**3GPP TSG-RAN WG2 #126 *R2-240xxxx***

**Fukuoka Japan May 22nd – 26th, 2024**

Agenda Item: 8.3.2.1

Source: OPPO(rapporteur)

Title: Draft summary of [AT126][030][AIMob] Simulation assumptions (Oppo)

Document for: Discussion, Decision

# Introduction

The offline discussion intends to fix the open issues left after online discussion on summary of post email discussion [POST125bis][021][AIML mobility] [1]. The simulation assumptions for FR2 and FR1 are listed in Annex by taking the agreement so far into account. The highlighted part is expected to be settled down during this offline discussion.

# Discussion

## Metrics related issues

### Definition of L3 RSRP difference

During post email discussion [1] there are 4 options on the table as following:

* Option 1: CDF of RSRP difference (5)
* Option 2: Average RSRP difference (9)
* Option 3: RMSE of RSRP difference (7)
* Option 4: X dB margin of RSRP difference (3)

The statistics of preferred options is listed after each option. Based on this situation, rapporteur recommend option 2 as following since the options with majority support are option 2 and option 3, while they represent similar meaning with each other:

Proposal 8: option 2 i.e., average RSRP difference is taken as prediction accuracy metric for RRM measurement prediction. Note the RSRP difference values should be an absolute value before they are averaged.

**Agreement 1: option 2 i.e., average RSRP difference is taken as prediction accuracy metric for RRM measurement prediction. Note the RSRP difference values should be an absolute value before they are averaged**

### Reduction rate(s)

RAN2 have following agreements:

8 To agree on methodology of Intra\_F\_C\_T\_Case B:

Intra-frequency intra-cell temporal domain prediction is done by predicting sub set measurement (case B) instances in temporal domain of the same cell for both FR1\_to\_FR1 and FR2\_to\_FR2. Several measurement reduction rates should be aligned among companies. The detail values for measurement reduction rate are FFS.

10 Methodology of Intra\_F\_C\_S: Intra-frequency intra-cell spatial domain prediction is done by measuring sub set of configured SSB as input to the model to predict L3 cell level measurements for every instance of the same cell. It is only evaluted for FR2 intra-frequency scenario and RRM sub case 1 and 3. Several measurement reduction rates should be aligned among company without defining detail pattern. The detail rate values are FFS.

The issue to be discussed is the potential candidate of the measurement reduction rate. The proposal from [4] is {1/2,3/4 and 7/8}.

**Agreement 2: To agree measurement reduction rates e.g. 1/2, for both intra-frequency intra-cell temporal domain prediction case B and spatial domain prediction. Revision in RAN2#127 is open.**

### Prediction window

RAN2 agreed:

7 To agree on methodology of Intra\_F\_C\_T\_Case A as following:

Intra-frequency intra-cell temporal domain case A prediction is done by predicting measurement result(s) in prediction window based on measurement results in observation window of the same cell for both FR1\_to\_FR1 and FR2\_to\_FR2. FFS aligning the prediction window

The issue to be discussed is whether we need align the prediction window. If yes, what could be the potential candidates. It is rapporteur’s understanding that logic to align prediction window is the same as measurement reduction rate(s) i.e., prediction accuracy is comparable among companies by assuming same prediction window(s). The value should be multiple times of sample window of corresponding frequency range. It means for FR1, they could be 40ms\*N; for FR2, they could be 20ms\*M. For example, the minimum N or M could be 10.

**Agreement 3: To agree one prediction window for FR1 and FR2 respectively as baseline. The detail value to be decided in the post email discussion.**

## UE trajectory

There are 3 UE trajectory options on the table:

Option 1: Linear trajectory model with random direction change (10)

Option 2: Linear trajectory model with random and smooth direction change (2)

Option 3: Random direction straight-line trajectories (6)

The statistics of preferred options is listed after each option. Based on this situation, rapporteur recommend option 1 during post email discussion because it could be a compromised option. Another approach it to leave it to company’s implementation.

**Agreement 4: UE trajectory option is up to company’s implementation and report**

2nd issue for boundary processing issue i.e. UE’s behaviour when it “touches” environment boundary. There are also 3 options:

 

Option 1 Option 2 Option 3

Figure 2.2-1 Options for boundary processing [2]

For the wrap-around model (option 1), when the UE hit the simulation border (the wrap-around contour), it will wrap around and enter the simulation area from a different point on the wrap-around contour. For the bouncing-circle model (option 2), when the UE hit the simulation border (the bouncing-circle), it will bounce back with a random angle and hence only area within circle can be used. For option 3, UE trajectory is terminated when UE hits the simulation border. Then another UE will be dropped randomly. We can either decide on one option or leave to company’s implementation.

**Agreement 5: UE trajectory boundary processing is up to company’s implementation and report**

## UE speed

The candidate UE speeds for simulation are 3,30,60,90,120 Km/h, which is from the table 6.3.1-1[3]. The summary of the answer to the question Question 2.3.1.4-1[1] and proposals are as below:

Summary: 14/20 company are willing to do some down selection to some extent. 2/20 (E///,Nokia) don’t it is mature to do any down selection. Among 14/20 company, 8 company would like to pick high speed to evaluate 2nd study goal i.e. to enhance HO performance since they are more challenging. The named speed(s) are 60,90,120km/h. 5 companies support to choose low and middle speed to evaluate measurement reduction while 3 companies think high speed is also valuable. 10 companies pick some of the listed UE speeds for all cases in general but no consensus. RAN2 agreed prioritized evaluation scenarios, which is illustrated by table

**Agreement 6: For study goal 2, the candidate speeds are 60,90 120 km/h and company can report UE speed along with simulation result**

**Agreement 7: For study goal 1, the candidate speeds are 3,30,60,90,120 km/h and company can report UE speed along with simulation result**

## RRC parameters

For RRC parameter RAN2 agreed:

26 Following RRC parameters need be aligned as simulation parameters:

- RRC parameters for measurement consolidation

- RRC parameters for L3 filtering (filter coefficient, measurement period)

29 The sample period(s) are aligned among companies for intra-frequency intra-cell temporal domain prediction. We can start with 20ms for FR2 and 40ms for FR1.

Measurement period: FFS – suggestion from rapporteur is to start with 480ms for FR2 and 200ms for FR1

Agreements

For the cell level measurement prediction, start with consider a fixed value for L3 filtering in simulation. FFS which fixed value

For consolidation parameter, they are absThreshSS-BlocksConsolidation and nrofSS-BlocksToAverage assuming SSB is reference signal. [5] pointed out that nrofSS-BlocksToAverage should be different between FR1 and FR2 due to the fact FR2 cell could be configured much more beams than FR1. The proposed value is 1 and 3 for FR1 and FR2 respectively. [6] proposes -156dbm for absThreshSS-BlocksConsolidation. [5] suggest that it could be also saved and always pick top nrofSS-BlocksToAverage of beams.

For FilterCoefficient, both [5][6] suggests value 4. Other values are FFS during online discussion. The associated measurement period should be different between FR1 and FR2. In the 38.133, the measurement period should be different between intra-frequency and inter-frequency measurement. this is valid at least for benchmark case where FR1 inter-frequency will be performed. So basically, we need align 3 values i.e. FR1 intra-frequency measurement period, FR1 inter-frequency measurement period and FR2 intra-frequency measurement period.

Contribution [6] proposes:

|  |  |
| --- | --- |
| Handover scenarios | Recommended value |
| FR1 to FR1 intra-frequency w.o. gap | 200ms Note1 |
| FR1 to FR1 inter-frequency with gap | Max(120ms, 3\*MGRP) Note2 |
| FR2 to FR2 intra-frequency w.o. gap | 480ms Note3 |

Table 2.4-1

*Note1: According to Table 9.2.5.2-1 [38.133], assuming SMTC period=20ms, CCSFintra=1 and Kp=1*

*Note2: According to Table 9.3.4-3 [38.133], assuming SMTC period=20ms ,Kgap =1,CCSFinter=1. (MGRP could be 40ms i.e. align with sample period), in this case the measurement period is 120ms*

*Note3: According to Table 9.2.5.2-2 [38.133], assuming SMTC period=20ms, CCSFintra=1 and Kp=1, Mmeas\_period\_w/o\_gaps =24*

**Agreement 8: To decide on the values in table 2.4-2/3/4 in post email.**

|  |  |
| --- | --- |
| L3 filtering parameter for both FR1 and FR2 | Recommended value |
| FilterCoefficient | 4 |

Table 2.4-2

|  |  |
| --- | --- |
| Measurement period | Recommended value |
| FR1 to FR1 intra-frequency w.o. gap | 200ms |
| FR1 to FR1 inter-frequency with gap | 120ms |
| FR2 to FR2 intra-frequency w.o. gap | 480ms |

Table 2.4-3

|  |  |
| --- | --- |
| Consolidation parameter | Recommended value |
| nrofSS-BlocksToAverage for FR1 | 1 |
| nrofSS-BlocksToAverage for FR2 | 3 |
| absThreshSS-BlocksConsolidation | FFS |

Table 2.4-4

## Bandwidth for FR2

RAN2 agreed:

30 Simulation parameters in table 2.3.4-1 (by removing Table A.2.1-7 and Table 2.1-10) are taken as starting point for both UE sided model and network sided model for FR2. The number of beams could be left for company to report. FFS Use 100Mhz for channel BW?

The bandwidth in table 6.3.1-1[3] is 80MHz. The reason behind 100MHz is that it is typical carrier bandwidth in field deployment. The issue is to choose 80MHz and 100MHz.

**Agreement 9: To agree on 80MHz as bandwidth for FR2**

## The BS antenna height for FR2

For FR2, RAN2 agreed Umi Urban as channel modelling and the ISD is 200m. Then some company believe the antenna height should be 10m instead of 25m.

**Agreement 10: To agree on 10m for BS antenna height for FR2**

## Channel modelling aspect

For fast fading, RAN2 agreed:

20 Fast fading is necessary for RRM sub case 1 and 3. FFS case 2

The reason to have different assumption for RRM sub case 2 is because both input and output of model is L3 cell level measurement result, for which fast fading will be filtered and hence doesn’t make sense. The channel modelling will impact the way to generate data set. So if one company want to simulate all RRM sub cases, it doesn’t really matter whether sub case 2 is exception or not. Otherwise, channel modelling could be simplified for RRM sub case 2. During the discussion of prioritization of evaluation scenarios, RAN2 agreed that it is up to company to report RRM sub cases. So maybe the straight way is to assume it for all RRM sub cases.

**Agreement 11: Fast fading is necessary for RRM sub case 2 too.**

As for shadowing correlation for FR1 to FR1 inter-frequency case, RAN2 agreed

25 Section 7.6.5 in 38.901 is taken as baseline for inter-frequency correlation model. Whether inter-frequency correlation model is used is optional and companies can report what they use. FFS on the understanding shadowing correlation in inter-freq. For now companies should report what assumption they have made

The discussion point is the shadowing correlation between two FR1 frequency:

1, Not correlated or

2, Partial correlated or

3, Full correlated

As Samsung, OPPO and ZTE said, the shadowing fading of two different frequency layers should be the same, i.e., full correlated, according TS 38.901.

**Agreement 12: The shadowing fading of two different frequency layers can be reported by company**

## Cluster approach

During post email discussion [1] it seems cluster approach is not clarified clearly still. So rapporteur have:

**Proposal 22: Cluster prediction approach refers to the prediction methodology where the number of cells for measurement or cells for prediction or both is more than one**

**Proposal 23: RAN2 is requested to further clarify detail of cluster approach**

Discussion on RRM measurement prediction Samsung discussion Rel-19 FS\_NR\_AIML\_Mob Late

Proposal. 2: RAN2 to consider the following two approaches for RRM measurement prediction.

**For Approach 2 (N-to-K approach, aka Cluster approach)**

The model input is the measurement results for SET B of N cells

The model output is the prediction results for SET A of K cells

For general temporal domain prediction: SET A SET B (1<= K<=N) or   
For pure temporal domain prediction: SET A = SET B (1<=K=N)

For spatial/frequency domain prediction: SET A SET B

[R2-2404713](file:///C:\Users\panidx\OneDrive%20-%20InterDigital%20Communications,%20Inc\Documents\3GPP%20RAN\TSGR2_126\Docs\R2-2404713.zip) Discussion on simulation assumptions of RRM measurement OPPO discussion Rel-19 FS\_NR\_AIML\_Mob

Proposal 4: The cluster methodology is defined as follows:

Cluster approach is applicable only for co-located cells.

The number of input cells and output cells should be no more than 3 and the number of output cells should be <= the number of input cells.

The input measurement result should be L3 cell level measurement results

For intra-frequency scenario, the output cells should be full or subset of the input cells

For inter-frequency scenario, the input cells are from measured frequency layer and the output cells are from predicted frequency layer

[R2-2404999](file:///C:\Users\panidx\OneDrive%20-%20InterDigital%20Communications,%20Inc\Documents\3GPP%20RAN\TSGR2_126\Docs\R2-2404999.zip) Discussion on other aspects related to RRM measurement prediction NTT DOCOMO, INC. discussion Rel-19

Proposal 1

- For all 3 cases, study the cluster-based prediction with the following detailed schemes,

Input the measurement results from multiple cells to the AI/ML models, including the serving and neighboring cells.

Output the predicted measurements corresponding to the same cells of inputs.

Discussion: the aspects of cluster approach mattering:

The number of input cells, number of output cells and their relationship in temporal domain, spatial domain and frequency domain.

**Agreement 13: To define cluster approach at least based on the number of input cells, number of output cells and their relationship in temporal domain, spatial domain and frequency domain**

# Conclusion

**Agreement 1: option 2 i.e., average RSRP difference is taken as prediction accuracy metric for RRM measurement prediction. Note the RSRP difference values should be an absolute value before they are averaged**

**Agreement 2: To agree measurement reduction rates e.g. 1/2, for both intra-frequency intra-cell temporal domain prediction case B and spatial domain prediction. Revision in RAN2#127 is open.**

**Agreement 3: To agree one prediction window for FR1 and FR2 respectively as baseline. The detail value to be decided in the post email discussion.**

**Agreement 4: UE trajectory option is up to company’s implementation and report**

**Agreement 5: UE trajectory boundary processing is up to company’s implementation and report**

**Agreement 6: For study goal 2, the candidate speeds are 60,90 120 km/h and company can report UE speed along with simulation result**

**Agreement 7: For study goal 1, the candidate speeds are 3,30,60,90,120 km/h and company can report UE speed along with simulation result**

**Agreement 8: To decide on the values in table 2.4-2/3/4 in post email discussion.**

|  |  |
| --- | --- |
| L3 filtering parameter for both FR1 and FR2 | Recommended value |
| FilterCoefficient | 4 |

Table 2.4-2

|  |  |
| --- | --- |
| Measurement period | Recommended value |
| FR1 to FR1 intra-frequency w.o. gap | 200ms |
| FR1 to FR1 inter-frequency with gap | 120ms |
| FR2 to FR2 intra-frequency w.o. gap | 480ms |

Table 2.4-3

|  |  |
| --- | --- |
| Consolidation parameter | Recommended value |
| nrofSS-BlocksToAverage for FR1 | 1 |
| nrofSS-BlocksToAverage for FR2 | 3 |
| absThreshSS-BlocksConsolidation | FFS |

Table 2.4-4

**Agreement 9: To agree on 80MHz as bandwidth for FR2**

**Agreement 10: To agree on 10m for BS antenna height for FR2**

**Agreement 11: Fast fading is necessary for RRM sub case 2 too.**

**Agreement 12: The shadowing fading of two different frequency layers can be reported by company**

**Agreement 13: To define cluster approach at least based on the number of input cells, number of output cells and their relationship in temporal domain, spatial domain and frequency domain**

# Reference

1. R2-2405941 Summary of [POST125bis][021][AIML mobility] Simulation assumptions and methodology (OPPO)

[2] R2-2402562 Discussion on Simulation assumption and evaluation methodology vivo

[3] TR 38.843 Study on Artificial Intelligence (AI)/Machine Learning (ML) for NR air interface

[4] R2-2404715 Discussion on open issue of RRM measurement use case OPPO

[5] R2-2405064 Discussion on simulation assumption for RRM measurement prediction ZTE Corporation discussion Rel-19 FS\_NR\_AIML\_Mob

[6] R2-2404713 Discussion on simulation assumptions of RRM measurement OPPO discussion

# Annex simulation assumption so far:

|  |  |
| --- | --- |
| Parameter | Value |
| Frequency Range | FR2 @ 30 GHz; SCS: 120 kHz |
| Deployment | 200m ISD, 2-tier model with wrap-around (7 sites, 3 sectors/cells per site) |
| Channel model | UMa with distance-dependent LoS probability function defined in Table 7.4.2-1 in TR 38.901.  Fast fading is optional? LOSsoft is optional modelled.  Oxygen absorption, Time-varying Doppler shift , Explicit ground reflection model and blockage are not considered. |
| System BW | 80MHz |
| UE Speed | For spatial domain beam prediction: 3km/h  For time domain beam prediction: 30km/h (baseline), 60km/h (optional) 90km/h (optional), 120km/h (optional)  Other values are not precluded |
| UE distribution | 100% outdoor and UE’s distribution is up to company |
| BS Antenna Configuration | Antenna setup and port layouts at gNB: (4, 8, 2, 1, 1, 1, 1), (dV, dH) = (0.5, 0.5) λ  Other assumptions are not precluded. |
| BS Antenna radiation pattern | TR 38.802 Table A.2.1-6, |
| UE Antenna Configuration | Antenna setup and port layouts at UE: (1, 4, 2, 1, 2, 1, 1), 2 panels (left, right)  Other assumptions are not precluded |
| UE Antenna radiation pattern | TR 38.802 Table A.2.1-8, |
| BS Tx Power | 40 dBm (baseline)  Other values (e.g., 34 dBm) not precluded |
| Maximum UE Tx Power | 23 dBm |
| BS receiver Noise Figure | 7 dB |
| UE receiver Noise Figure | 10 dB |
| Inter site distance | 200 m |
| BS Antenna height | 25 m |
| UE Antenna height | 1.5 m |
| Spatial consistency | companies report the one of spatial consistency procedures:  - Procedure A in TR38.901  - Procedure B in TR38.901 |
| UE trajectory model |  |

Table 5-1 FR2 simulation assumptions

|  |  |
| --- | --- |
| Parameter | Value |
| Frequency Range | FR1@{4GHz,30KHz} as central frequency for intra-frequency scenario  FR1@{2GHz, 15Khz/30KHz} as another frequency for inter-frequency scenario |
| Deployment | 500m ISD, 2-tier model with wrap-around (7 sites, 3 sectors/cells per site) |
| Channel model | UMa with distance-dependent LoS probability function defined in Table 7.4.2-1 in TR 38.901  Fast fading is optional? LOSsoft is optional modelled.  Oxygen absorption, Time-varying Doppler shift , Explicit ground reflection model and blockage are not considered. |
| System BW | 1  20MHz |
| UE Speed |  |
| UE distribution | 100% outdoor and UE’s distribution is up to company |
| BS Antenna Configuration | Companies need to report which option(s) are used between  - 32 ports: (8,8,2,1,1,2,8), (dH,dV) = (0.5, 0.8)λ  - 16 ports: (8,4,2,1,1,2,4), (dH,dV) = (0.5, 0.8)λ  Other configurations are not precluded. |
| BS Antenna radiation pattern | 3-sector antenna radiation pattern, 8 dBi |
| UE Antenna Configuration | 4RX: (1,2,2,1,1,1,2), (dH,dV) = (0.5, 0.5)λ for (rank 1-4)  2RX: (1,1,2,1,1,1,1), (dH,dV) = (0.5, 0.5)λ for (rank 1,2)  Other configuration is not precluded. |
| UE Antenna radiation pattern | Omni-direction |
| BS Tx Power | 44dBm for 20MHz |
| Maximum UE Tx Power | 23dbm |
| BS receiver Noise Figure | 5db |
| UE receiver Noise Figure | 9dB |
| Inter site distance | 500m |
| BS Antenna height | 25m |
| UE Antenna height | Follow TR36.873, which is 1.5m |
| Spatial consistency | companies report the one of spatial consistency procedures:  - Procedure A in TR38.901  - Procedure B in TR38.901 |
| UE trajectory model |  |

Table 5-2 FR1 simulation assumptions