3GPP TSG RAN WG1 Meeting #100bis R1-200xxxx

e-Meeting, April 20th – 30th, 2020

**Agenda item:** **7.2.10.2**

**Source: Apple Inc.**

**Title:** **FL summary of remaining issues on enhancements for single Tx transmission in EN-DC**

**Document for:** **Decision**

# Introduction and Proposals

Per chairman’s guidance, I’d like to kick off the email discussion on following issue:

[100b-e-NR- LTE\_NR\_DC\_CA-SingleTx-01] Email discussion/approval regarding the following issues:

* Issue 1 on type 1 UE hailing of colliding UL in single Tx operation, as described in section 2 of [R1-2002348](file:///c:/Users/wanshic/OneDrive%2520-%2520Qualcomm/Documents/Standards/3GPP%2520Standards/Meeting%2520Documents/TSGR1_100b/Docs/R1-2002348.zip)
* Issue 2 on type 1 UE capability with semi-static UL transmission, as described in section 3 of [R1-2002348](file:///c:/Users/wanshic/OneDrive%2520-%2520Qualcomm/Documents/Standards/3GPP%2520Standards/Meeting%2520Documents/TSGR1_100b/Docs/R1-2002348.zip)
  + Discussion of the TP is delayed until the corresponding UE feature discussions finish.
* Issue 3a and 3b on clarification of Type 2 UE behavior, as described in sections 4.1 and 4.2 of [R1-2002348](file:///c:/Users/wanshic/OneDrive%2520-%2520Qualcomm/Documents/Standards/3GPP%2520Standards/Meeting%2520Documents/TSGR1_100b/Docs/R1-2002348.zip), respectively.

till 4/23, with potential TPs for approval till 4/28 – (Apple, Wei)

# Type 1 UE handling of colliding UL in 1Tx operation

**Background**: It was discussed in RAN1 #100e that the current description in 38.213 does not capture type 1 UE behavior for ‘single-tx’ case, as the corresponding text is under the condition “*If a UE is configured with …*”. For single-tx case, the UE cannot transmit simultaneously on LTE and NR regardless of *, * settings. So, the behavior of dropping NR should be specified outside the ** restriction.

This issue was brought up and discussed in RAN1 #100e, and two alternative TP’s were proposed. However no consensus was reached. For this meeting, a 3rd TP was also proposed by Qualcomm [6]. These 3 proposed TP are listed below:

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| **TP option 1**  ---------------------------- start TP1 to sub clause 7.6.1 of 38.213v16.1.0 --------------------------------------  7.6.1 EN-DC  If a UE is configured with a MCG using E-UTRA radio access and with a SCG using NR radio access, the UE is configured a maximum power  for transmissions on the MCG by *p-MaxEUTRA* and a maximum power  for transmissions in FR1 on the SCG by *p-NR-FR1*.  The UE determines a transmission power for the MCG as described in [13, TS 36.213] using  as the maximum transmission power. The UE determines transmission power for the SCG in FR1 as described Clauses 7.1 through 7.5 using  as the maximum transmission power. The UE determines transmission power for the SCG in FR2 as described Clauses 7.1 through 7.5.  A UE does not expect to be configured for operation with shortened TTI and/or processing time [13, TS 36.213] on a cell that is included in an EN-DC configuration.  If the UE indicates capability for dynamic power sharing between E-UTRA and NR for EN-DC, and if the UE is configured with *tdm-PatternConfig-r16*, then for the band combinations for which the UE indicates using *singleUL-Transmission* that it does not support simultaneous  UL transmissions (as defined in TS 38.101-3 [8-3]), the UE does not transmit on the SCG in FR1 when the UE has overlapped transmission on a subframe on the MCG.  If a UE is configured with , where  is the linear value of ,  is the linear value of , and  is the linear value of a configured maximum transmission power for EN-DC operation as defined in [8-3, TS 38.101-3] for FR1, the UE determines a transmission power for the SCG as follows.  - If the UE is configured with reference TDD configuration for E-UTRA (by *tdm-PatternConfig-r15* or by *tdm-PatternConfig-r16* in [13, TS 36.213])  - If the UE does not indicate a capability for dynamic power sharing between E-UTRA and NR for EN-DC, the UE does not transmit in a slot on the SCG in FR1 when a corresponding subframe on the MCG is an UL subframe in the reference TDD configuration.  - ~~If the UE indicates a capability for dynamic power sharing between E-UTRA and NR for EN-DC, and does not indicate a capability~~ *~~tdm-Pattern-dualTx~~* ~~in [16, TS 38.306], and is configured with~~ *~~tdm-PatternConfig-r16~~*~~, the UE does not transmit on the SCG in FR1 when the UE has overlapped transmission on a subframe on the MCG.~~  - If the UE indicates a capability for dynamic power sharing between E-UTRA and NR for EN-DC and  - if UE transmission(s) in subframe  of the MCG overlap in time with UE transmission(s) in slot  of the SCG in FR1, and |

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| **TP option 2**  ---------------------------- start TP2 to sub clause 7.6.1 of 38.213v16.1.0 --------------------------------------  7.6.1 EN-DC  If a UE is configured with a MCG using E-UTRA radio access and with a SCG using NR radio access, the UE is configured a maximum power  for transmissions on the MCG by *p-MaxEUTRA* and a maximum power  for transmissions in FR1 on the SCG by *p-NR-FR1*.  The UE determines a transmission power for the MCG as described in [13, TS 36.213] using  as the maximum transmission power. The UE determines transmission power for the SCG in FR1 as described Clauses 7.1 through 7.5 using  as the maximum transmission power. The UE determines transmission power for the SCG in FR2 as described Clauses 7.1 through 7.5.  A UE does not expect to be configured for operation with shortened TTI and/or processing time [13, TS 36.213] on a cell that is included in an EN-DC configuration.  If the UE indicates capability for dynamic power sharing between E-UTRA and NR for EN-DC and does not indicate a capability tdm-Pattern-dualTx in [16, TS 38.306], and is configured with *tdm-PatternConfig-r16*, the UE does not transmit on the SCG in FR1 when the UE has overlapped transmission on a subframe on the MCG.  If a UE is configured with , where  is the linear value of ,  is the linear value of , and  is the linear value of a configured maximum transmission power for EN-DC operation as defined in [8-3, TS 38.101-3] for FR1, the UE determines a transmission power for the SCG as follows.  - If the UE is configured with reference TDD configuration for E-UTRA (by *tdm-PatternConfig-r15* or by *tdm-PatternConfig-r16* in [13, TS 36.213])  - If the UE does not indicate a capability for dynamic power sharing between E-UTRA and NR for EN-DC, the UE does not transmit in a slot on the SCG in FR1 when a corresponding subframe on the MCG is an UL subframe in the reference TDD configuration.  - ~~If the UE indicates a capability for dynamic power sharing between E-UTRA and NR for EN-DC, and does not indicate a capability~~ *~~tdm-Pattern-dualTx~~* ~~in [16, TS 38.306], and is configured with~~ *~~tdm-PatternConfig-r16~~*~~, the UE does not transmit on the SCG in FR1 when the UE has overlapped transmission on a subframe on the MCG.~~  - If the UE indicates a capability for dynamic power sharing between E-UTRA and NR for EN-DC and  - if UE transmission(s) in subframe  of the MCG overlap in time with UE transmission(s) in slot  of the SCG in FR1, and |

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| **TP option 3**  ---------------------------- start TP3 to sub clause 7.6.1 of 38.213v16.1.0 --------------------------------------  If the UE indicates a capability for dynamic power sharing between E-UTRA and NR for EN-DC, for the band combinations for which the UE indicates *singleUL-Transmission*, if the conditions in TS 38.101-3 [8-3] are fullfilled,  - If the UE is configured with reference TDD configuration for E-UTRA (by *tdm-PatternConfig-r16* in [13, TS 36.213]),  - the UE does not transmit on the SCG in FR1 when the UE has overlapped transmission on an UL-offset subframe (as specified in [13, TS 36.213]) on the MCG  - the UE does not expect to be configured or indicated to transmit on the SCG in FR1 when the UE has overlapped transmission on a subframe other than the UL-offset subframes (as specified in [13, TS 36.213]) on the MCG  - Otherwise,  - the UE does not expect to be configured or indicated to transmit on the SCG in FR1 when the UE has overlapped transmission on any subframe on the MCG.  If a UE is configured with , where  is the linear value of ,  is the linear value of , and  is the linear value of a configured maximum transmission power for EN-DC operation as defined in [8-3, TS 38.101-3] for FR1, the UE determines a transmission power for the SCG as follows.  - If the UE is configured with reference TDD configuration for E-UTRA (by *tdm-PatternConfig-r15* or by *tdm-PatternConfig-r16* in [13, TS 36.213])  - If the UE does not indicate a capability for dynamic power sharing between E-UTRA and NR for EN-DC, the UE does not transmit in a slot on the SCG in FR1 when a corresponding subframe on the MCG is an UL subframe in the reference TDD configuration.  ~~- If the UE indicates a capability for dynamic power sharing between E-UTRA and NR for EN-DC, and does not indicate a capability~~ *~~tdm-Pattern-dualTx~~* ~~in [16, TS 38.306], and is configured with~~ *~~tdm-PatternConfig-r16~~*~~, the UE does not transmit on the SCG in FR1 when the UE has overlapped transmission on a subframe on the MCG.~~  - If the UE indicates a capability for dynamic power sharing between E-UTRA and NR for EN-DC and  - if UE transmission(s) in subframe  of the MCG overlap in time with UE transmission(s) in slot  of the SCG in FR1, and  - if  in any portion of slot  of the SCG,  the UE reduces transmission power in any portion of slot  of the SCG so that  in any portion of slot , where  and  are the linear values of the total UE transmission powers in subframe  of the MCG and in slot  of the SCG in FR1, respectively. The UE is not required to transmit in any portion of slot  of the SCG if  would need to be reduced by more than the value provided by *XSCALE* in order for  in any portion of slot  of the SCG. The UE is required to transmit in slot  of the SCG if  would not need to be reduced by more than the value provided by *XSCALE* in order for  in all portions of slot .  - If the UE does not indicate a capability for dynamic power sharing between E-UTRA and NR for EN-DC, the UE expects to be configured with reference TDD configuration for E-UTRA (by *tdm-PatternConfig-r15* or by *tdm-PatternConfig-r16* in [13, TS 36.213]). |

It seems to me that main difference between option 1 vs option 2 is

I’d like companies to provide input to the following questions:

* **Q1-1: In addition to the following cases, is there any other case where network can configure a UE can be configured with case 1 Reference HARQ timing (i.e. tdm-PatternConfig-r16)? (If yes, please also point us to the RAN1 agreement)**
  + **Case 1): type 1 UE indicates singleUL-Transmission for the difficult BC listed in 38.101**
  + **Case 2): type 1 UE indicates tdm-pattern-dualTx for BC with potential DL de-sense due to harmonics**
  + **Case 3): type 2 UE configured with P\_lte + P\_nr > P\_total**

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| Company | Comments |
| ZTE | We feel like the current spec doesn’t preclude configuring tdm-PatternConfig for other cases in addition to the above three cases. The key issue is, for a UE indicates neither singleUL-Transmission or tdm-pattern-dualTx, it is not clear whether it should be regarded as a “single Tx” UE or a “dual Tx” UE.  ***tdm-Pattern***  Indicates whether the UE supports the *tdm-PatternConfig* for *single UL-transmission* associated functionality, as specified in TS 36.331 [17]. Support is conditionally mandatory in (NG)EN-DC for UEs that do not support dynamicPowerSharingENDC and for UEs that indicate single UL transmission for any (NG)EN-DC BC. Support is conditionally mandatory in NE-DC for UEs that do not support dynamicPowerSharingNEDC and for UEs that indicate single UL transmission for any NE-DC BC. The feature is optional otherwise. |
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* **Q1-2: Which of the 3 proposed TPs are accept**

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| Company | Comments |
| ZTE | We prefer Option1.  For a UE indicates neither singleUL-Transmission or tdm-pattern-dualTx, our understanding is that this UE should be regarded as a “dual Tx” UE.  Seems like two issues are mixed up in Option3. We prefer to separate the discussion of “not expect to be configured or indicated to transmit”. |
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# Type 1 UE capability with semi-static UL transmission

In RAN1#99, the following agreements were reached [7]. According to the agreement, whether the semi-static configured UL transmissions are allowed in all UL subframes is subjected to UE capability. Two text proposals are provided by [2] [6].

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| Agreements:  For a UE configured with DL-reference DL/UL configuration in Rel-16 (including single Tx with LTE TDD PCell or LTE FDD PCell, and dual Tx cases):   * For type 2 UE (i.e., UE without dynamic power sharing capability), any LTE UL transmissions should take place only in UL subframes designated for HARQ-ACK feedback. * For type 1 UE (i.e., UE with dynamic power sharing capability),   + Confirm that any LTE UL transmissions scheduled/triggered by DCI can take place in UL subframes not designated for HARQ-ACK feedback.   + FFS UE is not expected to transmit semi-statically configured LTE UL transmissions in the UL subframes other than those designated as UL in the DL-reference configuration if such transmission collide with NR UL transmissions.   Agreements  For the FFS part in the agreement above,   * semi-statically configured LTE UL transmissions are allowed in all UL subframes.   + Note: In case of collision, LTE transmission is prioritized   + Note: this configuration is subject to UE capability |

**Proposal 2: Discussion further the detailed TP.**

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| ---------------------------- start ZTE TP to sub clause 7.6.1 of 38.213v16.1.0 --------------------------------------  If a UE is configured with , where  is the linear value of ,  is the linear value of , and  is the linear value of a configured maximum transmission power for EN-DC operation as defined in [8-3, TS 38.101-3] for FR1, the UE determines a transmission power for the SCG as follows.  - If the UE is configured with reference TDD configuration for E-UTRA (by *tdm-PatternConfig-r15* or by *tdm-PatternConfig-r16* in [13, TS 36.213])  - If the UE does not indicate a capability for dynamic power sharing between E-UTRA and NR for EN-DC, the UE does not transmit in a slot on the SCG in FR1 when a corresponding subframe on the MCG is an UL subframe in the reference TDD configuration.  - If the UE indicates a capability for dynamic power sharing between E-UTRA and NR for EN-DC, and does not indicate a capability *tdm-Pattern-dualTx* in [16, TS 38.306], and is configured with *tdm-PatternConfig-r16*, the UE does not transmit on the SCG in FR1 when the UE has overlapped transmission on a subframe on the MCG.  - If the UE indicates a capability for dynamic power sharing between E-UTRA and NR for EN-DC, and indicates a capability tdm-Pattern-dualTx and a capability semi-staticULTransInAllSubframe in [16, TS 38.306], and is configured with tdm-PatternConfig-r16, the UE does not transmit on the SCG in FR1 when the UE has overlapped transmission that is not associated with a DCI on a subframe on the MCG. |  |

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| ---------------------------- start ZTE TP to sub clause 5.1 of 36.213v16.1.0 --------------------------------------  For a UE configured with EN-DC, if the UE does not indicate a capability for dynamic power sharing (as specified in [17]) and if the UE is configured with *subframeAssignment-r16* for a serving cell, the UE is not expected to transmit any uplink physical channel or signal in the serving cell on subframes other than offset-UL subframes, where the offset-UL subframes are determined by applying an offset value given by *harq-Offset-r16* to the subframes denoted as uplink in the UL/DL configuration *subframeAssignment-r16*.  For a UE configured with EN-DC, if the UE indicates a capability for dynamic power sharing and does not indicate a capability *semi-staticULTransInAllSubframe* (as specified in [17]) and if the UE is configured with *subframeAssignment-r16* for a serving cell, the UE is not expected to transmit any uplink physical channel or signal without associated DCI in the serving cell on subframes other than offset-UL subframes, where the offset-UL subframes are determined by applying an offset value given by *harq-Offset-r16* to the subframes denoted as uplink in the UL/DL configuration *subframeAssignment-r16*. |

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| ---------------------------- start Qualcomm TP to clause 6 or 8 of 36.213v16.1.0 --------------------------------------  For a UE configured with EN-DC/NE-DC and serving cell frame structure type 1, if the UE is configured with *subframeAssignment-r15* for the serving cell, the UE is not expected to transmit any uplink physical channel or signal in the serving cell on subframes other than offset-UL subframes, where the offset-UL subframes are determined by applying an offset value given by *harq-Offset-r15* to the subframes denoted as uplink in the UL/DL configuration *subframeAssignment-r15*.  For a UE configured with EN-DC, if the UE does not indicate a capability for dynamic power sharing (as specified in [17]) and if the UE is configured with *subframeAssignment-r16* for the serving cell, the UE is not expected to transmit any uplink physical channel or signal in the serving cell on subframes other than offset-UL subframes, where the offset-UL subframes are determined by applying an offset value given by *harq-Offset-r16* to the subframes denoted as uplink in the UL/DL configuration *subframeAssignment-r16*.  For a UE configured with EN-DC, if the UE indicates a capability for dynamic power sharing (as specified in [17]) and if the UE is configured with *subframeAssignment-r16* for the serving cell, the UE is not expected to be configured or indicated to transmit any uplink physical channel or signal, in the serving cell on subframes other than offset-UL subframes, where the offset-UL subframes are determined by applying an offset value given by *harq-Offset-r16* to the subframes denoted as uplink in the UL/DL configuration *subframeAssignment-r16*, if the UE does not indicate the UE capability *[FG18-2a or FG18-3a]* (as specified in [17]). |

As the exact definition of the corresponding UE capability will be discussed in this meeting, and there are different proposals, it might be desirable to wait until the corresponding UE feature discussed is concluded.

***FL proposal 2****: The related TP discussion could be delayed until the corresponding UE feature discussion is completed.*

# Clarifications on Type 2 UE behavior

## Clarification on Type 2 UE behavior

Background: The type 2 UE behavior is not fully specified in the specification TS38.213 for the case of P\_LTE+P\_NR <= P\_total. Specifically, the following proposal on clarification of type 2 UE behavior is made in [3] as follows:

Proposal : Clarify the whether the following UE behaviour is matching the Rel-16 agreement for UL collision handling:

* For Type 2 UE, NR UL can collide with LTE UL under “P\_LTE+P\_NR <= P\_total” and the corresponding transmission behavior is up to UE implementation
* since all slots can be scheduled for NR UL (no restriction) when tdm-PatternConfig-r15 or *tdm-PatternConfig-r15* is configured according to current spec of 38.213 Rel-16 spec 7.6.1 EN-DC.

FL summary: In general, type 2 UE (i.e., without fast communication between LTE and NR modems) has been quite clear from existing agreements:

- LTE UL is only transmitted

- Colliding UL Tx is considered as error case, and it is up to UE implementation.

However, it seems that existing 38.213 does not explicitly capture this for type 2 UE in the case of P\_LTE+P\_NR <= P\_total.

* **Q2-1: Do we need a TP to explicitly clarify in 38.213 type 2 UE assumption/behavior when P\_lte + P\_nr <= P\_total and the UE is configured with Reference HARQ timing? (e.g. up to UE implementation)**

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| Company | Comments |
| ZTE | Our view is that we may first discuss what’s the intended UE behavior in case of P\_lte + P\_nr <= P\_total for type2 UE. And then we could discuss whether a TP is needed or not.  Our preliminary understanding is the UE behavior in case of P\_lte + P\_nr <= P\_total for type2 UE could be the same as that in case of P\_lte + P\_nr > P\_total. We are open to further discuss the intended UE behavior. |
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## Type 2 UE’s assumption on “other than offset-UL subframes”

In Rel.15, the following agreements made in RAN1#90bis.

Agreements:

* In Case 1, LTE TDD UL HARQ timing is supported and the UE is allowed to transmit only in the subframes designated as UL in the reference TDD configuration. Additionally, a UE-specific HARQ subframe offset can be configured.

The agreement was captured in three places, i.e., section 5.1, section 6 and section 8 of TS36.213, with the same contents.

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| For a UE configured with EN-DC/NE-DC and serving cell frame structure type 1, if the UE is configured with *subframeAssignment-r15* for the serving cell, the UE is not expected to transmit any uplink physical channel or signal in the serving cell on subframes other than offset-UL subframes, where the offset-UL subframes are determined by applying an offset value given by *harq-Offset-r15* to the subframes denoted as uplink in the UL/DL configuration *subframeAssignment-r15*. |

In Rel. 16, the similar agreements were reached in EN-DC enhancement, as shown below. The agreements were captured in both section 6 and section 8 of TS36.213, but not in section 5.1. To avoid confusion between Rel.15 and Rel.16, It was proposed to capture the same contents in section 5.1 as these in section 6 and section 8 by [4]. But according to [1], this alignment is not necessary.

Agreements:

For a UE configured with DL-reference DL/UL configuration in Rel-16 (including single Tx with LTE TDD PCell or LTE FDD PCell, and dual Tx cases):

* For type 2 UE (i.e., UE without dynamic power sharing capability), any LTE UL transmissions should take place only in UL subframes designated for HARQ-ACK feedback.

**Proposal 3: Discuss further whether adopt the proposed text proposal on uplink power control section in TS36.213.**

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| 5.1 Uplink power control < Unchanged parts are omitted > For a UE configured with EN-DC/NE-DC and serving cell frame structure type 1, if the UE is configured with *subframeAssignment-r15* for the serving cell, the UE is not expected to transmit any uplink physical channel or signal in the serving cell on subframes other than offset-UL subframes, where the offset-UL subframes are determined by applying an offset value given by *harq-Offset-r15* to the subframes denoted as uplink in the UL/DL configuration *subframeAssignment-r15*.  For a UE configured with EN-DC, if the UE does not indicate a capability for dynamic power sharing (as specified in [17]) and if the UE is configured with *subframeAssignment-r16* for the serving cell, the UE is not expected to transmit any uplink physical channel or signal in the serving cell on subframes other than offset-UL subframes, where the offset-UL subframes are determined by applying an offset value given by *harq-Offset-r16* to the subframes denoted as uplink in the UL/DL configuration *subframeAssignment-r16*. |

* **Q2-2: Do we need to copy the same text on R16 UE behavior from section 6 & 8 to section 5.1 as well in 36.213? (Note that we indeed have the same text in section 6 & 8 & 5.1 on R15 UE behavior)**

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| Company | Comments |
| ZTE | Copying the same text seems fine to us. |
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# References

1. R1-2001529, “Enhancements for single UL operation for EN-DC”, Huawei, HiSilicon, 3GPP RAN1#100 bis e-meeting, April 20th – 30th, 2020
2. R1-2001619, “Remaining Issues on Single Tx Switched Uplink Solution for EN-DC”, ZTE, 3GPP RAN1#100 bis e-meeting, April 20th – 30th, 2020
3. R1-2001835, “Remaining issues on single Tx switched UL solution for EN-DC”, MediaTek Inc., 3GPP RAN1#100 bis e-meeting, April 20th – 30th, 2020
4. R1-2002347, “Remaining issues on single Tx operation for EN-DC”, Apple, 3GPP RAN1#100 bis e-meeting, April 20th – 30th, 2020
5. R1-2002419, “Remaining issues for single Tx UL enhancements”, Ericsson, 3GPP RAN1#100 bis e-meeting, April 20th – 30th, 2020
6. R1-2002559, “Remaining issues for EN-DC Single-Tx TDM Operation”, Qualcomm Incorporated, 3GPP RAN1#100 bis e-meeting, April 20th – 30th, 2020
7. “Chairman Notes, RAN1 #99”, 3GPP RAN1 #99, Reno, USA, November 18th – 22nd, 2019.