**FDD CSI**

Study following alternatives, down-select one or more alternatives in RAN1 104e:

**Proposal 3-0: Alt 0:** Based on $ W=W\_{1}W\_{2}$or$ W=W\_{1}W\_{2}W\_{f}$**,** $ W\_{1}$can be an identity matrix

**Proposal 3-1**: Based on $ W=W\_{1}W\_{2}$**,**  study following detailed design of matrices$ W\_{1},$ at least for rank 1.

* Alt1: $W\_{1}\in N^{ P\_{CSI-RS}×K\_{1}}$($K\_{1}\leq P\_{CSI-RS}$) is a port selection matrix in order to freely select $K\_{1}$ ports out of $P\_{CSI-RS}$ CSI-RS ports or $\frac{K\_{1}}{2}$ ports out of $\frac{P\_{CSI-RS}}{2}$ CSI-RS ports (FFS polarization-common/specific selection) whereas each column of $W\_{1} $has only one element of “1”
* Alt2: $W\_{1}\in N^{ P\_{SD-FD}×K\_{2}}$($K\_{2}\leq P\_{SD-FD }= O\_{f}P\_{CSI-RS, }, O\_{f}\geq 1$) is a SD-FD basis selection matrix in order to freely select $K\_{2}$ bases out of $P\_{SD-FD}$ bases or $\frac{K\_{2}}{2}$ bases out of $\frac{P\_{SD-FD}}{2}$ bases (FFS polarization-common/specific selection) whereas each column of $W\_{1} $has only one element of “1”
	+ FFS the mechanism of conveying more than one SD-FD beamforming bases per CSI-RS port which is to be discussed in Proposal 4
* ~~Note that~~ $W\_{1}$~~can be an identity matrix for above Alternative~~

**Proposal 3-2**: Based on $ W=W\_{1}W\_{2}W\_{f}^{H}$**,**  study following detailed design of matrices $ W\_{1}$ and $ W\_{f}$ , at least for rank 1.

* Alt3: $W\_{1}\in N^{ P\_{CSI-RS}×K\_{1}}$($K\_{1}\leq P\_{CSI-RS}$) is a port selection matrix in order to freely select $K\_{1}$ ports out of $P\_{CSI-RS}$ CSI-RS ports or $\frac{K\_{1}}{2}$ ports out of $\frac{P\_{CSI-RS}}{2}$ CSI-RS ports (FFS polarization-common/specific selection) whereas each column of $W\_{1} $has only one element of “1”, i.e. $P\_{SD-FD }= O\_{f}P\_{CSI-RS} and O\_{f}\geq 1$
	+ Alt3-0 (one SD-FD/SD pair per port):$W\_{f}\in C^{N\_{3}× M\_{v}}$($ M\_{v} \leq N\_{3}$) is a DFT based compression matrix (FFS: configured/indicated to the UE and/or selected/reported by the UE), whereas $N\_{3}$ = NCQISubband\*R and $ M\_{v}\geq 1$.
	+ Alt3-1 (Multi-SD-FD pairs per port):$W\_{f}\in C^{N\_{3}× M\_{v}}$($ M\_{v}\leq N, N \leq N\_{3}$) is a DFT matrix selected by the UE from N pre-configured/pre-defined DFT vectors, whereas $N\_{3}$ = NCQISubband\*R and $ M\_{v}\geq 1$.
		- FFS the mechanism of conveying more than one SD-FD beamforming bases per CSI-RS port which is to be discussed in Proposal 4
		- Note that $ M\_{v}=N$ is not excluded by gNB/codebook configuration.
	+ Alt3-2 (Multi-SD-FD/SD pairs per port):$ W\_{f}\in N^{K\_{3}×M}$($M\leq K\_{3}$) is a selection matrix in order to select M SD-FD basis whereas each column of $W\_{f} $has only one element of “1”,
		- FFS the mechanism of conveying more than one SD-FD beamforming bases per CSI-RS port which is to be discussed in Proposal 4
		- Note that $W\_{f}$can be an identity matrix
* Alt4: $W\_{1}\in N^{ P\_{group}×K\_{4}} $($K\_{4}$ $\leq P\_{group}$) is a port-group selection matrix to freely select $K\_{4}$ groups out of $P\_{group}$ port groups or $K\_{4}/2$ groups out of $P\_{group}/2$ port groups (FFS polarization-common/specific selection) whereas $P\_{CSI-RS}$ CSI-RS ports in a resource are divided into $P\_{group}$ groups with $K\_{5}$ ports per group, and each port group corresponding to the same SD basis, i.e. $P\_{SD-FD }= O\_{f}P\_{CSI-RS} and O\_{f}\leq 1$
	+ $ W\_{f}\in N^{K\_{5}×M}$($M\leq K\_{5}$) is a selection matrix to select the same M ports across all port groups each column of $W\_{f} $has only one element of “1”.
* Alt5: $W\_{1}\in N^{ P\_{SD-FD}×K\_{2}}$($K\_{2}\leq P\_{SD-FD }= O\_{f}P\_{CSI-RS, }, O\_{f}\geq 1$) is a SD-FD basis selection matrix in order to freely select $K\_{2}$ bases out of $P\_{SD-FD}$ bases or $\frac{K\_{2}}{2}$ bases out of $\frac{P\_{SD-FD}}{2}$ bases (FFS polarization-common/specific selection) whereas each column of $W\_{1} $has only one element of “1”
	+ $W\_{f}\in C^{N\_{3}× M\_{v}}$($ M\_{v}\leq N, N \leq N\_{3}$) is a DFT based compression matrix (FFS: configured/indicated to the UE and/or selected/reported by the UE), whereas $N\_{3}$ = NCQISubband\*R and $ M\_{v}\geq 1$..
	+ FFS the mechanism of conveying more than one SD-FD beamforming bases per CSI-RS port which is to be discussed in Proposal 4
* Note that $W\_{1}$can be an identity matrix for above Alternative