**3GPP TSG- Meeting #-RAN2#131**

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| *CR-Form-v12.3* |
| **CHANGE REQUEST** |
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|  |  | **CR** |  | **rev** | **-** | **Current version:** |  |  |
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| *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)*.* |
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| ***Proposed change affects:*** | UICC apps |  | ME | **X** | Radio Access Network | **X** | Core Network |  |

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| ***Title:***  | Stage 2 CR for Introduction of IoT NTN TDD mode |
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| ***Source to WG:*** |  |
| ***Source to TSG:*** |  |
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| ***Work item code:*** |  |  | ***Date:*** |  |
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| ***Category:*** |  |  | ***Release:*** |  |
|  | *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 canbe 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-17 (Release 17)Rel-18 (Release 18)Rel-19 (Release 19) Rel-20 (Release 20)* |
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| ***Reason for change:*** | Introduction of Rel-19 IoT NTN TDD mode into TS 36.300. |
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| ***Summary of change:*** | Introduction of general description of IoT NTN TDD mode and including the IoT NTN TDD mode in relevant clauses. Description is based on the first LS from RAN1 in R1-2504883 and the second LS from RAN1 in R1-2506535  |
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| ***Consequences if not approved:*** | IoT NTN TDD has no stage 2 description. |
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| ***Clauses affected:*** |  |
|  |  |
|  | **Y** | **N** |  |  |
| ***Other specs*** | **X** |  |  Other core specifications  | TS 36.304 CR 0883TS 36.306 CR 1914 |
| ***affected:*** |  | **N** |  Test specifications | TS 36.321 CR 1592 |
| ***(show related CRs)*** |  | **N** |  O&M Specifications | TS 36.331 CR 5138  |
|  |  |
| ***Other comments:*** |  |
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| ***This CR's revision history:*** | This is the revision of R2-2505256. |

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| START OF CHANGE |

# 3 Definitions, symbols and abbreviations

## 3.1 Definitions

For the purposes of the present document, the following terms and definitions apply.

**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.

**Access Control:** the process that checks whether a UE is allowed to access and to be granted services in a closed cell.

**Aerial UE communication**: functionality enabling Aerial UE function as defined in 23.17.

**Anchor carrier**: in NB-IoT, a carrier where the UE assumes that NPSS/NSSS/NPBCH/SIB-NB for FDD and IoT NTN TDD or NPSS/NSSS/NPBCH for TDD are transmitted.

**Carrier frequency**: center frequency of the cell.

**Cell:** combination of downlink and optionally uplink resources. The linking between the carrier frequency of the downlink resources and the carrier frequency of the uplink resources is indicated in the system information transmitted on the downlink resources.

**Cell Group**: in dual connectivity, a group of serving cells associated with either the MeNB or the SeNB.

**CHO candidate cell: a** candidate cell for CHO, for which UE has been configured with a CHO configuration.

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

**Control plane CIoT 5GS Optimisation**: Enables support of efficient transport of user data (IP, Ethernet and Unstructured) or SMS messages over control plane via the AMF without triggering user-plane resource establishment, as defined in TS 24.501 [91]. In the context of this specification, a NB-IoT UE that only supports Control plane CIoT 5GS Optimisation is a UE that does not support User plane CIoT 5GS Optimisation and NG-U data transfer but may support other CIoT 5GS Optimisations.

**Control plane CIoT EPS optimisation**: Enables support of efficient transport of user data (IP, non-IP or SMS) over control plane via the MME without triggering data radio bearer establishment, as defined in TS 24.301 [20]. In the context of this specification, a NB-IoT UE that only supports Control plane CIoT EPS optimisation is a UE that does not support User plane CIoT EPS optimisation and S1-U data transfer but may support other CIoT EPS optimisations.

**CSG Cell:** a cell broadcasting a CSG indicator set to true and a specific CSG identity.

**CSG ID Validation:** the process that checks whether the CSG ID received via handover messages is the same as the one broadcast by the target E-UTRAN.

**CSG member cell:** a cell broadcasting the identity of the selected PLMN, registered PLMN or equivalent PLMN and for which the Permitted CSG list of the UE includes an entry comprising cell's CSG ID and the respective PLMN identity.

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

**DCN-ID:** DCN identity identifies a specific dedicated core network (DCN).

**Dual Connectivity**: mode of operation of a UE in RRC\_CONNECTED, configured with a Master Cell Group and a Secondary Cell Group.

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

**en-gNB**: as defined in TS 37.340 [76].

**Ephemeris:** a set of parameters that describe the movement of an NTN node over time.

**E-RAB:** an E-RAB uniquely identifies the concatenation of an S1 Bearer and the corresponding Data Radio Bearer. When an E-RAB exists, there is a one-to-one mapping between this E-RAB and an EPS bearer of the Non Access Stratum as defined in [17].

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

**Frequency layer**: set of cells with the same carrier frequency.

**FeMBMS:** further enhanced multimedia broadcast multicast service.

**FeMBMS/Unicast-mixed cell**: cell supporting MBMS transmission and unicast transmission as SCell.

**Geosynchronous Orbit:** Earth-centred orbit at approximately 35,786 kilometres in altitude 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.

**Handover**: procedure that changes the serving cell of a UE in RRC\_CONNECTED.

**Hybrid cell**: a cell broadcasting a CSG indicator set to false and a specific CSG identity. This cell is accessible as a CSG cell by UEs which are members of the CSG and as a normal cell by all other UEs.

**IoT NTN TDD mode**: A working mode that allows use of NB-IoT channels in TDD fashion, but based on Frame Structure Type 1, as specified in clause 5.0. For this working mode, uplink and downlink transmissions are separated in the time domain and consist of a set of D=8 non-overlapping usable contiguous DL subframes and a set of U=8 usable contiguous UL subframes separated by a fixed guard periods (GP), at the uplink time synchronization reference point defined in clause 16.1.2 of TS 36.213 [6]. This pattern is repeated every N=9 radio frames. This working mode is applicable for the IoT NTN TDD band (1616-1626.5 MHz) specified in TS 36.102 [96]. IoT NTN TDD mode applies to NB-IoT unless specified otherwise. IoT NTN TDD mode does not apply to TDD or TDD mode unless specified otherwise.

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

**Local Home Network**: as defined in TS 23.401 [17].

**LTE bearer**: in LTE-WLAN Aggregation, a bearer whose radio protocols are located in the eNB only to use eNB radio resources only.

**LWA bearer**: in LTE-WLAN Aggregation, a bearer whose radio protocols are located in both the eNB and the WLAN to use both eNB and WLAN resources.

**LWAAP PDU**: in LTE-WLAN Aggregation, a PDU with DRB ID generated by LWAAP entity for transmission over WLAN.

**Make-Before-Break HO/SeNB change**: maintaining source eNB/SeNB connection after reception of RRC message for handover or change of SeNB before the initial uplink transmission to the target eNB during handover or change of SeNB.

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

**Master Cell Group**: in dual connectivity, a group of serving cells associated with the MeNB, comprising of the PCell and optionally one or more SCells.

**Master eNB**: in dual connectivity, the eNB which terminates at least S1-MME.

**MBMS-dedicated cell**: cell dedicated to MBMS transmission.

**MBMS/Unicast-mixed cell**: cell supporting both unicast and MBMS transmissions.

**MCG bearer**: in dual connectivity, a bearer whose radio protocols are only located in the MeNB to use MeNB resources only.

**Membership Verification:** the process that checks whether a UE is a member or non-member of a hybrid cell.

**Multi-Connectivity**: Mode of operation whereby a multiple Rx/Tx UE in the connected mode is configured to utilise radio resources amongst E-UTRA and/or NR provided by multiple distinct schedulers connected via non-ideal backhaul.

**NB-IoT:** NB-IoT allows access to network services via E-UTRA with a channel bandwidth limited to 200 kHz.

**NB-IoT UE**: a UE that uses NB-IoT.

**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.

**Non-anchor carrier**: in NB-IoT, a carrier where the UE does not assume that NPSS/NSSS/NPBCH/SIB-NB for FDD or NPSS/NSSS/NPBCH for TDD are transmitted.

**Non-geosynchronous orbit**: Earth-centred orbit with an orbital period that does not match Earth's rotation on its axis. This includes Low Earth Orbit (LEO) and Medium Earth Orbit (MEO).

**Non-terrestrial networks:** an E-UTRAN consisting of eNBs, which provide non-terrestrial LTE access to UEs by means of an NTN payload embarked on a space-borne NTN vehicle and an NTN Gateway.

**NR:** NR radio access

**NR sidelink communication**: AS functionality enabling at least V2X Communication as defined in TS 23.287 [93], 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.

**PLMN ID Check:** the process that checks whether a PLMN ID is the RPLMN identity or an EPLMN identity of the UE.

**Power saving mode**: mode configured and controlled by NAS that allows the UE to reduce its power consumption, as defined in TS 24.301 [20], TS 23.401 [17], TS 23.682 [57].

**Primary PUCCH group:** a group of serving cells including PCell whose PUCCH signalling is associated with the PUCCH on PCell.

**Primary Timing Advance Group**: Timing Advance Group containing the PCell. In this specification, Primary Timing Advance Group refers also to Timing Advance Group containing the PSCell unless explicitly stated otherwise.

**ProSe-enabled Public Safety UE:** a UE that the HPLMN has configured to be authorized for Public Safety use, and which is ProSe-enabled and supports ProSe procedures and capabilities specific to Public Safety. The UE may, but need not, have a USIM with one of the special access classes {12, 13, 14}.

**ProSe Per-Packet Priority:** a scalar value associated with a protocol data unit that defines the priority handling to be applied for transmission of that protocol data unit.

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

**ProSe UE-to-Network Relay Selection:** Process of identifying a potential ProSe UE-to Network Relay, which can be used for connectivity services (e.g. to communicate with a PDN).

**ProSe UE-to-Network Relay Reselection:** process of changing previously selected ProSe UE-to-Network Relay and identifying potential a new ProSe UE-to-Network Relay, which can be be used for connectivity services (e.g. to communicate with PDN).

**Public Safety ProSe Carrier:** carrier frequency for public safety sidelink communication and public safety sidelink discovery.

**PUCCH group:** either primary PUCCH group or a secondary PUCCH group.

**PUCCH SCell:** a Secondary Cell configured with PUCCH.

**RACH-less HO/SeNB change**: skipping random access procedure during handover or change of SeNB.

**Receive Only Mode:** See TS 23.246 [48].

**Remote UE:** a ProSe-enabled Public Safety UE, that communicates with a PDN via a ProSe UE-to-Network Relay.

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

**SCG bearer**: in dual connectivity, a bearer whose radio protocols are only located in the SeNB to use SeNB resources.

**Secondary Cell Group**: in dual connectivity, a group of serving cells associated with the SeNB, comprising of PSCell and optionally one or more SCells.

**Secondary eNB**: in dual connectivity, the eNB that is providing additional radio resources for the UE but is not the Master eNB.

**Secondary PUCCH group:** a group of SCells whose PUCCH signalling is associated with the PUCCH on the PUCCH SCell.

**Secondary Timing Advance Group**: Timing Advance Group containing neither the PCell nor PSCell.

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

**Short Processing Time**: For 1 ms TTI length, the operation with short processing time in UL data transmission and DL data reception.

**Short TTI:** TTI length based on a slot or a subslot.

**Sidelink**: UE to UE interface for sidelink communication, V2X sidelink communication and sidelink discovery. The Sidelink corresponds to the PC5 interface as defined in TS 23.303 [62].

**Sidelink Control period**: period over which resources are allocated in a cell for sidelink control information and sidelink data transmissions. The Sidelink Control period corresponds to the PSCCH period as defined in TS 36.213 [6].

**Sidelink communication**: AS functionality enabling ProSe Direct Communication as defined in TS 23.303 [62], between two or more nearby UEs, using E-UTRA technology but not traversing any network node. In this version, the terminology "sidelink communication" without "V2X" prefix only concerns PS unless specifically stated otherwise.

**Sidelink discovery**: AS functionality enabling ProSe Direct Discovery as defined in TS 23.303 [62], using E-UTRA technology but not traversing any network node.

**Split bearer**: in dual connectivity, a bearer whose radio protocols are located in both the MeNB and the SeNB to use both MeNB and SeNB resources.

**Split LWA bearer**: in LTE-WLAN Aggregation, a bearer whose radio protocols are located in both the eNB and the WLAN to use both eNB and WLAN radio resources.

**Switched LWA bearer**: in LTE-WLAN Aggregation, a bearer whose radio protocols are located in both the eNB and the WLAN but uses WLAN radio resources only.

**Timing Advance Group**: a group of serving cells that is configured by RRC and that, for the cells with an UL configured, use the same timing reference cell and the same Timing Advance value.

**User plane CIoT 5GS Optimisation**: Enables support for change from 5GMM-IDLE mode to 5GMM-CONNECTED mode without the need for using the Service Request procedure, as defined in TS 24.501 [91].

**User plane CIoT EPS optimisation**: Enables support for change from EMM-IDLE mode to EMM-CONNECTED mode without the need for using the Service Request procedure, as defined in TS 24.301 [20].

**V2X sidelink communication**: AS functionality enabling V2X Communication as defined in TS 23.285 [72], between nearby UEs, using E-UTRA technology but not traversing any network node.

**WLAN Termination**: the logical node that terminates the Xw interface on the WLAN side.

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## 23.21 Support for BL UEs, UEs in enhanced coverage and NB-IoT UEs over Non-Terrestrial Networks

## 23.21.1 General

Support for BL UEs, UEs in enhanced coverage and NB-IoT UEs over Non-Terrestrial Networks (see clause 4.12) is only applicable to E-UTRA connected to EPC. UEs not supporting NTN are barred from accessing an NTN cell.

In NTN, only BL UEs, UEs in enhanced coverage and NB-IoT UEs with GNSS capability are supported in this release of the specification.

To accommodate long propagation delays in NTN, increased timer values and window sizes, or delayed starting times are supported for the physical layer and for higher layers.

UL segmented transmission is supported for UL transmission with repetitions. The UE shall apply UE pre-compensation per segment of UL transmission of PUSCH/PUCCH/PRACH for BL UEs or UEs in enhanced coverage and NPUSCH/NPRACH for NB-IoT UEs from one segment to the next segment.

In this release of the specification, NTN system only supoorts FDD mode and IoT NTN TDD mode.

In NTN, the distance refers to Euclidean distance.

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# Annex: Agreements for IoT NTN TDD

## RAN2#129

Agreements:

1. RAN2 will continue studying paging aspects based, on RAN1 progress
2. RAN2 assumes Kmac has to be extended (or a new parameter with higher range introduced) to address the case where the number of hops exceeds a certain limit. We continue the discussion in the next meeting to investigate if there are any other implications and in case of any decisions we send an LS to other groups if needed.
3. RAN2 confirms that idle mode eDRX is supported in IoT-NTN TDD network.
4. RAN2 thinks that a change of H-SFN duration (Option 1-1) and/or H-SFN total number (option 2-2) will impact RAN2 and SA2 specification regarding the support of idle mode eDRX in IoT-NTN TDD network and the impact should be evaluated.
5. RAN2 assumes that legacy coverage enhancement techniques (i.e. transmission with repetitions) are supported in IoT-NTN TDD system.
6. RAN2 can continue the discussion also on RAR window
7. Legacy barring bit will be used (FFS is cellBarred or cellBarred-NTN)

## RAN2#129bis

Agreements:

1. Regarding paging occasion determination, legacy NB-IoT PO determination mechanism is used. When the determined paging subframe is not a valid downlink subframe, the Paging monitoring is postponed to the nearest valid downlink subframe.

2. In IoT-NTN TDD mode, existing cell barring mechanism using the IE cellBarred-r13 and cellBarred-NTN-r17 in SIB1 is sufficient to control access to the IoT-NTN TDD cell.

3. Existing value ranges of timers in unit of PDCCH periods are reused for IoT NTN TDD (FFS on the possible clarification to take into account the impact of invalid subframes

4. When PUR resource start subframe does not align with the UL subframes in the H-SFN, UE postpones the PUR resource start subframe to the next valid UL subframe

5. When the UL SPS overlaps with non-U NB-IoT subframes UE postpones the UL SPS resource to the next valid UL subframe

6. For IoT NTN TDD mode, support k-Mac with a value range up to 1023 ms (add corresponding a restriction in the field description)

## RAN2#130

Agreements:

1. The SI-message transmission can be postponed to the next valid D frame within the SI-Window

2. It is up to NW implementation to avoid SI-window overlap

3. SI repetitions will not overlap (in case of collision the subsequent SI repetition is postponed)

4. In IoT-NTN TDD mode, the RA-RNTI should be calculated based on the SFN of the first radio frame in which the Random-Access Preamble is transmitted (i.e. no spec change)

5. For the timer of ra-ResponseWindowSize and mac-ContentionResolutionTimer, the absolute value limitation for FDD (i.e., 10.24s) is used for IoT NTN TDD.

6. In IoT-NTN TDD mode the same formula as for RA-RNTI calculation for FDD is reused

7. No extension is needed on the value range of timer in unit of ms or s for IoT NTN TDD

8. The remaining paging repetitions falling on the invalid DL SFNs are postponed to the next valid DL SFNs.

9. It is up to network to configure the gap between two POs (i.e., parameter NB) to be sufficiently long such that it includes enough number of valid DL subframes for NumRepetitionPaging-r13 (no spec impact)

10. Introduce the following definition for IoT-NTN TDD mode in the impacted RAN2 specifications:
IoT-NTN TDD mode: allows use of NB-IoT channels with TDD mode for NTN with fixed values of D non-overlapping usable contiguous DL subframes and set of U usable contiguous UL subframes separated by fixed guard period (can revisit this based on the TP being prepared by RAN1)

11. In Rel19, RAN2 will not work on any specific enhancements to ensure that the features being specified in IoT\_NTN\_Ph3-Core will also work for IoT NTN TDD mode

12. In IoT\_NTN\_Ph3-Core, RAN2 will not work on any specific enhancements to ensure that the features being specified in IoT\_NTN\_Ph3-Core will also work for IoT NTN TDD mode. RAN2 understands that, as part of the IoT\_NTN\_TDD WI, we can discuss on a case by case basis whether minor specific enhancements – not affecting other WGs - can be supported to ensure that (some of) the features being specified in IoT\_NTN\_Ph3-Core will also work for IoT NTN TDD mode