UE Interactions: 5G Standalone Access Registration

Preconditions

1:RRC_IDLE

The UE is in RRC idle state

5G-NR RRC Connection Setup

2:Msg1: Preamble

Zadoff-Chu sequence

The UE picks a random preamble. The preamble is referenced with the Random Access Preamble Id (RAPID). The preamble transmission is a Zadoff-Chu sequence.

3:T300

Start T300 to await the RRC Setup message from the network.

4:Start decoding the PDCCH for the RA-RNTI

In response to a PRACH transmission, a UE attempts to detect a DCI Format 1_0 with CRC scrambled by a the RA-RNTI corresponding to the RACH transmission. The UE looks for message during a configured window of length ra-ResponseWindow.

5:PDCCH DCI Format 1_0 [RA-RNTI]

Frequency domain resource assignment,
Time domain resource assignment,
Downlink MCS

The RA-RNTI scrambled DCI message signals the frequency and time resources assigned for the transmission of the Transport Block containing the Random Access Response message.

6:Msg2: Random Access Response

Timing Advance Command,
UL Grant = { Frequency hopping flag, Msg3 PUSCH frequency+time resource allocation,
Uplink MCS, TPC command, CSI request},
Temporary C-RNTI

The UE detects a DCI Format 1_0 with CRC scrambled by the corresponding RA-RNTI and receives a transport block in a corresponding PDSCH. The RAR carries the timing advance, uplink grant and the Temporary C-RNTI assignment.

7:ue-identity = Random number between 0 and 2^39-1

UE picks a random identity that will be used during contention resolution.

8:Extract UL Grant from the RAR

The uplink allocation contained in the RAR will be used to transmit Msg3 (RRC Setup Request).

9:Msg3: RRCSetupRequest

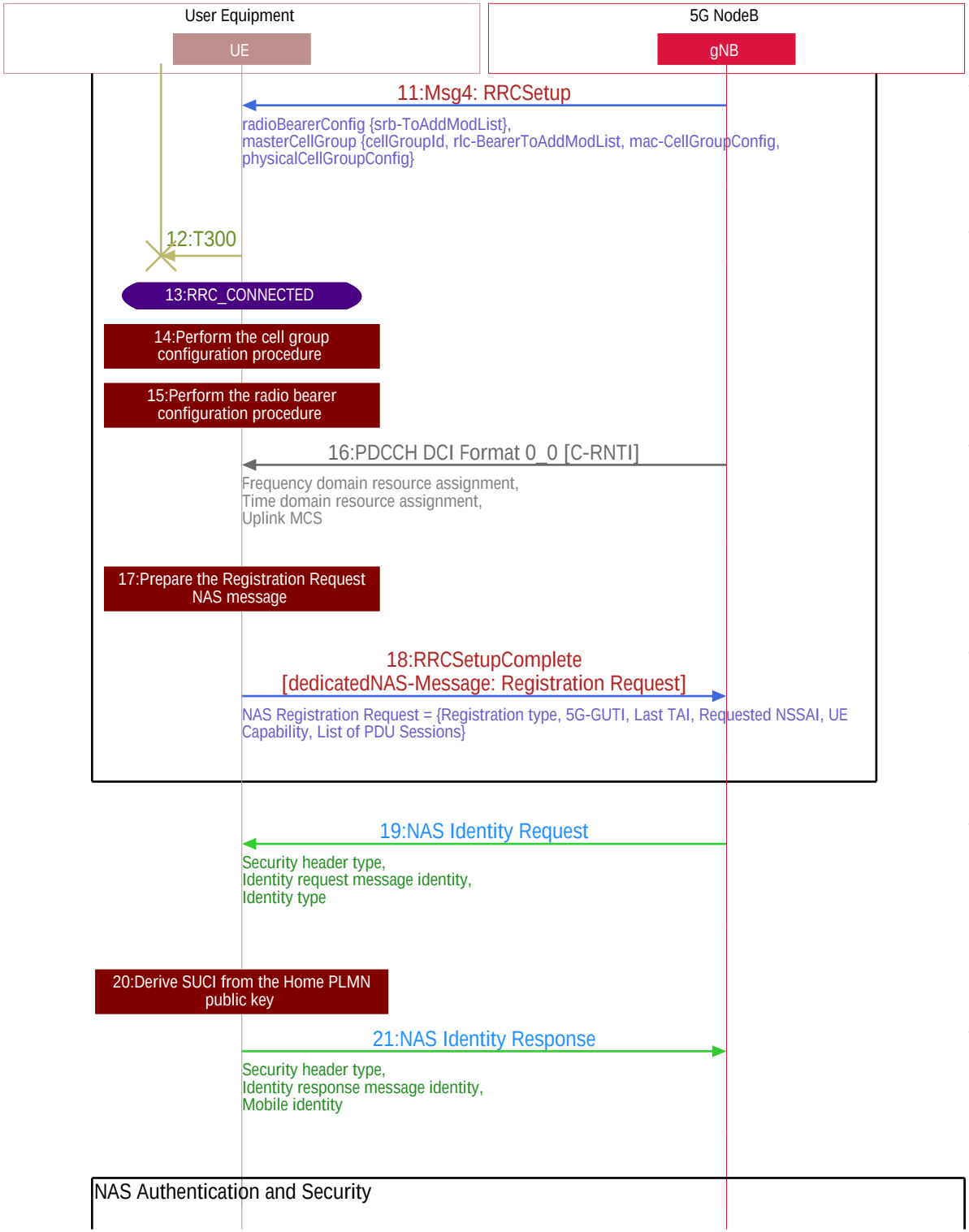
ue-Identity,
establishmentCause

The RRC Setup Request is sent with the random ue-Identity and an establishment cause.

10:PDCCH DCI Format 1_0 [C-RNTI]

Frequency domain resource assignment,
Time domain resource assignment,
Downlink MCS

The C-RNTI scrambled DCI message signals the frequency and time resources assigned for the transmission of the Transport Block containing the RRC Setup message.



The RRC Setup message is sent to setup SRB1 and the master cell. The message carries the radioBearerConfig and masterCellGroup information elements.

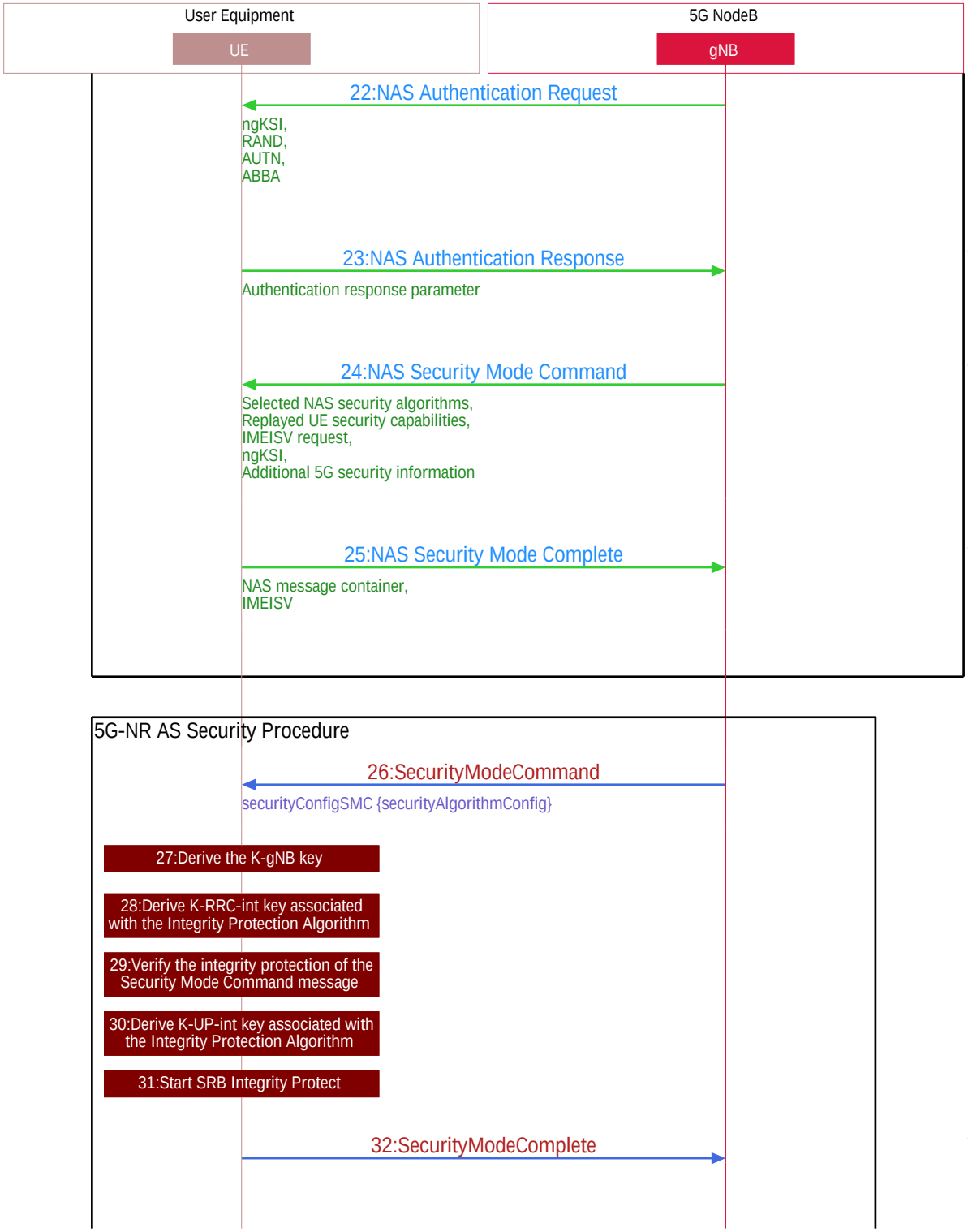
The UE stops T300 as it has received the RRC Setup message.

The gNB assigns uplink resource to the UE so that it can send the RRC Setup Complete message.

The UE sends the RRC Setup Complete message with a "Registration Request" in the dedicatedNAS-Message field.

The New AMF requests UE Identity (SUCI) from the UE via a NAS message.

The UE responds to the Identity Request.



Initiate the authentication procedure with the UE. Send the key selector, RAND and AUTN to the UE.

The UE responds to the authentication challenge.

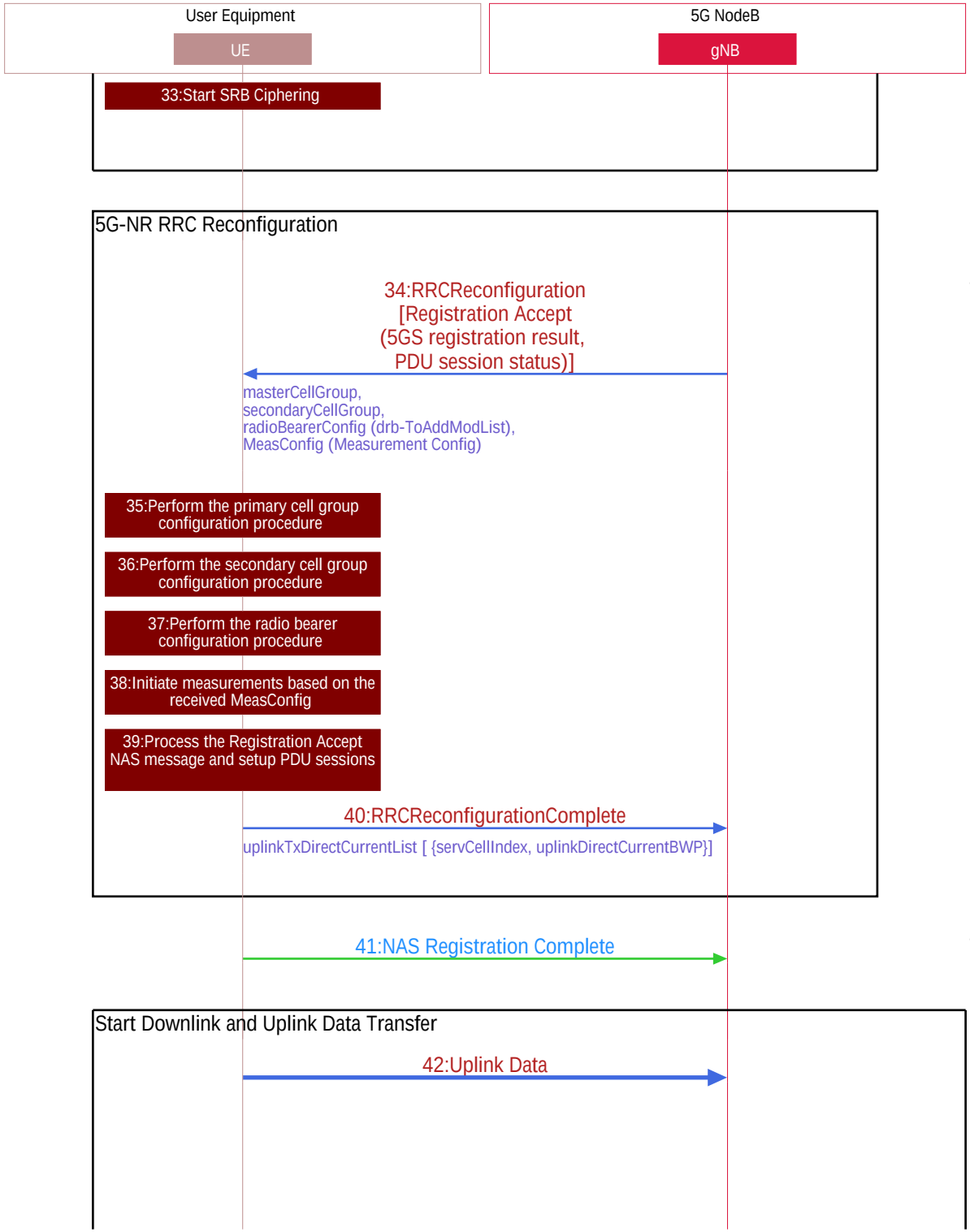
The AMF signals the selected NAS security algorithm to the UE. The AMF also requests the IMEISV from the UE.

The UE signals the completion of the NAS security procedure. The message contains the IMEISV.

K-gNB is a key derived by UE and AMF from K-AMF.

Configure lower layers to apply SRB integrity protection using the indicated algorithm and the K-RRC-int key immediately.

The security mode complete message confirms the successful completion of the security mode command. This message is integrity protected but not ciphered. Ciphering will start immediately after sending this message.



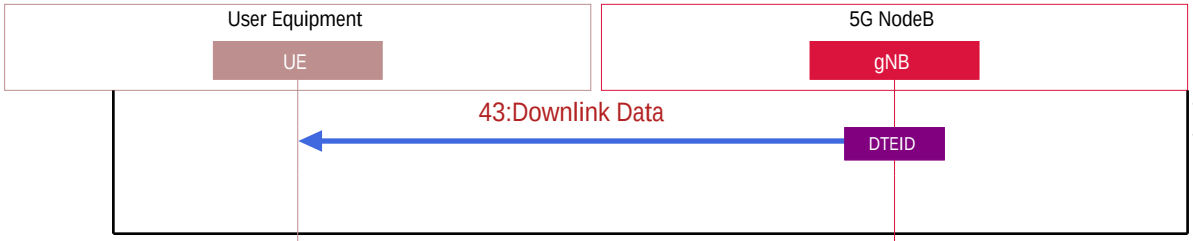
Configure lower layers to apply SRB ciphering using the indicated algorithm, the K-RRC-enc key after completing the procedure. The Security Mode Complete message is not ciphered.

The RRC Reconfiguration message is sent to the UE for setting up radio bearers, setup a secondary cell and initiate UE measurements.

Confirm the successful completion of an RRC connection reconfiguration.

The UE signals the completion of the registration via the "Registration Complete" message to the AMF.

Since the uplink path has been setup completely, the UE starts sending data. The gNB sends the UE data to the Uplink TEID.



The UPF sends the buffered data to the gNB using the Downlink TEID for the PDU session. All new downlink data also takes the same path.