**3GPP TSG-RAN WG4 Meeting #109 R4-2321399**

**Chicago, USA, November 13 – 17, 2023**

**Agenda item:** 8.25.4

**Source:** Apple

**Title:** WF on RRM performance requirements of R18 Further NR mobility enhancement

**Document for:** Approval

# Topic #1: LTM

**Issue 4-1-1: accuracy requirements**

* Candidate solutions:
	+ Proposal 1: for intra-frequency L1-RSRP measurement, the legacy L1-RSRP accuracy requirements specified in clauses 10.1.19 for FR1 and 10.1.20 for FR2, respectively can be reused at least for UE capable of RTD>CP. (CMCC)
	+ Proposal 2: it is proposed to define accuracy requirements for inter-frequency L1-RSRP measurement. (CMCC)
	+ Proposal 3: Absolute and relative accuracy for intra-frequency and inter-frequency LTM L1-RSRP measurement are to be specified. (HW, MTK)
	+ Proposal 4: Side condition in intra-frequency and inter-frequency L1-RSRP measurement accuracy requirements is SNR=-3dB. (MTK)
	+ Proposal 5: Reuse legacy SSB based L1-RSRP absolute and relative accuracy requirements for intra-frequency L1-RSRP measurement. (MTK)
	+ Proposal 6: When UE is not capable of RTD > CP, if UE uses single timing for measuring neighbour cells, measurement accuracy should be studied through simulations. When different timing is assumed for measuring neighbour cells, measurement accuracy is same as legacy. (E///)
	+ Proposal 7: Intra and Inter-frequency measurement accuracy can be assumed same. (E///)
* Recommended WF
	+ Discuss candidate solutions.

**Issue 4-1-2: test coverage**

* Candidate solutions for L1 measurement test cases:
	+ Option 1: (CATT, Nokia)
		- Test cases for intra-frequency L1-RSRP measurement
		- Test cases for inter-frequency L1-RSRP measurement
	+ Option 1a: (HW)
		- Test case for intra-frequency L1-RSRP measurement with UE capability within CP
		- Test case for inter-frequency L1-RSRP measurement
	+ Option 1c: (MTK)
		- intra-frequency L1-RSRP measurement with UE incapable of RTD> CP
		- intra-frequency L1-RSRP measurement with UE capable of RTD> CP
		- inter-frequency L1-RSRP measurement with Type 1 MG
		- inter-frequency L1-RSRP measurement without gap
* Candidate solutions for cell switch test cases:
	+ Option 1: (CATT)
		- RACH-based or RACH-less
		- Frequency range of serving cell and target cell, intra- or inter
		- Whether the target TCI state is on the active TCI state list
		- Whether the target cell is a current serving cell or not an active serving cell
	+ Option 2: (Nokia)
		- RACH-based cell switch with TCI activation+indication at cell switch command
		- RACH-based cell switch with early TCI state activation
		- RACH-less cell switch with TCI state activation+indication at cell switch command
		- RACH-less cell switch with early TCI state activation
	+ Option 3: (E///)
		- Cell switch to neigour cell to be tested in following scenarios
		- Source cell is in FR1 and neighbour is in FR1
		- Source cell is in FR1 and neighbour is in FR2
		- Source cell is in FR2 and neighbour is in FR1
		- Source cell is in FR2 and neighbour is in FR2
* Candidate solutions for PDCCH order RACH:
	+ Option 1: RAN4 to consider defining a test case for early TA acquisition based on PDCCH order separately from LTM cell switch and/or together with LTM cell switch. Details of the test case(s) are pending core part agreements. (Nokia)
	+ Option 2: PDCCH order based RACH to neigour cell to be tested in following scenarios for delay and interruption (E///)
		- Source cell is in FR1 and neighbour is in FR1
		- Source cell is in FR1 and neighbour is in FR2
		- Source cell is in FR2 and neighbour is in FR1
		- Source cell is in FR2 and neighbour is in FR2
* Candidate solutions for TCI state activation on neighbour cell:
	+ Option 1: RAN4 to deifne Test to verify prioritization of cells measurement after TCI state is activated (E///)
* Recommended WF
	+ Discuss test case coverage based on the following table provided by MTK:

|  |  |  |
| --- | --- | --- |
| **Core requirements defined** | **Detail**  | **Note** |
| PCell Cell switch requirements | A.6.3.x.1* RACH based Cell switch from FR1 to FR1
	+ Intra-frequency cell switch
 | There are totally 4 dimensions, i.e.,* RACH based or RACH-less
* FR1 or FR2
* PCell or PSCell
* Intra-f or inter-f

There can be 16 combinations, which are too many.Considering that the delay requirements of RACH-less cell switch is part of that of RACH based cell switch, it is enough to test RACH-less cell switch for intra-frequency cell switch only.Considering that PSCell cell switch delay is the same as PCell cell switch delay. The difference lies in interruption requirements, we think it is enough to only test RACH-based PSCell cell switch for intra-frequency. |
| A.6.3.x.2* RACH based Cell switch from FR1 to FR1
	+ Inter-frequency cell switch
 |
| A.6.3.x.3* RACH-less Cell switch from FR1 to FR1
	+ Intra-frequency cell switch
 |
| A.7.3.x.1* RACH based Cell switch from FR2 to FR2
	+ Intra-frequency cell switch
 |
| A.7.3.x.2* RACH based Cell switch from FR2 to FR2
	+ Inter-frequency cell switch
 |
| A.7.3.x.3* RACH-less Cell switch from FR2 to FR2
	+ Intra-frequency cell switch
 |
| PSCell cell switch | A.6.3.y.1* RACH based Cell switch from FR1 to FR1

Intra-frequency cell switch |
| A.7.3.y.1* RACH based Cell switch from FR2 to FR2
	+ Intra-frequency cell switch
 |
| UL transmit timing requirements | No need to have independent test case as can be tested in TCs for cell switch requirements |  |
| PDCCH-order RACH on neighbor cell | A.6.5.x.1* intra-frequency target cell in FR1
* RACH BW is within active BWP
 |  |
| A.6.5.x.2* inter-frequency target cell in FR1
* RACH BW is outside any configured BWP
 |
| A.7.5.x.1* intra-frequency target cell in FR2
* RACH BW is within active BWP
 |
| A.7.5.x.2* inter-frequency target cell in FR2
* RACH BW is outside any configured BWP
 |
| Intra-f L1-RSRP measurement for LTM | A.6.6.x.1* Intra-f L1-RSRP measurement in FR1
	+ RTD<CP
		- UE does not support RTD>CP
	+ Single frequency layer
	+ 1 serving cell, 2 neighbor cells
 | UE capable of RTD>CP does not need to test the test cases for RTD<CP. A.7.6.x.3 and A.7.6.x.4 may be not needed. It depends on the conclusion on UE behavior if not claiming to support RTD>CP. |
| A.6.6.x.2* Intra-f L1-RSRP measurement in FR1
	+ RTD>CP
		- UE supports RTD>CP
		- TBD: otherwise
	+ Single frequency layer
	+ 1 serving cell, 2 neighbor cells
 |
| A.7.6.x.1* Intra-f L1-RSRP measurement in FR2
	+ RTD<CP
	+ Single frequency layer
	+ 1 serving cell, 2 neighbor cells, none of neighbor cells’ TCI state activated
 |
| A.7.6.x.2* Intra-f L1-RSRP measurement in FR2
	+ RTD<CP
	+ Single frequency layer
	+ 1 serving cell, 2 neighbor cells, one of neighbor cells’ TCI state activated
 |
| [A.7.6.x.3* Intra-f L1-RSRP measurement in FR2
	+ RTD>CP and UE supports RTD>CP
	+ Single frequency layer
	+ 1 serving cell, 2 neighbor cells, none of neighbor cells’ TCI state activated]
 |
| [A.7.6.x.4* Intra-f L1-RSRP measurement in FR2
	+ RTD>CP and UE supports RTD>CP
	+ Single frequency layer
	+ 1 serving cell, 2 neighbor cells, one of neighbor cells’ TCI state activated]
 |
| Inter-f L1-RSRP measurement with Type 1 MG | A.6.6.y.1* Inter-f L1-RSRP measurement with Type 1 MG in FR1
	+ RTD<CP
	+ With known SBI
	+ 2 neighbor cells
 |  |
| A.7.6.y.1* Inter-f L1-RSRP measurement with Type 1 MG in FR2
	+ RTD<CP
	+ With known SBI
	+ 2 neighbor cells
 |  |
| Inter-f L1-RSRP measurement without gap for LTM | A.6.6.z.1* Inter-f L1-RSRP measurement without gap in FR1
	+ RTD<CP
	+ Single frequency layer
	+ 2 neighbor cells
 | As UE behavior is basically the same as L1-RSRP measurement on intra-frequency neighbor cell(s), there is no need to test all the cases.  |
| A.7.6.z.1* Inter-f L1-RSRP measurement without gap in FR2
	+ RTD<CP
	+ Single frequency layer
	+ 2 neighbor cells, none of neighbor cells’ TCI state activated
 |

# Topic #2: NR-DC with selective activation of cell groups via L3 enhancements

**Issue 4-2-1: test coverage**

* Candidate solutions:
	+ Option 1: define the following two test cases (CATT)
		- Intra-frequency CPC from FR1-FR2 NR-DC to FR1-FR2 NR-DC)
		- Inter-frequency CPC from FR1-FR1 NR-DC to FR1-FR1 NR-DC)
	+ Option 2: define the following two test cases (Apple)
		- FR1-FR1 NR-DC to FR1-FR1 NR-DC
		- FR1-FR1 NR-DC to FR1-FR2 NR-DC (with testability issue)
	+ Option 2a: define the following two test cases (vivo)
		- Intra-frequency CPC from FR1-FR1 NR-DC to FR1-FR1 NR-DC
		- Inter-frequency CPC from FR1-FR1 NR-DC to FR1-FR2 NR-DC (with testability issue)
	+ Option 3: For subsequent-CPAC testing of PSCell change delay, introduce a new test case to test the delay requirement for PSCell change after a PSCell change. (Nokia)
	+ Option 4: For subsequent-CPAC, it is proposed to define test for both FR1-FR1 NR-DC and FR1-FR2 NR-DC (ZTE)
	+ Option 5: Introduce test cases with multiple configurations for subsequent Conditional PSCell Change to cover different scenarios. UEs capable of multiple DC combinations only need to test one of the test cases or one of the configurations. (MTK)
* Recommended WF
	+ Discuss candidate solutions.

**Issue 4-2-2: test configuration**

* Candidate solutions:
	+ Option 1: Using existing legecy CPC test configuration as baseline, add the second activation with 2 observation time T5 is the time when UE 2nd time send PRACH preamble and T6 is the UE receive the test system RRC\_Release message. (E///)
	+ Option 2: Test parameters in existing conditional PSCell addition can be used as baseline for subsequent Conditional PSCell Change test cases. (Apple, vivo)
* Recommended WF
	+ Discuss candidate solutions.

# Topic #3: improvement on SCell/SCG setup delay

**Issue 4-3-1: test scope**

* Candidate solutions:
	+ Option 1: RAN4 can consider a new test case to verify the new measurement result validity procedure, e.g. use one EMR test case as baseline, and then add the newly introduced timer X. TE shall trigger measurement report after T331 expires and with X second window. (Apple)
	+ Option 2: For eEMR, define test cases for verifying measurement accuracy of UE reported idle/inactive mode measurements for the cases with and without enhanced measurements. The details of the measurements and reporting are depending on further RAN4 and RAN2 agreements. (Nokia)
	+ Option 3: Define test case for solutions based on existing measurement. No need to define test cases for solutions based on enhanced measurement. (MTK)
	+ Option 4: For Solution 1 based on existing measurement results can reuse Rel-16 EMR test case as baseline with update configuration of the maximum value of both validity time and T331 timer. For Solution 2 based on enhanced measurement, the performance part can wait for more progress on the core part. (E///)
* Recommended WF
	+ Discuss candidate solutions.

# Topic #4: enhanced CHO configurations

## CHO including target MCG and target SCG in NR-DC (obj.3)

**Issue 4-4-1: whether to introduce test case for CHO including target MCG and target SCG in NR-DC (obj.3).**

* Candidate solutions:
	+ Option 1: yes (CATT, vivo, CMCC, Nokia, ZTE, HW, E///)
	+ Option 2: no, given that UE anyway has to pass conditional handover test cases and handover with PSCell test cases (Apple)
* Recommended WF
	+ Agree on option 1.

**Issue 4-4-2: scope and scenario for CHO including target MCG and target SCG in NR-DC (obj.3).**

* Candidate solutions:
	+ Option 1: define test cases for both FR1+FR2 and FR1+FR1 NR-DC. (CATT, CMCC)
	+ Option 1a: (vivo, [ZTE])
		- TC1: Conditional handover with PSCell change from NR-DC to NR-DC with parallel processing (both PCell and PSCell are in FR1)
		- TC2: Conditional handover with PSCell change from NR-DC to NR-DC with sequential processing (PCell is in FR1 and PSCell is in FR2)
	+ Option 2:
		- FR1-FR1 NR-DC to FR1-FR1 NR-DC,
		- FR1-FR2 NR-DC to FR1-FR1 NR-DC,
		- FR1-FR1 NR-DC to FR1-FR2 NR-DC,
		- FR1-FR2 NR-DC to FR1-FR2 NR-DC.
	+ Option 3: Fine to define test cases or test case with multiple configurations to cover more scenarios, but UE only needs to test one of the test cases or one of the configurations if UE supports multiple NR-DC combinations. (MTK)
* Recommended WF
	+ Discuss candidate solutions.

**Issue 4-4-3: test coverage for CHO including target MCG and target SCG in NR-DC (obj.3).**

* Candidate solutions:
	+ Option 1: define test to cover both PCell handover delay and PSCell handover delay. (CMCC)
* Recommended WF
	+ Agree option 1.

## CHO including target MCG and candidate SCG in NR-DC (obj.4)

**Issue 4-4-4: scope and scenario for CHO including target MCG and candidate SCG in NR-DC (obj.4)**

* Candidate solutions:
	+ Option 1: introduce the following two test cases (Apple, vivo, [ZTE])
		- FR1-FR1 NR-DC to FR1-FR1 NR-DC
		- FR1-FR1 NR-DC to FR1-FR2 NR-DC (with testability issue)
	+ Option 1a: define test cases for both FR1+FR2 and FR1+FR1 NR-DC. (CATT)
	+ Option 2:
		- FR1-FR1 NR-DC to FR1-FR1 NR-DC,
		- FR1-FR2 NR-DC to FR1-FR1 NR-DC,
		- FR1-FR1 NR-DC to FR1-FR2 NR-DC,
		- FR1-FR2 NR-DC to FR1-FR2 NR-DC.
	+ Option 3: Fine to define test cases or test case with multiple configurations to cover more scenarios, but UE only needs to test one of the test cases or one of the configurations if UE supports multiple NR-DC combinations. (MTK)
* Recommended WF
	+ Discuss candidate solutions.

**Issue 4-4-5: whether to define new test case for CHO with candidate PSCell for the case when CPC condition is not met and the UE proceeds with CHO-only**

* Candidate solutions:
	+ Option 1: No. RAN4 already has CHO-only test cases. (Apple, CATT, Nokia, ZTE)
	+ Option 2: Yes (CMCC, E///)
* Recommended WF
	+ Discuss candidate solutions.

**Issue 4-4-6: test configuration for CHO including target MCG and candidate SCG in NR-DC (obj.4)**

* Candidate solutions:
	+ Option 1: test parameters in test cases for conditional handover and handover with PSCell can be used as baseline for conditional handover including target MCG and candidate SCG. (CATT, Apple)
* Recommended WF
	+ Discuss candidate solutions.