

**Agenda item: 4.1**

**Source: Samsung**

**Title: On Rel-18 NR MIMO enhancements for 5G Advanced**

**Document for: Discussion and Decision**

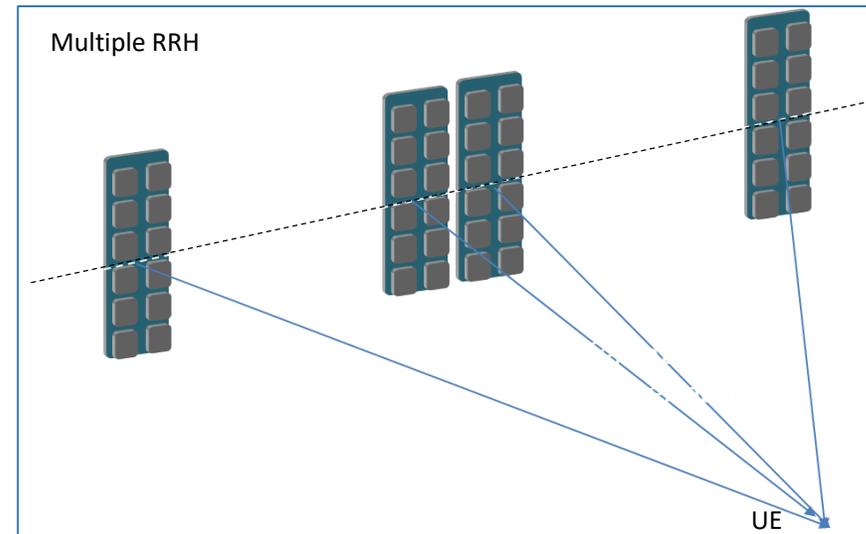
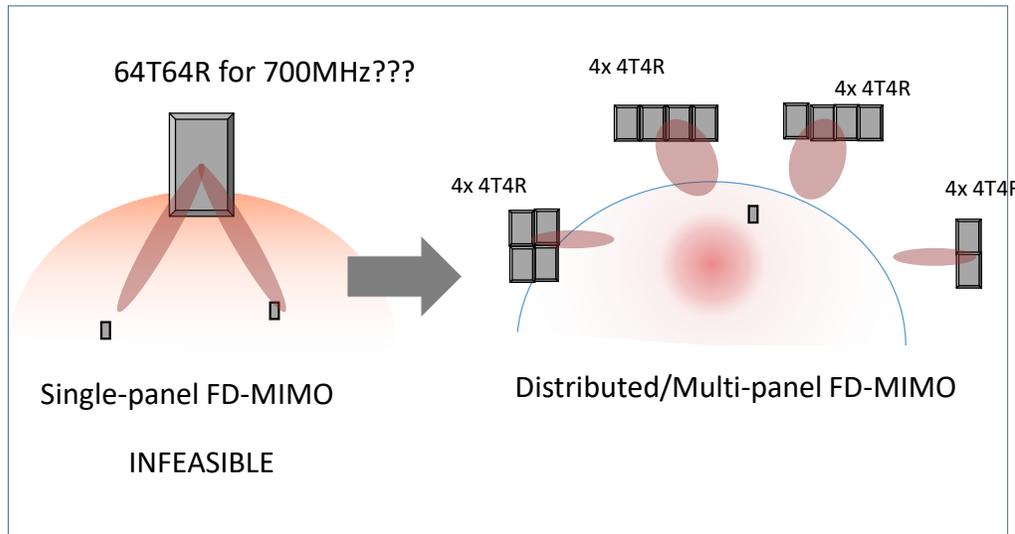
# MIMO | Overview of scope for Rel-18 NR MIMO

- ◇ Enabling new use cases and deployment scenarios
  - ◆ [Goal 1.1] FR1: high throughput for sub-1GHz regime
  - ◆ [Goal 1.2] FR2: 60GHz regime, high-speed, asymmetric DL-UL (e.g. UL dense deployment)
- ◇ Extending features introduced in Rel-16/17
  - ◆ [Goal 2.1] Unified TCI framework: better support for multi-TRP and MP-UE
  - ◆ [Goal 2.2] Inter-cell beam management to facilitate L1/L2-centric inter-cell mobility: including higher-layer RAN2/3 enhancements
  - ◆ [Goal 2.3] FeType-II codebook with Doppler-domain (DD) compression in addition to SD+FD

Item	Goal				
	1.1	1.2	2.1	2.2	2.3
<b>Multi-beam</b>	--	Enhanced UL (separate) TCI including PC aspects; ADV tracking/refinement	Enhanced signaling for M, N>1; STxMP support for MPUE	Use of Rel-17 TCI of M,N>1 for simultaneous Tx/Rx; higher-layer enhancement for L1/L2-triggered mobility/RRM	--
<b>Multi-TRP</b>	Asynchronous	Asynchronous	--	--	--
<b>Distributed MIMO</b>	Channel model, CSI/codebook, UL aspects	--	--	--	--
<b>Ultra HD Codebook/CSI</b>	--	--	--	--	SD/FD/DD compression for Type-II, explicit feedback, UL

# MIMO | Distributed MIMO: Motivation and Scope

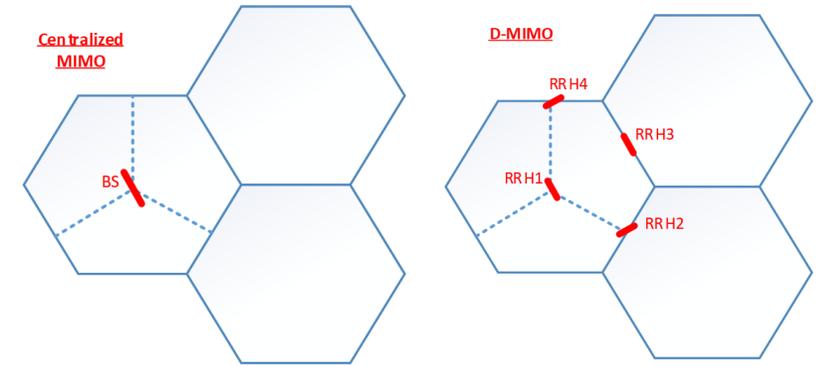
- ◇ Facilitate distributed MIMO deployments with multiple RRH or Active Antenna modules
  - ◆ Targeting FR1 especially low frequency bands (sub-1GHz)
  - ◆ Capacity/coverage limitation for sub-1GHz (form factor limitation at gNB)
  - ◆ Study on assumptions and channel modeling seems needed (for the first, e.g., 2 meetings)
- ◇ Potential enhancement/study areas:
  - ◆ New CSI codebook(s) accommodating largely-spaced RRHs (possibly with different # of ports) and the necessary CSI reporting with >32 ports, including for (if required) UE-assisted calibration
  - ◆ Applications and extensions of M-TRP framework to enable distributed DL and UL MIMO
  - ◆ New (interference) measurement for enabling dynamic RRH selection



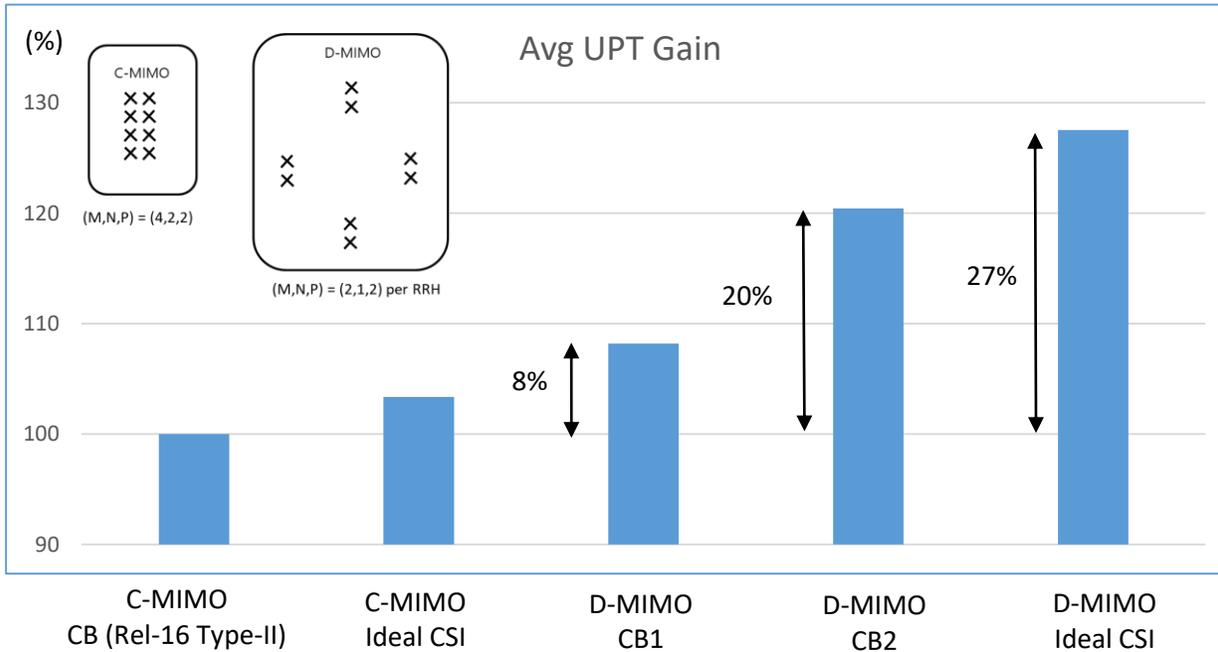
# MIMO | Distributed MIMO: Performance

◇ 700MHz band, 10MHz system bandwidth, RMa 1.7km ISD, MU-MIMO with 2-RX UEs, FTP-1 traffic

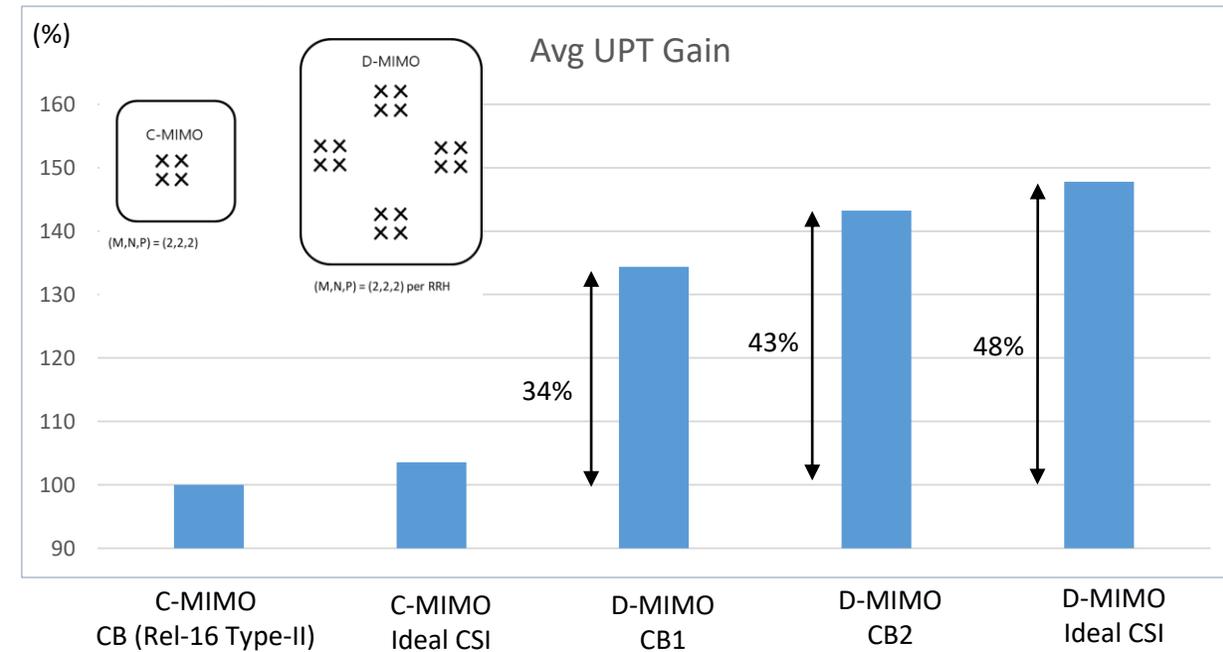
- ◆ CB1: eType-II per RRH
- ◆ CB2: Modified eType-II (SD per RRH, FD across RRHs)



## - Scenario #1

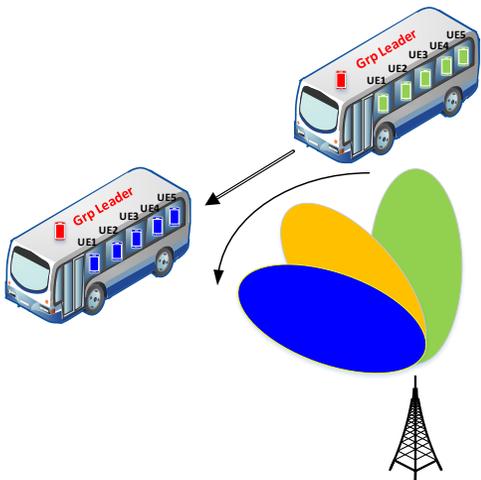


## - Scenario #2



# MIMO | Multi-beam: unified TCI++ and ADV beam tracking/refinement

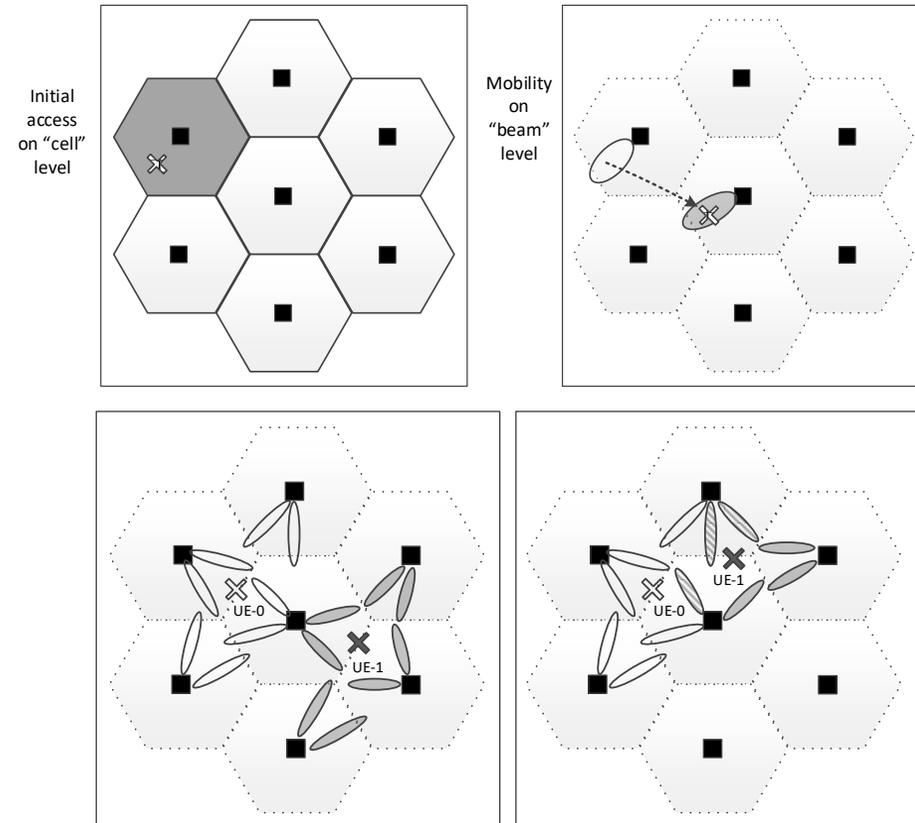
- ◇ Building upon **Rel-17 unified TCI** by enhancing at least the following components:
  - ◆ Enhanced signaling support for  $M, N > 1$  (up to, e.g.  $M=4$  and  $N=4$ ) to be used for mTRP and inter-cell beam management: beam indication and measurement/reporting
  - ◆ Enhanced separate DL/UL TCI to improve efficiency for asymmetric (not necessarily non-reciprocal) DL-UL: UL dense scenario (centralized DL, distributed UL), MPUE with simultaneous transmission (STxMP)
  - ◆ Combination between DL mTRP and UL STxMP: study the support of overlapping transmissions of different UL channels/signals
- ◇ Advanced **beam refinement/tracking** (“issue 6” in Rel-17):
  - ◆ Expected support in Rel-17 is modest at best → Rel-18 should continue where Rel-17 ends and more
  - ◆ Essential for taking full advantage of fast DCI-based beam indication in Rel-17
  - ◆ Including faster beam refinement during initial access



# MIMO | Multi-beam: inter-cell BM++ for L1/L2-centric inter-cell mobility

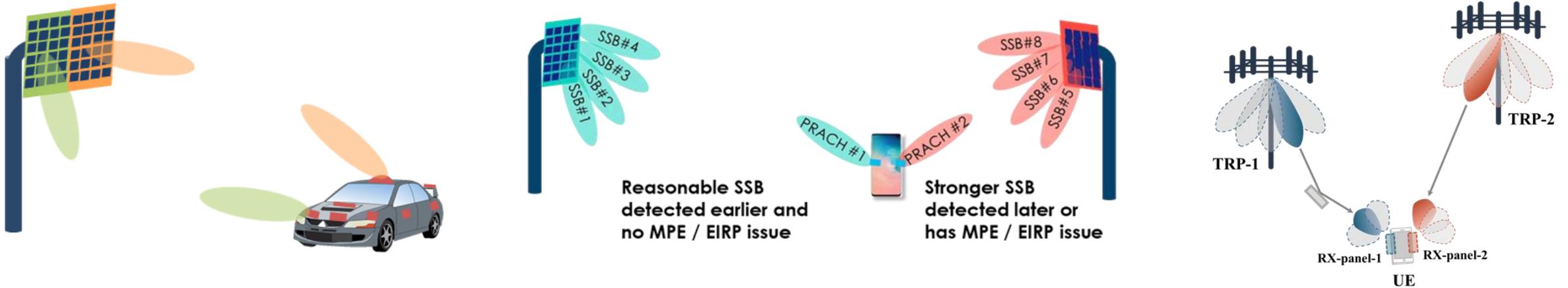
- ◇ Facilitating L1/L2-centric inter-cell mobility (**L12-XCM**) to approximate “boundary-less network”
  - ◆ Inter-cell beam management enhancement (RAN1): DL Rx from and/or UL Tx to another cell before HO is completed (i.e. before serving-cell is changed) along with necessary L1 measurement/reporting
  - ◆ Inter-cell mobility enhancement (RAN2): Handover/HO (serving cell change) procedure triggered by L1/L2 measurement/reporting

	Rel-17	Rel-18
WGs (TUs)	RAN1, (a little) RAN2	RAN2, (a little) RAN1, (some) RAN3
CU-DU split	Intra-DU: limit applicability to intra-vendor operation (all cells engaging in L12-XCM must use gNBs from the same vendor)	Also inter-DU: to approach boundary-less NW, efficient inter-vendor operation in the same NW should be possible
Serving cell	Assume legacy HO (no serving cell change for inter-cell BM)	Potentially new L1/L2-triggered inter-cell mobility (HO)
C-RNTI, RACH, etc.	C-RNTI assignment is left to NW implementation, no assumption on RA procedure	Investigate the need for C-RNTI update (e.g. via MAC CE) to facilitate inter-vendor operation
Beam indication	One link (either DL or UL) and one cell at a time (in one beam indication instance)	Use M,N>1 to facilitate simultaneous Tx/Rx-like operation from/to multiple cells without changing serving cell

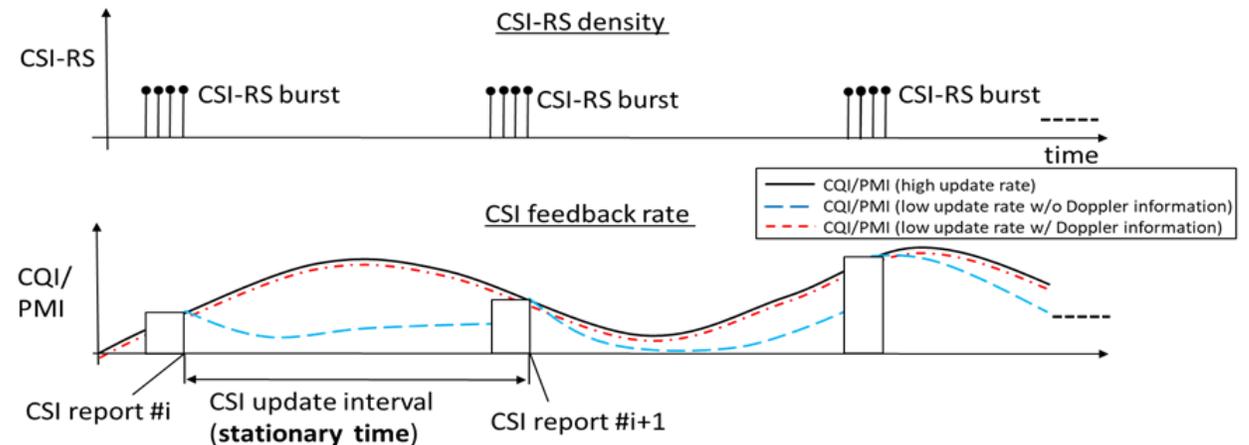
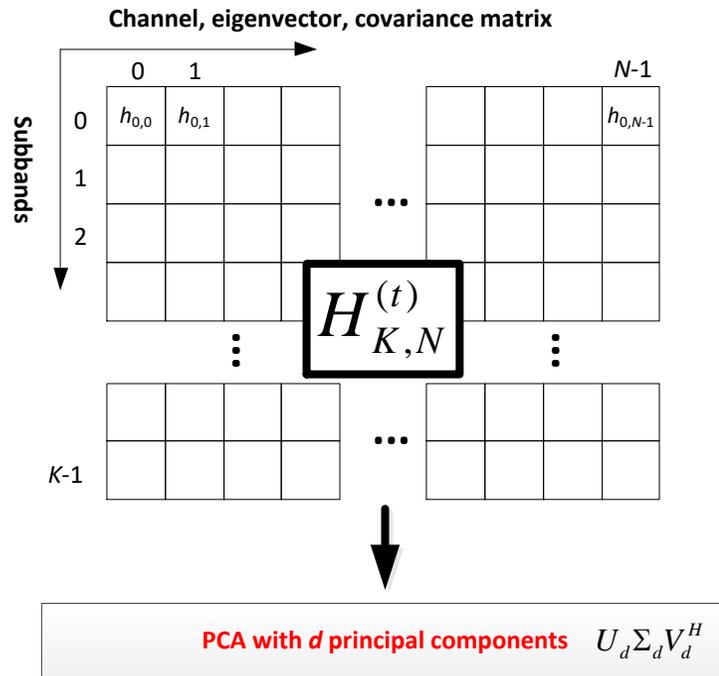


## ◇ Potential enhancement areas (carry-over from Rel-17):

- ◆ FR2: Extend coverage-improving features developed in Rel-16 with Rel-17 unified TCI
- ◆ Facilitate asynchronous inter-TRP/panel scenarios including UL synchronization aspect
- ◆ Facilitate multi-panel reception at the UE (especially FR2)
- ◆ TRP/panel-specific DL-UL (TDD) configuration, taking into account inter-panel (self-) and cross-link interference



- ◇ Study possible improvement in CSI resolution for DL MU-MIMO, UL MIMO, and higher-speed UEs targeting FR1
- ◇ Potential enhancement areas:
  - ◆ DL MIMO: “Explicit feedback” of eigenvectors (non-ULA array geometry), including progressively-refined high-resolution CSI reporting
  - ◆ DL MIMO: Doppler-domain compression in addition to space- and frequency-domain (enhancement over Rel.16 eType-II)
  - ◆ UL SU-MIMO: DL control signaling to enable UL frequency selective precoding (frequency-selective TPMI)



**Thank you**