**3GPP TSG RAN WG1 Meeting #100-BIS-e                     R1-200170x**

**eMeeting, April 20 - 30, 2020**

**Agenda Item: 7.2.2.2.2**

**Source: Moderator (Charter Communications)**

**Title: Feature lead summary#1 on NR-U enhancement to initial access procedures**

**Document for: Discussion and Decision**

# Introduction

A number of proposed corrections to Rel-16 specifications have been submitted to RAN1#100-BIS-e on initial access procedures for NR-U [1]-[13]. This first summary provides a list of the submitted corrections/clarifications and a proposal for 3 email discussions to resolve the corrections identified as higher priority.

The outcomes of email discussions in RAN1#100-e [14]-[16]are provided in the Appendix.

# Corrections for SS/PBCH Block

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| Issue # | Description | Tdoc | Email discussion |
| 2.1 | Based on LS response from RAN2, the UE interprets ~~ssb~~SubcarrierSpacingCommon (1 bit) and LSB of ssb-SubcarrierOffset (1 bit) of the Rel-15 MIB for providing the value of ssbPositionQCL-Relationship-r16.Misc: (How to set LSB of k\_SSB to determine PRB grid can be discussed under agenda item 7.2.2.1.1)Misc: Correct “*ssbSubcarrierSpacingCommon”* to *“SubcarrierSpacingCommon”* in TS 38.213 Subclause 4.1. | R1-2001936R1-2001988R1-2001706R1-2001760R1-2001535R1-2002118 | Y |
| 2.2 | UE performs rate-matching for all of SS/PBCH block candidate position indices (within configured DRS transmission window) QCLed with actually transmitted SS/PBCH block indices that are provided by *ssb-PositionsInBurst* in RMSI.When DCI format 1\_1 contains rate matching indication and at least one configured rate-match pattern overlaps the REs of candidate SSB, UE shall perform the rate-matching around candidate SSB for PDSCH reception based on rate matching indication. | R1-2001936R1-2001760 | N |
| 2.3 | Discuss/clarify whether the transmission of repetition of SSBs with the same beam within DRS transmission window is allowed or not | R1-2002248 | N |
| 2.4 | Missing instances of ‘candidate SS/PBCH block index’ terminology in: TS 38.214 Subclause 5.1.4 relating to PDSCH rate matching.TS 38.213 Subclause 8.1 relating to RO validation.TS 38.213 Subclause 11.1.1 relating to UL validation in SFI.TS 38.213 Subclause 5 relating to RLM. | R1-2002248R1-2002263R1-2002118 | N (propose to resolve in next meeting) |
| 2.5 | For RRM measurement configuration from *MeasObjectNR* and *SIB2/SIB4*, down-select one of the following:* Option 1: Network always provides a common Q value (*ssb-PositionQCL-Common-r16*) per frequency to UE.
* Option 2: If no Q value is provided, UE assumes Q=8.

For SCell addition, SCG addition, and reconfiguration with sync, down-select one of the following:* Option 1: The Q value of the cell to be added is always provided to UE via dedicated RRC signaling, i.e. ssb-PositionQCL-r16 in *ServingCellConfigCommon*.
* Option 2: If no Q value is provided, UE assumes Q=8.

Send LS to RAN2 based on outcome. | R1-2002407R1-2001706R1-2002118R1-2002032 | Y |
| 2.6 | Proposal: Within a discovery burst transmission window, the number of candidate SS/PBCH blocks from the first transmitted SS/PBCH block to the last transmitted SS/PBCH block should not be greater than Q | R1-2002407 | Y |
| 2.7 | UE behavior in case GSCN offset refers to a GSCN which is not allowed in band n46. If the GSCN offset refers to a GSCN which is not allowed in [8-1, TS 38.101-1] for FR1, UE may ignore the information related to GSCN of SS/PBCH locations in performing cell search. | R1-2001760 | N (propose to resolve in next meeting) |
| 2.8 | Proposal: “For the CSI-RS outside DRS window, the associated SSB index should be the SSB index, for the CSI-RS inside DRS window, the associated SSB should be the candidate SSB index.” | R1-2001760 |  |
| 2.9 | Replace terminology “discovery burst transmission window” with “SS/PBCH block transmission window” in TS 38.213 | R1-2002263 | N (editorial) |
| 2.10 | Merge the determination process of QCL and SSB index in Clause 4.1 in TS 38.213. | R1-2001706 | N (editorial) |
| 2.11 | Update the reference [38.104] provided within 38.211 subclauses 7.3.3.1 and 7.4.1.4.1 as [38.213] within a related CR. | R1-2002278 | N (this change is already there in 38.211 V16.0.0) |
| 2.12 | Clarify in TS 38.213 Subclause 4.1 that “when the candidate SS/PBCH index is known by the UE” is required when is computed. | R1-2002278 | N (close to being a editorial change) |
| 2.13 | Reflect RAN4 agreement that UE is allowed to take any active SCell in the cell group as timing reference cell in TS 38.213 Subclause 4.1. | R1-2001706 | N (this is valid but email thread is already overloaded) |
| 2.14 | Support for semi-static channel access mode***.*** Update TS 38.213 Subclause 4.1 to reflect RAN1#100-e conclusion that the SSB candidate positions in idle period is invalid | R1-2001535R1-2002531 | N (no consensus on these proposals in RAN1#100-e) |
| 2.15 | Correct the citation of TS 38.104 in TS 38.213 Subclause 4.1 in relation to the definition of (either remove citation, or point to TS 38.133 and notify RAN4 that the word “candidate” should be removed in the paragraph above Table 8.1.1-2 in 38.133 to be consistent with Rel-16 notation). Applies to both licensed and shared spectrum operation. | R1-2002118R1-2002032R1-2002278 | Y due to possible dependence with RAN4 spec |

# Corrections for RACH

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| Issue # | Description | Tdoc | Email discussion |
| 3.1 | To accommodate DL processing time at UE, a PRACH resource is considered invalid if it overlaps with the first X symbols at the front of each FFP when FBE operation is indicated, where X could be configured or fixed in spec.  | R1-2001653 | Y |
| 3.2 | MsgA PRACH-PUSCH gap:Proposal 1: Apply the same PRACH-PUSCH gap defined in R16 to msgA PRACH for NR-U.Proposal 2: Apply CP extension to PUSCH to enable no-gap msgA. | R1-2002407R1-2001936R1-2002032 | Y |
| 3.3 | New PRACH sequences introduced in TS 38.211 should be applicable only to NR-U.L\_RA = 839 is not supported for NR-U. | R1-2002278 | N (not essential correction for NR-U itself) |
| 3.4 | Reply to RAN2 whether the new NR-U long ZC sequences are applicable for NR-U 2-step RA as well. | R1-2002278R1- 2002373R1-2002310 (Not applicable) | Y |
| 3.5 | In FBE mode, COT detection for IDLE UEs should be based on PDCCH monitoring, where DCI payload is configured in SIB1. UE assumes that FFP is acquired by gNB if detects PDCCH of configured payload size scrambled with SI-RNTI in the lowest PDCCH candidate of TYPE0 CSS in the first slot of the FFP containing at least one valid RO. | R1-2002278 | N(No consensus in RAN1#100-e) |
| 3.6 | Capture in TS 38.213 Subclauses 8.2 and 8.2A the RAN2 agreement that downlink assignment is valid for successful RAR reception if the two LSB bits of the SFN indicated in DCI format 1\_0 scrambled by RA-RNTI or msgB-RNTI correspond to the PRACH occasion used to transmit the Random Access Preamble. | R1-2001988R1-2001706R1-2002531R1-2002032R1-2001535 | Y |
| 3.7 | Update TS 38.213 for RACH occasion validation in FBE mode when UE is not provided tdd-UL-DL-ConfigurationCommon, and for Type-2 RA procedure.Related proposal: A PRACH resource in the channel occupancy of a Fixed Frame Period is valid only if a UE detects any DL transmission in the serving cell before the PRACH resource in the same FFP. | R1-2001706R1-2001535R1-2002032 | Y |
| 3.8 | Capture 12 bits for PUSCH frequency resource allocation in RAR in Section 8.3 of TS 38.213 | R1-2001706R1-2001533 | N (propose to discuss in next meeting) |
| 3.9  | If a PRACH occasion is overlapped (fully or partially) with a slot which contains RMSI, the PRACH occasion should be treated as invalid PRACH occasion. | R1-2001760 | N (no consensus in last meeting to prioritize this issue) |

# Corrections for RRM/RLM

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| Issue # | Description | Tdoc | Email discussion |
| 4.1 | If SSB is configured as RLM-RS, UE will only use one SSB sample with the largest RSRP among the set of candidate SSBs indicated by ssb-Index. | R1-2001653 | Y |
| 4.2 | If one CSI-RS resource is configured as RLM-RS, UE should skip invalid CSI-RS when performing IS and OOS evaluation. Besides, UE will stop IS and OOS evaluation and not report any state when there is no any valid CSI-RS sample in the latest indication period between current indication time and previous indication time. | R1-2001653 | N (no consensus in WI phase) |
| 4.3 | Converge on TP to 38.215 for agreement on RSSI definition and configuration in RAN1#100-e (TP alternatives provided below this table). | R1-2001988R1-2001706R1-2002032 | Y |
| 4.4 | Alt. 1: The number of OFDM symbols for RSSI measurement duration should be scale with configured reference SCS. i.e.· For 15 kHz: {sym1, sym14, sym28, sym42, sym70}· For 30 kHz: {sym2, sym28, sym54, sym84, sym140}· For 60 kHz+NCP: {sym4, sym56, sym108, sym168, sym280}· For 60 kHz+ECP: {sym4, sym48, sym96, sym144, sym240}Alt. 2: Add extra symbols or modify supported symbols of baseline set {sym1, sym14, sym28, sym42, sym70} to account for ECP. | R1-2001535R1-2002118 | Y |
| 4.5 | One CSI-RS resource shall have multiple potential transmission locations within the discovery burst transmission window, similar to SSB.The group of CSI-RS sequences corresponding to the group of QCLed SS/PBCH blocks shall utilize the same CSI-RS sequence, similar to LTE LAA. | R1-2002118 | N (propose to discuss in next meeting) |

TP1 for issue 4.3 [3][6]:

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| **Definition** | Received Signal Strength Indicator (RSSI), comprises the linear average of the total received power (in [W]) measured by the UE from all sources, including co-channel serving and non-serving cells, adjacent channel interference, thermal noise etc. The UE measures ~~observed~~ only in configured OFDM symbols and in the ~~configured~~ measurement bandwidth ~~over~~ *~~N~~* ~~number of resource blocks~~ corresponding to the ~~LBT~~ channel bandwidth [TS 37.213 §4.0] where the channel has center frequency ~~of~~ configured by *ARFCN-ValueNR*~~, by the UE from all sources, including co-channel serving and non-serving cells, adjacent channel interference, thermal noise etc.~~Higher layers configure the ~~measurement bandwidth,~~ *ARFCN-ValueNR,* reference subcarrier spacing and the measurement duration ~~and~~, i.e. which OFDM symbol(s) should be measured by the UE.For frequency range 1, the reference point for the RSSI shall be the antenna connector of the UE. If receiver diversity is in use by the UE, the reported RSSI value shall not be lower than the corresponding RSSI of any of the individual receiver branches. |
| **Applicable for** | RRC\_CONNECTED intra-frequency,RRC\_CONNECTED inter-frequency |

TP2 for issue 4.3 [7]:

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| **Definition** | Received Signal Strength Indicator (RSSI), comprises the linear average of the total received power (in [W]) observed only in the configured OFDM symbol~~s~~ and in the configured measurement bandwidth over *N* number of resource blocks corresponding to LBT bandwidth with the center frequency of configured ARFCN, by the UE from all sources, including co-channel serving and non-serving cells, adjacent channel interference, thermal noise etc.Higher layers configure the reference numerology, measurement bandwidth, measurement duration and which OFDM symbol(s) should be measured by the UE.For frequency range 1, the reference point for the RSSI shall be the antenna connector of the UE. If receiver diversity is in use by the UE, the reported RSSI value shall not be lower than the corresponding RSSI of any of the individual receiver branches. |
| **Applicable for** | RRC\_CONNECTED intra-frequency,RRC\_CONNECTED inter-frequency |

# Other submitted TPs/proposals not for email discussion in this agenda

Multiple editorial changes listed in Section 4 of [11], Section 2.7 of [7], and Section 2.7 of [3] can be addressed in the next meeting.

# Proposed email discussions for phase 1 of RAN1#100-BIS-e

The following three email discussions and sub-topics are proposed for further discussion in AI 7.2.2.2.2 during the RAN1#100-BIS-e preparation phase until 4/17:

* [Email discussion A on SS/PBCH blocks]
	+ (#2.1) Signaling of Q in MIB based on RAN2 LS response.
	+ (#2.5) Whether configuration of Q for RRM measurements and SCell/SCG (re)config is mandatory, or a default value of Q=8 can be assumed by UE.
	+ (#2.6) Whether the number of candidate SS/PBCH blocks from the first transmitted SS/PBCH block to the last transmitted SS/PBCH block should not be greater than Q.
	+ (#2.15) Correct the citation of TS 38.104 in TS 38.213 Subclause 4.1 in relation to the definition of L\_max (either remove citation, or point to TS 38.133 and notify RAN4 that the word “candidate” should be removed in the paragraph above Table 8.1.1-2 in 38.133 to be consistent with Rel-16 notation).
* [Email discussion B on RA procedure]
	+ (#3.1, #3.7) Remaining details of RACH occasion validation for FBE access
	+ (#3.2) MsgA PRACH-PUSCH gap for NR-U.
	+ (#3.4) Reply to RAN2 LS whether the new NR-U long ZC sequences are applicable for NR-U 2-step RA as well.
	+ (#3.6) Capture in TS 38.213 Subclauses 8.2 and 8.2A the RAN2 agreement that downlink assignment is valid for successful RAR reception if the two LSB bits of the SFN indicated in DCI format 1\_0 scrambled by RA-RNTI or msgB-RNTI correspond to the PRACH occasion used to transmit the RAR.
* [Email discussion C on RRM/RLM]
	+ (#4.1) If SSB is configured as RLM-RS, UE will only use one SSB sample with the largest RSRP among the set of candidate SSBs indicated by ssb-Index.
	+ (#4.3) Converge on TP to 38.215 for agreement on RSSI definition and configuration in RAN1#100-e.
	+ (#4.4) Finalize the number of OFDM symbols for RSSI measurement duration configuration.

For issues not included above, it does not mean that corrections are not needed; rather, these issues can be discussed at the next meeting.

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| **Company** | **Views** |
| Huawei, HiSilicon | On 3.8, we submitted our tdoc in UL AI, according to the discussion in 100eOn 2.14, we think it worth discussion again although no consensus in last meeting. It was observed that most companies interested in this topic had common understanding to cut down SSB position. The difference is how to cut down.  |
| Nokia, Nokia Shanghai Bell | - 2.11: please note that this topic is related to 38.211 Rel-15, for which the (wrong) reference to 38.104 is still there; for Rel-16 it has been indeed corrected.As this topic is similar to 2.15 we propose to discuss both, possibly within the same item.- 3.3: we fail to understand how a discrepancy between RAN1 agreements and RAN1 Specifications (namely 38.211) could be felt as a “non-essential correction”.We would therefore respectfully ask the FL to have this topic discussed.- 3.5: it is correct that no consensus has been reached during RAN1 #100-e meeting, but in our understanding one main reason for that was the scrambling with SFI-RNTI; now our proposal is to scramble with the SI-RNTI.Furthermore there is a real issue to be solved anyway: for short FFPs (say 1 or 2 ms) it is not realistic to manage within the same FFP both SSB/RMSI and PRACH ROs, hence another mean to detect DL transmission has to be found.We would therefore respectfully ask the FL to have this topic discussed or alternatively, to elaborate about the proper way to solve this issue. |
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# Appendix

[100e-NR-unlic-NRU-InitAccessProc-01] Email discussion/approval regarding SSB position validation for FBE scenario, clarification on interpretation of ssb-PositionsInBurst for UE procedure for receiving control information, and LS to RAN4 on candidate SS/PBCH block index and SS/PBCH block index terminology for alignment by 2/28; if there is a spec impact, followed by endorsing the corresponding TP by 3/3

Conclusions

Agreement:

Adopt the following TP for TS 38.213:

--------------------------------- Begin TP ---------------------------------

10       UE procedure for receiving control information

<Unchanged part omitted>

For monitoring of a PDCCH candidate by a UE in a slot or in a span, if the UE

-     has received *ssb-PositionsInBurst* in *SIB1* and has not received *ssb-PositionsInBurst* in *ServingCellConfigCommon* for a serving cell, and

-     does not monitor PDCCH candidates in a Type0-PDCCH CSS set, and

-     at least one RE for a PDCCH candidate overlaps with at least one RE corresponding to candidate SS/PBCH blocks corresponding to a SS/PBCH block index provided by *ssb-PositionsInBurst* in *SIB1*,

the UE is not required to monitor the PDCCH candidate.

For monitoring of a PDCCH candidate by a UE in a slot, if the UE

-     has received *ssb-PositionsInBurst* in *ServingCellConfigCommon* for a serving cell, and

-     does not monitor PDCCH candidates in a Type0-PDCCH CSS set, and

-     at least one RE for a PDCCH candidate overlaps with at least one RE corresponding to candidate SS/PBCH blocks corresponding to a SS/PBCH block index provided by *ssb-PositionsInBurst* in *ServingCellConfigCommon*,

the UE is not required to monitor the PDCCH candidate.

<Unchanged part omitted>

--------------------------------- End TP ----------------------------------------

Conclusion:

For semi-static channel access, SSBs that (partially) fall in the idle region of a fixed frame period should be considered as invalid. No PDSCH rate matching and no RLM/RRM measurement will be done for those candidate SSB positions.

Agreement:

LS to RAN2/4 on SSB index and candidate SSB index for NR-U is endorsed in R1-2001357

[100e-NR-unlic-NRU-InitAccessProc-02] Email discussion/approval regarding issues related to RA procedure including: HARQ-ACK LBT parameter signaling in success RAR for 2-step RACH procedure and Configuration of RNTI and DCI payload for IDLE UE on FBE cell to permit PRACH within FFP by 2/28; if there is a spec impact, followed by endorsing the corresponding TP by 3/3

Conclusions

The following agreements were made:

Agreement:

LBT parameter applied for HARQ-ACK transmission corresponding to Msg. B reception is provided via each success RAR in Msg. B PDSCH.

Agreement:

The following text proposal for TS 38.213 is adopted.

------------------------------ Text Proposal --------------------------------

8.2A  Random access response - Type-2 random access procedure

In response to a transmission of a PRACH and a PUSCH, a UE attempts to detect a DCI format 1\_0 with CRC scrambled by a corresponding RA-RNTI during a window controlled by higher layers [11, TS 38.321]. The window starts at the first symbol of the earliest CORESET the UE is configured to receive PDCCH for Type1-PDCCH CSS set, as defined in Clause 10.1, that is at least one symbol, after the last symbol of the PUSCH occasion corresponding to the PUSCH transmission, where the symbol duration corresponds to the SCS for Type1-PDCCH CSS set. The length of the window in number of slots, based on the SCS for Type1-PDCCH CSS set, is provided by *ra-ResponseWindow*.

If the UE detects the DCI format 1\_0, with CRC scrambled by the corresponding RA-RNTI, and a transport block in a corresponding PDSCH within the window, the UE passes the transport block to higher layers. The higher layers indicate to the physical layer

-    an uplink grant if the RAR message(s) is for fallbackRAR and a random access preamble identity (RAPID) associated with the PRACH transmission is identified, and the UE procedure continues as described in Clause 8.2 when the UE detects a RAR UL grant, or

-    transmission of a PUCCH with HARQ-ACK information having ACK value if the RAR message(s) is for successRAR, where

-     a PUCCH resource for the transmission of the PUCCH is indicated by PUCCH resource indicator field of 4 bits in the successRAR from a PUCCH resource set that is provided by *pucch-ResourceCommon*

-     a slot for the PUCCH transmission is indicated by a PDSCH-to-HARQ\_feedback timing indicator field of 3 bits in the successRAR having a value from {1, 2, 3, 4, 5, 6, 7, 8} and, with reference to slots for PUCCH transmission having duration , the slot is determined as where is a slot of the PDSCH reception, is as defined for PUSCH transmission in Table 6.1.2.1.1-5 of [6, TS 38.214], and

-     the UE does not expect the first symbol of the PUCCH transmission to be after the last symbol of the PDSCH reception by a time smaller than msec where is the PDSCH processing time for UE processing capability 1 [6, TS 38.214]

-     a channel access type and CP extension for PUCCH transmission is indicated by ChannelAccess-CPext field of 2 bits in the successRAR for operation with shared spectrum channel access [15, TS 37.213]

-     the PUCCH transmission is with a same spatial domain transmission filter and in a same active UL BWP as a last PUSCH transmission

If the UE detects the DCI format 1\_0 with CRC scrambled by a C-RNTI and a transport block in a corresponding PDSCH within the window, the UE transmits a PUCCH with HARQ-ACK information having ACK value if the UE correctly detects the transport block or NACK value if the UE incorrectly detects the transport block and the time alignment timer is running [11, TS 38.321].

---------------------------- Unchanged text omitted---------------------------

------------------------------------------------- End of TP-------------------------------------------------------------------------

Agreement:

The following text proposal for TS 37.213 is adopted

------- Start of Text proposal for TS37.213 --------

4.2.1     Channel access procedures for uplink transmission(s)

*[Unchanged text omitted]*

A UE shall use Type 1 channel access procedures for PUCCH transmissions unless stated otherwise in this subclause. If a DL grant or a RAR message for successRAR scheduling a PUCCH transmission indicates Type 2 channel access procedures, the UE shall use Type 2 channel access procedures.

*[Unchanged text omitted]*

------- End of Text proposal for TS37.213 --------

[100e-NR-unlic-NRU-InitAccessProc-03] Email discussion/approval regarding issues related to RRM/RLM including:

* RSSI measurement duration
* RMTC configuration in RRC signalling and FFS points for value ranges compared to LAA LTE
* The need to replace Lmax with and add values 10, 20 for RLM in TS 38.213 subclause 5

by 2/28; if there is a spec impact, followed by endorsing the corresponding TP by 3/3

Conclusions

The following agreements were made:

Agreement:

The RMTC-Config can indicate a reference SCS and CP as one of {15 kHz, 30 kHz, 60 kHz-NCP, 60 kHz-ECP}

Agreement:

The L1 averaging duration of RSSI measurements (within a configured measurement duration) is limited to 1 OFDM symbol of a configured reference subcarrier spacing.

Agreement:

Keep value range for rmtc-Period-r16 and rmtc-SubframeOffset-r16 the same as for LTE-LAA.

Agreement:

Keep value range for rssi-Result-r16 and channelOccupancyThreshold-r16 the same as for LTE-LAA and inform RAN2 of this decision.

Agreement:

For RSSI (and channel occupancy measurements) layer 3 filtering is not applied.

LS to RAN2 on RRM and Random Access is approved in R1-2001375

# References

1. R1-2001535 Maintainance on the initial access procedures Huawei, HiSilicon
2. R1-2001653 Remaining issues on initial access procedure for NR-U vivo
3. R1-2001706 Remaining issues on the initial access procedure for NR-U ZTE, Sanechips
4. R1-2001760 Discussion on the remaining issues of enhancements to initial access procedure OPPO
5. R1-2001936 Remaining issues of initial access and mobility for NR-U LG Electronics
6. R1-2001988 Enhancements to initial access and mobility for NR-unlicensed Intel Corporation
7. R1-2002032 Enhancements to initial access procedures Ericsson
8. R1-2002118 Initial access procedures for NR-U Samsung
9. R1-2002248 Remaining issues on initial access procedure for NR-U ETRI
10. R1-2002263 Remaining issues on initial access procedure Spreadtrum Communications
11. R1-2002278 On Enhancements to Initial Access Procedures for NR-U Nokia, Nokia Shanghai Bell
12. R1-2002407 Remaining issues on initial access procedure for NR-U operation MediaTek Inc.
13. R1-2002531 TP for Initial access and mobility procedures for NR-U Qualcomm Incorporated
14. R1-2001315 Outcome of email thread [100e-NR-unlic-NRU-InitAccessProc-01] Charter Communications
15. R1-2001316 Outcome of email thread [100e-NR-unlic-NRU-InitAccessProc-02] Charter Communications
16. R1-2001317 Outcome of email thread [100e-NR-unlic-NRU-InitAccessProc-03] Charter Communications