**3GPP TSG-RAN WG2 Meeting #111 Electronic *R2-200xxxx***

**Elbonia, 17 – 28 August 2020**

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| *CR-Form-v12.0* | | | | | | | | |
| **CHANGE REQUEST** | | | | | | | | |
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|  |  | **CR** | **0383** | **rev** | **1** | **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 |  | Radio Access Network | **x** | Core Network |  |

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| ***Title:*** | Update to IAB-MT capabilities | | | | | | | | | |
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| ***Source to WG:*** | Nokia, Nokia Shanghai Bell | | | | | | | | | |
| ***Source to TSG:*** | R2 | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Work item code:*** | NR\_IAB-Core | | | | |  | ***Date:*** | | | 2020-09 |
|  |  | | | |  | |  | | |  |
| ***Category:*** | **F** |  | | | | | ***Release:*** | | | 16 |
|  | *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-12 (Release 12)* *Rel-13 (Release 13) Rel-14 (Release 14) Rel-15 (Release 15) Rel-16 (Release 16)* | |
|  |  | | | | | | | | | |
| ***Reason for change:*** | | R15 features that are mandatory with capability signalling if not included in IAB-MT features minimum set, they become optional for IAB-MT.  During RAN#88e meeting it was agreed that Rel-15 Layer-2 and Layer-3 UE Feature that should mandatory with capability signalling for wide-area and local-area IAB-MTs is:  4-1 Intra-NR measurements and reports  The conclusions captured in RP-201292 need to be reflected in TS 38.306.  RAN2#111-e meeting agreed that for mandatory and optional features for which capability bits exist they are re-used for IAB-MT with further explanation on IAB-MT applicability in TS 38.306.  In particular, for identified:   * mandatory features for IAB-MT: *eventA-MeasAndReport, intraAndInterF-MeasAndReport,* and * optional feature for IAB-MT: *handoverInterF , multipleTCI, pdsch-MappingTypeA, pucch-F2-WithFH, pucch-F3-WithFH*   existing UE capability bits are re-used with further explanation on applicability to IAB-MT in TS38.306  Furthermore, RAN2#111-e agreed that *HO-IntraF-IAB-r16* is signalled per Band. With the consistency condition agreed according to R2-2006936 for UE capabilities that are changed from per UE requiring xDD-Diff and FRx-Diff to per band, a new condition needs to be added (i.e. UE shall set the capability value consistently for all FDD-FR1 bands, all TDD-FR1 bands and all TDD-FR2 bands respectively). | | | | | | | | |
|  | |  | | | | | | | | |
| ***Summary of change:*** | | 1. In section 4.2.15.1 is updated to account for the change in interpreting mandatory UE capabilities which re-use existing capability signalling. 2. In section 4.2.15.7.1, *handoverIntraF-IAB-r16* parameter definition is introduced (moved from 4.2.15.8) to reflect requirement on capability per band. 3. In section 4.2.15.7.1, *handoverIntraF-IAB-r16* and *rasterShift7dot5-IAB-r16* parameters definitions are changed to clarify applicability for FDD-TDD DIFF and FR1-FR2 DIFF. The fields are changed to be N/A as per band will already indicate whether it is TDD or FDD and FR1 or FR2. 4. In section 4.2.15.7.1, *multipleTCI* parameter definition is introduced to reflect its optional applicability for IAB-MT. 5. In section 4.2.15.7.2, *pdsch-MappingTypeA, pucch-F2-WithFH, pucch-F3-WithFH* parameters definition are introduced to reflect its optional applicability for IAB-MT 6. In section 4.2.15.7.2 editorial change is made to change *ul-flexibleDL-SlotFormatDynamic-IAB* to *ul-flexibleDL-SlotFormatDynamic****s****-IAB*, to align with 38.331. 7. In section 4.2.15.8, *eventA-MeasAndReport* and *intraAndInterF-MeasAndReport* parameters definitions are introduced to clarify these are mandatory parameters for an IAB-MT. 8. In section 4.2.15.8, *handoverInterF* parameter definition is introduced to clarify this is optional parameter for an IAB-MT and apply differently than common capabilitybit for *handoverInterF.*   **Impact analysis**  Impacted functionality: IAB-MT capability signalling.  Inter-operability:   1. If the IAB-DU/IAB-CU is implemented according to the CR and the IAB-MT is not, there are no interoperability issues 2. If the IAB-MT is implemented according to the CR and the IAB-DU/IAB-CU is not, there are no interoperability issues. | | | | | | | | |
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| ***Consequences if not approved:*** | | Signalling of mandatory UE features which are optional for IAB-MT becomes ambiguous without separate parameters for IAB-MT.  *eventA-MeasAndReport* and *intraAndInterF-MeasAndReport* remain optional for IAB-MTs, which is contradicotry to RAN#88e agreement. | | | | | | | | |
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| ***Clauses affected:*** | | 4.2.15.1, 4.2.15.7, 4.2.15.8 | | | | | | | | |
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|  | | **Y** | **N** |  | | | |  | | |
| ***Other specs*** | |  | **x** | Other core specifications | | | | TS38.331 CR ... | | |
| ***affected:*** | |  | **x** | Test specifications | | | | TS/TR ... CR ... | | |
| ***(show related CRs)*** | |  | **x** | O&M Specifications | | | | TS/TR ... CR ... | | |
|  | |  | | | | | | | | |
| ***Other comments:*** | |  | | | | | | | | |
|  | |  | | | | | | | | |
| ***This CR's revision history:*** | |  | | | | | | | | |

*First Modified Subclause*

### 4.2.15 IAB Parameters

#### 4.2.15.1 Mandatory IAB-MT features

Table 4.2.11.1-1, Table 4.2.11.1-2 and Table 4.2.11.1-3 capture feature groups, which are mandatory for an IAB-MT. All other feature groups or components of the feature groups as captured in TR 38.822 [24] as well as capabilities specified in this specification are optional for an IAB-MT, unless indicated otherwise.

Table 4.2.15.1-1: Layer-1 mandatory features for IAB-MT

| Features | Index | Feature group | Components | Additional information |
| --- | --- | --- | --- | --- |
| 0. Waveform, modulation, subcarrier spacings, and CP | 0-1 | CP-OFDM waveform for DL and UL | 1) CP-OFDM for DL  2) CP -OFDM for UL |  |
| 0-3 | DL modulation scheme | 1) QPSK modulation  2) 16QAM modulation  3) 64QAM modulation for FR1 |  |
| 0-4 | UL modulation scheme | 1) QPSK modulation  2) 16QAM modulation |  |
| 1. Initial access and mobility | 1-1 | Basic initial access channels and procedures | 1) RACH preamble format  2) SS block based RRM measurement  3) Broadcast SIB reception including RMSI/OSI and paging | Only 1 preamble for component 1), component 2), component 3) except paging |
| 1-3 | SS block based RLM | SS-SINR measurement |  |
| 2. MIMO | 2-1 | Basic PDSCH reception | 1) Data RE mapping  2) Single layer transmission  3) Support one TCI state |  |
| 2-5 | Basic downlink DMRS  for scheduling type A | 1) Support 1 symbol FL DMRS without additional symbol(s)  2) Support 1 symbol FL DMRS and 1 additional DMRS symbol  3) Support 1 symbol FL DMRS and 2 additional DMRS symbols for at least one port. |  |
| 2-6 | Basic downlink DMRS  for scheduling type B | 1) Support 1 symbol FL DMRS without additional symbol(s)  2) Support 1 symbol FL DMRS and 1 additional DMRS symbol |  |
| 2-12 | Basic PUSCH transmission | Data RE mapping  Single layer (single Tx) transmission  Single port, single resource SRS transmission (SRS set use is configured as for codebook) |  |
| 2-16 | Basic uplink DMRS (uplink) for scheduling type A | 1) Support 1 symbol FL DMRS without additional symbol(s)  2) Support 1 symbol FL DMRS and 1 additional DMRS symbols  3) Support 1 symbol FL DMRS and 2 additional DMRS symbols |  |
| 2-16a | Basic uplink DMRS  for scheduling type B | 1) Support 1 symbol FL DMRS without additional symbol(s)  2) Support 1 symbol FL DMRS and 1 additional DMRS symbol |  |
| 2-22 | Aperiodic beam report | Support aperiodic report on PUSCH |  |
| 2-32 | Basic CSI feedback | 1) Type I single panel codebook based PMI (further discuss which mode or both to be supported as mandatory)  2) 2Tx codebook for FR1 and FR2  3) 4Tx codebook for FR1  4) 8Tx codebook for FR1 when configured as wideband CSI report  7) a-CSI on PUSCH (at least Z value >= 14 symbols, detail processing time to be discussed separately)  further check a-CSI on p-CSI-RS and/or SP-CSI-RS from component-7 |  |
| 2-50 | Basic TRS | 1) Support of TRS (mandatory)  2) All the periodicity are supported. |  |
| 2-52 | Basic SRS | 1) Support 1 port SRS transmission  2) Support periodic/aperiodic SRS transmission |  |
| 3. DL control channel and procedure | 3-1 | Basic DL control channel | 1) One configured CORESET per BWP per cell in addition to CORESET0  - CORESET resource allocation of 6RB bit-map and duration of 1 – 3 OFDM symbols for FR1  - For type 1 CSS without dedicated RRC configuration and for type 0, 0A, and 2 CSSs, CORESET resource allocation of 6RB bit-map and duration 1-3 OFDM symbols for FR2  - For type 1 CSS with dedicated RRC configuration and for type 3 CSS, UE specific SS, CORESET resource allocation of 6RB bit-map and duration 1-2 OFDM symbols for FR2  - REG-bundle sizes of 2/3 RBs or 6 RBs  - Interleaved and non-interleaved CCE-to-REG mapping  - Precoder-granularity of REG-bundle size  - PDCCH DMRS scrambling determination  - TCI state(s) for a CORESET configuration  2) CSS and UE-SS configurations for unicast PDCCH transmission per BWP per cell  - PDCCH aggregation levels 1, 2, 4, 8, 16  - UP to 3 search space sets in a slot for a scheduled SCell per BWP  This search space limit is before applying all dropping rules.  - For type 1 CSS with dedicated RRC configuration, type 3 CSS, and UE-SS, the monitoring occasion is within the first 3 OFDM symbols of a slot  - For type 1 CSS without dedicated RRC configuration and for type 0, 0A, and 2 CSS, the monitoring occasion can be any OFDM symbol(s) of a slot, with the monitoring occasions for any of Type 1- CSS without dedicated RRC configuration, or Types 0, 0A, or 2 CSS configurations within a single span of three consecutive OFDM symbols within a slot  3) Monitoring DCI formats 0\_0, 1\_0, 0\_1, 1\_1  4) Number of PDCCH blind decodes per slot with a given SCS follows Case 1-1 table  5) Processing one unicast DCI scheduling DL and one unicast DCI scheduling UL per slot per scheduled CC for FDD |  |
| 4. UL control channel and procedure | 4-1 | Basic UL control channel | 1) PUCCH format 0 over 1 OFDM symbols once per slot  2) PUCCH format 0 over 2 OFDM symbols once per slot with frequency hopping as "enabled"  3) PUCCH format 1 over 4 – 14 OFDM symbols once per slot with intra-slot frequency hopping as "enabled"  5) One SR configuration per PUCCH group  6) HARQ-ACK transmission once per slot with its resource/timing determined by using the DCI  7)  SR/HARQ multiplexing once per slot using a PUCCH when SR/HARQ-ACK are supposed to be sent by overlapping PUCCH resources with the same starting symbols in a slot  8) HARQ-ACK piggyback on PUSCH with/without aperiodic CSI once per slot when the starting OFDM symbol of the PUSCH is the same as the starting OFDM symbols of the PUCCH resource that HARQ-ACK would have been transmitted on  9) Semi-static beta-offset configuration for HARQ-ACK  10) Single group of overlapping PUCCH/PUCCH and overlapping PUCCH/PUSCH s per slot per PUCCH cell group for control multiplexing |  |
| 4-10 | Dynamic HARQ-ACK codebook | Dynamic HARQ-ACK codebook |  |
| 5. Scheduling/HARQ operation | 5-1 | Basic scheduling/HARQ operation | 1) Frequency-domain resource allocation  - RA Type 0 only and Type 1 only for PDSCH without interleaving  - RA Type 1 for PUSCH without interleaving  2) Time-domain resource allocation  - 1-14 OFDM symbols for PUSCH once per slot  - One unicast PDSCH per slot  - Starting symbol, and duration are determined by using the DCI  - PDSCH mapping type A with 7-14 OFDM symbols  - PUSCH mapping type A and type B  - For type 1 CSS without dedicated RRC configuration and for type 0, 0A, and 2 CSS, PDSCH mapping type A with {4-14} OFDM symbols and type B with {2, 4, 7} OFDM symbols  3) TBS determination  4) Nominal UE processing time for N1 and N2 (Capability #1)  5) HARQ process operation with configurable number of DL HARQ processes of up to 16  6) Cell specific RRC configured UL/DL assignment for TDD  7) Dynamic UL/DL determination based on L1 scheduling DCI with/without cell specific RRC configured UL/DL assignment  9) In TDD support at most one switch point per slot for actual DL/UL transmission(s)  10) DL scheduling slot offset K0=0  12) UL scheduling slot offset K2<=12  For type 1 CSS without dedicated RRC configuration and for type 0, 0A, and 2 CSS, interleaving for VRB-to-PRB mapping for PDSCH |  |
| 6. CA/DC, BWP, SUL | 6-1 | Basic BWP operation with restriction | 1) 1 UE-specific RRC configured DL BWP per carrier  2) 1 UE-specific RRC configured UL BWP per carrier  3) RRC reconfiguration of any parameters related to BWP  4) BW of a UE-specific RRC configured BWP includes BW of CORESET#0 (if CORESET#0 is present) and SSB for PCell/PSCell (if configured) and BW of the UE-specific RRC configured BWP includes SSB for SCell if there is SSB on SCell |  |
| 7. Channel coding | 7-1 | Channel coding | 1) LDPC encoding and associated functions for data on DL and UL  2) Polar encoding and associated functions for PBCH, DCI, and UCI  3) Coding for very small blocks |  |
| 8. UL TPC | 8-3 | Basic power control operation | 1) Accumulated power control mode for closed loop  2) 1 TPC command loop for PUSCH, PUCCH respectively  3) One or multiple DL RS configured for pathloss estimation  4) One or multiple p0-alpha values configured for open loop PC  5) PUSCH power control  6) PUCCH power control  7) PRACH power control  8) SRS power control  9) PHR |  |

Table 4.2.15.1-2: Layer-2 and Layer-3 mandatory features for IAB-MT

| Features | Index | Feature group | Components | Additional information |
| --- | --- | --- | --- | --- |
| 0. General | N/A | IAB procedures | 1) Routing using BAP protocol, as specified in TS 38.340 [23]  2) Bearer mapping using BAP protocol, as specified in TS 38.340 [23]  3) IAB-node IP address signalling over RRC, as specified in TS 38.331 [9] |  |
| 1. PDCP | 1-0 | Basic PDCP procedures | 1) (de)Ciphering on SRB  2) Integrity protection on SRB  3) Timer based SDU discard  4) Re-ordering and in-order delivery  6) Duplicate discarding  7) 18bits SN |  |
| 2. RLC | 2-0 | Basic RLC procedures | 1) RLC TM  2) RLC AM with 18bits SN  3) SDU discard |  |
| 2-4 | NR RLC SN size for SRB | NR RLC SN size for SRB |  |
| 3. MAC | 3-0 | Basic MAC procedures | 1) RA procedure on PCell  2) IAB-MT initiated RA procedure (including for beam recovery purpose)  3) NW initiated RA procedure (i.e. based on PDCCH)  4) Support of ssb-Threshold and association between preamble/PRACH occasion and SSB  5) Preamble grouping  6) UL single TA maintenance  7) HARQ operation for DL and UL  8) LCH prioritization  9) Prioritized bit rate  10) Multiplexing  11) SR with single SR configuration  12) BSR  13) PHR  14) 8bits and 16bits L field |  |
| 9. RRC | 9-1 | RRC buffer size | Maximum overall RRC configuration size | 45 Kbytes |
| 9-2 | RRC processing time | 1) RRC connection establishment  2) RRC connection resume without SCell addition/release and SCG establishment/modification/release  3) RRC connection reconfiguration without SCell addition/release and SCG establishment/modification/release  4) RRC connection re-establishment.  5) RRC connection reconfiguration with sync procedure  6) RRC connection reconfiguration with SCell addition/release or SCG establishment/modification/release  7) RRC connection resume  8) Initial security activation  9) Counter check  10) UE capability transfer | 1) to 3) 10ms  4) 10ms  5): 10ms + additional delay (cell search time and synchronization) defined in TS 38.133  6) and 7) 16ms  7) 10 or 6ms  (See details in clause 12, TS 38.331)  8) and 9) 5ms  10) 80ms |

Table 4.2.11.1-3: RF/RRM mandatory features for IAB-MT

| Features | Index | Feature group | Components | Additional information |
| --- | --- | --- | --- | --- |
| 1. System parameter | 1-2 | 64QAM modulation for FR2 PDSCH | 64QAM modulation for FR2 PDSCH |  |
| 1-3 | 64QAM for PUSCH | 64QAM for PUSCH |  |

*Next Modified Subclause*

#### 4.2.15.7 Physical layer parameters

##### 4.2.15.7.1 BandNR parameters

| Definitions for parameters | Per | M | FDD-TDD  DIFF | FR1-FR2  DIFF |
| --- | --- | --- | --- | --- |
| UE shall set the capability value consistently for all FDD-FR1 bands, all TDD-FR1 bands and all TDD-FR2 bands respectively. | Band |  | N/A | N/A |
| ***multipleTCI***  Indicates whether UE supports more than one TCI state configurations per CORESET. UE is only required to track one active TCI state per CORESET. UE is required to support minimum between 64 and number of configured TCI states indicated by *tci-StatePDSCH*. | Band | No | N/A | N/A |
| ***rasterShift7dot5-IAB-r16***  Indicates whether the IAB-MT supports 7.5kHz UL raster shift in the indicated band. | Band | No | N/A | N/A |

##### 4.2.15.7.2 Phy-Parameters

| Definitions for parameters | | Per | M | FDD-TDD  DIFF | | FR1-FR2  DIFF |
| --- | --- | --- | --- | --- | --- | --- |
| ***dft-S-OFDM-WaveformUL-IAB-r16***  Indicates whether the IAB-MT supports DFT-S-OFDM waveform for UL and transform precoding for single-layer PUSCH. | | IAB-MT | No | No | | No |
| ***dci-25-AI-RNTI-Support-IAB-r16***  Indicates the support of monitoring DCI Format 2\_5 scrambled by AI-RNTI for indication of soft resource availability to an IAB node as specified in TS 38.212 [10]. | IAB-MT | | No | No | No | |
| ***guardSymbolReportReception-IAB-r16***  Indicates the support of DesiredGuardSymbols reporting and ProvidedGuardSymbols reception as specified in TS 38.213 [11]. | IAB-MT | | No | No | No | |
| ***pdsch-MappingTypeA***  Indicates whether the IAB-MT supports receiving PDSCH using PDSCH mapping type A with less than seven symbols. | IAB-MT | | No | No | No | |
| ***pucch-F2-WithFH***  Indicates whether the UE supports transmission of a PUCCH format 2 (2 OFDM symbols in total) with frequency hopping in a slot. | IAB-MT | | No | No | Yes | |
| ***pucch-F3-WithFH***  Indicates whether the UE supports transmission of a PUCCH format 3 (4~14 OFDM symbols in total) with frequency hopping in a slot. | IAB-MT | | No | No | Yes | |
| ***seperateSMTC-InterIAB-Support-r16***  Indicates the support of up to 4 SMTCs configurations per frequency location, including IAB-specific SMTC window periodicities. | IAB-MT | | No | No | No | |
| ***seperateRACH-IAB-Support-r16***  Indicates the support of separate RACH configurations including new IAB-specific offset and scaling factors. | IAB-MT | | No | No | No | |
| ***t-DeltaReceptionSupport-IAB-r16***  Indicates the support of T\_delta reception for case 1 OTA timing alignment as specified in TS 38.213 [11]. | IAB-MT | | No | No | No | |
| ***ul-flexibleDL-SlotFormatSemiStatic-IAB-r16***  Indicates the support of semi-static configuration/indication of UL-Flexible-DL slot formats for IAB-MT resources. | IAB-MT | | No | No | No | |
| ***ul-flexibleDL-SlotFormatDynamics-IAB-r16***  Indicates the support of dynamic indication of UL-Flexible-DL slot formats for IAB-MT resources. | IAB-MT | | No | No | No | |

*Next Modified Subclause*

#### 4.2.15.8 MeasAndMobParameters Parameters

| Definitions for parameters | Per | M | FDD-TDD  DIFF | FR1-FR2  DIFF |
| --- | --- | --- | --- | --- |
| *eventA-MeasAndReport*  Indicates whether the IAB-MT supports NR measurements and events A triggered reporting as specified in TS 38.331 [9]. | IAB-MT | Yes | Yes | No |
|  |  |  |  |  |
| ***handoverInterF***  Indicates whether the IAB-MT supports inter-frequency HO. It indicates the support for inter-frequency HO from the corresponding duplex mode if this capability is included in fdd-Add-UE-NR-Capabilities or tdd-Add-UE-NR-Capabilities. It indicates the support for inter-frequency HO from the corresponding frequency range if this capability is included in fr1-Add-UE-NR-Capabilities or fr2-Add-UE-NR-Capabilities. | IAB-MT | No | Yes | Yes |
| ***mfbi-IAB-r16***  Indicates whether the IAB-MT supports multiple frequency band indication. | IAB-MT | No | No | No |
| ***multipleNS-And-Pmax-IAB-r16***  Indicates whether the IAB-MT supports multiple NS/P-Max. | IAB-MT | No | No | No |
| ***intraAndInterF-MeasAndReport***  Indicates whether the IAB-MT supports NR intra-frequency and inter-frequency measurements and at least periodical reporting. | IAB-MT | Yes | Yes | No |

*End of changes*