**3GPP TSG RAN WG1 Meeting #101-e                     R1-200xxxx**

**e-Meeting, May 25 – June 5, 2020**

**Agenda Item: 7.2.2.2.2**

**Source: Moderator (Charter Communications)**

**Title: Draft [101-e-NR-unlic-NRU-InitAccessProc-04]**

**Document for: Discussion and Decision**

# Introduction

Four email discussions have been sanctioned in RAN1#101-e on initial access procedures for NR-U based on contributions submitted to this meeting [1]-[13]. This fourth discussion that aims to converge by 5/27 has the following scope:

[101-e-NR-unlic-NRU-InitAccessProc-04] Email discussion/approval of the following from R1-2003306 until 5/27 – Amitav (Charter)

* (#3.4) Clarify and correct capturing the validation of SFN LSBs in Section 8.2 and 8.2A of TS 38.213, respectively and consider some special cases, e.g., RAR window size of <=10ms and contention-free random access (CFRA).

Note: this is a continuation of email discussion [100b-e-NR-unlic-NRU-InitAccessProc-05] Email approval of the corresponding TP to address LS from RAN2 in R1-2001506 by 4/23 - Jing (Qualcomm)

These issues have been selected based on the preparatory discussion summarized in [14]. The status of the discussion on SFN LSB bits in the previous meeting can be found in [15].

# Discussion

This issue was addressed in [2][10][12][6][3][13].

Summarizing the views:

* It is a mandatory behavior for UE to monitor the last two bits of SFN in DCI 1\_0 for RACH operation in shared spectrum if there is no special situation (case of “applicable”).
	+ Special situation – if UE supports RAR reception window of 10 ms or less, or for RAR in CFRA – this is a case of “not applicable”. Case of “not applicable” can also be met by UE implementation [2][10].
	+ Further discuss to define under what conditions the SFN LSB bits are not applicable, e.g., RAR window <= 10 ms [6][3].
* It is a mandatory behavior for UE to monitor the last two bits of SFN in DCI 1\_0 for RACH operation in shared spectrum if the bits are included. There are no special cases or “applicable” versus “not applicable” in the specification [12][13].

Majority of companies are fine with “applicable/not applicable” verbiage. Therefore, the two TP alternatives proposed in [10] can be used for further discussion:

================ TP alternative 1 for 38.213 8.2 and 8.2A================

8.2 Random access response - Type-1 random access procedure

-------Unchanged part omitted---------------------

If the UE detects the DCI format 1\_0 with CRC scrambled by the corresponding RA-RNTI, and the LSBs of SFN field in the DCI format 1\_0, if included and applicable, match the LSBs of the SFN in which the PRACH is transmitted, and the UE receives a transport block in a corresponding PDSCH within the window, the UE passes the transport block to higher layers. The higher layers parse the transport block for a random access preamble identity (RAPID) associated with the PRACH transmission. If the higher layers identify the RAPID in RAR message(s) of the transport block, the higher layers indicate an uplink grant to the physical layer. This is referred to as random access response (RAR) UL grant in the physical layer.

If the UE does not detect the DCI format 1\_0 with CRC scrambled by the corresponding RA-RNTI within the window, or if the UE detects the DCI format 1\_0 with CRC scrambled by the corresponding RA-RNTI within the window but the LSBs of SFN field in the DCI format 1\_0, if included and applicable, do not match the LSBs of the SFN in which the PRACH is transmitted, or if the UE does not correctly receive the transport block in the corresponding PDSCH within the window, or if the higher layers do not identify the RAPID associated with the PRACH transmission from the UE, the higher layers can indicate to the physical layer to transmit a PRACH. If requested by higher layers, the UE is expected to transmit a PRACH no later than  msec after the last symbol of the window, or the last symbol of the PDSCH reception, where  is a time duration of  symbols corresponding to a PDSCH processing time for UE processing capability 1 assuming  corresponds to the smallest SCS configuration among the SCS configurations for the PDCCH carrying the DCI format 1\_0, the corresponding PDSCH when additional PDSCH DM-RS is configured, and the corresponding PRACH. For , the UE assumes  [6, TS 38.214]. For a PRACH transmission using 1.25 kHz or 5 kHz SCS, the UE determines  assuming SCS configuration .

If the UE detects a DCI format 1\_0 with CRC scrambled by the corresponding RA-RNTI and the LSBs of SFN field in the DCI format 1\_0, if included and applicable, match the LSBs of the SFN in which the PRACH is transmitted and the UE receives a transport block in a corresponding PDSCH, the UE may assume same DM-RS antenna port quasi co-location properties, as described in [6, TS 38.214], as for a SS/PBCH block or a CSI-RS resource the UE used for PRACH association, as described in Clause 8.1, regardless of whether or not the UE is provided *TCI-State* for the CORESET where the UE receives the PDCCH with the DCI format 1\_0.

If the UE attempts to detect the DCI format 1\_0 with CRC scrambled by the corresponding RA-RNTI in response to a PRACH transmission initiated by a PDCCH order that triggers a contention-free random access procedure for the SpCell [11, TS 38.321], the UE may assume that the PDCCH that includes the DCI format 1\_0 and the PDCCH order have same DM-RS antenna port quasi co-location properties. If the UE attempts to detect the DCI format 1\_0 with CRC scrambled by the corresponding RA-RNTI in response to a PRACH transmission initiated by a PDCCH order that triggers a contention-free random access procedure for a secondary cell, the UE may assume the DM-RS antenna port quasi co-location properties of the CORESET associated with the Type1-PDCCH CSS set for receiving the PDCCH that includes the DCI format 1\_0.

A RAR UL grant schedules a PUSCH transmission from the UE. The contents of the RAR UL grant, starting with the MSB and ending with the LSB, are given in Table 8.2-1.

If the value of the frequency hopping flag is 0, the UE transmits the PUSCH without frequency hopping; otherwise, the UE transmits the PUSCH with frequency hopping.

The UE determines the MCS of the PUSCH transmission from the first sixteen indexes of the applicable MCS index table for PUSCH as described in [6, TS 38.214].

The TPC command value  is used for setting the power of the PUSCH transmission, as described in Clause 7.1.1, and is interpreted according to Table 8.2-2.

The CSI request field is reserved.

The ChannelAccess-CPext field indicates a channel access type and CP extension for operation with shared spectrum channel access [15, TS 37.213].

-------Unchanged part omitted---------------------

Unless the UE is configured a SCS, the UE receives subsequent PDSCH using same SCS as for the PDSCH reception providing the RAR message.

If the UE does not detect the DCI format with CRC scrambled by the corresponding RA-RNTI where the LSBs of SFN field in the DCI format 1\_0, if included and applicable, match the LSBs of the SFN in which the PRACH is transmitted, or the UE does not correctly receive a corresponding transport block within the window, the UE procedure is as described in [11, TS 38.321].

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

-------Unchanged part omitted---------------------

If the UE detects the DCI format 1\_0, with CRC scrambled by the corresponding MsgB-RNTI, and the LSBs of SFN field in the DCI format 1\_0, if included and applicable, match the LSBs of the SFN in which the PRACH is transmitted, and the UE receives 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 $k$ from {1, 2, 3, 4, 5, 6, 7, 8} and, with reference to slots for PUCCH transmission having duration $T\_{slot}$, the slot is determined as $n+k+∆$, where $n$ is a slot of the PDSCH reception and $∆$ is as defined for PUSCH transmission in Table 6.1.2.1.1-5 of [6, TS 38.214]

- 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 $N\_{T,1}+0.5$ msec where $N\_{T,1}$ is the PDSCH processing time for UE processing capability 1 [6, TS 38.214]

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

- 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].

The UE does not expect to be indicated to transmit the PUCCH with the HARQ-ACK information at a time that is prior to a time when the UE applies a TA command that is provided by the transport block. If the UE does not detect the DCI format 1\_0 with CRC scrambled by the corresponding MsgB-RNTI within the window, or if the UE detects the DCI format 1\_0 with CRC scrambled by the corresponding MsgB-RNTI within the window but the LSBs of SFN field in the DCI format 1\_0, if included and applicable, do not match the LSBs of the SFN in which the PRACH is transmitted, or if the UE does not correctly receive the transport block in the corresponding PDSCH within the window, or if the higher layers do not identify the RAPID associated with the PRACH transmission from the UE, the higher layers can indicate to the physical layer to transmit only PRACH according to Type-1 random access procedure or to transmit both PRACH and PUSCH according to Type-2 random access procedure [11, TS 38.321]. If requested by higher layers, the UE is expected to transmit a PRACH no later than $N\_{T,1}+0.75$ msec after the last symbol of the window, or the last symbol of the PDSCH reception, where $N\_{T,1}$ is a time duration of $N\_{1}$ symbols corresponding to a PDSCH processing time for UE processing capability 1 when additional PDSCH DM-RS is configured. For $μ=0$, the UE assumes $N\_{1,0}=14$ [6, TS 38.214].

Unless the UE is configured a SCS, the UE receives subsequent PDSCH using same SCS as for the PDSCH reception providing the RAR message.

If the UE does not detect the DCI format with CRC scrambled by the corresponding MsgB-RNTI where the LSBs of SFN field in the DCI format 1\_0, if included and applicable, match the LSBs of the SFN in which the PRACH is transmitted, or the UE does not correctly receive a corresponding transport block within the window, the UE procedure is as described in [11, TS 38.321].

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================ TP alternative 2 for 38.213 8.2 and 8.2A================

8.2 Random access response - Type-1 random access procedure

-------Unchanged part omitted---------------------

If the UE detects the DCI format 1\_0 with CRC scrambled by the corresponding RA-RNTI, and the LSBs of SFN field in the DCI format 1\_0, if included, match the LSBs of the SFN in which the PRACH is transmitted, and the UE receives a transport block in a corresponding PDSCH within the window, the UE passes the transport block to higher layers. The higher layers parse the transport block for a random access preamble identity (RAPID) associated with the PRACH transmission. If the higher layers identify the RAPID in RAR message(s) of the transport block, the higher layers indicate an uplink grant to the physical layer. This is referred to as random access response (RAR) UL grant in the physical layer.

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If the UE detects a DCI format 1\_0 with CRC scrambled by the corresponding RA-RNTI and the LSBs of SFN field in the DCI format 1\_0, if included, match the LSBs of the SFN in which the PRACH is transmitted and the UE receives a transport block in a corresponding PDSCH, the UE may assume same DM-RS antenna port quasi co-location properties, as described in [6, TS 38.214], as for a SS/PBCH block or a CSI-RS resource the UE used for PRACH association, as described in Clause 8.1, regardless of whether or not the UE is provided *TCI-State* for the CORESET where the UE receives the PDCCH with the DCI format 1\_0.

If the UE attempts to detect the DCI format 1\_0 with CRC scrambled by the corresponding RA-RNTI in response to a PRACH transmission initiated by a PDCCH order that triggers a contention-free random access procedure for the SpCell [11, TS 38.321], the UE may assume that the PDCCH that includes the DCI format 1\_0 and the PDCCH order have same DM-RS antenna port quasi co-location properties. If the UE attempts to detect the DCI format 1\_0 with CRC scrambled by the corresponding RA-RNTI in response to a PRACH transmission initiated by a PDCCH order that triggers a contention-free random access procedure for a secondary cell, the UE may assume the DM-RS antenna port quasi co-location properties of the CORESET associated with the Type1-PDCCH CSS set for receiving the PDCCH that includes the DCI format 1\_0.

A RAR UL grant schedules a PUSCH transmission from the UE. The contents of the RAR UL grant, starting with the MSB and ending with the LSB, are given in Table 8.2-1.

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The UE determines the MCS of the PUSCH transmission from the first sixteen indexes of the applicable MCS index table for PUSCH as described in [6, TS 38.214].

The TPC command value  is used for setting the power of the PUSCH transmission, as described in Clause 7.1.1, and is interpreted according to Table 8.2-2.

The CSI request field is reserved.

The ChannelAccess-CPext field indicates a channel access type and CP extension for operation with shared spectrum channel access [15, TS 37.213].

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Unless the UE is configured a SCS, the UE receives subsequent PDSCH using same SCS as for the PDSCH reception providing the RAR message.

If the UE does not detect the DCI format with CRC scrambled by the corresponding RA-RNTI where the LSBs of SFN field in the DCI format 1\_0, if included, match the LSBs of the SFN in which the PRACH is transmitted, or the UE does not correctly receive a corresponding transport block within the window, the UE procedure is as described in [11, TS 38.321].

In the procedures above, UE may ignore the LSBs of SFN field when contention free random access procedure is applied or RAR window size is equal to or smaller than 10ms.

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

-------Unchanged part omitted---------------------

If the UE detects the DCI format 1\_0, with CRC scrambled by the corresponding MsgB-RNTI, and the LSBs of SFN field in the DCI format 1\_0, if included, match the LSBs of the SFN in which the PRACH is transmitted, and the UE receives 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 $k$ from {1, 2, 3, 4, 5, 6, 7, 8} and, with reference to slots for PUCCH transmission having duration $T\_{slot}$, the slot is determined as $n+k+∆$, where $n$ is a slot of the PDSCH reception and $∆$ is as defined for PUSCH transmission in Table 6.1.2.1.1-5 of [6, TS 38.214]

- 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 $N\_{T,1}+0.5$ msec where $N\_{T,1}$ is the PDSCH processing time for UE processing capability 1 [6, TS 38.214]

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

- 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].

The UE does not expect to be indicated to transmit the PUCCH with the HARQ-ACK information at a time that is prior to a time when the UE applies a TA command that is provided by the transport block. If the UE does not detect the DCI format 1\_0 with CRC scrambled by the corresponding MsgB-RNTI within the window, or if the UE detects the DCI format 1\_0 with CRC scrambled by the corresponding MsgB-RNTI within the window but the LSBs of SFN field in the DCI format 1\_0, if included, do not match the LSBs of the SFN in which the PRACH is transmitted, or if the UE does not correctly receive the transport block in the corresponding PDSCH within the window, or if the higher layers do not identify the RAPID associated with the PRACH transmission from the UE, the higher layers can indicate to the physical layer to transmit only PRACH according to Type-1 random access procedure or to transmit both PRACH and PUSCH according to Type-2 random access procedure [11, TS 38.321]. If requested by higher layers, the UE is expected to transmit a PRACH no later than $N\_{T,1}+0.75$ msec after the last symbol of the window, or the last symbol of the PDSCH reception, where $N\_{T,1}$ is a time duration of $N\_{1}$ symbols corresponding to a PDSCH processing time for UE processing capability 1 when additional PDSCH DM-RS is configured. For $μ=0$, the UE assumes $N\_{1,0}=14$ [6, TS 38.214].

Unless the UE is configured a SCS, the UE receives subsequent PDSCH using same SCS as for the PDSCH reception providing the RAR message.

If the UE does not detect the DCI format with CRC scrambled by the corresponding MsgB-RNTI where the LSBs of SFN field in the DCI format 1\_0, if included, match the LSBs of the SFN in which the PRACH is transmitted, or the UE does not correctly receive a corresponding transport block within the window, the UE procedure is as described in [11, TS 38.321].

In the procedures above, UE may ignore the LSBs of SFN field when contention free random access procedure is applied or RAR window size is equal to or smaller than 10ms

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| **Company** | **Views** |
| ZTE | Alt.1 is slightly preferred. To our understanding, if applicable can refer to the UE capability of supporting RAR window size > 10ms. However we also understand the concern that the interpretation of “if applicable” may be different.Therefore, we are also fine to change it back to “if included ~~and applicable~~”. For Alt.2, we do not think it is necessary to capture the sentence that “UE may ignore…”If the RAR window is smaller than 10ms, there is no ambiguity, and the UE will always know the SFN field matches the SFN in which the PRACH is transmitted as long as the RA-RNTI is matched. Based on the previous discussion, I think the concern from LGE was that the current proposal may enforce UE to read the MIB to get SFN. But to our understanding it can be up to UE implementation. The current proposal just says the UE is mandatory to read the 2bits if included in the DCI, but the UE is not required to compare the 2bits to the SFN in which the PRACH is transmitted, if the UE already knows the SFN will be matched without reading MIB, e.g. when the RAR window is <= 10ms.In addition, we are not supportive to ignore the SFN field for CFRA if the RAR window is larger than 10ms. |
| Samsung  | **Point 1:**To save time, we can be fine with the compromise on adopting “applicable”, thus alt.1 is preferred. But we share the view of ZTE, that “we are not supportive to ignore the SFN field for CFRA if the RAR window is larger than 10ms.”, and to us, the applicable is based on the RAR window<10ms. **Point 2:**However, we have a comment on the additional change LGE made in the alt.1:“If the UE does not detect the DCI format with CRC scrambled by the corresponding RA-RNTI where the LSBs of SFN field in the DCI format 1\_0, if included and applicable, match the LSBs of the SFN in which the PRACH is transmitted, or the UE does not correctly receive a corresponding transport block within the window, the UE procedure is as described in [11, TS 38.321].”By LGE’s analysis in their tdoc, the motivation to make the change is the previous wording is not clear. But I feel the updated one is also confusing. Based on my understanding, the original wording is trying to solve 3 cases:1. UE does not detect the DCI format with CRC scrambled by the corresponding RA-RNTI (or msgB-RNTI);2. UE detects the DCI format with CRC scrambled by the corresponding RA-RNTI (or msgB-RNTI) but the LSBs of SFN does not match;3. UE does not correctly receive a corresponding transport block within the window. But with the updated wording, it seems it can only cover case #2, and #3, which I think it’s incorrect.So suggested change is: “If the UE does not detect the DCI format with CRC scrambled by the corresponding RA-RNTI, the UE detects the DCI format with CRC scrambled by the corresponding RA-RNTI but the LSBs of SFN field in the DCI format 1\_0, if included and applicable, don’t match the LSBs of the SFN in which the PRACH is transmitted, or the UE does not correctly receive a corresponding transport block within the window, the UE procedure is as described in [11, TS 38.321].”Similar change can applied to the part for msgB-RNTI. |
| LG | In last RAN1 meeting, TP alt.1 was agreeable to most companies who joined the long discussion, so we hope alt.1 could be acceptable to all the companies in this meeting.Nevertheless, the reason we raised TP alt.2 in R1-2002996 is that some companies raised comment that “if applicable” is not precise. We think “if applicable” is ok since reasonable UE implementation will appropriately follow SFN LSB 2 bits when it is necessary for RAR message validation. However, if the companies still want precise indication, that we think alt.2 is the way we can go.So far no company objected to allow UE implementation of not exploiting SFN LSB 2 bits in some reasonable cases and we are objective to do nothing in this aspect in the specifications, which may make specifications read UE is mandated to do SFN LSB 2 bits check. So, we hope we can choose between alt.1 and alt.2 in this meeting.In addition, ***not related to the above topic,*** in both alt1 and alt2 TP, we changed original TP :From:“If the UE does not detect the DCI format with CRC scrambled by the corresponding RA-RNTI, or if the UE does detect the DCI format 1\_0 with CRC scrambled by the corresponding RA-RNTI but the LSBs of SFN field in DCI format 1\_0, if included and applicable, do not match the LSBs of the SFN in which the PRACH is transmitted, or the UE does not correctly receive a corresponding transport block within the window, the UE procedure is as described in [11, TS 38.321].” To: “If the UE does not detect the DCI format with CRC scrambled by the corresponding RA-RNTI where the LSBs of SFN field in the DCI format 1\_0, if included, match the LSBs of the SFN in which the PRACH is transmitted, or the UE does not correctly receive a corresponding transport block within the window, the UE procedure is as described in [11, TS 38.321]. ”This is because original TP reads logically that UE should follow 38.321 behavior (stop monitoring RAR) “once the UE detects RA-RNTI DCI but SFN does not match”, which is not original intension.On the other hand, Samsung suggested other alternative modification in the email discussion above. At first look, the suggested modification may still be interpreted again that UE should follow 38.321 behavior (stop monitoring RAR) “once the UE detects RA-RNTI DCI but SFN does not match”, which is not original intension.However, we are open to any good modifications and want to hear other companies opinions further. |
| Ericsson | We prefer Alt-2, but we share the view with ZTE and Samsung that the wording “UE may ignore …” should be removed. We agree with ZTE that the UE, by implementation know whether or not the SFN bits are applicable, e.g., if the RAR window < 10 ms. The gNB would clearly not use those 2 bits anyway in that case, so why would the UE be expected to read them?It seems that Point #2 from Samsung is also applicable to Alt-2. |
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# References

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2. R1-2003451 Remaining issues on the initial access procedure for NR-U ZTE, Sanechips
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4. R1-2003657 Remaining issues on initial access procedure for NR-U operation MediaTek Inc.
5. R1-2003729 Enhancements to initial access and mobility for NR-unlicensed Intel Corporation
6. R1-2003844 Enhancements to initial access procedures Ericsson
7. R1-2003861 Initial access procedures for NR-U Samsung
8. R1-2003973 Remaining issues on initial access procedure for NR-U ETRI
9. R1-2004001 Remaining issues on initial access procedure Spreadtrum Communications
10. R1-2004014 Remaining issues of initial access and mobility for NR-U LG Electronics
11. R1-2004086 Discussion on the remaining issues of enhancements to initial access procedure OPPO
12. R1-2004444 TP for Initial access and mobility procedures for NR-U Qualcomm Incorporated
13. R1-2004526 On Enhancements to Initial Access Procedure for NR-U Nokia, Nokia Shanghai Bell
14. R1-2003306 Feature lead summary on for initial access procedures enhancements Charter Communications
15. R1-2002996 Summary of email discussion on LSB of SFN validation Qualcomm Incorporated