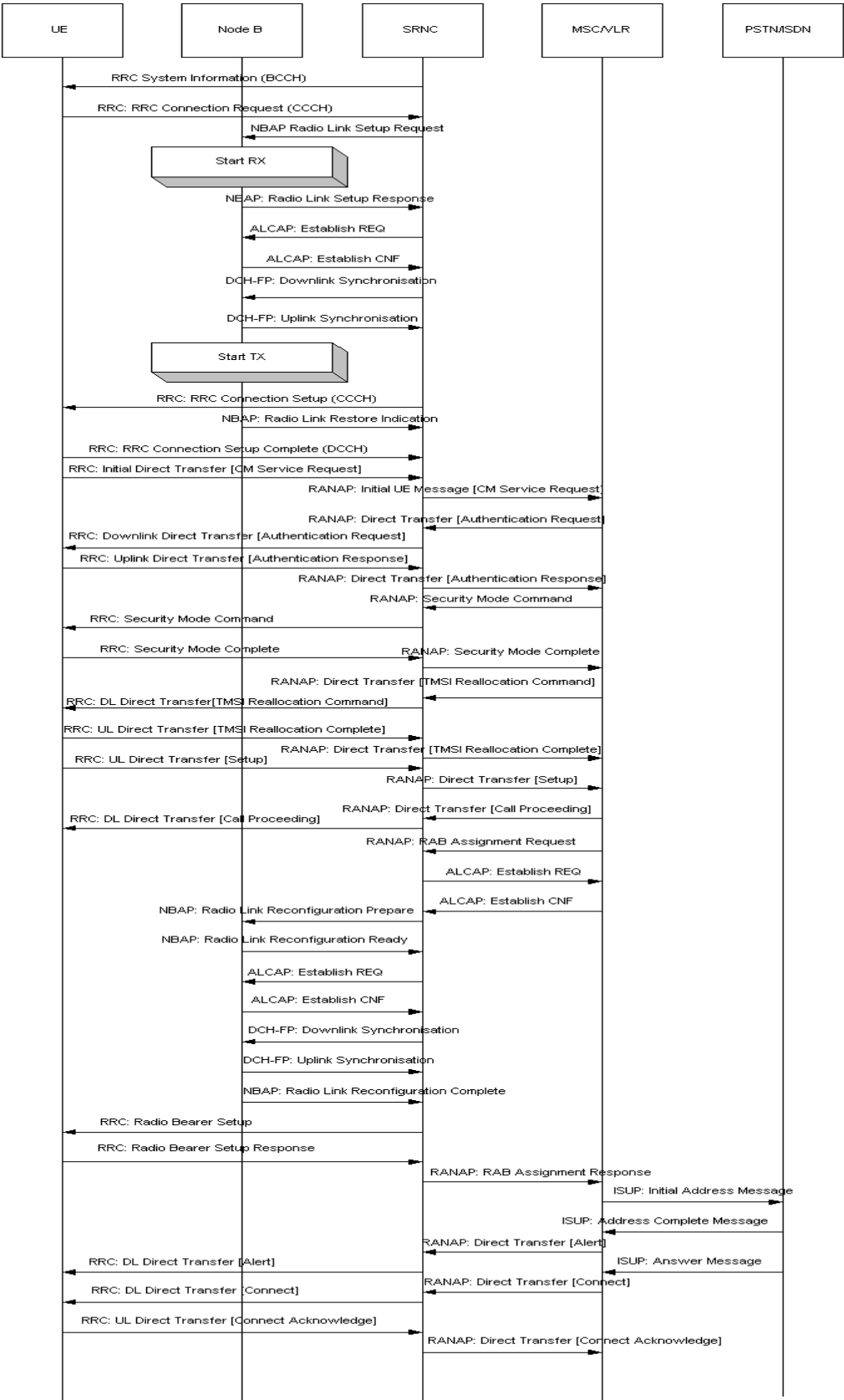


3G/UMTS Complete Mobile Originated Circuit Switched Call Setup

July 2009, Turin



1. System Information (BCCH)

The UE reads the System Information that is broadcast on BCCH. The information is not read continuously. It is only read if the information changes

2. RRC: RRC Connection Request (CCCH)

The Mobile user decides to initiate a voice call. The first message the UE will send on CCCH is RRC Connection Request. This will contain among other things, Initial UE Identity and Establishment Cause

3. NBAP: Radio Link Setup Request

The SRNC sends this message to Node B. It will pass the Cell Id, TFS, TFCS, frequency, UL Scrambling code, etc to Node B.

4. NBAP: Radio Link Setup Response

Node B allocates the resources and starts PHY Reception. While transmitting the response it includes the Transport layer addressing information that includes the Binding Identity of the AAL2 for Iub data transport bearer

5. ALCAP: Establish REQ

The AAL2 binding identity (Iub Data Transport Bearer Id) is passed to ALCAP protocol in Node B. The Iub Data Transport bearer is now bound to DCH.

6. ALCAP: Establish CNF

Establish confirm from ALCAP in Node B

7: DCH-FP: Downlink Synchronisation

The Node B and SRNC establishes synchronisation for the Iub Data Transport bearer by means of exchange of the appropriate DCH Frame Protocol frames.

8: DCH-FP: Uplink Synchronisation

Once the UL synchronisation is achieved, Node B starts DL transmission.

9: RRC: RRC Connection Setup (CCCH)

RRC Connection Setup message is sent on CCCH with the parameters required to establish DCH. Also the state indicator will be set to DCH for the voice (or CS) call.

10: NBAP: Radio Link Restore Indication

Once the UE establishes Radio Link, Node B will send RL Restore indication to the SRNC.

11: RRC: RRC Connection Setup Complete (DCCH)

RRC Connection Setup complete will be sent on DCCH. Integrity and Ciphering related parameters and UE capability information will be sent back to SRNC

12: RRC: Initial Direct Transfer [CM Service Request]

First NAS message is now sent by the UE. It indicates that a UE originated Voice call is required. The UE identity (TMSI) will also be passed in this message

13: RANAP: Initial UE Message [CM Service Request]

The NAS message will be forwarded to appropriate CN Domain (CS Domain in this case). Along with the CM service request, it will also include LAI and SAI.

14: RANAP: Direct Transfer [Authentication Request]

MSC/VLR needs to perform authentication to make sure that the UE is genuine. For this reason it will challenge the UE with a Authentication token and RAND (random number)

15: RRC: Downlink Direct Transfer [Authentication Request]

SRNC transfers the NAS message to the UE

16: RRC: Uplink Direct Transfer [Authentication Response]

UE computes the response (RES) and sends it back in the NAS message

17: RANAP: Direct Transfer [Authentication Response]

SRNC relays the response to the MSC/VLR. The MSC/VLR will compare the response RES with the expected response XRES. If they are the same then the procedure will continue.

18: RANAP: Security Mode Command

MSC/VLR sends the Security Mode Command to start Ciphering and Integrity Protection. Ciphering is optional while Integrity Protection is mandatory. The Algorithms, etc are known to the MSC/VLR and the UE and only the ones that are common between them are used.

19: RRC: Security Mode Command

RRC Forwards the Security Mode command received from MSC/VLR to the UE.

20: RRC: Security Mode Complete

The UE configures the Ciphering and Integrity Protection and responds back to the network. The response message is Integrity Protected for further safety. Ciphering is started at Ciphering activation time. Since this is a Circuit switched call, the Ciphering will be started in MAC. In case of AM and UM bearers it is started in RLC.

21: RANAP: Security Mode Complete

The network forwards the Security Mode Complete message to MSC/VLR.

22: RANAP: Direct Transfer [TMSI Reallocation Command]

The network may decide to re-allocate the TMSI to the UE. It sends a DT message which includes the NAS TMSI Reallocation Command.

23: RRC: DL Direct Transfer [TMSI Reallocation Command]

The RNC relays the DT message to the UE.

24: RRC: UL Direct TRansfer [TMSI Reallocation Complete]

The UE takes the new TMSI and responds with the Complete message

25: RANAP: Direct Transfer [TMSI Reallocation Complete]

The RNC relays the message to the CN domain

26: RRC: UL Direct TRansfer [Setup]

The UE now sends the 'Setup' message in UL Direct Transfer message. This will include all the required parameters for setting up the voice call. It will include the number that UE wishes to be contacted and the bearer capability

27: RANAP: Direct TRansfer [Setup]

The network relays the message to the MSC/VLR

28: RANAP: Direct TRansfer [Call Proceeding]

The MSC/VLR sends Call Proceeding to the UE indicating that it is now starting with the RAB establishment procedure.

29: RRC: DL Direct TRansfer [Call Proceeding]

The network relays it to the UE.

30: RANAP: RAB Assignment Request

The CN initiates establishment of the Radio Access Bearer using the RAB Assignment Request message. This message includes the QoS of the call being established, the Transport Address, Iu Transport association, etc.

31: ALCAP: Establish REQ

SRNC initiates the set-up of Iu Data Transport bearer using ALCAP protocol. The request contains the AAL2 Binding Identity to Bind the Iu Data Transport Bearer to the RAB. (Note that this is not done in case of PS RAB)

32: ALCAP: Establish CNF

The CN responds with the ALCAP Establish CNF

33: NBAP: Radio Link Reconfiguration Prepare

SRNC requests Node B to prepare establishment of DCH to carry the RAB. It passes the TFS, TFCS and Power Control Information in the message.

34: NBAP: Radio Link Reconfiguration Ready

Node B allocates the resources and responds with the Ready message. It sends back the AAL2 address and the AAL2 binding Id for the Iub data transport bearer.

35: ALCAP: Establish REQ

SRNC initiates setup of Iub Data Transport Bearer using ALCAP protocol. The request contains the AAL2 Binding Identity to bind the Iub Data Transport Bearer to DCH.

36: ALCAP: Establish CNF

The Node B responds with the Establish Confirm.

37: DCH-FP: Downlink Synchronisation

The Node B and SRNC establish synchronism for the Iub Data Transport Bearer by means of exchange of the appropriate DCH frame protocol frames. SRNC sends the DL Synchronisation frames.

38: DCH-FP: Uplink Synchronisation

The Node B responds with the UE Synchronisation frames.

39: NBAP: Radio Link Reconfiguration Complete

Finally the SRNC instructs the Node B of the CFN at which the new configuration will come into effect.

40: RRC: Radio Bearer Setup

SRNC sends the RB Setup message to add the new DCH's. The message will be received using the old configuration.

41: RRC: Radio Bearer Setup Reponse

After the activation time the UE will respond with complete message using the new configuration.

42: RANAP: RAB Assignment Reponse

The SRNC responds with the response to the MSC/VLR.

43: ISUP: Initial Address Message

MSC/VLR sends the Initial Address Message to the PSTN. The message tells the PSTN to reserve

an idle trunk circuit from originating switch to the destination switch.

44: ISUP: Address Complete Message

The ACM message is sent to indicate that the remote end of the trunk circuit has been reserved.

45: RANAP: Direct Transfer [Alert]

The Alert message is sent to the SRNC. This message contains the ACM received from the PSTN.

46: RRC: Direct Transfer [Alert]

The Alert message is forwarded to the UE. The Alert message will initiate the ringing tone on the handset.

47: ISUP: Answer Message

When the person that is being called picks up his phone, an Answer message is sent to the MSC/VLR.

48: RANAP: Direct Transfer [Connect]

The MSC/VLR sends the Connect message to the SRNC via Direct Transfer message. The Connect message indicates that the End User has answered the call.

49: RRC: DL Direct Transfer [Connect]

The SRNC forwards the Connect message to the UE.

50: RRC: UL Direct Transfer [Connect Acknowledge]

The UE confirms the reception of the Connect message using the Connect Acknowledge and sending it via Direct Transfer

51: RANAP: Direct Transfer [Connect Acknowledge]

The Network forwards the Connect Acknowledge to the MSC/VLR. The call has now been successfully established.

Further Reading:

[1] 3GPP TS 25.331: RRC Protocol Specification

[2] 3GPP TS 25.413: RANAP Protocol Specification

[3] 3GPP TS 25.433: NBAP Protocol Specification

[4] 3GPP TS 24.008: Mobile radio interface Layer 3 specifications; Core Network Protocols; Stage

[5] ISUP (ISDN User Part) Tutorial: <http://www.pt.com/tutorials/ss7/isup.html>

[6] ITU-T Recommendation Q.2630.1: "AAL2 Type 2 Signalling Protocol".