**3GPP TSG RAN WG1 #110 R1-2206783**

**Toulouse, France, August 22nd – 26th, 2022**

**Agenda item:** 9.1.2

**Source:** Moderator (Samsung)

**Title:** Moderator Summary of Tuesday Offline Session on Rel-18 CSI enhancements

**Document for:** Discussion and Decision

## Introduction

This contribution includes the summary for the Tuesday offline session.

## Discussion

### Issue 1: Type-II codebook refinement for CJT

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| **Proposal 1.G**: On the Type-II codebook refinement for CJT mTRP, down-select from the following TRP selection/determination schemes (where N is the number of cooperating TRPs assumed in PMI reporting):* Alt1. N is gNB-configured via higher-layer (RRC) signalling
	+ The N configured TRPs are gNB-configured via higher-layer (RRC) signalling
	+ Note: only one transmission hypothesis is reported
* Alt2. N is UE-selected and reported as a part of CSI report where N$\in ${1,..., NTRP}
	+ N is the number of cooperating TRPs, while NTRP is the maximum number of cooperating TRPs configured by gNB
	+ In this case, the selection of N out of NTRP TRPs is also reported (FFS: exact reporting scheme)
	+ FFS: Configuration of NTRP TRPs and the value of NTRP, whether explicit or implicit
	+ Note: only one transmission hypothesis is reported
	+ ~~FFS: In addition to one transmission hypothesis, whether reporting multiple transmission hypotheses (with the same N value or possibly different N values) is supported~~
* Alt3. The UE reports CSI corresponding to K transmission hypotheses
	+ The N configured TRPs per hypothesis are gNB-configured via higher-layer (RRC) signalling
	+ FFS: supported value(s) of K, and whether the K transmission hypotheses are gNB-configured or UE-reported
	+ FFS: Whether the same N value or possibly different N values
* Alt4. The UE reports CSI corresponding to K transmission hypotheses where N is UE-selected and reported as a part of CSI report where N$\in ${1,..., NTRP}
	+ N is the number of cooperating TRPs per hypothesis, while NTRP is the maximum number of cooperating TRPs configured by gNB
	+ In this case, the selection of N out of NTRP TRPs is also reported (FFS: exact reporting scheme)
	+ FFS: Configuration of NTRP TRPs and the value of NTRP, whether explicit or implicit
	+ FFS: Whether the same N value or possibly different N values

FFS: Whether S-TRP transmission hypothesis is also reported **Alt1:** Samsung, Huawei/HiSi, Xiaomi, CMCC, AT&T, Nokia/NSB, DOCOMO, Google, Fraunhofer IIS/HHI**Alt2:** ZTE, Spreadtrum, vivo (one hypothesis), NEC, Xiaomi, CEWiT, Ericsson (one hypothesis), Sony, MediaTek, LG, CATT, Qualcomm, Apple, Intel, OPPO**Alt3:** IDC, Lenovo, Xiaomi* Concern (overhead, UE complexity): Nokia/NSB, Samsung, MediaTek, AT&T, vivo, DOCOMO, Spreadtrum, Intel, CEWiT, Huawei/HiSi, Ericsson

**Alt4**: Sony, ZTE, CATT* Concern (overhead, UE complexity): Nokia/NSB, Samsung, MediaTek, AT&T, vivo, DOCOMO, Spreadtrum, Intel, CEWiT, Huawei/HiSi, Ericsson
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| **Proposal 1.I**: On the Type-II codebook refinement for CJT mTRP, regarding W2 quantization group and Strongest Coefficient Indicator (SCI) design, for each layer, down-select from the following alternatives:* Alt1. One group comprises one polarization across all TRPs/TRP-groups (*C*group,phase=1, *C*group,amp=2), one (common) SCI across all TRPs/TRP groups
	+ Without the strongest TRP/TRP-group indicator
* Alt2. One group comprises one polarization for one TRP/TRP-group (*C*group,phase=N, *C*group,amp=2N), per-TRP/TRP-group SCI
	+ With the strongest TRP/TRP-group indicator
	+ FFS: Quantization of N strongest coefficients
* Alt3. One group comprises one polarization for one TRP/TRP-group with a common phase reference across TRPs/TRP-groups (*C*group,phase=1, *C*group,amp=2N), per-TRP/TRP-group SCI
	+ With the strongest TRP/TRP-group indicator
	+ FFS: Quantization of N strongest coefficients
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### Issue 2: Type-II codebook refinement for high/medium UE velocities (with time/Doppler-domain compression)

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| * On the definition of UE-side prediction, down-select from the following alternatives:
	+ Alt1. UE “predicting” channel/CSI after the slot with a reference resource
	+ Alt2. UE “predicting” channel/CSI after slot n (where the CSI is reported)
	+ Alt3. UE “predicting” channel/CSI after the slot where CSI-RS resides

**Alt1:** Qualcomm, Samsung, LG, ZTE, Fraunhofer IIS/HHI, DOCOMO**Alt2:** Huawei/HiSi, vivo, Nokia/NSB (2nd pref), Lenovo, Google, Intel**,** MediaTek, Ericsson, Spreadtrum, CATT, CMCC, Apple**Alt3:** Samsung, DOCOMO, NEC, Nokia/NSB (1st pref) |

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| **Proposal 2.F**: On the CSI reporting and measurement for the Rel-18 Type-II codebook refinement for high/medium velocities, when UE-side prediction is assumed, down-select ~~at least~~ one from the following alternatives:* ~~Alt1.A:~~ *~~l~~* ~~+~~ *~~W~~*~~CSI~~ ~~–1 ≤~~ *~~n~~*~~ref~~
	+ *~~n~~*~~ref~~ ~~(CSI reference resource slot) as boundary~~
* Alt1.B:  *l* ≥ *n*ref
	+ *n*ref (CSI reference resource slot) as boundary
* Alt2.B: *l* ≥ *n*
	+ *n* (report slot) as boundary
* Alt3.B: *l* ≥ *k* + *W*meas –1
	+ End slot of *W*meas (*k* + *W*meas –1) as boundary, assuming CSI-RS measurement window of [*k*,*k*+*W*meas –1]

Alt1.B:Alt2.B:Alt3.B:[Alt3.C: *l* < *k* + *W*meas –1 and *l* + *W*CSI –1 > *k* + *W*meas –1 with the following as special cases:* + *l=k,* *l* + *W*CSI = *n*
	+ *l=k,* *l* + *W*CSI > *n*]

Support: Samsung, Qualcomm, Fraunhofer IIS/HHIConcern: vivo, MediaTek, Xiaomi, Spreadtrum  |

### Issue 3: TRS-based reporting of time-domain channel properties (TDCP)

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| **Proposal 3.B**: For the Rel-18 TRS-based TDCP reporting, down select one of the following alternatives by RAN1#110bis-e:* AltA. Based on Doppler profile
	+ E.g., Doppler spread derived from the 2nd moment of Doppler power spectrum, average Doppler shifts, Doppler shift per resource, maximum Doppler shift, relative Doppler shift, etc.
* AltB. Based on time-domain correlation profile
	+ E.g. correlation within one TRS resource, correlation across multiple TRS resources
	+ Note: the correlation over one or more lags of TRS resource may be considered. The lags may be within one TRS burst or different TRS bursts
* AltC: CSI-RS resource and/or CSI reporting setting configuration parameter(s) to assist network
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