

3GPP TSG RAN WG1 Meeting#96

Athens, Greece, 25th February – 1st March, 2019

Agenda item – 7.1.5

R1-1902825

Discussion on Rel-15 SRS Power Scaling

Ericsson

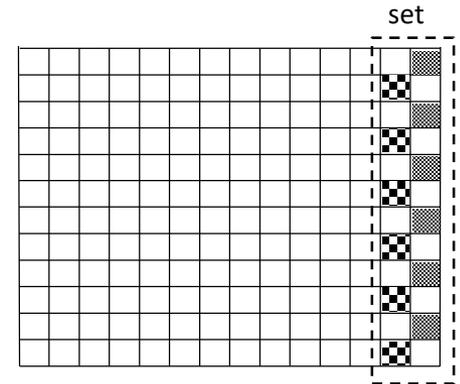
Background

- The SRS power scaling is currently specified in 38.213 section 7.3 as:
 - “For SRS, a UE splits a linear value $\hat{P}_{SRS,b,c}(i, q_s, l)$ of the transmit power $P_{SRS,b,c}(i, q_s, l)$ on active UL BWP b of carrier f of serving cell c equally across the configured antenna ports for SRS”
- The formulation “configured antenna ports for SRS” is ambiguous. It could for instance be interpreted as
 - a) Number of SRS ports in SRS resource set q_s
 - b) Number of SRS ports in the corresponding SRS resource
 - c) Number of SRS ports transmitted in a given OFDM symbol
 - d) Number of SRS ports transmitted in time interval i

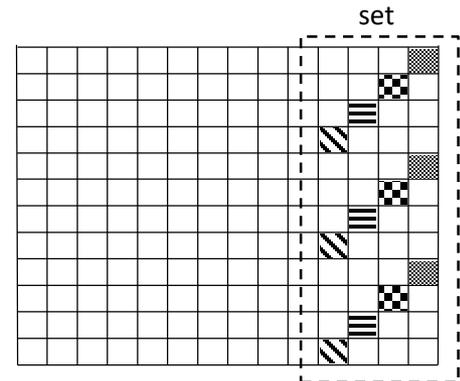
UE SRS power scaling behavior is unclear!

Consequence

- Potential SRS configurations for codebook and beam management are illustrated on the right. Each SRS resource is identified using one texture.
 - It is assumed that for the codebook case each resource contains 4 SRS ports.
 - For the beam management case each resource will contain 1 SRS port.
- The resulting power per SRS port is shown below given interpretations a)-d) of “configured antenna ports for SRS” from the previous slide.
 - It is assumed that $P = \hat{P}_{SRS,b,f,c}(i, q_s, l)$.



SRS for codebook



SRS for beam management

Interpretation	Power per SRS port (codebook)	Power per SRS port (beam management)
a) SRS ports in SRS resource set	P/8	P/4
b) SRS ports in the SRS resource	P/4	P
c) SRS ports in OFDM symbol	P/4	P
d) SRS ports in Tx occasion i	P/8	P/4

The UE behavior needs to be clarified!

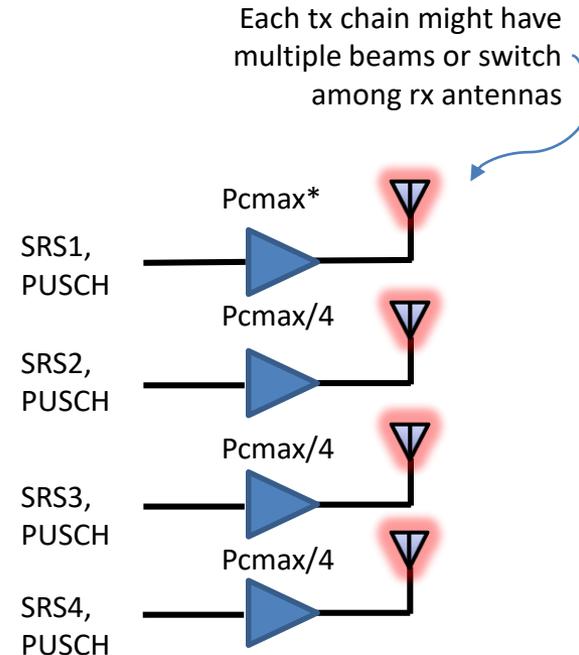
Note: Detailed explanation can be found in R1-1811499

Background

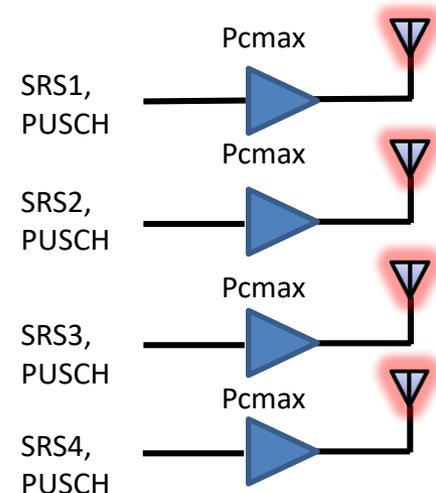
- Rel-15 UEs can transmit PUSCH at P_{cmx} over 1 antenna port, i.e. when
 - configured with 1 antenna port and scheduled with DCI format 0_1, or
 - scheduled with DCI format 0_0
- For Rel-15 codebook based operation:
 - PUSCH power scaling divides PUSCH power by the number of UE Tx chains (N_{tx})
 - As identified by the max # of SRS ports in an SRS resource supported by the UE
 - Precoders with zeroes always deliver less than P_{cmx}
- For Rel-15 non-codebook based operation:
 - PUSCH power scaling splits power equally among layers
 - P_{cmx} can be transmitted for any rank
- Beam management and SRS switching should scale power similarly to codebook based PUSCH
 - Both can transmit multiple SRS ports in an SRS resource
 - Both can switch power among Tx chains (either among beams or among Rx antennas)
- ***SRS SINR should reflect PUSCH SINR, and so should be scaled with the same assumptions as PUSCH***

Note: Detailed explanation can be found in R1-1811499

*Virtualization may be used instead of a full power PA to reach P_{cmx} for 1 port operation



Codebook Based



Non-Codebook Based

Proposal Overview

- Antenna ports within an SRS resource set transmit at the same power and at most
 - P_{cm} for non-codebook based transmission
 - Scale by $1/\beta(i, q_s)$, where
 - $\beta(i, q_s)$ = the maximum number of antenna ports transmitted in one of the OFDM symbols corresponding to SRS resource set q_s in transmission occasion i
 - P_{cm}/N_{tx} for codebook based transmission, beam management, and antenna switching
 - Scale by $1/\beta(i, q_s)$, where
 - $\beta(i, q_s)=1$ for when there is a 1 SRS port SRS resource in the set
 - $\beta(i, q_s)=N_{tx}$ for more than 1 SRS port in a resource in the set
- Transmissions on multiple SRS resource sets in a transmission occasion i are scaled down when they exceed P_{cm}
 - Scale by $\alpha(i) = \min\left\{\frac{P_{cm, f, c}(i)}{P_{tot}(n, i)}, 1\right\}$, where
 - $P_{tot}(n, i)$ is the power in OFDM symbol n in transmission occasion i from all sets in the symbol

Text Proposal for 38.213, Section 7.3 (without change marks)

For SRS, the antenna ports of SRS resource set q_s in transmission period i on active UL BWP b of carrier f of serving cell c are transmitted with the power $\alpha(i)/\beta(i, q_s)\hat{P}_{SRS,b,c}(i, q_s, l)$ per antenna port, where

- $\hat{P}_{SRS,b,c}(i, q_s, l)$ is the linear value of the transmit power $P_{SRS,b,c}(i, q_s, l)$
- For SRS resource set q_s with usage set to 'nonCodebook', $\beta(i, q_s)$ is the maximum number of antenna ports transmitted in one of the OFDM symbols corresponding to SRS resource set q_s in transmission occasion i
- For SRS resource set q_s with usage set to 'codebook', 'beamManagement', or 'antennaSwitching',
 - When the number of SRS ports in any SRS resource of the set is 1, $\beta(i, q_s) = 1$
 - Otherwise, $\beta(i, q_s) = N_{srs_max}$, where N_{srs_max} is the maximum number of SRS ports supported by the UE in one SRS resource.
- $\alpha(i) = \min_n \left\{ \frac{P_{cmax,f,c}(i)}{P_{tot}(n,i)}, 1 \right\}$ where n denotes the OFDM symbol index in transmission period i and
 - $P_{tot}(n, i) = \sum_{q_s} d(q_s, n, i)\hat{P}_{SRS,b,c}(i, q_s, l)$ with
 - $d(q_s, n, i) = 1$ if a transmission corresponding to SRS resource set q_s is transmitted in symbol n in transmission occasion i , and
 - $d(q_s, n, i) = 0$ if no transmission corresponding to SRS resource set q_s is transmitted in symbol n in transmission occasion i .