**3GPP TSG RAN WG1 #101 R1-200xxxx**

**e-Meeting, May 25th – June 5th, 2020**

Source: moderator (vivo)

Title: Feature lead summary on [101-e-NR-eMIMO-ULFPTx-01]

Agenda Item: 7.2.6.4

Document for: Discussion and Decision

1. Introduction

Per guidance from Mr. Chairman, this is to kick-off following email discussion, please provide your views below.

[101-e-NR-eMIMO-ULFPTx-01] Additional entries of full power TPMI grouping indication with Mode 2 operation by 5/29 and corresponding TP (if any) by 6/5 – Rakesh (vivo)

* Issue 1 of the FL summary
* Companies are encouraged to provide simulation results
* Note that having this email thread does not automatically mean that additional entries will be included into the specification

For reference, the agreement from RAN1#99 is copied below.

**Agreement**

For 4 ports, number of bits to indicate TPMI(s) which can deliver UL full power:

* + Non Coherent 2 bits
	+ Partial coherent 4 bits
		- Additional entries on top of existing entries may be added to table 1 and table 2
	+ Whether is this capability reporting is optional or not will be discussed as part of UE capability discussions

Table 1.

|  |  |
| --- | --- |
| 4Tx, nonCoherent | 4Tx, partial coherent (4bit) |
| G0 | G0 |
| G1 | G1 |
| G2 | G2 |
| G3 | G3 |
|  | G4 |
|  | G5 |
|  | G6 |
|  |  |

Definition of G0~G6 can be found in the table below.

Table 2.



1. Remaining issues
	1. Issue 1: Additional entries of full power TPMI grouping indication with Mode 2 operation

There are diverging views/proposals on this issue in contribution submitted in this RAN1#101-e and following alternatives are listed:

Alt1: Whether to revise the number of bits for partial coherent case? i.e. revise the bit size to 3bits for 4Tx partial coherent

Alt2: Whether to revise TPMI groups G0~G6? i.e. revise the existing TPMI groups

Alt3: Whether to introduce more TPMI groups for 4Tx partial coherent? If yes, how many groups and TPMI group details

|  |  |
| --- | --- |
| Company | Comment |
| ZTE | For Alt 1, we do not agree to reduce the bit size to 3bits, because it means the number of supported UE PA architectures will be reduced from 16 to 8 for partial-coherent case. From the technical perspective, it make no sense to penalize this functionality by restricting the diversity of UE implementation. Instead, some more types of the partial-coherent 4-Tx UE with different PA architectures should be captured to optimize this functionality.For Alt 2, we propose to adopt the following modifications, because there are still some obvious logical leaks of the existing G0 to G6.* Considering the beam-forming gain from partial-coherent ports, precoding matrices , ,  and  should be added in the existing G1 and G2.
* In order to optimize TPMI group based full power capability reporting, entries of TPMI groups should be decoupled as much as possible and corresponds to independent PA architectures and coherent capabilities. Based on that, G3 is a redundant entry of G5 and should be removed accordingly.

For Alt 3, we propose to add six new TPMI groups, which are G0+G4, G0+G5, G1+G5, G0+G6, G1+G6 and G2+G6, with the following comments. * From the perspective of permutation and combination of antenna ports PA architecture, there are 76 out of 81 types of the partial-coherent 4-Tx UE should be captured. However, the size of partial-coherent 4-Tx UE is 4 bits, up to 16 TPMI groups can be adopted.
* As a middle ground between signaling overhead and supported UE types, if just consider the PA combination architecture, there are only 12 out of 15 types of the partial-coherent 4-Tx UE need to be captured. Further, the existing G0 to G6 have captured 6 PA combination architectures. Therefore, it is only need to capture the remaining 6 PA combinations.
* Based on the first two reasons, it is recommended that the maximum power value of PA for each port obey the following rule: port {1000} ≥ port {1002} ≥ port {1001} ≥ port {1003}. Correspondingly, G0+G4, G0+G5, G1+G5, G0+G6, G1+G6 and G2+G6 should be introduced.
 |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |

# References

[1] R1-2003402, “Feature lead summary on ULFPTx”, vivo, RAN1#101-e

**Annex**

|  |  |  |
| --- | --- | --- |
| **TPMI groups** | **Precoder** | **Source company** |
| 1 | $$ \frac{1}{2}\left[\begin{array}{c}1\\0\\0\\0\end{array}\begin{array}{c}0\\1\\0\\0\end{array}\right]$$ | DCM |
| 2 | $\frac{1}{2}\left[\begin{array}{c}1\\0\\0\\0\end{array}\right]$,$ \frac{1}{2}\left[\begin{array}{c}1\\0\\0\\0\end{array}\begin{array}{c}0\\1\\0\\0\end{array}\right]$ | DCM |
| 3 | $\frac{1}{2}\left[\begin{array}{c}1\\0\\0\\0\end{array}\right]$, $\frac{1}{2}\left[\begin{array}{c}0\\1\\0\\0\end{array}\right]$, $\frac{1}{2}\left[\begin{array}{c}\begin{matrix}1&0\end{matrix}\\\begin{matrix}0&1\end{matrix}\\\begin{matrix}0&0\end{matrix}\\\begin{matrix}0&0\end{matrix}\end{array}\right]$ | LG |
| 4 | $$\frac{1}{2}\left[\begin{matrix}\begin{matrix}\begin{matrix}1\\0\end{matrix}\\1\end{matrix}\\0\end{matrix}\right],\frac{1}{2}\left[\begin{matrix}\begin{matrix}\begin{matrix}1\\0\end{matrix}\\-1\end{matrix}\\0\end{matrix}\right],\frac{1}{2}\left[\begin{matrix}\begin{matrix}\begin{matrix}1\\0\end{matrix}\\j\end{matrix}\\0\end{matrix}\right], \frac{1}{2}\left[\begin{matrix}\begin{matrix}\begin{matrix}1\\0\end{matrix}\\-j\end{matrix}\\0\end{matrix}\right]$$ | NOK |
| 5 | $$\left\{\frac{1}{2}\left[\begin{matrix}1\\0\\\begin{matrix}0\\0\end{matrix}\end{matrix}\right], \frac{1}{2}\left[\begin{matrix}0\\0\\\begin{matrix}1\\0\end{matrix}\end{matrix}\right],\frac{1}{2}\left[\begin{matrix}1\\0\\\begin{matrix}1\\0\end{matrix}\end{matrix}\right],\frac{1}{2}\left[\begin{matrix}1\\0\\\begin{matrix}-1\\0\end{matrix}\end{matrix}\right],\frac{1}{2}\left[\begin{matrix}1\\0\\\begin{matrix}j\\0\end{matrix}\end{matrix}\right],\frac{1}{2}\left[\begin{matrix}1\\0\\\begin{matrix}-j\\0\end{matrix}\end{matrix}\right],\frac{1}{2}\left[\begin{matrix}1&0\\0&0\\\begin{matrix}0\\0\end{matrix}&\begin{matrix}1\\0\end{matrix}\end{matrix}\right]\right\}$$ | HW, LG |
| 6 | $\frac{1}{2}\left[\begin{matrix}1\\0\\0\\0\end{matrix}\right],\frac{1}{2}\left[\begin{matrix}1\\0\\1\\0\end{matrix}\right]$,$ \frac{1}{2}\left[\begin{matrix}1\\0\\-1\\0\end{matrix}\right]$,$ \frac{1}{2}\left[\begin{matrix}1\\0\\j\\0\end{matrix}\right]$,$ \frac{1}{2}\left[\begin{matrix}1\\0\\-j\\0\end{matrix}\right]$,$ \frac{1}{2}\left[\begin{matrix}1&0\\0&0\\0&1\\0&0\end{matrix}\right]$ | QC, ZTE, DCM, CMCC |
| 7 | $$\frac{1}{2}\left[\begin{matrix}\begin{matrix}\begin{matrix}1\\0\end{matrix}\\1\end{matrix}\\0\end{matrix}\right],\frac{1}{2}\left[\begin{matrix}\begin{matrix}\begin{matrix}1\\0\end{matrix}\\-1\end{matrix}\\0\end{matrix}\right],\frac{1}{2}\left[\begin{matrix}\begin{matrix}\begin{matrix}1\\0\end{matrix}\\j\end{matrix}\\0\end{matrix}\right], \frac{1}{2}\left[\begin{matrix}\begin{matrix}\begin{matrix}1\\0\end{matrix}\\-j\end{matrix}\\0\end{matrix}\right],\frac{1}{2}\left[\begin{matrix}\begin{matrix}1\\0\end{matrix}&\begin{matrix}0\\0\end{matrix}\\\begin{matrix}0\\0\end{matrix}&\begin{matrix}1\\0\end{matrix}\end{matrix}\right], \frac{1}{2}\left[\begin{matrix}\begin{matrix}1\\0\end{matrix}&\begin{matrix}0\\1\end{matrix}\\\begin{matrix}0\\0\end{matrix}&\begin{matrix}0\\0\end{matrix}\end{matrix}\right], \frac{1}{2}\left[\begin{matrix}\begin{matrix}0\\1\end{matrix}&\begin{matrix}0\\0\end{matrix}\\\begin{matrix}0\\0\end{matrix}&\begin{matrix}1\\0\end{matrix}\end{matrix}\right] $$ | NOK |
| 8 | $$\frac{1}{2}\left[\begin{matrix}\begin{matrix}\begin{matrix}1\\0\end{matrix}\\1\end{matrix}\\0\end{matrix}\right],\frac{1}{2}\left[\begin{matrix}\begin{matrix}\begin{matrix}1\\0\end{matrix}\\-1\end{matrix}\\0\end{matrix}\right],\frac{1}{2}\left[\begin{matrix}\begin{matrix}\begin{matrix}1\\0\end{matrix}\\j\end{matrix}\\0\end{matrix}\right], \frac{1}{2}\left[\begin{matrix}\begin{matrix}\begin{matrix}1\\0\end{matrix}\\-j\end{matrix}\\0\end{matrix}\right], \frac{1}{2}\left[\begin{matrix}\begin{matrix}\begin{matrix}0\\1\end{matrix}\\0\end{matrix}\\1\end{matrix}\right],\frac{1}{2}\left[\begin{matrix}\begin{matrix}\begin{matrix}0\\1\end{matrix}\\0\end{matrix}\\-1\end{matrix}\right],\frac{1}{2}\left[\begin{matrix}\begin{matrix}\begin{matrix}0\\1\end{matrix}\\0\end{matrix}\\j\end{matrix}\right], \frac{1}{2}\left[\begin{matrix}\begin{matrix}\begin{matrix}0\\1\end{matrix}\\0\end{matrix}\\-j\end{matrix}\right]$$ | NOK |
| 9 | $$\frac{1}{2}\left[\begin{matrix}\begin{matrix}\begin{matrix}1\\0\end{matrix}\\1\end{matrix}\\0\end{matrix}\right],\frac{1}{2}\left[\begin{matrix}\begin{matrix}\begin{matrix}1\\0\end{matrix}\\-1\end{matrix}\\0\end{matrix}\right],\frac{1}{2}\left[\begin{matrix}\begin{matrix}\begin{matrix}1\\0\end{matrix}\\j\end{matrix}\\0\end{matrix}\right], \frac{1}{2}\left[\begin{matrix}\begin{matrix}\begin{matrix}1\\0\end{matrix}\\-j\end{matrix}\\0\end{matrix}\right], \frac{1}{2}\left[\begin{matrix}\begin{matrix}\begin{matrix}0\\1\end{matrix}\\0\end{matrix}\\1\end{matrix}\right],\frac{1}{2}\left[\begin{matrix}\begin{matrix}\begin{matrix}0\\1\end{matrix}\\0\end{matrix}\\-1\end{matrix}\right],\frac{1}{2}\left[\begin{matrix}\begin{matrix}\begin{matrix}0\\1\end{matrix}\\0\end{matrix}\\j\end{matrix}\right], \frac{1}{2}\left[\begin{matrix}\begin{matrix}\begin{matrix}0\\1\end{matrix}\\0\end{matrix}\\-j\end{matrix}\right], $$$$\frac{1}{2}\left[\begin{matrix}\begin{matrix}1\\0\end{matrix}&\begin{matrix}0\\0\end{matrix}\\\begin{matrix}0\\0\end{matrix}&\begin{matrix}1\\0\end{matrix}\end{matrix}\right], \frac{1}{2}\left[\begin{matrix}\begin{matrix}1\\0\end{matrix}&\begin{matrix}0\\1\end{matrix}\\\begin{matrix}0\\0\end{matrix}&\begin{matrix}0\\0\end{matrix}\end{matrix}\right], \frac{1}{2}\left[\begin{matrix}\begin{matrix}0\\1\end{matrix}&\begin{matrix}0\\0\end{matrix}\\\begin{matrix}0\\0\end{matrix}&\begin{matrix}1\\0\end{matrix}\end{matrix}\right], \frac{1}{2}\left[\begin{matrix}\begin{matrix}0\\1\end{matrix}&\begin{matrix}0\\0\end{matrix}\\\begin{matrix}0\\0\end{matrix}&\begin{matrix}0\\1\end{matrix}\end{matrix}\right], \frac{1}{2}\left[\begin{matrix}\begin{matrix}1\\0\end{matrix}&\begin{matrix}0\\0\end{matrix}\\\begin{matrix}0\\0\end{matrix}&\begin{matrix}0\\1\end{matrix}\end{matrix}\right], \frac{1}{2}\left[\begin{matrix}\begin{matrix}0\\0\end{matrix}&\begin{matrix}0\\0\end{matrix}\\\begin{matrix}1\\0\end{matrix}&\begin{matrix}0\\1\end{matrix}\end{matrix}\right]$$ | NOK |
| 10 | $\frac{1}{2}\left[\begin{array}{c}0\\1\\0\\1\end{array}\right]$, $\frac{1}{2}\left[\begin{array}{c}0\\1\\0\\-1\end{array}\right],\frac{1}{2}\left[\begin{array}{c}0\\1\\0\\j\end{array}\right]$,$\frac{1}{2}\left[\begin{array}{c}0\\1\\0\\-j\end{array}\right]$,$ \frac{1}{2}\left[\begin{array}{c}\begin{matrix}0&0\end{matrix}\\\begin{matrix}1&0\end{matrix}\\\begin{matrix}0&0\end{matrix}\\\begin{matrix}0&1\end{matrix}\end{array}\right]$ | LG, vivo |
| 11 | $\frac{1}{2}\left[\begin{array}{c}0\\1\\0\\0\end{array}\right]$, $\frac{1}{2}\left[\begin{array}{c}0\\0\\0\\1\end{array}\right]$, $ \frac{1}{2}\left[\begin{array}{c}0\\1\\0\\1\end{array}\right]$, $\frac{1}{2}\left[\begin{array}{c}0\\1\\0\\-1\end{array}\right],\frac{1}{2}\left[\begin{array}{c}0\\1\\0\\j\end{array}\right]$,$\frac{1}{2}\left[\begin{array}{c}0\\1\\0\\-j\end{array}\right]$,$ \frac{1}{2}\left[\begin{array}{c}\begin{matrix}0&0\end{matrix}\\\begin{matrix}1&0\end{matrix}\\\begin{matrix}0&0\end{matrix}\\\begin{matrix}0&1\end{matrix}\end{array}\right]$ | LG |
| 12 | $\frac{1}{2}\left[\begin{array}{c}0\\1\\0\\0\end{array}\right]$, $\frac{1}{2}\left[\begin{array}{c}0\\0\\0\\1\end{array}\right]$, $ \frac{1}{2}\left[\begin{array}{c}0\\1\\0\\1\end{array}\right]$, $\frac{1}{2}\left[\begin{array}{c}0\\1\\0\\-1\end{array}\right],\frac{1}{2}\left[\begin{array}{c}0\\1\\0\\j\end{array}\right]$,$\frac{1}{2}\left[\begin{array}{c}0\\1\\0\\-j\end{array}\right]$,$ \frac{1}{2}\left[\begin{array}{c}\begin{matrix}0&0\end{matrix}\\\begin{matrix}1&0\end{matrix}\\\begin{matrix}0&0\end{matrix}\\\begin{matrix}0&1\end{matrix}\end{array}\right]$,$ \frac{1}{2}\left[\begin{array}{c}\begin{matrix}0&0\end{matrix}\\\begin{matrix}0&0\end{matrix}\\\begin{matrix}1&0\end{matrix}\\\begin{matrix}0&1\end{matrix}\end{array}\right]$ | vivo |
| 13 | $\frac{1}{2}\left[\begin{array}{c}0\\1\\0\\0\end{array}\right]$, $\frac{1}{2}\left[\begin{array}{c}0\\0\\0\\1\end{array}\right]$, $ \frac{1}{2}\left[\begin{array}{c}0\\1\\0\\1\end{array}\right]$, $\frac{1}{2}\left[\begin{array}{c}0\\1\\0\\-1\end{array}\right],\frac{1}{2}\left[\begin{array}{c}0\\1\\0\\j\end{array}\right]$,$\frac{1}{2}\left[\begin{array}{c}0\\1\\0\\-j\end{array}\right]$,$ \frac{1}{2}\left[\begin{array}{c}\begin{matrix}1&0\end{matrix}\\\begin{matrix}0&0\end{matrix}\\\begin{matrix}0&1\end{matrix}\\\begin{matrix}0&0\end{matrix}\end{array}\right]$,$ \frac{1}{2}\left[\begin{array}{c}\begin{matrix}1&0\end{matrix}\\\begin{matrix}0&0\end{matrix}\\\begin{matrix}0&0\end{matrix}\\\begin{matrix}0&1\end{matrix}\end{array}\right]$,$ \frac{1}{2}\left[\begin{array}{c}\begin{matrix}0&0\end{matrix}\\\begin{matrix}0&0\end{matrix}\\\begin{matrix}1&0\end{matrix}\\\begin{matrix}0&1\end{matrix}\end{array}\right]$ | vivo |
| 14 | $\frac{1}{2}\left[\begin{array}{c}1\\0\\0\\0\end{array}\right]$,$ \frac{1}{2}\left[\begin{array}{c}1\\0\\1\\0\end{array}\right]$, $\frac{1}{2}\left[\begin{array}{c}1\\0\\-1\\0\end{array}\right]$, $\frac{1}{2}\left[\begin{array}{c}1\\0\\j\\0\end{array}\right]$, $\frac{1}{2}\left[\begin{array}{c}1\\0\\-j\\0\end{array}\right]$, $\frac{1}{2}\left[\begin{array}{c}1\\0\\0\\0\end{array}\begin{array}{c}0\\1\\0\\0\end{array}\right]$, $\frac{1}{2}\left[\begin{array}{c}1\\0\\0\\0\end{array}\begin{array}{c}0\\0\\1\\0\end{array}\right]$, $\frac{1}{2}\left[\begin{array}{c}0\\1\\0\\0\end{array}\begin{array}{c}0\\0\\1\\0\end{array}\right]$, $\frac{1}{2}\left[\begin{array}{c}1\\0\\0\\0\end{array}\begin{array}{c}0\\1\\0\\0\end{array}\begin{array}{c}0\\0\\1\\0\end{array}\right]$ | DCM, ZTE |
| 15 | $\frac{1}{2}\left[\begin{array}{c}1\\0\\0\\0\end{array}\right]$,$ \frac{1}{2}\left[\begin{array}{c}1\\0\\1\\0\end{array}\right]$, $\frac{1}{2}\left[\begin{array}{c}1\\0\\-1\\0\end{array}\right]$, $\frac{1}{2}\left[\begin{array}{c}1\\0\\j\\0\end{array}\right]$, $\frac{1}{2}\left[\begin{array}{c}1\\0\\-j\\0\end{array}\right]$, $\frac{1}{2}\left[\begin{array}{c}0\\1\\0\\1\end{array}\right]$, $\frac{1}{2}\left[\begin{array}{c}0\\1\\0\\-1\end{array}\right]$, $\frac{1}{2}\left[\begin{array}{c}0\\1\\0\\j\end{array}\right]$, $\frac{1}{2}\left[\begin{array}{c}0\\1\\0\\-j\end{array}\right]$,$\frac{1}{2}\left[\begin{array}{c}1\\0\\0\\0\end{array}\begin{array}{c}0\\1\\0\\0\end{array}\right]$, $\frac{1}{2}\left[\begin{array}{c}1\\0\\0\\0\end{array}\begin{array}{c}0\\0\\1\\0\end{array}\right]$, $\frac{1}{2}\left[\begin{array}{c}0\\1\\0\\0\end{array}\begin{array}{c}0\\0\\1\\0\end{array}\right]$, $\frac{1}{2}\left[\begin{array}{c}1\\0\\0\\0\end{array}\begin{array}{c}0\\0\\0\\1\end{array}\right]$*,* $\frac{1}{2}\left[\begin{array}{c}0\\1\\0\\0\end{array}\begin{array}{c}0\\0\\0\\1\end{array}\right]$*,* $\frac{1}{2}\left[\begin{array}{c}0\\0\\1\\0\end{array}\begin{array}{c}0\\0\\0\\1\end{array}\right]$*,* $\frac{1}{2}\left[\begin{array}{c}1\\0\\0\\0\end{array}\begin{array}{c}0\\1\\0\\0\end{array}\begin{array}{c}0\\0\\1\\0\end{array}\right]$ | DCM, ZTE |
| 16 | $\frac{1}{2}\left[\begin{array}{c}1\\0\\0\\0\end{array}\right]$, $\frac{1}{2}\left[\begin{array}{c}0\\0\\1\\0\end{array}\right]$, $\frac{1}{2}\left[\begin{array}{c}1\\0\\0\\0\end{array}\begin{array}{c}0\\0\\1\\0\end{array}\right]$,$ \frac{1}{2}\left[\begin{array}{c}1\\0\\1\\0\end{array}\right]$, $\frac{1}{2}\left[\begin{array}{c}1\\0\\-1\\0\end{array}\right]$, $\frac{1}{2}\left[\begin{array}{c}1\\0\\j\\0\end{array}\right]$, $\frac{1}{2}\left[\begin{array}{c}1\\0\\-j\\0\end{array}\right]$, $\frac{1}{2}\left[\begin{array}{c}1\\0\\0\\0\end{array}\begin{array}{c}0\\1\\0\\0\end{array}\right]$, $\frac{1}{2}\left[\begin{array}{c}1\\0\\0\\0\end{array}\begin{array}{c}0\\0\\1\\0\end{array}\right]$, $\frac{1}{2}\left[\begin{array}{c}0\\1\\0\\0\end{array}\begin{array}{c}0\\0\\1\\0\end{array}\right]$, $\frac{1}{2}\left[\begin{array}{c}1\\0\\0\\0\end{array}\begin{array}{c}0\\1\\0\\0\end{array}\begin{array}{c}0\\0\\1\\0\end{array}\right]$ | DCM, ZTE |
| 17 | $\frac{1}{2}\left[\begin{array}{c}1\\0\\0\\0\end{array}\right]$, $\frac{1}{2}\left[\begin{array}{c}0\\0\\1\\0\end{array}\right]$, $\frac{1}{2}\left[\begin{array}{c}1\\0\\0\\0\end{array}\begin{array}{c}0\\0\\1\\0\end{array}\right]$,$ \frac{1}{2}\left[\begin{array}{c}1\\0\\1\\0\end{array}\right]$, $\frac{1}{2}\left[\begin{array}{c}1\\0\\-1\\0\end{array}\right]$, $\frac{1}{2}\left[\begin{array}{c}1\\0\\j\\0\end{array}\right]$, $\frac{1}{2}\left[\begin{array}{c}1\\0\\-j\\0\end{array}\right]$, $\frac{1}{2}\left[\begin{array}{c}0\\1\\0\\1\end{array}\right]$, $\frac{1}{2}\left[\begin{array}{c}0\\1\\0\\-1\end{array}\right]$, $\frac{1}{2}\left[\begin{array}{c}0\\1\\0\\j\end{array}\right]$, $\frac{1}{2}\left[\begin{array}{c}0\\1\\0\\-j\end{array}\right]$,$\frac{1}{2}\left[\begin{array}{c}1\\0\\0\\0\end{array}\begin{array}{c}0\\1\\0\\0\end{array}\right]$, $\frac{1}{2}\left[\begin{array}{c}1\\0\\0\\0\end{array}\begin{array}{c}0\\0\\1\\0\end{array}\right]$, $\frac{1}{2}\left[\begin{array}{c}0\\1\\0\\0\end{array}\begin{array}{c}0\\0\\1\\0\end{array}\right]$, $\frac{1}{2}\left[\begin{array}{c}1\\0\\0\\0\end{array}\begin{array}{c}0\\0\\0\\1\end{array}\right]$*,* $\frac{1}{2}\left[\begin{array}{c}0\\1\\0\\0\end{array}\begin{array}{c}0\\0\\0\\1\end{array}\right]$*,* $\frac{1}{2}\left[\begin{array}{c}0\\0\\1\\0\end{array}\begin{array}{c}0\\0\\0\\1\end{array}\right]$*,* $\frac{1}{2}\left[\begin{array}{c}1\\0\\0\\0\end{array}\begin{array}{c}0\\1\\0\\0\end{array}\begin{array}{c}0\\0\\1\\0\end{array}\right]$ | DCM, OPPO,ZTE |
| 18 | $\frac{1}{2}\left[\begin{matrix}1\\0\\0\\0\end{matrix}\right],\frac{1}{2}\left[\begin{matrix}0\\0\\1\\0\end{matrix}\right]$,$\frac{1}{2}\left[\begin{matrix}1\\0\\1\\0\end{matrix}\right]$,$ \frac{1}{2}\left[\begin{matrix}1\\0\\-1\\0\end{matrix}\right]$,$ \frac{1}{2}\left[\begin{matrix}1\\0\\j\\0\end{matrix}\right]$,$ \frac{1}{2}\left[\begin{matrix}1\\0\\-j\\0\end{matrix}\right]$,$ \frac{1}{2}\left[\begin{matrix}0\\1\\0\\1\end{matrix}\right]$,$ \frac{1}{2}\left[\begin{matrix}0\\1\\0\\-1\end{matrix}\right]$,$ \frac{1}{2}\left[\begin{matrix}0\\1\\0\\j\end{matrix}\right]$,$ \frac{1}{2}\left[\begin{matrix}0\\1\\0\\-1\end{matrix}\right]$$\frac{1}{2}\left[\begin{matrix}1&0\\0&1\\0&0\\0&0\end{matrix}\right],\frac{1}{2}\left[\begin{matrix}1&0\\0&0\\0&1\\0&0\end{matrix}\right] ,\frac{1}{2}\left[\begin{matrix}1&0\\0&0\\0&0\\0&1\end{matrix}\right],\frac{1}{2}\left[\begin{matrix}0&0\\1&0\\0&1\\0&0\end{matrix}\right]$,$ \frac{1}{2}\left[\begin{matrix}0&0\\1&0\\0&1\\0&0\end{matrix}\right],\frac{1}{2}\left[\begin{matrix}0&0\\0&0\\1&0\\0&1\end{matrix}\right], \frac{1}{2}\left[\begin{matrix}1&0&0\\0&1&0\\0&0&1\\0&0&0\end{matrix}\right]$ | QC, CMCC,LG |
| 19 | $\frac{1}{2}\left[\begin{array}{c}1\\0\\0\\0\end{array}\right]$, $\frac{1}{2}\left[\begin{array}{c}0\\1\\0\\0\end{array}\right]$, $\frac{1}{2}\left[\begin{array}{c}0\\0\\1\\0\end{array}\right]$, $\frac{1}{2}\left[\begin{array}{c}1\\0\\0\\0\end{array}\begin{array}{c}0\\1\\0\\0\end{array}\right]$, $\frac{1}{2}\left[\begin{array}{c}1\\0\\0\\0\end{array}\begin{array}{c}0\\0\\1\\0\end{array}\right]$, $\frac{1}{2}\left[\begin{array}{c}0\\1\\0\\0\end{array}\begin{array}{c}0\\0\\1\\0\end{array}\right]$, $\frac{1}{2}\left[\begin{array}{c}1\\0\\0\\0\end{array}\begin{array}{c}0\\1\\0\\0\end{array}\begin{array}{c}0\\0\\1\\0\end{array}\right]$,$ \frac{1}{2}\left[\begin{array}{c}1\\0\\1\\0\end{array}\right]$, $\frac{1}{2}\left[\begin{array}{c}1\\0\\-1\\0\end{array}\right]$, $\frac{1}{2}\left[\begin{array}{c}1\\0\\j\\0\end{array}\right]$, $\frac{1}{2}\left[\begin{array}{c}1\\0\\-j\\0\end{array}\right]$, $\frac{1}{2}\left[\begin{array}{c}0\\1\\0\\1\end{array}\right]$, $\frac{1}{2}\left[\begin{array}{c}0\\1\\0\\-1\end{array}\right]$, $\frac{1}{2}\left[\begin{array}{c}0\\1\\0\\j\end{array}\right]$, $\frac{1}{2}\left[\begin{array}{c}0\\1\\0\\-j\end{array}\right]$,$\frac{1}{2}\left[\begin{array}{c}1\\0\\0\\0\end{array}\begin{array}{c}0\\1\\0\\0\end{array}\right]$, $\frac{1}{2}\left[\begin{array}{c}1\\0\\0\\0\end{array}\begin{array}{c}0\\0\\1\\0\end{array}\right]$, $\frac{1}{2}\left[\begin{array}{c}0\\1\\0\\0\end{array}\begin{array}{c}0\\0\\1\\0\end{array}\right]$, $\frac{1}{2}\left[\begin{array}{c}1\\0\\0\\0\end{array}\begin{array}{c}0\\0\\0\\1\end{array}\right]$*,* $\frac{1}{2}\left[\begin{array}{c}0\\1\\0\\0\end{array}\begin{array}{c}0\\0\\0\\1\end{array}\right]$*,* $\frac{1}{2}\left[\begin{array}{c}0\\0\\1\\0\end{array}\begin{array}{c}0\\0\\0\\1\end{array}\right]$*,* $\frac{1}{2}\left[\begin{array}{c}1\\0\\0\\0\end{array}\begin{array}{c}0\\1\\0\\0\end{array}\begin{array}{c}0\\0\\1\\0\end{array}\right]$ | DCM, ZTE |
| 20 | $$\frac{1}{2}\left[\begin{matrix}1\\0\\0\\0\end{matrix}\right]$$$\left\{\frac{1}{2}\left[\begin{matrix}1\\0\\1\\0\end{matrix}\right],\frac{1}{2}\left[\begin{matrix}1\\0\\-1\\0\end{matrix}\right],\frac{1}{2}\left[\begin{matrix}1\\0\\j\\0\end{matrix}\right],\frac{1}{2}\left[\begin{matrix}1\\0\\-j\\0\end{matrix}\right]\right\};\{\frac{1}{2}\left[\begin{matrix}0\\1\\0\\1\end{matrix}\right],\frac{1}{2}\left[\begin{matrix}0\\1\\0\\-1\end{matrix}\right],\frac{1}{2}\left[\begin{matrix}0\\1\\0\\j\end{matrix}\right],\frac{1}{2}\left[\begin{matrix}0\\1\\0\\-j\end{matrix}\right]\}$;$\{\frac{1}{2}\left[\begin{matrix}1&0\\0&0\\0&1\\0&0\end{matrix}\right],\frac{1}{2}\left[\begin{matrix}0&0\\1&0\\0&0\\0&1\end{matrix}\right],\frac{1}{2}\left[\begin{matrix}1&0\\0&1\\0&0\\0&0\end{matrix}\right],\frac{1}{2}\left[\begin{matrix}1&0\\0&0\\0&0\\0&1\end{matrix}\right], \frac{1}{2}\left[\begin{matrix}0&0\\1&0\\0&1\\0&0\end{matrix}\right],\frac{1}{2}\left[\begin{matrix}0&0\\0&0\\1&0\\0&1\end{matrix}\right]\}$;$\frac{1}{2}\left[\begin{matrix}1&0&0\\0&1&0\\0&0&1\\0&0&0\end{matrix}\right]$ | CMCC, LG |
| 21 | $$\frac{1}{2}\left[\begin{matrix}1\\0\\0\\0\end{matrix}\right],\frac{1}{2}\left[\begin{matrix}0\\1\\0\\0\end{matrix}\right],\frac{1}{2}\left[\begin{matrix}0\\0\\1\\0\end{matrix}\right]\}$$$\left\{\frac{1}{2}\left[\begin{matrix}1\\0\\1\\0\end{matrix}\right],\frac{1}{2}\left[\begin{matrix}1\\0\\-1\\0\end{matrix}\right],\frac{1}{2}\left[\begin{matrix}1\\0\\j\\0\end{matrix}\right],\frac{1}{2}\left[\begin{matrix}1\\0\\-j\\0\end{matrix}\right]\right\};\{\frac{1}{2}\left[\begin{matrix}0\\1\\0\\1\end{matrix}\right],\frac{1}{2}\left[\begin{matrix}0\\1\\0\\-1\end{matrix}\right],\frac{1}{2}\left[\begin{matrix}0\\1\\0\\j\end{matrix}\right],\frac{1}{2}\left[\begin{matrix}0\\1\\0\\-j\end{matrix}\right]\}$;$\{\frac{1}{2}\left[\begin{matrix}1&0\\0&0\\0&1\\0&0\end{matrix}\right],\frac{1}{2}\left[\begin{matrix}0&0\\1&0\\0&0\\0&1\end{matrix}\right],\frac{1}{2}\left[\begin{matrix}1&0\\0&1\\0&0\\0&0\end{matrix}\right],\frac{1}{2}\left[\begin{matrix}1&0\\0&0\\0&0\\0&1\end{matrix}\right], \frac{1}{2}\left[\begin{matrix}0&0\\1&0\\0&1\\0&0\end{matrix}\right],\frac{1}{2}\left[\begin{matrix}0&0\\0&0\\1&0\\0&1\end{matrix}\right]\}$;$\frac{1}{2}\left[\begin{matrix}1&0&0\\0&1&0\\0&0&1\\0&0&0\end{matrix}\right]$ | CMCC, LG |
| 22 | $$\left\{\frac{1}{2}\left[\begin{matrix}1\\0\\\begin{matrix}0\\0\end{matrix}\end{matrix}\right],\frac{1}{2}\left[\begin{matrix}0\\1\\\begin{matrix}0\\0\end{matrix}\end{matrix}\right],\frac{1}{2}\left[\begin{matrix}0\\0\\\begin{matrix}1\\0\end{matrix}\end{matrix}\right],\frac{1}{2}\left[\begin{matrix}1\\0\\\begin{matrix}1\\0\end{matrix}\end{matrix}\right],\frac{1}{2}\left[\begin{matrix}1\\0\\\begin{matrix}-1\\0\end{matrix}\end{matrix}\right],\frac{1}{2}\left[\begin{matrix}1\\0\\\begin{matrix}j\\0\end{matrix}\end{matrix}\right],\frac{1}{2}\left[\begin{matrix}1\\0\\\begin{matrix}-j\\0\end{matrix}\end{matrix}\right],\frac{1}{2}\left[\begin{matrix}1&0\\0&0\\\begin{matrix}0\\0\end{matrix}&\begin{matrix}1\\0\end{matrix}\end{matrix}\right],\frac{1}{2}\left[\begin{matrix}1&0\\0&1\\\begin{matrix}0\\0\end{matrix}&\begin{matrix}0\\0\end{matrix}\end{matrix}\right],\frac{1}{2}\left[\begin{matrix}0&0\\1&0\\\begin{matrix}0\\0\end{matrix}&\begin{matrix}1\\0\end{matrix}\end{matrix}\right],\frac{1}{2}\left[\begin{matrix}1&0&0\\0&1&0\\\begin{matrix}0\\0\end{matrix}&\begin{matrix}0\\0\end{matrix}&\begin{matrix}1\\0\end{matrix}\end{matrix}\right]\right\}$$ | HW, LG |
| 23 | $$\left\{\frac{1}{2}\left[\begin{matrix}1\\0\\\begin{matrix}1\\0\end{matrix}\end{matrix}\right],\frac{1}{2}\left[\begin{matrix}1\\0\\\begin{matrix}-1\\0\end{matrix}\end{matrix}\right],\frac{1}{2}\left[\begin{matrix}1\\0\\\begin{matrix}j\\0\end{matrix}\end{matrix}\right],\frac{1}{2}\left[\begin{matrix}1\\0\\\begin{matrix}-j\\0\end{matrix}\end{matrix}\right], \frac{1}{2}\left[\begin{matrix}1&0\\0&0\\\begin{matrix}0\\0\end{matrix}&\begin{matrix}1\\0\end{matrix}\end{matrix}\right],\frac{1}{2}\left[\begin{matrix}1&0\\0&1\\\begin{matrix}0\\0\end{matrix}&\begin{matrix}0\\0\end{matrix}\end{matrix}\right],\frac{1}{2}\left[\begin{matrix}0&0\\1&0\\\begin{matrix}0\\0\end{matrix}&\begin{matrix}1\\0\end{matrix}\end{matrix}\right],\frac{1}{2}\left[\begin{matrix}1&0&0\\0&1&0\\\begin{matrix}0\\0\end{matrix}&\begin{matrix}0\\0\end{matrix}&\begin{matrix}1\\0\end{matrix}\end{matrix}\right]\right\}$$ | HW |
| 24 | $\frac{1}{2}\left[\begin{array}{c}1\\0\\1\\0\end{array}\right]$, $\frac{1}{2}\left[\begin{array}{c}1\\0\\-1\\0\end{array}\right],\frac{1}{2}\left[\begin{array}{c}1\\0\\j\\0\end{array}\right]$,$\frac{1}{2}\left[\begin{array}{c}1\\0\\-j\\0\end{array}\right],\frac{1}{2}\left[\begin{array}{c}\begin{matrix}1&0\end{matrix}\\\begin{matrix}0&0\end{matrix}\\\begin{matrix}0&1\end{matrix}\\\begin{matrix}0&0\end{matrix}\end{array}\right]$,$\frac{1}{2}\left[\begin{array}{c}\begin{matrix}1&0\end{matrix}\\\begin{matrix}0&1\end{matrix}\\\begin{matrix}0&0\end{matrix}\\\begin{matrix}0&0\end{matrix}\end{array}\right]$,$\frac{1}{2}\left[\begin{array}{c}\begin{matrix}0&0\end{matrix}\\\begin{matrix}1&0\end{matrix}\\\begin{matrix}0&1\end{matrix}\\\begin{matrix}0&0\end{matrix}\end{array}\right],\frac{1}{2}\left[\begin{array}{c}\begin{matrix}1&0&0\end{matrix}\\\begin{matrix}0&1&0\end{matrix}\\\begin{matrix}0&0&1\end{matrix}\\\begin{matrix}0&0&0\end{matrix}\end{array}\right]$ | LG |
| 25 | $All precoders$ in partial/noncoherent codebooksubset for 4 Tx UE | QC |