | CM-Sub-MSC | SM-RL-MSC | VLR | SMS-IWMSC | SM-TL-SC | SC |

## GSM Mobile Originated SMS

This scenario describes the session setup for a GSM originating SMS. This sequence diagram describes the SMS signaling and data transfer between the mobile subscriber and the SMS service center. [ SMS is implemented by sending Short message transported via a GSM SDCCH (Standalone Dedicated Control CHannel) signalling channel.  Thus they can be received while the user is talking. The MS establishes an SDCCH using RR establishment procedure.  Copyright © 2013 EventHelix.com Inc. All Rights Reserved.

**Select the called person's number**

The user keys in the phone number for the called mobile subscriber and ..

SMS Protocol stack consists of (1) SM Application layer (AL) (2) SM Transfer layer (TL):SM-TL transfers SM-AL messages. SM-TL messages are called Transfer Protocol Data units (TPDUs). (3) SM Relay layer (RL):SM-RL provides services to transfer TPDUs and corresponding delivery report for the SM-TL. SM-RP is the protocol between peer SM-RL entities at MS and MSC.  SM-RP messages are Relay Protocol Data Units (RPDUs). (4) SM Connection Management sub-layer (CM-sub). CM-sub layer protocol,  Short Message Control Protocol SM-CP provides services to SM-RL and communication between peer Short message Control entities, SMCs.  (5) SC talks to MSC via TCAP/MAP.

Before any message of CM-sub layer is delivered, a Mobility Management MM connection must be established between MS and MSC. Then RPDU is transferred over the connection. Then MM-connection is released by SMC with a flag indicating  whether or not the transmission was successful.

**Key in the Short Message and Send SMS Button**

.. presses the "Send SMS" button.

### Short Message Transfer

Destination directory number digits,
Service center address,
Short message data,
Message validity period,
Send status report

The Mobile sends the short message transfer to establish a SMS originatinating sesion setup. The message contains the dialed digits and other information needed for session establishment. Message validity period indicating the time from where the message is no longer valid is sent in the message.

### SM-RL-DATA-Req (SMS-SUBMIT)

Message type indicator
MTI,
Reject Duplicate RD,
Status report request
SRR,
Relay Path RP,
SM-AL-Mobile Short message transfer information

Short Message Transfer is a SM-AL message transferred by SMS SUBMIT(TPDU) which contains message type indicator (MTI), Reject Duplicate (RD) which indicate the SC should reject the duplicated SMS SUBMIT TPDU, Status -Report- Request (SRR), Relay Path (RP) which indicates whether the relay path is used and the SM-AL Short Message Tranfer message information.

### MNSMS-EST-Req
RP-DATA(MO)

SM-RL message RPDU, RP-DATA passes SMS-SUBMIT TPDU. It contains the originating address, terminating address and user-data.

SMS session related information needs to be transported from the mobile phone to the SMS Service Center (SC). This requires the establishment of a Radio Resource (RR) connection to the BSS. The first phase of the session setup just sets up this RR connection.

The MS establishes an SDCCH using the standard RR establishment procedure.

**RR and MM Setup**

### Begin RR Connection Establishment

### RR CHANNEL REQUEST
RACH
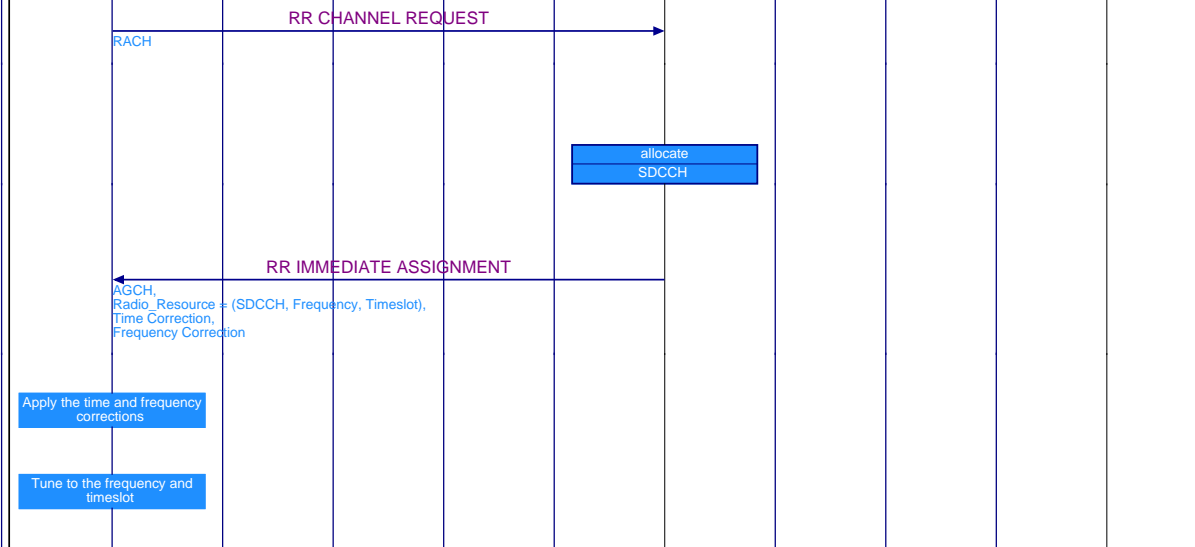
RR connection establishment is triggered by sending the Channel Request message. This message requests the Base Station System (BSS) for allocation for radio resources for the RR connection setup. The mobile now waits for an assignment on the Access Grant Channel (AGCH). At this point the mobile is listening to the AGCH for a reply.
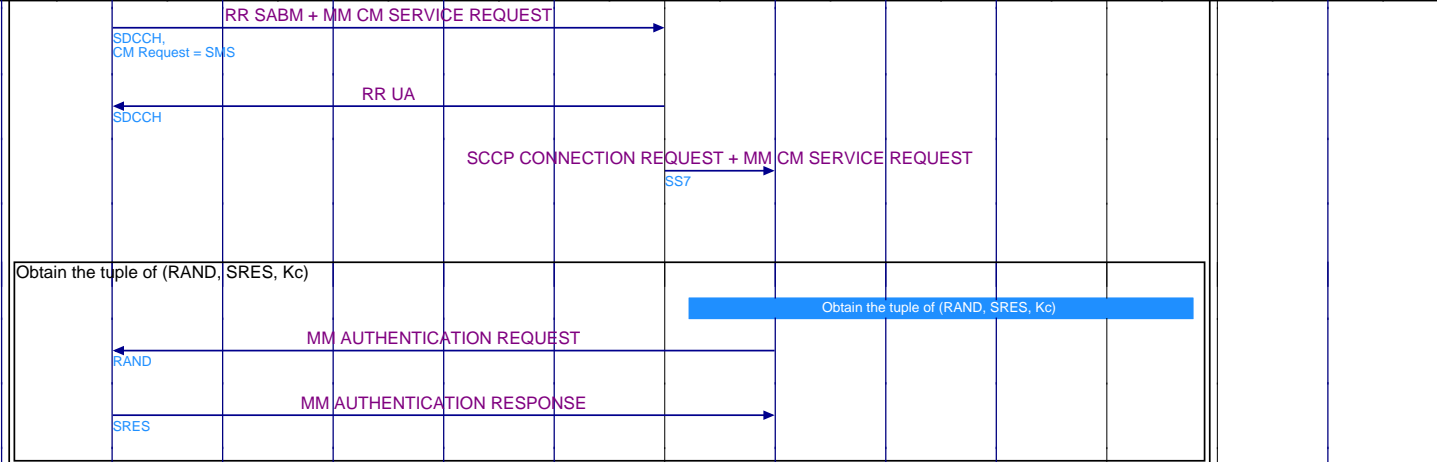
**allocate SDCCH**

The BSS allocates a Traffic Channel (SDCCH) to the mobile. The SDCCH allocation assigns a specifies a frequency and a timeslot on that frequency. After the mobile receives this message, the mobile shall only use the specified resources for communication with the mobile network.

### RR IMMEDIATE ASSIGNMENT
AGCH,
Radio_Resource = (SDCCH, Frequency, Timeslot),
Time Correction,
Frequency Correction

The BSS transmits the radio resource assignment to the Mobile via the AGCH channel. The message also contains the time and frequency corrections. The time corrections allow the mobile to time it's transmissions so that they reach the BSS only in the specified slot. The frequency corrections correct for the Doppler shift caused by the mobile's motion.

**Apply the time and frequency corrections**

Adjust the frequency and timing based on the advice from the BSS. This step is required so that transmissions from the mobile reach the base station at the precise time and with the correct frequency.

**Tune to the frequency and timeslot**

The mobile detunes from the AGCH and tunes to the specified radio channel.

| | | Cell | | | | Mobile Network | | | | | | | EventStudio System Designer 6 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Mobile Station | | | | Base Stations | | Mobile Switching Center | | | NSS | SMS-IWMSC | Service Center | |
| User | | GSM Mobile | | | | BSS | | | | | VLR | | | |
| SMS User | Mobile | SM-AL-Mobile | SM-TL-Mobile | SM-RL-Mobile | CM-Sub-Mobile | BSS | MSC | CM-Sub-MSC | SM-RL-MSC | VLR | SMS-IWMSC | SM-TL-SC | SC | 29-Oct-13 20:36 (Page 2) |

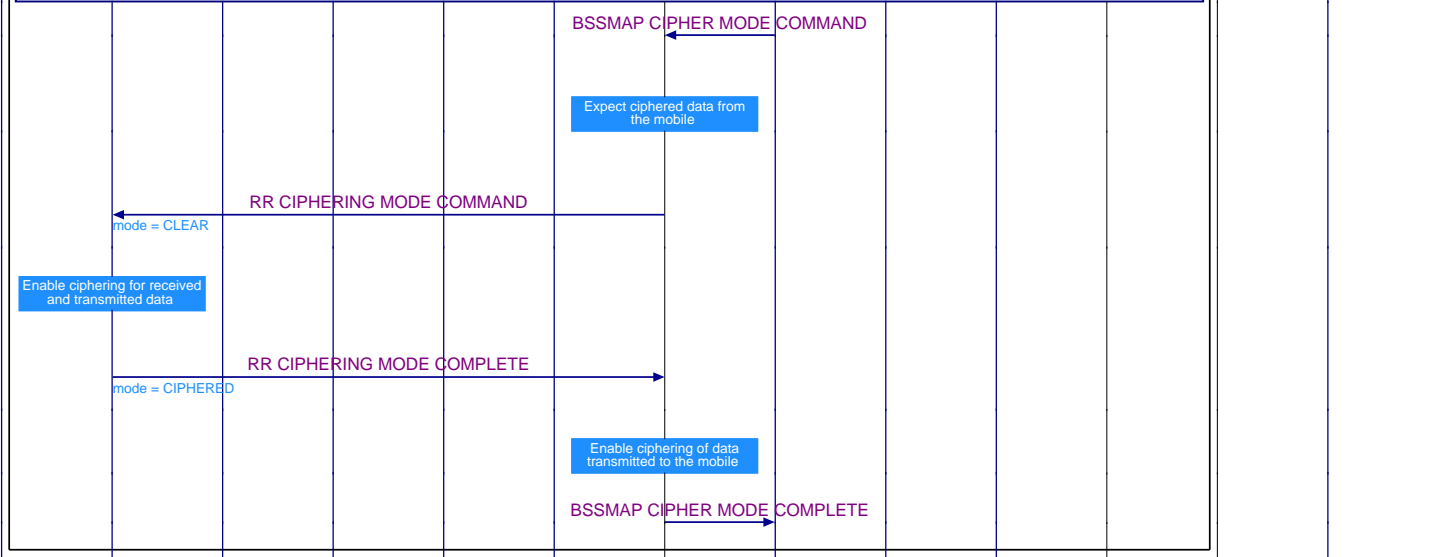**RR SABM + MM CM SERVICE REQUEST**

SDCCH,
CM Request = SMS

This is the first message that is sent after tuning to the channel. The CM Service Request is sent to the MSC.

**RR UA**

SDCCH

The BSS replies with Unnumbered Acknowledge (UA) to complete the LAPm setup handshake

**SCCP CONNECTION REQUEST + MM CM SERVICE REQUEST**

SS7

The BSS receives the CM Service Request message from the mobile and forms a "BSSMAP COMPLETE LAYER 3 INFORMATION". The BSS then piggy backs the message on the SCCP connection request message.

LEG: Initiate Authentication Procedure

Obtain the tuple of (RAND, SRES, Kc)

Obtain the tuple of (RAND, SRES, Kc)

**MM AUTHENTICATION REQUEST**

RAND

**MM AUTHENTICATION RESPONSE**

SRES

## Enable Ciphering

**BSSMAP CIPHER MODE COMMAND**

Since the subscriber has been successfully authenticated, the MSC initiates ciphering of the data being sent on the channel. The channel is ciphered so as so protect the call from eavesdropping.

Expect ciphered data from the mobile

Ciphering on the radio link is enabled in three steps. As a first step, the BSS starts expecting ciphered data from the mobile but continues to send data in clear. Since the mobile has not been informed about the ciphering, all data received from the mobile will be in error.

**RR CIPHERING MODE COMMAND**

mode = CLEAR

The BSS sends the CIPHERING MODE COMMAND to the mobile. The mobile will be able to receive this message as the transmission from the BSS is still in clear.

Enable ciphering for received and transmitted data

As a second step, the Mobile receives the message and enables ciphering in transmit and receive directions. This action will result in all BSS data being received in error. (The BSS is still transmitting data in clear.)
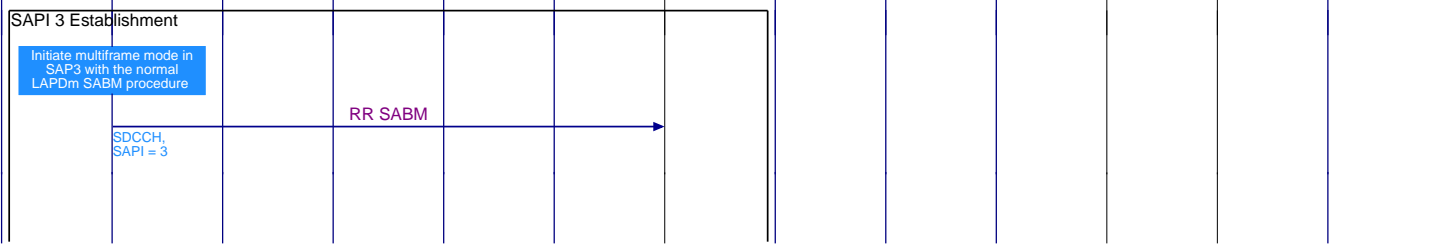
**RR CIPHERING MODE COMPLETE**

mode = CIPHERED

Ciphering has already been enabled, so this message is transmitted with ciphering. The BSS will receive this message as it is already expecting ciphered data in the receive direction.

Enable ciphering of data transmitted to the mobile

The third and final step in the ciphering handshake. The BSS enables the ciphering in transmit direction. From this point on ciphering is enabled in both directions.
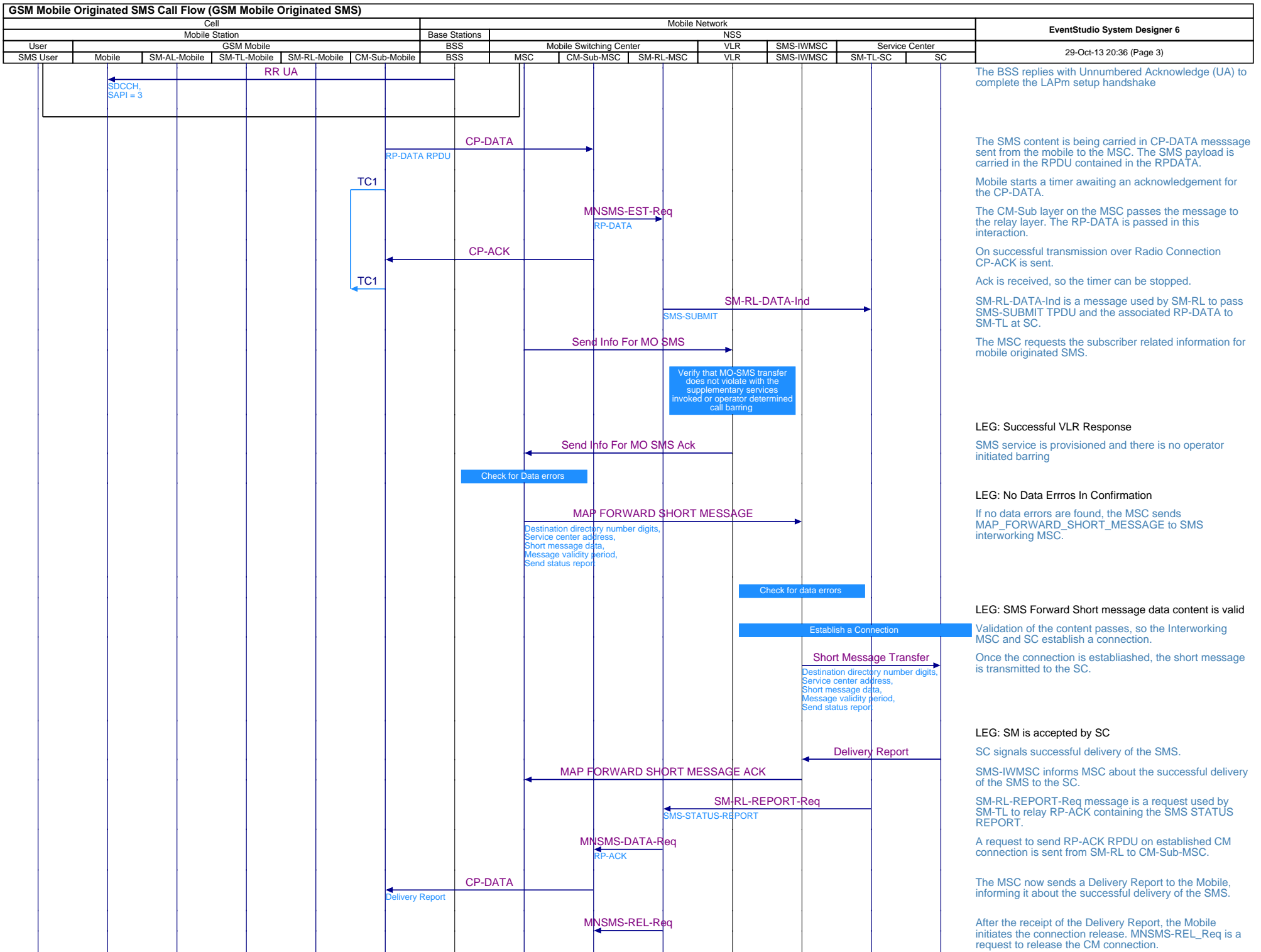
**BSSMAP CIPHER MODE COMPLETE**

BSS replies back to the MSC, indicating that ciphering has been successfully enabled.

At this point a connection has been setup between the Mobile and the MSC. From this point onward, the BSS is just acting as a conduit for transporting the signaling messages between the Mobile and the MSC.

## SMS sent from Mobile to MSC

SAPI 3 Establishment

Initiate multiframe mode in SAP3 with the normal LAPDm SABM procedure

**RR SABM**

SDCCH,
SAPI = 3

The Mobile initiates a LAPm connection with the BSC by sending a Set Asynchronous Balanced Mode (SABM) message.

| Cell | | | | | | Mobile Network | | | | | | | EventStudio System Designer 6 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Mobile Station | | | | | | Base Stations | NSS | | | | | | |
| User | GSM Mobile | | | | | BSS | Mobile Switching Center | | | VLR | SMS-IWMSC | Service Center | | 29-Oct-13 20:36 (Page 3) |
| SMS User | Mobile | SM-AL-Mobile | SM-TL-Mobile | SM-RL-Mobile | CM-Sub-Mobile | BSS | MSC | CM-Sub-MSC | SM-RL-MSC | VLR | SMS-IWMSC | SM-TL-SC | SC | |

**RR UA**
SDCCH, SAPI = 3

The BSS replies with Unnumbered Acknowledge (UA) to complete the LAPm setup handshake

**CP-DATA**
RP-DATA RPDU

The SMS content is being carried in CP-DATA messsage sent from the mobile to the MSC. The SMS payload is carried in the RPDU contained in the RPDATA.

TC1

Mobile starts a timer awaiting an acknowledgement for the CP-DATA.

**MNSMS-EST-Req**
RP-DATA

The CM-Sub layer on the MSC passes the message to the relay layer. The RP-DATA is passed in this interaction.

**CP-ACK**

On successful transmission over Radio Connection CP-ACK is sent.

TC1

Ack is received, so the timer can be stopped.

**SM-RL-DATA-Ind**
SMS-SUBMIT

SM-RL-DATA-Ind is a message used by SM-RL to pass SMS-SUBMIT TPDU and the associated RP-DATA to SM-TL at SC.

**Send Info For MO SMS**

The MSC requests the subscriber related information for mobile originated SMS.

Verify that MO-SMS transfer does not violate with the supplementary services invoked or operator determined call barring

**LEG: Successful VLR Response**

**Send Info For MO SMS Ack**

SMS service is provisioned and there is no operator initiated barring

Check for Data errors

**LEG: No Data Errros In Confirmation**

**MAP FORWARD SHORT MESSAGE**
Destination directory number digits,
Service center address,
Short message data,
Message validity period,
Send status report

If no data errors are found, the MSC sends MAP_FORWARD_SHORT_MESSAGE to SMS interworking MSC.

Check for data errors

**LEG: SMS Forward Short message data content is valid**

Establish a Connection

Validation of the content passes, so the Interworking MSC and SC establish a connection.

**Short Message Transfer**
Destination directory number digits,
Service center address,
Short message data,
Message validity period,
Send status report

Once the connection is establiashed, the short message is transmitted to the SC.

**LEG: SM is accepted by SC**

**Delivery Report**

SC signals successful delivery of the SMS.

**MAP FORWARD SHORT MESSAGE ACK**

SMS-IWMSC informs MSC about the successful delivery of the SMS to the SC.

**SM-RL-REPORT-Req**
SMS-STATUS-REPORT

SM-RL-REPORT-Req message is a request used by SM-TL to relay RP-ACK containing the SMS STATUS REPORT.

**MNSMS-DATA-Req**
RP-ACK

A request to send RP-ACK RPDU on established CM connection is sent from SM-RL to CM-Sub-MSC.

**CP-DATA**
Delivery Report

The MSC now sends a Delivery Report to the Mobile, informing it about the successful delivery of the SMS.

**MNSMS-REL-Req**

After the receipt of the Delivery Report, the Mobile initiates the connection release. MNSMS-REL_Req is a request to release the CM connection.

| Cell | | | | | | Base Stations | Mobile Network | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Mobile Station | | | | | | BSS | Mobile Switching Center | | | VLR | SMS-IWMSC | Service Center | | |
| User | GSM Mobile | | | | | BSS | NSS | | | VLR | SMS-IWMSC | | | |
| SMS User | Mobile | SM-AL-Mobile | SM-TL-Mobile | SM-RL-Mobile | CM-Sub-Mobile | BSS | MSC | CM-Sub-MSC | SM-RL-MSC | VLR | SMS-IWMSC | SM-TL-SC | SC | |

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29-Oct-13 20:36 (Page 4)

MNSMS-DATA-Req
RP-ACK

MNSMS-DATA-Ind
RP-ACK

SM-RL-REPORT-Ind
SMS-STATUS-REPORT

SM-RL-REPORT-Ind is an indication used by SM-RL to the RP-ACK to SM-TL.

MNSMS-REL-Req

MM-Connection Release

**RR Connection Release**

BSSMAP CLEAR COMMAND

Call release has been completed, now the RR connection is released by the MSC.

RR CHANNEL RELEASE

The BSS initiates RR release with the mobile.

BSSMAP CLEAR COMPLETE

The BSS informs the the MSC that the RR connection has been released.

RR DISC
SAPI = 0

The mobile sends a disconnect message to release the LAPm connection.

RR UA
SAPI = 0

The BSS replies with an Unnumbered Acknowledge message.

Locally release SAPI=3 connection

free
SDCCH

The BSS releases the SDCCH channel.

The network releases the SDCCH with the RR Channel Release message. This implies a closure of the MM sublayer and triggers the release of L2 and L1.

Call Released Indication

Mobile goes back to the default display to indicate that SMS session has been completely released.