**3GPP TSG RAN meeting #92e RP-21xxxx**

**Electronic Meeting, June 14-18, 2021**

## Status Report to TSG

**Agenda item:** 9.7.1.7

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| **WI / SI Name** | Support of reduced capability NR devices |
| included in this status report | Study Item: No | Core part: Yes | Performance part:Yes | Testing part:No |
| **Acronym** | NR\_redcap |
| **Unique ID** | 900062 |
| **TSG Tdoc of latest approved WI/SI description (if any)** | [RP-210918](https://www.3gpp.org/ftp/tsg_ran/TSG_RAN/TSGR_91e/Docs/RP-210918.zip) |
| **Target Completion Date****(indicate if changed)** | Study Item:  | Core part:03/2022 | Performance part:09/2022 | Testing part:  |
| **Overall Completion level** | Study Item:  | Core part:30% | Performance Part:0% | Testing part:  |

**Source:**

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| **Leading WG** | RAN1 |
| **Rapporteur** | **Name** | Johan BERGMAN |
| **Company** | Ericsson |
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## 1 Work plan related evaluation

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| **Do you want to modify the time budget for this WI/SI compared to what was endorsed at the last RAN meeting?** | No |

## 2. Detailed progress in RAN WGs

## 2.1 RAN1

#### 2.1.1 Agreements

##### 2.1.1.1 RAN1#104bis-e

97 contributions were submitted to this meeting (for details see agenda item 8.6 in [Tdoc list](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_104b-e/Docs/TDoc_List_Meeting_RAN1%23104-bis-e.xlsx)).

An updated WI work plan was provided before the meeting in [R1-2102721](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_104b-e/Docs/R1-2102721.zip) (for latest version, see RAN1#105-e).

RAN1 carried out online (GTW) discussions and the following offline email discussions:

* [104b-e-NR-R17-RedCap-01] Email discussion on aspects related to reduced maximum UE bandwidth
	+ Summarized in [R1-2103823](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_104b-e/Docs/R1-2103823.zip), [R1-2103824](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_104b-e/Docs/R1-2103824.zip), [R1-2103825](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_104b-e/Docs/R1-2103825.zip), [R1-2103944](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_104b-e/Docs/R1-2103944.zip)
* [104b-e-NR-R17-RedCap-02] Email discussion on aspects related to reduced number of Rx
	+ Summarized in [R1-2103799](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_104b-e/Docs/R1-2103799.zip), [R1-2103866](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_104b-e/Docs/R1-2103866.zip), [R1-2103899](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_104b-e/Docs/R1-2103899.zip), [R1-2103967](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_104b-e/Docs/R1-2103967.zip)
* [104b-e-NR-R17-RedCap-03] Email discussion on aspects related to duplex operation
	+ Summarized in [R1-2103796](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_104b-e/Docs/R1-2103796.zip), [R1-2103884](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_104b-e/Docs/R1-2103884.zip), [R1-2103935](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_104b-e/Docs/R1-2103935.zip)

An updated RAN1 agreement summary was provided after the meeting in [R1-2104027](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_104b-e/Docs/R1-2104027.zip) (for latest version, see RAN1#105-e).

RAN1 made the following agreements related to **reduced maximum UE bandwidth**:

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| Working assumption:* During initial access, the bandwidth of the initial DL BWP for RedCap UEs is not expected to exceed the maximum RedCap UE bandwidth.
	+ The bandwidth and location of the initial DL BWP for RedCap UEs can be the same as the bandwidth and location of the MIB-configured initial DL BWP for non-RedCap UEs.
	+ This does not preclude a SIB-configured initial DL BWP for non-RedCap UEs only with a wider bandwidth than the maximum RedCap UE bandwidth.
	+ This does not preclude separate or additional bandwidth and location for initial DL BWP for RedCap UEs (FFS).

Working assumption: * After initial access, at least for BWP#0 configuration option 1 (as in 38.331, Appendix B2), a RedCap UE is not expected to operate with an initial DL BWP wider than the maximum RedCap UE bandwidth.
	+ FFS: BWP#0 configuration option 2 (as in 38.331, Appendix B2)

Agreements:* During initial access, for the scenario where the initial UL BWP for non-RedCap UEs is configured to be wider than the RedCap UE bandwidth, down select among the following options in RAN1#105-e
	+ Option 1: The scenario is allowed, and a RedCap UE can use the same UL BWP.
	+ Option 2: The scenario is allowed, but a separate initial UL BWP no wider than the RedCap UE maximum bandwidth is configured/defined for RedCap UEs.
	+ Option 3: The scenario is not allowed, and a RedCap UE is not expected to operate in an initial UL BWP wider than the RedCap UE maximum bandwidth.

Agreements:* After initial access, for the scenario where the initial UL BWP for non-RedCap UEs is configured to be wider than the RedCap UE bandwidth, down select among the following options in RAN1#105-e:
	+ Option 1: The scenario is allowed, and a RedCap UE can use the same UL BWP.
	+ Option 2: The scenario is allowed, but a separate initial UL BWP no wider than the RedCap UE maximum bandwidth is configured/defined for RedCap UEs.
	+ Option 3: The scenario is not allowed, and a RedCap UE is not expected to operate in an initial UL BWP wider than the RedCap UE maximum bandwidth.

Working assumption: * A RedCap UE cannot be configured with a non-initial (DL or UL) BWP (i.e., a BWP with a non-zero index) wider than the maximum bandwidth of the RedCap UE.
	+ At least for FR1, FG 6-1 ("Basic BWP operation with restriction" as described in TR 38.822) is used as a starting point for the RedCap UE type capability.
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RAN1 made the following agreements related to **reduced minimum number of Rx branches**:

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| Agreements:* At least using UE capability report according the existing framework to indicate (implicitly or explicitly) the number of Rx branches
* FFS: whether/how to support earlier indication of Redcap UEs with # Rx branches by Msg1 and/or Msg3, and MsgA
	+ FFS: Network configurability of early indication of the number of Rx branches via SIB1, if supported

Agreements:* Reuse the existing DCI formats 0\_x/1\_x (including Rel-16 DCI format 0\_2/1\_2) applicable to Redcap devices as a starting point.
	+ FFS Whether and how potential modification on fields of existing DCI formats is considered to reduce PDCCH block issue, if any.
	+ FFS: Which DCI formats are mandatory for the RedCap UEs to support.
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RAN1 made the following agreements related to **duplex operation**:

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| Agreements:* For Case 1 (dynamically scheduled DL reception vs. semi-statically configured UL transmission), reuse the existing collision handling principles in Rel-15/16 NR for operation on a single carrier /single cell in unpaired spectrum.
	+ FFS whether the timeline is extended to include the RX/TX switching time for HD-FDD
* For Case 4: dynamically scheduled DL reception vs. dynamic scheduled UL transmission, reuse the existing collision handling principles in Rel-15/16 NR for operation on a single carrier /single cell in unpaired spectrum
	+ That is, it is considered as an error case if a dynamically scheduled DL reception overlaps with a dynamically scheduled UL transmission
* For Case 2 (semi-statically configured DL reception vs. dynamically scheduled UL transmission), reuse the existing collision handling principles in Rel-15/16 NR for operation on a single carrier/single cell in unpaired spectrum
	+ The semi-statically configured DL reception may include PDCCH (excluding ULCI), SPS PDSCH, CSI-RS or PRS.
		- FFS on PDCCH carrying ULCI, including whether or not it is supported by RedCap UEs (including potential difference between HD vs. FD RedCap UEs)
	+ The dynamically scheduled UL transmission may include PUSCH, PUCCH, SRS or PRACH triggered by PDCCH order

Agreements:* For Case 3, semi-statically configured DL reception vs. semi-statically configured UL transmission
	+ A HD-FDD UE does not expect to receive both dedicated higher layer parameters configuring transmission from the UE in the set of symbols of the slot and dedicated higher layer parameters configuring reception in the set of symbols of the slot
	+ A HD-FDD UE does not expect to receive both dedicated higher layer parameters configuring transmission from the UE in the set of symbols of the slot and cell specific higher layer parameters configuring reception in the set of symbols of the slot
	+ A HD-FDD UE does not expect to receive both cell specific higher layer parameters configuring transmission from the UE in the set of symbols of the slot and dedicated higher layer parameters configuring reception in the set of symbols of the slot
	+ FFS on cell-specifically configured DL reception vs. cell-specifically configured UL transmission
	+ FFS: whether or not there are conditions that need to be considered

Working assumption:* For HD-FDD, no additional UE behavior for switching position determination is specified as compared to the existing specification.

**Conclusion**: Enhancement for potential UL and DL collision handling due to TA misalignment is not considered for Type-A HD-FDD operation of RedCap UEs Working assumption:* For HD-FDD, reuse the same principle as Rel-15/16 UE not capable of full-duplex communication
	+ A HD-FDD UE is not expected to transmit in the uplink earlier than [*NRX-TX Tc*] after the end of the last received downlink symbol in the same cell
	+ A HD-FDD UE is not expected to receive in the downlink earlier than [*NTX-RX Tc*] after the end of the last transmitted uplink symbol in the same cell
	+ FFS NTX-RX and NRX-TX
	+ FFS: how it jointly works with the agreement for other collision cases

Working assumption:* If a dynamically scheduled UL transmission overlaps with an SSB, down-select one of the following options:
	+ Option 1: Follow the handling of case 2 that dynamic UL is prioritized over SSB
	+ Option 2: Reuse the existing collision handling principles of Rel-15/16 for NR TDD that SSB is prioritized over dynamic UL
	+ Option 3: Leave to UE implementation whether to receive the SSB or transmit the UL transmission
	+ Other options are not precluded
* If a semi-static configured UL transmission overlaps with an SSB, down-select from the following options
	+ Option 1: Up to gNB configuration to avoid such collision and if it happens it is an error case
	+ Option 2: Reuse the existing collision handling principles of Rel-15/16 for NR TDD that SSB is prioritized over semi-static UL
	+ Option 3: Leave to UE implementation whether to receive the SSB or transmit the UL transmission
	+ Other options are not precluded
* FFS: whether/how to account for Tx/Rx switching time before and after the set of SSB symbols
* FFS: whether or not the semi-static configured UL transmission includes a valid RO
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##### 2.1.1.2 RAN1#105-e

159 contributions were submitted to this meeting (for details see agenda item 8.6 in [Tdoc list](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_105-e/Docs/TDoc_List_Meeting_RAN1%23105-e.xlsx))

An updated WI work plan was provided before the meeting in [R1-2104178](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_105-e/Docs/R1-2104178.zip).

RAN1 carried out online (GTW) discussions and the following offline email discussions:

* [105-e-NR-R17-RedCap-01] Email discussion regarding aspects related to reduced maximum UE bandwidth
	+ Summarized in [R1-2105999](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_105-e/Docs/R1-2105999.zip), [R1-2106000](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_105-e/Docs/R1-2106000.zip), [R1-2106001](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_105-e/Docs/R1-2106001.zip), [R1-2106002](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_105-e/Docs/R1-2106002.zip)
* [105-e-NR-R17-RedCap-02] Email discussion regarding aspects related to reduced number of Rx branches
	+ Summarized in [R1-2105112](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_105-e/Docs/R1-2105112.zip), [R1-2106081](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_105-e/Docs/R1-2106081.zip), [R1-2106125](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_105-e/Docs/R1-2106125.zip), [R1-2106333](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_105-e/Docs/R1-2106333.zip)
* [105-e-NR-R17-RedCap-03] Email discussion regarding aspects related to duplex operation
	+ Summarized in [R1-2106006](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_105-e/Docs/R1-2106006.zip), [R1-2106145](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_105-e/Docs/R1-2106145.zip), [R1-2106244](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_105-e/Docs/R1-2106244.zip)
* [105-e-NR-R17-RedCap-04] Email discussion regarding other aspects of UE complexity reduction
	+ Summarized in [R1-2106027](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_105-e/Docs/R1-2106027.zip), [R1-2106166](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_105-e/Docs/R1-2106166.zip), [R1-2106282](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_105-e/Docs/R1-2106282.zip)
* [105-e-NR-R17-RedCap-05] Email discussion regarding RAN1 aspects for RAN2-led features
	+ Summarized in [R1-2105981](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_105-e/Docs/R1-2105981.zip), [R1-2106094](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_105-e/Docs/R1-2106094.zip), [R1-2106146](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_105-e/Docs/R1-2106146.zip), [R1-2106195](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_105-e/Docs/R1-2106195.zip), [R1-2106328](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_105-e/Docs/R1-2106328.zip)

An updated RAN1 agreement summary was provided after the meeting in [R1-2106213](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_105-e/Docs/R1-2106213.zip).

RAN1 made the following agreements related to **reduced maximum UE bandwidth**:

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| Agreements: Replace the RAN1#104bis-e working assumption with the following working assumption (for option 1) and working assumption (for option 2):* Working assumption: After initial access (i.e., after RRC Setup, RRC Resume, or RRC Reestablishment), for BWP#0 configuration option 1 (as in 38.331, Appendix B2), a RedCap UE is not expected to operate with an initial DL BWP wider than the maximum RedCap UE bandwidth.
* Working assumption: After initial access (i.e., after RRC Setup, RRC Resume, or RRC Reestablishment), for BWP#0 configuration option 2 (as in 38.331, Appendix B2), a RedCap UE is not expected to operate with an initial DL BWP wider than the maximum RedCap UE bandwidth.

Agreements:* Both during and after initial access, the scenario where the initial UL BWP for non-RedCap UEs is configured to be wider than the maximum RedCap UE bandwidth is allowed.
* Working assumption: Both during and after initial access, for the scenario where the initial UL BWP for non-RedCap UEs is configured to be wider than the RedCap UE bandwidth, a separate initial UL BWP no wider than the RedCap UE maximum bandwidth is configured/defined for RedCap UEs.
	+ FFS: whether/how to avoid or minimize PUSCH resource fragmentation due to PUCCH transmission for the above case
	+ Support the case when the centre frequency is assumed to be the same for the initial DL and UL BWPs in TDD.
		- FFS whether or not to additionally support the case when the centre frequency is different; if so, how to minimize centre frequency retuning

Agreements: Take the following as an agreement, revised from the RAN1#104bis-e working assumption:* A RedCap UE cannot be configured with a non-initial (DL or UL) BWP (i.e., a BWP with a non-zero index) wider than the maximum bandwidth of the RedCap UE.
	+ At least for FR1, FG 6-1 (“Basic BWP operation with restriction” as described in TR 38.822) is used as a starting point for the mandatory RedCap UE type capability.
		- This does not preclude support of FG 6-1a (“BWP operation without restriction on BW of BWP(s)” as described in TR 38.822) as a UE capability for RedCap UEs.

Working assumption:* Both during and after initial access, even for the scenario where the initial UL BWP for non-RedCap UEs is not configured to be wider than the RedCap UE bandwidth, a separate initial UL BWP can optionally be configured/defined for RedCap UEs.
	+ RO sharing between RedCap and non-RedCap is not precluded.

Working assumption:* For enabling/supporting that the RACH occasion (RO) associated with the best SSB falls within the RedCap UE bandwidth, support separate initial UL BWP for RedCap UEs (which is not expected to exceed the maximum RedCap UE bandwidth), and this separate initial UL BWP for RedCap includes ROs for RedCap UEs.
	+ Note: these ROs can be dedicated for RedCap UEs or shared with non-RedCap UEs.

Working assumption:* For enabling/supporting that PUCCH (for Msg4/[MsgB] HARQ feedback) and/or PUSCH (for Msg3/[MsgA]) transmissions fall within the RedCap UE bandwidth during initial access, support separate initial UL BWP for RedCap UEs (which is not expected to exceed the maximum RedCap UE bandwidth).
	+ FFS: whether/how the specification also supports separate PUCCH/Msg3/[MsgA] PUSCH configuration/indication or a different interpretation of the same configuration/indication for RedCap (e.g., disabled frequency hopping or different frequency hopping)

Working assumption:* At least for TDD, an initial DL BWP for RedCap UEs (which is not expected to exceed the maximum RedCap UE bandwidth) can be optionally configured/defined separately from the initial DL BWP for non-RedCap UEs at least after initial access
	+ FFS the details of the configuration/definition
		- The configuration for a separately configured initial DL BWP for RedCap UEs is signaled in SIB.
		- whether to support that separate initial DL BWP for RedCap UEs can include a configuration of CORESET and CSS(s)
		- whether part of the configuration can be defined instead of signaled
	+ If a separate initial DL BWP for RedCap UEs is configured/defined, this separate initial DL BWP for RedCap UEs can be used at least after initial access (i.e., at least after RRC Setup, RRC Resume, or RRC Reestablishment).
		- FFS during the initial access
	+ FFS: whether a separately configured initial DL BWP for RedCap UEs needs to contain the entire CORESET #0, and, if not, the Redcap UE behaviour for CORESET #0 monitoring
	+ FFS: supported bandwidths in the separate initial DL BWP
	+ FFS: whether additional SSB is transmitted in the separately configured initial DL BWP for RedCap UEs
	+ FFS: FDD case
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RAN1 made the following agreements related to **reduced minimum number of Rx branches**:

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| Agreements:* Redcap UE is mandated to support at least DCI format 0\_0/1\_0.

Agreements:* For UE capability signalling, the number of Rx branches for RedCap is implicitly indicated by the corresponding capability parameter *maxNumberMIMO-LayersPDSCH* in the existing UE capability framework.
	+ Detailed signalling is up to RAN2

**Conclusion:*** No consensus to support early identification of the number of Rx branches in Msg1/Msg3/MsgA for Redcap UE in Rel-17

Agreements:* Regarding DCI format 0\_1/1\_1 and DCI format 0\_2 and 1\_2,
	+ DCI format 0\_1/1\_1 are mandatory as in legacy. DCI 0\_2/1\_2 are optionally supported.
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RAN1 made the following agreements related to **duplex operation**:

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| Agreements:* For Case 2 (semi-statically configured DL reception vs. dynamically scheduled UL transmission), a HD-FDD RedCap UE is not required to monitor ULCI
	+ No special handling on the priority rule for PDCCH carrying ULCI

**Conclusion:*** No consensus of specification support of semi-static UL/DL pattern to HD-FDD RedCap UEs in Rel-17.

Agreements:* For Case 8 of valid RO overlapping with PDCCH in Type 0/0A/1/2 CSS set, down-select from the following options
	+ Option 1: Reuse the existing collision handling principles of Rel-15/16 for NR TDD that valid RO is prioritized over configured PDCCH
	+ Option 2: Leave to UE implementation whether to receive the configured PDCCH or transmit the PRACH on the valid RO
	+ Option 3: If configured PDCCH is in a Type-2 CSS set, then PDCCH is prioritized; otherwise the valid RO is prioritized
	+ Option 4: Configured PDCCH is prioritized over valid RO
	+ Option 5: Configured by network, e.g. via a priority indicator
	+ FFS: whether or not the set of symbols overlapping with PDCCH in CSS set includes also Ngap symbols before the valid RO and whether the same value for Ngap in current spec is reused for HD-FDD
	+ FFS whether a valid RO follows TDD’s or FDD’s definition, and if so, the corresponding impact
* FFS: whether or not the same principle is applied to PUSCH occasion of MSGA in 2-step RACH, if supported

Agreements:* For Case 8 of valid RO overlapping with UE-dedicated configured DL reception (e.g. PDCCH in USS, SPS PDSCH, CSI-RS or DL PRS), down-select from the following options
	+ Option 1: Reuse the existing collision handling principles of Rel-15/16 for NR TDD that valid RO is prioritized over configured DL
	+ Option 2: Leave to UE implementation whether to receive the configured DL or transmit the PRACH on the valid RO
	+ Option 5: Configured by network, e.g. via a priority indicator
	+ Other options are not precluded.
	+ FFS: whether or not the set of symbols overlapping with configured DL includes also Ngap symbols before the valid RO and whether the same value for Ngap in current spec is reused for HD-FDD
* FFS: whether or not the same principle is applied to PUSCH occasion of MSGA in 2-step RACH, if supported

Agreements:* For Case 8 of valid RO overlapping with dynamically scheduled DL reception, down-select from the following options
	+ Option 1: Reuse the existing collision handling principles of Rel-15/16 for NR TDD for operation on a single carrier /single cell in unpaired spectrum
	+ Option 2: Leave to UE implementation whether to receive the DL or transmit the PRACH on a valid RO
	+ Option 3: Follow the handling of Case 1 that when the cancellation timeline is satisfied, the UE cancels the PRACH transmission and receives the DL signal/channels on the symbols overlapping with PRACH occasion (Interpretation 2 in R1-2103809)
	+ Option 4: Valid RO is prioritized over dynamic DL that UE performs PRACH transmission and does not perform the DL receptions (Interpretation 3 in R1-2103809)
	+ Option 5: When the cancellation timeline is satisfied, the UE neither performs transmission nor receives any DL signal/channels on the symbols overlapping with PRACH occasion (Interpretation 1 in R1-2103809)
	+ FFS: whether or not the set of symbols overlapping with dynamic DL reception includes also Ngap symbols before the valid RO and whether the same value for Ngap in current spec is reused for HD-FDD
* FFS: whether or not the same principle is applied to PUSCH occasion of MSGA in 2-step RACH, if supported
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RAN1 made the following agreements related to **maximum number of DL MIMO layers**:

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| **Conclusion:*** For a RedCap UE, when motivated by reduced max number of DL MIMO layers modifications to CSI measurement and/or reporting mechanisms are not pursued in Rel-17.
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RAN1 made the following agreements related to **relaxed maximum modulation order**:

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| Agreements:* For a RedCap UE, 64QAM MCS tables (Table 5.1.3.1-1 in TS 38.214 for DL and UL OFDM and Table 6.1.4.1-1 in TS 38.214 for UL w/ transform precoding respectively) are the “default” ones and are mandatory.
* The following is optionally supported by RedCap UEs:
	+ 256QAM MCS tables (Table 5.1.3.1-2 in TS 38.214 for DL and UL OFDM)
	+ 64QAM low SE MCS tables (Table 5.1.3.1-3 in TS 38.214 for DL and UL OFDM and Table 6.1.4.1-2 in TS 38.214 for UL w/ transform precoding respectively)

Agreements:* For a RedCap UE, “CQI table 1” (Table 5.2.2.1-2 in TS 38.214), that corresponds to MCS Table 5.1.3.1-1 in TS 38.214, is mandatory.
* The following is optionally supported by a RedCap UE:
	+ “CQI table 2” (Table 5.2.2.1-3 in TS 38.214) that corresponds to MCS Table 5.1.3.1-2 in TS 38.214 (256QAM MCS table)
	+ “CQI table 3” (Table 5.2.2.1-4 in TS 38.214) that corresponds to MCS Table 5.1.3.1-3 in TS 38.214 (64QAM low SE MCS table)

Agreements:* Both 256QAM MCS table for PDSCH and “CQI table 2” (Table 5.2.2.1-3 in TS 38.214) are supported by a RedCap UE indicating support of 256QAM for PDSCH.

Agreements:* For a RedCap UE, support of 64QAM low SE MCS table for PDSCH and support of “CQI table 3” (Table 5.2.2.1-4 in TS 38.214) are not coupled and capability of each can be reported independent of the other.

Agreements:* For a RedCap UE, support of 64QAM low SE MCS table for PDSCH (Table 5.1.3.1-3 in TS 38.214) and support of 64QAM low SE MCS tables for PUSCH (Table 5.1.3.1-3 in TS 38.214 for UL OFDM and Table 6.1.4.1-2 in TS 38.214 for UL w/ transform precoding respectively) are not coupled and capability of each can be reported independent of the other.
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RAN1 made the following agreements related to **RAN2-led objectives**:

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| Working assumption:* For 4-step RACH, support the early indication of RedCap UEs at least in Msg1.
	+ The early indication in Msg1 can be configured to be enabled/disabled
		- FFS How to support enable/disable the early indication
	+ FFS details e.g.:
		- separate initial UL BWP
		- separate PRACH resource
		- PRACH preamble partitioning
	+ FFS the possibility of supporting Msg3 for the early indication

Agreements: (if the above working assumption is confirmed)* Early indication of RedCap UEs in Msg1 can be enabled/disabled via SIB

Send an LS to RAN2 informing them the above working assumption and the agreement for early indication, possibly also RAN2-related agreements. Draft LS in [R1-2106216](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_105-e/Docs/R1-2106216.zip) which is approved, with final LS in [R1-2106329](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_105-e/Docs/R1-2106329.zip).Working assumption:* RedCap UE type is defined based on one of the following options
	+ Option 2: Only include the reduced capabilities that the network needs to know during initial access, if any.
	+ Option 4: The corresponding minimum set of the reduced capabilities that one RedCap UE type shall mandatorily support
	+ FFS: details of the set of reduced capabilities

**Conclusion:*** RAN1 postpones the discussion on constraining of reduced capabilities, and if deemed necessary, RAN1 can come back

Agreements:* Support 2-step RACH for RedCap UEs as an optional feature
	+ FFS details of early indication in MsgA, e.g.:
		- Separation of 2-step RACH resources or MsgA preambles
		- Separation of initial UL BWP
		- Using a new indication in MsgA PUSCH part
	+ Note: Discussion on 4-step RACH for early indication should be prioritised
 |

#### 2.1.2 Remaining Open issues

* Remaining physical layer aspects of reduced maximum UE bandwidth
* Remaining physical layer aspects of reduced minimum number of Rx branches
* Remaining physical layer aspects of minimum number of DL MIMO layers
* Remaining physical layer aspects of relaxed maximum modulation order
* Remaining physical layer aspects of half-duplex FDD operation
* Remaining physical layer aspects of RAN2-led objectives

## 2.2 RAN2

#### 2.2.1 Agreements

##### 2.2.1.1 RAN2#113bis-e

48 contributions were submitted to this meeting (for details see agenda item 8.12 in [Tdoc list](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_113bis-e/Docs/TDoc_List_Meeting_RAN2%23113-bis-e.xlsx)).

RAN2 carried out online (GTW) discussions and the following offline email discussions:

* [AT113bis-e][101][RedCap] eDRX cycles (Intel)
	+ Summarized in [R2-2104360](http://www.3gpp.org/ftp/tsg_ran/WG2_RL2//TSGR2_113bis-e/Docs//R2-2104360.zip) and [R2-2104367](http://www.3gpp.org/ftp/tsg_ran/WG2_RL2//TSGR2_113bis-e/Docs//R2-2104367.zip).
* [AT113bis-e][102][RedCap] RRM relaxations (Qualcomm)
	+ Summarized in [R2-2104361](http://www.3gpp.org/ftp/tsg_ran/WG2_RL2//TSGR2_113bis-e/Docs//R2-2104361.zip), [R2-2104368](http://www.3gpp.org/ftp/tsg_ran/WG2_RL2//TSGR2_113bis-e/Docs//R2-2104368.zip) and [R2-2104375](http://www.3gpp.org/ftp/tsg_ran/WG2_RL2//TSGR2_113bis-e/Docs//R2-2104375.zip).

RAN2 made the following agreements related to **eDRX cycles:**

|  |
| --- |
| Agreements:* RAN decides and configures eDRX via RRC for RRC\_INACTIVE (FFS on the need and details of coordination with the CN)
* At least for eDRX cycle, the configurations of the eDRX for RRC\_IDLE and RRC\_INACTIVE can be different (FFS for PTW, e.g. length and starting point, when eDRX cycles are longer than 10.24s)

Agreements - via email (from offline [101]):* RAN2 assumes that CN provides necessary assistance information on eDRX config. for RRC\_IDLE to RAN (e.g. reusing eDRX config. defined in “CN Assistance Information for RRC INACTIVE IE” for E-UTRA/5GC).
* eDRX feature, including the related parameters (i.e. PH, PTW. H-SFN) and corresponding paging operation defined for E-UTRA/5GC is used as baseline to enable eDRX >10.24sec for both RRC\_IDLE and RRC\_INACTIVE in NR/5GC
* RAN2 confirms that CN paging and RAN paging use the same paging frame offset and first PDCCH monitoring occasion in PO, which are configured by RAN without involvement of CN.
* RAN2 confirms that SI modification mechanism from LTE is used as a baseline for SI change (other than ETWS and CMAS), i.e. by using an eDRX acquisition period and a flag to indicate SI modification for eDRX in Short Message (e.g. systemInfoModification-eDRX)
 |

RAN2 made the following agreements related to **RRM relaxations:**

|  |
| --- |
| Agreements:* Assuming there will be a stationary property based on subscription (which is FFS), we will not restrict to this and will continue to assume that a UE can use some RSRP/RSRQ based criteria (FFS whether reuse R16 thresholds or new ones. FFS also on the use of a beam based criteria)

Agreements:* At least for RRC idle/inactive, a measurement-based R17 stationarity criterion can be configured separately from R16 low-mobility criterion for R17 UEs supporting the feature. FFS how the configuration is provided. FFS whether this stationarity criterion is based on:
	+ the same algorithm used in R16 low-mobility criterion but with its own specific set of thresholds; and/or
	+ a combination of R16 low-mobility criterion and/or beam-change based criterion. Exact details of beam change criterion are FFS.

Agreements - via email (from offline [102]):* Network can configure R17 stationarity criterion/criteria together with a not-at-cell-edge criterion, to trigger RRM relaxations in RRC Idle/Inactive for R17 UEs supporting the feature. FFS whether the R16 not-at-cell-edge thresholds can be reused or separate R17 not-at-cell-edge thresholds are needed.
 |

RAN2 agreed to hold the following post-meeting email discussion:

* [Post113bis-e][108][RedCap] LS on eDRX cycles (Ericsson)

Scope: Discuss the content of an LS to SA2/CT1 based on meeting agreements. Check if additional questions/RAN2 preferences can be included in the LS (based on the discussion in the meeting).

Intended outcome: Approved LS

Deadline (for companies' feedback): Monday 2021-04-26 16.00 UTC

Deadline (for final LS in R2-2104374): Tuesday 2021-04-27 16.00 UTC

* [Post113bis-e][102][RedCap] RRM relaxations (Qualcomm)

Scope: Discuss the following aspects:

1. Possible use of the Stationarity information in subscription information (e.g. any benefits to use this information - besides the measurement-based R17 stationarity criterion being specified - to trigger RRM relaxations? Where does the subscription info come from (UE or CN) and how is it used?)
2. Possible reuse of the R17 RRM relaxation criteria being specified for RRC Idle/Inactive also for RRM relaxations in RRC Connected (e.g. pros/cons, etc.)

Intended outcome: email discussion summary

Deadline: Long (May 10th)

RAN2 approved the LS on eDRX cycles in [R2-2104374](http://www.3gpp.org/ftp/tsg_ran/WG2_RL2//TSGR2_113bis-e/Docs//R2-2104374.zip).

##### 2.2.1.2 RAN2#114-e

91 contributions were submitted to this meeting (for details see agenda item 8.12 in [Tdoc list](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_114-e/Docs/TDoc_List_Meeting_RAN2%23114-e.xlsx))

RAN2 carried out online (GTW) discussions and the following offline email discussions:

* [AT114-e][105][RedCap] Definition of RedCap UE and reduced capabilities (Intel)
	+ Summarized in [R2-2106521](http://www.3gpp.org/ftp/tsg_ran/WG2_RL2//TSGR2_114-e/Docs//R2-2106521.zip) and [R2-2106528](http://www.3gpp.org/ftp/tsg_ran/WG2_RL2//TSGR2_114-e/Docs//R2-2106528.zip)
* [AT114-e][106][RedCap] Identification and access restrictions (Huawei)
	+ Summarized in [R2-2106522](http://www.3gpp.org/ftp/tsg_ran/WG2_RL2//TSGR2_114-e/Docs//R2-2106522.zip) and [R2-2106529](http://www.3gpp.org/ftp/tsg_ran/WG2_RL2//TSGR2_114-e/Docs//R2-2106529.zip)
* [AT114-e][110][RedCap] eDRX aspects (Ericsson)
	+ Summarized in [R2-2106530](http://www.3gpp.org/ftp/tsg_ran/WG2_RL2//TSGR2_114-e/Docs//R2-2106530.zip)
* [AT114-e][111][RedCap] RRM relaxation criteria in idle/inactive (Samsung)
	+ Summarized in [R2-2106531](http://www.3gpp.org/ftp/tsg_ran/WG2_RL2//TSGR2_114-e/Docs//R2-2106531.zip)

RAN2 made the following agreements related to **definition of RedCap UE type and reduced capabilities:**

|  |
| --- |
| Working assumption: * Extend UE-NR-Capability using NCE to capture RedCap capabilities

Agreements:* We will continue the discussion on which capability are applicable to RedCap UE (FFS if we need to have an exhaustive check)
* At least for early identification there will be only one RedCap UE (no need to define separate RedCap UE types for FR1 and FR2)
* It is up to the network how to prevent RedCap UEs from using radio capabilities not intended for RedCap UEs (no specification impact is foreseen at least in RAN2. FFS whether something is needed from SA2/CT1)

Agreements online:* RAN2 Working Assumption: by default, all non-RedCap UE capabilities are applicable for RedCap UE, and therefore only for non-RedCap capabilities that are not appliable for RedCap UE, we clarify in the definitions for parameters in TS38.306, the value or feature is not applicable for RedCap UE
* We will have an email discussion until the next meeting to discuss which higher layer capabilities are not applicable for RedCap UEs (it could result in a draft 38.306 CR) and how to reflect the handling of RedCap specific capabilities (e.g. Maximum BW, Max Rx, MIMO-Layer, 256QAM, CA/DC, HD-FDD, etc)
* The network needs to know if the UE is a RedCap UE or not in order to at least correctly identify the set of mandatory features (i.e. baseline capabilities) that the UE supports, including Handover case
* The network needs to unambiguously know whether the UE is a RedCap or a non-RedCap UE from its reported UE capability information.
 |

RAN2 made the following agreements related to **identification, access and camping restrictions:**

|  |
| --- |
| Agreements:* SIB1 (not MIB) indicates cell barring for 1 Rx branch and 2 Rx branches separately for RedCap UEs. Further details of the solution are FFS
* The cell barring for RedCap UE is per cell (not per PLMN).
* RedCap UE supports the Intra Frequency Reselection Indicator.
* Either Msg1 and/or Msg3 early identification will be supported

Agreements via email (from offline 106):* There is no need to support Rx branches specific early identification from RAN2 perceptive (final decision up to RAN1).
* Send LS to ask RAN3 to consider the coordination between gNBs on whether a neighbour/target gNB supports RedCap UEs, if needed, to avoid handover RedCap to a target cell that it can’t access. We can come back in the next meeting with discussions on other restrictions, e.g. related to number of RX
 |

RAN2 approved LS to RAN3 on the coordination between gNBs on the supporting of RedCap UEs in [R2-2106536](http://www.3gpp.org/ftp/tsg_ran/WG2_RL2//TSGR2_114-e/Docs//R2-2106536.zip).

RAN2 made the following agreements related to **eDRX cycles:**

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| --- |
| Agreements via email - from offline 110:* Lower bound for eDRX configuration in RRC\_IDLE and RRC\_INACTIVE is 2.56 seconds. Inform SA2/CT1 and check if there is any concern.
* It is up to RAN to configure the length for PTW for RAN paging, the RAN PTW length can be different from the CN PTW length.
* When RAN and CN paging coincide in the same PH, the PTW starting locations are the same. FFS how to calculate the PTW starting location so that it is the same for RAN and CN PTW.

Agreements online:* Continue in the next meeting the discussion on how UE is expected to monitor RAN and CN PTW, e.g. whether UE in RRC\_INACTIVE monitors for only RAN PTW or both CN and RAN PTW when they overlap
 |

RAN2 approved LS to SA2, CT1 (cc RAN3) on lower bound for eDRX cycle length in [R2-2106537](http://www.3gpp.org/ftp/tsg_ran/WG2_RL2//TSGR2_114-e/Docs//R2-2106537.zip).

RAN2 made the following agreements related to **RRM relaxation:**

|  |
| --- |
| Agreements:* An RSRP/RSRQ based stationarity criterion (Working Assumption: the same as in idle/inactive) can be configured for UEs in RRC Connected. If the criterion is met, this is reported to the network (FFS how/when). It is FFS whether, based on this, besides possibly reconfiguring RRM measurements (up to network implementation), the network can enable RRM measurement relaxation (FFS whether same method as in Idle/Inactive)

Agreements:* Subscription based relaxation criteria will not be considered in Rel-17 RRM relaxation

Agreements via email (from offline 111):* Reuse R16 low mobility criterion, as part or whole of Rel-17 stationary criterion in RRC\_IDLE/INACTIVE. When NW configures both Rel-17 stationary criterion and Rel-16 low mobility criterion, NW configures different Rel-17 thresholds (i.e., SSearchDeltaP\_stationary/TSearchDeltaP\_stationary) from Rel-16 (SSearchDeltaP / TSearchDeltaP). How to configure the criterion (e.g. more stringent) is left to NW implementation (i.e. no specification impact to RAN2).

Postpone the following discussion until RAN4 defines RRM relaxation method for Rel-17:* When NW configures both R16/R17 relaxation criteria and the UE fulfills both, UE performs:
	+ Option 1) UE performs Rel-17 RRM relaxation method
	+ Option 2) It is up to UE implementation to select either Rel-16 or Rel-17 relaxation operation

Agreements online:* Working Assumption: If beam-level criterion is adopted for Rel-17 stationary criterion in RRC\_IDLE/INACTIVE, it is configured separately with Rel-16 low mobility criterion reused
* When NW configures Rel-17 RRM relaxation for RRC\_IDLE/INACTIVE, Rel-17 stationary criterion is mandatory, and Rel-17 not-at-cell-edge criterion is optional configuration. FFS whether the same applies to RRC Connected
* Continue discussion on Rel-17 not-at-cell-edge criterion in RRC\_IDLE/INACTIVE within two options:
	+ Option 1) Reuse Rel-16 not-at-cell-edge criterion with the same thresholds (i.e., SSearchThresholdP / SSearchThresholdQ)

- Option 2) Reuse Rel-16 not-at-cell-edge criterion with the different thresholds |

RAN2 agreed to hold the following post-meeting email discussion:

* [Post114-e][105][RedCap] Capabilities (Intel)

 Scope: Discuss which higher layer capabilities are not applicable for RedCap UEs and how to reflect the handling of RedCap specific capabilities (e.g. Maximum BW, Max Rx, MIMO-Layer, 256QAM, CA/DC, HD-FDD, etc.). Can take the principles in P3.x in R2-2106528 as an initial guideline.

 Intended outcome: email discussion summary (it could also result in a draft 38.306 CR)

#### 2.2.2 Remaining Open issues

* Definition of UE type including capabilities for identifying and constraining RedCap UEs
* Functionality that will enable RedCap UEs to be explicitly identifiable, including possible early identification
* System information indication to indicate whether RedCap UE can camp on the cell/frequency
* Necessary updates to UE capabilities in TS 38.306 and TS 38.331
* Support for extended DRX enhancements
* RRM measurement relaxation for stationary devices for neighboring cells

## 2.3 RAN3

The RAN3 work starts in the next meeting.

## 2.4 RAN4

#### 2.4.1 Agreements

##### 2.4.1.1 RAN4#98bis-e

8 contributions were submitted to this meeting (for details see agenda item 12.1 in [Tdoc list](https://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_98bis_e/Docs/TDoc_List_Meeting_RAN4%2398-bis-e.xlsx))

RAN4 carried out the following offline email discussion:

* [98-bis-e][149] NR\_reply\_LS\_Part\_1
	+ Summarized in [R4-2105222](https://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_98bis_e/Docs/R4-2105222.zip) and [R4-2105484](https://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_98bis_e/Docs/R4-2105484.zip)

##### 2.4.1.2 RAN4#99-e

20 contributions were submitted to this meeting (for details see agenda item 9.19 in [Tdoc list](https://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_99-e/Docs/TDoc_List_Meeting_RAN4%2399-e.xlsx))

RAN4 carried out the following offline email discussions:

* [99-e][149] NR\_RedCap\_1
	+ Summarized in [R4-2107675](https://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_99-e/Docs/R4-2107675.zip) and [R4-2107959](https://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_99-e/Docs/R4-2107959.zip)
* [99-e][236] NR\_redcap\_RRM
	+ Summarized in [R4-2108160](https://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_99-e/Docs/R4-2108160.zip) and [R4-2108408](https://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_99-e/Docs/R4-2108408.zip)

RAN4 made the following agreements related to **RRM impacts**:

|  |
| --- |
| Agreements:* RAN4 discussed and agreed on the RRM work plan provided in [R4-2111247](https://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_99-e/Docs/R4-2111247.zip).
* RAN4 to start discussing the eDRX for IDLE/INACTIVE state from RAN4#100e meeting.
* RAN4 to start discussing RRM relaxation work based on the outcome from RAN2 from RAN4#100e meeting.

Agreements:* RRM requirements are developed for all three duplex modes, i.e. FD-FDD, HD-FDD type A and TDD in Release 17 RedCap.
* RRM requirements are developed for both 1 Rx and 2Rx for each duplex mode (FD-FDD, HD-FDD type A and TDD).
* RAN4 should focus on RRM requirements that are relevant to PCell operation, i.e. no DC or CA is considered for RedCap in release 17.
* Inter-frequency mobility
	+ FFS whether to define inter-frequency RRM requirements for RedCap UE in Rel-17.
* Inter-RAT mobility
	+ Option 1:
		- Do not define inter-RAT RRM requirements for RedCap UE in Rel-17.
	+ Option 2:
		- Do not define inter-RAT RRM requirements on 2G/3G for RedCap UE in Rel-17
		- FFS: whether define inter-RAT RRM requirements on LTE for RedCap UE in Rel-17

Agreements:* List of RRM requirements that are impacted in TS 38.133 were identified in [R4-2108359](https://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_99-e/Docs/R4-2108359.zip).
* List of RRM requirements that are impacted in TS 36.133 were identified in [R4-2108359](https://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_99-e/Docs/R4-2108359.zip).
 |

RAN4 made the following agreements related to **RF impacts**:

|  |
| --- |
| Agreements:* The RF requirement impacts are identified and agreed in WF ([R4-2108005](https://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_99-e/Docs/R4-2108005.zip))
 |

#### 2.4.2 Remaining Open issues

RRM/demod:

* Continue discussion on RRM impacts from UE complexity reduction features
* Identify potential simulation work
* Initial discussions on simulation assumptions
* Discuss and align the simulation results, and update simulation assumptions (if needed)
* Specification impact analysis and initial discussions on CRs
* Discuss draft CRs and agree on the CRs for the core part
* Initial discussions on demodulation work including time plan
* Initial discussions on RRM performance work

RF:

* FFS on use case of RedCap UE in FR2 e,g Power class, frequency band etc.
* FFS on RX-TX switching time for HD-FDD Type A device

The work with the performance part has not started yet.

## 4. References

RAN1#104bis-e

97 contributions (for details see agenda item 8.6 in [Tdoc list](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_104b-e/Docs/TDoc_List_Meeting_RAN1%23104-bis-e.xlsx))

RAN1#105-e

159 contributions (for details see agenda item 8.6 in [Tdoc list](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_105-e/Docs/TDoc_List_Meeting_RAN1%23105-e.xlsx))

RAN2#113bis-e

48 contributions (for details see agenda item 8.12 in [Tdoc list](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_113bis-e/Docs/TDoc_List_Meeting_RAN2%23113-bis-e.xlsx))

RAN2#114-e

91 contributions (for details see agenda item 8.12 in [Tdoc list](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_114-e/Docs/TDoc_List_Meeting_RAN2%23114-e.xlsx))

RAN4#98bis-e

8 contributions (for details see agenda item 12.1 in [Tdoc list](https://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_98bis_e/Docs/TDoc_List_Meeting_RAN4%2398-bis-e.xlsx))

RAN4#99-e

20 contributions (for details see agenda item 9.19 in [Tdoc list](https://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_99-e/Docs/TDoc_List_Meeting_RAN4%2399-e.xlsx))