***Proposal 3.4b:***

For partially coherent uplink precoding by an 8TX UE codebook, Ng=4,

* Following rank cases are supported,
* Down-select number of permutations for each cases based on the potential use-case, performance, and overall DCI overhead

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| *Rank* | *All layers in one Antenna Group* | *Layers split across 4 Antenna Groups*  *(All possible permutations)* | *Supported permutations* |
| *2* |  | *Transmission by 2 of the 4 antenna groups:*  *(1,1,0,0), (1,0,1,0), (1,0,0,1)*  *(0,1,1,0), (0,1,0,1), (0,0,1,1)* | * Ericsson: No pruning; use permutations shown. * vivo: keep it all possible combinations and potentially down-select next when the proposals on precoders are clear * OPPO: Agreed. * Samsung: No pruning * DCM: No pruning. * ZTE: This has already been agreed. No need more discussion. * Huawei, HiSilicon: support the permutations. * Intel: same view as ZTE. * Lenovo: same view as vivo * Xiaomi: No pruning. |
| *3* |  | *Transmission by 2 of the 4  antenna groups:*  *(2,1,0,0), (2,0,1,0), (2,0,0,1)*  *(1,2,0,0), (0,2,1,0), (0,2,0,1)*  *(1,0,2,0), (0,1,2,0), (0,0,2,1)*  *(1,0,0,2), (0,1,0,2), (0,0,1,2)*    *Transmission by 3 of the 4  antenna groups:*  *(1,1,1,0), (1,1,0,1), (1,0,1,1), (0,1,1,1)* | * Ericsson: No pruning; use permutations shown. * vivo: keep it all possible combinations and potentially down-select next when the proposals on precoders are clear * OPPO: We think selection of antenna port group is more important than allocation of layers to selected antenna port group. For 2 groups, (2,1,0,0), (2,0,1,0), (2,0,0,1) (0,2,1,0), (0,2,0,1) (0,0,2,1) can be prioritized and others can be considered for overhead reduction. * Samsung: Same view as OPPO, layer splitting based on 3 out of 4 groups can be deprioritized. * DCM: No pruning. * ZTE: Fine. * Huawei, HiSilicon: if the direction is to reduce DCI overhead by pruning layer splitting, for 2 of 4, only (2,1,0,0), (2,0,1,0), (2,0,0,1), (1,2,0,0) can be prioritized. For 3 out 4, fine with all. * Intel: No pruning needed. * Lenovo: same view as vivo * Xiaomi: No pruning. |
| *4* |  | *Transmission by 2 of  the 4  antenna groups:*  *(2,2,0,0), (2,0,2,0), (2,0,0,2)*  *(0,2,2,0), (0,2,0,2), (0,0,2,2)* | * Ericsson: No pruning; use permutations shown. * vivo: keep it all possible combinations and potentially down-select next when the proposals on precoders are clear * OPPO: Fine. * Samsung: No pruning * DCM: No pruning. * ZTE: This has already been agreed. No need more discussion. * Huawei, HiSilicon: support all permutations. * Intel: Same view as ZTE. * Lenovo: same view as vivo * Xiaomi: No pruning. |
| *5* |  | *Transmission by 3 of the antenna groups:*  *(2,2,1,0), (2,2,0,1), (2,1,2,0), (2,1,0,2), (2,0,1,2), (2,0,2,1), (0,2,2,1), (0,2,1,2), (1,2,2,0), (1,2,0,2)*  *(0,1,2,2), (1,0,2,2)*    *Transmission by ~~2~~ 4 of the 4 antenna groups:*  *(1,1,2,1), (1,1,1,2),*(2,1,1,1),(1,2,1,1)  *(0,0,0,0) 🡪 no PC rank 5 is supported (i.e., NC rank 5 can be included instead)* | * Ericsson: support only (1,1,2,1), (1,1,1,2); and (2,0,2,1), (0,2,1,2) * vivo: keep it all possible combinations and potentially down-select next when the proposals on precoders are clear * OPPO: It should be “Transmission by 4 antenna groups”. We think selection of antenna port group is more important than allocation of layers to selected antenna port group. For 3 groups, (2,2,1,0), (2,2,0,1), (2,0,2,1), (0,2,2,1) can be prioritized and others can be considered for overhead reduction. For 4 groups, one of the permutations may be sufficient for such a high rank. * Samsung: for rank >4 TPMI indication, it is preferred to reduce # configured rank>4 precoders. So, we may support several from these layer splittings, but the configured codebook for TPMI, should include small number (e.g. 1 or 2) of layer splits. Added an example, (0,0,0,0) 🡪 no PC rank 5 layer split (NC rank 5 can be included) * DCM: For transmission by 3 of the antenna groups, keep one from three permutations for the same antenna selection precoders, e.g., keep one from (2,2,1,0), (2,1,2,0), (1,2,2,0); keep one from (2,2,0,1), (1,2,0,2), (2,1,0,2); etc. * ZTE: Fine with original selections for 4 groups. Considering rank 5 is a high rank and the number combinations for 3 groups seems too large, so it needs reduction, e.g., without permutation. We can live with (2,0,2,1), (0,2,1,2) as suggested by Ericsson, and (2,2,0,1), (0,1,2,2) as well. * Huawei, HiSilicon: for 3 out of 4, we are fine to support only (2,2,1,0), (2,2,0,1), (2,1,2,0), (2,1,0,2); for 4 out of 4, we are fine to support only (1,1,2,1), (1,1,1,2). * Intel: We think transmission over more antenna groups should have better performance. Regarding Samsung’s suggestion, why Rank-5 PC precoders is not supported? * Lenovo: Keep all transmissions by 3 and 4 antenna groups for now and potential for down selection when the proposals for the precoder is clear. We do not think it is a good idea to use only NC codewords for rank 5. PC rank 5 codewords provide better performance and should be supported. * Xiaomi: For transmission by 3 of the antenna groups, support to deprioritize (1,2,2,0), (1,2,0,2), (0,1,2,2), and (1,0,2,2). For transmission by all antenna groups, prefer (1,1,2,1) and (1,1,1,2). |
| *6* |  | *Transmission by 3 of the 4 antenna groups:*  *(2,2,2,0), (2,2,0,2), (2,0,2,2), (0,2,2,2)*    *Transmission by four antenna groups:*  *(2,1,2,1), (1,2,1,2)* , (2,2,1,1), (1,2,2,1),(1,1,2,2),(2,1,1,2)  *(0,0,0,0) 🡪 no PC rank 6 is supported (i.e., NC rank 6 can be included instead)* | * Ericsson: support only (2,1,2,1), (1,2,1,2); this saves 32 out of 160 precoders (without other optimizations) * vivo: keep it all possible combinations and potentially down-select next when the proposals on precoders are clear * OPPO: We think selection of antenna port group is more important than allocation of layers to selected antenna port group. For 4 groups, one of the permutations may be sufficient for such a high rank. * Samsung: for rank >4 TPMI indication, it is preferred to reduce # configured rank>4 precoders. So, we may support several from these layer splittings, but the configured codebook for TPMI, should include small number (e.g. 1 or 2) of layer splits. Added an example, (0,0,0,0) 🡪 no PC rank 6 layer split (NC rank 6 can be included) * DCM: No pruning. * ZTE: Fine. * Huawei, HiSilicon: for 4 out of 4, support (2,1,2,1), (1,2,1,2) ,(2,1,1,2) and (1,2,2,1) * Intel: We think transmission over more antenna groups should have better performance. Regarding Samsung’s suggestion, why Rank-6 PC precoders is not supported? * Lenovo: Keep all transmissions by 3 and 4 antenna groups for now and potential for down selection when the proposals for the precoder is clear. We do not think it is a good idea to use only NC codewords for rank 5. PC rank 5 codewords provide better performance and should be supported. * Xiaomi: For transmission by 3 of the 4 antenna groups, support all cases. For transmission by four antenna groups, prefer to prioritize (2,1,2,1), (1,2,2,1), (2,1,1,2), and (1,2,1,2). |
| *7* |  | *(2,2,2,1), (2,2,1,2), (2,1,2,2), (1,2,2,2)*  *(0,0,0,0) 🡪 no PC rank 7 is supported (i.e., NC rank 7 can be included instead)* | * Ericsson: support only (2,1,2,2), (1,2,2,2); this saves 64 out of 128 precoders (without other optimizations) * vivo: keep it all possible combinations and potentially down-select next when the proposals on precoders are clear * OPPO: We think one of the permutations may be sufficient for such a high rank. * Samsung: for rank >4 TPMI indication, it is preferred to reduce # configured rank>4 precoders. So, we may support several from these layer splittings, but the configured codebook for TPMI, should include small number (e.g. 1 or 2) of layer splits. Added an example, (0,0,0,0) 🡪 no PC rank 7 layer split (NC rank 7 can be included) * DCM: No pruning. * ZTE: We can live with Ericsson’s suggestion. No need all combinations for higher ranks. * Huawei, HiSilicon: support all permutations. * Intel: Either pruning or not is fine. * Lenovo: We do not think it is a good idea to use only NC codewords for rank 5. PC rank 5 codewords provide better performance and should be supported. * Xiaomi: Prefer to prioritize (2,1,2,2) and (1,2,2,2). Maybe it is enough for Ng=4 and high rank. |
| *8* |  | *(2,2,2,2)*  *(0,0,0,0) 🡪 no PC rank 8 is supported (i.e., NC rank 8 can be included instead)* | * Samsung: Added an example, (0,0,0,0) 🡪 no PC rank 8 layer split (NC rank 8 can be included) * DCM: No pruning. * Lenovo: We do not think it is a good idea to use only NC codewords for rank 5. PC rank 5 codewords provide better performance and should be supported. |

*Note: Above is not relevant to how precoders are indicated.*