**3GPP TSG-RAN WG4 Meeting # 112 R4-24xxxxx**

**Maastricht, Netherlands, 19th – 23rd August, 2024**

**Agenda item:** 8.22.5

**Source:** Moderator (vivo)

**Title:** draft Minutes for LP-WUR ad hoc discussion

**Document for:** Approval

**Issue 2-1-1-1: SNR setting for serving and interference cell derivation from SINR setting**

* Proposals
  + P1: Use two cells for RAN4 simulation. To derive SNR for serving cell and interference cell from serving cell Ês/Iot, a relationship for the SNR or transmission power between serving cell and interference cell need be pre-defined. Suggest to consider the SNR/transmission power of the interference cell is 9 dB or 6 dB lower compared with that of the serving cell. (vivo, Ericsson)
  + P2: Discuss what is the meaning of Cell 1 and Cell 2 in the simulated scenario as the LP-WUR only supports serving cell measurements. (Nokia)

*Recommendations:*

Agreement:

To derive SNR for serving cell and interference cell from serving cell Ês/Iot, a relationship for the SNR or transmission power between serving cell and interference cell need be pre-defined.

Consider the SNR/transmission power of the interference cell is 9 dB or 6 dB lower compared with that of the serving cell. Other value can be considered.

**Issue 2-1-3: Time/frequency error**

* Proposals
  + P1: Suggest that 5 ppm is used for SSB based LP-WUR receivers and [5 10 20]ppm is used for OOK based receivers. Suggest the timing error are: OFDM type receiver: Residual timing error + 5\*320ms; OOK type receiver: Residual timing error + [5 10 20] \*320ms. (vivo)
  + P2: Discuss Time/frequency error in simulation assumption based on RAN1’s and RF’s agreement (Apple)
  + P3: Use 20ppm Residual Frequency error as the simulation baseline, 0ppm and 10ppm can also be involved if companies interested. Further update is not precluded. (CMCC)
  + P4: 20 ppm frequency error can be considered for OOK based on LR for initial RAN4 evaluation work. (Samsung)
  + P5: Frequency error: 5ppm; Time error: up to companies to report (Huawei)
  + P5: Frequency error: 5ppm for SSB based and [5, 10]ppm for OOK based (Ericsson)

*Recommendations:*

*Residual frequency error:*

Agreement:

OFDM based receiver [5] ppm

OOK based receiver [ 10 20] ppm

Timing error

Timing error = Residual timing error (up to company report) + residual frequency error\* reference signal periodicity (320ms);

**Issue 2-1-5: Measurement interval**

* Proposals
  + P1: LP-SS measurement requirement in IDLE/Inactive mode shall be defined based on LP-SS periodicity (Apple, Ericsson)
  + P2: Define the LR measurement requirements based on measurement interval of 320ms for both LP-SS and SSB based measurement. (vivo Huawei)
  + P3: SSB burst periodicity: 20ms (CMCC, Ericsson)
  + P4: SSB periodicity 160ms (CATT)

*Recommendations:*

Agreement:

Use 320ms for SSB based LP-WUR firstly.

**Issue 2-1-4: Accuracy baseline for simulation**

* Proposals
  + P1: The accuracy requirement defined for Redcap with 1Rx for RSRP or RSRQ in 10.1A can be used as the base when defining requirements for LP-WUR serving cell measurement. (vivo)
  + P2: RAN4 to use the legacy measurement accuracy for CONNECTED mode in Clause 10.1.2 TS 38.133 as baseline. (CATT CMCC)
  + P3: Use the accuracy requirement defined for CA/DC Idle Mode Measurements, i.e., ±6dB RSRP measurement accuracy and ±4dB RSRQ measurement accuracy, as the starting point when determining the measurement accuracy in RRC\_IDLE/INACTIVE state for LP-WUR serving cell measurement. RAN4 to consider the same target accuracy when defining LP-SS based and PSS/SSS based RRM delay requirements for LP-WUR (xiaomi)
  + P4: RAN4 not to define baseline for accuracy requirements for LR measurement. (Huawei)

*Recommendations:*

**Issue 2-2-2: Simulation parameters (include all other parameters not discussed in above issues)**

Agreement:

|  |  |
| --- | --- |
| LP-SS block BW | 132 subcarriers for SCS=30kHz for LP-SS initially |

Simulation assumptions

Table 1: General parameters

|  |  |
| --- | --- |
| **Simulation parameters** | **Comments/values** |
| Carrier frequency for Cell 1 and Cell 2 | Agreement: 2.6 GHz initially |
| Prior knowledge of Cell 1 / Cell 2 by the UE | Interfering cell (Cell 2) is not known to UE |
| DRX | No applicable for LP-WUR |
| BS transmit antennas for LP-SS blocks | 1 Tx |
| UE receive antennas | 1 Rx |
| Data and control channel subcarrier spacing | [Data, SSB and LP-SS have the same SCS] |
| Subcarrier spacing | 30KHz initially  TBD for 15 KHz |
| Measurement period (in number of measurement samples) | LP-SS for OOK based LP-WUR: [4, 5, other number could be studied upon a need]  SSB for OFDM based LP-WUR: [4, 5] (other number could be studied upon a need) |
| LP-SS/SSB measurement interval | LP-SS: 320 ms  SSB: 320 ms |
| LP-SS BW | 132 subcarriers for SCS=30kHz for LP-SS initially  TBD for 15KHz SCS |
| SSS | 30KHz for SSS, TBD for 15KHz |
| Actual LP-SS transmissions | always transmitted |
| Guard band | 1 RB on each side of LP-SS/LP-WUS signal |

Table 2: Cell-specific parameters

|  |  |  |  |
| --- | --- | --- | --- |
| Parameter | Unit | Cell 1 | Cell 2 |
| RF Channel number | - | Channel 1 | Channel 1 |
| NR-PSS, NR-SSS (OFDM based LP-WUR) | - | To be indicated by companies | To be indicated by companies |
| LP-SS (OOK based LP-WUR receiver) |  | OOK-1; or  OOK-4 with M = [2,4]  Note: M value [2 4] are up to company selection | when Cell 1 uses OOK-1; OOK-1 or NR signal is used for Cell 2  when Cell 1 uses OOK-4,  OOK-4 with same M value as cell 1 or NR signal is used for Cell 2 |
| LP-SS pattern |  | [M sequence]  [Golden sequence]  [Computer search sequence]  Note: Company can simulate one or all of them | [M sequence]  [Golden sequence]  [Computer search sequence]  Note: Company can simulate one or all of them |
| PBCH and DMRS power offset with respect to NR-PSS, NR-SSS and LP-SS | dB | 0 | 0 |
| Data and control PSD relative to NR-PSS,NR-SSS and LP-SS | dB | 0 | 0 |
| RB Utilization | % | 100 | 100 |
| Data Modulation | - | QPSK | QPSK |
| Slot length | - | 14 symbols | 14 symbols |
| CP Length | - | Normal | Normal |
| Frequency offset relative to UE frequency reference | Hz | OFDM based receiver [5] ppm  OOK based receiver [ 10 20] ppm | N/A |
| Timing error |  | Residual timing error  + timing drift (frequency offset\* 320ms (reference signal periodicity)  Residual timing error: company report |  |
| 1)Relative Delay of 1st Path (synchronous) | µs | 0 | CP/2 |
| 2) Relative Delay of 1st Path (asynchronous): Fixed delay | ms | 0 | 3 ms |
| SNR | dB | SNR setting for serving and interference cell are derived based on agreement of Issue 2-1-1-1 | |
| When Ês/Iot = -3 dB   * When SNR of cell 2 is 9 dB lower compared with cell 2;   SNR = [-2.7]   * When SNR of cell 2 is 6 dB lower compared with cell 2   SNR = [-2.4] | When Ês/Iot = -3 dB   * When SNR of cell 2 is 9 dB lower compared with cell 2;   SNR = [-11.7]   * When SNR of cell 2 is 6 dB lower compared with cell 2;   SNR = [-8.4] |
| When Ês/Iot = -0.5 dB  Note: Determine the SNR based on based on agreement of Issue 2-1-1-1 | When Ês/Iot = -0.5 dB  Note: Determine the SNR based on based on agreement of Issue 2-1-1-1 |
| When Ês/Iot = 2 dB  Note: Determine the SNR based on based on agreement of Issue 2-1-1-1 | When Ês/Iot = 2 dB  Note: Determine the SNR based on based on agreement of Issue 2-1-1-1 |
| Ês/Iot | dB | -3; -0.5dB; 2dB | N/A |
| Propagation conditions | - | FR1:  AWGN  TDL-C 300ns | |
| UE speed |  | 3 km/h | |
|  | | | |

Table 3: UE-specific parameters

|  |  |
| --- | --- |
| [Receiver Filter] | [3th/5th Order Butterworth with 3.96MHz bandwidth] |
| [Receiver ADC bit width] | [4 or 8-bitADC] |
| [Receiver Sampling Rate for LP-SS only] | [3.84 or 7.68MHz] |