**3GPP TSG-RAN WG1#80bis** **R1-151923**

**Belgrade, Serbia, 20th - 24th April 2015**

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# TITLE: DISCUSSION OF BASELINE SCHEMES FOR FDD

AGENDA ITEM: 7.2.5.1.2

DOCUMENT FOR: DISCUSSION AND DECISION

# SUMMARY

- Observations on FDD baseline categories defined in RAN1#80:
  - **Category 1**:  Sectorization with different cell-ID for each sector
    - Useful baseline for up to 16 TXRUs

  - **Category 2**: Single cell-ID virtual sectorization
    - Good baseline for comparison to beamformed CSI-RS enhancements and for up to ~16 TXRUs
      - Both baseline and enhancement are open loop schemes
      - Significant involvement of higher layer signaling
      - Suffers more from CSI-RS overhead

  - **Category 3**:  Kronecker precoding with 2 CSI processes
    - Can be used as a baseline to compare with other non-precoded CSI-RS schemes
      - Both baseline and enhancement are closed loop schemes
    - Poor performance compared to Phase 1 and requires 2 CSI processes

# CATEGORY 1

- Category 1:  Sectorization (in one or both of vertical and horizontal domains) with different cell-ID for each sector
  - **Background**:
    - 6 sectors are well established in deployments
      - Fully backward compatible to Rel-8
    - Supports up to 6 cells / site efficiently using shifted CRS
      - Allows good performance with standard MMSE-IRC receiver from interference estimation through non-colliding CRS
      - With 2 cells per 120° panel, can have up to 16 CSI-RS ports per panel
    - More than 6 cells / site require colliding CRS
      - Complicates reception, can degrade performance
    - Narrower sectors require more frequent handover
  - **Observation**:
    - Category 1 is a useful baseline for up to 16 TXRUs

# CATEGORY 2

- Category 2: Virtual sectorization using one or more beamformed CSI-RS resource(s) with a single cell-ID (single sector as a special case)
  - **Background**
    - Reduces CRS interference by using e.g. only 1 shift / 120° panel.
      - Avoids need for additional CRS shifts or colliding CRS
    - Large arrays will require high CSI-RS overhead
    - Vertical spatial resolution is poor
      - Only suitable for special (low rise) scenarios
      - MU-MIMO performance degrades
    - Requires higher layer signaling for beam tracking, increasing with TXRUs
      - Rel-8/9/10 UEs require RRC reconfiguration to switch virtual sectors
      - Rel-11 UEs may use multiple CSI processes to track neighbor virtual sectors
        - At the cost of more reporting overhead
        - Multiple CSI processes is optionally supported
  - **Observations**
    - Category 2 is a useful baseline:
      - For up to 16 TXRUs in classical scenarios
      - For more than 16 TXRUs in limited scenarios
        - Rel-8/9 UEs will have degraded performance due to restricted scheduling for large # CSI-RS ports
        - Pre-Rel-11 UEs can be used in more limited mobility and angle spreads
        - Rel-11+ UEs can operate at higher speeds or in more angle spread

# CATEGORY 3

- Category 3: Kronecker precoding with 2 CSI processes
  - **Background**
    - eNB combines separate vertical and horizontal CSI reports
      - Allows Rel-11 UEs to be supported with 2DAAs
      - Better mobility and robustness to angle spread than Category 2
        - No need for RRC reconfiguration to switch beams or additional RSRP measurements to track beams.
    - CSI accuracy degrades due to partial measurement of the array [1]
      - Vertical and Horizontal patterns don't fully decouple
      - Array gain can't be accounted for in CSI reports
      - Rank is estimated on only one (e.g. H) dimensions
      - UE does not know SINR, so rank or non-linear receivers can't be factored into the CQI
  - **Observations**:
    - Category 3 can be used as a baseline to compare with other non-precoded CSI-RS schemes
      - Baseline and enhancement then have similar behavior for mobility, angle spread, higher layer signaling & measurements, etc.
    - Category 3 has limited performance benefit
      - Also assumes all UEs have at least 2 CSI processes (optional for Rel.11+ UEs)

# REFERENCE

[1] R1-151922, “Performance results and discussion of Cat.3 baseline”, Ericsson, 3GPP TSG RAN1 Meeting #80bis, Belgrade, Serbia, 20-24 April 2015

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