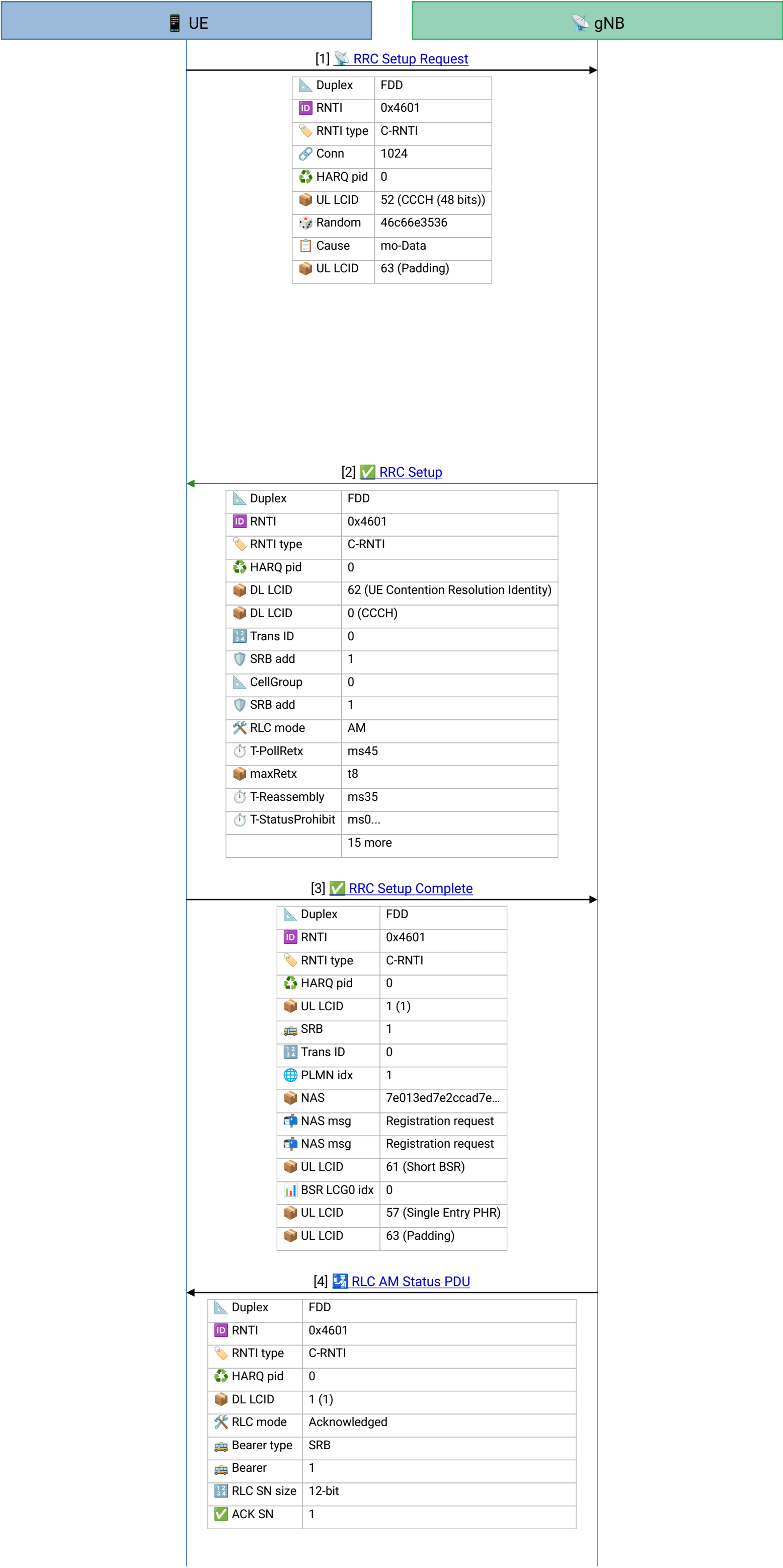




[Frame 1]

PHASE 1 — Random-access completion & RRC connection setup

Msg3: RRC Setup Request. Msg1 and Msg2 occurred before the capture. The UE sends RRCSetupRequest on SRB0/CCCH (UL LCID 52, the fixed 48-bit CCCH SDU format). Its initialUE-Identity is the 39-bit randomValue displayed as 46c66e3536, and its establishment cause is mo-Data (mobile-originated data). The RRC message does **not** propose C-RNTI 0x4601 : that temporary identity was assigned in the missing Random Access Response and appears here as MAC capture context. Contention resolution will determine whether the UE keeps it.

[Frame 2] **Msg4: RRC Setup + Contention Resolution.** gNB -> UE on CCCH (LCID 0) . The MAC **UE Contention Resolution Identity** CE (DL LCID 62) carries the first 48 bits of the Msg3 UL CCCH SDU - not just the RRC random value. A match tells the UE that it won contention, after which the temporary C-RNTI becomes its C-RNTI. The accompanying RRCSetup installs SRB1 and the master cell group. SRB1 uses RLC-AM with t-PollRetransmit = 45 ms and maxRetxThreshold = t8 ; the cell-group configuration already includes p-NR-FR1 = 10 dBm, plus BSR/PHR configuration. Applying the setup moves the UE into RRC_CONNECTED. The 45 ms poll-retransmit timer explains the cadence in Phase 6.

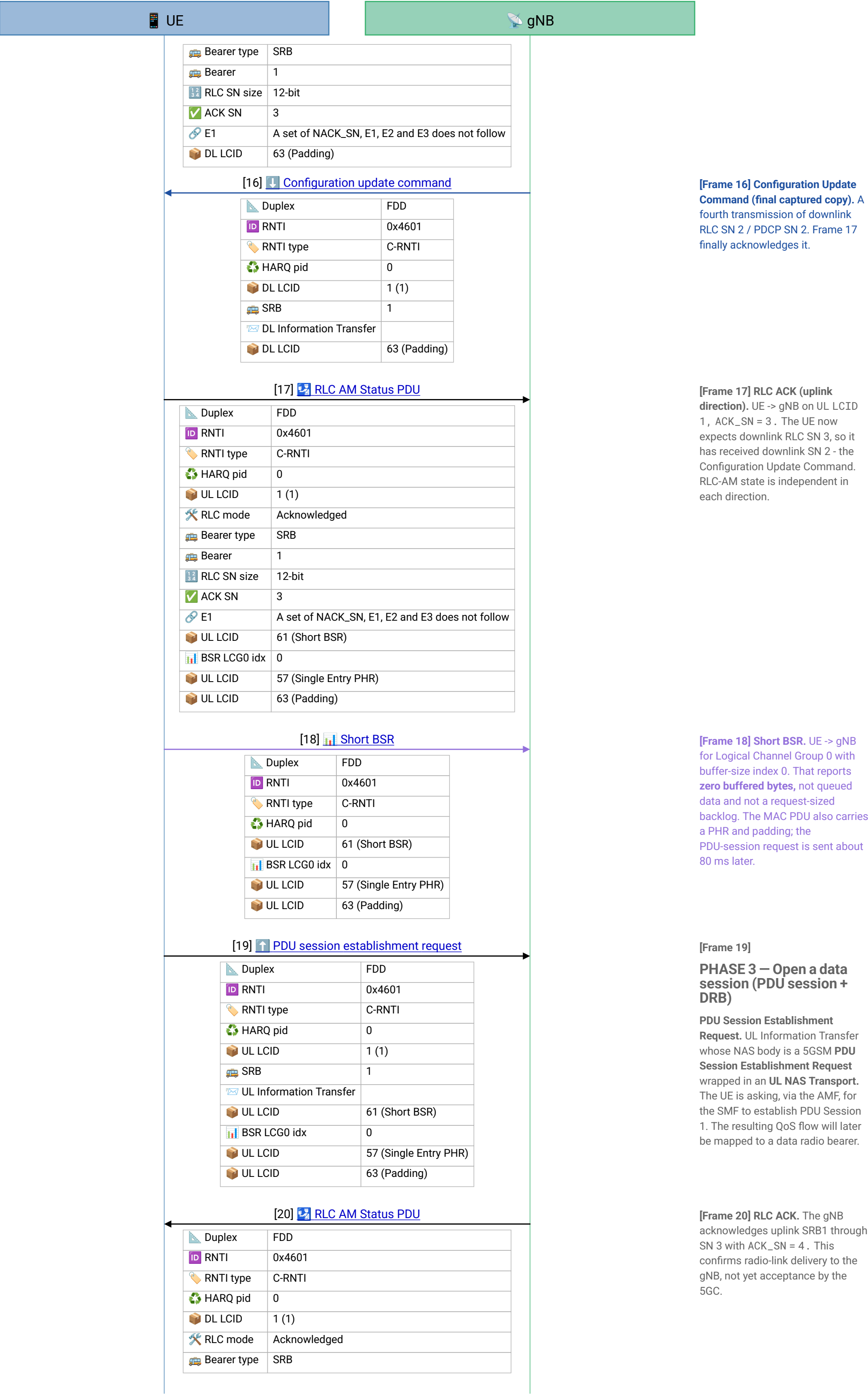
[Frame 3] **RRC Setup Complete with NAS.** UE -> gNB on SRB1 (LCID 1 , RLC-AM SN 0). RRCSetupComplete carries the first **captured** NAS message, a 5GMM Registration Request , in dedicatedNAS-Message . This is often informally called "Msg5," but it is outside the four-message random-access procedure. The same MAC PDU also includes a Short BSR with buffer-size index 0 and a PHR. From this point, RRC provides the radio signaling transport while NAS procedures run between the UE and 5GC.

[Frame 4]

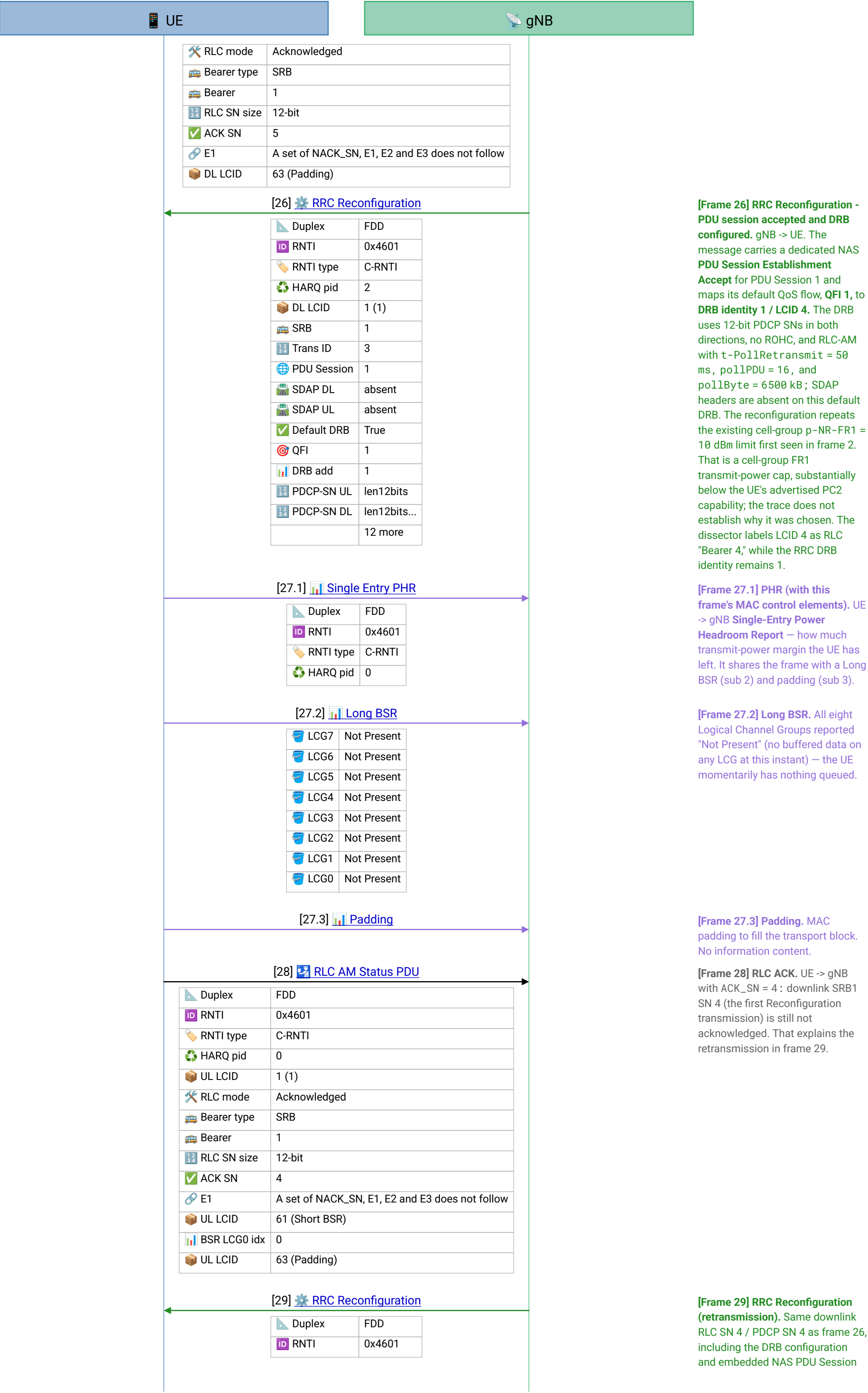
PHASE 2 — AS security, then NAS registration completes

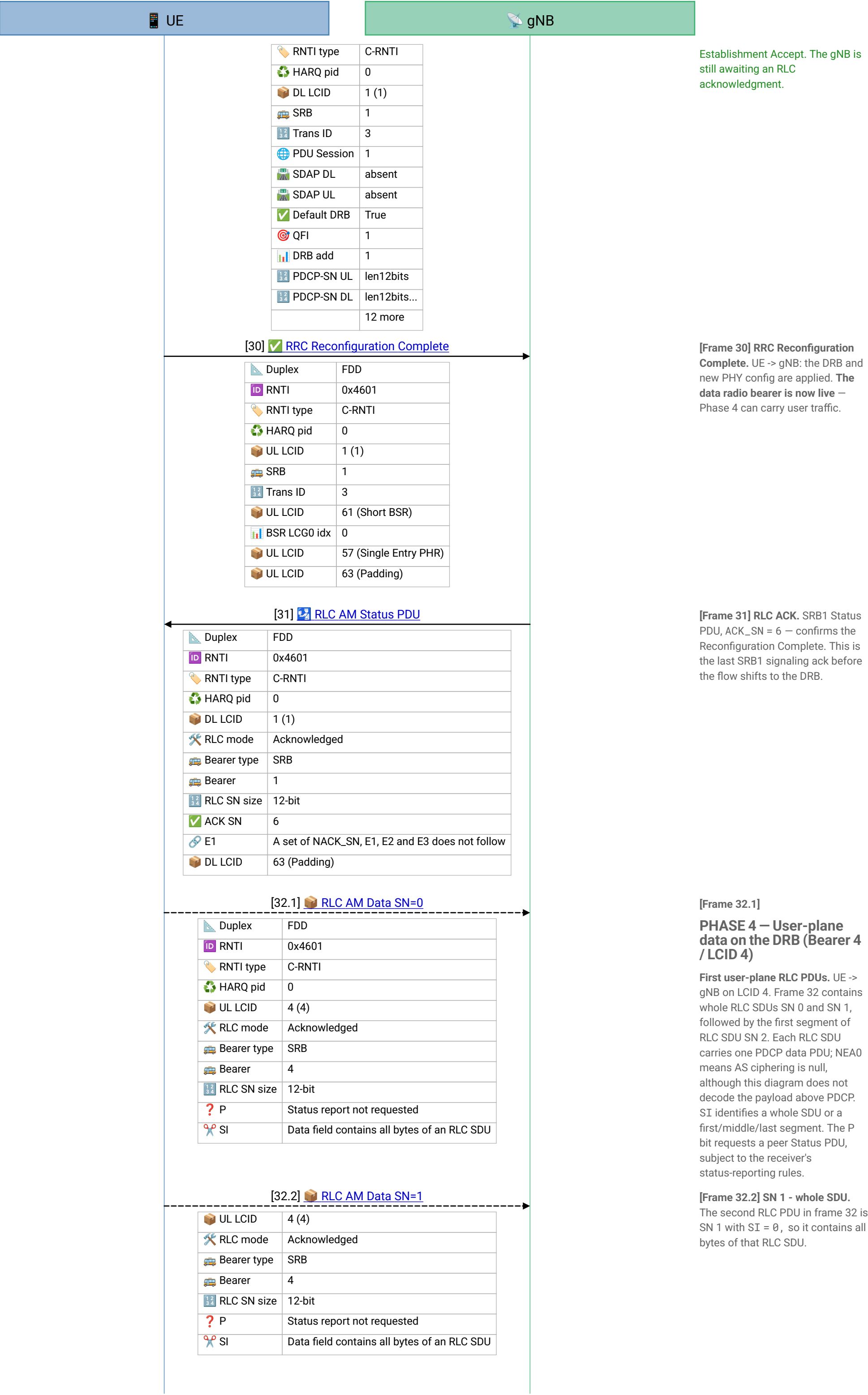
RLC ACK for the setup. The gNB sends an SRB1 RLC-AM Status PDU with ACK_SN = 1 and no NACKs: it expects uplink SN 1 next, so uplink SN 0 was received. This confirms delivery to the gNB RLC entity, including the bytes that carried RRCSetupComplete ; it does not by itself confirm delivery to the AMF.











UE

gNB

[32.3] RLC AM Data SN=2

UL LCID	4 (4)
RLC mode	Acknowledged
Bearer type	SRB
Bearer	4
RLC SN size	12-bit
P	Status report not requested
SI	Data field contains the first segment of an RLC SDU
UL LCID	61 (Short BSR)
UL LCID	57 (Single Entry PHR)

[33] RLC AM Data SN=2

Duplex	FDD
RNTI	0x4601
RNTI type	C-RNTI
HARQ pid	0
UL LCID	4 (4)
RLC mode	Acknowledged
Bearer type	SRB
Bearer	4
RLC SN size	12-bit
P	Status report is requested
SI	Data field contains the last segment of an RLC SDU
SO	394
SDU fragments	2
UL LCID	62 (Long BSR)
UL LCID	63 (Padding)

[34] RLC AM Status PDU

Duplex	FDD
RNTI	0x4601
RNTI type	C-RNTI
HARQ pid	0
DL LCID	4 (4)
RLC mode	Acknowledged
Bearer type	SRB
Bearer	4
RLC SN size	12-bit
ACK SN	3
E1	A set of NACK_SN, E1, E2 and E3 does not follow
DL LCID	63 (Padding)

[35] RLC AM Data SN=3

Duplex	FDD
RNTI	0x4601
RNTI type	C-RNTI
HARQ pid	0
UL LCID	4 (4)
RLC mode	Acknowledged
Bearer type	SRB
Bearer	4
RLC SN size	12-bit
P	Status report is requested
SI	Data field contains all bytes of an RLC SDU
UL LCID	61 (Short BSR)
BSR LCG0 idx	0
UL LCID	57 (Single Entry PHR)
UL LCID	63 (Padding)

[36.1] RLC AM Data SN=4

Duplex	FDD
RNTI	0x4601
RNTI type	C-RNTI
HARQ pid	0

[Frame 32.3] SN 2 - first segment.

The third RLC PDU has SI = 1 , beginning a segmented RLC SDU. MAC also multiplexes a Short BSR and PHR in the same transport block.

[Frame 33] SN 2 - last segment, poll set.

SI = 2 , SO = 394 ; together with frame 32 this completes RLC SDU SN 2 in two segments. The P bit requests a Status PDU. With t-StatusProhibit = 0 , the gNB answers in the next frame.

[Frame 34] RLC ACK on the DRB.

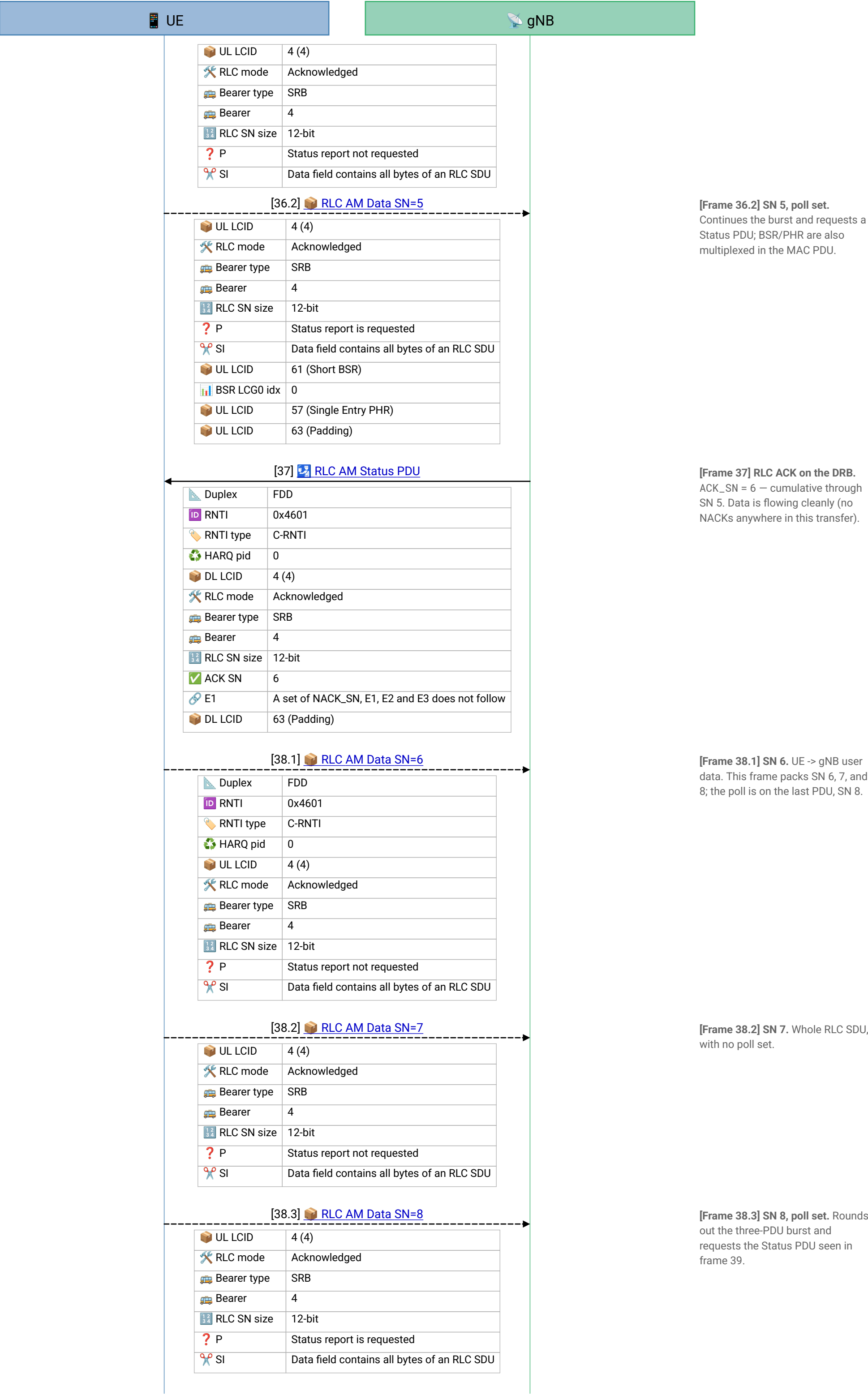
gNB -> UE Status PDU on **Bearer 4**, ACK_SN = 3 — cumulative through SN 2. This answers the status request from frame 33. Notice that ARQ is now bookkeeping the *data* bearer separately from SRB1.

[Frame 35] SN 3, poll set.

UE -> gNB, a whole RLC SDU whose P bit requests another DRB Status PDU.

[Frame 36.1] SN 4.

UE -> gNB user data (whole SDU). Shares the frame with SN 5.



UE

gNB

 UL LCID	61 (Short BSR)
 BSR LCG0 idx	0
 UL LCID	57 (Single Entry PHR)
 UL LCID	63 (Padding)

[39]  RLC AM Status PDU

 Duplex	FDD
 RNTI	0x4601
 RNTI type	C-RNTI
 HARQ pid	0
 DL LCID	4 (4)
 RLC mode	Acknowledged
 Bearer type	SRB
 Bearer	4
 RLC SN size	12-bit
 ACK SN	9
 E1	A set of NACK_SN, E1, E2 and E3 does not follow
 DL LCID	63 (Padding)

[40]  RLC AM Data SN=9

 Duplex	FDD
 RNTI	0x4601
 RNTI type	C-RNTI
 HARQ pid	0
 UL LCID	4 (4)
 RLC mode	Acknowledged
 Bearer type	SRB
 Bearer	4
 RLC SN size	12-bit
 P	Status report not requested
 SI	Data field contains the first segment of an RLC SDU
 UL LCID	61 (Short BSR)
 UL LCID	57 (Single Entry PHR)

[41]  RLC AM Data SN=9

 Duplex	FDD
 RNTI	0x4601
 RNTI type	C-RNTI
 HARQ pid	0
 UL LCID	4 (4)
 RLC mode	Acknowledged
 Bearer type	SRB
 Bearer	4
 RLC SN size	12-bit
 P	Status report is requested
 SI	Data field contains the last segment of an RLC SDU
 SO	534
 SDU fragments	2
 UL LCID	62 (Long BSR)
 UL LCID	63 (Padding)

[42]  RLC AM Status PDU

 Duplex	FDD
 RNTI	0x4601
 RNTI type	C-RNTI
 HARQ pid	0
 DL LCID	4 (4)
 RLC mode	Acknowledged
 Bearer type	SRB
 Bearer	4
 RLC SN size	12-bit
 ACK SN	10
 E1	A set of NACK_SN, E1, E2 and E3 does not follow
 DL LCID	63 (Padding)

[Frame 39] RLC ACK on the DRB.
ACK_SN = 9 – through SN 8.

[Frame 40] SN 9 – first segment.
UE -> gNB; the SDU is split again (see the matching last segment in the next frame). Note the ~1 s gap before this frame – the user-plane traffic is bursty, not continuous.

[Frame 41] SN 9 – last segment, poll set. S0 = 534, 2 fragments reassembled; poll set to demand a status report.

[Frame 42] RLC ACK on the DRB.
ACK_SN = 10 – through SN 9 (both segments).

UE

gNB

[43] RLC AM Data SN=10

Duplex	FDD
RNTI	0x4601
RNTI type	C-RNTI
HARQ pid	0
UL LCID	4 (4)
RLC mode	Acknowledged
Bearer type	SRB
Bearer	4
RLC SN size	12-bit
P	Status report is requested
SI	Data field contains all bytes of an RLC SDU
UL LCID	61 (Short BSR)
BSR LCG0 idx	0
UL LCID	57 (Single Entry PHR)
UL LCID	63 (Padding)

[44] RLC AM Data SN=11

Duplex	FDD
RNTI	0x4601
RNTI type	C-RNTI
HARQ pid	0
UL LCID	4 (4)
RLC mode	Acknowledged
Bearer type	SRB
Bearer	4
RLC SN size	12-bit
P	Status report is requested
SI	Data field contains all bytes of an RLC SDU
UL LCID	61 (Short BSR)
BSR LCG0 idx	0
UL LCID	57 (Single Entry PHR)
UL LCID	63 (Padding)

[45] RLC AM Status PDU

Duplex	FDD
RNTI	0x4601
RNTI type	C-RNTI
HARQ pid	0
DL LCID	4 (4)
RLC mode	Acknowledged
Bearer type	SRB
Bearer	4
RLC SN size	12-bit
ACK SN	12
E1	A set of NACK_SN, E1, E2 and E3 does not follow
DL LCID	63 (Padding)

[46] RLC AM Data SN=12

Duplex	FDD
RNTI	0x4601
RNTI type	C-RNTI
HARQ pid	0
UL LCID	4 (4)
RLC mode	Acknowledged
Bearer type	SRB
Bearer	4
RLC SN size	12-bit
P	Status report not requested
SI	Data field contains the first segment of an RLC SDU
UL LCID	61 (Short BSR)
UL LCID	57 (Single Entry PHR)

[47.1] RLC AM Data SN=12

[Frame 43] SN 10, poll set. Whole RLC SDU with a status request.

[Frame 44] SN 11, poll set. Another whole RLC SDU with a status request. Consecutive polls do not by themselves indicate packet loss; the following Status PDU has no NACKs.

[Frame 45] RLC ACK on the DRB. ACK_SN = 12 – through SN 11.

[Frame 46] SN 12 – first segment. Another ~2 s gap, then a segmented SDU begins.

[Frame 47.1] SN 12 – last segment, then SN 13. S0 = 534, 2



