3GPP TSG RAN Rel-18 workshop
Electronic Meeting
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Agenda Item: 4.1

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NR mobility enhancements considered for Rel-18

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Background

- LTE Rel-14
  - make-before-break handover and RACH-less handover
- NR Rel-15
  - only basic handover is supported
- Rel-16 mobility enhancements WI
  - Dual Active Protocol Stack (DAPS) handover
  - Conditional handover (CHO)
  - Intra-node Conditional PSCell Change (CPC)
  - 2-step CFRA (contention-free random access) for handover in NR (in 2-step RACH WI)
- Rel-17 mobility enhancements in multiple WIs
  - In the feMIMO WI, work is ongoing on inter-cell support for beam management including L1/L2-centric mobility for NR
  - In the further MR-DC/CA enhancements WI, inter-node CPC and Conditional PSCell Addition (CPA) are being specified
  - In NTN, some NTN related mobility enhancements are being introduced, such as CHO enhancements

Mobility interruption enhancements for Rel-18

- **Reduction of mobility interruption time when CA/DC is configured**
  - High bitrate services and/or services requiring high reliability , including XR and URLLC, often rely on PDCP duplication and/or CA/DC in order to ensure required QoS
  - CA/DC (and as consequence, PDCP duplication) cannot be used together with DAPS handover in Rel-16
    - Therefore, consistent QoS during mobility for high-data rate bounded latency applications using PDCP duplication and/or CA/DC cannot be ensured with DAPS
  - A solution is needed to reduce mobility interruption when CA/DC is configured
  - Potential solutions:
    - enhance DAPS to work also with CA and DC
    - enhanced make-before-break handover (like Rel-14 LTE make-before-break, but enhanced to even further reduce interruption time and to support CA/DC)

- **Reduction of mobility interruption time in FR2**
  - DAPS is not feasible for FR2<->FR2 handover
  - L1/L2-centric mobility does not replace L3 handover at least in Rel-17 as it is limited to certain scenarios, such as intra-DU
  - A solution is needed to reach close to 0ms interruption during mobility within FR2
  - Potential solutions:
    - enhanced make-before-break handover (like the Rel-14 LTE make-before-break, but enhanced to even further reduce interruption time)

- **Leaner DAPS HO L3 signaling flow**
  - Reduce the number of message exchanges due to downgrading the source DAPS configuration

Mobility robustness enhancements for Rel-18

- **CHO+MR-DC enhancements**
  - In legacy HO, the target gNB receive measurements enabling it to select SCG cells (SCells and PSCell). It is currently possible for the target candidate gNodeB to configure an SCG (PSCell and SCells) in the CHO command. However, SCG cells (PSCell and SCells) are selected based on measurements received in CHO Request (i.e. much earlier), which might be outdated at CHO execution. In addition, the CHO execution conditions are only based on the PCell.
  - The target cannot configure MR-DC effectively within CHO, and instead likely only configures MR-DC after the handover, which reduces MR-DC utilization and increases signalling. Another possible consequence is an SCG failure after the CHO execution, the target gNodeB selects for a PCell candidate a PSCell that is not in good radio conditions when CHO is executed.
  - RAN3 impact: it is assumed that with CPA functions (SN Addition Request) a target candidate MN can configure the UE with an SCG in CHO. If that is not completed in Rel-17, this could also be considered part of the functions to be standardized in this topic.
  - In this topic, it would be beneficial that for a given candidate PCell the UE would select the best PSCell during CHO execution.
  - Examples:
    - Conditions based on both PCell and PSCell (for a PCell, there may be multiple PSCell candidates);
    - Measurements within RRCReconfigurationComplete sent at CHO execution (to enable faster MR-DC setup and/or SCG activation);

Mobility robustness enhancements for Rel-18

- **CHO and RRC_INACTIVE**
  - In Rel-16, CHO can only be configured in an RRCReconfiguration. Hence, after a transition from Inactive to Connected, an additional RRCReconfiguration is required to configure CHO, even though in many cases the target candidates may be known to the network from the time the UE resumes.
  - Semi-static UE suspends/resumes most of the time to the same cell. But in Rel-16, a UE releases the CHO configurations when going to INACTIVE. Hence, the gNB needs to re-add them again after resume which leads to an additional RRC Reconfiguration procedure.
  - Examples:
    - CHO in RRCResume message
    - UE stores CHO upon receiving RRCRelease (suspendConfig), restores upon RRCResume;

Mobility robustness enhancements for Rel-18

- **Enhancements on execution conditions**
  - In legacy handover, a HO algorithm at the network can be based on measurements on different RS types and/or for different measurement objects, L3 filtered beam measurements (so source can decide to handover to the cell with better beam measurements), etc.
  - In CHO, the UE applies an RRCReconfiguration upon fulfillment of an execution condition configured as one or two measID(s). However, ~~some~~ restrictions were introduced for these execution conditions:
    - both measId(s) need to refer to the same RS type and the same measurement object
    - execution conditions cannot refer to beam measurements, etc.
  - It would be beneficial to specify enhancements to the design of the execution conditions, trying to extend to CHO some behaviors from legacy HO functions so that CHO executions can be based on information that network would also use to make HO decision.
  - Examples:
    - Multiple conditions can be AND but also OR;
    - measId(s) based on SSB and CSI-RS; and/or different measurement objects;
    - execution conditions based on beam measurements;

Mobility robustness enhancements for Rel-18

- **CHO/CPC within handover/CHO command**
  - In legacy a restriction has been added:
    - A HO command cannot contain another CHO
    - a CHO cannot contain a CHO
  - The consequence is that another RRCReconfiguration in target is needed right after the HO/CHO. This additional procedure leads to increased signaling (one more RRCReconfiguration in target after the HO). It also increases the risks of RLF in target after CHO execution (CHO to the wrong cell/ too early handover) as after the CHO execution, in target, if the UE triggers RLF it cannot apply CHO (as it has not been configured yet).
  - It would be beneficial to allow HO command (and CHO command) to contain a CHO configuration;
    - Signaling reduction and improved robustness (and/or faster recovery of RLF after CHO execution)
  - Examples:
    - CHO within HO command,
    - CHO within CHO.

- **Combination of CHO and DAPS**
  - In Rel-16 , CHO and DAPS handover are not supported simultaneously
  - There is a benefit to support the combination of CHO and DAPS:
    - DAPS handover command size is larger. By allowing DAPS execution using a conditional configuration, RLF due too late handover execution is avoided.
    - If the UE can keep CHO configurations during DAPS HO it may execute CHO if a DAPS HO fails