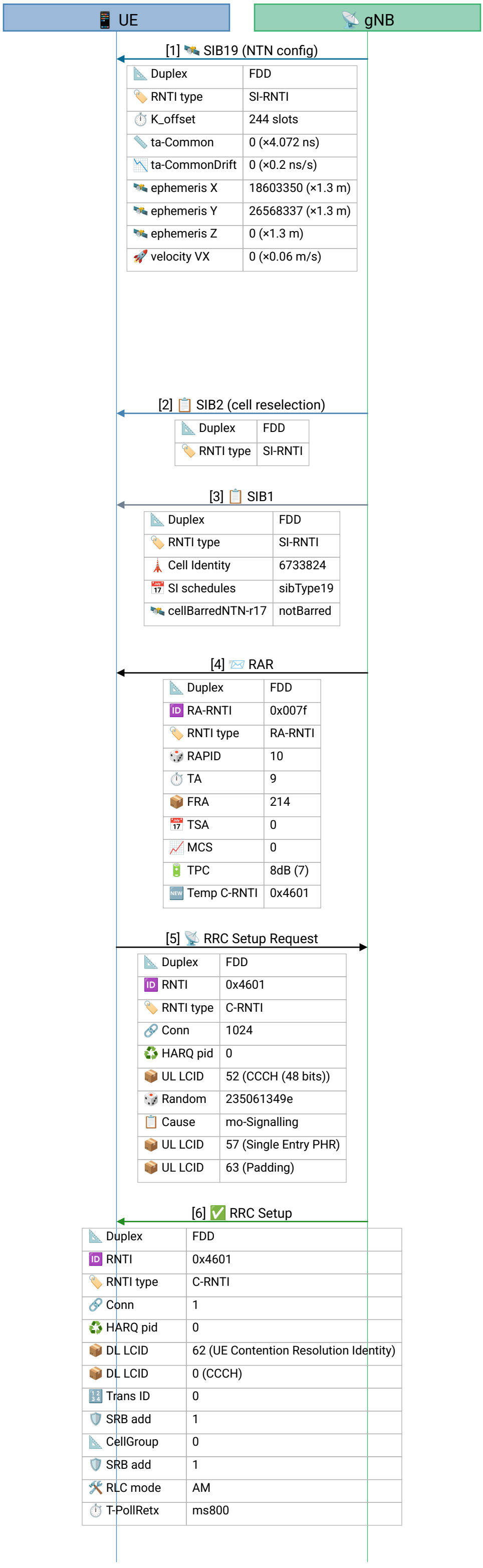
ntn-geo-satellite-attach.annotated



[Frame 1]

Phase 1: A satellite cell announces itself

SIB19: the message that makes this a satellite cell. System Information Block 19 is new in 3GPP Release 17 and exists only for non-terrestrial networks (NTN). It tells the phone where the satellite is, so the phone can work out its own timing before it transmits.

The ephemeris (the satellite's position and velocity) gives the orbit away. `positionX` 18,603,350 and `positionY` 26,568,337, in units of 1.3 m, put the satellite 42,164 km from Earth's center: the geostationary radius. `positionZ` is 0 (over the equator) and all three velocity components are 0. A geostationary (GEO) satellite holds still relative to the rotating Earth, so its position never changes.

`cellSpecificKoffset-r17: 244` is the scheduling offset `K_offset: 244` slots, which at 15 kHz subcarrier spacing is 244 ms. Every uplink grant and every HARQ acknowledgement is pushed this much later, so a grant can cross the satellite before the transmission it schedules is due.

Also note what is missing: no `epochTime-r17`, no `ntn-UlSyncValidityDuration-r17`, no `kmac-r17`, and `ta-Common-r17` is 0. A moving low-orbit satellite needs those fields because its ephemeris goes stale within seconds. A satellite that never moves does not.

[Frame 2] SIB2. Ordinary cell-reselection thresholds, nothing NTN.

[Frame 3] SIB1: the NTN access gate, and two windows that look too short. `cellBarredNTN-r17: notBarred` is read only by NTN-capable phones, which use it in place of the ordinary barring flag. Operators use this pair to keep phones without NTN support off a satellite cell. The scheduling list maps `sibType19` into a Release 17 system-information message.

The random-access settings look wrong at first. `ra-ResponseWindow` is `sl10` (10 ms) and `ra-ContentionResolutionTimer` is `sf64` (64 ms), both far shorter than a 244 ms round trip. They are correct: in NTN, TS 38.321 starts both windows one UE-to-gNB round trip later than on a terrestrial cell. The length stays the same and only the start moves.

[Frame 4]

Phase 2: Random access, with the phone doing the timing

The random-access response (RAR) shows the phone already did the timing work. It arrives 98 s after the system information, when the test UE starts its attach. `Timing Advance: 9` is nine steps of 0.52 µs, about 4.7 µs of correction.

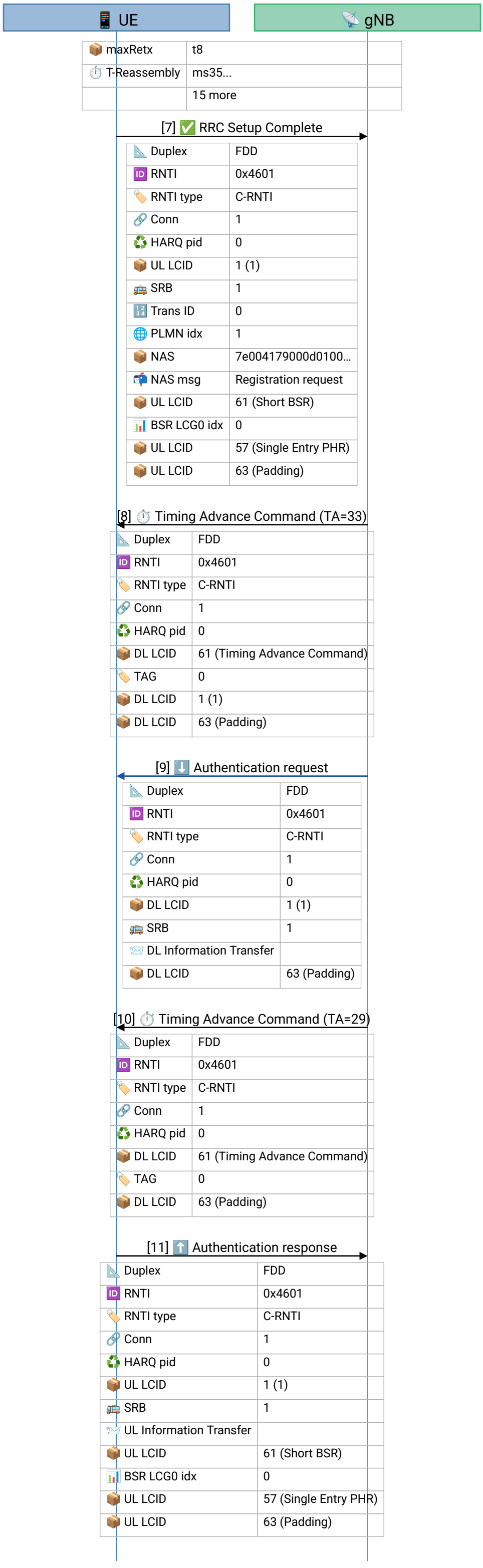
The 12-bit RAR field tops out at 3,846 steps, about 2.0 ms. It could never express a quarter-second round trip, and it doesn't need to. Before sending its preamble, the UE computed its own advance from the SIB19 ephemeris and its GNSS (satellite-navigation) position. The RAR carries only the small error the gNB still measures. On a terrestrial cell it is the other way round: the phone transmits with no advance and the RAR value is the whole correction.

[Frame 5] Msg3 (RRC Setup Request), 255 ms after the RAR. On a terrestrial cell this gap is a few milliseconds. Here it is `K_offset` (244 ms) plus the usual few slots of grant delay: the RAR's uplink grant is deliberately scheduled 244 slots later so the UE can receive it and transmit on time.

[Frame 6] RRC Setup: a poll timer sized for the satellite. Signaling radio bearer 1 (SRB1) is set up in RLC acknowledged mode with `t-PollRetransmit: ms800`. This timer is how long the sender waits for a status report before asking again. No report can return in under one round trip here, so 800 ms is a safe value. `t-StatusProhibit: ms0` means status reports are never held back, because each one already costs a round trip.

Two MAC settings matter later. Scheduling-request opportunities come every 320 ms (`sl320`): that is how often the UE may ask for uplink capacity. And there are 16 downlink HARQ processes, with HARQ feedback due 4 slots after each transmission plus `K_offset`.

Keep the 800 ms timer in mind: the data bearer configured later gets a very different value.



[Frame 7] RRC Setup Complete, 293 ms after the Setup. This is the first clean measurement of the link. The srsRAN maintainer computed a 243.7 ms round trip from the UE and satellite coordinates. The rest is processing and scheduling.

Every UE reply in this attach lands 266-319 ms after the message that prompted it, while the gNB's own back-to-back messages are under 10 ms apart. That contrast, milliseconds at the gNB and a third of a second across the space link, is the shape of every GEO flow.

[Frame 8] Timing Advance Command, TA = 33. The 6-bit MAC command runs 0-63, with 31 meaning "no change", so 33 is +2 steps, about +1.0 µs. The gNB's closed loop is trimming about a microsecond while the UE's own advance covers the whole satellite delay.

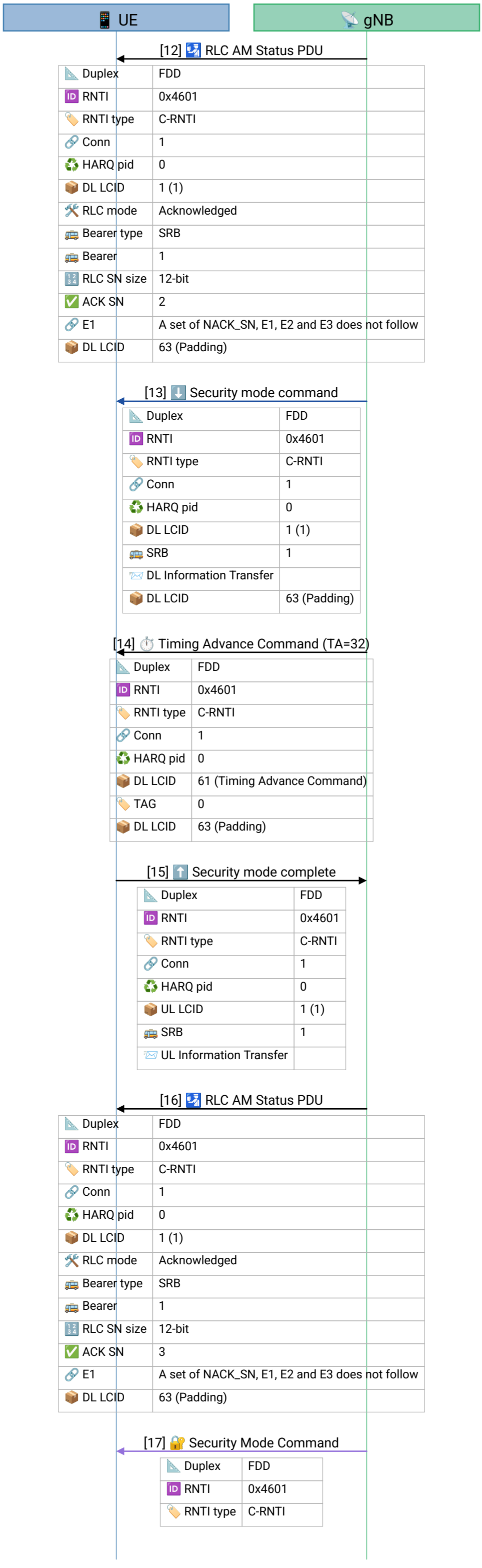
[Frame 9]

Phase 3: Registration, one round trip per step

Authentication Request. Ordinary 5G NAS; only the clock differs. The answer arrives 311 ms later.

[Frame 10] Timing Advance Command, TA = 29: two steps below neutral, about -1.0 µs. The corrections wander either side of zero, as expected for a satellite that does not move. A low-orbit satellite would drift steadily in one direction through a pass.

[Frame 11] Authentication Response, 311 ms after the request.



[Frame 12] RLC status report on SRB1. The gNB acknowledges at once (`t-StatusProhibit: ms0`).

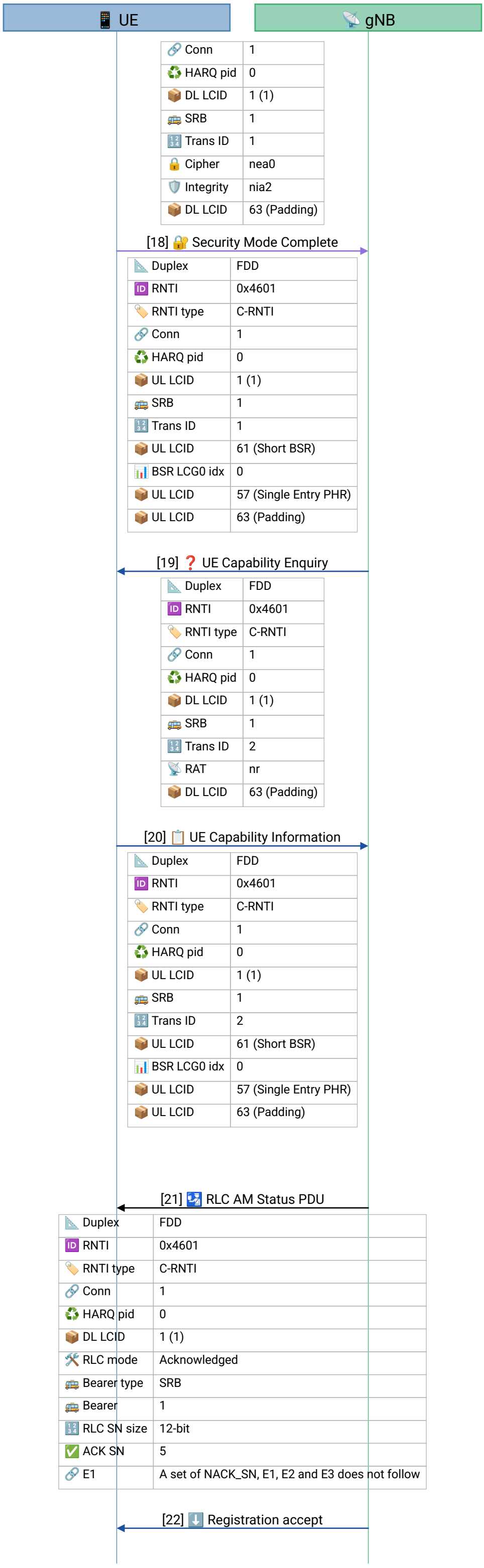
[Frame 13] NAS Security Mode Command. The core selects `5G-EA0` (null ciphering) with `128-5G-IA2` integrity. Null ciphering is why every NAS message after this point is still readable in the capture.

[Frame 14] Timing Advance Command, TA = 32: one step above neutral, about +0.5 µs.

[Frame 15] NAS Security Mode Complete, 310 ms after the command.

[Frame 16] RLC status report on SRB1.

[Frame 17] RRC Security Mode Command. Radio-layer security with `nea0` (null) ciphering and `nia2` integrity. NTN changes nothing here; null ciphering is what keeps the RRC messages and user data readable.



[Frame 18] RRC Security Mode Complete, 295 ms later.

[Frame 19] UE Capability Enquiry. The reply is the most NTN-specific message in the capture.

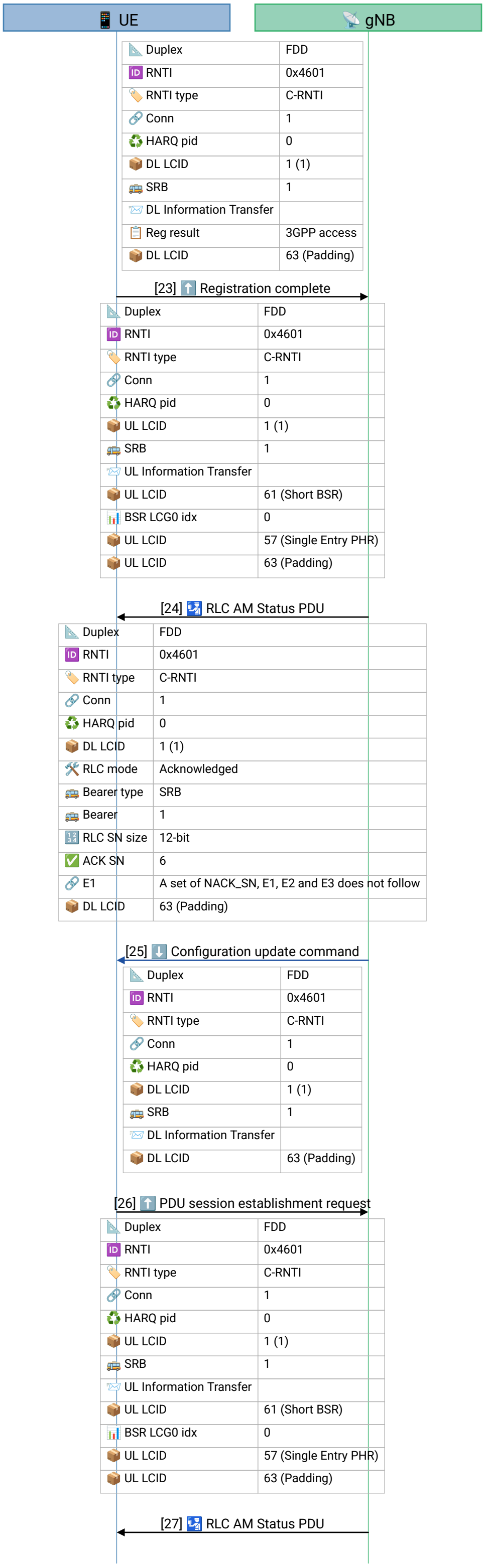
[Frame 20] UE Capability Information: the NTN feature set. The UE reports `accessStratumRelease: rel17` and `nonTerrestrialNetwork-r17: supported`, plus the features that go with it:

- `harq-FeedbackDisabled-r17:` HARQ feedback can be switched off per process. Over a quarter-second round trip, a HARQ process that waits for its acknowledgement sits idle; recovery can move up to RLC instead.
- `max-HARQ-ProcessNumber-r17: u32d32 :` 32 uplink and 32 downlink HARQ processes instead of 16, to keep more data in flight.
- `ue-specific-K-Offset-r17:` a per-UE scheduling offset on top of the cell-wide `K_offset.`
- `uplink-TA-Reporting-r17` and `sr-TriggeredBy-TA-Report-r17:` the UE can report its own timing advance to the gNB.
- `locationBasedCondHandover-r17, timeBasedCondHandover-r17, eventA4BasedCondHandover-r17, eventD1-MeasReportTrigger-r17:` handover triggered by position or time. A satellite's coverage moves on a known schedule, so handover can be planned rather than only measured.
- `uplink-Harq-ModeB-r17, lastTransmissionUL-r17:` further long-delay adaptations.

The gNB never uses `harq-FeedbackDisabled-r17:` no RRC Reconfiguration here turns it on. HARQ runs with feedback, 16 processes, over the full round trip.

[Frame 21] RLC status report on SRB1.

[Frame 22] Registration Accept. Ordinary 5G registration, slice SST 1 (eMBB, enhanced mobile broadband).



[Frame 23] Registration Complete, 314 ms later. From RRC Setup to here took about 1.9 s for six request-reply exchanges. On GEO, each exchange costs a round trip, which is why NTN design counts round trips, not bytes.

[Frame 24] RLC status report on SRB1.

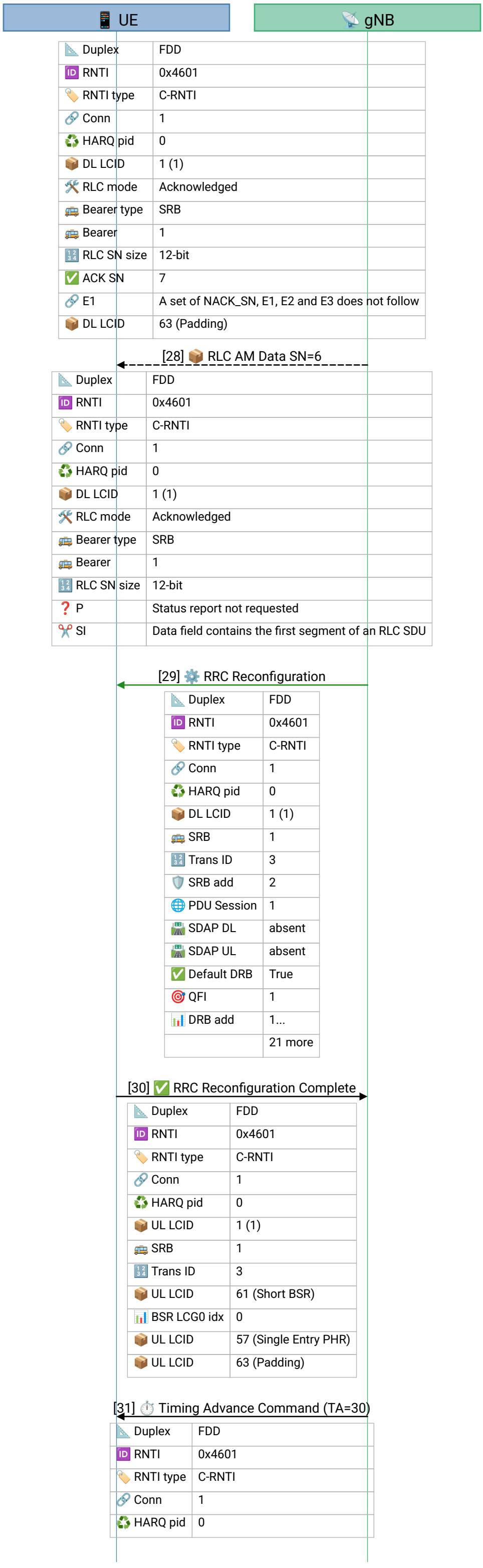
[Frame 25] Configuration Update Command.

[Frame 26]

Phase 4: The data bearer

PDU Session Establishment Request for DNN `internet`, PDU session 1. The network's acceptance rides inside the RRC Reconfiguration that follows.

[Frame 27] RLC status report on SRB1.



[Frame 28] RLC data, SN 6 on SRB1: the first segment of the large RRC Reconfiguration that follows.

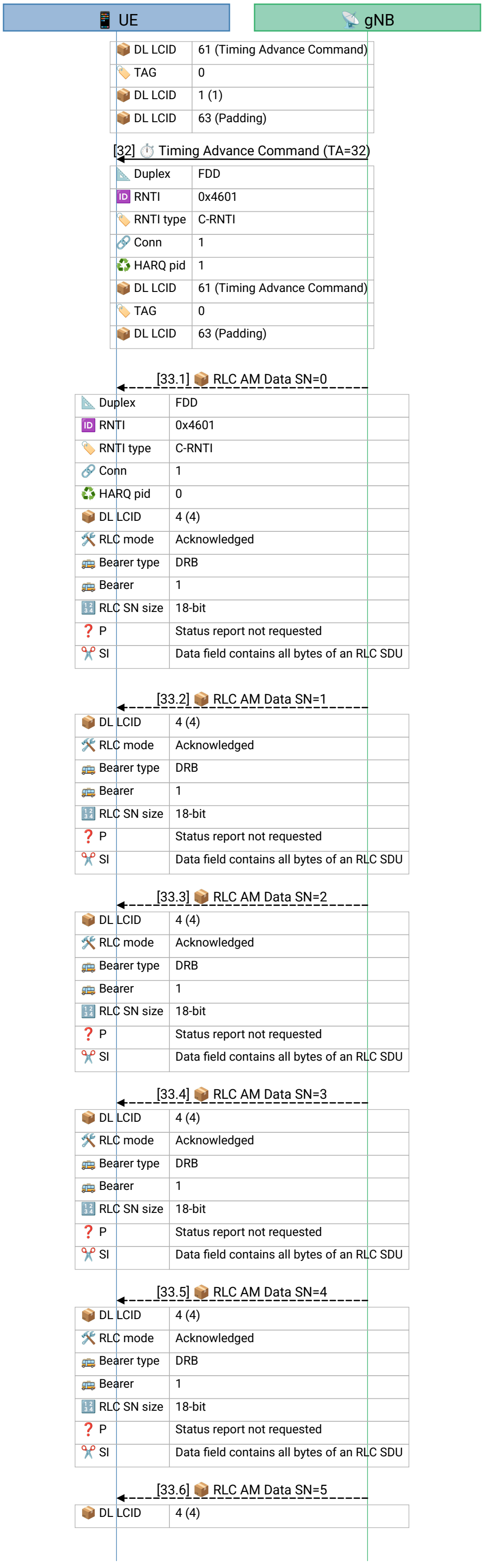
[Frame 29] RRC Reconfiguration: the data bearer gets a terrestrial poll timer. This adds SRB2 and data radio bearer 1 (DRB1). Read in order (SRB2 first, then DRB1), the two RLC configurations differ:

Setting	SRB2	DRB1
`t-PollRetransmit`	ms800	ms100
`pollPDU`	infinity	p16
`maxRetxThreshold`	t8	t32
`t-StatusProhibit`	ms0	ms10

SRB2 inherits the 800 ms poll timer. DRB1 gets 100 ms, well under the round trip, so on the data bearer the timer always expires before any status report can arrive. PDCP `t-Reordering` on the same bearer is `ms220`. The poll timer's effect shows at the very end of the full run (see the last data frame).

[Frame 30] RRC Reconfiguration Complete, 266 ms later. The bearer is up. User data starts three frames later.

[Frame 31] Timing Advance Command, TA = 30: one step below neutral.



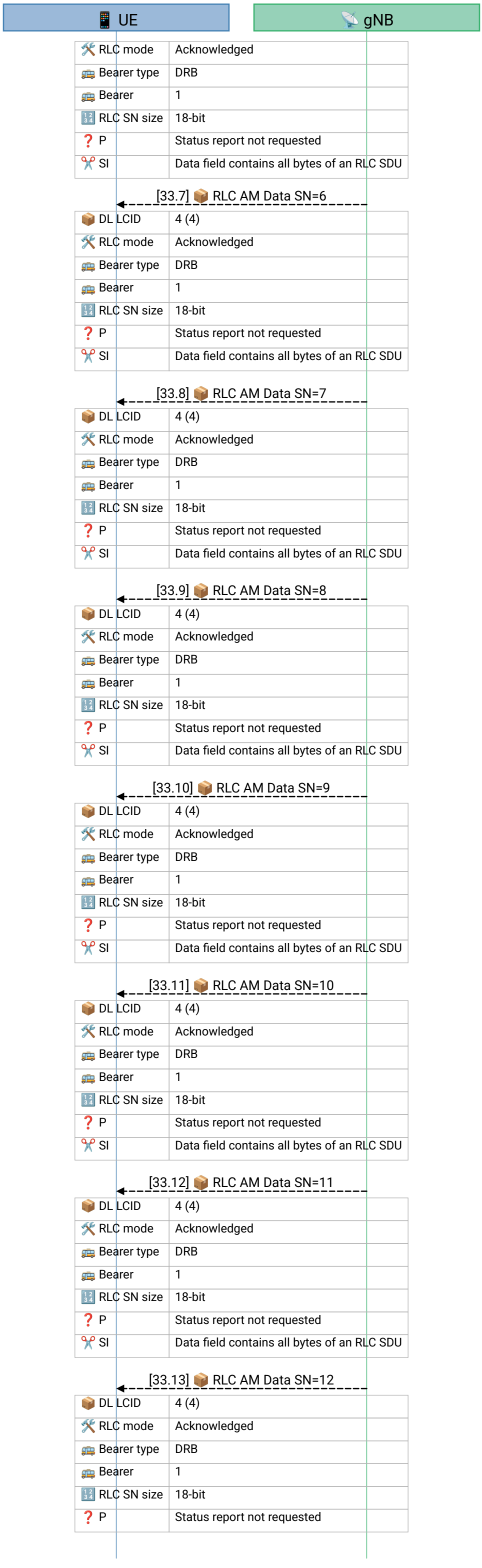
[Frame 32] Timing Advance Command, TA = 32: one step above. That makes five closed-loop corrections in the attach, each worth about a microsecond.

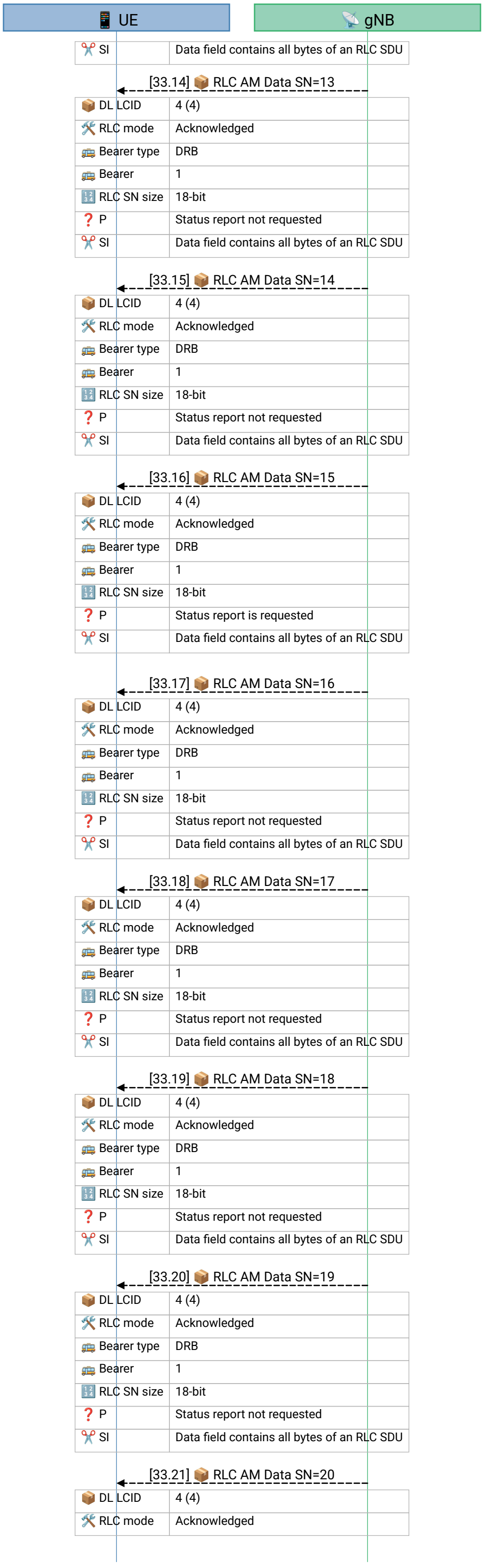
[Frame 33.1]

Phase 5: Downlink data across the satellite

One transport block, 56 RLC PDUs. The first downlink data frame carries RLC sequence numbers 0-55 on DRB1 in a single 11.5 kB MAC PDU. These are iperf UDP packets (192.168.32.41 to the UE at 10.45.0.2, port 5001) that queued while the bearer was being built.

The payload is readable because user-plane ciphering is null and the decode maps logical channel 4 to DRB1 from the RRC configuration. Without that mapping, these PDUs would be passed to the RRC dissector and shown as nonsense.


📱 UE
📡 gNB
🛠️ RLC mode | Acknowledged
🚌 Bearer type | DRB
🚌 Bearer | 1
🔢 RLC SN size | 18-bit
❓ P | Status report not requested
✂️ SI | Data field contains all bytes of an RLC SDU
[33.7] 📦 RLC AM Data SN=6
📦 DL LCID | 4 (4)
🛠️ RLC mode | Acknowledged
🚌 Bearer type | DRB
🚌 Bearer | 1
🔢 RLC SN size | 18-bit
❓ P | Status report not requested
✂️ SI | Data field contains all bytes of an RLC SDU
[33.8] 📦 RLC AM Data SN=7
📦 DL LCID | 4 (4)
🛠️ RLC mode | Acknowledged
🚌 Bearer type | DRB
🚌 Bearer | 1
🔢 RLC SN size | 18-bit
❓ P | Status report not requested
✂️ SI | Data field contains all bytes of an RLC SDU
[33.9] 📦 RLC AM Data SN=8
📦 DL LCID | 4 (4)
🛠️ RLC mode | Acknowledged
🚌 Bearer type | DRB
🚌 Bearer | 1
🔢 RLC SN size | 18-bit
❓ P | Status report not requested
✂️ SI | Data field contains all bytes of an RLC SDU
[33.10] 📦 RLC AM Data SN=9
📦 DL LCID | 4 (4)
🛠️ RLC mode | Acknowledged
🚌 Bearer type | DRB
🚌 Bearer | 1
🔢 RLC SN size | 18-bit
❓ P | Status report not requested
✂️ SI | Data field contains all bytes of an RLC SDU
[33.11] 📦 RLC AM Data SN=10
📦 DL LCID | 4 (4)
🛠️ RLC mode | Acknowledged
🚌 Bearer type | DRB
🚌 Bearer | 1
🔢 RLC SN size | 18-bit
❓ P | Status report not requested
✂️ SI | Data field contains all bytes of an RLC SDU
[33.12] 📦 RLC AM Data SN=11
📦 DL LCID | 4 (4)
🛠️ RLC mode | Acknowledged
🚌 Bearer type | DRB
🚌 Bearer | 1
🔢 RLC SN size | 18-bit
❓ P | Status report not requested
✂️ SI | Data field contains all bytes of an RLC SDU
[33.13] 📦 RLC AM Data SN=12
📦 DL LCID | 4 (4)
🛠️ RLC mode | Acknowledged
🚌 Bearer type | DRB
🚌 Bearer | 1
🔢 RLC SN size | 18-bit
❓ P | Status report not requested



[Frame 33.16] SN 15 carries the poll bit. `pollPDU : p16 :` the sender asks for a status report every 16 PDUs.

📱 UE	gNB 📡

🚌 Bearer type	DRB
🚌 Bearer	1
🔢 RLC SN size	18-bit
❓ P	Status report not requested
✂️ SI	Data field contains all bytes of an RLC SDU

[33.22] 📦 RLC AM Data SN=21

📦 DL LCID	4 (4)
🛠️ RLC mode	Acknowledged
🚌 Bearer type	DRB
🚌 Bearer	1
🔢 RLC SN size	18-bit
❓ P	Status report not requested
✂️ SI	Data field contains all bytes of an RLC SDU

[33.23] 📦 RLC AM Data SN=22

📦 DL LCID	4 (4)
🛠️ RLC mode	Acknowledged
🚌 Bearer type	DRB
🚌 Bearer	1
🔢 RLC SN size	18-bit
❓ P	Status report not requested
✂️ SI	Data field contains all bytes of an RLC SDU

[33.24] 📦 RLC AM Data SN=23

📦 DL LCID	4 (4)
🛠️ RLC mode	Acknowledged
🚌 Bearer type	DRB
🚌 Bearer	1
🔢 RLC SN size	18-bit
❓ P	Status report not requested
✂️ SI	Data field contains all bytes of an RLC SDU

[33.25] 📦 RLC AM Data SN=24

📦 DL LCID	4 (4)
🛠️ RLC mode	Acknowledged
🚌 Bearer type	DRB
🚌 Bearer	1
🔢 RLC SN size	18-bit
❓ P	Status report not requested
✂️ SI	Data field contains all bytes of an RLC SDU

[33.26] 📦 RLC AM Data SN=25

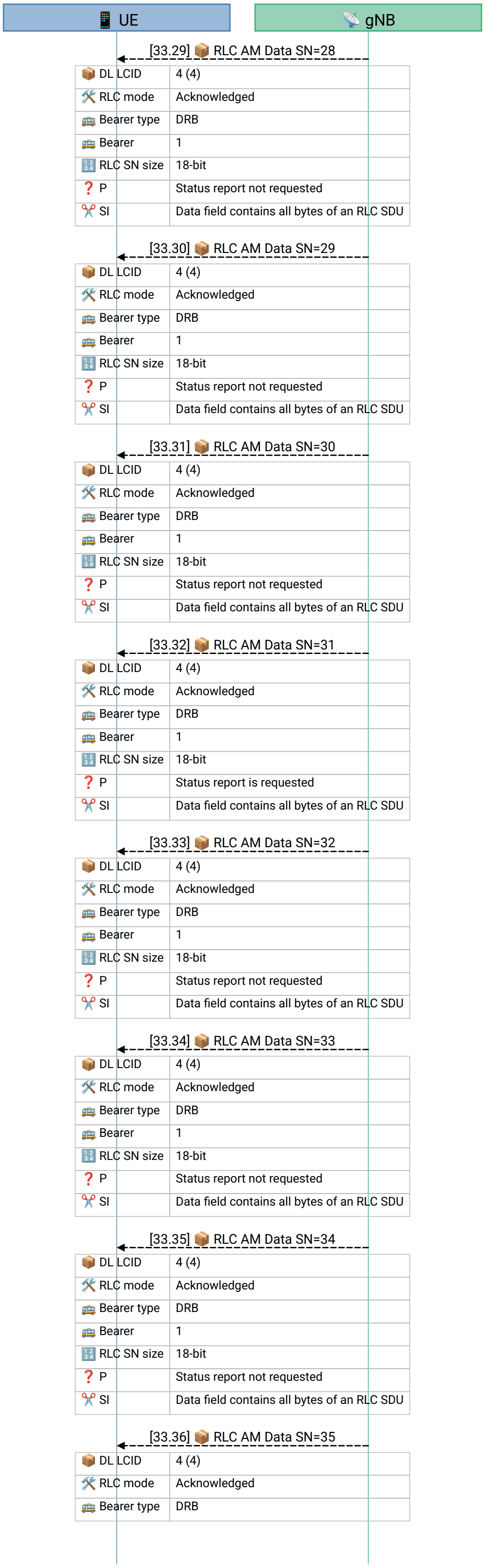
📦 DL LCID	4 (4)
🛠️ RLC mode	Acknowledged
🚌 Bearer type	DRB
🚌 Bearer	1
🔢 RLC SN size	18-bit
❓ P	Status report not requested
✂️ SI	Data field contains all bytes of an RLC SDU

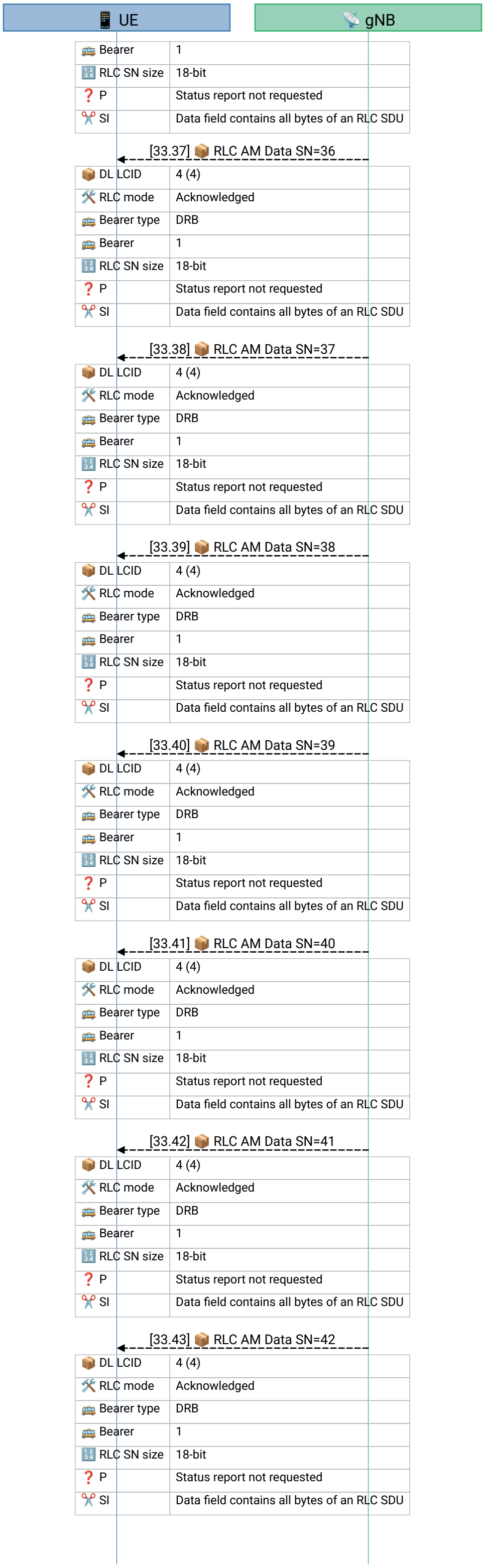
[33.27] 📦 RLC AM Data SN=26

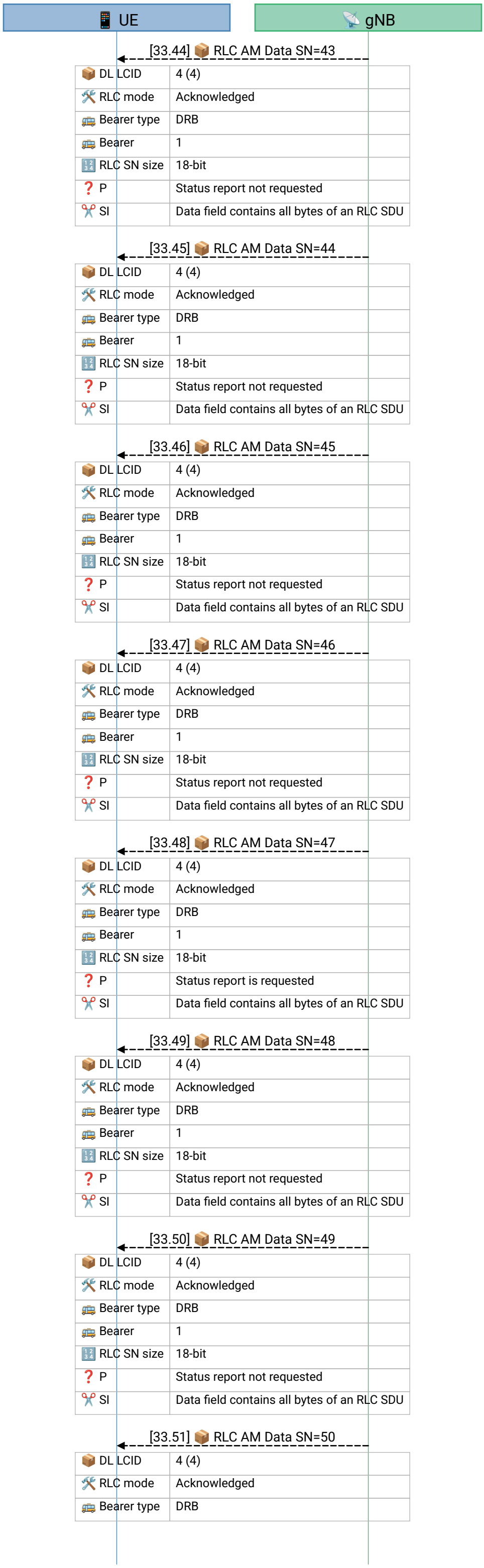
📦 DL LCID	4 (4)
🛠️ RLC mode	Acknowledged
🚌 Bearer type	DRB
🚌 Bearer	1
🔢 RLC SN size	18-bit
❓ P	Status report not requested
✂️ SI	Data field contains all bytes of an RLC SDU

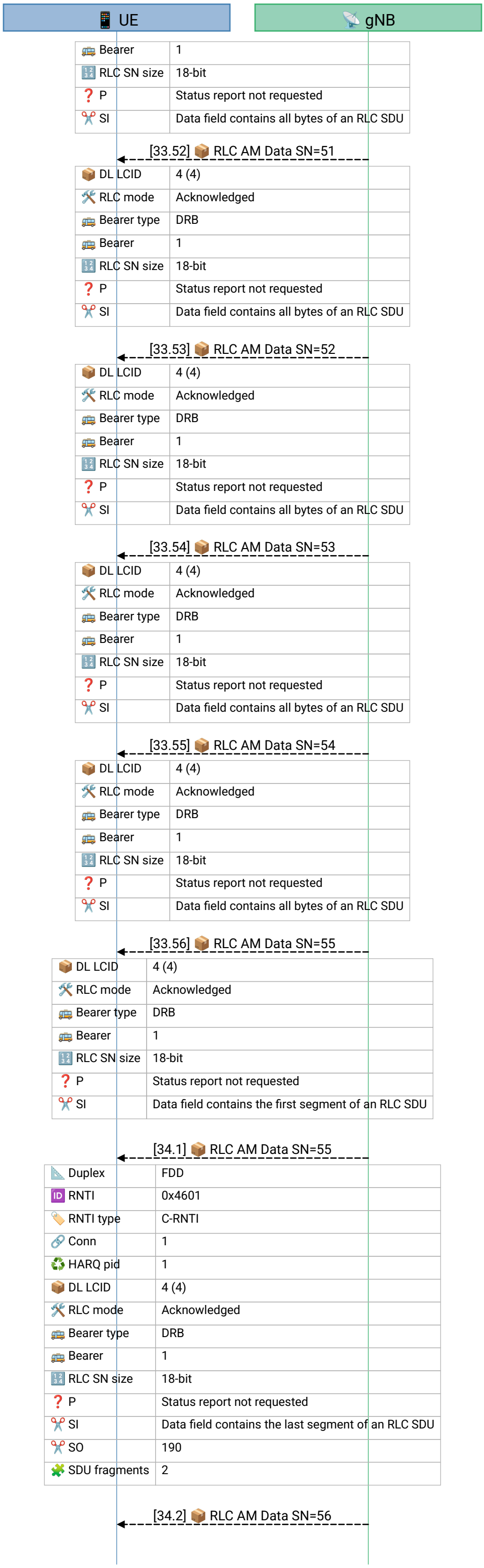
[33.28] 📦 RLC AM Data SN=27

📦 DL LCID	4 (4)
🛠️ RLC mode	Acknowledged
🚌 Bearer type	DRB
🚌 Bearer	1
🔢 RLC SN size	18-bit
❓ P	Status report not requested
✂️ SI	Data field contains all bytes of an RLC SDU


📱 UE
📡 gNB
[33.29] 📦 RLC AM Data SN=28
📦 DL LCID 4 (4)
🛠️ RLC mode Acknowledged
🚌 Bearer type DRB
🚌 Bearer 1
🔢 RLC SN size 18-bit
❓ P Status report not requested
✂️ SI Data field contains all bytes of an RLC SDU
[33.30] 📦 RLC AM Data SN=29
📦 DL LCID 4 (4)
🛠️ RLC mode Acknowledged
🚌 Bearer type DRB
🚌 Bearer 1
🔢 RLC SN size 18-bit
❓ P Status report not requested
✂️ SI Data field contains all bytes of an RLC SDU
[33.31] 📦 RLC AM Data SN=30
📦 DL LCID 4 (4)
🛠️ RLC mode Acknowledged
🚌 Bearer type DRB
🚌 Bearer 1
🔢 RLC SN size 18-bit
❓ P Status report not requested
✂️ SI Data field contains all bytes of an RLC SDU
[33.32] 📦 RLC AM Data SN=31
📦 DL LCID 4 (4)
🛠️ RLC mode Acknowledged
🚌 Bearer type DRB
🚌 Bearer 1
🔢 RLC SN size 18-bit
❓ P Status report is requested
✂️ SI Data field contains all bytes of an RLC SDU
[33.33] 📦 RLC AM Data SN=32
📦 DL LCID 4 (4)
🛠️ RLC mode Acknowledged
🚌 Bearer type DRB
🚌 Bearer 1
🔢 RLC SN size 18-bit
❓ P Status report not requested
✂️ SI Data field contains all bytes of an RLC SDU
[33.34] 📦 RLC AM Data SN=33
📦 DL LCID 4 (4)
🛠️ RLC mode Acknowledged
🚌 Bearer type DRB
🚌 Bearer 1
🔢 RLC SN size 18-bit
❓ P Status report not requested
✂️ SI Data field contains all bytes of an RLC SDU
[33.35] 📦 RLC AM Data SN=34
📦 DL LCID 4 (4)
🛠️ RLC mode Acknowledged
🚌 Bearer type DRB
🚌 Bearer 1
🔢 RLC SN size 18-bit
❓ P Status report not requested
✂️ SI Data field contains all bytes of an RLC SDU
[33.36] 📦 RLC AM Data SN=35
📦 DL LCID 4 (4)
🛠️ RLC mode Acknowledged
🚌 Bearer type DRB


📱 UE
📡 gNB
🚌 Bearer 1
🔢 RLC SN size 18-bit
❓ P Status report not requested
✂️ SI Data field contains all bytes of an RLC SDU
[33.37] 📦 RLC AM Data SN=36
📦 DL LCID 4 (4)
🛠️ RLC mode Acknowledged
🚌 Bearer type DRB
🚌 Bearer 1
🔢 RLC SN size 18-bit
❓ P Status report not requested
✂️ SI Data field contains all bytes of an RLC SDU
[33.38] 📦 RLC AM Data SN=37
📦 DL LCID 4 (4)
🛠️ RLC mode Acknowledged
🚌 Bearer type DRB
🚌 Bearer 1
🔢 RLC SN size 18-bit
❓ P Status report not requested
✂️ SI Data field contains all bytes of an RLC SDU
[33.39] 📦 RLC AM Data SN=38
📦 DL LCID 4 (4)
🛠️ RLC mode Acknowledged
🚌 Bearer type DRB
🚌 Bearer 1
🔢 RLC SN size 18-bit
❓ P Status report not requested
✂️ SI Data field contains all bytes of an RLC SDU
[33.40] 📦 RLC AM Data SN=39
📦 DL LCID 4 (4)
🛠️ RLC mode Acknowledged
🚌 Bearer type DRB
🚌 Bearer 1
🔢 RLC SN size 18-bit
❓ P Status report not requested
✂️ SI Data field contains all bytes of an RLC SDU
[33.41] 📦 RLC AM Data SN=40
📦 DL LCID 4 (4)
🛠️ RLC mode Acknowledged
🚌 Bearer type DRB
🚌 Bearer 1
🔢 RLC SN size 18-bit
❓ P Status report not requested
✂️ SI Data field contains all bytes of an RLC SDU
[33.42] 📦 RLC AM Data SN=41
📦 DL LCID 4 (4)
🛠️ RLC mode Acknowledged
🚌 Bearer type DRB
🚌 Bearer 1
🔢 RLC SN size 18-bit
❓ P Status report not requested
✂️ SI Data field contains all bytes of an RLC SDU
[33.43] 📦 RLC AM Data SN=42
📦 DL LCID 4 (4)
🛠️ RLC mode Acknowledged
🚌 Bearer type DRB
🚌 Bearer 1
🔢 RLC SN size 18-bit
❓ P Status report not requested
✂️ SI Data field contains all bytes of an RLC SDU


📱 UE
📡 gNB
[33.44] 📦 RLC AM Data SN=43
📦 DL LCID 4 (4)
🛠️ RLC mode Acknowledged
🚌 Bearer type DRB
🚌 Bearer 1
🔢 RLC SN size 18-bit
❓ P Status report not requested
✂️ SI Data field contains all bytes of an RLC SDU
[33.45] 📦 RLC AM Data SN=44
📦 DL LCID 4 (4)
🛠️ RLC mode Acknowledged
🚌 Bearer type DRB
🚌 Bearer 1
🔢 RLC SN size 18-bit
❓ P Status report not requested
✂️ SI Data field contains all bytes of an RLC SDU
[33.46] 📦 RLC AM Data SN=45
📦 DL LCID 4 (4)
🛠️ RLC mode Acknowledged
🚌 Bearer type DRB
🚌 Bearer 1
🔢 RLC SN size 18-bit
❓ P Status report not requested
✂️ SI Data field contains all bytes of an RLC SDU
[33.47] 📦 RLC AM Data SN=46
📦 DL LCID 4 (4)
🛠️ RLC mode Acknowledged
🚌 Bearer type DRB
🚌 Bearer 1
🔢 RLC SN size 18-bit
❓ P Status report not requested
✂️ SI Data field contains all bytes of an RLC SDU
[33.48] 📦 RLC AM Data SN=47
📦 DL LCID 4 (4)
🛠️ RLC mode Acknowledged
🚌 Bearer type DRB
🚌 Bearer 1
🔢 RLC SN size 18-bit
❓ P Status report is requested
✂️ SI Data field contains all bytes of an RLC SDU
[33.49] 📦 RLC AM Data SN=48
📦 DL LCID 4 (4)
🛠️ RLC mode Acknowledged
🚌 Bearer type DRB
🚌 Bearer 1
🔢 RLC SN size 18-bit
❓ P Status report not requested
✂️ SI Data field contains all bytes of an RLC SDU
[33.50] 📦 RLC AM Data SN=49
📦 DL LCID 4 (4)
🛠️ RLC mode Acknowledged
🚌 Bearer type DRB
🚌 Bearer 1
🔢 RLC SN size 18-bit
❓ P Status report not requested
✂️ SI Data field contains all bytes of an RLC SDU
[33.51] 📦 RLC AM Data SN=50
📦 DL LCID 4 (4)
🛠️ RLC mode Acknowledged
🚌 Bearer type DRB



[Frame 33.56] SN 55 is split: its first segment ends this transport block and the rest opens the next one.

[Frame 34.1] SN 55 (remaining segment) through SN 66. The poll on SN 62 is the next 16-PDU poll, counting the segmented SN 55 twice.

📱 UE | 📡 gNB

📦 DL LCID	4 (4)
🛠️ RLC mode	Acknowledged
🚌 Bearer type	DRB
🚌 Bearer	1
🔢 RLC SN size	18-bit
❓ P	Status report not requested
✂️ SI	Data field contains all bytes of an RLC SDU

[34.3] 📦 RLC AM Data SN=57

📦 DL LCID	4 (4)
🛠️ RLC mode	Acknowledged
🚌 Bearer type	DRB
🚌 Bearer	1
🔢 RLC SN size	18-bit
❓ P	Status report not requested
✂️ SI	Data field contains all bytes of an RLC SDU

[34.4] 📦 RLC AM Data SN=58

📦 DL LCID	4 (4)
🛠️ RLC mode	Acknowledged
🚌 Bearer type	DRB
🚌 Bearer	1
🔢 RLC SN size	18-bit
❓ P	Status report not requested
✂️ SI	Data field contains all bytes of an RLC SDU

[34.5] 📦 RLC AM Data SN=59

📦 DL LCID	4 (4)
🛠️ RLC mode	Acknowledged
🚌 Bearer type	DRB
🚌 Bearer	1
🔢 RLC SN size	18-bit
❓ P	Status report not requested
✂️ SI	Data field contains all bytes of an RLC SDU

[34.6] 📦 RLC AM Data SN=60

📦 DL LCID	4 (4)
🛠️ RLC mode	Acknowledged
🚌 Bearer type	DRB
🚌 Bearer	1
🔢 RLC SN size	18-bit
❓ P	Status report not requested
✂️ SI	Data field contains all bytes of an RLC SDU

[34.7] 📦 RLC AM Data SN=61

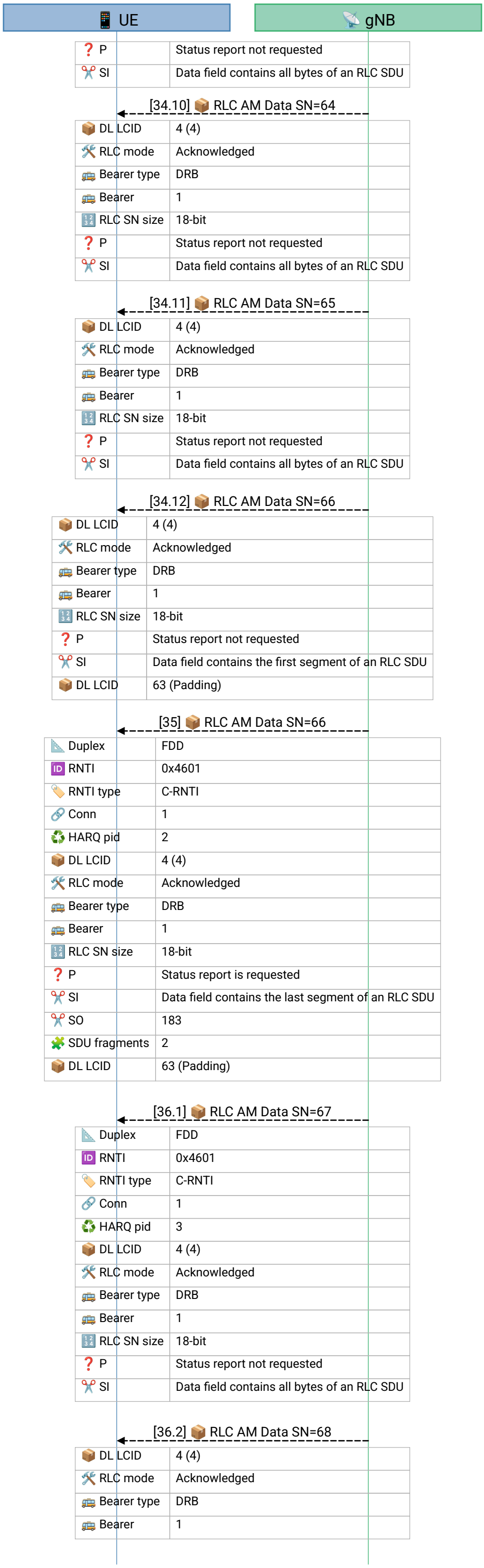
📦 DL LCID	4 (4)
🛠️ RLC mode	Acknowledged
🚌 Bearer type	DRB
🚌 Bearer	1
🔢 RLC SN size	18-bit
❓ P	Status report not requested
✂️ SI	Data field contains all bytes of an RLC SDU

[34.8] 📦 RLC AM Data SN=62

📦 DL LCID	4 (4)
🛠️ RLC mode	Acknowledged
🚌 Bearer type	DRB
🚌 Bearer	1
🔢 RLC SN size	18-bit
❓ P	Status report is requested
✂️ SI	Data field contains all bytes of an RLC SDU

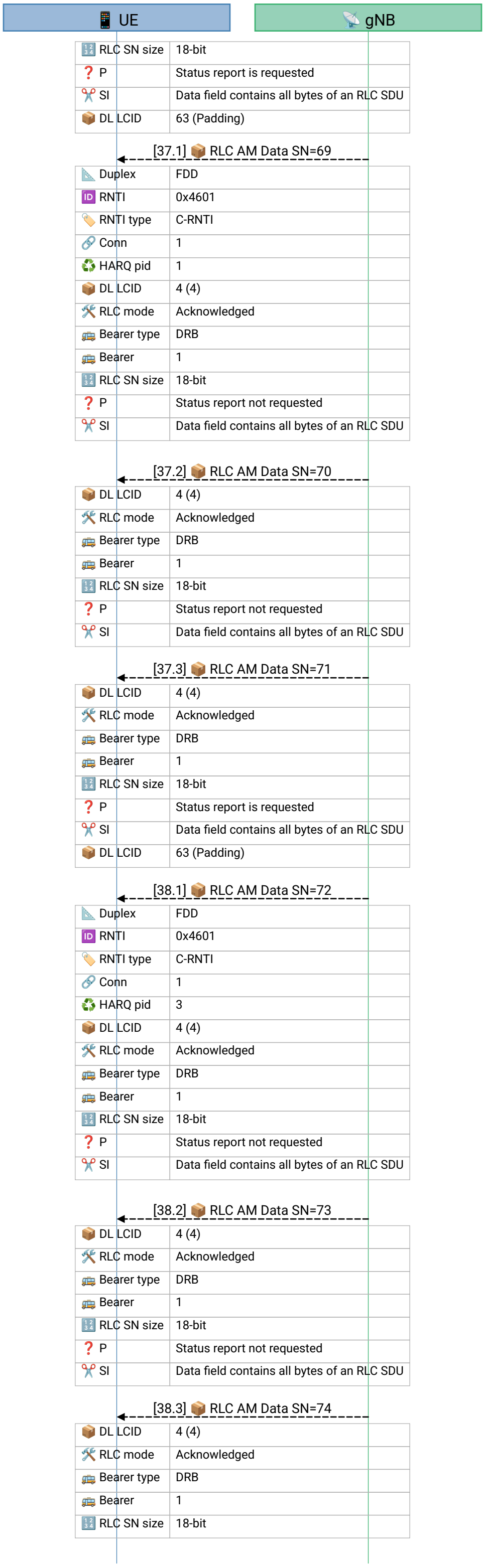
[34.9] 📦 RLC AM Data SN=63

📦 DL LCID	4 (4)
🛠️ RLC mode	Acknowledged
🚌 Bearer type	DRB
🚌 Bearer	1
🔢 RLC SN size	18-bit



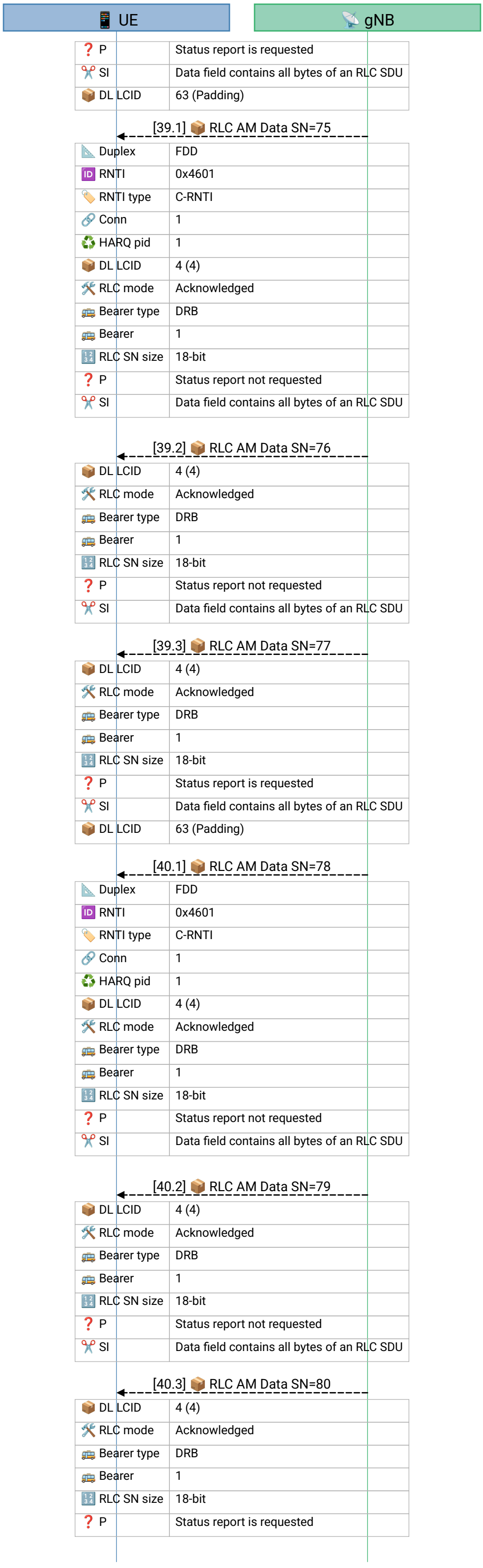
[Frame 35] SN 66 (remaining segment).

[Frame 36.1] The backlog is drained. From here each transport block carries only what has arrived, and its last PDU carries the poll bit. RLC sets the poll whenever its send buffer empties, so in steady state almost every PDU polls: 7,895 of the run's 7,980.



[Frame 37.1] SN 69-71.

[Frame 38.1] SN 72-74.



[Frame 39.1] SN 75-77.

[Frame 40.1] SN 78-80.

📱 UE | 📡 gNB

✂️ SI	Data field contains all bytes of an RLC SDU
📦 DL LCID	63 (Padding)

[41] 📦 RLC AM Data SN=81

[Frame 41] SN 81.

📐 Duplex	FDD
🆔 RNTI	0x4601
🏷️ RNTI type	C-RNTI
🔗 Conn	1
♻️ HARQ pid	3
📦 DL LCID	4 (4)
🛠️ RLC mode	Acknowledged
🚌 Bearer type	DRB
🚌 Bearer	1
🔢 RLC SN size	18-bit
❓ P	Status report is requested
✂️ SI	Data field contains all bytes of an RLC SDU
📦 DL LCID	63 (Padding)

[42] 📦 RLC AM Data SN=82

[Frame 42] SN 82.

📐 Duplex	FDD
🆔 RNTI	0x4601
🏷️ RNTI type	C-RNTI
🔗 Conn	1
♻️ HARQ pid	2
📦 DL LCID	4 (4)
🛠️ RLC mode	Acknowledged
🚌 Bearer type	DRB
🚌 Bearer	1
🔢 RLC SN size	18-bit
❓ P	Status report is requested
✂️ SI	Data field contains all bytes of an RLC SDU
📦 DL LCID	63 (Padding)

[43] 📦 RLC AM Data SN=83

[Frame 43] SN 83.

📐 Duplex	FDD
🆔 RNTI	0x4601
🏷️ RNTI type	C-RNTI
🔗 Conn	1
♻️ HARQ pid	0
📦 DL LCID	4 (4)
🛠️ RLC mode	Acknowledged
🚌 Bearer type	DRB
🚌 Bearer	1
🔢 RLC SN size	18-bit
❓ P	Status report is requested
✂️ SI	Data field contains all bytes of an RLC SDU
📦 DL LCID	63 (Padding)

[44] 📦 RLC AM Data SN=84

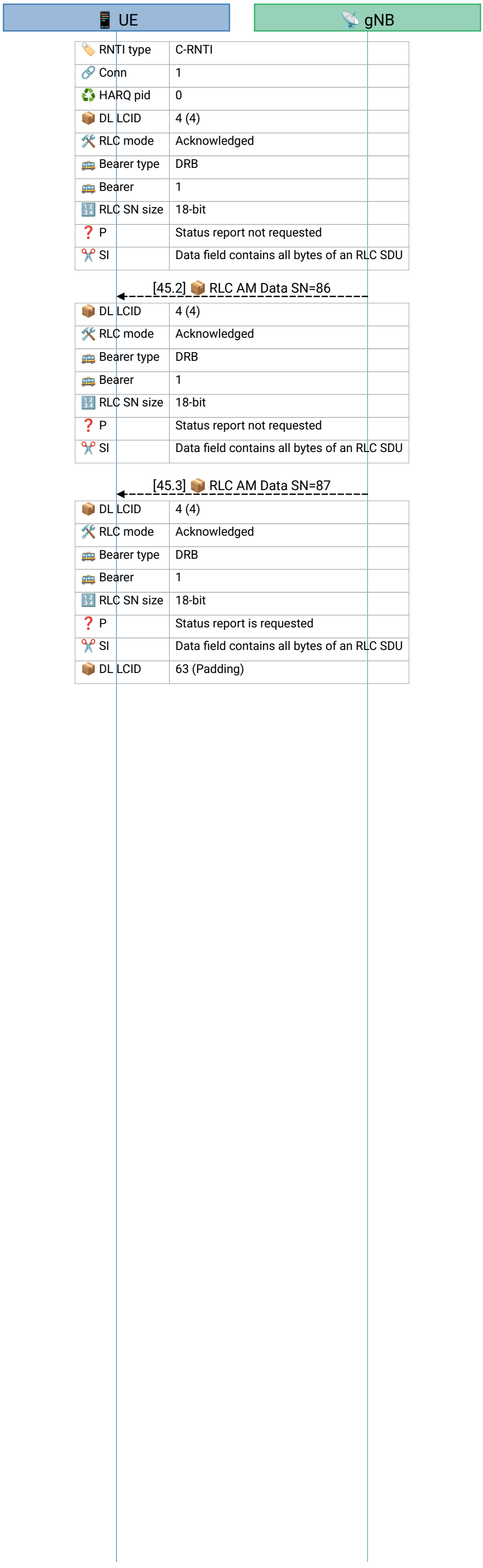
[Frame 44] SN 84.

📐 Duplex	FDD
🆔 RNTI	0x4601
🏷️ RNTI type	C-RNTI
🔗 Conn	1
♻️ HARQ pid	1
📦 DL LCID	4 (4)
🛠️ RLC mode	Acknowledged
🚌 Bearer type	DRB
🚌 Bearer	1
🔢 RLC SN size	18-bit
❓ P	Status report is requested
✂️ SI	Data field contains all bytes of an RLC SDU
📦 DL LCID	63 (Padding)

[45.1] 📦 RLC AM Data SN=85

[Frame 45.1] The slice ends here; the full run shows how it finishes. Downlink data flows for 10.9 s at about 735 PDUs per second, about the length of a default 10-second iperf test. The UE answers with only nine status reports, and every gap between them (1.28, 0.96, 2.24, 0.32 s,…) is an exact multiple of 320 ms. Status reports leave the UE only on a

📐 Duplex	FDD
🆔 RNTI	0x4601



scheduling-request opportunity, which comes every 320 ms.

The last report says ACK_SN = 7977 : every PDU arrived, with no NACKs anywhere. The 100 ms poll timer shows itself once: 100 ms after the last new PDU, with the buffer empty, the gNB retransmits SN 7111, the oldest unacknowledged PDU. The UE then stays connected for another 54 s. This run works. The companion run, with a different `K_offset`, does not.