3GPP TSG-RAN WG1 Meeting #113 R1-23NNNN

Incheon, Korea, May 22nd – May 26th 2023

Agenda Item: 9.5

Source: Ericsson

Title: Draft LS discussion for DL PRS and UL SRS frequency hopping Switching time

Document for: Discussion, Decision

# Received LS

The LS from RAN4 contains a response to our LS from RAN1#112, as well as a further question:

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| *LS from R1-2304316*  **11. Overall Description:**  RAN4 thanks RAN1 for LS R1-2302127. RAN4 has discussed the question in the LS and reached the following agreements:   * For RedCap UE UL SRS Tx frequency hopping, RAN4 considers the switching time of {70us, 140us} for FR1 as the starting point   + SRS Tx frequency hopping range can be up to 100MHz.   + Which specific value for frequency hopping is applied depends on UE capability, if multiple values are agreed. * For UL SRS Tx frequency hopping, RAN4 considers the switching time of {35us, 70us, 140us} for FR2 as the starting point * SRS Tx frequency hopping range can be up to 400MHz * Which specific value for frequency hopping is applied depends on UE capability, if multiple values are agreed * For RedCap UE DL PRS Rx frequency hopping, RAN4 considers the switching time of {70us, 140us} for FR1 as the starting point   + PRS Rx frequency hopping range can be up to 100MHz   + Which specific value for frequency hopping is applied depends on UE capability, if multiple values are agreed * For DL PRS Rx frequency hopping, RAN4 considers the switching time of {35us, 70us, 140us} for FR2 as the starting point * PRS Rx frequency hopping range can be up to 400MHz * Which specific value for frequency hopping is applied depends on UE capability, if multiple values are agreed   RAN4 will notify RAN1 of further relevant agreements if there are any updates in future meetings.  RAN4 also thinks additional switch time may be needed for SRS transmission between the initial/active BWP to the first hop and last hop to initial/active BWP, and therefore, has below question:   * Is the additional switch time for SRS transmission between the initial/active BWP to first hop and switch time between last hop to the initial/active BWP relevant for RedCap frequency hopping and should it be discussed in RAN4?   **2. Actions:**  **To RAN WG1 group.**  **ACTION:** RAN4 kindly requests that RAN1 consider the above information in its future work and provide answer for question above. |

# Discussion

## Received comments in contributions

Several companies comment that the existing switching time capability may be re-used

In [1][8], it is proposed to reuse the switching time values from rel17, i.e. values specified for switching during RRC\_INACTIVE. In [2,3] it is commented that it is not necessary to introduce an enhancement switching time for SRS transmission for the first hop and after the last hop. [4] proposes to agree to further discussion. In [5,6], it is identified that the additional times need to be taken into account.

In [1], additional values for switching time are discussed. This will be treated separately during AI 9.5.5.

The comments are summarised below:

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| **Contribution** | **Comments** |
| [1] | Answer: RAN1 thinks ‘the switching time between SRS Tx and other Tx in initial UL BWP or Rx in initial DL BWP’ in Rel-17 can be reused, and it is no need for further discussed by RAN4.  due to limited capability of RedCap UEs. RAN1 respectfully asks RAN4 to confirm these values.   * 210us, 500us for FR1 * 210us for FR2 |
| [2][3] | **Proposal 1: From RAN1’s perspective, there’s** **no need to support an enhanced switch time for SRS transmission between the initial/active BWP to first hop and switch time between last hop to the initial/active BWP relevant for RedCap frequency hopping in Rel-18.** |
| [4] | With regard to RAN4’s question, i.e. is the additional switch time for SRS transmission between the initial/active BWP to first hop and switch time between last hop to the initial/active BWP relevant for RedCap frequency hopping and should it be discussed in RAN4? RAN1 thinks it can be discussed in RAN4, and RAN1 needs further RAN4’s reply. |
| [5][6] | Observation 1 Switching time before the first hop and after the last hop need to be included in the total duration of the SRS with Tx frequency hopping. |
| [7] | **Proposal 2-1**: Send LS back to RAN4 for the following messages,   * + The additional switch time between BWP and the first hop, and between last hop and the return to BWP may be needed if the partial overlapping is required. From RAN1 perspective, reuse the same value between hops   + RAN1 to further consider 210us switch time to accommodate different RedCap UE implementation cost concern. It is also seen in RRC that, 210us is supported for the parameter of uplinkTxSwitchingPeriod. Check with RAN4 for the feasibility   + A question to RAN4: whether the RF switch time needs to be extended if TX hopping duration and RX hopping duration have overlapping. Or TX hopping duration and RX hopping duration need to be separate? |
| [8] | **Observation: The Rel-17 feature of positioning SRS transmission outside the initial UL BWP has already defined the switching time in the UE capability signaling for RRC\_INACTIVE state.**  **Proposal 1: RAN1 suggests RAN4 further discuss the switching time between active/initial BWP and an SRS hop, taking into account the switching time for SRS transmission outside initial UL BWP in Rel-17 (R4-2210604).** |
| [9] | ***Proposal 6: From RAN1 perspective, the potential other UL signal transmission/DL reception might require additional time for UE to handle, especially with different SCS or TA;*** |

## Discussion

From the received contributions, and the received LS we should discuss the following:

* Should the design of SRS hopping account for switching time before the first hop, and after the last hop
* Can the switching time be supported by existing capability from rel17, and if so, is there anything left to do for RAN4?

We therefore formulate the following two question for discussion:

* **Question 1:** for UL SRS transmission with TX hopping for redcap UEs, Is there additional switch time for SRS transmission between the initial/active BWP to first hop and switch time between last hop to the initial/active BWP?
* **Question 2:** if the answer to Question 1 is yes, can this additional switching time be covered by the Rel-17 capability for switching time for SRS transmission outside the initial BWP?

Please provide your response to the questions above in the table below, along with any additional comment:

|  |  |
| --- | --- |
| **Company** | **Answer to Q1/Q2 and comments** |
| mtk | Q1: the switch time may be needed to reach partial overlapping between adjacent hops.  For the value, it seems to re-use the value provided by RAN4 in the reply LS maybe sufficient |
| Nokia/NSB | Q1: yes, but only in the case that the active/initial BWP is different than the first and/or last hop  Q2: We think this can be discussed between RAN4 and UE feature discussion. No need to discuss this now as part of the reply LS in our view. |
| Qualcomm | Q1: Yes  To Nokia: SRS will be defined outside a BWP, so yes it will always be different, atleast nominally. SRS config will have its own SCS, CP, BW of a hop. Maybe Nokia considers the case that it happens by configuration that the SCS of SRS, the CP, the BW of the hop is exactly the same as that of the BWP before/after that hop, and in that case, maybe a retune is not needed. Even though, technically, this may be the case, it appears to us as an optimization that may not be necessary to specify. We can be open to discuss it; however we need to be careful with regards to the conditions under which indeed such a retune is not needed.  Q2: We prefer to leave it up to RAN4 to decide the values, and try to guide RAN4 to make a decision. We suggest to provide the following additional information to RAN4 so that they can decide the most appropriate values:   * + **Numerology, bandwidth, Tx/Rx antennas between the initial/active BWP and the SRS hop(s) could be different** |
| ZTE | Q1: Yes. If the the initial BWP is the same as the first/last hop and has the same SCS/CP and bandwidth, then there is no need for the switching time.  Q2: It can be handled by RAN4. Probably the Rel-17 capability values can be reused, but it still need RAN4’s confirmation. |
| Huawei, HiSilicon | Q1: Yes.  Q2: Can provide them to RAN4 for their consideration. |
| Samsung | Q1: yes, but our thinking is that if the UE needs to do other UL Tx or DL reception, more time may be needed to switching back for SRS tx;  Q2: not sure reuse is enough or not, likely not enough, for example, if UE switches to do other UL tx in another BWP (in another CC) with different TA, the TA adjustment will take much time. |
| Futurewei | Q1: Yes  Q2: RAN4 can answer this question. |
| CATT | Q1: Yes, but there’s no need to support an enhanced switch time for SRS transmission between the initial/active BWP to first hop and switch time between last hop to the initial/active BWP relevant for RedCap frequency hopping in Rel-18.  Q2: We think it can be covered by the Rel-17 capability for switching time for SRS transmission outside the initial BWP, and prefer to provide such Rel-17 capability for switching time to RAN4 for their double-check. |
| Intel | Q1: Yes, if the SRS transmission in either the first or last hops extends beyond the boundaries of the initial or active UL BWP or different SCSs are used, then additional switching time would be necessary.  Q2: it would be more appropriate that RAN4 can handle this. |
| NTT DOCOMO | Q1: Yes  Q2: It may be up to RAN4, but we think it can be covered by the Rel-17 capability for switching time for SRS transmission outside the initial BWP. |
| Ericsson | Q1: Yes  Q2: we can leave it to RAN4, and based on their answer we can discuss any UE feature impact. |

## Summary of collected views

* Regarding Q1, all comments received indicate that yes, there is a need for additional switching time for both the time between the initial/active BWP and the first hop as well as the switching time between the end of the last hop and the return to initial/active BWP.
* Regarding Q2, the majority view is that RAN4 can handle by themselves the needed values for these additional switching times.

# Initial draft LS (v000\_FL)

**1. Overall Description:**

RAN1 would like to thank RAN4 for the question in the LS in R1-2304316. The question is copied below for convenience:

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| *LS from R1-2304316*  **11. Overall Description:**  RAN4 thanks RAN1 for LS R1-2302127. RAN4 has discussed the question in the LS and reached the following agreements:   * For RedCap UE UL SRS Tx frequency hopping, RAN4 considers the switching time of {70us, 140us} for FR1 as the starting point   + SRS Tx frequency hopping range can be up to 100MHz.   + Which specific value for frequency hopping is applied depends on UE capability, if multiple values are agreed. * For UL SRS Tx frequency hopping, RAN4 considers the switching time of {35us, 70us, 140us} for FR2 as the starting point * SRS Tx frequency hopping range can be up to 400MHz * Which specific value for frequency hopping is applied depends on UE capability, if multiple values are agreed * For RedCap UE DL PRS Rx frequency hopping, RAN4 considers the switching time of {70us, 140us} for FR1 as the starting point   + PRS Rx frequency hopping range can be up to 100MHz   + Which specific value for frequency hopping is applied depends on UE capability, if multiple values are agreed * For DL PRS Rx frequency hopping, RAN4 considers the switching time of {35us, 70us, 140us} for FR2 as the starting point * PRS Rx frequency hopping range can be up to 400MHz * Which specific value for frequency hopping is applied depends on UE capability, if multiple values are agreed   RAN4 will notify RAN1 of further relevant agreements if there are any updates in future meetings.  RAN4 also thinks additional switch time may be needed for SRS transmission between the initial/active BWP to the first hop and last hop to initial/active BWP, and therefore, has below question:   * Is the additional switch time for SRS transmission between the initial/active BWP to first hop and switch time between last hop to the initial/active BWP relevant for RedCap frequency hopping and should it be discussed in RAN4?   **2. Actions:**  **To RAN WG1 group.**  **ACTION:** RAN4 kindly requests that RAN1 consider the above information in its future work and provide answer for question above. |

Based on the discussion in RAN1#113, RAN1 reached the following conclusions:

**For the need of additional switching time**

* **I**t is RAN1’s view that for UL SRS for positioning Tx frequency hopping, switching time before the first hop and after the last hop need to be included in the total duration of the SRS with Tx frequency hopping.
  + RAN4 is kindly requested to evaluate the applicable switching time required ahead of the first hop and after the last hop.

**2. Actions:**

**To RAN4:**

**ACTION: RAN1 respectfully asks RAN4 to take the above answers into account, and provide applicable values for the additional switching time for UL SRS for positioning Tx hopping.**

# Comments on the Draft LS

Please enter any comment on the draft LS text in the table. If the comment also is related to a revised version of the draft LS, please add the version number applicable.

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| **Companies** | **Comments** |
| vivo | Based on our understanding, ‘the switching time between SRS Tx and other Tx in initial UL BWP or Rx in initial DL BWP’ in Rel-17 can be reused, and RAN1 can ask RAN4 to take the above answers into account. |
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# References

1. R1-2304447 Draft reply LS on switching time for DL PRS or UL SRS frequency hopping for RedCap UEs vivo
2. R1-2304698 Discussion on switching time for DL PRS or UL SRS frequency hopping for RedCap UEs CATT
3. R1-2304699 Draft reply LS on switching time for DL PRS or UL SRS frequency hopping for RedCap UEs CATT
4. R1-2304925 Draft Reply LS on switching time for DL PRS or UL SRS frequency hopping for RedCap UEs ZTE
5. R1-2305823 Discussion on LS reply on switching time for DL PRS or UL SRS frequency hopping for RedCap UEs Ericsson
6. R1-2305824 Draft LS reply on switching time for DL PRS or UL SRS frequency hopping for RedCap UEs Ericsson
7. R1-2305852 Discussion on the LS reply on switching time for DL PRS or UL SRS frequency hopping for RedCap UEs MediaTek (Chengdu) Inc.
8. R1-2305935 Discussion on switching time for RedCap UE positioning Huawei, HiSilicon
9. R1-2305524 On Positioning for RedCap UEs Samsung