**3GPP TSG RAN WG1 #108-e R1-22nnnnn**

**e-Meeting, February 21st – March 3rd, 2022**

**Agenda item:** 8.16

**Source:** Moderators (AT&T, NTT DOCOMO, INC.)

**Title:** Updated RAN1 UE features list for Rel-17 LTE after RAN1 #108-e

**Document for:** Information

1. Introduction

This contribution includes the updated RAN1 UE features list for Rel-17 LTE after RAN1 #108-e.

1. NB\_IOTenh4\_LTE\_eMTC6

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| Features | Index | Feature group | Components | Prerequisite feature groups | Need for the eNB to know if the feature is supported | [Need for the UE to know if the feature is supported (only for V2X WI, where the PC5-RRC capability signalling is delivered between the UEs)] | **Consequence if the feature is not supported by the UE** | **Type****(the ‘type’ definition from UE features should be based on the granularity of 1) Per UE or 2) Per Band or 3) Per BC or 4) Per FS or 5) Per FSPC)** | Need of FDD/TDD differentiation | Capability interpretation for mixture of FDD/TDD | Note | Mandatory/Optional |
| 1. NB\_IOTenh4\_LTE\_eMTC6 | 1-1 | 16-QAM for unicast NPDSCH | 1. Reception of unicast NPDSCH modulated with 16-QAM2. CQI report to support 16-QAM modulation3. Downlink power allocation for 16-QAM | Category NB-2 | Yes | N/A | The network cannot schedule a unicast NPDSCH modulated with 16-QAM for the UE | Per UE | Yes | N/A | It is RAN1 assumption that 16-QAM for unicast in DL is compatible with all other NB-IoT features in connected-mode plus PURDwPTS in special subframe configuration 9 for normal cyclic prefix is not used for NPDSCH transmission with 16QAM, when 16QAM is configured. | Optional with capability signaling |
| 1. NB\_IOTenh4\_LTE\_eMTC6 | 1-2 | 16-QAM for unicast NPUSCH | 1. Transmission of unicast NPUSCH modulated with 16-QAM2. New term in the UE’s transmit power control equation. | Category NB-2 | Yes | N/A | The network cannot schedule a unicast NPUSCH modulated with 16-QAM for the UE | Per UE | Yes | N/A | It is RAN1 assumption that 16-QAM for unicast in UL is compatible with all other NB-IoT features in connected-mode plus PUR | Optional with capability signaling |
| 1. NB\_IOTenh4\_LTE\_eMTC6 | 1-3 | 14 HARQ processes for PDSCH for HD-FDD Cat. M1 UEs | 1. Support of 14 DL HARQ processes for unicast in HD-FDD in CE mode A in RRC\_CONNECTED2. PDSCH scheduling delay3. HARQ-ACK delay solution with Alt-1 and Alt-2e | 1. Category M12. HD-FDD | Yes | N/A | The network cannot enable 14 HARQ processes for the UE | Per UE | FDD only | N/A | * PDSCH scheduling delay:
	+ 2 BL/CE DL subframes.
	+ 1 BL/CE DL subframe + 1 subframe + 3 BL/CE UL subframes + 1 subframe + 1 BL/CE DL subframe.
	+ 1 subframe + 3 BL/CE UL subframes + 1 subframe + 2 BL/CE DL subframes.
* HARQ-ACK delay:
	+ Alt-1: The HARQ-ACK delay is determined through an expression consisting of different subframe types (Using a similar principle as the PDSCH scheduling delay).
	+ Alt-2e: The HARQ-ACK delay is determined following the legacy approach. That is, the “HARQ-ACK delay” is kept expressed in terms of “absolute subframes”.

For component 3, UE reports one of {Alt-1, Alt-1 and Alt-2e}It is RAN1 assumption the 14 HARQ processes feature is compatible with all other eMTC features in connected-mode applicable for HD-FDD Cat. M1 UEs in CE mode A, except for the simultaneous configuration with Rel-16 Multi-TB scheduling. In Rel-17 for the 14 HARQ processes feature, the HARQ-ACK delays are only provided through the “PDSCH scheduling delay and HARQ-ACK delay for 14 HARQ” DCI field. | Optional with capability signaling |
| 1. NB\_IOTenh4\_LTE\_eMTC6 | 1-4 | A maximum DL TBS of 1736 bits for HD-FDD Cat. M1 UEs in CE mode A only | 1. Support of 1736 bits max DL TBS for unicast in HD-FDD in CE mode A in RRC\_CONNECTED | 1. Category M12. HD-FDD | Yes | N/A | The network cannot schedule a PDSCH with TBS larger than 1000 bits for Cat. M1 UEs | Per UE | FDD only | N/A |  | Optional with capability signaling |

1. LTE\_NBIOT\_eMTC\_NTN

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| Features | Index | Feature group | Components | Prerequisite feature groups | Need for the eNB to know if the feature is supported | [Need for the UE to know if the feature is supported (only for V2X WI, where the PC5-RRC capability signalling is delivered between the UEs)] | **Consequence if the feature is not supported by the UE** | **Type****(the ‘type’ definition from UE features should be based on the granularity of 1) Per UE or 2) Per Band or 3) Per BC or 4) Per FS or 5) Per FSPC)** | Need of FDD/TDD differentiation | Capability interpretation for mixture of FDD/TDD | Note | Mandatory/Optional |
| 2. LTE\_NBIOT\_eMTC\_NTN | 2-1 | Basic IoT over NTN support | 1. UE derives its position based on its GNSS measurements[1-1. UE reports the information associated with the validity duration of GNSS]2. UE receives serving satellite ephemeris in either state vector format or orbital element format 4. UE calculates UE specific TA in RRC\_IDLE and RRC\_CONNECTED state based on its GNSS-acquired position and the serving satellite ephemeris6. UE calculates common TA in RRC\_IDLE and RRC\_CONNECTED according to the parameters provided by the network (UE considers common TA as 0 if the parameter is not provided)7. For TA update in RRC\_CONNECTED state, UE uses a combination of both open (i.e. UE autonomous TA estimation, and common TA estimation) and closed (i.e., received TA commands) control loops8. In RRC\_IDLE and RRC\_CONNECTED state, UE calculates frequency pre-compensation to counter shift the Doppler experienced on the service link [in DL] [and] [in UL]10. UE supports a validity timer of UL synchronization that is configured by the network  15. UE estimates UE-gNB RTT and delays the starts of ra-ResponseWindow by UE-gNB RTT16. Delay the UE action and assumption on a downlink configuration carried by MAC CE command by K\_mac if it is indicated17. In RRC\_IDLE state and RRC\_CONNECTED state, UE pre-compensates the calculated frequency offset and TA in uplink transmissions |  | Yes | N/A | Release 17 UE cannot communicate via satellite | [per UE/per band] | No | No |  | Optional with capability signallingFor UEs supporting NB-IoT/eMTC NTN, it must indicate this FG is supportedNote: This UE feature group is applicable only for IoT-NTN cell for communication via satellite, for any other cell this feature is not supported |
| 2. LTE\_NBIOT\_eMTC\_NTN | 2-1a | Segment duration configuration | Support segment duration configuration by the network  |  | Yes | N/A | Release 17 UE cannot access [NTN/satellite] | [Per UE/per band] | No | No | For UEs support NSGO scenarios, it must indicate this FG is supported. | Optional with capability signalling[Note: This UE feature group is applicable only for IoT-NTN cell, for terrestrial cell this feature is not supported] |
| 2. LTE\_NBIOT\_eMTC\_NTN | 2-2 | Enhancing timing relationships using a time offset | 1. UE receives and applies UE specific K\_offset/K\_mac in timing relationship enhancements
 | 2-1 , 2-3 | Yes  | N/A | UE does not know the offset to apply for UL transmission  | [per UE/per band] | No | No | The K\_offset is a scheduling offset used for the identified timing relationships that need to be modified for IoT NTN. For IoT NTN, support cell-specific Koffset configuration for use during initial access.For IoT NTN, support the use of UE-specific Koffset in CONNECTED mode. | Optional with capability signalling |
| 2. LTE\_NBIOT\_eMTC\_NTN | 2-3 | TA pre-compensation reporting | 1. Support reporting of information about the UE specific TA pre-compensation
 | 2-1 | Yes | No | UL scheduling for FDD-HD: Use of UE-specific TA and/or K\_offset to avoid UL-DL collisions in FDD-HD | [per UE/per band] | No | No | UE-specific TA reporting is supported in IoT-NTN | Optional with capability signalling |

1. LTE\_terr\_bcast\_bands\_part1

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| Features | Index | Feature group | Components | Prerequisite feature groups | Need for the eNB to know if the feature is supported | [Need for the UE to know if the feature is supported (only for V2X WI, where the PC5-RRC capability signalling is delivered between the UEs)] | **Consequence if the feature is not supported by the UE** | **Type****(the ‘type’ definition from UE features should be based on the granularity of 1) Per UE or 2) Per Band or 3) Per BC or 4) Per FS or 5) Per FSPC)** | Need of FDD/TDD differentiation | Capability interpretation for mixture of FDD/TDD | Note | Mandatory/Optional |
| 3. LTE\_terr\_bcast\_bands\_part1 | 3-1a | Support of 6MHz channel bandwidth for PMCH | Support of 6MHz channel bandwidth for PMCH | Support of dedicated MBMS cells | Yes |  | UE cannot receive MBMS in the corresponding MBSFN area | Per band | N/A | N/A | NOTE: This capability is sent to a unicast eNB, and indicates whether the UE in RRC\_CONNECTED supports MBMS reception via MBSFN from MBMS-dedicated cells in an MBSFN area with 6MHz. | Optional with capability signaling |
| 3. LTE\_terr\_bcast\_bands\_part1 | 3-1b | Support of 7MHz channel bandwidth for PMCH | Support of 7MHz channel bandwidth for PMCH | Support of dedicated MBMS cells | Yes |  | UE cannot receive MBMS in the corresponding MBSFN area | Per band | N/A | N/A | NOTE: This capability is sent to a unicast eNB, and indicates whether the UE in RRC\_CONNECTED supports MBMS reception via MBSFN from MBMS-dedicated cells in an MBSFN area with 7MHz. | Optional with capability signaling |
| 3. LTE\_terr\_bcast\_bands\_part1 | 3-1c | Support of 8MHz channel bandwidth for PMCH | Support of 8MHz channel bandwidth for PMCH | Support of dedicated MBMS cells | Yes |  | UE cannot receive MBMS in the corresponding MBSFN area | Per band | N/A | N/A | NOTE: This capability is sent to a unicast eNB, and indicates whether the UE in RRC\_CONNECTED supports MBMS reception via MBSFN from MBMS-dedicated cells in an MBSFN area with 8MHz. | Optional with capability signaling |

1. NR\_SL\_enh

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| Features | Index | Feature group | Components | Prerequisite feature groups | Need for the eNB to know if the feature is supported | [Need for the UE to know if the feature is supported (only for V2X WI, where the PC5-RRC capability signalling is delivered between the UEs)] | **Consequence if the feature is not supported by the UE** | **Type****(the ‘type’ definition from UE features should be based on the granularity of 1) Per UE or 2) Per Band or 3) Per BC or 4) Per FS or 5) Per FSPC)** | Need of FDD/TDD differentiation | Capability interpretation for mixture of FDD/TDD | Note | Mandatory/Optional |
| 4. NR\_SL\_enh | 4-2 | Receiving NR sidelink of PSFCH/S-SSB  | 1) UE can receive NR PSFCH/S-SSB.FFS whether other components will be included | None | [Yes] | [No] |  | [Per band] | N.A. | N.A. |  | Optional with capability signalling. |
| 4. NR\_SL\_enh | 4-4 | Transmitting NR sidelink mode 2 with partial sensing | 1) UE can transmit PSCCH/PSSCH using NR sidelink mode 2 with partial sensing configured by NR Uu or preconfiguration. Up to B sidelink processes are supported.2) UE can transmit PSSCH according to the normal 64QAM MCS table.3) UE supports PT-RS transmission in FR2.4) UE can perform periodic-based partial sensing and resource allocation operation.5) UE can perform contiguous partial sensing and resource allocation operation.6) UE can transmit using the subcarrier spacing and CP length defined for a given band in RAN48) Supports 14-symbol SL slot with all DMRS patterns corresponding to {#PSSCH symbols} = {12, 9} for slots w/wo PSFCH. If UE signals support of ECP, support 12-symbol SL slot with all DMRS patterns corresponding to {#PSSCH symbols} = {10,7} for slots w/wo PSFCH.10) UE can transmit using 30 kHz and normal CP subcarrier spacing in FR1, 120 kHz subcarrier spacing with normal CP FR211) DL pathloss based open loop power control when mode 2 is configured by NR Uu | [TBD] | Yes | No | UE does not support transmission according to the partial sensing and resource allocation | Per FS | N.A. | N.A. | Note: Random selection [according to Rel-16] in the exceptional pool is supported.Note: configuration by NR Uu is not required to be supported in a band indicated with only the PC5 interface in 38.101-1 Table 5.2E.1-1Candidate values for B are {8,16}If UE reports more than one FGs of Rel-16 5-3, 4-4 and 4-4a, the reported value B in each FG is the total number of SL processes and the same among those FGs.Note: Component 6 is not required to be signalled in a band indicated with only the PC5 interface in 38.101-1 Table 5.2E.1-1Component-6 candidate value set in FR1:{{15 kHz}, {30 kHz}, {60 kHz}, {15, 30 kHz}, {30, 60 kHz}, {15, 60 kHz}, {15, 30, 60 kHz}}Component-6 candidate value set in FR2:{{60 kHz}, {120 kHz}, {60, 120 kHz}}Component-6 candidate value set for CP length: {NCP,NCP and ECP} (ECP only applies to SCS of 60 kHz)Note: Component 10 is only required in a band indicated with only the PC5 interface in 38.101-1 Table 5.2E.1-1Note: Component 11 is not required to be supported in a band indicated with only the PC5 interface in 38.101-1 Table 5.2E.1-1 | Optional with capability signalling. |
| 4. NR\_SL\_enh | 4-4a | Transmitting NR sidelink mode 2 with random resource selection | 1) UE can transmit PSCCH/PSSCH using NR sidelink mode 2 with random resource selection configured by NR Uu or preconfiguration. Up to B sidelink processes are supported.2) UE can transmit PSSCH according to the normal 64QAM MCS table.3) UE supports PT-RS transmission in FR2.4) UE can transmit using the subcarrier spacing and CP length defined for a given band in RAN45) Supports 14-symbol SL slot with all DMRS patterns corresponding to {#PSSCH symbols} = {12, 9} for slots w/wo PSFCH. If UE signals support of ECP, support 12-symbol SL slot with all DMRS patterns corresponding to {#PSSCH symbols} = {10,7} for slots w/wo PSFCH.6) UE can transmit using 30 kHz and normal CP subcarrier spacing in FR1, 120 kHz subcarrier spacing with normal CP FR27) DL pathloss based open loop power control when mode 2 is configured by NR Uu | [TBD] | Yes | No | UE does not support transmission according to the random resource selection and resource allocation | Per band | N.A. | N.A. | [Note: Random selection according to Rel-16 in the exceptional pool is supported.]Note: configuration by NR Uu is not required to be supported in a band indicated with only the PC5 interface in 38.101-1 Table 5.2E.1-1Candidate values for B are {8,16}If UE reports more than one FGs of Rel-16 5-3, 4-4 and 4-4a, the reported value B in each FG is the total number of SL processes and the same among those FGs.Note: Component 4 is not required to be signalled in a band indicated with only the PC5 interface in 38.101-1 Table 5.2E.1-1Component-4 candidate value set in FR1:{{15 kHz}, {30 kHz}, {60 kHz}, {15, 30 kHz}, {30, 60 kHz}, {15, 60 kHz}, {15, 30, 60 kHz}}Component-4 candidate value set in FR2:{{60 kHz}, {120 kHz}, {60, 120 kHz}}Component-4 candidate value set for CP length: {NCP,NCP and ECP} (ECP only applies to SCS of 60 kHz)Note: Component 6 is only required in a band indicated with only the PC5 interface in 38.101-1 Table 5.2E.1-1Note: Component 7 is not required to be supported in a band indicated with only the PC5 interface in 38.101-1 Table 5.2E.1-1 | Optional with capability signalling. |
| 4. NR\_SL\_enh | 4-4b | Synchronization sources for NR sidelink transmission | 1) UE supports GNSS as the synchronization reference according to the synchronization procedure with sl-SyncPriority set to GNSS and sl-NbAsSync set to false.2) UE can transmit NR sidelink based on the synchronization to an gNB3) UE additionally supports gNB and GNSS as the synchronization reference according to the synchronization procedure with sl-SyncPriority set to gnbEnb if the UE supports Components 1 and 24) UE additionally supports gNB and GNSS as the synchronization reference according to the synchronization procedure with sl-SyncPriority set to GNSS and sl-NbAsSync set to true if the UE supports Components 1 and 2.5) UE can transmit S-SSB in NR sidelink if it supports Rel-16 5-2 or Rel-16 5-3 or 4-4 or 4-4a6) UE supports SyncRef UE as the synchronization reference and can receive S-SSB in NR sidelink if it supports Rel16 5-1. |  | Yes | No |  | Per band | N.A. | N.A. | Note: configuration by NR Uu is not required to be supported in a band indicated with only the PC5 interface in 38.101-1 Table 5.2E.1-1Note: Component 1 is only required to be supported in a band indicated with only the PC5 interface in 38.101-1 Table 5.2E.1-1Note: Components 2/3/4 are not required to be supported in a band indicated with only the PC5 interface in 38.101-1 Table 5.2E.1-1 | Optional with capability signalling. |
| 4. NR\_SL\_enh | 4-4c | eNB type synchronization sources for NR sidelink transmission | 1) UE can transmit NR sidelink based on the synchronization to an eNB.2) If UE supports component 1 in FG 4-4b, UE additionally supports eNB and GNSS as the synchronization reference according to the synchronization procedure with sl-SyncPriority set to gnbEnb.3) If UE supports component 1 in FG 4-4b, UE additionally supports eNB and GNSS as the synchronization reference according to the synchronization procedure with sl-SyncPriority set to GNSS and sl-NbAsSync set to true. | 4-4b | Yes | No |  | Per band | N.A. | N.A. | Note: configuration by NR Uu is not required to be supported in a band indicated with only the PC5 interface in 38.101-1 Table 5.2E.1-1 | Optional with capability signalling. |
| 4. NR\_SL\_enh | 4-5a-1 | Transmitting Inter-UE coordination scheme 1 in NR sidelink mode 2 | 1) UE can transmit inter-UE coordination information of preferred resource set/non-preferred resource set in NR sidelink mode 2.2) UE can receive an explicit request for inter-UE coordination information of both preferred resource set and non-preferred resource set. | [At least one of 4-5a-2 and 4-5a-3] | Yes | Yes | UE does not support transmitting inter-UE coordination scheme 1 in NR sidelink mode 2.UE does not receive an explicit request for inter-UE coordination information | [Per band] | [N.A.] | [N.A.] | FFS | Optional with capability signalling. |
| 4. NR\_SL\_enh | 4-5a-2 | Receiving Inter-UE coordination information of preferred resource set in NR sidelink mode 2 | 1) UE can receive inter-UE coordination information of preferred resource set and use the received information in its own resource (re-)selection in NR sidelink mode 2.2) UE can transmit an explicit request for inter-UE coordination information of preferred resource set only. | [TBD] | Yes | Yes | UE does not support receiving inter-UE coordination of preferred resource set in NR sidelink mode 2.UE does not transmit an explicit request for inter-UE coordination information of preferred resource set only | Per band | N.A. | N.A. | FFS | Optional with capability signalling. |
| 4. NR\_SL\_enh | 4-5a-3 | Receiving Inter-UE coordination information of non-preferred resource set in NR sidelink mode 2 | 1) UE can receive inter-UE coordination information of non-preferred resource set and use the received information in its own resource (re-)selection in NR sidelink mode 2.2) UE can transmit an explicit request for inter-UE coordination information of non-preferred resource set only. | [TBD] | Yes | Yes | UE does not support receiving inter-UE coordination of non-preferred resource set in NR sidelink mode 2.UE does not transmit an explicit request for inter-UE coordination information of non-preferred resource set only | Per band | N.A. | N.A. | FFS | Optional with capability signalling. |
| 4. NR\_SL\_enh | 4-5b-1 | Transmitting Inter-UE coordination scheme 2 in NR sidelink mode 2 | 1) UE can transmit inter-UE coordination information of presence of expected/potential resource conflict in NR sidelink mode 2.2) UE can transmit up to M PSFCH(s) resources in a slot | 4-5b-2, TBD | Yes | Yes | UE does not support transmitting inter-UE coordination scheme 2 in NR sidelink mode 2. | [Per band] | [N.A.] | [N.A.] | [Note: configuration by NR Uu is not required to be supported in a band indicated with only the PC5 interface in 38.101-1 Table 5.2E.1-1]Candidate values for M are {4, 8, 16}If UE reports more than one FGs of Rel-16 5-8 and 4-5b-1, the reported value M in each FG is the total number and the same among those FGs. | Optional with capability signalling. |
| 4. NR\_SL\_enh | 4-5b-2 | Receiving Inter-UE coordination scheme 2 in NR sidelink mode 2 | 1) UE can receive inter-UE coordination information of presence of expected/potential resource conflict and use the received information in its own resource re-selection in NR sidelink mode 2.2) UE can receive up to N PSFCH(s) resources in a slot. | [TBD] | Yes | Yes | UE does not support receiving inter-UE coordination scheme 2 in NR sidelink mode 2. | Per band | N.A. | N.A. | [Note: configuration by NR Uu is not required to be supported in a band indicated with only the PC5 interface in 38.101-1 Table 5.2E.1-1]Candidate values for N are {5, 15, 25, 32, 35, 45, 50, 64}If UE reports more than one FGs of Rel-16 5-11 and 4-5b-2, the reported value N in each FG is the total number and the same among those FGs. | Optional with capability signalling. |
| 4. NR\_SL\_enh | 4-6-1 | Reception of Scheme 1 inter-UE coordination information over 2nd SCI | 1) UE can receive Scheme 1 inter-UE coordination transmission over 2nd SCI that is used in addition to the MAC-CE carrying the same inter-UE coordination information in the same transmission. | FFS | Yes | Yes | UE is not required to decode SCI 2-C and the associated PSSCH | Per band | N.A. | N.A. | Note: configuration by NR Uu is not required to be supported in a band indicated with only the PC5 interface in 38.101-1 Table 5.2E.1-1 | Optional with capability signalling |
| 4. NR\_SL\_enh | 4-6-2 | Reception of Scheme 1 explicit request over 2nd SCI | 1) UE can receive an explicit request for inter-UE coordination information of both preferred resource set and non-preferred resource set over 2nd SCI that is used in addition to the MAC-CE carrying the explicit request in the same transmission | FFS | Yes | Yes | UE is not required to decode SCI 2-C and the associated PSSCH | [Per band] | [N.A.] | [N.A.] | Note: configuration by NR Uu is not required to be supported in a band indicated with only the PC5 interface in 38.101-1 Table 5.2E.1-1 | Optional with capability signalling |
| 4. NR\_SL\_enh | 4-7 | Determination of expected conflict in Scheme 2 based on RSRP difference | 1) UE can determine a conflict for overlapping resource reservation between UE-B and another UE based on RSRP difference of the two reservations | 4-5b-1 | No | Yes |  | [Per band] | [N.A.] | [N.A.] | Note: configuration by NR Uu is not required to be supported in a band indicated with only the PC5 interface in 38.101-1 Table 5.2E.1-1 | Optional with capability signalling |