# ~~Crossed out in red~~ = superseded by later agreements

# Issue 1

* [Issue 1] For Rel.17 NR FeMIMO, on the unified TCI framework
  1. Support joint TCI for DL and UL based on and analogous to Rel.15/16 DL TCI framework
     + The term “TCI” at least comprises a TCI state that includes at least one source RS to provide a reference (UE assumption) for determining QCL and/or spatial filter
     + The source reference signal(s) in M TCIs provide common QCL information at least for UE-dedicated reception on PDSCH and all or subset of CORESETs in a CC
       - ~~FFS: Optionally this common QCL information can also apply to CSI-RS resource for CSI, CSI-RS resource for BM, and CSI-RS for tracking~~
       - ~~FFS: Applicability on PDSCH includes PDSCH default beam~~
       - ~~Working Assumption: Select between M=1 and M>=1~~
     + The source reference signal(s) in N TCIs provide a reference for determining common UL TX spatial filter(s) at least for dynamic-grant/configured-grant based PUSCH, all or subset of dedicated PUCCH resources in a CC,
       - Optionally, this UL TX spatial filter can also apply to all SRS resources in resource set(s) configured for antenna switching/codebook-based/non-codebook-based UL transmissions
       - ~~FFS: applicability of this UL TX spatial filter to SRS configured for beam management (BM)~~
       - ~~FFS: PUSCH port determination based on the TCI, e.g., to be mapped with SRS ports analogous to Rel.15/16~~
       - ~~Working Assumption: Select between N=1 and N>=1~~
     + ~~FFS: extension to common QCL information applied to only some of the CORESETs or PUCCH resources in a CC, e.g. for mTRP~~
     + FFS: When used for the purpose of joint beam indication for UL and DL, whether a joint TCI pool for DL and UL dedicated for the purpose is used, or the same TCI pool as that used for the purpose of separate DL/UL beam indication is used
     + Note: The resulting beam indication directly refers to the associated source RS(s)
     + ~~FFS (RAN1#103-e): Details on extension to intra- and inter-band CA~~
     + ~~FFS (RAN1#103-e): The supported number of active TCI states considering factors such as multi-TRP and issue 6~~
     + ~~FFS (RAN1#103-e): Applicable QCL types, and co-existence with DL TCI and spatial relation indication in Rel.15/16~~
  2. ~~In RAN1#103-e, investigate, for the purpose of down selection, the following alternatives for accommodating the case of separate beam indication for UL and DL~~
     + ~~Alt1. Utilize the joint TCI to include references for both DL and UL beams~~
     + ~~Alt2. Utilize two separate TCI states, one for DL and one for UL. The TCI state for the DL is the same as agreed in 1a. The TCI state for the UL can be newly introduced.~~
       - ~~Alt 2-1: The UL TCI state is taken from the same pool of TCI states as the DL TCI state~~
       - ~~Alt 2-2: The UL TCI state is taken from another pool of TCI states than the DL TCI state~~
     + ~~Note: The resulting beam indication directly refers to the associated source RS(s)~~
     + ~~FFS (RAN1#103-e): Details on extension to intra- and inter-band CA~~
     + ~~Note: This may be related to issue 5 as well as other reasons for different TCIs such as network flexibility/scheduling~~
  3. Support the use of SSB/CSI-RS for BM and/or SRS for BM as source RS to determine a UL TX spatial filter in the unified TCI framework
     + Whether the UL TX spatial filter corresponds to UL TCI (separate from DL TCI) depends on the outcome of 1b) above
     + ~~FFS: Support the use of non-BM CSI-RS and/or non-BM SRS in addition~~
  4. ~~In RAN1#103-e, decide if SRS for BM can be configured as a source RS to represent a DL RX spatial filter in the unified TCI framework~~
  5. ~~In RAN1#103-e, decide/finalize all other parameters included in or concurrent with (but not included in) the TCI, e.g. UL-PC-related parameters (involving P0/alpha, PL RS, and/or closed loop index), UL-timing-related parameters~~
  6. ~~In RAN1#103-e, identify issues pertaining to alignment between DL and UL default beam assumptions using the unified TCI framework~~

On Rel-17 unified TCI framework, to accommodate the case of separate beam indication for UL and DL:

* Utilize two separate TCI states, one for DL and one for UL.
  + ~~FFS: Contents of separate UL TCI state~~
  + Note: For FR1, UE does not expect UL TCI to provide a reference for determining common UL TX spatial filter(s), if UL TCI is supported for FR1
* For the separate DL TCI:
  + The source reference signal(s) in M TCIs provide QCL information at least for UE-dedicated reception on PDSCH and for UE-dedicated reception on all or subset of CORESETs in a CC
* For the separate UL TCI:
  + The source reference signal(s) in N TCIs provide a reference for determining common UL TX spatial filter(s) at least for dynamic-grant/configured-grant based PUSCH, all or subset of dedicated PUCCH resources in a CC
  + Optionally, this UL TX spatial filter can also apply to all SRS resources in resource set(s) configured for antenna switching/codebook-based/non-codebook-based UL transmissions
* ~~FFS: Whether the UL TCI state is taken from a common/same or separate TCI state pool from DL TCI state~~
  + ~~Note that TCI state pool for joint DL and UL beam indication is still FFS~~
* ~~FFS: Whether Rel.17 supports TCI configured for single channel (e.g. PDSCH only, single CORESET)~~
* Note: This does not preclude the type of UE supporting only 1 beam tracking loop, i.e. UE reports value of 1 in UE FG 2-62.

**~~Conclusion~~**

~~There is no consensus in RAN1 to include the following as part of RAN1 agreement for AI 8.1.1 in RAN1 #103e:~~

* ~~FFS beam indication for the TCI state assumption/update for the following cases:~~ 
  + ~~The beam indication UE-specific DCI (i.e. the CORESETs with the DCI received by UE), the scheduled PDSCH by the DCI and the associated PUCCH for the acknowledgment of the beam indication DCI~~
  + ~~Non-UE-specific CORESETs and PUSCH/PDSCH scheduled/activated and PUCCH transmission triggered by non-UE-specific CORESETs~~

On Rel-17 unified TCI framework, support common TCI state ID update and activation to provide common QCL information and/or common UL TX spatial filter(s) across a set of configured CCs:

* The above applies to intra-band CA
* The above applies to joint DL/UL and separate DL/UL beam indications
* Just as Rel.16, the RS in the TCI state that provides QCL-TypeA ~~[or QCL-TypeB]~~ shall be in the same CC as the target channel or RS
* The common TCI state ID implies that the same/single RS determined according to the TCI state(s) indicated by a common TCI state ID is used to provide QCL Type-D indication and to determine UL TX spatial filter across the set of configured CCs
* ~~FFS: The above also applies to inter-band CA~~
* ~~FFS: TCI state pool for CA~~ 
  + ~~Opt-1: sharing a single RRC TCI state pool for the set of configured CCs, e.g., cell-group TCI state pool, or reuse TCI state pool for PDSCH in a reference cell; A CC ID for QCL-Type A RS is absent in a TCI state, and the CC ID for QCL-Type A RS is determined according to a target CC of the TCI state.~~
    - ~~FFS: Whether it is possible that a single TCI state in the pool includes all source RSs from different CCs~~
  + ~~Opt-2: configuring RRC TCI state pool per individual CC~~
* ~~FFS: Whether the Rel-17 common beam update across multiple CCs applies to beam indication for single channel (e.g. PDSCH only, single CORESET), a subset of channels, or all channels~~

On Rel-17 unified TCI framework:

* A pool of joint DL/UL TCI state is used for joint DL/UL TCI state update (beam indication).
* ~~FFS: The pool for separate DL and UL TCI state update (beam indication)~~
* Note: Here, TCI state pool refers to a pool configured via higher-layer (RRC) signaling
* ~~FFS: Whether joint TCI may include UL specific parameter(s) such as UL PC/timing parameters, PL RS, panel-related indication, etc. and if it is included, it is used only for UL transmission of the DL and UL transmissions to which the joint TCI is applied~~

**Conclusion**

On Rel.17 unified TCI framework, based on the agreements in RAN1#102-e and 103-e, the following terms are defined as follows (at least for the purpose of discussion and reaching agreements).

For M=1:

* DL TCI: The source reference signal(s) (analogous to Rel.15, two, if qcl\_Type2 is configured in addition to qcl\_Type1) in the DL TCI provides QCL information at least for UE-dedicated reception on PDSCH and all of CORESETs in a CC

For N=1:

* UL TCI: The source reference signal in the UL TCI provides a reference for determining UL TX spatial filter at least for dynamic-grant/configured-grant based PUSCH and all of dedicated PUCCH resources in a CC

For M=N=1:

* Joint DL/UL TCI: A TCI refers to at least a common source reference RS used for determining both the DL QCL information and the UL TX spatial filter.
* Separate DL/UL TCI: The DL TCI and UL TCI are distinct (therefore, separate).

For M>1:

* DL TCI: Each of the M source reference signals (or 2M, if qcl\_Type2 is configured in addition to qcl\_Type1) in the M DL TCIs provides QCL information at least for one of the M beam pair links for UE-dedicated receptions on PDSCH and/or subset of CORESETs in a CC

For N>1:

* UL TCI: Each of the N source reference signals in the N UL TCIs provide a reference for determining UL TX spatial filter at least for one of the N beam pair links associated with dynamic-grant(s)/configured-grant(s) based PUSCH, and/or subset of dedicated PUCCH resources in a CC

For M>1 and/or N>1:

* Joint DL/UL TCI: A TCI refers to at least a common source reference RS used for determining both the DL QCL information and the UL TX spatial filter. In this case, M=N.
* Separate DL/UL TCI: The M DL TCIs and N UL TCIs are distinct (therefore, separate).

Note: Other TCI types/terms such as “common TCI” are not used.

On Rel.17 unified TCI framework, the supported source/target QCL relations in the current TS38.214 V16.4.0 is supported for QCL Type D.

* Note: This implies that the following source RS types for DL QCL (Type D, for DL RX spatial filter reference) information for DL UE-dedicated reception on PDSCH and all/subset of CORESETs are supported:
  + CSI-RS for beam management
  + CSI-RS for tracking
* ~~FFS (to be decided by RAN1#104bis-e): If SSB, CSI-RS for CSI, and/or SRS for BM are also supported as source RS types~~

On Rel.17 unified TCI framework, the following source RS types for UL TX spatial filter are supported:

* CSI-RS for tracking
* Note: SRS for BM, SSB, and CSI-RS for BM have been agreed in RAN1#102-e
* ~~FFS (to be decided by RAN1#104bis-e): non-BM CSI-RS other than for tracking, non-BM SRS~~

On Rel.17 unified TCI framework:

* For joint and separate DL/UL TCI, DL large scale QCL properties are inferred from one (qcl-Type1) or two RSs (qcl-Type1 and qcl-Type2) analogous to Rel.15/16
* For joint DL/UL TCI, UL spatial filter is derived from the RS of DL QCL Type D

~~On Rel.17 unified TCI framework, by RAN1#104bis-e, down select or modify at least one from the following alternatives:~~

* ~~Alt1. A UE can be dynamically indicated with either joint DL/UL TCI or separate DL/UL TCI~~ 
  + ~~Details on dynamic indication are FFS~~
  + ~~FFS: UE capability for the support of joint DL/UL TCI and/or separate DL/UL TCI~~
* ~~Alt2A. A UE can be configured with either joint DL/UL TCI or separate DL/UL TCI via RRC signaling~~
* ~~Alt2B. A UE can be configured with either joint DL/UL TCI, separate DL/UL TCI, or both via RRC signaling~~
* ~~Alt3. A UE can be configured with either joint DL/UL TCI or separate DL/UL TCI via MAC CE signaling~~
  + ~~Details on how this is signaled in relation to TCI activation are FFS~~

~~On Rel.17 unified TCI framework, decide by RAN1#104bis-e:~~

* ~~Whether DL or, if applicable, joint TCI also applies to the following signals. If not, FFS any other enhancement over Rel.15/16:~~
  + ~~CSI-RS resources for CSI~~
  + ~~Some CSI-RS resources for BM, if so, which ones (e.g. aperiodic, repetition ‘ON’)~~
  + ~~CSI-RS for tracking~~
* ~~Whether UL or, if applicable, joint TCI also applies to the following signals~~
  + ~~Some SRS resources or resource sets for BM~~

~~On the setting of UL PC parameters except for PL-RS (P0, alpha, closed loop index) for Rel.17 unified TCI framework:~~

* ~~The setting of (P0, alpha, closed loop index) is at least associated with UL channel or UL RS~~
* ~~Select or modify from one of the following alternatives by RAN1#104bis-e for PUCCH, PUSCH, and SRS separately:~~
  + ~~Alt1. The setting of (P0, alpha, closed loop index) is also associated with UL or (if applicable) joint TCI state~~
  + ~~Alt2. The setting of (P0, alpha, closed loop index) is included with UL or (if applicable) joint TCI state~~
  + ~~Alt3. The setting of (P0, alpha, closed loop index) is neither associated with nor included in UL or (if applicable) joint TCI state~~
  + ~~Alt4. The setting of (P0, alpha, closed loop index) is determined as in Rel-16 without enhancement~~

~~On Rel.17 unified TCI framework:~~

* ~~Select at least one of the following alternatives by RAN1#104bis-e for path-loss measurement (PL-RS):~~ 
  + ~~Alt1. PL-RS can be included in UL TCI state or (if applicable) joint TCI state.~~ 
    - ~~FFS: Whether it is always included or not. If not included, PL-RS is the periodic DL-RS used as a source RS for determining spatial TX filter or the PL RS used for the UL RS in UL or (if applicable) joint TCI state.~~
  + ~~Alt2. PL-RS can be associated with (but not included in) UL TCI state or (if applicable) joint TCI state~~ 
    - ~~FFS: Exact association mechanism~~
    - ~~FFS: Whether it is always associated or not. If not associated, PL-RS is the periodic DL-RS used as a source RS for determining spatial TX filter or the PL RS used for the UL RS in UL or (if applicable) joint TCI state~~
  + ~~Alt3. The periodic DL-RS used as a source RS for determining spatial TX filter can be used as PL-RS. In case the periodic DL-RS used as a source RS for determining spatial TX filter is not used as PL-RS, reuse Rel.16 procedure with the same signaling structure (MAC CE+SRI field in UL-related DCI) to indicate PL-RS for UL transmission with minimum enhancement (e.g. pertaining to the use for PUCCH, or using default PL-RS)~~ 
    - ~~PL-RS is not additionally configured in or associated to UL TCI state or (if applicable) joint TCI state~~
  + ~~Alt4. UE calculates path-loss based on periodic DL RS configured as the source RS or a periodic QCL-Type-D/spatialRelationInfo source of the source RS in UL TCI state or (if applicable) joint TCI state~~ 
    - ~~FFS: Whether UE can calculate path-loss based on DL periodic RS for path-loss calculation for UL RS in the UL TCI~~
* ~~FFS: Application time of PL-RS~~
* NOTE: As in Rel-16, a UE does not expect to simultaneously maintain more than four path-loss estimates per serving cell for all PUSCH/PUCCH/SRS transmissions
  + FFS: investigate the condition(s) agreed in Rel-17 and, if needed, study whether a UE can simultaneously maintain more than four path-loss estimates

**Conclusion**

On Rel.17 unified TCI framework, at least for dynamic-grant/configured-grant based PUSCH and all of dedicated PUCCH resources in a CC, there is no consensus in supporting non-BM CSI-RS other than for tracking and non-BM SRS as source RS types for UL TX spatial filter reference

No further discussion in Rel-17

~~On the setting of UL PC parameters except for PL-RS (P0, alpha, closed loop index) for Rel.17 unified TCI framework, for each of PUSCH, PUCCH, and SRS, in RAN1#105-e, further discuss to down-select or combine from the following alternatives:~~

1. ~~AltA. The setting of (P0, alpha, closed loop index) is also associated with UL or (if applicable) joint TCI state~~
2. ~~AltB. The setting of (P0, alpha, closed loop index) is also included with UL or (if applicable) joint TCI state~~
3. ~~AltC. The setting of (P0, alpha, closed loop index) is neither associated with nor included in UL or (if applicable) joint TCI state~~

~~Note: It has been agreed that the setting of (P0, alpha, closed loop index) is associated with UL channel or UL RS (therefore the setting is channel- and signal-specific).~~

~~On Rel.17 unified TCI framework, in RAN1#105-e, further discuss to down select or combine from the following three alternatives for PL-RS (note: the text below is based on the agreed description in RAN1#104-e):~~

* ~~AltA. PL-RS can be included in UL TCI state (or, if applicable, joint TCI state).~~
  + ~~FFS: Whether it is always included or not. If not included, PL-RS is the periodic DL-RS used as a source RS for determining spatial TX filter or the PL RS used for the UL RS in UL or (if applicable) joint TCI state.~~
* ~~AltB. PL-RS can be associated with (but not included in) UL TCI state (or, if applicable, joint TCI state)~~
  + ~~FFS: Exact association mechanism~~
  + ~~FFS: Whether it is always associated or not. If not associated, PL-RS is the periodic DL-RS used as a source RS for determining spatial TX filter or the PL RS used for the UL RS in UL or (if applicable) joint TCI state~~
* ~~AltC. UE calculates path-loss based on periodic DL RS configured as the source RS for determining spatial TX filter in UL or (if applicable) joint TCI state~~ 
  + ~~FFS: If a PL RS is not included in or associated with the UL TCI state (or, if applicable, joint TCI state), whether the UE can estimate path-loss based on the PL-RS of an UL RS provided in an UL TCI state (or, if applicable, joint TCI state) as a source RS for determining the spatial TX filter.~~

~~In addition:~~

* ~~FFS (to be decided in RAN1#105-e) whether a fallback scheme is needed and, if so, the details~~
* ~~FFS: Support additional UE capability to report whether above PLRS determination mechanism is supported~~
* Note: As agreed in RAN1#104-e, the total number of maintained PL-RSs per CC is no more than 4
* FFS: investigate the condition(s) agreed in Rel-17 and, if needed, study whether a UE can simultaneously maintain more than four path-loss estimates based on UE capability
* FFS: UE capability for maximum number of active PL-RS across CCs per band

On Rel.17 unified TCI framework,

* Any DL RS that is a valid target DL RS of a Rel-15/16 TCI state based on the Rel-15/16 QCL rules can be configured as a target DL RS of a Rel-17 DL TCI (hence the Rel-17 DL TCI state pool)
  + Note: This does not imply that all such DL RSs necessarily share a same TCI state
  + The DL RS includes CSI-RS and DMRS for PDSCH or PDCCH
* ~~FFS: Whether some SRS resources or resource sets for BM can be configured as a target signal/channel of a Rel-17 UL TCI (hence the Rel-17 UL TCI state pool)~~
* Note: This does not imply that DL and UL TCI state pools are separate or shared for separate DL/UL TCI (this issue is still TBD)

~~On Rel.17 unified TCI framework, discuss and decide by RAN1#106-e (August 2021)~~

* ~~Whether each of the following DL RSs can share the same indicated Rel-17 TCI state as UE-dedicated reception on PDSCH and for UE-dedicated reception on all or subset of CORESETs in a CC~~
  + ~~CSI-RS resources for CSI~~
  + ~~Some CSI-RS resources for BM, if so, which ones (e.g. aperiodic, repetition ‘ON’)~~
  + ~~CSI-RS for tracking~~
  + ~~DMRS(s) associated with non-UE-dedicated reception on PDSCH and all/subset of CORESETs~~
* ~~Whether some SRS resources or resource sets for BM can share the same indicated Rel-17 TCI state as dynamic-grant/configured-grant based PUSCH, all or subset of dedicated PUCCH resources in a CC~~

~~On Rel.17 unified TCI framework, for any DL RS that does not share the same indicated Rel-17 TCI state(s) as UE-dedicated reception on PDSCH and for UE-dedicated reception on all or subset of CORESETs in a CC, but can be configured as a target DL RS of a Rel-17 DL TCI (hence the Rel-17 DL TCI state pool), discuss and down-select by RAN1#106-e (August 2021) between the following two alternatives:~~

* ~~Alt1. Rel-15/16 TCI state update signaling/configuration mechanism(s) are reused to update/configure the Rel-17 TCI state~~
* ~~Alt2. Rel-17 TCI state update signaling/configuration mechanism(s) are used, e.g. with Rel-17 MAC-CE/DCI-based beam indication for Rel-17 joint/separate TCI~~

Note: The DL RS includes CSI-RS and DMRS for PDSCH or PDCCH

Note: For some channels/signals, only one of the above two alternatives may apply (to be discussed).

On path-loss measurement for Rel.17 unified TCI framework, a PL-RS (configured for path-loss calculation) is either included in UL TCI state or (if applicable) joint TCI state or associated with UL TCI state or (if applicable) joint TCI state.

* Whether a UE supports “beam misalignment or not” (detailed definition FFS) between the DL source RS in the UL or (if applicable) joint TCI state to provide spatial relation indication and the PL-RS is a UE capability
  + Note: The term “beam misalignment” is for discussion purpose only
* Whether it is ‘included in’ or ‘associated with’ (including the manner it is performed and the signaling) is up to RAN2
* The UE maintains the PL-RS of the activated UL TCI state or (if applicable) joint TCI state
* The maximum number of activated UL TCI states or (if applicable) joint TCI states per band per cell is a UE capability
* FFS: detailed aspects of PL-RS, e.g. CSI-RS type(s), restriction on configuration
* ~~FFS: For the definition of “beam misalignment or not”, at least consider the case where the periodic DL source RS in the UL or (if applicable) joint TCI state to provide spatial relation indication is configured/associated as the PL-RS~~
* Note: PL-RS is assumed to be periodic

On Rel.17 unified TCI framework, for common TCI state ID update and activation to provide common QCL information at least for UE-dedicated PDCCH/PDSCH and/or common UL TX spatial filter(s) at least for UE-dedicated PUSCH/PUCCH across a set of configured CCs/BWPs

* The source RS determined from the indicated common TCI state ID to provide QCL Type-D indication and to determine UL TX spatial filter for a target CC can be configured in the target CC or other CC
* For intra-band CA, the following configurations can be supported without additional QCL rules:
  + One source RS across CCs can be determined from the indicated common TCI state ID to provide QCL Type-D indication and to determine UL TX spatial filter for the set of configured CCs
  + One source RS per CC can be determined from the indicated common TCI state ID to provide QCL Type-D indication and to determine UL TX spatial filter for the set of configured CCs, and the CC-specific source RSs are further associated with a same QCL-TypeD RS
* “A set of configured CCs/BWPs” includes all the BWPs in the set of configured CCs

For common TCI state ID update and activation to provide common QCL information at least for UE-dedicated PDCCH/PDSCH and/or common UL TX spatial filter(s) at least for UE-dedicated PUSCH/PUCCH across a set of [configured] CCs/BWPs:

* RRC-configured TCI state pool(s) can be configured in the PDSCH configuration (*PDSCH-Config*) for each BWP /CC as in Rel-15/16
  + Note: Such RRC-configured TCI state pool(s) configuration doesn’t imply that separate DL/UL TCI state pool is excluded or supported
* RRC-configured TCI state pool(s) can be absent in the PDSCH configuration (*PDSCH-Config*) for each BWP/CC, and replaced with a reference to RRC-configured TCI state pool(s) in a reference BWP/CC
  + In the PDSCH configuration (*PDSCH-Config*) of the reference BWP/CC, RRC-configured TCI state pool(s) shall be configured
  + For a BWP/CC where the PDSCH configuration contains a reference to the RRC-configured TCI state pool(s) in a reference BWP/CC, the UE applies the RRC-configured TCI state pool(s) in the reference BWP/CC
* When the BWP/CC ID (i.e. *bwp-Id* or *cell*) for QCL-Type A/D source RS in a *QCL-Info* of the TCI state is absent, the UE assumes that QCL-Type A/D source RS is in the BWP/CC to which the TCI state applies
* Introduce a UE capability to report maximum number of TCI state pools it can support across BWPs and CCs in a band, and the candidate value at least includes 1
* FFS: Introduce a UE capability to report maximum number of configured TCI states that it can support across BWPs and CCs in a band
* ~~FFS: How to define reference BWP/CC~~

On the setting of UL PC parameters except for PL-RS (P0, alpha, closed loop index) for Rel.17 unified TCI framework,

* For each of PUSCH and PUCCH, the setting of (P0, alpha, closed loop index) can be associated with UL or (if applicable) joint TCI state per BWP.
  + In this case, multiple settings are configured. Each setting can be associated with at least one TCI state, and, for a given TCI state, only one setting for PUSCH and only one setting for PUCCH can be associated at a time.
  + ~~(Working Assumption) In this case, for each of the PUSCH and PUCCH, each of the activated UL or (if applicable) joint TCI states is associated with one of the settings.~~
* If not associated, for each of the PUSCH and PUCCH, the setting(s) of (P0, alpha, closed loop index) per channel/signal per BWP is independent of the UL or (if applicable) joint TCI states
* ~~FFS: If the setting of (P0, alpha, closed loop index) for SRS can also be associated with UL or (if applicable) joint TCI state.~~
* ~~FFS: (to be decided in RAN1#106-e) whether to configure the same setting of (P0, alpha, closed loop index) per TCI state across channels and apply a channel dependent component, or configure a channel dependent setting of (P0, alpha, closed loop index) per TCI state~~

~~On Rel-17 unified TCI, in RAN1#106-e, for M>1 and/or N>1:~~

* ~~Identify and agree on use cases~~
* ~~Decide whether to support M>1 and/or N>1, and if so, the maximum value of M and/or N~~
* ~~If supported, identify feasible candidate schemes for beam indication signaling mechanism (including TCI state activation)~~

~~Note:~~

* ~~Previous agreement in RAN1#104b-e that remaining unused DCI fields and codepoints are reserved in R17 are not to be reverted.~~
* ~~The use case of simultaneous UL transmission from multiple UE panels are not to be considered in Rel-17 as it is out of scope~~

On Rel.17 unified TCI framework, the following DL RSs can share the same indicated Rel-17 TCI state as UE-dedicated reception on PDSCH and for UE-dedicated reception on all or subset of CORESETs in a CC

* Aperiodic CSI-RS resources for CSI
  + ~~FFS: Discuss if further restriction or further case is necessary~~
* Aperiodic CSI-RS resources for BM
  + ~~FFS: Discuss if further restriction or further case is necessary~~
* ~~FFS: Other CSI-RS time-domain behaviors and/or restriction(s)~~

On Rel.17 unified TCI framework:

* Aperiodic SRS resources or resource sets for BM can share the same indicated Rel-17 TCI state as dynamic-grant/configured-grant based PUSCH, all or subset of dedicated PUCCH resources in a CC
  + ~~FFS: Discuss if/which restriction is necessary, e.g. only for aperiodic, apply to all resources in a set~~
  + Note: This doesn’t imply that all time-domain behaviors are automatically supported

On path-loss measurement for Rel.17 unified TCI framework, at least for discussion purposes:

* “Beam alignment” is defined as follows:
  + The event that the PL-RS is identical to the spatial relation RS in the UL or (if applicable) joint TCI state.
  + FFS: how to define “beam alignment” if the PL-RS and the spatial relation RS in the UL or (if applicable) joint TCI state are not identical
* Any other case, it is defined as beam misalignment

On Rel.17 unified TCI framework, for any DL RS that does not share the same indicated Rel-17 TCI state(s) as UE-dedicated reception on PDSCH and for UE-dedicated reception on all or subset of CORESETs in a CC, but can be configured as a target DL RS of a Rel-17 DL TCI (hence the Rel-17 DL TCI state pool), Rel-17 mechanism(s) which reuse the Rel-15/16 TCI state update signaling/configuration design(s) are used to update/configure such DL RS(s) with Rel-17 TCI state(s).

* Applies for both intra-cell and inter-cell beam indication

On the setting of UL PC parameters except for PL-RS (P0, alpha, closed loop index) for Rel.17 unified TCI framework, the setting of (P0, alpha, closed loop index) for SRS can also be associated with UL or (if applicable) joint TCI state.

* If not associated, the setting(s) of (P0, alpha, closed loop index) for SRS per BWP is independent of the UL or (if applicable) joint TCI states
* This is only applicable for SRS sets using Rel-17 TCI state to determine their spatial relation.

FFS: Whether more than one parameter sets can be configured, e.g. for different traffics

**Conclusion**

On the setting of UL PC parameters except for PL-RS (P0, alpha, closed loop index) for Rel.17 unified TCI framework, there is no consensus in configuring the same setting of (P0, alpha, closed loop index) per TCI state across channels and apply a channel dependent component

* Note: It has been agreed that “The setting of (P0, alpha, closed loop index) is at least associated with UL channel or UL RS” and hence the setting of (P0, alpha, closed loop index) is channel/signal dependent (separate settings for PUCCH, PUSCH, and SRS)

**Conclusion**

On Rel-17 unified TCI, for Rel-17, there is no consensus in supporting additional (M,N) values other than (M,N)=(1,1)

On Rel.17 unified TCI framework, for Rel-17 unified TCI:

* For the number of codepoints in the TCI field for DCI-based beam indication (hence the number of codepoints activated via MAC-CE-based TCI state activation), the largest value is 8
* ~~Further discuss and finalize in RAN1#106bis-e: the largest number of configured TCI states (including joint TCI state(s), DL-only TCI state(s), and/or UL-only TCI state(s))~~

On Rel.17 unified TCI framework, for Rel-17 unified TCI:

* For DL channels/signals that do not share the same indicated Rel-17 TCI state as UE-dedicated reception on PDSCH/PDCCH (via Rel-17 MAC-CE/DCI TCI state update), all the QCL rules defined in section 5.1.5 in 38.214 are supported
  + Note: For CSI-RS used to provide QCL indication for non-UE dedicated channels, the CSI-RS should only be QCLed with SSB of the same PCID as that from the serving cell
* For DL channels/signals that share the same indicated Rel-17 TCI state as UE-dedicated reception on PDSCH/PDCCH (via Rel-17 MAC-CE/DCI TCI state update), the following options on source RSs and QCL-Types are supported
  + Option 1: TRS is configured for QCL-TypeA source RS and CSI-RS for BM is configured for QCL-TypeD source RS
  + Option 2: TRS is configured for QCL-TypeA and QCL-TypeD source RS
  + Note: For inter-cell beam management, SSB with PCID different from that from the serving cell can be used as a QCL Type-C/D source RS for CSI-RS for BM and/or TRS
  + Further discuss and decide in RAN1#106bis-e whether CSI-RS for CSI can be used as a source RS or not, and if so whether some restriction(s) are needed

On Rel.17 unified TCI framework, remove the brackets and clarify as indicated in red from the following *previous agreement*:

*On Rel-17 unified TCI framework, support common TCI state ID update and activation to provide common QCL information and/or common UL TX spatial filter(s) across a set of configured CCs:*

* *…*
* *Just as Rel.16, the source RS in the Rel-17 TCI state that provides QCL-TypeA ~~[or QCL-TypeB]~~ shall be in the same CC as the target channel or RS*
* *…*

On Rel.17 unified TCI framework, the source RS in the Rel-17 TCI state that provides QCL-TypeA or QCL-TypeB shall be in the same CC/BWP as the target channel or RS

On path-loss measurement for Rel.17 unified TCI framework, a PL-RS (configured for path-loss calculation, already assumed periodic) is either a periodic CSI-RS or an SSB. When a periodic CSI-RS is used as a PL-RS,

* Opt2. Both 1- and 2-port (reusing Rel-16 UE capability signalling) periodic CSI-RS are supported for PL-RS

On Rel.17 unified TCI framework, regarding the common TCI state ID update and activation for CA,

* The details on how the PDSCH configuration (for each of those CCs/BWPs) contains a reference to the RRC-configured TCI state pool(s) in a reference BWP/CC are up to RAN2

**Conclusion**

On Rel.17 unified TCI framework, there is no consensus in supporting the following DL source RS type:

* SSB as QCL Type-D source RS, with TRS as QCL Type-A source RS
* SRS for BM as QCL Type-D source RS, optionally with TRS as QCL Type-A source RS

On Rel.17 unified TCI framework, for Rel-17 unified TCI, the largest number of configured TCI states is given as follows (following Rel-15/16 principles):

* When a UE is configured with joint DL/UL TCI: the largest number of configured TCI states for joint DL/UL TCI state update is 128 per BWP per CC
* ~~Further discuss and decide in RAN1#106bis-e when a UE is configured with separate DL/UL TCI~~

**Conclusion**

On Rel.17 unified TCI framework, in case of separate DL/UL TCI, it is up to RAN2 whether UL TCI shares the same TCI state pool as joint DL/UL TCI or UL TCI uses a separate TCI state pool from joint DL/UL TCI

* Note: By previous agreements, DL TCI shares the same TCI state pool as joint DL/UL TCI

On Rel.17 unified TCI framework, for the case when the settings of (P0, alpha, closed loop index) for PUSCH, PUCCH, and/or SRS are associated with UL or (if applicable) joint TCI states per BWP, for each of the PUSCH, PUCCH, and/or SRS, one individual setting is optionally associated with each of the UL or (if applicable) joint TCI states in a BWP via RRC

* FFS: MAC-CE based update for the closed loop index associated with UL or (if applicable) joint TCI state
* Above is applicable for eMBB
  + FFS: Details on power control setting for URLLC

On Rel.17 unified TCI framework, for Rel-17 unified TCI, for DL or UL channels/signals that can share the same indicated Rel-17 TCI state as UE-dedicated reception on PDSCH/PDCCH or dynamic-grant/configured-grant based PUSCH, all of dedicated PUCCH resources (via Rel-17 MAC-CE/DCI TCI state update):

* For DL: A non-UE dedicated PDCCH/PDSCH associated with the serving cell PCI or AP CSI-RS for BM or CSI (per previous agreements) sharing the same indicated Rel-17 TCI state as UE-dedicated reception on PDSCH/PDCCH (via Rel-17 MAC-CE/DCI TCI state update) is configured via RRC.
* For UL: An SRS for BM, for antenna switching, or for codebook/non-codebook based uplink transmission (per previous agreements) sharing the same indicated Rel-17 TCI state as dynamic-grant/configured-grant based PUSCH, all of dedicated PUCCH resources (via Rel-17 MAC-CE/DCI TCI state update) is configured via RRC.

Note: The details of this RRC configuration (e.g. whether via a new RRC parameter or other means) is up to RAN2. This does not imply that a new RRC parameter(s) is necessary from RAN1 point of view.

FFS: Relevant UE capability to be discussed under UE feature agenda item.

On Rel.17 unified TCI framework, for Rel-17 unified TCI, when a UE is configured with separate DL/UL TCI

* The number of configured TCI states a UE can support is a UE capability including the following candidate values per BWP per CC:
  + DL TCI: 64, 128
  + UL TCI: 32, 64
* Note: This doesn’t imply that UL TCI shares the same TCI state pool as or uses a different TCI state pool from joint DL/UL TCI.

On Rel-17 unified TCI framework, for intra-cell beam management, after X symbols from the UE receives the BFRR from NW, the UE assumes the same QCL parameter as the ones associated with the index q new for all PDSCH /PDCCH receptions in a CC, as well as other signals/channels configured to sharing the same indicated Rel-17 TCI state as PDSCH /PDCCH reception.

* The above applies to Rel-15 SpCell BFR, Rel-16 CBRA based SpCell BFR , and Rel-16 SCell BFR
* Note: q new is a candidate beam identified by the UE in set q1. q1 is the set of candidate beams

On Rel-17 unified TCI framework, after X symbols from the UE receives the BFRR from NW, the UE uses the same UL spatial filter as the one associated with the index q new or the last PRACH transmission for all PUSCH transmissions and all of PUCCH resources in a CC, as well as other signals/channels configured to sharing the same indicated Rel-17 TCI state as PUSCH and all of PUCCH resources.

* The above applies to Rel-15/16 SpCell BFR, Rel-16 CBRA based SpCell BFR, and Rel-16 SCell BFR
* Note: q new is a candidate beam identified by the UE in set q1. q1 is the set of candidate beams
* FFS: UL PC control including q u , q d , and closed loop index

On Rel-17 unified TCI framework, any SRS resource or resource set that is a valid target signal of a Rel-15/16 spatial relation based on the Rel-15/16 spatial relation rules (on source-target relations) can be configured as a target signal of a Rel-17 UL or, if applicable, joint TCI (hence the Rel-17 UL or, if applicable, joint TCI state pool).

* This feature does not require a new type of source RS on top of the ones supported for UL TCI and joint DL /UL TCI
  + Note: This doesn’t preclude the content of pending proposal 1.E (on CSI -RS for CSI as QCL Type-A/D source RS) to be agreed in the future
* Note: This does not imply that DL and UL TCI state pools are separate or shared for separate DL /UL TCI (this issue is up to RAN2)
* Note: A Rel-17 UE is not required to support both this feature and optional Rel-16 features of SRS spatial relation info within a same band

**Working Assumption**

The UE is not expected to be configured with Rel-15/Rel-16 TCI/*SpatialRelationInfo* if the UE is configured with Rel-17 TCI in any CC in a band

* The CC list for Rel-16 multi-CC beam indication should not contain any CC configured with Rel-17 TCI

For Rel-17 unified TCI framework, on applying the indicated Rel-17 TCI state to PDCCH reception and the respective PDSCH reception:

* For discussion purposes, define as follows:
  + ‘CORESET A’: A CORESET other than CORESET#0 associated with only UE-dedicated reception on PDCCH in a CC, comprising CORESETs in association with:
    - [USS and/or CSS Type 3]
  + ‘CORESET B’: A CORESET other than CORESET#0 associated with only non-UE-dedicated reception on PDCCH in a CC, comprising CORESETs in association with:
    - [CSS or CSS other than Type 3]
  + ‘CORESET C’: A CORESET other than CORESET#0 associated with both UE-dedicated and non-UE-dedicated reception on PDCCH in a CC
  + CORESET#0
* For Rel-17 TCI state indication, support per CORESET determination as follows:
  + For any PDCCH reception on a ‘CORESET A’ and the respective PDSCH reception, UE always applies the indicated Rel-17 TCI state.
  + For any PDCCH reception on a ‘CORESET B’ and the respective PDSCH reception, whether or not UE to apply the indicated Rel-17 TCI state associated with the serving cell is determined per CORESET by RRC
* FFS: For intra-cell BM, whether CORESET C is supported or not
  + If CORESET C is supported, the TCI state of CORESET C
* FFS: For inter-cell BM, whether CORESET C is supported or not
  + If CORESET C is supported, the TCI state of CORESET C
* FFS: The TCI state of CORESET 0

# Issue 2

* ~~[Issue 2] For Rel.17 NR FeMIMO, on L1/L2-centric inter-cell mobility:~~ 
  1. ~~In RAN1#103-e, finalize scope and use cases for L1/L2-centric inter-cell mobility, including:~~ 
     + ~~Applicability in various non-CA and CA setups such as intra-band and inter-band CA~~
     + ~~Use cases in comparison to Rel.15 L3-based handover (HO) taking into account potential extension of DAPS-based Rel.16 mobility enhancement to FR2-FR2 HO~~
     + ~~The extent of RAN2 impact (MAC CE, RRC, user plane protocols)~~
     + ~~Network architecture, e.g. NSA vs. SA, inter-RAT scenarios~~
  2. ~~In RAN1#103-e, depending on the outcome of 2a), further identify additional components –along with the associated alternatives –required for supporting inter-cell mobility based on the same unified TCI framework as that for intra-cell mobility (including dynamic TCI state update signaling), including~~
     + ~~Method(s) for incorporating non-serving cell information associated with TCI~~
     + ~~Method(s) for DL measurements and UE reporting (e.g. L1-RSRP) associated with non-serving cell(s)~~
     + ~~UE behavior for reception of signals and non-UE-specific control and data channels associated with non-serving cell(s)~~
     + ~~UL-related enhancements, e.g. related to RA procedure including TA~~
     + ~~Beam-level event-driven mechanism for L1/L2-centric inter-cell mobility~~

~~On Rel-17 enhancements to enable L1/L2-centric inter-cell mobility:~~

* ~~The following use cases are assumed:~~ 
  + ~~Network architecture:~~ 
    - ~~NSA, i.e. LTE PCell and NR-PSCell~~
    - ~~SA~~
  + ~~Intra-band CA~~ 
    - ~~FFS: If inter-band CA is also included~~
  + ~~Intra- RAT (excluding inter-RAT)~~
  + ~~Intra-frequency scenario:~~ 
    - ~~The SSBs of non-serving cells have the same center frequency and SCS as the SSBs of the serving cell~~
    - ~~An SSB of a non-serving cell is associated with a PCI different from the PCI of the serving cell~~
    - ~~FFS: Support for inter-frequency scenario~~
  + ~~FFS: Whether to support intra-DU only operation, or whether inter-DU is also allowed~~
* ~~The following enhancement scope is assumed:~~ 
  + ~~Facilitating measurement and reporting of non-serving RSs via incorporating non-serving cell info with some TCI(s), along with the necessary measurement and reporting scheme(s)~~ 
    - ~~FFS: Detailed/exact method(s)~~
    - ~~FFS: Whether this also implies the support of beam indication (TCI state update along with the necessary TCI state activation) for TCI(s) associated with non-serving cell RS(s)~~
    - ~~FFS: Metric for the measurement and reporting, e.g. L1-RSRP or L3-RSRP or time- or spatial-domain-filtered L1-RSRP~~
    - ~~FFS: Beam-level event-driven mechanism, using serving cell RS and/or non-serving cell RS~~
  + ~~Facilitate serving cell to provide configurations for non-serving cell SSBs via RRC~~ 
    - ~~FFS: details for the configurations, e.g. time/frequency location, transmission power, etc.~~
    - ~~FFS: other information needed for inter-cell mobility~~
  + ~~Note: In RAN1's understanding, non-serving cell SSB and non-serving cell RS can be part of the serving cell configuration~~
* ~~FFS: The following enhancement scope is assumed by RAN1:~~ 
  + ~~Whether RRC reconfiguration signaling is needed or not when a TCI associated with non-serving cell RS is indicated~~ 
    - ~~A non-serving cell RS is an RS that is or has an SSB of a non-serving cell as direct or indirect QCL source~~
    - ~~This implies no C-RNTI update when UE receives DL channel RS associated to non-serving cell RS as QCL source.~~
    - ~~FFS whether TCI associated with non-serving cell can be indicated to or are applicable for all channels.~~
  + ~~Whether some RRC parameters need to be updated without additional RRC signaling, e.g. some RRC parameters are pre-configured, which are associated with TCI states with neighbor cell RS as QCL source~~
  + ~~Whether UE needs/can change serving cell during L1/L2-centric inter-cell mobility.~~
  + ~~The above assumption to be verified by RAN2~~

On Rel.17 multi beam measurement/reporting enhancements for L1/L2-centric inter-cell mobility and inter-cell mTRP:

* A quality of up to K beams associated at least with non-serving cell(s) can be reported in a single CSI reporting instance
  + For each beam, the UE can report at least: (1) a Measured RS Indicator, and (2) a Beam Metric associated with the Measured RS Indicator
  + ~~FFS: Maximum value of K~~
  + ~~FFS: If K is fixed, configured, reported by UE capability, or dynamically selected~~
  + ~~FFS: The type of beam metric (e.g. L1-RSRP, L3-RSRP, or hybrid L1/L3-RSRP) and related measurement behavior~~
  + ~~FFS: Whether or not beam reporting associated with non-serving cell(s) can be mixed with that with serving-cell in one reporting instance~~

At the end of RAN1#104-e, send an LS to RAN2 with all the RAN1-related inter-cell mobility agreements done so far during Rel17.

On Rel.17 multi beam measurement/reporting enhancements for L1/L2-centric inter-cell mobility and inter-cell mTRP:

* Rel.15 L1-RSRP is used as reporting quantity for measurement and reporting of non-serving-cell(s)
  + Support SSB as a measurement RS for L1/L2-centric inter-cell mobility and inter-cell mTRP, and Rel.15 SS-RSRP calculated from SSB of non-serving cell(s)
    - ~~FFS: Whether the measurement for SS-RSRP is limited within SMTC~~
    - ~~FFS: Detailed reporting method, e.g. via including existing L1-RSRP report, UE-initiated report etc.~~
  + ~~FFS: Whether or not to support CSI-RS (for e.g. mobility and/or tracking) of non-serving cell(s) as a measurement RS for L1/L2-centric inter-cell mobility and inter-cell mTRP. If the support of CSI-RS (for e.g. mobility and/or tracking) of non-serving cell(s) as a measurement RS for L1/L2-centric inter-cell mobility and inter-cell mTRP is confirmed, Rel.15 CSI-RSRP is also supported~~ 
    - ~~Whether the support applies to CSI-RS with or without QCL source, or both~~
  + ~~FFS: The number of non-serving cell(s) for measurement/reporting~~
  + ~~FFS: time behavior of the reporting, i.e. periodic, semi-persistent, aperiodic, or UE-initiated~~
* ~~FFS: If other reporting quantities are supported, e.g. L3-RSRP, hybrid L1/L3-RSRP~~
* ~~FFS: Dynamic activation/deactivation/selection of the beam measurement on the RS(s) associated with non-serving cell(s) via MAC CE~~
* ~~FFS: Timing assumption (e.g. time of arrival and time of the measurement) for measurement of non-serving cell RS measurement~~

~~On Rel.17 enhancements for L1/L2-centric inter-cell mobility,~~

* ~~Discuss whether to support at least the source RS types already agreed for intra-cell mobility for the purpose of referencing to non-serving cell(s). Note: This implies the following source RS(s):~~ 
  + ~~CSI-RS for BM configured for non-serving cell(s) for DL QCL and UL TX spatial references~~
  + ~~CSI-RS for tracking (TRS) configured for non-serving cell(s) for DL QCL and UL TX spatial references~~
  + ~~SSB configured for non-serving cell(s) for UL TX spatial references~~
  + ~~SRS for BM configured for non-serving cell(s) for UL TX spatial references~~
  + ~~FFS: whether to support CSI-RS for mobility~~
  + ~~FFS: whether to support other source RS(s) potentially agreed later for intra-cell mobility~~
  + ~~FFS: whether to support CSI-RS for BM and tracking configured for non-serving cell(s) and without non-serving cell SSB as QCL-TypeD source~~

On Rel.17 multi-beam measurement/reporting enhancements for L1/L2-centric inter-cell mobility and inter-cell mTRP,

* ~~On the value of K (defined in RAN1#104-e as the number of beam qualities associated at least with non-serving cell(s) can be reported in a single CSI reporting instance),~~ 
  + ~~For the supported maximum value(s) of K, down-select at least one from the following candidates {4, 8, 16}~~
  + ~~FFS: whether the maximum value of K is a UE capability~~
* Periodic, semi-persistent, and aperiodic reporting (and the respective measurements) are supported.
  + Note: Semi-persistent and aperiodic reporting (and their respective measurements) are NW-initiated

On Rel.17 multi-beam measurement/reporting enhancements for L1/L2-centric inter-cell mobility and inter-cell mTRP,

* In one reporting instance, depending on NW configuration, beam(s) associated with a non-serving cell can be mixed with that associated with serving-cell
  + ~~FFS: whether this applies to periodic, semi-persistent, and/or aperiodic~~
  + ~~FFS: How to report the K beams and corresponding qualities if the Tx power among the non-serving cell and with serving-cell is not the same~~
  + ~~Note: The supported numbers of non-serving cells (in terms of measurement/reporting) have not yet been decided. The above description doesn’t imply only one non-serving cell is allowed to be configured for measurement. Nor does this imply that only one non-serving cell is allowed in one reporting instance.~~

~~On Rel.17 multi-beam measurement/reporting enhancements for L1/L2-centric inter-cell mobility and inter-cell mTRP, for L1-RSRP measurement and at least aperiodic reporting, investigate and, if needed, specify MAC CE based dynamic activation/deactivation of a subset of higher-layer-configured measurement for non-serving cell SSBs~~

On Rel.17 L1-RSRP multi-beam measurement/reporting enhancements for L1/L2-centric inter-cell mobility and inter-cell mTRP,

* Support at least K=4, where K is defined as the number of beams associated at least with non-serving cell(s) reported in a single CSI reporting instance
  + The maximum value of supported K is a UE capability
  + K is configured by NW based on the UE capability
  + ~~FFS: The support of K=8 and 16~~
    - ~~For K>4, the maximum number of beams associated with one cell is 4~~
* ~~FFS: Support L1-based event-driven reporting based on Rel-16 SCell BFR framework or analogous to L3-based event-driven reporting, including the definition of L1-based event, if needed~~

~~Note: If another beam metric other than L1-RSRP is supported (e.g. L3-RSRP is still FFS), the above also applies~~

~~On Rel.17 L1-RSRP multi-beam measurement/reporting enhancements for L1/L2-centric inter-cell mobility and inter-cell mTRP, decide by RAN1#106-e whether to support the following RS types as measurement RS or not:~~

* ~~CSI-RS for mobility/RRM associated with a non-serving cell~~
* ~~CSI-RS for BM associated with a non-serving cell~~
* ~~CSI-RS for tracking associated with a non-serving cell~~

~~Note: If another beam metric other than L1-RSRP is supported (e.g. L3-RSRP is still FFS), the above also applies~~

~~Note: An RS is associated with a non-serving cell means that it is either configured for a non-serving cell or configured for a serving cell but is QCLed with a non-serving cell SSB~~

On Rel.17 beam indication enhancements for inter-cell beam management, support the following:

* Rel-17 MAC-CE-based and/or DCI-based beam indication (at least using DCI formats 1\_1/1\_2 with and without DL assignment including the associated MAC-CE-based TCI state activation)
  + ~~FFS (to be decided in RAN1#106-e): Whether this also applies to PDSCH/PUSCH associated with UE-dedicated CORESETs only or additional target channels (e.g. UE-dedicated PDCCH/PUCCH)~~
  + ~~FFS: Whether the above is supported only for joint TCI, or both joint TCI and separate DL/UL TCI (including that, if separate DL/UL TCI is supported, the DL TCI and UL TCI associated with a same cell)~~
  + ~~FFS: Whether to support activation of TCI states for more than one cells simultaneously~~
  + ~~FFS: Whether down-selection between MAC-CE only based and MAC-CE+DCI-based beam indication scheme is necessary~~
* The DL QCL and UL spatial relation rules already agreed for intra-cell scenario
  + Already agreed up to RAN1#106-e day2
* ~~FFS: The use of SSB associated with a physical cell ID different from that of the serving cell as an indirect QCL reference for UE-dedicated PDSCH~~ 
  + ~~FFS (to be decided in RAN1#106-e): Whether this also applies to UE-dedicated PDCCH~~
  + ~~Note: When RS X is an indirect QCL reference of a target channel, there exists at least one other source signal on the QCL chain between RS X and the target channel~~
  + ~~FFS (to be decided in RAN1#106-e): Whether SSB associated with a physical cell ID different from that of the serving cell can also be used as a direct QCL reference (source RS) for UE-dedicated PDCCH/PDSCH~~

On Rel.17 beam indication enhancements for inter-cell management, the supported Rel-17 MAC-CE-based and/or DCI-based beam indication (at least using DCI formats 1\_1/1\_2 with and without DL assignment including the associated MAC-CE-based TCI state activation) apply to:

* Both joint TCI and separate DL/UL TCI
* ~~FFS: For separate DL/UL TCI, whether the indicated DL TCI and UL TCI are associated with SSBs of a same physical cell ID~~

On Rel.17 beam indication enhancements for inter-cell management, for the supported Rel-17 MAC-CE-based and/or DCI-based beam indication (at least using DCI formats 1\_1/1\_2 with and without DL assignment including the associated MAC-CE-based TCI state activation):

* Both MAC-CE based and MAC-CE+DCI-based beam indication schemes are supported
* Note: Previous agreement in RAN1#104b-e that remaining unused DCI fields and codepoints are reserved in R17 are not to be reverted

On Rel.17 beam indication enhancements for inter-cell beam management, for the supported Rel-17 MAC-CE-based and/or DCI-based beam indication (at least using DCI formats 1\_1/1\_2 with and without DL assignment including the associated MAC-CE-based TCI state activation):

* Support a UE feature on how many physical cell IDs (including that of the serving cell) can be associated with the activated TCI states
  + ~~FFS: If UE is configured for only one physical cell ID, decide between the following two options:~~
    - ~~Opt1: the NW can activate TCI states associated with either the same physical cell ID as that of the serving cell or a different physical cell ID from that of the serving cell~~
    - ~~Opt2: the NW can only activate TCI states associated with the same physical cell ID as that of the serving cell~~

Note: The above does not necessarily mean that more than 1 physical cell ID that is not serving cell in RRC

On Rel.17 unified TCI framework, for intra-cell beam indication, the following DL RSs can share the same indicated Rel-17 TCI state as UE-dedicated reception on PDSCH and for UE-dedicated reception on all or subset of CORESETs in a CC:

* DMRS(s) associated with non-UE-dedicated reception on CORESET(s) and the associated PDSCH
* FFS (to be concluded in RAN1#106bis-e): Non-UE-dedicated PUCCH and non-UE-dedicated PUSCH

On Rel.17 beam indication enhancements for inter-cell beam management, the supported Rel-17 MAC-CE-based and/or DCI-based beam indication (at least using DCI formats 1\_1/1\_2 with and without DL assignment including the associated MAC-CE-based TCI state activation) applies to:

* The channels and signals as for intra-cell beam management except for non-UE dedicated channels/signals
* For the aforementioned applicable channels and signals, SSB associated with a physical cell ID different from that of the serving cell is used as an indirect QCL reference for DL TCI (in case of separate DL/UL TCI) or joint TCI, or an indirect/direct QCL reference for UL TCI (in case of separate DL/UL TCI)
  + Note: When RS X is an indirect QCL reference of a target channel, there exists at least one other source signal on the QCL chain between RS X and the target channel. Here, Rel-15/16 QCL rule is reused by replacing SSB with SSB associated with a physical cell ID different from that of the serving cell
* For inter-cell beam management, the support of more than one Rel-17 active DL TCI state / QCL per band is a UE capability
  + If UE does not support such capability, MAC-CE based beam indication (activation of one TCI state) can be used to switch between two different DL receptions along two different beams
    - Note: The serving cell does not change when beam selection is done
  + Note: This does not preclude the possibility for TA update on non-serving cell
  + FFS: For a UE supporting Rel.17 beam indication feature for inter-cell beam management, up to 5 CORESETs can be configured per BWP

**Conclusion**

On Rel.17 L1-RSRP multi-beam measurement/reporting enhancements for inter-cell beam management and inter-cell mTRP, there is no consensus in supporting additional value(s) of KMAX other than 4

On Rel.17 L1-RSRP multi-beam measurement/reporting enhancements for inter-cell beam management and inter-cell mTRP, in RAN1#106bis-e, select one of the following alternatives:

* Alt1. Support L1-based event-driven beam reporting for inter-cell beam management and inter-cell mTRP
* Alt2. Support MAC CE based event-driven beam reporting for inter-cell beam management and inter-cell mTRP
* Alt3. In Rel-17, event-driven beam reporting is not supported for inter-cell beam management and inter-cell mTRP

**Conclusion**

On Rel.17 enhancements for inter-cell beam management,

* In Rel-17, RAN1 cannot reach consensus in supporting same or different TA values across the serving cell and TRPs with different PCIs from that of the serving cell

~~On Rel.17 enhancements for inter-cell beam management,~~

* ~~To be finalized in RAN1#106bis-e): UE timing assumption on reception of signals from TRPs with PCIs different from the serving cell compared to that for serving cell~~

~~On Rel.17 L1-RSRP multi-beam measurement/reporting enhancements for inter-cell beam management and inter-cell mTRP, select N~~~~MAX~~~~(the maximum number of RRC configured PCIs different from the serving cell for measurement/reporting) from the following alternatives (to be decided in RAN1#106bis-e):~~

* ~~Alt1: N~~~~MAX~~~~is up to UE capability with candidate values of 1 and X.~~
  + ~~Note: X as agreed in AI 8.1.2.2~~
  + ~~When N~~~~MAX~~~~is configured to be X, the UE measures up to X PCIs different from the serving cell PCI~~
  + ~~Additional restriction may be added by RAN4~~
* ~~Alt2. N~~~~MAX~~~~=1~~

**Conclusion**

On Rel-17 beam indication enhancements for inter-cell beam management, for separate DL/UL TCI, there is no consensus in restricting the indicated DL TCI and UL TCI to be associated with SSBs of a same physical cell ID.

* Whether a corresponding UE feature can be introduced can be discussed in UE feature agenda

On Rel-17 beam indication enhancements for inter-cell beam management, the supported number of physical cell IDs different from that of the serving cell that are associated with activated TCI states for the supported Rel-17 MAC-CE-based and/or DCI-based beam indication (at least using DCI formats 1\_1/1\_2 with and without DL assignment including the associated MAC-CE-based TCI state activation) will be decided as a part of UE feature discussion.

* Decide in conjunction with inter-cell mTRP, where the candidate value(s) include at least 1

On Rel-17 enhancements for inter-cell beam management and inter-cell mTRP, the L1-RSRP reporting reuses Rel-15 L1-RSRP table

On Rel.17 enhancements to facilitate MPE mitigation, support N=1, 2, 3, and 4

* N is defined as the number of reported measurements
* UE reports supported largest N value as a UE capability

On Rel-17 enhancements for inter-cell beam management and inter-cell mTRP, NMAX (the maximum number of RRC-configured PCIs different from the serving cell for measurement/reporting) is up to UE capability with candidate values of at least 1 and X.

* Note: The upper bound for X as agreed in AI 8.1.2.2
* When NMAXis configured to be X, the UE is RRC-configured for L1-RSRP measurement with up to X PCIs different from the serving cell PCI
* Additional restriction may be added by RAN4
* FFS: UE measurement behaviour when SSBs associated with different PCIs overlap, including whether this is up to UE capability

**Conclusion**

On Rel-17 enhancements for inter-cell beam management and inter-cell mTRP, there is no consensus in RAN1 on UE timing assumption on reception of signals from TRPs with PCIs different from the serving cell compared to that for serving cell

~~On Rel-17 enhancements for inter-cell beam management and inter-cell mTRP, in RAN1#107-e, select one of the following alternatives:~~

* **~~Alt1.~~** ~~Rel-15 L1-RSRP reporting format is reused for all L1-RSRP(s) in one L1-RSRP reporting instance, i.e. for K>1, (K-1) 4-bit differential L1-RSRP(s) calculated relative to the reference (absolute) 7-bit L1-RSRP~~
* **~~Alt2~~**~~. Differential L1-RSRP per PCI is used:~~~~When more than one L1-RSRP(s) associated with a same PCI are reported, Rel-15 L1-RSRP reporting format is used for L1-RSRP(s) associated with the same PCI , i.e. 4-bit differential L1-RSRP (s) calculated relative to the PCI -specific reference (absolute) 7-bit L1-RSRP~~

On Rel-17 enhancements for inter-cell beam management and inter-cell mTRP, Rel-15 L1-RSRP reporting format is reused for all SSBRI-RSRP pairs in one L1-RSRP reporting instance, i.e. for K>1, (K-1) 4-bit differential L1-RSRP(s) calculated relative to the reference (absolute) 7-bit L1-RSRP

On Rel-17 enhancements for inter-cell beam management and inter-cell mTRP, a CSI-SSB-ResourceSet configured for L1-RSRP measurement/reporting includes at least a set of SSB indices where PCI indices are associated with the set of SSB indices, respectively. The PCI indices refer to PCIs within the set of PCIs configured for inter-cell beam management or inter-cell multi-TRP.

* The additionalInfo associated with SSB(s) with PCI(s) different from the serving cell agreed in RAN1 Agenda Item 8.1.2.2 is also applicable to inter-cell BM
* Detailed signaling design is up to RAN2
* ~~FFS (to be concluded in RAN1#107-e): Whether the above L1-RSRP measurement/reporting also includes group-based beam report for inter-cell mTRP~~

**Conclusion**

On Rel-17 enhancements for inter-cell beam management and inter-cell mTRP , in Rel-17, there is no consensus that the agreed L1-RSRP measurement/reporting also includes group-based beam report for inter-cell mTRP

With regards to the below question in RAN2 LS, provide the following response.

|  |
| --- |
| If UE is receiving DL data from *TRP with different PCI* on dedicated channels, is the UE still able to receive short message (e.g. paging) and system information from *serving cell TRP*at the same time? |

**Answer: No, it is not.**

**Conclusion**

On Rel-17 enhancements for inter-cell beam management and inter-cell mTRP , in Rel-17, on the UE behavior when there is overlap for L1-RSRP measurement for SSB associated with serving cell PCI and PCIs different from the serving cell PCI

* Prepare an LS to RAN4 informing and recommending RAN4 to investigate the issue
* Note: Discussion in UE feature agenda on this issue is not ruled out

# Issue 3

* ~~[Issue 3] For Rel.17 NR FeMIMO, on dynamic TCI state update signaling medium:~~ 
  1. ~~In RAN1#103-e, investigate, for the purpose of down selection, the following alternatives:~~
     + ~~Alt1. DCI~~
     + ~~Alt2. MAC CE~~
     + ~~Note: Combination between DCI and MAC CE for, e.g. different use cases or control information partitioning can also be considered~~
     + ~~Note: The study should consider factors such as feasibility for pertinent use cases, performance (based on at least the agreed EVM), overhead (including PDCCH capacity), latency, flexibility, reliability including the support of retransmission~~
     + ~~Note: This may be related to outcome of issue 1a), 1b), and 6a)~~
  2. ~~In RAN1#103-e, depending on the outcome of 3a), identify candidates for more detailed design issues for the dynamic TCI state update such as~~ 
     + ~~Exact content~~
     + ~~Signaling format~~
     + ~~Reliability aspects including the support of retransmission~~
     + ~~Extensions, including the support of UE-group (in contrast to UE-dedicated) signaling~~

On beam indication signaling medium to support joint or separate DL/UL beam indication in Rel.17 unified TCI framework:

* Support L1-based beam indication using at least UE-specific (unicast) DCI to indicate joint or separate DL/UL beam indication from the active TCI states
  + The existing DCI formats 1\_1 and 1\_2 are reused for beam indication
  + Support a mechanism for UE to acknowledge successful decoding of beam indication
    - The ACK/NAK of the PDSCH scheduled by the DCI carrying the beam indication can be used as an ACK also for the DCI
    - ~~FFS: Whether any additional specification support is needed~~
* Support activation of one or more TCI states via MAC CE analogous to Rel.15/16:
  + At least for the single activated TCI state, the activated TCI state is applied
  + The content for the MAC CE is determined based on the outcome of issue 1
  + ~~FFS: If supported, default TCI state when more than one TCI states are activated by MAC CE~~
  + Note: There is no implications on the support of single TRP or multi-TRP
* ~~FFS: Additional enhancement such as L1-based beam indication with group-common DCI~~
* ~~FFS: Whether the Rel.17 beam indication can also apply to beam indication for single channel (e.g. PDSCH only, single CORESET) or a subset of channels~~
* ~~FFS: Additional details on extending the support of L1-based beam indication when separate UL (from DL) common beam indication is configured~~

~~In RAN1#104-e, on the Rel-17 L1-based TCI state update (beam indication) for the unified TCI framework, interested companies are to provide the following:~~

* ~~How to use DCI formats 1\_1 and 1\_2 for UL-only (in case of separate DL/UL) TCI state update (beam indication)~~ 
  + ~~Note: The agreement implies that DCI formats 1\_1 and 1\_2 can be used for UL-only TCI state update beam indication).~~
  + ~~FFS: Using DCI format 1\_1 and 1\_2 without DL assignment, and with a new acknowledgment mechanism directly in response to decoding DCI format 1\_1 and 1\_2, e.g., analogous to SPS PDSCH release~~
* ~~Whether/how to support at least one additional DCI format dedicated for UL-only beam indication (in case of separate DL/UL), including:~~
  + ~~Whether the format can also be used for DL-only beam indication (in case of separate DL/UL) and joint DL/UL beam indication~~
  + ~~Whether it is a “brand new” format or based on some extension of the existing DCI formats other than 1\_1 and 1\_2 (e.g. 1\_0, 0\_0, 0\_1, or 0\_2)~~
    - ~~If UL-related DCI is used, whether it is accompanied with UL grant or not~~
  + ~~Acknowledgment mechanism~~

~~On Rel.17 DCI-based beam indication:~~

* ~~Regarding application time of the beam indication: if beam indication is received, down-select from the following:~~
  + ~~Alt1: the first slot that is at least X ms or Y symbols after the DCI with the joint or separate DL/UL beam indication~~
  + ~~Alt2: the first slot that is at least X ms or Y symbols after the acknowledgment of the joint or separate DL/UL beam indication~~
  + ~~FFS: whether any existing timing defined for DCI based TCI/spatial relation update can be used for X/Y~~
* ~~FFS: When to apply the minimum indication delay (e.g., when the newly indicated beam is different with the previously indicated beam)~~

~~On Rel.17 DCI-based beam indication, the beam application time is to be down-selected or modified from the following:~~

* ~~Alt1: The beam application time can be configured by the gNB based on UE capability~~
  + ~~Support a UE capability for the minimum value of beam application time~~
  + ~~FFS: the exact minimum values of beam application time supported by UE~~
  + ~~FFS: whether existing UE capability can be reused as this UE capability.~~
  + ~~FFS: whether different beam application time values are supported for uplink and downlink~~
  + ~~FFS: whether UE capability needs to be introduced for the maximum value of beam application time~~
* ~~Alt2: The beam application time is fixed and defined in specification~~
* ~~Alt3: The beam application time can be configured by the gNB where the minimum value of beam application time is fixed and defined in specification~~

Consider multi-panel UE, layer 1/2 inter-cell cases, carrier aggregation aspects

On the beam application time for Rel.17 DCI-based beam indication, the beam application time can be configured by the gNB based on UE capability

* Support a UE capability for the minimum value of beam application time
* FFS: the exact minimum values of beam application time supported by UE
* FFS: whether existing UE capability can be reused as this UE capability.
* FFS: whether different beam application time values are supported for uplink and downlink
* FFS: whether UE capability needs to be introduced for the maximum value of beam application time
* FFS: the reference for defining the UE capability (e.g. from DCI reception or ACK transmission)
* FFS: whether a UE is allowed to report more than 1 values in case of MPUE
* FFS: the application time when DCI and applied channel(s) are on different CCs with same/different SCS(s)s

~~On the Rel.17 DCI-based beam indication, in RAN1#104bis-e, down-select at least one of the following alternatives regarding the support of DCI format(s) for beam indication in addition to the agreed DCI formats 1\_1/1\_2 with DL assignment (in RAN1#103-e):~~

* ~~Alt0: No additional DCI format is supported~~
* ~~Alt1: DCI formats 1\_1 and 1\_2 without DL assignment, applicable for joint TCI as well as separate DL/UL TCI~~ 
  + ~~Support DCI acknowledgment mechanism, e.g. based on SPS PDSCH release, based on triggered SRS, based on DCI indicating SCell dormancy~~
  + ~~FFS: How to identify DCI formats 1\_1/1\_2 used for beam indication only (not for scheduling a PDSCH reception, not indicating a SPS PDSCH release, or not indicating SCell dormancy), considering impacts on PDCCH coverage and scheduling mechanism~~
  + ~~FFS: Whether the UE can/shall assume the gNB configured application time is after ACK transmission~~
* ~~Alt2: Dedicated DCI format other than 1\_1/1\_2 without DL assignment, applicable for joint TCI as well as separate DL/UL TCI~~ 
  + ~~Support DCI acknowledgment mechanism, e.g. based on SPS PDSCH release, based on triggered SRS, based on DCI indicating SCell dormancy~~
  + ~~FFS: If the format is based on an existing DCI format, how to identify the DCI format used for beam indication only~~
  + ~~FFS: Whether the UE can/shall assume the gNB configured application time is after ACK transmission~~
* ~~Alt3: UL-related DCI formats 0\_1/0\_2 with UL grant, applicable only for UL-only TCI of separate DL/UL TCI~~

~~On Rel.17 DCI-based beam indication, regarding application time of the beam indication: if beam indication is successfully received and the newly indicated beam in the beam indication is different from the previously indicated beam, down-select (no later than RAN1#105-e) one from the following. No other alternatives will be considered:~~

* ~~Alt1: the first slot that is at least X ms or Y symbols after the [first/last] symbol of the DCI with the joint or separate DL/UL beam indication~~
* ~~Alt2A: the first slot that is at least X ms or Y symbols after the [first/last] symbol of the acknowledgment of the joint or separate DL/UL beam indication~~
* ~~Alt 2B: the first slot that is at least X ms or Y symbols after the [first/last] symbol of the acknowledgment of the joint or separate DL/UL beam indication, except that the (new) TCI state update can be applied to the PDSCH, if it exists, (scheduled by the beam indication DCI) and corresponding ACK transmission (provided that the time offset between the DCI and the scheduled PDSCH exceed the threshold, analogous to Rel.15/16)~~
* ~~Alt2C: Support both Alt1 and Alt2A, and introduce a UE capability that indicates the support of Alt1 or Alt2A~~
* ~~Alt3: the first slot that is at least X1 ms or Y1 symbols after the [first/last] symbol of the DCI with beam indication and X2 ms or Y2 symbols after the [first/last] symbol of the acknowledgment of the beam indication~~
* ~~FFS: whether any existing timing defined for DCI based TCI/spatial relation update can be used for X/Y~~

For beam indication with Rel-17 unified TCI, support DCI format 1\_1/1\_2 without DL assignment:

* Use ACK/NACK mechanism analogous to that for SPS PDSCH release with both type-1 and type-2 HARQ-ACK codebook:
  + Upon a successful reception of the beam indication DCI, the UE reports an ACK
    - Note that upon a failed reception of the beam indication DCI, a NACK can be reported.
    - For type-1 HARQ-ACK codebook, a location for the ACK information in the HARQ-ACK codebook is determined based on a virtual PDSCH indicated by the TDRA field in the beam indication DCI, based on the time domain allocation list configured for PDSCH
    - For type-2 HARQ-ACK codebook, a location for the ACK information in the HARQ-ACK codebook is determined according to the same rule for SPS release
  + The ACK is reported in a PUCCH *k* slots after the end of the PDCCH reception where *k* is indicated by the PDSCH-to-HARQ\_feedback timing indicator field in the DCI format, or provided *dl-DataToUL-ACK* or *dl-DataToUL-ACK-ForDCI-Format1-2-r16* if the PDSCH-to-HARQ\_feedback timing indicator field is not present in the DCI
* When used for beam indication:
  + CS-RNTI is used to scramble the CRC for the DCI
  + The values of the following DCI fields are set as follows:
    - RV = all ‘1’s
    - MCS = all ‘1’s
    - NDI = 0
    - Set to all ‘0’s for FDRA Type 0, or all ‘1’s for FDRA Type 1, or all ‘0’s for *dynamicSwitch* (same as in Table 10.2-4 of TS38.213)
    - FFS: Whether HPN is also used
* Use the existing TCI field (always present) to signal the following: 1) Joint DL/UL TCI state, 2) DL-only TCI state (for separate DL/UL TCI), 3) UL-only TCI state (for separate DL/UL TCI)
  + ~~FFS: Whether both DL TCI and UL TCI states can be signaled in one instance of beam indication DCI~~
  + ~~FFS: Relation with joint vs separate TCI (DL and/or UL) switching, including M/N>1 if supported~~
* In addition, use the following DCI fields as the fields are being used in Rel-16:
  + Identifier for DCI formats
  + Carrier indicator
  + Bandwidth part indicator
  + TDRA
  + Downlink assignment index (if configured)
  + TPC command for scheduled PUCCH
  + PUCCH resource indicator
  + PDSCH-to-HARQ\_feedback timing indicator (if present)
* The remaining unused DCI fields and codepoints are reserved in R17
* Support UE to report whether or not to support TCI update by DCI format 1\_1/1\_2.
  + For a UE supporting TCI update by DCI format 1\_1/1\_2, it must support TCI update by using DCI 1\_1/1\_2 with DL assignment, and support of the above feature for TCI update by DCI format 1\_1/1\_2 without DL assignment is UE optional
  + ~~FFS: How to handle the case when there is only UL data~~
  + ~~FFS: The case for UE being indicated with separate UL TCI in DCI format 1\_1/1\_2 with DL assignment~~
* FFS: When more than one TCI codepoints are activated by MAC CE, the activated TCI state(s) for the lowest codepoint is/are applied
  + Support of this feature is UE optional
  + The “lowest codepoint” function can be configured on or off.
  + ~~FFS: Interaction with the DCI based beam update if needed, whether/how to support the case with M or N > 1 if supported~~
* ~~Note: This agreement on DCI beam indication design is not to be used to be against the support of the cases of M/N>1. The support of M/N>1 will be separately discussed and not dependent on the decision here.~~

On Rel-17 DCI-based beam indication, regarding application time of the beam indication, the first slot that is at least X ms or Y symbols after the last symbol of the acknowledgment of the joint or separate DL/UL beam indication.

* Note: The gap between the last symbol of the beam indication DCI and that first slot shall satisfy the UE capability
* ~~FFS: Application time and whether additional offset is needed for the application time in case of cross carrier beam indication and common TCI state ID update across a set of configured CCs if CCs have different SCSs~~
* FFS: Whether inter-cell beam switching needs higher X/Y values than intra-cell
* FFS: Whether application time can be indicated/determined dynamically for different scenarios, e.g. cross CC, inter-cell, inter-panel without reverting previous RAN1 agreements

For M=N=1, on Rel-17 unified TCI, for separate DL/UL TCI, one instance of beam indication using DCI formats 1\_1/1\_2 (with and without DL assignment) can be used as follows:

* One TCI field codepoint represents a pair of DL TCI state and UL TCI state. If the DCI indicates such a TCI field codepoint, the UE applies the corresponding DL TCI state and UL TCI state.
* One TCI field codepoint represents only a DL TCI state. If the DCI indicates such a TCI field codepoint, the UE applies the corresponding DL TCI state, and keeps the current UL TCI state.
* One TCI field codepoint represents only an UL TCI state. If the DCI indicates such a TCI field codepoint, the UE applies the corresponding UL TCI state, and keeps the current DL TCI state.

~~FFS: the cases of M or N>1~~

**Conclusion**

On Rel-17 unified TCI framework, for a UE configured with both joint TCI and separate DL/UL TCI, configuration of joint TCI or separate DL/UL TCI is based on RRC signaling

* There is no consensus in RAN1 on how to support dynamic switching (either MAC-CE or codepoint based)

On Rel-17 DCI-based beam indication, regarding application time of the beam indication, the first slot to apply the indicated TCI is at least Y symbols after the last symbol of the acknowledgment of the joint or separate DL/UL beam indication.

* Note: The Y symbols are configured by the gNB based on UE capability, which is also reported in units of symbols.
* FFS whether Y is configured per BWP, per CC or per band or per SCS, or independent of BWP/CC/SCS
  + Note: Previous agreement in RAN1#104b-e that remaining unused DCI fields and codepoints are reserved in R17 are not to be reverted

~~On Rel-17 DCI-based beam indication, regarding application time of the beam indication, in RAN1#106-bis-e, further down select one from the following alternatives for the case of CA:~~

* ~~Alt1: The first slot and the Y symbols are both determined on the carrier with the smallest SCS among the carrier(s) applying the beam indication~~
* ~~Alt2: The first slot and the Y symbols are both determined on the carrier with smallest SCS among the carrier(s) applying the beam indication and the UL carrier carrying the acknowledgment~~
* ~~Alt3: The first slot and the Y symbols are both determined on the UL carrier carrying the acknowledgment.~~

On Rel-17 DCI-based beam indication, regarding application time of the beam indication for CA, the first slot and the Y symbols are both determined on the carrier with the smallest SCS among the carrier(s) applying the beam indication.

* For Rel-17 MAC-CE based beam indication (when only a single TCI codepoint is activated) and activation, it follows the Rel-16 application timeline of MAC-CE activation
  + How to capture this in the specifications is up to the editors

On Rel-17 DCI-based beam indication, regarding application time of the beam indication, the UE can assume that one beam application time (BAT) for a given SCS is configured for all the CCs configured with the common TCI state ID update,

* Note: It was agreed that the BAT associated with the carrier(s) (hence BWP(s)/CC(s)) on which the beam indication applies is determined based on the carrier with the smallest SCS among the carrier(s) (hence BWP(s)/CC(s)) applying the beam indication
* TBD (maintenance): whether a second configured BAT is also supported, e.g. for MPUE or inter-cell BM
* The detailed signaling of the BAT is up to RAN2
* FFS: For CC(s) not configured with a common TCI state ID update

# Issue 4

* ~~[Issue 4] For Rel.17 NR FeMIMO, on MP-UE assumption to facilitate fast UL panel selection:~~
  1. ~~The following assumptions are used:~~ 
     + ~~In terms of RF functionality, a UE panel comprises a collection of TXRUs that is able to generate one analog beam (one beam may correspond to two antenna ports if dual-polarized array is used)~~
     + ~~UE panels can constitute the same as well as different number of antenna ports, number of beams, and EIRP~~
     + ~~No beam correspondence across different UE panels~~
     + ~~FFS: For each UE panel, it can comprise an independent unit of PC, FFT timing window, and/or TA.~~
     + ~~FFS: Same or different sets of UE panels can be used for DL reception and UL transmission, respectively~~
  2. ~~In RAN1#103-e, identify candidate use cases including MPE, and consider remaining aspects if use cases are identified~~
  3. ~~In RAN1#103-e, identify candidate signaling schemes for the following:~~
     + ~~NW to MP-UE (taking into account potential extension of the unified TCI framework in issue 1)~~
     + ~~MP-UE to NW~~

~~In Rel-17 enhancement for facilitating fast uplink panel selection, the following use cases are assumed:~~

* ~~MPE mitigation~~
* ~~UE power saving~~
* ~~UL interference management~~
* ~~Support different configurations across panels~~
* ~~UL mTRP~~

~~In Rel-17 enhancement on MP-UE to facilitate fast UL panel selection and MPE mitigation, UL Tx panel(s) are assumed to be a same set or subset of DL Rx panel(s)~~

In Rel.17 enhancement for facilitating fast uplink panel selection, UE-initiated UL panel selection/activation are supported:

* FFS: Whether NW-initiated panel selection/activation is also supported
* FFS: Whether specification support for this feature is necessary and if so the details of such spec support.

**Conclusion**: On Rel.17 enhancements to facilitate UL beam selection for MP-UE, the following terms are used at least for the purpose of discussion:

* ‘Panel activation’ (at least for DL/UL measurement): activating L out of P available UE panel(s) at least for the purpose of DL and UL beam measurements (e.g. reception of DL measurement RS, transmission of SRS)
* ‘Panel selection’ (for UL transmission): selecting 1 out of L activated UE panel(s) for the purpose of UL transmission
* Note: UE-initiated panel activation and selection have been agreed in RAN1#103-e

On Rel.17 enhancement for facilitating fast uplink panel selection,

* Rel.17 TCI state update (based on MAC CE + DCI along with the necessary TCI state activation, or MAC CE only) can be used for UE UL panel selection
* FFS: Whether specification support for this feature is necessary and if so the details of such spec support, e.g.
  + Additional spec support in TCI state definition to accommodate UL panel
  + UE reporting to facilitate UL panel selection
  + UE reporting, e.g. panel-specific report, including UE-panel state, e.g. inactive, active for DL/UL measurement, active for DL reception only, active for UL transmission, or other combination(s) of UE-panel states
  + Support for linking or association of UE panels with CSI-RS/SSB resources or resource sets, SRS resource sets, and/or PUCCH resource groups, etc.

On Rel.17 enhancement for facilitating fast uplink panel selection, for discussion purpose, a panel entity corresponds to one or more RS resources:

* For CSI/beam reporting, the RS resource is an RS associated with measurement and/or reporting
* For beam indication, the RS resource is a source RS for UL TX spatial filter information
* Note: For one RS resource, the corresponding panel entity may vary and is controlled by the UE, and whether/how to maintain a common understanding between gNB and UE can be further discussed/decided
* Note: The above does not preclude possibility that an RS resource can be mapped to multiple panels
* Note: The one or more RS resources may correspond to one or more RS resource set(s) depending on further discussion/decision
* Note: Specification should not be designed in such a way that the UE is required to disclose its antenna implementation

~~On Rel.17 enhancements to facilitate UE-initiated panel activation and selection, for CSI/beam measurement/reporting, down select and/or modify from the following candidates:~~

* ~~Opt1-1: A panel entity corresponds to a reported CSI-RS and/or SSB resource index in a beam reporting instance~~
  + ~~The correspondence between a panel entity and a reported CSI-RS and/or SSB resource index is informed to NW~~
    - ~~FFS: How to inform through CSI/beam reporting framework~~
  + ~~FFS: Detailed design of the correspondence including the conveyed information~~
  + ~~Note: the correspondence between a CSI-RS and/or SSB resource index and a panel entity is determined by the UE (analogous to Rel-15/16)~~
* ~~Opt1-2: A panel entity is referring to a new panel ID within CSI/beam reports~~
  + ~~FFS: Detailed design of the new panel ID including the information conveyed by the new panel ID~~
  + ~~Note: The association between the new panel ID and the panel entity is determined by the UE~~
* ~~Opt1-3: No additional specification support~~
* ~~The duration in which the above panel entity reference is valid and the respective setting are FFS~~

~~Note: “panel entity” is only used for discussion purpose~~

~~On Rel.17 enhancements for MPUE, investigate and,~~ **~~if needed~~**~~, specify the following:~~

* ~~UE reporting of panel-specific information as a UE capability, for example:~~
  + ~~Information related to the total number of DL/UL panel entities~~
  + ~~Information related to the number of (max) antenna ports/layers per panel entity~~
  + ~~Information related to the maximum number of resources per panel entity for SRS BM~~
  + ~~Information related to panel selection delay~~
  + ~~Information related to panel activation delay~~
* ~~UE reporting information related to minimal activation/selection delay for a panel based on L1 or L2 signaling~~
* ~~UE reporting of panel activation/selection status of a panel entity, e.g. active state for both DL and UL, or active state for DL only~~
  + ~~FFS: details of this information (e.g. minimal activation/selection delay for a panel) and signaling (e.g. L1 or L2 signaling)~~
* ~~UE-reported information in MPE report (if supported) is used to indicate the minimal activation/selection delay and panel activation/selection status~~
* ~~Note: above ‘panel entity’ is a logical entity and how to map physical panels to the logical entities is up to UE implementation~~
* ~~Note: This will depend on the final outcome of whether specification support for UE-initiated panel activation/selection is agreed~~

~~On Rel.17 enhancements for MPUE, for codebook based UL transmission, decide by August RAN1 meeting whether to support CB-based SRS resources with different numbers of ports~~

* ~~FFS details (e.g. per resource or per resource set)~~
* ~~Note: the above is not for Rel-16 full power transmission but for Rel-17 panel-specific UL transmission~~
* ~~FFS: non-codebook based UL transmission for MPUE~~

~~FFS whether existing BWP switch based mechanism (discussed previously in Rel-16 power saving WI) can serve such purpose~~

**~~For future meetings (to be captured in my notes):~~**

~~Continue to study necessary enhancements to optimize transmission from UEs with different number of max number of UL MIMO layers per panel entity~~

~~On Rel.17 enhancements to facilitate UE -initiated panel activation and selection, down select or modify from the following two schemes in RAN1#106bis-e:~~

* ~~Scheme 1:~~
  + ~~A panel entity corresponds to a reported CSI-RS and/or SSB resource index in a beam reporting instance (i.e. Opt1-1 per RAN1#104-bis-e agreement)~~
    - ~~The correspondence between a panel entity and a reported CSI-RS and/or SSB resource index is informed to NW~~
      * ~~FFS: Detailed design of how to inform the correspondence to NW~~
    - ~~Note: the correspondence between a CSI-RS and/or SSB resource index and a panel entity is determined by the UE (analogous to Rel-15/16)~~
  + ~~Support UE reporting of maximum number of SRS ports and coherence type for each panel entity as a UE capability~~
  + ~~Support multiple c odebook -based SRS resource sets with different maximum number of SRS ports~~
    - ~~The indicated SRI is based on the SRS resources corresponding to one SRS resource set, where the SRS resource set should be aligned with the UE capability for the panel entity~~
* ~~Scheme 2:~~
  + ~~Support UE reporting one of the following (to be down selected in RAN1#106bis-e):~~
    - ~~Opt1. A list of supported UL ranks (number of UL transmission layers)~~
    - ~~Opt2. A list of supported number of SRS antenna ports~~
    - ~~Opt3. A list of coherence types (as in Rel-15) indicating a subset of ports~~
  + ~~The NW configures an association between an rank index and rank/number of SRS antenna ports/coherence type~~
  + ~~Include at least one of the index, the maximum UL rank or SRS antenna ports or coherence type corresponding to a reported SSBRI/CRI in a beam reporting instance~~
    - ~~FFS: timeline to apply above result in the beam report instance~~
  + ~~Support multiple codebook -based SRS resource sets with different number of SRS antenna ports~~
    - ~~The indicated SRI is based on the SRS resources corresponding to one SRS resource set, where the SRS resource set should be aligned with the UE reported info corresponding to the index~~

**Working Assumption**

Support the UE reporting a list of UE capability value sets

* Each UE capability value set comprises the max supported number of SRS ports
* For any two different value sets, at least one capability value needs to be different
  + FFS: If in addition also identical value sets are allowed.
* Whether the UE capability value set can be common across all BWPs/CCs in same band or BC can be discussed in UE feature session

On Rel.17 enhancements to facilitate UE -initiated panel activation and selection via UE reporting a list of UE capability value sets, the correspondence between each reported CSI-RS and/or SSB resource index and one of the UE capability value sets in the reported list is determined by the UE (analogous to Rel-15/16) and is informed to NW in a beam reporting instance.

* The Rel-15/16 beam reporting framework is used, i.e. the index of corresponding UE capability value set is reported along with the pair of SSBRI/CRI and L1-RSRP/SINR (up to 4 pairs, with 7-bit absolute and 4-bit differential) in the beam reporting UCI and down select (maintenance) between the following twooptions:
  + Option 1: UE can report one index for all the reported CRIs/SSBRIs in one beam reporting
  + Option 2: UE can report one index for each reported CRI/SSBRI in one beam reporting.
  + FFS: whether/how to take DL-only panel into account in the report
* FFS: Time-domain behaviour, e.g. the support periodic, semi-persistent, and aperiodic reporting
  + FFS: Semi-persistent and/or aperiodic reporting is triggered only when periodic reporting is configured
* (**Working assumptions**): Support acknowledgement mechanism of the reported correspondence from NW to UE, which doesn't preclude reusing/reinterpreting existing signaling/procedure
  + FFS (maintenance): the application time for the reported correspondence (if any), the exact acknowledgement mechanism and whether spec impact is needed, e.g. based on TCI state update, BFR response like mechanism, including the application time for the reported correspondence, if any
  + No new DCI format and no new RNTI are introduced for this function.

**Conclusion**

On Rel.17 enhancements to facilitate UE -initiated panel activation and selection via UE reporting a list of UE capability value sets, other than the max supported number of SRS ports (note: currently pending endorsement in proposal 4.A), there is no consensus on supporting another UE capability type

# Issue 5

* ~~[Issue 5] For Rel.17 NR FeMIMO, on MPE mitigation (that is, minimizing the UL coverage loss due to the UE having to meet the MPE regulation), in RAN1#103-e:~~ 
  1. ~~If needed, identify candidate solutions to be down-selected in future meeting(s). The following sub-categories can be used:~~
     + ~~CAT0. The need for specification support for MPE event detection and, if needed, candidate solutions~~
     + ~~CAT1. The need for UE reporting associated with an MPE and/or a potential/anticipated MPE event if the UE selects a certain UL spatial resource, e.g., corresponding to DL or UL RS~~
     + ~~CAT2. The need for NW signaling in response to the reported MPE event (taking into account issue 1) and UE behavior after receiving the NW signaling~~
     + ~~Note: RAN4 has agreed to specify P-MPR reporting (cf. CRs for TS 38.101/102/133) which can be used as a baseline scheme for further enhancement~~
     + ~~Note: This may be related to outcome of issue 4b)~~
  2. ~~Companies are encouraged to submit evaluation results based on the agreed EVM to justify the benefits of the candidate solutions~~

~~On UE reporting for MPE mitigation for Rel-17, investigate and, if needed, specify the following:~~

* ~~Reporting of P-MPR report based on Rel.16 framework.~~
  + ~~FFS: Whether panel/beam level based P-MPR report is supported~~
  + ~~FFS: Maximum reported number of panels, e.g. single or multiple~~
* ~~Reporting SSBRI(s)/CRI(s) and/or indication of panel selection for the purpose of indicating:~~
  + ~~Alt1: alternative UE panel(s) or TX beam(s) for UL transmission~~
  + ~~Alt2: feasible UE panel(s) or TX beam(s) for UL transmission taking the MPE effect into account~~
  + ~~FFS: indication of panel selection details (e.g. explicit/implicit)~~
* ~~Any additional reporting content: down-select from the following in RAN1#104-e~~ 
  + ~~Alt0: no additional reporting content~~
  + ~~Alt1: Additional reporting content is included (for example P-MPR + L1-RSRP, virtual PHR + L1-RSRP, L1-RSRP/SINR with and without MPE effect, virtual PHR, P-MPR or virtual PHR + CRI/SSBRI, estimated max UL RSRP)~~ 
    - ~~Note: Other options are not precluded~~
    - ~~FFS: Whether the above reporting is triggered by UE or configured by NW~~

~~On Rel.17 enhancements to facilitate MPE mitigation,~~

* ~~On further enhancing the P-MPR report in Rel.16 (already agreed RAN4 framework, including triggering), down select between beam-level and panel-select reporting~~
* ~~On SSBRI(s)/CRI(s) and/or indication of panel selection, focus study on the following:~~ 
  + ~~Reporting of at least SSBRI(s)/CRI(s) to indicate gNB beam(s) that is feasible for UL transmission: additional reporting quantities are FFS~~
  + ~~Reporting of at least an indicator associated with a UE ‘panel’ that is feasible for UL transmission: additional reporting quantities are FFS~~
* ~~Note: Just as agreed in RAN1#103-e, the purpose is to assess whether specification is needed or not~~

~~On Rel.17 enhancements to facilitate MPE mitigation, decide in RAN1#104bis-e whether to support at least one the following (not necessarily, but can be, in one reporting instance):~~

* ~~{Rel.16 P-MPR based (beam/panel-level)} + {A}, where A is either Opt1A, Opt1B, Opt1C, or Opt1D:~~
  + ~~Option 1A: Virtual PHR or a modified version associated with each activated UL TCI or, if applicable, joint TCI~~
  + ~~Option 1B: {SSBRI(s)/CRI(s) and/or panel indication}~~
  + ~~Option 1C: {SSBRI(s)/CRI(s) and/or panel indication} + virtual PHR or a modified version associated with each of the reported SSBRI(s)/CRI(s) and/or panel indication (if configured)~~
  + ~~Option 1D: No additional reporting quantity~~
* ~~{SSBRI(s)/CRI(s) and/or panel indication} + {A}, where A is either Opt2A, Opt2B, Opt2A+ Opt2B, or Option 2C~~
  + ~~Option 2A: L1-RSRP [L1-SINR] or a modified version that accounts for MPE effect associated with each of the reported SSBRI(s)/CRI(s) and/or panel indication (if configured)~~
    - ~~FFS: How panel-level L1-RSRP [L1-SINR] is reported if L1-RSRP [L1-SINR] is associated with panel~~
    - ~~FFS: Whether/how to account for MPE effect in L1-RSRP [L1-SINR] report, e.g. by using scaled L1-RSRP [L1-SINR]~~
    - ~~FFS: Whether/how to enhance existing beam reporting format to support Option 2A~~
  + ~~Option 2B: Virtual PHR or a modified version associated with each of the reported SSBRI(s)/CRI(s) and/or panel indication (if configured)~~
  + ~~Option 2C: No additional reporting quantity~~

~~On Rel.17 enhancements to facilitate MPE mitigation, in RAN1#105-e, further discuss to down-select at least one or combine from the following options:~~

* ~~Opt 1A. {Rel.16 P-MPR based (beam/panel-level)} + Virtual PHR or a modified version~~ 
  + ~~The modified version may be associated with each activated UL TCI or, if applicable, joint TCI, or associated with each of the reported SSBRI(s)/CRI(s) and/or panel indication (if configured) from candidate pool, if reported.~~
  + ~~The reporting reuses the event-driven mechanisms from the Rel-16 P-MPR reporting~~
  + ~~FFS: how to determine the virtual PHR or the modified version.~~
* ~~Opt 1D. {Rel.16 P-MPR based (beam/panel-level)}~~
  + ~~The reporting reuses the event-driven mechanisms from the Rel-16 P-MPR reporting~~
* ~~Opt 2A. {SSBRI(s)/CRI(s) and/or panel indication} + L1-RSRP [L1-SINR] or a modified version that accounts for MPE effect associated with each of the reported SSBRI(s)/CRI(s) and/or panel indication (if configured)~~
  + ~~FFS: How panel-level L1-RSRP [L1-SINR] is reported if L1-RSRP [L1-SINR] is associated with panel~~
  + ~~FFS: Whether/how to account for MPE effect in L1-RSRP [L1-SINR] report, e.g. by using scaled L1-RSRP [L1-SINR]~~
  + ~~FFS: Whether/how to enhance existing beam reporting format to support Option 2A~~
  + ~~FFS: When multiple SSBRIs/CRIs and their corresponding metrics are reported in the same reporting instance, whether to allow mixture between the SSBRI(s)/CRI(s)) intended for MPE mitigation and for DL beam reporting~~
  + ~~FFS: Whether the reporting is UE-initiated (event-driven) and/or NW-initiated~~
  + ~~FFS: If Opt2A is selected and there is no consensus on a modified L1-RSRP definition, at least the Rel-15 L1-RSRP definition is reused and virtual PHR may be added~~

~~FFS: If gNB acknowledges MPE report from UE for UE-initiated (event-driven) reporting~~

~~FFS: If differential report is supported when multiple UL beams are reported in the same report~~

On Rel.17 enhancements to facilitate MPE mitigation, support the following enhancement on the Rel-16 event-triggered P-MPR-based reporting (included in the PHR report when a threshold is reached, reported via MAC-CE):

* In addition to the existing field in the PHR MAC-CE, N≥1 P-MPR values can be reported
  + The N P-MPR values are reported together with the following:
    - For each P-MPR value, up to M SSBRI(s)/CRI(s), where the SSBRI(s)/CRI(s) is selected by the UE from a candidate SSB/CSI-RS resource pool (FFS: how to perform the selection)
      * Support M=1

On Rel.17 enhancements to facilitate MPE mitigation, support N=1, 2, 3, and 4

* N is defined as the number of reported measurements
* UE reports supported largest N value as a UE capability

On Rel.17 enhancements to facilitate MPE mitigation, the candidate resource pool corresponds to a CSI-RS/SSB resource set configured via RRC (details up to RAN2)

On Rel.17 enhancements to facilitate MPE mitigation, there is no consensus on a specification-based criterion for selecting N from a candidate SSB/CSI-RS resource pool

# Issue 6

~~On Rel.17 enhancements based on the unified TCI framework, perform study and, if needed, specify the following:~~

* ~~Group1: Beam management with reduced DL signaling to reduce latency~~
* ~~Group2: Reducing activation delay of TCI states and PL-RSs (including other WGs, e.g. RAN4)~~
  + ~~On RAN4-related matters, assessment/study phase can be done in RAN1. If RAN4-based enhancements are found necessary, a LS to RAN4 will be sent (to prepare RAN4 work)~~

~~Note: Given its dependence on the maturity compared to other issues (1 to 5), when to start the work and how much work is done on issue 6 should depend on the progress on the other issues.~~

~~Note: Aim for at most one solution for each of the group in Rel-17 to address issue 6~~

~~On Rel.17 enhancements to facilitate advanced beam refinement/tracking, perform study (for the purpose of down-selection and/or combining) and, if needed, specify the following candidate schemes from Group 1:~~

* ~~Opt 1-1A: Beam measurement/reporting/refinement/selection triggered by beam indication (without CSI request)~~
* ~~Opt 1-1B: UE-initiated beam selection/activation based on beam measurement (without beam indication or activation from NW)~~
* ~~Opt 1-2: Semi-static NW-configured beam selection (without beam indication and measurement/reporting)~~
* ~~Opt 1-3: SSB grouping to reduce beam training~~
* ~~Opt 1-4: Aperiodic beam measurement/reporting based on multiple resource sets for reducing beam measurement latency~~
* ~~Note: Aim for at most one solution for Group 1 in Rel-17 to address issue 6~~

~~On Rel.17 enhancements to facilitate advanced beam refinement/tracking, perform study (for the purpose of down-selection and/or combining) and, if needed, specify the following candidate schemes from Group 2:~~

* ~~Opt 2-1A: Latency reduction for MAC CE based TCI state activation, or frequency/time/beam tracking~~
* ~~Opt 2-1B: Latency reduction for MAC CE based PL-RS activation~~
* ~~Opt 2-1C: Latency reduction for MAC CE based PUCCH resource/resource group activation~~
* ~~Opt 2-2: Direct SCell TCI state activation~~
* ~~Opt 2-3: Replacing RRC-based with MAC CE (or DCI) based for DL QCL or UL information update~~
* ~~Opt 2-4: One-shot timing update for TCI state update~~
* ~~Note: Aim for at most one solution for Group 2 in Rel-17 to address issue 6~~
* ~~Note: At least for Opt 2-1A/B, 2-2, and 2-4, RAN2 and RAN4 will at least have to be involved (some may be exclusively RAN2 and/or RAN4 work)~~

~~On Rel.17 enhancements to facilitate advanced beam refinement/tracking, focus study (including down-selection) and, if needed, specification effort on the following options:~~

* ~~Group 1: Aim for at most one solution for Group 1 in Rel-17 to address issue 6~~
  + ~~Opt 1-A. UE-initiated beam selection/activation based on beam measurement and/or reporting (without beam indication or activation from NW)~~
  + ~~Opt 1-B. Beam measurement/reporting/refinement/selection triggered by beam indication (without CSI request)~~
  + ~~Opt 1-C. Aperiodic beam measurement/reporting based on multiple resource sets for reducing beam measurement latency~~
* ~~Group 2: Aim for at most one solution for Group 2 in Rel-17 to address issue 6~~
  + ~~Opt 2-A: Latency reduction for MAC CE based TCI state activation, or frequency/time/beam tracking~~
  + ~~Opt 2-B: Latency reduction for MAC CE based PL-RS activation~~
  + ~~Opt 2-C: One-shot timing update for TCI state update~~

~~On Rel-17 enhancements to facilitate advanced beam refinement/tracking, in Rel-17, further focus study (including down-selection) and, if needed, specification effort on Opt 1-A as agreed in RAN1#105-e (UE -initiated beam selection/activation based on beam measurement and/or reporting, without beam indication or activation from NW) comprising:~~

* ~~UE -initiated (DL-only or DL/UL) beam selection, including the following options~~
  + ~~Opt1. The selected beam is reported by an event-triggered UE beam reporting via, e.g. UCI, MAC CE, UL CG, or Type 1/Type 2 CBRA/CFRA~~
  + ~~Opt2. The selected beam is reported by a legacy UE beam report (NW-configured)~~
  + ~~FFS on triggering condition and NW-indication of a beam group in which the UE is allowed to do the beam selection, e.g., the NW-indication via MAC-CE~~
  + ~~FFS: NW confirmation, e.g. if no NW beam selection command overwriting the selected beam is received in a time window after the report~~
* ~~UE-initiated beam activation based on beam reporting~~
  + ~~The reported beam(s) are activated as active TCI/spatial relation RS(s) automatically w/o NW activation command after receiving gNB response signalling, e.g. DCI/MAC CE~~
  + ~~FFS: The reported beam is applied directly if the number of supported activated beam by the UE is one and/or after receiving gNB response signaling, or if no NW activation command overwrites the beam(s) activated by the report in a time window after the report~~
* ~~UE -initiated UL-only beam selection considering potential misalignment between network and UE on the selected beams~~
  + ~~The UE can select an alternative beam from the other beams in the gNB -configured set containing more than one UL beam~~

**~~Conclusion~~**

~~Discussion on advanced beam refinement/tracking (“issue 6”) is suspended for the remaining of Rel-17 NR\_FeMIMO multi-beam enhancement (due to lack of time).~~