**3GPP TSG-RAN WG2 Meeting #123 *R2-230xxxx***

**Toulouse, France, 21– 25 August 2023**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| *CR-Form-v12.2* | | | | | | | | |
| **CHANGE REQUEST** | | | | | | | | |
|  | | | | | | | | |
|  | **38.300** | **CR** | **Num** | **rev** | **-** | **Current version:** | **18.x.y** |  |
|  | | | | | | | | |
| *For* [***HE******LP***](http://www.3gpp.org/3G_Specs/CRs.htm#_blank)*on using this form: comprehensive instructions can be found at* [*http://www.3gpp.org/Change-Requests*](http://www.3gpp.org/Change-Requests)*.* | | | | | | | | |
|  | | | | | | | | |

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| ***Proposed change affects:*** | UICC apps |  | ME | **X** | Radio Access Network | **X** | Core Network |  |

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | | | | | | | | | | |
| ***Title:*** | Introduction of UAV support in Rel-18 NR | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Source to WG:*** | Nokia, Nokia Shanghai Bell | | | | | | | | | |
| ***Source to TSG:*** | R2 | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Work item code:*** | NR\_UAV-Core | | | | |  | ***Date:*** | | | 2023-08-11 |
|  |  | | | |  | |  | | |  |
| ***Category:*** | **B** |  | | | | | ***Release:*** | | | Rel-18 |
|  | *Use one of the following categories:* ***F*** *(correction)* ***A*** *(mirror corresponding to a change in an earlier release)* ***B*** *(addition of feature),* ***C*** *(functional modification of feature)* ***D*** *(editorial modification)*  Detailed explanations of the above categories can be found in 3GPP [TR 21.900](http://www.3gpp.org/ftp/Specs/html-info/21900.htm). | | | | | | | | *Use one of the following releases: Rel-8 (Release 8) Rel-9 (Release 9) Rel-10 (Release 10) Rel-11 (Release 11) … Rel-16 (Release 16) Rel-17 (Release 17) Rel-18 (Release 18) Rel-19 (Release 19)* | |
|  |  | | | | | | | | | |
| ***Reason for change:*** | | Introduction of UAV support in Rel-18 NR. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Summary of change:*** | | Explain the corresponding changes:   1. First change 2. Second change   **Impact analysis**  Impacted functionality: functionality impacted.  Inter-operability:   1. If the network is implemented according to the CR and the UE is not… 2. If the UE is implemented according to the CR and the network is not… | | | | | | | | |
|  | |  | | | | | | | | |
| ***Consequences if not approved:*** | | Explain the consequences if the changes are not approved. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Clauses affected:*** | | 3.1, 3.2, 16.X | | | | | | | | |
|  | |  | | | | | | | | |
|  | | **Y** | **N** |  | | | |  | | |
| ***Other specs*** | |  | **X** | Other core specifications | | | | TS/TR ... CR ... | | |
| ***affected:*** | |  |  | Test specifications | | | | TS/TR ... CR ... | | |
| ***(show related CRs)*** | |  |  | O&M Specifications | | | | TS/TR ... CR ... | | |
|  | |  | | | | | | | | |
| ***Other comments:*** | |  | | | | | | | | |
|  | |  | | | | | | | | |
| ***This CR's revision history:*** | |  | | | | | | | | |

*First Modified Subclause*

# 3 Abbreviations and Definitions

## 3.1 Abbreviations

For the purposes of the present document, the abbreviations given in TR 21.905 [1], in TS 36.300 [2] and the following apply. An abbreviation defined in the present document takes precedence over the definition of the same abbreviation, if any, in TR 21.905 [1] and TS 36.300 [2].

5GC 5G Core Network

5GS 5G System

5QI 5G QoS Identifier

A2X Aircraft-to-Everything

A-CSI Aperiodic CSI

AGC Automatic Gain Control

AKA Authentication and Key Agreement

AMBR Aggregate Maximum Bit Rate

AMC Adaptive Modulation and Coding

AMF Access and Mobility Management Function

ARP Allocation and Retention Priority

BA Bandwidth Adaptation

BCCH Broadcast Control Channel

BCH Broadcast Channel

BFD Beam Failure Detection

BH Backhaul

BL Bandwidth reduced Low complexity

BPSK Binary Phase Shift Keying

BRID Broadcast Remote Identification

C-RNTI Cell RNTI

CAG Closed Access Group

CAPC Channel Access Priority Class

CBRA Contention Based Random Access

CCE Control Channel Element

CD-SSB Cell Defining SSB

CFR Common Frequency Resource

CFRA Contention Free Random Access

CG Configured Grant

CHO Conditional Handover

CIoT Cellular Internet of Things

CLI Cross Link interference

CMAS Commercial Mobile Alert Service

CORESET Control Resource Set

CP Cyclic Prefix

CPA Conditional PSCell Addition

CPC Conditional PSCell Change

DAA Detect And Avoid

DAG Directed Acyclic Graph

DAPS Dual Active Protocol Stack

DFT Discrete Fourier Transform

DCI Downlink Control Information

DCP DCI with CRC scrambled by PS-RNTI

DL-AoD Downlink Angle-of-Departure

DL-SCH Downlink Shared Channel

DL-TDOA Downlink Time Difference Of Arrival

DMRS Demodulation Reference Signal

DRX Discontinuous Reception

E-CID Enhanced Cell-ID (positioning method)

EHC Ethernet Header Compression

ePWS enhancements of Public Warning System

ETWS Earthquake and Tsunami Warning System

FS Feature Set

FSA ID Frequency Selection Area Identity

G-CS-RNTI Group Configured Scheduling RNTI

G-RNTI Group RNTI

GFBR Guaranteed Flow Bit Rate

GIN Group ID for Network selection

GNSS Global Navigation Satellite System

GSO Geosynchronous Orbit

H-SFN Hyper System Frame Number

HAPS High Altitude Platform Station

HRNN Human-Readable Network Name

IAB Integrated Access and Backhaul

IFRI Intra Frequency Reselection Indication

I-RNTI Inactive RNTI

INT-RNTI Interruption RNTI

KPAS Korean Public Alarm System

L2 Layer-2

L3 Layer-3

LDPC Low Density Parity Check

LEO Low Earth Orbit

MBS Multicast/Broadcast Services

MCE Measurement Collection Entity

MCCH MBS Control Channel

MDBV Maximum Data Burst Volume

MEO Medium Earth Orbit

MIB Master Information Block

MICO Mobile Initiated Connection Only

MFBR Maximum Flow Bit Rate

MMTEL Multimedia telephony

MNO Mobile Network Operator

MPE Maximum Permissible Exposure

MRB MBS Radio Bearer

MT Mobile Termination

MTCH MBS Traffic Channel

MTSI Multimedia Telephony Service for IMS

MU-MIMO Multi User MIMO

Multi-RTT Multi-Round Trip Time

MUSIM Multi-Universal Subscriber Identity Module

NB-IoT Narrow Band Internet of Things

NCD-SSB Non Cell Defining SSB

NCGI NR Cell Global Identifier

NCL Neighbour Cell List

NCR Neighbour Cell Relation

NCRT Neighbour Cell Relation Table

NGAP NG Application Protocol

NGSO Non-Geosynchronous Orbit

NID Network Identifier

NPN Non-Public Network

NR NR Radio Access

NSAG Network Slice AS Group

NTN Non-Terrestrial Network

P-MPR Power Management Maximum Power Reduction

P-RNTI Paging RNTI

PCH Paging Channel

PCI Physical Cell Identifier

PDC Propagation Delay Compensation

PDCCH Physical Downlink Control Channel

PDSCH Physical Downlink Shared Channel

PEI Paging Early Indication

PH Paging Hyperframe

PLMN Public Land Mobile Network

PNI-NPN Public Network Integrated NPN

PO Paging Occasion

PRACH Physical Random Access Channel

PRB Physical Resource Block

PRG Precoding Resource block Group

PRS Positioning Reference Signal

PS-RNTI Power Saving RNTI

PSS Primary Synchronisation Signal

PTM Point to Multipoint

PTP Point to Point

PTW Paging Time Window

PUCCH Physical Uplink Control Channel

PUSCH Physical Uplink Shared Channel

PWS Public Warning System

QAM Quadrature Amplitude Modulation

QFI QoS Flow ID

QMC QoE Measurement Collection

QoE Quality of Experience

QPSK Quadrature Phase Shift Keying

RA Random Access

RA-RNTI Random Access RNTI

RACH Random Access Channel

RANAC RAN-based Notification Area Code

REG Resource Element Group

RIM Remote Interference Management

RLM Radio Link Monitoring

RMSI Remaining Minimum SI

RNA RAN-based Notification Area

RNAU RAN-based Notification Area Update

RNTI Radio Network Temporary Identifier

RQA Reflective QoS Attribute

RQoS Reflective Quality of Service

RS Reference Signal

RSRP Reference Signal Received Power

RSRQ Reference Signal Received Quality

RSSI Received Signal Strength Indicator

RSTD Reference Signal Time Difference

RTT Round Trip Time

SCS SubCarrier Spacing

SD Slice Differentiator

SDAP Service Data Adaptation Protocol

SDT Small Data Transmission

SFI-RNTI Slot Format Indication RNTI

SHR Successful Handover Report

SIB System Information Block

SI-RNTI System Information RNTI

SLA Service Level Agreement

SMC Security Mode Command

SMF Session Management Function

SMTC SS/PBCH block Measurement Timing Configuration

S-NSSAI Single Network Slice Selection Assistance Information

SNPN Stand-alone Non-Public Network

SNPN ID Stand-alone Non-Public Network Identity

SPS Semi-Persistent Scheduling

SR Scheduling Request

SRAP Sidelink Relay Adaptation Protocol

SRS Sounding Reference Signal

SRVCC Single Radio Voice Call Continuity

SS Synchronization Signal

SSB SS/PBCH block

SSS Secondary Synchronisation Signal

SSSG Search Space Set Group

SST Slice/Service Type

SU-MIMO Single User MIMO

SUL Supplementary Uplink

TA Timing Advance

TB Transport Block

TCE Trace Collection Entity

TNL Transport Network Layer

TPC Transmit Power Control

TRP Transmit/Receive Point

TRS Tracking Reference Signal

U2N UE-to-Network

UAV Uncrewed Aerial Vehicle

UCI Uplink Control Information

UDC Uplink Data Compression

UE-Slice-MBR UE Slice Maximum Bit Rate

UL-AoA Uplink Angles of Arrival

UL-RTOA Uplink Relative Time of Arrival

UL-SCH Uplink Shared Channel

UPF User Plane Function

URLLC Ultra-Reliable and Low Latency Communications

VR Virtual Reality

V2X Vehicle-to-Everything

Xn-C Xn-Control plane

Xn-U Xn-User plane

XnAP Xn Application Protocol

*Next Modified Subclause*

## 3.2 Definitions

For the purposes of the present document, the terms and definitions given in TR 21.905 [1], in TS 36.300 [2] and the following apply. A term defined in the present document takes precedence over the definition of the same term, if any, in TR 21.905 [1] and TS 36.300 [2].

**A2X communication**: A communication to support A2X services leveraging PC5 reference points. A2X services are realized by various types of A2X applications, e.g. BRID or DAA.

**Aerial UE communication:** functionality enabling Aerial UE function, as defined in 16.x.

**BH RLC channel**: an RLC channel between two nodes, which is used to transport backhaul packets**.**

**Boundary IAB-node:** as defined in TS 38.401 [4].

**Broadcast MRB**:A radio bearer configured for MBS broadcast delivery.

**CAG Cell**:a PLMN cell broadcasting at least one Closed Access Group identity.

**CAG Member Cell**:for a UE, a CAG cell broadcasting the identity of the selected PLMN, registered PLMN or equivalent PLMN, and for that PLMN, a CAG identifier belonging to the Allowed CAG list of the UE for that PLMN.

**CAG-only cell**: a CAG cell that is only available for normal service for CAG UEs.

**Cell-Defining SSB**: an SSB with an RMSI associated.

**Child node**: IAB-DU's and IAB-donor-DU's next hop neighbour node; the child node is also an IAB-node.

**Conditional Handover (CHO**): a handover procedure that is executed only when execution condition(s) are met.

**CORESET#0**: the control resource set for at least SIB1 scheduling, can be configured either via MIB or via dedicated RRC signalling.

**DAPS Handover**: a handover procedure that maintains the source gNB connection after reception of RRC message for handover and until releasing the source cell after successful random access to the target gNB.

**Direct Path**: a type of UE-to-Network transmission path, where data is transmitted between a UE and the network without sidelink relaying.

**Downstream**: direction toward child node or UE in IAB-topology.

**Early Data Forwarding**: data forwarding that is initiated before the UE executes the handover.

**Earth-centered, earth-fixed**: a global geodetic reference system for the Earth intended for practical applications of mapping, charting, geopositioning and navigation, as specified in NIMA TR 8350.2 [51].

**Feeder link**: wireless link between the NTN Gateway and the NTN payload.

**Geosynchronous Orbit**: earth-centered orbit at approximately 35786 kilometres above Earth's surface and synchronised with Earth's rotation. A geostationary orbit is a non-inclined geosynchronous orbit, i.e. in the Earth's equator plane.

**Group ID for Network Selection**: an identifier used during SNPN selection to enhance the likelihood of selecting a preferred SNPN that supports a Default Credentials Server or a Credentials Holder, as specified in TS 23.501 [3].

**gNB**: node providing NR user plane and control plane protocol terminations towards the UE, and connected via the NG interface to the 5GC.

**High Altitude Platform Station**: airborne vehicle embarking the NTN payload placed at an altitude between 8 and 50 km.

**IAB-donor**:gNB that provides network access to UEs via a network of backhaul and access links.

**IAB-donor-CU**: as defined in TS 38.401 [4].

**IAB-donor-DU**:as defined in TS 38.401 [4].

**IAB-DU**: gNB-DU functionality supported by the IAB-node to terminate the NR access interface to UEs and next-hop IAB-nodes, and to terminate the F1 protocol to the gNB-CU functionality, as defined in TS 38.401 [4], on the IAB-donor.

**IAB-MT**: IAB-node function that terminates the Uu interface to the parent node using the procedures and behaviours specified for UEs unless stated otherwise. IAB-MT function used in 38-series of 3GPP Specifications corresponds to IAB-UE function defined in TS 23.501 [3].

**IAB-node**: RAN node that supports NR access links to UEs and NR backhaul links to parent nodes and child nodes. The IAB-node does not support backhauling via LTE.

**IAB topology**: the unison of all IAB-nodes and IAB-donor-DUs whose F1 and/or RRC connections are terminated at the same IAB-donor-CU.

**Indirect Path**: a type of UE-to-Network transmission path, where data is forwarded via a U2N Relay UE between a U2N Remote UE and the network.

**Inter-donor partial migration:** migration of an IAB-MT to a parent node underneath a different IAB-donor-CU while the collocated IAB-DU and its descendant IAB-node(s), if any, are terminated at the initial IAB-donor-CU. The procedure renders the said IAB-node as a boundary IAB-node.

**Intra-system Handover**:handover that does not involve a CN change (EPC or 5GC).

**Inter-system Handover**:handover that involves a CN change (EPC or 5GC).

**Late Data Forwarding**: data forwarding that is initiated after the source NG-RAN node knows that the UE has successfully accessed a target NG-RAN node.

**Mapped Cell ID**: in NTN, it corresponds to a fixed geographical area.

**MBS Radio Bearer**: A radio bearer configured for MBS delivery.

**MSG1**: preamble transmission of the random access procedure for 4-step random access (RA) type.

**MSG3**: first scheduled transmission of the random access procedure.

**MSGA**:preamble and payload transmissions of the random access procedure for 2-step RA type.

**MSGB**:response to MSGA in the 2-step random access procedure. MSGB may consist of response(s) for contention resolution, fallback indication(s), and backoff indication.

**Multicast/Broadcast Service**: A point-to-multipoint service as defined in TS 23.247 [45].

**Multicast MRB**:A radio bearer configured for MBS multicast delivery.

**Multi-hop backhauling**: using a chain of NR backhaul links between an IAB-node and an IAB-donor.

**ng-eNB**: node providing E-UTRA user plane and control plane protocol terminations towards the UE, and connected via the NG interface to the 5GC.

**NG-C**: control plane interface between NG-RAN and 5GC.

**NG-U**: user plane interface between NG-RAN and 5GC.

**NG-RAN node**: either a gNB or an ng-eNB.

**Non-CAG Cell**: a PLMN cell which does not broadcast any Closed Access Group identity.

**Non-Geosynchronous orbit**: earth-centered orbit with an orbital period that does not match Earth's rotation on its axis. This includes Low and Medium Earth Orbit (LEO and MEO). LEO operates at altitudes between 300 km and 1500 km and MEO at altitudes between 7000 km and 25000 km, approximately.

**Non-terrestrial network**: an NG-RAN consisting of gNBs, which provide non-terrestrial NR access to UEs by means of an NTN payload embarked on an airborne or space-borne NTN vehicle and an NTN Gateway.

**NR backhaul link**: NR link used for backhauling between an IAB-node and an IAB-donor, and between IAB-nodes in case of a multi-hop backhauling.

**NR sidelink communication**: AS functionality enabling at least V2X communication as defined in TS 23.287 [40] and the ProSe communication (including ProSe non-Relay and UE-to-Network Relay communication) as defined in TS 23.304 [48], between two or more nearby UEs, using NR technology but not traversing any network node.

**NR sidelink discovery**: AS functionality enabling ProSe non-Relay Discovery and ProSe UE-to-Network Relay discovery for Proximity based Services as defined in TS 23.304 [48] between two or more nearby UEs, using NR technology but not traversing any network node.

**NTN Gateway**: an earth station located at the surface of the earth, providing connectivity to the NTN payload using the feeder link. An NTN Gateway is a TNL node.

**NTN payload**: a network node, embarked on board a satellite or high altitude platform station, providing connectivity functions, between the service link and the feeder link. In the current version of this specification, the NTN payload is a TNL node.

**Numerology**: corresponds to one subcarrier spacing in the frequency domain. By scaling a reference subcarrier spacing by an integer *N*, different numerologies can be defined.

**Parent node**: IAB-MT's next hop neighbour node; the parent node can be IAB-node or IAB-donor-DU

**PC5 Relay RLC channel**: an RLC channel between L2 U2N Remote UE and L2 U2N Relay UE, which is used to transport packets over PC5 for L2 UE-to-Network Relay**.**

**PLMN Cell**: a cell of the PLMN.

**RedCap UE**: a UE with reduced capabilities as specified in clause 4.2.21.1 in TS 38.306 [11].

**Relay discovery**: AS functionality enabling 5G ProSe UE-to-Network Relay Discovery as defined in TS 23.304 [48], using NR technology but not traversing any network node.

**Satellite**:a space-borne vehicle orbiting the Earth embarking the NTN payload.

**Service link**:wireless link between the NTN payload and UE.

**SNPN Access Mode**: mode of operation whereby a UE only accesses SNPNs.

**SNPN-only cell**: a cell that is only available for normal service for SNPN subscribers.

**SNPN Identity**: the identity of Stand-alone NPN defined by the pair (PLMN ID, NID).

**Transmit/Receive Point**:part of the gNB transmitting and receiving radio signals to/from UE according to physical layer properties and parameters inherent to that element.

**U2N Relay UE**: a UE that provides functionality to support connectivity to the network for U2N Remote UE(s).

**U2N Remote UE**: a UE that communicates with the network via a U2N Relay UE.

**Upstream**: direction toward parent node in IAB-topology.

**Uu Relay RLC channel**: an RLC channel between L2 U2N Relay UE and gNB, which is used to transport packets over Uu for L2 UE-to-Network Relay**.**

**V2X sidelink communication**: AS functionality enabling V2X communication as defined in TS 23.285 [41], between nearby UEs, using E-UTRA technology but not traversing any network node.

**Xn**: network interface between NG-RAN nodes.

*Next Modified Subclause*

## 16.X Support for Aerial UE communication

### 16.X.1 General

NR connectivity for UEs capable of Aerial communication is supported via the following functionalities:

- subscription-based Aerial UE identification and authorization, as specified in TS 23.502 [22], clause 5.2.3.3.1.

- height reporting based on the measurement event(s) where the UE's altitude has crossed a network-configured reference altitude threshold.

- height-dependent configurations which apply only to specific height regions.

- interference detection based on a measurement reporting that is triggered when a configured number of cells (i.e. larger than one) fulfills the triggering criteria simultaneously.

- signalling of flight path information from UE to NG-RAN and from the source gNB to target gNB during handover.

- location information reporting, including UE's horizontal and vertical velocity.

- broadcasting of BRID and DAA messages.

### 16.X.2 Subscription based identification of Aerial UE

Support for Aerial UE functions is stored in the user's subscription information in UDM. UDM transfers this information to the AMF during Registration, Service Request and Mobility Registration Update procedures.

The Aerial UEsubscription information can be provided by the AMF to the NG-RAN node via the NGAP INITIAL CONTEXT SETUP REQUEST message during the Registration, Mobility Registration Update and Service Request procedures. The subscription information can also be updated via the NGAP UE Context Modification procedure and NGAP Path Switch Acknowledge procedure. In addition, for Xn-based handover, the source NG-RAN node can include the Aerial UEsubscription information in the XnAP HANDOVER REQUEST message and RETRIEVE UE CONTEXT RESPONSE message to the target NG-RAN node.

For intra- and inter-AMF NG-based handover, the AMF provides the Aerial UEsubscription information to the target NG-RAN node after the handover procedure.

### 16.X.3 Height-based reporting for Aerial UE communication

An Aerial UE can be configured with height-dependent, event-based measurement reporting (i.e. events H1 and H2 in TS 38.331 [12]). An Aerial UE sends a measurement report when its altitude becomes higher or lower than configured threshold. The UE includes its height in the measurement report if configured to do so by NG-RAN. The aerial UE can be also configured to trigger measurement reporting when both a height-dependent and RSRP/RSRQ/SINR-based conditions are met. For this purpose, events supporting simultaneous RSRP/RSRQ/SINR, and height thresholds are supported (as defined in TS 38.331 [12]).

Editor’s note: FFS on the other content of the measurement report (other than UE’s height).

### 16.X.4 Height-dependent Configuration for Aerial UE communication

An Aerial UE can be configured with multiple height-dependent configurations, each of which is applied in its corresponding height range. Height-dependent configurations can be provided independently in measurement object or in measurement reporting configurations (as per TS 38.331 [12]).

### 16.X.5 Interference detection and mitigation for Aerial UE communication

For interference detection, an aerial UE can be configured with RRM event A3, A4 or A5 that triggers measurement report when individual (per cell) RSRP values for a configured number of cells fulfil the configured event. Once such condition is met and a measurement report is sent, the list of triggered cells is updated when subsequent cell(s) fulfil the event. However, further measurement reports are not sent while the list of triggered cells remains larger than or equal to the configured number of cells unless reportOnLeave (see [12]) is configured.

Editor’s note: The content of the report is FFS.

### 16.X.6 Flight path information reporting for Aerial UE communication

If configured by the NG-RAN and if the associated time- or distance-based condition(s) (see x and y in [12]) for indication reporting are met, the Aerial UE indicates the availability of the flight path information. NG-RAN can request the Aerial UE to report flight path information consisting of a number of waypoints defined as 3D locations, defined in TS 37.355 [43]. A UE reports up to configured number of waypoints if flight path information is available at the UE. The report can also contain a time stamp per waypoint if configured by the NG-RAN and if available at the UE. The flight path information can be also provided by the source gNB to the target gNB during handover.

### 16.X.7 Location reporting for Aerial UE communication

Location information for Aerial UE communication can include horizontal and vertical speed if configured. Location information can be included in RRM report and in height-based reporting (as described in 16.X.3).

### 16.X.8 BRID and DAA support via A2X communication

The aerial UE supports broadcasting of BRID and DAA messages via A2X using NR sidelink. BRID and DAA message transmission is supported in both in-coverage and out-of-coverage scenarios and relies on UE autonomous resource selection for NR sidelink communication. BRID and DAA follow the QoS framework defined for NR sidelink.

*End of Changes*

# Annex: RAN2 agreements

At RAN2#119 (August 2022) the following UAV-related agreements have been made [1]:

|  |
| --- |
| Agreements  1 Use LTE principle as a baseline, introduce similar event H1 (aerial UE height become higher than threshold) and H2 (aerial UE height become lower than threshold. FFS if further NR enhancements are needed. FFS study scaling of RRM parameters (e.g. which parameters and what is the purpose/benefit of the scaling and how)  FFS how to limit excessive measurements and measurement reporting  FFS if user consent is needed for location reporting in CONNECTED  FFS study the vertical movement and associated mobility for UAV UEs  2 Rel-18 NR supports reporting of UAV UE’s height, location and velocity. It is for further study what accuracy and reporting mechanisms are required and if further enhancements are needed.  3 As in LTE, flight path plan reporting will be introduced. Location list of waypoints (3D location information) and timestamp is adopted as the basic content of flight path report. FFS if timestamp is mandatory or optional for NR. FFS if further enhancements are needed  4 Introduce similar functionality to LTE (numberofTriggeringCells). FFS whether numberoftriggerbeams for NR is required or other enhancements. FFS study how to avoid sending the measurement reports mainly due to reportOnLeave. |

At RAN2#119bis (October 2022) the following UAV-related agreements have been made [2]:

|  |
| --- |
| **Agreements:**   1. The time information reported as part of flight path plan is optional. UE includes time info, if configured by the network and available at the UE. FFS on flight path details (waypoints and what is time information). 2. Allow the flight path to be updated. FFS on the details. 3. FFS on reporting format and initial flight path reporting (i.e. what information to report and how) – next meeting 4. Continue to study height-depending scaling, triggering and combinations 5. As in LTE, as a baseline, events A3, A4 and A5 can be configured with the configured number of cells (numberofTriggeringCells) |

At RAN2#120 (November 2022) the following UAV-related agreements have been made [3]:

|  |
| --- |
| **Agreements:**   1. A waypoint is a planned location for the UE along the flight path and is described via the existing parameter type LocationCoordinates defined in TS 37.355. 2. A timestamp provides the UTC time associated with estimated time of arrival to a waypoint as baseline. FFS on granularity 3. No requirements are placed on spatial distribution of waypoints 4. A UE indicates whether flight plan information is available within the RRCReconfigurationComplete, RRCReestablishmentComplete, RRCResumeComplete, or RRCSetupComplete message. Flight path reporting uses at the UE Information request/response procedure as baseline. 5. UE indicates to the network a new flight path is available in the UE (whether it is initial or update). Then, reuse the normal request/response procedure of flight path report. 6. UAI message can also be used to indicate the UE has flight path availability. 7. FFS whether and what triggering conditions are specified for flight update. FFS The maximum number of waypoints within flight path plan is left FFS. |

At RAN2#121 (February 2023) the following UAV-related agreements have been made [4]:

|  |
| --- |
| Agreements:   1. When event H1 or H2 triggers, the content of the measurement report is configurable by the network (i.e. it can contain UAV UEs height, location information and/or RSRP/RSRQ measurement results). FFS whether UAV UE’s height is mandatorily reported and which parameter/IE is used for height reporting. 2. Joint use of height-dependent condition and RSRP/RSRQ/SINR-based condition for measurement report triggering is supported in NR Rel-18 UAV. The combination of existing events will be used 3. Height-dependent parameter scaling is not supported as a part of Rel-18 NR 4. Do not extend the Number of triggering cells mechanism to apply to the inter-RAT scenario, i.e. event B1 and B2 triggering 5. Do not restrict the applicability of Number of triggering cells mechanism to FR1 only. In other words, the Number of triggering cells mechanism is applicable to FR1 and FR2 (up to network configuration). 6. The UE shall not ignore or bypass the Number of triggering cells mechanism, once configured. 7. Do not introduce the use of a “numberOfTriggeringBeams” mechanism. 8. Do not introduce an alternative mechanism to the Number of triggering cells mechanism. 9. Do not introduce an additional mechanism based on Number of changed cells. 10. For the purpose of interference control (i.e. for number of trigger cells), do not introduce a prohibit timer mechanism. 11. Report on leave is not triggered by a cell that was not previously included in the measurement report for the number of triggering cell. 12. - PC5-U is used to support BRID for UAV 13. - Support both in-coverage and out-of-coverage scenarios 14. - Mode 2 will be supported. FFS whether further mode 1 will be supported. 15. - FFS whether separate pools are needed 16. - FFS whether current configurations can support UAV requirements |

At RAN2#121bis (April 2023) the following UAV-related agreements have been made [5]:

|  |
| --- |
| Agreements  1. Height-dependent more-than-one configurations is supported on parameter/field level (i.e. different fields/values within the same MO) where different values (or value ranges) of the parameter/field applies to different height or height range.  2. For MO configuration parameters: at least the following will have ability to be configured with height-dependent more-than-one configurations/values, each for a specific height region: SSB-ToMeasure. Details on how to specify is FFS. FFS on UE behavior on L1 and L3 measurement.  3. For MR configuration parameters: at least the following will have ability to be configured with height-dependent more-than-one configurations/values, each for a specific height region: Event A4 threshold and numberoftriggeringcells. Details on how to specify is FFS (i.e. maybe it can be achieved by combination of events).  4. When height-dependent more-than-one configurations are provided, UE applies the new value once it moves to new height (or height range) similar to the case of RRC reconfiguration. Need Codes, field descriptions, etc. as in legacy specifications apply  5. If a height-specific value is not explicitly configured for certain height, whether to keep using the value that was used or consider the parameter as released (i.e. parameter/value not applicable at this height) should be looked into case by case, and can be clarified by need code, field description, or procedural text as needed. FFS details |

|  |
| --- |
| Agreements:  1. Flightpath update indication in UAI is configurable by the network  2. Maximum number of waypoints is set to 20 same as in LTE and number of waypoints is configurable by network as in LTE  3. Flightpath information should be forwarded from source gNB to target gNB during handover. Send LS to RAN3 to check for feasibility [LS to RAN3 over email 307]  4. As a baseline, we can consider a simple network control mechanisms (e.g. a threshold(s)) that controls triggering the flightpath update indication in UAI. FFS if new threshold or the kind of threshold(s)  5. As a baseline, single indication is used for both initial and updated flightpath available (i.e. same flag is used for initial and updated flight path indication. FFS if further differentiation is needed if we decide to have delta signaling |

|  |
| --- |
| Agreements:  1. DAA can be supported using the same framework as used for BRID transmission over the LTE and NR PC5 interface, without any specific enhancements.  2. LTE PC5 Mode-4 resource allocation is supported, and LTE PC5 Mode-3 is not supported  3. NR PC5 mode-1 is not supported  4. For LTE PC5, we will follow the NR PC5 framework agreements, unless explicitly identified e.g. a strong technical reason  5. RAN2 assumes that BRID and DAA services will be delivered on a frequency designated by regulators  6. As a baseline, we will use the existing V2X QoS framework. FFS whether different resource pools are needed for UAV services  7. No further enhancement on PC5 range for A2X broadcast services will be pursued in this release  8. We will not investigate interference for BRID and DAA broadcast  9. Send an LS to SA2 to:  a. inform them as a result of RAN Plenary decision to re-use BRID RAN2 will only support PC5 broadcast for deconfliction in RAN in release 18.  b. ask SA2 whether BRID and DAA broadcast over LTE and NR PC5 requires new QoS requirements and parameters not supported within the ranges supported for V2X |

At RAN2#122 (May 2023) the following UAV-related agreements have been made [6]:

|  |
| --- |
| Agreements  1. Add height-based list of SSB-ToMeasure with corresponding height ranges and hysteresis in MeasObjectNR. FFS on the number of height ranges  2. As a basic principle, if no height-specific SSB-ToMeasure is configured for a specific height region, the legacy behaviour applies.  3. For UE behavior on L1 and L3 measurement, it is left to UE implementation whether to keep/discard the old samples while UE moves to a new height region with a different SSB-ToMeasure value  4. New event types will be introduced on the combination of event Ax and event Hx, at least for event A4 + event H1/H2. FFS for other event Ax + event H1/H2. FFS on details, e.g. whether to include one height threshold (H1 or H2 threshold) or a height range (both H1 and H2 threshold) in the new event, how to configure height-dependent numberOfTriggeringCells, etc. This will be applied to all height dependent MR parameters.  5. Whether UE height is included when UAV specific MR is triggered is configurable by the network.  6. We will use LTE UEheight. |

|  |
| --- |
| Agreements  1. The network can configure the UE to trigger a flightpath update notification based on a configured delta time (when timestamp is configured to be reported) or distance configuration. |

|  |
| --- |
| Agreement:  1. The subscription-based aerial-UE identification adopted in LTE can be taken as the baseline for NR UAV (i.e. the RAN3 endorsed CR will be captured in stage 2) . No further NR specific enhancements will be pursued. |

# References

1. R2-2208703 Report for Rel-17 Small data and URLLC/IIoT 3GPP TSG-RAN WG2 Meeting #119 electronic Online, August 2022
2. R2-2210803 Report from UP, Small data, URLLC/IIoT, RACH indication, NWES and UAV Session chair (InterDigital) 3GPP TSG RAN2 Meeting #119bis Electronic Meeting, Oct 10 - 19, 2022
3. R2-2213352 Report from Session on NES, UAV, Small Data, Rel-15-17 UP, Rel-17 Small Data, IIoT/URLLC, and RACH partitioning 3GPP TSG RAN2 Meeting #120, Nov 14 - 18, 2022
4. R2-2301903 Report from Session on NES, UAV, Small Data, Rel-15-17 UP, Rel-17 Small Data, IIoT/URLLC, and RACH partitioning Session chair (InterDigital) 3GPP TSG RAN2 Meeting #121, Feb 27 – Mar 3, 2023
5. R2-2304203 Report from Session on NES, UAV, Rel-15-17 UP, Rel-17 Small Data, IIoT/URLLC, and RACH partitioning 3GPP TSG RAN2 Meeting #121bis, 17th – 26th of April 2023
6. R2-2306543 Report from Session on NES, UAV, Rel-15-17 UP, Rel-17 Small Data, IIoT/URLLC, and RACH partitioning 3GPP TSG RAN2 Meeting #122, 22nd – 26th of May 2023
7. 3GPP TS 36.300 V17.4.0 (2023-03), “3rd Generation Partnership Project; Technical Specification Group Radio Access Network; Evolved Universal Terrestrial Radio Access (E-UTRA) and Evolved Universal Terrestrial Radio Access Network (E-UTRAN); Overall description; Stage 2 (Release 17), March 2023
8. 3GPP TS 38.300 V17.4.0 (2023-03), “3rd Generation Partnership Project; Technical Specification Group Radio Access Network; NR; NR and NG-RAN Overall Description; Stage 2 (Release 17), March 2023