**3GPP TSG RAN WG1 #115 R1-231xyzw**

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Source: Moderator (Samsung)

Title: TP for TR 38.858 Study on Evolution of NR Duplex Operation

Agenda item: 8.17

Document for: Endorsement

# 1. Introduction

This TP is to correct some wrongly captured evaluation results in TR 38.858 v1.0.0 [1].

# 2.Text proposals

--------------------------------------------------------- Start of text proposal -----------------------------------------------------------

7.3.1.3.1.1 Summary of the observations

**For the indoor layer of 2-layer Scenario B (FR1) in SBFD deployment case 3-2, assuming SBFD antenna configuration option-2 (twice area and same TxRUs):**

--------------------------------------------------------- Other parts are omitted ---------------------------------------------------------

- In case of using SBFD Alt 2 and large packet size, (SBFD#3-2\_ScenarioB\_FR1\_Sub#4, 3 sources)

* Semi-static SBFD provides mean and 5% DL Average-UPT loss of {-24.90%, -28.72%} at low load level, mean and 5% DL Average-UPT loss of {-28.31%, -32.62%} at medium load level, mean and 5% DL Average-UPT loss of {-36.34%, -51.41%} at high load level.
* Semi-static SBFD provides mean and 5% UL Average-UPT gain of {91.29%, 41.77%} at low load level, mean and 5% UL Average-UPT gain of {116.68%, 106.71%} at medium load level, mean and 5% UL Average-UPT gain of {123.40%, 174.07%} at high load level.
* With 49dBm BS transmission power assumed by 1 source,
  + Semi-static SBFD provides mean and 5% DL Average-UPT loss of {-24.90%, -24.40%} at low load level, mean and 5% DL Average-UPT loss of {-24.30%, -29.50%} at medium load level, mean and 5% DL Average-UPT loss of {-31.98%, -33.13%} at high load level.
  + Semi-static SBFD provides mean and 5% UL Average-UPT gain of {64.90%, 23.40%} at low load level, mean and 5% UL Average-UPT gain of {69.90%, 63.80%} at medium load level, mean and 5% UL Average-UPT gain of {123.40%, 134.00%} at high load level.
* With 53dBm BS transmission power assumed by 2 sources,
  + Semi-static SBFD provides mean and 5% DL Average-UPT loss of {-24.94%, -29.07%} at low load level, mean and 5% DL Average-UPT loss of {-32.95%, -38.72%} at medium load level, mean and 5% DL Average-UPT loss of {-46.67%, -64.24%} at high load level.
  + Semi-static SBFD provides mean and 5% UL Average-UPT gain of {99.22%, 67.37%} at low load level, mean and 5% UL Average-UPT gain of {118.06%, 126.09%} at medium load level, mean and 5% UL Average-UPT gain of {152.63%, 349.09%} at high load level.
* All results assumed piecewise linear noise figure model.

--------------------------------------------------------- Other parts are omitted ---------------------------------------------------------

7.3.1.4.2.1 Summary of the observations

**For Urban Macro (FR1) with 100% grid shift in SBFD deployment case 4, if the total capability of spatial isolation and digital isolation for co-site inter-sector CLI is no less than 93 dB, assuming SBFD antenna configuration option-2 (twice area and same TxRUs):**

--------------------------------------------------------- Other parts are omitted ---------------------------------------------------------

- In case of using SBFD Alt 2 and large packet size, (SBFD#4\_UMA\_FR1\_100%\_Sub#3, 4 sources)

* For operator 1 (Legacy TDD operator):
* Semi-static SBFD provides mean and 5% DL Average-UPT loss of {-0.30%, -0.16%} at low load level, mean and 5% DL Average-UPT loss of {-1.61%, -3.59%} at medium load level, mean and 5% DL Average-UPT loss of {-3.21%, -3.92%} at high load level.
* Semi-static SBFD provides no change on mean and 5% UL Average-UPT for all load levels.
* With 49dBm BS transmission power assumed by 1 source,
  + Semi-static SBFD provides mean and 5% DL Average-UPT loss of {-0.30%, -0.16%} at low load level, mean and 5% DL Average-UPT loss of {-2.67%, -3.59%} at medium load level, mean and 5% DL Average-UPT loss of {-4.17%, -3.79%} at high load level.
  + Semi-static SBFD provides no change on mean and 5% UL Average-UPT at all load levels.
* With 53dBm BS transmission power assumed by 2 sources,
  + Semi-static SBFD provides mean and 5% DL Average-UPT loss of {-0.35%, -1.87%} at low load level, mean and 5% DL Average-UPT loss of {-1.59%, -4.64%} at medium load level, mean and 5% DL Average-UPT loss of {-3.09%, -3.95%} at high load level.
  + Semi-static SBFD provides mean and 5% UL Average-UPT gain of {0.02%, 1.20%} at low load level, mean and 5% UL Average-UPT gain of {0.04%, 0.78%} at medium load level, mean UL Average-UPT gain of 0.01% and 5% UL Average-UPT loss of -1.50% at high load level.
* All results assumed piecewise linear noise figure model.
* For operator 2 (SBFD operator):
* Semi-static SBFD provides mean and 5% DL Average-UPT loss of {-22.30%, -21.49%} at low load level, mean and 5% DL Average-UPT loss of {-24.57%, -31.46%} at medium load level, mean and 5% DL Average-UPT loss of {-25.84%, -51.80%} at high load level.
* Semi-static SBFD provides mean and 5% UL Average-UPT gain of {90.01%, 94.35%} at low load level, mean and 5% UL Average-UPT gain of {94.07%, 58.67%} at medium load level, mean and 5% UL Average-UPT gain of {36.70%, 38.16%} at high load level.
* With 49dBm BS transmission power assumed by 2 sources,
  + Semi-static SBFD provides mean and 5% DL Average-UPT loss of {-24.13%, -15.39%} at low load level, mean and 5% DL Average-UPT loss of {-24.57%, -17.56%} at medium load level, mean and 5% DL Average-UPT loss of {-25.84%, -33.07%} at high load level.
  + Semi-static SBFD provides mean and 5% UL Average-UPT gain of {101.42%, 94.35%} at low load level, mean and 5% UL Average-UPT gain of {95.42%, 66.67%} at medium load level, mean and 5% UL Average-UPT gain of {46.12%, 52.46%} at high load level.
* With 53dBm BS transmission power assumed by 2 sources,
  + Semi-static SBFD provides mean and 5% DL Average-UPT loss of {-18.21%, -45.92%} at low load level, mean and 5% DL Average-UPT loss of {-23.60%, -47.81%} at medium load level, mean and 5% DL Average-UPT loss of {-31.85%, -60.56%} at high load level.
  + Semi-static SBFD provides mean and 5% UL Average-UPT gain of {43.40%, 75.77%} at low load level, mean and 5% UL Average-UPT gain of {19.46%, 5.71%} at medium load level, mean and 5% UL Average-UPT gain of {16.70%, 3.15%} at high load level.
* With piecewise noise figure model assumed by 3 sources,
  + Semi-static SBFD provides mean and 5% DL Average-UPT loss of {-23.21%, -18.44%} at low load level, mean and 5% DL Average-UPT loss of {-24.64%, -24.51%} at medium load level, mean and 5% DL Average-UPT loss of {-26.76%, -47.06%} at high load level.
  + Semi-static SBFD provides mean and 5% UL Average-UPT gain of {95.72%, 107.56%} at low load level, mean and 5% UL Average-UPT gain of {94.75%, 62.67%} at medium load level, mean and 5% UL Average-UPT gain of {41.41%, 45.31%} at high load level.
* With flat noise figure model assumed by 1 source,
  + Semi-static SBFD provides mean and 5% DL Average-UPT loss of {-14.13%, -66.67%} at low load level, mean and 5% DL Average-UPT loss of {-13.05%, -53.06%} at medium load level, mean and 5% DL Average-UPT loss of {-13.25%, -51.80%} at high load level.
  + Semi-static SBFD provides mean UL Average-UPT gain of 20.00% and no change on 5% UL Average-UPT at low load level, mean UL Average-UPT gain of 5.99% and no change on 5% UL Average-UPT at medium load level, mean UL Average-UPT gain of 5.99% and no change on 5% UL Average-UPT at high load level.

--------------------------------------------------------- Other parts are omitted ---------------------------------------------------------

**For Urban Macro (FR1) with 100% grid shift in SBFD deployment case 4, if the total capability of spatial isolation and digital isolation for co-site inter-sector CLI is equal to 93 dB, assuming SBFD antenna configuration option-2 (twice area and same TxRUs):**

--------------------------------------------------------- Other parts are omitted ---------------------------------------------------------

- In case of using SBFD Alt 2 and large packet size, (SBFD#4\_UMA\_FR1\_100%\_Sub#7, 2 sources)

* For operator 1 (Legacy TDD operator):
* Semi-static SBFD provides mean and 5% DL Average-UPT loss of {-0.30%, -0.16%} at low load level, mean and 5% DL Average-UPT loss of {-1.61%, -3.59%} at medium load level, mean and 5% DL Average-UPT loss of {-3.21%, -3.92%} at high load level.
* Semi-static SBFD provides no change on mean and 5% UL Average-UPT for all load levels.
* With 49dBm BS transmission power assumed by 1 source,
  + Semi-static SBFD provides mean and 5% DL Average-UPT loss of {-0.30%, -0.16%} at low load level, mean and 5% DL Average-UPT loss of {-2.67%, -3.59%} at medium load level, mean and 5% DL Average-UPT loss of {-4.17%, -3.79%} at high load level.
  + Semi-static SBFD provides no change on mean and 5% UL Average-UPT at all load levels.
* With 53dBm BS transmission power assumed by 2 sources,
  + Semi-static SBFD provides mean and 5% DL Average-UPT loss of {-0.35%, -1.87%} at low load level, mean and 5% DL Average-UPT loss of {-1.59%, -4.64%} at medium load level, mean and 5% DL Average-UPT loss of {-3.09%, -3.95%} at high load level.
  + Semi-static SBFD provides mean and 5% UL Average-UPT gain of {0.02%, 1.20%} at low load level, mean and 5% UL Average-UPT gain of {0.04%, 0.78%} at medium load level, mean UL Average-UPT gain of 0.01% and 5% UL Average-UPT loss of -1.50% at high load level.
* All results assumed piecewise linear noise figure model.
* For operator 2 (SBFD operator):
* Semi-static SBFD provides mean and 5% DL Average-UPT loss of {-24.13%, -15.39%} at low load level, mean and 5% DL Average-UPT loss of {-24.72%, -17.56%} at medium load level, mean and 5% DL Average-UPT loss of {-25.84%, -33.07%} at high load level.
* Semi-static SBFD provides mean and 5% UL Average-UPT gain of {101.42%, 120.78%} at low load level, mean and 5% UL Average-UPT gain of {95.42%, 58.67%} at medium load level, mean and 5% UL Average-UPT gain of {36.70%, 38.16%} at high load level.
* With 49dBm BS transmission power assumed by 1 source,
  + Semi-static SBFD provides mean and 5% DL Average-UPT loss of {-24.13%, -15.07%} at low load level, mean and 5% DL Average-UPT loss of {-24.64%, -17.54%} at medium load level, mean and 5% DL Average-UPT loss of {-25.84%, -33.01%} at high load level.
  + Semi-static SBFD provides mean and 5% UL Average-UPT gain of {127.81%, 85.73%} at low load level, mean and 5% UL Average-UPT gain of {100.78%, 62.67%} at medium load level, mean and 5% UL Average-UPT gain of {41.41%, 45.31%} at high load level.
* With 53dBm BS transmission power assumed by 1 source,
  + Semi-static SBFD provides mean and 5% DL Average-UPT loss of {-22.30%, -25.18%} at low load level, mean and 5% DL Average-UPT loss of {-34.16%, -42.56%} at medium load level, mean and 5% DL Average-UPT loss of {-50.45%, -69.33%} at high load level.
  + Semi-static SBFD provides mean and 5% UL Average-UPT gain of {66.80%, 151.54%} at low load level, mean and 5% UL Average-UPT gain of {32.94%, 11.43%} at medium load level, mean and 5% UL Average-UPT gain of {27.41%, 6.30%} at high load level.
* All results assumed piecewise linear noise figure model.

--------------------------------------------------------- Other parts are omitted ---------------------------------------------------------

#### 13.1.1.1 UPT performance

**SBFD deployment case 3-2 (Co-channel co-existence case)**

For the indoor layer of 2-layer scenario (FR1) in SBFD deployment case 3-2, when SBFD with XXXXX slot format for indoor layer and TDD with DDDSU for Macro layer are assumed,

* In case of small packet, semi-static SBFD provides performance improvement for DL at low and medium load levels and UL for all load levels (for at least one of mean and 5% UPT)
* {5.69%, 5.29%, -2.27%} / {6.87%, 3.42%, -50.93%} for mean/5% DL UPT gain/loss
* {91.80%, 89.00%, 78.10%} / {93.70%, 26.42%, -37.25%} for mean/5% UL UPT gain/loss
* In case of large packet, semi-static SBFD provides performance improvement for UL but suffers from degradation for DL
* {-5.38%, -7.29%, -9.20%} / {-10.49%, -11.87%, -12.30%} for mean/5% DL UPT loss
* {3.90%, 3.38%, 14.78%} / {17.83%, 68.34%, 71.07%} for mean/5% UL UPT gain

For the indoor layer of 2-layer scenario (FR1) in SBFD deployment case 3-2, when SBFD with XXXXU slot format for indoor layer and DDDSU slot format for Macro layer are assumed,

* In case of small packet size, semi-static SBFD provides significant performance improvement for UL but may suffer from degradation for DL for all load levels (for at least one of mean and 5% UPT for DL at low load)
* {0.43%, -1.58%, -13.98%} / {-0.01%, -7.82%, -80.99%} for mean/5% DL UPT gain/loss
* {99.80%, 102.60%, 110.12%} / {104.37%, 91.69%, 218.36%} for mean/5% UL UPT gain
* In case of large packet, semi-static SBFD provides significant performance improvement for UL but may suffer from degradation for DL for all load levels
* {-24.90%, -28.31%, -36.34%} / {-28.72%, -32.62%, -51.41%} for mean/5% DL UPT loss
* {91.29%, 116.68%, 123.40%} / {41.77%, 106.71%, 174.07%} for mean/5% UL UPT gain

**SBFD deployment case 4 (Adjacent channel co-existence)**

For SBFD deployment case 4 (FR1) with 0% grid shift, and the total capability of spatial isolation and digital isolation for co-site inter-sector CLI is no less than 93 dB, spatial isolation for co-site adjacent-channel CLI is no less than 93dB, and SBFD with XXXXX slot format and large packet size are assumed,

* For the SBFD operator, semi-static SBFD provides performance improvement for UL at all load levels (for at least one of mean and 5% UPT for UL at high load) but suffers from degradation for DL for all load levels
  + {-11.54%, -13.46%, -13.37%} / {-39.64%, -50.44%, -68.58%} for mean/5% DL UPT loss of SBFD operator
  + {21.09%, 18.52%, 3.26%} / {47.60%, 0%, -19.36%} for mean/5% UL UPT gain/loss of SBFD operator
* For the legacy TDD operator, regarding the performance impact of semi-static SBFD to legacy TDD of another operator, there may be limited or large degradation for UL and DL performance
  + {-6.46%, -6.73%, -5.22%} / {-29.43%, -39.73%, -53.81%} for mean/5% DL UPT loss of legacy TDD operator
  + {-16.16%, -24.42%, -27.10%} / {-16.18%, 0%, 0%} for mean/5% UL UPT loss of legacy TDD operator

For SBFD deployment case 4 (FR1) with 0% grid shift, and the total capability of spatial isolation and digital isolation for co-site inter-sector CLI is no less than 93 dB, spatial isolation for co-site adjacent-channel CLI is no less than 93dB, and SBFD with XXXXU slot format and large packet size are assumed,

* For the SBFD operator, semi-static SBFD provides performance improvement for UL but suffer from degradation for DL for all load levels
  + {-22.97%, -21.22%, -26.20%} / {-27.07%, -52.53%, -65.36%} for mean/5% DL UPT loss of SBFD operator
  + {59.89%, 26.32%, 23.29%} / {168.31%, 37.37%, 24.69%} for mean/5% UL UPT gain of SBFD operator
* For the legacy TDD operator, regarding the performance impact of semi-static SBFD to legacy TDD of another operator, there may be limited improvement and degradation for UL and DL performance
  + {-0.45%, -2.12%, -3.39%} / {-1.52%, -2.25%, -4.86%} for mean/5% DL UPT loss of legacy TDD operator
  + {-0.01%, 0.04%, 0.13%} / {0.07%, 0.10%, 2.08%} for mean/5% UL UPT gain/loss of legacy TDD operator

For SBFD deployment case 4 (FR1) with 0% grid shift, and the total capability of spatial isolation and digital isolation for co-site inter-sector CLI is equal to 93 dB, spatial isolation for co-site adjacent-channel CLI is equal to 93 dB, and SBFD with XXXXX slot format and large packet size are assumed,

* For the SBFD operator, semi-static SBFD provides performance improvement for UL at low load level but suffers from degradation for DL for all load levels
  + {-0.6%, -5.70%, -12.29%} / {3.34%, -10.72%, -23.48%} for mean/5% DL UPT gain/loss of SBFD operator
  + {3.50%, -36.04%, -55.59%} / {114.57%, -18.46%, -69.36%} for mean/5% UL UPT gain/loss of SBFD operator
* For the legacy TDD operator, regarding the performance impact of semi-static SBFD to legacy TDD of another operator, there may be limited or large degradation for UL and DL performance
  + {-0.44, -3.39%, -4.45%} / {-1.25%, -6.93%, -7.97%} for mean/5% DL UPT loss of legacy TDD operator
  + {-7.43%, -30.66%, -39.94%} / {-16.18%, -46.23%, -49.99%} for mean/5% UL UPT loss of legacy TDD operator

For SBFD deployment case 4 (FR1) with 0% grid shift, and the total capability of spatial isolation and digital isolation for co-site inter-sector CLI is equal to 93 dB, spatial isolation for co-site adjacent-channel CLI is equal to 93dB, and SBFD with XXXXU slot format and large packet size are assumed,

* For the SBFD operator, semi-static SBFD provides performance improvement for UL but suffers from degradation for DL for all load levels
  + {-23.27%, -29.59%, -40.53%} / {-23.08%, -38.52%, -49.36%} for mean/5% DL UPT loss of SBFD operator
  + {88.87%, 68.41%, 34.44%} / {168.31%, 37.37%, 24.69%} for mean/5% UL UPT gain of SBFD operator
* For the legacy TDD operator, regarding the performance impact of semi-static SBFD to legacy TDD of another operator, there may be limited improvement or degradation for UL and DL performance
  + {-0.45%, -2.12%, -3.39%} / {-1.52%, -2.25%, -4.86%} for mean/5% DL UPT loss of legacy TDD operator
  + {-0.01%, 0.04%, 0.13%} / {0.07%, 0.10%, 2.08%} for mean/5% UL UPT gain/loss of legacy TDD operator

For SBFD deployment case 4 (FR1) with 100% grid shift, and the total capability of spatial isolation and digital isolation for co-site inter-sector CLI is no less than 93 dB, and SBFD with XXXXX slot format and large packet size are assumed,

* For the SBFD operator, semi-static SBFD provides performance improvement for UL for low and medium load levels but suffers from degradation for DL for all load levels
  + {-0.85%, -5.76%, -10.65%} / {-3.79%, -13.28%, -22.06%} for mean/5% DL UPT loss of SBFD operator
  + {21.64%, 13.37%, -11.43%} / {32.42%, 10.67%, -3.28%} for mean/5% UL UPT gain/loss of SBFD operator
* For the legacy TDD operator, regarding the performance impact of semi-static SBFD to legacy TDD of another operator, there may be limited or large degradation for UL and DL performance
  + {-0.35%, -3.31%, -5.38%} / {-2.64%, -9.41%, -7.68%} for mean/5% DL UPT loss of legacy TDD operator
  + {-13.50%, -21.26%, -16.74%} / {-24.39%, -0.53%, -0.90%} for mean/5% UL UPT loss of legacy TDD operator

For SBFD deployment case 4 (FR1) with 100% grid shift, and the total capability of spatial isolation and digital isolation for co-site inter-sector CLI is no less than 93 dB, and SBFD with XXXXU slot format and large packet size are assumed,

* For the SBFD operator, semi-static SBFD provides performance improvement for UL but suffers from degradation for DL for all load levels
  + {-22.30%, -24.57%, -25.84%} / {-21.49%, -31.46%, -51.80%} for mean/5% DL UPT loss of SBFD operator
  + {90.01%, 94.07%, 36.70%} / {94.35%, 58.67%, 38.16%} for mean/5% UL UPT gain of SBFD operator
* For the legacy TDD operator, regarding the performance impact of semi-static SBFD to legacy TDD of another operator, there may be limited degradation for DL performance and no change for UL performance
  + {-0.30%, -1.61%, -3.21%} / {-0.16%, -3.59%, -3.92%} for mean/5% DL UPT loss of legacy TDD operator
  + {0%, 0%, 0%} / {0%, 0%, 0%} for mean/5% UL UPT gain/loss of legacy TDD operator

For SBFD deployment case 4 (FR1) with 100% grid shift, and the total capability of spatial isolation and digital isolation for co-site inter-sector CLI is equal to 93 dB, and SBFD with XXXXX slot format and large packet size are assumed,

* For the SBFD operator, semi-static SBFD provides performance improvement for both UL and DL for low load levels but suffers from degradation for both UL and DL for medium and high load levels
  + {3.11%, -5.76%, -10.65%} / {2.27%, -13.28%, -22.06%} for mean/5% DL UPT gain/loss of SBFD operator
  + {9.77%, -30.95%, -65.59%} / {89.73%, -17.62%, -53.26%} for mean/5% UL UPT gain/loss of SBFD operator
* For the legacy TDD operator, regarding the performance impact of semi-static SBFD to legacy TDD of another operator, there may be limited or large degradation for UL and DL performance
  + {-0.35%, -2.94%, -4.37%} / {-1.40%, -7.02%, -6.72%} for mean/5% DL UPT loss of legacy TDD operator
  + {-6.75%, -26.88%, -37.96%} / {-12.59%, -44.22%, -50.22%} for mean/5% UL UPT loss of legacy TDD operator

For SBFD deployment case 4 (FR1) with 100% grid shift, and the total capability of spatial isolation and digital isolation for co-site inter-sector CLI is equal to 93 dB, and SBFD with XXXXU slot format and large packet size are assumed,

* For the SBFD operator, semi-static SBFD provides performance improvement for UL for all load levels but suffers from degradation for DL for all load levels
  + {-24.13%, -24.72%, -25.84%} / {-15.39%, -17.56%, -33.07%} for mean/5% DL UPT loss of SBFD operator
  + {101.42%, 95.42%, 36.70%} / {120.78, 58.67%, 38.16%} for mean/5% UL UPT gain of SBFD operator
* For the legacy TDD operator, regarding the performance impact of semi-static SBFD to legacy TDD of another operator, there may be limited degradation for DL performance and no change for UL performance
  + {-0.30%, -1.61%, -3.21%} / {-0.16%. -3.59%, -3.92%} for mean/5% DL UPT loss of legacy TDD operator
  + {0%, 0%, 0%} / {0%, 0%, 0%} for mean/5% UL UPT gain/loss of legacy TDD operator

--------------------------------------------------------- End of text proposal -----------------------------------------------------------

# 3. Reference

1. RP-232421, TR 38.858 v1.0.0 for the Study on evolution of NR duplex operation, CMCC