**3GPP TSG RAN WG1 #116bis R1-240xxxx**

**Changsha, Hunan Province, China, April 15th – 19th, 2024**

**Source: Moderator (vivo)**

**Title:** **Summary#1 of discussion on SRS transmission occasion and power scaling**

**Agenda Item: 7**

**Document for:** **Discussion and Decision**

# Introduction

Number of contributions in RAN1#116bis discussed the issue of power splitting/scaling when multiple SRS resources are transmitted simultaneously. Based on the proposals in the contributions submitted, few questions with multiple options are put forward in section 2 for further discussion.

# Discussion

Power splitting/scaling for SRS with usage ‘nonCodebook’

* Option2:
  + equally split across all SRS ports in all the overlapping SRS resources in the same SRS resource set with usage ‘nonCodebook’ when they are fully overlapped in time.

Support: vivo, Samsung (all overlapped SRS resources shall be treated as a SRS transmission occasion), Ericsson

* Option4: restrict it to ‘nonCodebook’ and the case when UE transmit power exceeds ** as below
  + For simultaneous transmissions of SRS resources of a SRS resource set with higher layer parameter usage in SRS-ResourceSet set to ‘nonCodebook’, if the total UE transmit power for SRS transmission in a respective transmission occasion  would exceed , the UE should perform equal power scaling across the overlapping SRS resources.

Support: ZTE, New H3C, Google (also for BM SRS), OPPO, CATT (with clarification on SRS transmission occasion as per SRS resource), CMCC, Huawei

Observation1: Based on the tdocs, there is slight majority of companies supporting option 4. However, two contributions discussed its relation with definition of ‘transmission occasion’ when multiple SRS resources within a set with usage ‘nonCodebook’ are overlapped in time. Samsung proposed “all overlapped SRS resources shall be treated as a SRS transmission occasion” while CATT proposed “SRS transmission occasion is per SRS resource”. Definition of ‘transmission occasion’ will have influence on the discussion of the two options for power splitting/scaling.

Table1

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| Company | Comments |
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**Power splitting/scaling for SRS with usage ‘beamManagement’, when the total UE transmit power would not exceed**

Option1:

* For SRS resources in multiple SRS resource sets with usage of “beamManagement”, if multiple SRS resources across multiple SRS resource sets are fully overlapped in time domain, a SRS resource per each SRS resource set shall be treated as a SRS transmission occasion. Then, SRS transmit power can be determined per SRS resource from a SRS resource set, and SRS transmit power can be equally split across the configured number of SRS ports.

Support: Samsung

Option2: it is up to UE implementation

Table2

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| Company | Comments |
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**Power splitting/scaling for SRS with usage ‘beamManagement’, when the total UE transmit power would exceed**

Option1:

* When the total transmission power exceeds the maximum transmission power, for simultaneous transmission of SRS resources in different SRS resource sets for beam management, if the power scaling for the SRS is required, the UE performs equal power scaling for the overlapped SRS resources until the total transmission power is below or equal to the maximum transmission power

Support: Google

Option2:

* Up to UE implementation

Support: Samsung, CMCC

Table3

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| Company | Comments |
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**Multiple SRS resources overlapping in time**

Huawei has following proposal, please provide your views in table4 below.

* Multiple SRS resources with different usage are not expected to be overlapped in time.

Table4

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| Company | Comments |
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# conclusion

# Reference

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| [R1-2402067](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_116b/Docs/R1-2402067.zip) | Discussion on SRS power scaling | ZTE |
| Proposal 1: Regarding SRS power scaling in NCB, the following option can be considered as a starting point.   * Option4: restrict it to ‘nonCodebook’ and the case when UE transmit power exceeds  as below   + For simultaneous transmissions of SRS resources of a SRS resource set with higher layer parameter usage in SRS-ResourceSet set to ‘nonCodebook’, if the total UE transmit power for SRS transmission in a respective transmission occasion  would exceed , the UE should perform equal power scaling across the overlapping SRS resources. | | |
| [R1-2402171](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_116b/Docs/R1-2402171.zip) | Discussion on SRS transmission occasion and power scaling | New H3C Technologies Co., Ltd. |
| Proposal 1: For simultaneous transmissions of SRS resources of a SRS resource set with higher layer parameter usage in SRS-ResourceSet set to ‘nonCodebook’, if the total UE transmit power for SRS transmission in a respective transmission occasion  would exceed , the UE should perform equal power scaling across the overlapping SRS resources. | | |
| [R1-2402207](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_116b/Docs/R1-2402207.zip) | Discussion on SRS power scaling | vivo |
| Observation1：Transmission power of fully-overlapped SRS(s) in one SRS resource set is same even though it is calculated per SRS resource.   1. Support option 2. | | |
| [R1-2402208](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_116b/Docs/R1-2402208.zip) | Draft CR on SRS power scaling | vivo |
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| [R1-2402272](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_116b/Docs/R1-2402272.zip) | Draft CR on SRS power scaling | Google |
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| [R1-2402273](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_116b/Docs/R1-2402273.zip) | Discussion on SRS power scaling | Google |
| Proposal 1: Support a common solution for power scaling for simultaneous transmission of SRS for non-codebook and SRS for beam management.  Proposal 2: Do not support to modify the power split for SRS.  Proposal 3: Support to define the power scaling for SRS for non-codebook and SRS for beam management as follows:   * When the total transmission power exceeds the maximum transmission power, for simultaneous transmission of SRS resources in a SRS resource set for non-codebook or SRS resources in different SRS resource sets for beam management, if the power scaling for the SRS is required, the UE performs equal power scaling for the overlapped SRS resources until the total transmission power is below or equal to the maximum transmission power * Endorse CR R1-2402273 | | |
| [R1-2402298](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_116b/Docs/R1-2402298.zip) | Discussion on SRS transmission occasion and power scaling | OPPO |
| Proposal: The power scaling of simultaneously transmitted SRS resources for non-codebook when the total power exceeds max transmit power can be up to UE implementation.   * If further enhancement is needed, option 4 is preferred as a Rel-17/18 CR. | | |
| [R1-2402355](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_116b/Docs/R1-2402355.zip) | Discussion on SRS transmission occasion and power scaling | CATT |
| Observation 1: When multiple SRS resources belong to different SRS resource sets are overlapped in time, they cannot be considered as in the same SRS transmission occasion.  Observation 2: A clarification on SRS transmission occasion is needed for transmission power determination of SRS resources in an SRS resource set with usage set to ‘nonCodebook’.  Proposal 1: Clarifying in TS 38.213 that SRS transmission occasion is defined per SRS resource.  Proposal 2: For the power scaling of SRS resources in an SRS resource set with usage set to “nonCodebook”, Option 4 is adopted：   * Option4: restrict it to ‘nonCodebook’ and the case when UE transmit power exceeds  as below   + For simultaneous transmissions of SRS resources of a SRS resource set with higher layer parameter usage in SRS-ResourceSet set to ‘nonCodebook’, if the total UE transmit power for SRS transmission in a respective transmission occasion  would exceed , the UE should perform equal power scaling across the overlapping SRS resources. | | |
| [R1-2402416](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_116b/Docs/R1-2402416.zip) | Discussion on SRS transmission occasion | Samsung |
| Proposal 1. For SRS resources in a SRS resource set with usage of “nonCodebook”, if multiple SRS resources are fully overlapped in time domain, all overlapped SRS resources shall be treated as a SRS transmission occasion, and SRS transmit power can be equally split across the configured number of SRS ports, i.e., performing equal power allocation per SRS port (i.e., Modified Option 2 in [3]).  Proposal 2. For SRS resources in multiple SRS resource sets with usage of “beamManagement”, if multiple SRS resources across multiple SRS resource sets are fully overlapped in time domain, a SRS resource per each SRS resource set shall be treated as a SRS transmission occasion. Then, SRS transmit power can be determined per SRS resource from a SRS resource set, and SRS transmit power can be equally split across the configured number of SRS ports.  Proposal 3. For SRS resources in multiple SRS resource sets with usage of “beamManagement”, if multiple SRS resources across multiple SRS resource sets are fully overlapped in time domain and if the total UE transmit power would exceed , considering different power control parameters, it is better to leave UE implementation how to perform power scaling across the overlapping SRS resources. | | |
| [R1-2402548](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_116b/Docs/R1-2402548.zip) | Discussion on SRS power scaling | CMCC |
| Proposal 1: The calculated transmit power  in current TS 38.213 is defined per SRS resource.  Proposal 2: Support Option4: restrict it to ‘nonCodebook’ and the case when UE transmit power exceeds PCMAX as below:  For simultaneous transmissions of SRS resources of a SRS resource set with higher layer parameter usage in SRS-ResourceSet set to ‘nonCodebook’, if the total UE transmit power for SRS transmission in a respective transmission occasion i would exceed PCMAX, the UE should perform equal power scaling across the overlapping SRS resources.  Proposal 3: For SRS configured with usage “beamManagement”, if the total transmission power does not exceed PCMAX, the transmission power is defined per SRS resource, if the total transmission power exceeds PCMAX, transmission power split up to UE implementation. | | |
| [R1-2402549](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_116b/Docs/R1-2402549.zip) | Draft CR on SRS power scaling | CMCC |
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| [R1-2403097](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_116b/Docs/R1-2403097.zip) | SRS Tx occasion and power scaling | Ericsson |
| [Observation 1 Simultaneously transmitted SRS resources of a set should have equal power, although this is not stated in specifications. Options 2 and 4 both should assume this, although Option 4 only explicitly does so above Pcmax.](#_Toc163198981)  [Observation 2 It should be clarified if Option 4 has equal power SRS resources when the power is below Pcmax, or if this is left to UE implementation.](#_Toc163198982)  [Observation 3 In Option 4, when the power at Pcmax, the network can only know if the power per SRS resource is in a range of Pcmax/L to Pcmax for L SRS resources. Here Option 2 has a power per SRS resource of Pcmax/L.](#_Toc163198983)  [Observation 4 Option 4 makes it difficult to determine how changing the number of SRS resources will affect SRS power, limiting the ability of the network to adapt SRS to match channel conditions.](#_Toc163198984)  [Observation 5 Option 4 also makes it difficult to determine the power per PUSCH layer from SRS transmissions.](#_Toc163198985)  [Observation 6 Option 2 always splits power equally among SRS resources, similar to how power is split among PUSCH layers. This allows the network to adapt SRS to channel conditions and to determine power per PUSCH layer from SRS transmissions.](#_Toc163198986)  [Observation 7 While PUSCH and SRS may be in power limit at different times, this does not diminish the need to have a clear relationship of power among SRS resources and between SRS resources and PUSCH power.](#_Toc163198987)  [Observation 8 Changing the power split text in 38.213 section 7.3 from being over ‘the configured antenna ports for SRS’ to being over ‘all SRS ports of all SRS resources of an SRS resource set in a symbol for SRS transmission’ works for all SRS resource usages.](#_Toc163198988)  [Proposal 1 Correct 38.213 by changing the power split text in section 7.3 from being over ‘the configured antenna ports for SRS’ to being over ‘all SRS ports of all SRS resources of an SRS resource set in a symbol for SRS transmission’.](#_Toc163198989) | | |
| [R1-2403363](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_116b/Docs/R1-2403363.zip) | Discussion on SRS transmission occasion and power scaling | Huawei, HiSilicon |
| Proposal 1: Multiple SRS resources with different usage are not expected to be overlapped in time.  Observation 1: If the transmission power does not exceed the maximum transmission power, it is not necessary to explicitly specify the equal split between all SRS ports of all SRS resources.  Proposal 2: For simultaneous transmissions of SRS resources of a SRS resource set with higher layer parameter usage in SRS-ResourceSet set to ‘nonCodebook’, if the total UE transmit power for SRS transmission in a respective transmission occasion i would exceed  , the UE should perform equal power scaling across the overlapping SRS resources, or leave the power scaling to UE implementation. | | |
| [R1-2403384](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_116b/Docs/R1-2403384.zip) | Correction on Multi-Resource SRS Port Power Scaling | Ericsson |
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