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| **Conclusion 1.G**: On the Type-II codebook refinement for CJT mTRP, the lists of UCI parameters (along with the description of each parameter) are given in Table 1C, 1D, and 1E.* Note: The manner in which the UCI parameters are captured is up to the spec editors

***Table 1C: UCI parameter list for Rel-16 based***

|  |  |  |  |
| --- | --- | --- | --- |
| **Parameter** | **UCI** | **Details/description** | **Status** |
| # NZ coefficients | Part 1 | RI (∈{1,…, RIMAX}) and *KNZ,TOT* (the total number of non-zero coefficients summed across all the layers and all N CSI-RS resources, where *KNZ,TOT* ∈{1,2,…, 2*K*0} are reported in UCI part 1  | Complete |
| Wideband CQI | Part 1 | Same as R15 | Complete |
| Subband CQI | Part 1 | Same as R15 | Complete |
| CSI-RS resource selection bitmap | Part 1 | *Only reported when NTRP >1:* *NTRP*-bit bitmap to indicate the UE recommendation of *N* CSI-RS resources* Non-existent if the value of *N* is RRC-configured to NTRP
 | Complete |
| Indication of number of SD basis vectors {*L*1, …, *LNTRP*} | Part 1 | UE recommendation selecting one of the *NL* RRC-configured value combinations ($\left⌈log\_{2}(N\_{L})\right⌉$-bit indicator)* Non-existent if *NL*=1
 | Complete |
| N Bitmap(s) per layer | Part 2 | For RI=1-4: for layer *l* and CSI-RS resource *n*, size-$2L\_{n}M\_{v}$ where *n* denotes the *n*-th CSI-RS resource  | Complete |
| Strongest coefficient indicator (SCI) | Part 2 | RI=1: A $\left⌈log\_{2}K\_{NZ}\right⌉$-bit indicator for the strongest coefficient index $\left(l^{\*},m^{\*},n^{\*}\right)$RI>1: See Table 1E below | Complete |
| SD basis subset selection indicator for each of the *N* CSI-RS resources | Part 2 | SD basis subset selection indicator is a $\left⌈log\_{2}\left(\begin{matrix}N\_{1}N\_{2}\\L\_{n}\end{matrix}\right)\right⌉$-bit indicator for n=0,1,…,*N–*1. Details follow Rel.15 | Complete |
| FD basis subset selection indicator | Part 2 | Mode-1: See Table “SCI and FD basis subset selection indicator“ below + (*N –* 1) FD basis selection window offset values $φ\_{n}\in \left\{0,1,2,…,N\_{3}-1\right\}$ (basic) or $φ\_{n}\in \left\{0,\frac{1}{4},\frac{1}{2}…,N\_{3}-\frac{1}{4}\right\} $(optional), *n*=1,2,…,*N*–1Mode-2: See Table 1E “SCI and FD basis subset selection indicator“ below | Mode-1 completeMode-2 complete |
| LC coefficients: phase | Part 2 | Quantized independently across layers  | Complete |
| LC coefficients: amplitude | Part 2 | Alt1 (agreed): Quantized independently across layers (including a reference amplitude for weaker polarization, for each layer)Alt3 (WA): Quantized independently across layers (including 2N-1 reference amplitudes for 2N-1 (polarization, CSI-RS resource) pairs excluding the pair of (polarization, CSI-RS resource) associated with the SCI, for each layer) | WA on Alt3 support needs to be confirmed or reverted  |
| SD oversampling (rotation) factor q1, q2  | Part 2 | Values of q1,n, q2,n follow Rel.15, reported per CSI RS resource  | Complete |

***Table 1D: UCI parameter list for Rel-17 based***

|  |  |  |  |
| --- | --- | --- | --- |
| **Parameter** | **UCI** | **Details/description** | **Status** |
| # NZ coefficients | Part 1 | RI (∈{1,…, RIMAX}) and *KNZ,TOT* (the total number of non-zero coefficients summed across all the layers and all N CSI-RS resources, where *KNZ,TOT* ∈{1,2,…, 2*K*0} are reported in UCI part 1  | Complete |
| Wideband CQI | Part 1 | Same as R15 | Complete |
| Subband CQI | Part 1 | Same as R15 | Complete |
| CSI-RS resource selection bitmap | Part 1 | *NTRP*-bit bitmap to indicate the UE recommendation of *N* CSI-RS resources* Non-existent if the value of *N* is RRC-configured to NTRP
 | Complete |
| Indication of number of selected ports {*L*1, …, *LNTRP*}, where *Ln*=*n PCSI-RS /2* | Part 1 | UE recommendation selecting one of the *NL* RRC-configured value combinations ($\left⌈log\_{2}(N\_{L})\right⌉$-bit indicator)* Non-existent if *NL*=1
 | Complete |
| N Bitmap(s) per layer | Part 2 | For layer *l* and CSI-RS resource *n*, size-$2L\_{n}M$, or ($K\_{1,n}M$ where $L\_{n}=K\_{1,n}/2$) | Complete |
| Strongest coefficient indicator (SCI) | Part 2 | For layer *l*: A $\left⌈log\_{2}2M\sum\_{n=0}^{N-1}L\_{n}\right⌉$-bit indicator for the strongest coefficient index | Complete |
| Port selection indicator for each of the *N* CSI-RS resources | Part 2 | Port selection indicator is a $\left⌈log\_{2}\left(\begin{matrix}P\_{CSI-RS}/2\\L\_{n}\end{matrix}\right)\right⌉$-bit indicator for n=0,1,…,*N–*1, where *Ln*=*n PCSI-RS /2*. Details follow Rel.15 | Complete |
| FD basis subset selection indicator | Part 2 | Mode-1: See Mode-2+ (*N –* 1) FD basis selection window offset values $φ\_{n}\in \left\{0,1,2,…,N\_{3}-1\right\}$ (basic) or $φ\_{n}\in \left\{0,\frac{1}{4},\frac{1}{2}…,N\_{3}-\frac{1}{4}\right\} $(optional), *n*=1,2,…,*N*–1Mode-2: a $\left⌈log\_{2}(N-1)\right⌉$ bit indicator only if *N>M=2,* where $N\in \{2,4\}$ is configured with the higher-layer parameter *valueOfN,* when $M=2$. | Mode-1 completeMode-2 complete |
| LC coefficients: phase | Part 2 | Quantized independently across layers  | Complete |
| LC coefficients: amplitude | Part 2 | Alt1 (agreed): Quantized independently across layers (including a reference amplitude for weaker polarization, for each layer)Alt3 (WA): Quantized independently across layers (including 2*N*-1 reference amplitudes for 2*N*-1 (polarization, CSI-RS resource) pairs excluding the pair of (polarization, CSI-RS resource) associated with the SCI, for each layer) | WA on Alt3 support needs to be confirmed or reverted  |

***Table 1E: SCI and FD basis subset selection indicator for Rel-16-based Type-II CJT***

|  |
| --- |
| **SCI and FD basis subset selection indicator** |
| SCI for RI>1 | Per-layer SCI defined across N CSI-RS resources, where $SCI\_{i}$ is a $\left⌈log\_{2}2\sum\_{n=0}^{N-1}L\_{n}\right⌉$–bit ($i=0,1,…,(RI-1)$) indicator. The location (index) of the strongest LC coefficient for layer $i$ before index remapping is  $(l\_{i}^{\*},m\_{i}^{\*},n\_{i}^{\*})$, $SCI\_{i}indicates (l\_{i}^{\*},n\_{i}^{\*})$, and $m\_{i}^{\*}$ is not reported |
| Index remapping | For layer $i$, the index $m\_{i}$ of each nonzero LC coefficient $c\_{l\_{i},m\_{i}}$ is remapped with respect to $m\_{i}^{\*}$ to $\tilde{m}\_{i}$ such that $\tilde{m}\_{i}^{\*}=0$. The FD basis index $k\_{m\_{i}}$ associated to each nonzero LC coefficient $c\_{l\_{i},m\_{i}}$ is remapped with respect to $k\_{m\_{i}^{\*}}$ to $\tilde{k}\_{m\_{i}}$ such that $\tilde{k}\_{m\_{i}^{\*}}=0$. The sets $\left\{c\_{l\_{i},\tilde{m}\_{i}}\ne c\_{l\_{i}^{\*},0}\right\}$ and $\left\{\tilde{k}\_{m\_{i}}\ne 0\right\}$are reported.Informative note (for the purpose of reference procedure):The index $\left(l\_{i},m\_{i}\right)$ of nonzero LC coefficients is remapped as $(l\_{i},m\_{i})\rightarrow (l\_{i},\left(m\_{i}-m\_{i}^{\*}\right)modM\_{i})$. The codebook index associated with nonzero LC coefficient index $\left(l\_{i},m\_{i}\right)$ is remapped as $k\_{m\_{i}}\rightarrow \left(k\_{m\_{i}}-k\_{m\_{i}^{\*}}\right)modN\_{3}$.  |
| Combinatorial indicator for $N\_{3}\leq 19$ | $\left⌈log\_{2}\left(\begin{matrix}N\_{3}-1\\M\_{v}-1\end{matrix}\right)\right⌉$ bits  |
| Combinatorial indicator for $N\_{3}>19$ | $\left⌈log\_{2}\left(\begin{matrix}2M\_{v}-1\\M\_{v}-1\end{matrix}\right)\right⌉$ bits  |
| $$M\_{initial}$$ | Reported in UCI part 2, $M\_{initial}\in \left\{-2M\_{v}+1,-2M\_{v}+2,\cdots 0\right\}$, $\left⌈log\_{2}2M\_{v}\right⌉$ bits |

(\*) The red highlight parts are the new components in Rel-18 |
| **Conclusion 2.F.4**: For the Type-II codebook refinement for high/medium velocities, regarding SCI definition, there is no consensus on supporting the index remapping scheme analogous to that for FD basis for DD basis. Therefore, $SCI\_{i}$ is a $\left⌈log\_{2}2LQ\right⌉$–bit indicator where $i=0,1,…,(RI-1)$ and Q is the number of DD basis vectors (1 or 2)**FL Note**: The conclusion is based on the fact/reality that there is no consensus hence the implication follows whether one can accept (cope with) reality (that no consensus means no support) or not.**Support (ok with) DD basis index remapping:** Nokia/NSB,Intel, Huawei/HiSi, Xiaomi, Qualcomm, CMCC, OPPO, NEC, CATT, Fujitsu**Not support (concern on) DD basis index remapping:** Samsung, ZTE, vivo, Fraunhofer IIS/HHI |
| **Conclusion 2.F.5**: For the Type-II codebook refinement for high/medium velocities, there is no consensus on supporting the following additional features when the value of N4 is 1 (or configured to 1):* X=2 TD CQIs
* Additional constraint on the value of d: only d=1 is allowed

**FL Note**: The conclusion is based on the fact/reality that there is no consensus hence the implication follows whether one can accept (cope with) reality (that no consensus means no support) or not.The two questions inquire of some additional spec supports (agreements) beyond what we currently have.**X=2 for N4=1:*** **Yes:** Samsung (no scheme mentioned)
* **No:** Lenovo/MotM, Ericsson, Nokia/NSB, Intel, MediaTek, ZTE, Huawei/HiSi, vivo, Xiaomi, Fujitsu, [Fraunhofer IIS/HHI, CMCC]

**d=1 only for N4=1?*** **Yes:** Samsung
* **No:** Lenovo/MotM, Nokia/NSB, Intel, MediaTek, Huawei/HiSi, vivo, Xiaomi, Fujitsu, [Fraunhofer IIS/HHI, CMCC]
 |
| **Conclusion 2.G**: On the Type-II codebook refinement for high/medium velocities, the lists of UCI parameters (along with the description of each parameter) are given in Table 3C, 3D, and 3E.* Note: The manner in which the UCI parameters are captured is up to the spec editors

***Table 3C: UCI parameter list for Rel-16 based***

|  |  |  |  |
| --- | --- | --- | --- |
| **Parameter** | **UCI** | **Details/description** | **Status** |
| # NZ coefficients | Part 1 | RI (∈{1,…, RIMAX}) and *KNZ,TOT* (the total number of non-zero coefficients summed across all the Q selected DD basis and across all the layers, are reported in UCI part 1  | Complete  |
| Wideband CQI | Part 1 | Same as R15 | Complete |
| Subband CQI | Part 1 | Same as R15  | Complete  |
| Wideband CQI for the second TD CQI | Part 2 | Only applicable for X=2 (same format as CQIs for 2CW when RI>4 in R15)  | Complete |
| Subband CQI for the second TD CQI | Part 2 | Only applicable for X=2 (same format as CQIs for 2CW when RI>4 in R15)  | Complete |
| Q Bitmap(s) per layer | Part 2 | Q bitmaps where each bitmap has the same format/design as R16 eType-II | Complete  |
| Strongest coefficient indicator (SCI) | Part 2 | RI=1: A $\left⌈log\_{2}K\_{NZ}\right⌉$-bit indicator for the strongest coefficient index $\left(l^{\*},m^{\*},d^{\*}\right)$RI>1: See Table 3E below | Complete  |
| SD basis subset selection indicator  | Part 2 | SD basis subset selection indicator is a $\left⌈log\_{2}\left(\begin{matrix}N\_{1}N\_{2}\\L\end{matrix}\right)\right⌉$-bit indicator. Details follow Rel.15 | Complete |
| FD basis subset selection indicator | Part 2 | Details follow Rel.16 (Table 3E above) | Complete |
| DD basis subset selection indicator (per layer) | Part 2 | Reported only when N4>2 and Q=2: the selection of Q out of N4 DD basis vectors is indicated by a $\left⌈log\_{2}\left(N\_{4}-1\right)\right⌉$-bit indicator | Complete |
| LC coefficients: phase | Part 2 | Quantized independently across layers | Complete  |
| LC coefficients: amplitude | Part 2 | Quantized independently across layers (including a reference amplitude for weaker polarization, for each layer) | Complete |
| SD oversampling (rotation) factor q1, q2 | Part 2 | Values of q1, q2 follow Rel.15 | Complete |

***Table 3D: UCI parameter list for Rel-17 based***

|  |  |  |  |
| --- | --- | --- | --- |
| **Parameter** | **UCI** | **Details/description** | **Status** |
| # NZ coefficients | Part 1 | RI (Î{1,…, RIMAX}) and *KNZ,TOT* (the total number of non-zero coefficients summed across all the layers, are reported in UCI part 1  | Complete |
| Wideband CQI | Part 1 | Same as R15 | Complete |
| Subband CQI | Part 1 | Same as R15 (only X=1 TD CQI is supported) | Complete  |
| Bitmap per layer | Part 2 | Same as R17 eType-II | Complete |
| Strongest coefficient indicator (SCI) | Part 2 | For layer *l*: A $\left⌈log\_{2}2ML\right⌉$-bit indicator for the strongest coefficient index | Complete |
| Port selection indicator  | Part 2 | Port selection indicator is a $\left⌈log\_{2}\left(\begin{matrix}P\_{CSI-RS}/2\\L\end{matrix}\right)\right⌉$-bit indicator. Where $L=\frac{αP\_{CSI-RS}}{2}$, Details follow Rel.17 | Complete |
| FD basis subset selection indicator | Part 2 | a $\left⌈log\_{2}(N-1)\right⌉$ bit indicator only if *N>M=2,* where $N\in \{2,4\}$ is configured with the higher-layer parameter *valueOfN,* when $M=2$. | Complete |
| LC coefficients: phase | Part 2 | Quantized independently across layers | Complete  |
| LC coefficients: amplitude | Part 2 | Quantized independently across layers (including a reference amplitude for weaker polarization, for each layer) | Complete |

***Table 3E: SCI and FD basis subset selection indicator for Rel-16-based Type-II Doppler***

|  |
| --- |
| **SCI and FD basis subset selection indicator** |
| SCI for RI>1 | Per-layer SCI defined across Q DD basis vectors, where $SCI\_{i}$ is a $\left⌈log\_{2}2LQ\right⌉$–bit ($i=0,1,…,(RI-1)$) indicator. The location (index) of the strongest LC coefficient for layer $i$ before index remapping is  $(l\_{i}^{\*},m\_{i}^{\*},d\_{i}^{\*})$, $SCI\_{i}$ indicates $(l\_{i}^{\*},d\_{i}^{\*})$ and $m\_{i}^{\*}$ is not reported |
| Index remapping | For layer $i$, the index $m\_{i}$ of each nonzero LC coefficient $c\_{l\_{i},m\_{i}}$ is remapped with respect to $m\_{i}^{\*}$ to $\tilde{m}\_{i}$ such that $\tilde{m}\_{i}^{\*}=0$. The FD basis index $k\_{m\_{i}}$ associated to each nonzero LC coefficient $c\_{l\_{i},m\_{i}}$ is remapped with respect to $k\_{m\_{i}^{\*}}$ to $\tilde{k}\_{m\_{i}}$ such that $\tilde{k}\_{m\_{i}^{\*}}=0$. The sets $\left\{c\_{l\_{i},\tilde{m}\_{i}}\ne c\_{l\_{i}^{\*},0}\right\}$ and $\left\{\tilde{k}\_{m\_{i}}\ne 0\right\}$are reported.Informative note (for the purpose of reference procedure):The index $\left(l\_{i},m\_{i}\right)$ of nonzero LC coefficients is remapped as $(l\_{i},m\_{i})\rightarrow (l\_{i},\left(m\_{i}-m\_{i}^{\*}\right)modM\_{i})$. The codebook index associated with nonzero LC coefficient index $\left(l\_{i},m\_{i}\right)$ is remapped as $k\_{m\_{i}}\rightarrow \left(k\_{m\_{i}}-k\_{m\_{i}^{\*}}\right)modN\_{3}$.  |
| Combinatorial indicator for $N\_{3}\leq 19$ | $\left⌈log\_{2}\left(\begin{matrix}N\_{3}-1\\M\_{v}-1\end{matrix}\right)\right⌉$ bits  |
| Combinatorial indicator for $N\_{3}>19$ | $\left⌈log\_{2}\left(\begin{matrix}2M\_{v}-1\\M\_{v}-1\end{matrix}\right)\right⌉$ bits  |
| $$M\_{initial}$$ | Reported in UCI part 2, , $M\_{initial}\in \left\{-2M\_{v}+1,-2M\_{v}+2,\cdots 0\right\}$, $\left⌈log\_{2}2M\_{v}\right⌉$ bits |

(\*) The red highlighted parts are the new components in Rel-18 |
| **Proposal 3.A.3**: For the Rel-18 TRS-based TDCP reporting, for TDCP measurement and calculation, at least the following restrictions are supported:* When all the configured KTRS resource sets are periodic, the UE can assume that all the resource sets share a same QCL-Type-A/C and, if applicable, Type-D source
* If the joint use of P and AP-TRS resource sets is supported for TDCP measurement and calculation, when one of the KTRS configured resource sets is aperiodic, the UE can assume that the aperiodic resource set is configured with QCL-Type-A and, if applicable, Type-D source with the resources of the one of the (KTRS – 1) periodic TRS resource sets
	+ Note: Following the legacy specification, no more than 1 of the KTRS resource sets is aperiodic
	+ TBD (RAN1#113): whether the joint use of P and AP-TRS resource sets is supported for TDCP measurement and calculation or not
* FFS: whether the UE shall assume the same antenna port for the CSI-RS resources in all the resource sets

**FL Note: Proposal 2.A.3:*** **Support/fine:** Samsung, Qualcomm, vivo, [ZTE], OPPO, Fujitsu, Ericsson, Nokia/NSB, CMCC, NEC (ok), [MediaTek]
* **Not support:**
 |
| **Proposal 3.B.3**: For the Rel-18 TRS-based TDCP reporting, regarding phase quantization, down-select (by RAN1#113) from the following candidates:* Alt1. 1-bit (early vs. late) phase indicator
* Alt2. 3-bit (8-PSK) uniform quantization
* Alt3. 4-bit (16-PSK) uniform quantization (full reuse of Rel-16 eType-II W2 phase quantization)
* Alt4. Adaptive/gNB-configurable phase quantizer e.g. $\left\{m×f\left(q\right)+c, q=0,1,2,…, 2^{Q}-1\right\}$, where
	+ $f\left(q\right)$: legacy (Rel.16) based
		- Linear: legacy $2^{Q}$-PSK
		- Exponential: legacy Rel.16 amplitude, $2^{-\left(2^{Q}-1-q\right)∙0.25}$ or $2^{-\left(2^{Q}-1-q\right)∙0.5}$
	+ $m=$ a slope value from $[-x,x]$ depending on the amplitude $(a\_{1}$) of the 1st correlation (smallest delay), e.g. the slope decreases towards 0 as $a\_{1}$ increases towards 1
	+ $c\in \{0,2π\}$
* Alt5. A given correlation phase value $θ(D)$ is quantized to $\hat{θ}(D)$ based on the following alphabet (where $D$ denotes delay): $\hat{θ}\left(D\right)\in \left\{2^{-\left(N-q\right)∙s} ∙π, q=0,1,2,…, 2^{Q}-1\right\}∪\left\{-2^{-\left(N-q\right)∙s} ∙π, q=0,1,2,…, 2^{Q}-2\right\}∪\{0\}$
* Alt6. A given correlation phase value $θ(D)$ is quantized to $\hat{θ}(D)$ based on the following alphabet (where $D$ denotes delay and p(.) denotes amplitude quantization values used for Rel-16 e-TypeII codebook and $ε>0$):
	+ Mode 1: $\hat{θ}(D)\in \left\{p(q)^{2}∙2π, q=0,1,2,…, 2^{Q}-1\right\}$,
	+ Mode 2: $\hat{θ}(D)\in \left\{\left(1-p(q)^{2}\right)∙2π, q=0,1,2,…, 2^{Q}-1\right\}$
	+ The quantization mode is selected by UE and reported to gNB.
* Alt7. A given correlation phase value $θ\left(D\right)$ is quantized to $\hat{θ}\left(D\right)$ based on the following alphabet: $\hat{θ}\left(D\right)\in \left\{φ\frac{q-φ\_{0}}{2^{Q}}\right\}$, with $q=0,1,…,2^{Q}-1$, $φ\_{0}=2^{Q-1}-1$. TBD value(s) of $φ\in \left\{2π,π,\frac{π}{2},\frac{π}{4},\frac{π}{8}\right\}$

The evaluation should consider the impact of delay tracking operation at the UE where the phase difference between two slots can be close to zero.Note: This proposal doesn’t preclude the UE supporting only smaller delay values (e.g. 4-symbol only) for the phase report (which is already optional)**FL Note: Proposal 3.B.3:*** **Support/fine:** Samsung, Xiaomi, OPPO, Qualcomm, vivo, Fujitsu, NTT DOCOMO, ZTE, Lenovo/MotM, Ericsson, Nokia/NSB, CMCC
* **Not support:**
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