**3GPP T****SG-RAN WG2 Meeting #124 R2-2313647**

**Chicago, US, November 13-17, 2023**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| *CR-Form-v12.2* | | | | | | | | |
| **CHANGE REQUEST** | | | | | | | | |
|  | | | | | | | | |
|  | **37.340** | **CR** | **0375** | **rev** | **-** | **Current version:** | **17.6.0** |  |
|  | | | | | | | | |
| *For* [***HELP***](http://www.3gpp.org/3G_Specs/CRs.htm#_blank)*on using this form: comprehensive instructions can be found at* [*http://www.3gpp.org/Change-Requests*](http://www.3gpp.org/Change-Requests)*.* | | | | | | | | |
|  | | | | | | | | |

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| ***Proposed change affects:*** | UICC apps |  | ME | **x** | Radio Access Network | **x** | Core Network |  |

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | | | | | | | | | | |
| ***Title:*** | 37.340 running CR for introduction of NR further mobility enhancements | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Source to WG:*** | ZTE Corporation, Sanechips | | | | | | | | | |
| ***Source to TSG:*** | R2 | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Work item code:*** | NR\_Mob\_enh2-Core | | | | |  | ***Date:*** | | | 2023-11-23 |
|  |  | | | |  | |  | | |  |
| ***Category:*** | **B** |  | | | | | ***Release:*** | | | Rel-18 |
|  | *Use one of the following categories:* ***F*** *(correction)* ***A*** *(mirror corresponding to a change in an earlier release)* ***B*** *(addition of feature),* ***C*** *(functional modification of feature)* ***D*** *(editorial modification)*  Detailed explanations of the above categories can be found in 3GPP [TR 21.900](http://www.3gpp.org/ftp/Specs/html-info/21900.htm). | | | | | | | | *Use one of the following releases: Rel-8 (Release 8) Rel-9 (Release 9) Rel-10 (Release 10) Rel-11 (Release 11) … Rel-16 (Release 16) Rel-17 (Release 17) Rel-18 (Release 18) Rel-19 (Release 19)* | |
|  |  | | | | | | | | | |
| ***Reason for change:*** | | This CR is to introduce the further NR mobility enhancements features which comprises the following:  - Introduction of L1/L2 Triggered mobility  - Introduction of subsequent CPAC in NR-DC  - Introduction of CHO with candidate SCG(s)  Stage-2 related RAN2 agreements:   |  | | --- | | RAN2#119-e  Subsequent CPAC   * The selective activation of cell groups should correspond to support of subsequent conditional changes (CPC) after a cell group change (normal or conditional). CPA FFS. * Initial focus on SCG   CHO with candidate candidate SCG(s)   * CHO configuration referring to or including CPC/CPA configuration (intended to be applicable together) can be supported.   RAN2#119bis-e  Subsequent CPAC   * Baseline procedure to support subsequent secondary cell group change (FFS if UE keeps all configurations or if those are indicated by the network, FFS support of nested configs):  1. Step 1: when the execution condition of a CPC candidate PScell is met, a UE performs the execution of CPC towards this candidate PScell. 2. Step 2: After finishing the PSCell addition or change, the UE doesn’t release conditional configuration of other candidate PSCells for subsequent CPC, the UE continues evaluating the execution conditions of other candidate PScells. 3. Step 3: When the execution condition of a candidate PScell is met, the UE performs the execution of CPC towards this candidate PSCell.  * Confirm that “CPA” selective activation of cell groups will be supported for this WI objective * Confirm that we aim to support delta configuration, i.e. that there need to be a known reference. * RAN2 aim to support selective activation of cell groups without RRC reconfiguration with respect to security (FFS, need to consult with SA3 at some point in time).   RAN2#120  Subsequent CPAC  Delta configuration   * A UE stores the reference configuration as a separate configuration. * The reference configuration is managed separately   CHO with candidate SCG(s)   * Execution order: the UE doesn’t execute CPC/CPA unless CHO condition is fulfilled (regardless parallel or sequential evaluation)   RAN2#121  Subsequent CPAC   * Assume to support the following scenarios of SCG selective activation: * SN initiated intra-SN SCG selective activation * MN initiated inter-SN SCG selective activation * SN initiated inter-SN SCG selective activation * It is assumed that if the UE need to be able to return to a current SCG by conditional procedure, then the network could explicitly configure a candidate configuration for that cell. * In SCG selective activation, the CPC/CPA configurations of the UE should be released after Pcell change, at least for inter MN (by explicit indication from network, FFS other case). * R2 assumes that a CPA conditional configuration can be used for CPC (but with different triggering conditions) * For inter-SN CPC, MN should provide the reference configuration to all candidate T-SNs (in order to generate the T-SN candidate configuration). * R2 understands that A target SN may include an indication in SN Addition Request Ack for each candidate target PSCell, denoting whether the associated SCG configuration is a delta with respect to the reference SCG configuration.   CHO with candidate SCG(s)   * RAN2 agrees to support the simultaneous evaluation of CHO and CPC in Rel-18 * The UE should not need to unpack any of the nested conditionalconfiguration containers in order to measure, acc to agreement above   RAN2#121bis-e  Subsequent CPAC   * For the reference configuration for SCG Selective Activation, aim at following similar design as LTM. * For inter-SN SCG Selective Activation, the RRC reconfiguration message containing the Rel-18 CPC configurations provided to the UE is in MN format. * For MN initiated inter-SN SCG selective activation, source MN generates the execution conditions for the initial CPAC.   FFS on the following options for subsequent CPC:  Option 1: Source MN generates the execution conditions for all subsequent CPC.  Option 2: Candidate SN may generate execution conditions for subsequent CPC.   * For SN initiated inter-SN SCG selective activation, source SN generates the execution conditions for the initial CPC.  FFS if Candidate SN may generate/modify execution conditions for subsequent CPC * Assume for now that there is only one reference configuration. * The following may be included in the initial RRC reconfiguration message containing the Rel-18 CPC configurations: * Reference SCG configuration (Optionality FFS). Assume as for LTM Reference configuration may be empty.   FFS whether MCG configuration is included.  FFS RRC model for the reference configuration.  Initial List of candidate target PSCells (this list can be updated by the network, e.g., cells may be added or removed) with associated target SCG configurations. FFS whether the MCG configurations associated with the target SCG configurations are included.  3. The execution conditions associated with each candidate target PSCell.  a. For MN initiated procedure, execution conditions based on event A4 are supported. FFS whether A3/A5 are supported.  b. For SN initiated procedure, execution conditions based on events A3/A5 are supported.   * UE will keep R18 CPC configurations after CPC execution. It should be possible to release a CPC candidate explicitly by RRC reconfiguration procedure.   CHO with candidate SCG(s)  For the CHO+CPC case:   * When both CHO and CPC conditions are met, both CHO and CPC cell change is executed. * Baseline: The UE waits until both CHO and CPC conditions are met (always). (furthermore, it is assumed that if needed the network can provide a complementary CHO-only configuration, to avoid failures in deployments where failure would otherwise be likely to happen).   RAN2#122  Subsequent CPAC   * For SN-initiated SCG selective activation, candidate SN generates execution conditions for subsequent CPC. * FFS if it shall be possible to do something like MN-initiated CPA/CPC where Candidate SN generate execution conditions for subsequent CPC * The UE shall skip the condition evaluation for a candidate which is a current PScell. * The reference configuration is provided to all candidates involved in preparation, FFS which node initially generates it. Assume it can be provided in MN initiated and in SN initiated procedures. * Terminology is “Subsequent CPAC”   CHO with candidate SCG(s)   * P5: For CPA/CPC execution conditions, the candidate MN determines the parameters of the execution conditions for candidate PSCells (e.g. event A4 threshold). * P6: The candidate MN informs the source MN about the prepared candidate PSCells and parameters of the associated execution conditions (e.g. event A4 threshold). According to the received information from the candidate MN, the source MN generates the corresponding execution conditions based on the source MCG MeasConfig to the UE. * P8: For CHO with candidate SCGs for CPA/CPC, the RRCReconfigurtaion message in one CHO container includes one MCG configuration and one SCG configuration (i.e. similar to Rel-17 CHO with SCG configuration). * P9: The execution conditions associated with one CHO container includes both CHO execution condition(s) and CPA/CPC execution condition(s), i.e. triggering conditions on both candidate PCell and candidate PSCell. * P10: If there are multiple candidate PSCells associated with one candidate PCell, the NW can provide multiple CHO configurations for the same candidate PCell, i.e. each one contains one MCG configuration (for the same candidate PCell) and one SCG configuration (for different candidate PSCell). * P12: When the CPA/CPC execution condition is met but no CHO execution condition is met, the UE continues to evaluate both CHO and CPA/CPC execution conditions. * For CHO+CPC we only consider execution when BOTH conditions are met.   (When the CHO execution condition is met but no CPC execution condition is met, if there is an available CHO-only or Rel-17 CHO with SCG configuration for which the CHO condition is met, the UE performs the CHO-only or Rel-17 CHO with SCG execution, and THUS the network can handle such situation by providing proper configurations).  RAN2#123  LTM   * 1b) The case of PCell change (MCG) by LTM, without SCG, is supported (If there is an SCG configuration it is released at LTM execution). * 2b) The case of SCG LTM, without MN involvement is supported * as a working assumption (can be revisited e.g. at the last meeting), it is assumed that other MCG/SCG cases are not supported.   Subsequent CPAC   * For subsequent CPAC it is useful to support use of A3 A5 * A3 A5 is supported with SN-initiated subsequent CPAC * Proposal 1: For MN-initiated subsequent CPAC, MN initially triggers the candidate cell preparation of subsequent CPAC procedure, i.e. MN triggers the procedure as defined in Section 10.5.2 and Section 10.2.2 of TS 37.340 in the endorsed running CR. * Proposal 2: For SN-initiated inter-SN subsequent CPAC, SN initially triggers the candidate cell preparation of subsequent CPAC procedure, i.e. source SN triggers the procedure as defined in Section 10.5.2 of TS 37.340 in the endorsed running CR. * Proposal 3 (option2): For MN-initiated subsequent CPAC, the execution condition configuration is provided as following:   MN generates the execution conditions (A4 event) for initial CPAC execution, and the measID refers to the measurement configuration associated with MCG;  candidate SN generates the execution conditions (A3/A5 event) for subsequent CPC execution, and the measID refers to the measurement configuration associated with SCG.   * Will support the SA3 solution, i.e. update of Sk-counter at inter-SN-mobility, based on pre-configured multiple Sk-counter. UE need to know when Sk counter need to change.   CHO with candidate SCG(s)   * R2 assumes Source MN initiates the preparation of the R18 CHO with candidate SCG(s), e.g., S-MN tells the T-MN whether it is allowed to configure candidate SCG(s). FFS the signalling details. * candidate MN recommends the candidate PSCells to candidate SN (for CHO with MN-initiated CPC). * Recommendation of the candidate PSCells can be based on measurement results. * R2 assumes for this R18 feature that the evaluation of the execution conditions for CHO with Candidate SCG(s) do not need to continue once PSCell change is triggered. * selectedCondRRCReconfig-r17 is not reused to indicate the selected target SCG to the target MN, i.e., UE indicates physCellId and ARFCN-ValueNR of the selected PSCell to target MN.   RAN2#123-bis  LTM   * R2 assumes that SCG LTM with deactivated src SCG will not happen (no TS impact) * UE need to send an UL transmission for procedure competion also for SCG case. If SRB3 is not configured, FFS exactly if / what modification to 3GPP TS is needed.   Subsequent CPAC   * P1a: Upon SCG release, RAN2 confirms that the UE shall release the subsequent CPAC configuration within SCG VarConditionalReconfig autonomously. * P3: If there are maintained subsequent CPAC configurations with CPA execution conditions after SCG release, the maintained configurations can be used for the subsequent CPA execution. * P4: The coexistence of subsequent CPAC and SCG deactivation is not supported in Rel-18, i.e. follow the same principle as legacy CPAC. * P5: The candidate and reference configuration for subsequent CPAC can include both MCG and SCG part configurations. It can be up to the NW implementation whether to include the MCG part. * P6: The MN generates the MCG part of the reference configuration (if any), while the SN (source or candidate) generates the SCG part of the reference configuration. * P8: The MN is responsible for the reference configuration generation for MN/SN initiated inter-SN SCPAC. * P10: The MN can request an SCG reference configuration from any of the involved SNs. * P11: Candidate SN prepares the execution conditions for subsequent CPC when the candidate SN prepares the candidate SCG configuration(s) for candidate PSCell(s). * P12: For SN initiated inter-SN subsequent CPAC, in SN Change Required message, the source SN includes the following information to the MN: - A list of candidate SNs (can also include source SN) for the initial and subsequent CPC, and for each candidate SN in the list, a list of PSCells suggested to be prepared by the candidate SN. - Execution conditions associated with each suggested PSCell of the CPC. * P14: In SN Addition Request Acknowledge message, the candidate SN includes the following information to the MN:   1) List of prepared candidate PSCells and associated candidate SCG configurations, which include the candidate SCG measurement configurations, i.e. as legacy;  2) For each cell in 1), a list of proposed candidate PSCells for the subsequent CPC (e.g., the neighbour PSCells), and associated execution conditions (events A3/A5, based on the candidate SCG measurement configurations).  Note: The proposed candidate PSCells are selected from the recommended cell list provided by the MN, as the legacy.   * P15: The MN checks whether the proposed candidate PSCells for subsequent CPC have been prepared by other candidate SNs, and the MN may initiate an SN Modification procedure to the candidate SN, e.g. when not all proposed candidate PSCells for subsequent CPC have been prepared. * P16a: In SN Modification Request message, the MN includes the following information to the candidate SN:   Candidate PSCells for subsequent CPC that have been prepared by other candidate SNs.   * P16b: In SN Modification Request Acknowledge message, the candidate SN includes the following information to the MN:   Updated candidate SCG configurations and/or the execution conditions for subsequent CPC, if needed. The detailed signaling is similar to that in SN Addition Request Acknowledge message.   * For one UE, for CPC only either MN format or SN format (only intra-SN case is possible) is used * MN format is supported for intra-SN (in addition to SN format) * P13a: For MN initiated inter-SN subsequent CPAC, in SN Addition Request message, the MN includes the following information to each candidate SN:   - A list of candidate SNs, and for each candidate SN in the list, a list of cells recommended by MN (assume format as legacy)   * P13b: For SN initiated inter-SN subsequent CPAC, in SN Addition Request message, the MN includes the following information to each candidate SN:   A list of candidate SNs, and for each candidate SN in the list, a list of PSCells suggested to be prepared by the candidate SN.   * Mod P3: UE include the selected SK-counter value in the MN RRC Reconfiguration Complete message when UE selects new SK-counter value as part of S-CPAC execution. * Mod P4: For Pcell-change /PSCell-change /SCG Release scenarios, if the SCPAC configuration is maintained, UE also maintains the unused SK-counter values.   CHO with candidate SCG(s)   * P2: The execution of CHO with candidate SCG is prioritized, if both PCell for CHO only or CHO including target MCG and target SCG, and the PCell and the associated PSCell for CHO with candidate SCG(s) is triggered.   RAN2#124  LTM   * For SCG LTM completion, when SRB3 is not configured, any transmission from the UE completes the procedure, and the network can ensure that such transmission takes place. * LTM for simultaneous PCell and PSCell change is not supported in Rel 18   Subsequent CPAC   * RAN2 confirms that both MN format and SN format can be used for intra-SN subsequent CPAC. And It’s up to the source SN to decide which format to be used. * UE stops evaluating the subsequent CPC execution conditions upon MCG failure and SCG failure. * UE maintains the subsequent CPAC configurations upon MCG failure and SCG failure and relies on explicit signalling to release. |   Stage-2 related RAN3 agreements are reflected in R3-238085 and R3-238086. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Summary of change:*** | | In order to introduce the further NR mobility enhancements, following procedures and changes are introduced in the stage-2 specification.   1. Add definition for subsequent CPAC and abbreviation for LTM. 2. Add introduction of LTM in NR-DC, including general description, flow charts and procedural texts for SCG LTM. 3. Add introduction of subsequent CPAC in NR-DC, including general description, flow charts and procedural texts for SN initiated intra-SN subsequent CPAC, MN initiated inter-SN subsequent CPAC and SN initiated inter-SN subsequent CPAC. 4. Add introduction of CHO with candidate SCG(s), including general description, and procedural texts. 5. Changes in SCG/MCG failure handling.   Changes from RAN3 endorsed CR R3-238085 and R3-238086 are merged. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Consequences if not approved:*** | | Rel-18 further NR mobility enhancements (including LTM, subsequent CPAC and CHO with candidate SCG(s)) are not supported by TS 37.340. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Clauses affected:*** | | 3.1, 3.2, 7.7, 10.1, 10.3.2, 10.4.2, 10.6, 10.19.2, 10.19.x (new), 10.X (new) | | | | | | | | |
|  | |  | | | | | | | | |
|  | | **Y** | **N** |  | | | |  | | |
| ***Other specs*** | |  | **X** | Other core specifications | | | | TS/TR ... CR ... | | |
| ***affected:*** | |  | **X** | Test specifications | | | | TS/TR ... CR ... | | |
| ***(show related CRs)*** | |  | **X** | O&M Specifications | | | | TS/TR ... CR ... | | |
|  | |  | | | | | | | | |
| ***Other comments:*** | |  | | | | | | | | |
|  | |  | | | | | | | | |
| ***This CR's revision history:*** | | R2-2306952 (endorsed after RAN2#122 meeting)  R2-2309830 (endorsed at RAN2#123-bis meeting)  R2-2312235 (endorsed at RAN2#124 meeting) | | | | | | | | |

START OF CHANGES

# 3 Definitions, symbols and abbreviations

## 3.1 Definitions

For the purposes of the present document, the terms and definitions given in TR 21.905 [1] and the following apply. A term defined in the present document takes precedence over the definition of the same term, if any, in TR 21.905 [1] and TS 36.300 [2].

**Child node**: IAB-DU's or IAB-donor-DU's next hop neighbour IAB-node.

**Conditional PSCell Addition:** a PSCell addition procedure that is executed only when PSCell addition execution condition is met.

**Conditional PSCell Change:** a PSCell change procedure that is executed only when PSCell change execution condition is met.

**En-gNB:** node providing NR user plane and control plane protocol terminations towards the UE, and acting as Secondary Node in EN-DC.

**Fast MCG link recovery:** in MR-DC, an RRC procedure where the UE sends an MCG Failure Information message to the MN via the SCG upon the detection of a radio link failure on the MCG.

**IAB-donor:** gNB that provides network access to UEs via a network of backhaul and access links.

**IAB-MT:** IAB-node function that terminates the Uu interface to the parent node using the procedures and behaviours specified for UEs unless stated otherwise.

**IAB-node:** RAN node that supports NR access links to UEs and NR backhaul links to parent nodes and child nodes. The IAB-node does not support backhauling via E-UTRA.

**Master Cell Group**: in MR-DC, a group of serving cells associated with the Master Node, comprising of the SpCell (PCell) and optionally one or more SCells.

**Master node**: in MR-DC, the radio access node that provides the control plane connection to the core network. It may be a Master eNB (in EN-DC), a Master ng-eNB (in NGEN-DC) or a Master gNB (in NR-DC and NE-DC).

**MCG bearer**: in MR-DC, a radio bearer with an RLC bearer (or two RLC bearers, in case of CA packet duplication in an E-UTRAN cell group, or up to four RLC bearers in case of CA packet duplication in a NR cell group) only in the MCG.

**MN terminated bearer:** in MR-DC, a radio bearer for which PDCP is located in the MN.

**MCG SRB**: in MR-DC, a direct SRB between the MN and the UE.

**Multi-Radio Dual Connectivity:** Dual Connectivity between E-UTRA and NR nodes, or between two NR nodes.

**Ng-eNB**: as defined in TS 38.300 [3].

**NR sidelink communication**: AS functionality enabling at least V2X Communication as defined in TS 23.287 [18] and ProSe Communication (including ProSe UE-to-Network Relay and non-Relay communication) as defined in TS 23.304 [24], between two or more nearby UEs, using NR technology but not traversing any network node.

**NR sidelink discovery**: AS functionality enabling ProSe non-Relay Discovery and ProSe UE-to-Network Relay discovery for Proximity based Services as defined in TS 23.304 [24] between two or more nearby UEs, using NR technology but not traversing any network node.

**Parent node:** IAB-MT's next hop neighbour node; the parent node can be IAB-node or IAB-donor-DU.

**PCell**: SpCell of a master cell group.

**PSCell**: SpCell of a secondary cell group.

**RLC bearer:** RLC and MAC logical channel configuration of a radio bearer in one cell group.

**Secondary Cell Group**: in MR-DC, a group of serving cells associated with the Secondary Node, comprising of the SpCell (PSCell) and optionally one or more SCells.

**Secondary node**: in MR-DC, the radio access node, with no control plane connection to the core network, providing additional resources to the UE. It may be an en-gNB (in EN-DC), a Secondary ng-eNB (in NE-DC) or a Secondary gNB (in NR-DC and NGEN-DC).

**SCG bearer**: in MR-DC, a radio bearer with an RLC bearer (or two RLC bearers, in case of CA packet duplication in an E-UTRAN cell group, or up to four RLC bearers in case of CA packet duplication in a NR cell group) only in the SCG.

**SN terminated bearer:** in MR-DC, a radio bearer for which PDCP is located in the SN.

**SpCell**: primary cell of a master or secondary cell group.

**SRB3**: in EN-DC, NGEN-DC and NR-DC, a direct SRB between the SN and the UE.

**Split bearer:** in MR-DC, a radio bearer with RLC bearers both in MCG and SCG.

**Split PDU Session (or PDU Session split):** a PDU Session whose QoS Flows are served by more than one SDAP entities in the NG-RAN.

**Split SRB**: in MR-DC, a SRB between the MN and the UE with RLC bearers both in MCG and SCG.

**Subsequent Conditional PSCell Addition or Change (subsequent CPAC):** a conditional PSCell addition or change procedure that is executed after a PSCell addition, a PSCell change or an SCG release based on pre-configured subsequent CPAC configuration of candidate PSCell(s) without reconfiguration and re-initiation of CPC/CPA.

**User plane resource configuration:** in MR-DC with 5GC, encompasses radio network resources and radio access resources related to either one or more PDU sessions, one or more QoS flows, one or more DRBs, or any combination thereof.

**V2X sidelink communication**: AS functionality enabling V2X Communication as defined in TS 23.285 [19], between nearby UEs, using E-UTRA technology but not traversing any network node.

## 3.2 Abbreviations

For the purposes of the present document, the abbreviations given in TR 21.905 [1] and the following apply. An abbreviation defined in the present document takes precedence over the definition of the same abbreviation, if any, in TR 21.905 [1] and TS 36.300 [2].

BFD Beam Failure Detection

CHO Conditional Handover

CLI Cross Link Interference

CPA Conditional PSCell Addition

CPAC Conditional PSCell Addition or Change

CPC Conditional PSCell Change

DAPS Dual Active Protocol Stack

DC Intra-E-UTRA Dual Connectivity

DCP DCI with CRC scrambled by PS-RNTI

EN-DC E-UTRA-NR Dual Connectivity

IAB Integrated Access and Backhaul

LTM L1/L2-Triggered Mobility

MCG Master Cell Group

MN Master Node

MR-DC Multi-Radio Dual Connectivity

NE-DC NR-E-UTRA Dual Connectivity

NGEN-DC NG-RAN E-UTRA-NR Dual Connectivity

NR-DC NR-NR Dual Connectivity

RLM Radio Link Monitoring

SCG Secondary Cell Group

SMTC SS/PBCH block Measurement Timing Configuration

SN Secondary Node

V2X Vehicle-to-Everything

*NEXT CHANGE*

7.7 SCG/MCG failure handling

RLF is declared separately for the MCG and for the SCG.

If radio link failure is detected for MCG, fast MCG link recovery is configured and the SCG is not deactivated, the UE triggers fast MCG link recovery. Otherwise, the UE initiates the RRC connection re-establishment procedure. During the execution of PSCell addition or PSCell change, if radio link failure is detected for MCG, the UE initiates the RRC connection re-establishment procedure.

During fast MCG link recovery, the UE suspends MCG transmissions for all radio bearers, except SRB0, and, if any, BH RLC channels and reports the failure with *MCGFailureInformation* message to the MN via the SCG, using the SCG leg of split SRB1 or SRB3.

The UE includes in the *MCGFailureInformation* message the measurement results available according to current measurement configuration of both the MN and the SN. Once the fast MCG link recovery is triggered, the UE maintains the current measurement configurations from both the MN and the SN, and continues measurements based on configuration from the MN and the SN, if possible. The UE initiates the RRC connection re-establishment procedure if it does not receive an *RRCConnectionReconfiguration* message, *RRCReconfiguration* message, *MobilityFromNRCommand* message, *MobilityFromEUTRACommand* message, *RRCConnectionRelease* message or *RRCRelease* message within a certain time after fast MCG link recovery was initiated.

Upon reception of the *MCGFailureInformation* message, the MN can send *RRCConnectionReconfiguration* message, *RRCReconfiguration* message, *MobilityFromNRCommand* message, *MobilityFromEUTRACommand* message, *RRCConnectionRelease* message or *RRCRelease* message to the UE, using the SCG leg of split SRB1 or SRB3. Upon receiving an *RRCConnectionReconfiguration* message, *RRCReconfiguration* message, *MobilityFromNRCommand* message or *MobilityFromEUTRACommand* message, the UE resumes MCG transmissions for all radio bearers. Upon receiving an *RRCConnectionRelease* message or *RRCRelease* message, the UE releases all the radio bearers and configurations.

NOTE 1: It is up to network implementation to guarantee that the RRC-related messages are delivered to the UE by the SN before the release of its control plane resources.

The following SCG failure cases are supported:

- SCG RLF;

- SCG beam failure while the SCG is deactivated;

- SN addition/change failure;

- For EN-DC, NGEN-DC and NR-DC, SCG configuration failure or CPC configuration failure (only for messages on SRB3);

- For EN-DC, NGEN-DC and NR-DC, SCG RRC integrity check failure (on SRB3);

- For EN-DC, NGEN-DC and NR-DC, consistent UL LBT failure on PSCell;

- For IAB-MT, reception of a BH RLF indication from SCG;

- CPA/CPC or subsequent CPAC execution failure;

- SCG LTM cell switch failure.

Upon SCG failure, if MCG transmissions of radio bearers are not suspended, the UE suspends SCG transmissions for all radio bearers and, if any, BH RLC channels, if the SCG failure is not triggered by SCG beam failure, and reports the *SCGFailureInformation* to the MN, instead of triggering re-establishment. If SCG failure is detected while MCG transmissions for all radio bearers are suspended, the UE initiates the RRC connection re-establishment procedure.

SCG/MCG failure handling by UE also applies to IAB MT.

In all SCG failure cases, the UE maintains the current measurement configurations from both the MN and the SN and the UE continues measurements based on configuration from the MN and the SN if possible. The SN measurements configured to be routed via the MN will continue to be reported after the SCG failure.

NOTE 2: UE may not continue measurements based on configuration from the SN after SCG failure in certain cases (e.g. UE cannot maintain the timing of PSCell).

The UE includes in the *SCGFailureInformation* message the measurement results available according to current measurement configuration of both the MN and the SN. The MN handles the *SCGFailureInformation* message and may decide to keep, change, or release the SN/SCG. In all the cases, the measurement results according to the SN configuration and the SCG failure type may be forwarded to the old SN and/or to the new SN.

In case of CPA/CPC or subsequent CPAC, upon transmission of the *SCGFailureInformation* message to the MN or upon transmission of the *MCGFailureInformation* message to the SN, the UE stops evaluating the CPA/CPC or subsequent CPAC execution condition. The UE is not required to continue measurements for candidate PSCell(s) for execution condition upon transmission of the *SCGFailureInformation* message to the MN or upon transmission of the *MCGFailureInformation* message to the SN. The UE maintains the subsequent CPAC configuration upon MCG failure or SCG failure.

*NEXT CHANGE*

## 8.4 User data forwarding

Upon EN-DC specific activities, user data forwarding may be performed for E-RABs for which the bearer type change from/to MN terminated bearer to/from SN terminated bearer is performed. The behaviour of the node from which data is forwarded is the same as specified for the "source eNB" for handover, the behaviour of the node to which data is forwarded is the same as specified for the "target eNB" for handover.

For MR-DC with 5GC, user data forwarding may be performed between NG-RAN nodes whenever the logical node hosting the PDCP entity changes. The behaviour of the node from which data is forwarded is the same as specified for the "source NG-RAN node" for handover, the behaviour of the node to which data is forwarded is the same as specified for the "target NG-RAN node" for handover.

For SN change involving full configuration, the source SN behaviour is the same as the description as specified in intra-system data forwarding in TS 36.300 [2] for the source eNB or TS 38.300 [3] for the source NG-RAN node, respectively. In case that a DRB DL forwarding tunnel was established, the target SN may identify the PDCP SDUs for which delivery was attempted by the source SN, by the presence of the PDCP SN in the forwarded GTP-U packet and may discard them.

For mobility scenarios which involve more than two RAN nodes, either direct or indirect data forwarding may be applied. Two transport layer addresses of different versions may be provided to enable that the source RAN node can select either IPv4 or IPv6.

Direct data forwarding from source SN to target NG-RAN node and from source NG-RAN node to target SN for mobility scenario is supported. Direct data forwarding from source SN to target SN for SN change scenario is also supported.

In case of NR-DC to NR-DC handover, direct data forwarding from source SN to target MN, from source SN to target SN and from source MN to target SN is supported.

Direct data forwarding for inter-system handover is specified in TS 38.300 [3]. If a gNB and an en-gNB are involved in direct data forwarding and realised within the same network entity, inter-system handover to and from EN-DC allows direct data forwarding being performed in a node-internal way, in which case the source RAN node provides a UE context reference to the target side as described in clause 10.16. If the gNB and en-gNB are not realised within the same network entity, direct data forwarding for inter-system handover to and from en-gNB/gNB could be supported if there is direct connectivity between the two nodes.

For MR-DC with 5GC, offloading of QoS flows within one PDU session may be performed between NG-RAN nodes. The handling of End Marker packets in case of NG-RAN initiated PDU session split is described in clause 10.14.3 and 10.14.4.

*NEXT CHANGE*

# 10 Multi-Connectivity operation related aspects

## 10.1 General

Similar procedures as defined under clause 10.1.2.8 (Dual Connectivity operation) in TS 36.300 [2] apply for MR-DC.

Similar CHO principles as defined in TS 36.300 [2] and TS 38.300 [3] apply for the Conditional PSCell Change and Conditional PSCell Addition in MR-DC.

Similar LTM principles as defined in TS 38.300 [3] apply for MCG LTM and SCG LTM in NR-DC. MCG LTM with SN release and MCG LTM without SN involvement are supported. LTM for simultaneous PCell and PSCell change is not supported.

Conditional PSCell Change and conditional PSCell addition are not supported for the MR-DC options NE-DC and NGEN-DC.

Subsequent CPAC is only supported for NR-DC.

Configuration of a deactivated SCG in a conditional configuration, configuration of CPC (or subsequent CPAC) while the SCG is deactivated and SCG deactivation while CPC (or subsequent CPAC) is configured are not supported.

Configuration of a deactivated SCG in an SCG LTM configuration, configuration of SCG LTM while the SCG is deactivated and SCG deactivation while SCG LTM is configured are not supported.

In MR-DC, CHO is supported in Master Node to eNB/gNB Change procedure and Conditional Handover with Secondary Node procedure.

## 10.3 Secondary Node Modification (MN/SN initiated)

\*// skip unrelated part //\*

### 10.3.2 MR-DC with 5GC

The SN Modification procedure may be initiated either by the MN or by the SN and be used to modify the current user plane resource configuration (e.g. related to PDU session, QoS flow or DRB) or to modify other properties of the UE context within the same SN. It may also be used to transfer an RRC message from the SN to the UE via the MN and the response from the UE via MN to the SN (e.g. when SRB3 is not used). In NGEN-DC and NR-DC, the RRC message is an NR message (i.e., *RRCReconfiguration*) whereas in NE-DC it is an E-UTRA message (i.e., *RRCConnectionReconfiguration*). In case of CPA, inter-SN CPC or inter-SN subsequent CPAC, this procedure is used to modify CPA, inter-SN CPC or inter-SN subsequent CPAC configuration within the same candidate SN. In case of CPA, inter-SN CPC or inter-SN subsequent CPAC, this procedure may also be triggered by the candidate SN to add some prepared PSCells from the suggested list or cancel part of the prepared PSCells. In case of intra-SN CPC or intra-SN subsequent CPAC, this procedure is used to configure, modify or release intra-SN CPC or intra-SN subsequent CPAC configuration. In case of intra-SN SCG LTM, this procedure is used to configure, modify or release intra-SN SCG LTM configuration. This procedure may be initiated by the MN or SN to request the SN or MN to activate or deactivate the SCG.

The SN modification procedure does not necessarily need to involve signalling towards the UE.

**MN initiated SN Modification**



Figure 10.3.2-1: SN Modification procedure - MN initiated

The MN uses the procedure to initiate configuration changes of the SCG within the same SN, including addition, modification or release of the user plane resource configuration. The MN uses this procedure to perform handover within the same MN while keeping the SN, when the SN needs to be involved (i.e. in NGEN-DC). The MN also uses the procedure to query the current SCG configuration, e.g. when delta configuration is applied in an MN initiated SN change. The MN also uses the procedure to provide the S-RLF related information to the SN or to provide additional available DRB IDs to be used for SN terminated bearers. The MN also uses this procedure to activate or deactivate the SCG. The MN may not use the procedure to initiate the addition, modification or release of SCG SCells. The SN may reject the request, except if it concerns the release of the user plane resource configuration, or if it is used to perform handover within the same MN while keeping the SN. Figure 10.3.2-1 shows an example signalling flow for an MN initiated SN Modification procedure.

1. The MN sends the *SN Modification Request* message, which may contain user plane resource configuration related or other UE context related information, PDU session level Network Slice info and the requested SCG configuration information, including the UE capabilities coordination result to be used as basis for the reconfiguration by the SN. In case a security key update in the SN is required, a new *SN Security Key* is included. In case the PDCP data recovery in the SN is required, the *PDCP Change* *Indication* is included which indicates that PDCP data recovery is required in SN.

2. The SN responds with the *SN Modification Request Acknowledge* message, which may contain new SCG radio configuration information within an SN RRC reconfiguration message*,* and data forwarding address information (if applicable). If the MN requested the SCG to be activated or deactivated, the SN indicates whether the SCG is activated or deactivated.

NOTE 1: For MN terminated bearers to be setup for which PDCP duplication with CA is configured in NR SCG side, the MN allocates up to 4 separate Xn-U bearers and the SN provides a logical channel ID for primary or split secondary path to the MN.

For SN terminated bearers to be setup for which PDCP duplication with CA is configured in NR MCG side, the SN allocates up to 4 separate Xn-U bearers and the MN provides a logical channel ID for primary or split secondary path to the SN via an additional MN-initiated SN modification procedure.

2a. When applicable, the MN provides data forwarding address information to the SN. For SN terminated bearers using MCG resources, the MN provides Xn-U DL TNL address information in the *Xn-U Address Indication* message.

3/4. The MN initiates the RRC reconfiguration procedure, including an SN RRC reconfiguration message. The UE applies the new configuration, synchronizes to the MN (if instructed, in case of intra-MN handover) and replies with MN RRC reconfiguration complete message,including an SN RRC response message, if needed. In case the UE is unable to comply with (part of) the configuration included in the MN RRC reconfiguration message, it performs the reconfiguration failure procedure.

5. Upon successful completion of the reconfiguration, the success of the procedure is indicated in the *SN Reconfiguration Complete* message.

6. If instructed, the UE performs synchronisation towards the PSCell of the SN as described in SN addition procedure. Otherwise, the UE may perform UL transmission after having applied the new configuration.

7. If PDCP termination point is changed for bearers using RLC AM, and when RRC full configuration is not used, the SN Status Transfer takes place between the MN and the SN (Figure 10.3.2-1 depicts the case where a bearer context is transferred from the MN to the SN).

8. If applicable, data forwarding between MN and the SN takes place (Figure 10.3.2-1 depicts the case where a user plane resource configuration related context is transferred from the MN to the SN).

9. The SN sends the *Secondary RAT Data Usage Report* message to the MN and includes the data volumes delivered to and received from the UE as described in clause 10.11.2.

NOTE 2: The order the SN sends the *Secondary RAT Data Usage Report* message and performs data forwarding with MN is not defined. The SN may send the report when the transmission of the related QoS flow is stopped.

10. If applicable, a PDU Session path update procedure is performed.

**SN initiated SN Modification with MN involvement**



Figure 10.3.2-2: SN Modification procedure - SN initiated with MN involvement

The SN uses the procedure to perform configuration changes of the SCG within the same SN, e.g. to trigger the modification/release of the user plane resource configuration, to trigger the release of SCG resources (e.g., release SCG lower layer resources but keep SN), and to trigger PSCell changes (e.g. when a new security key is required or when the MN needs to perform PDCP data recovery). The MN cannot reject the release request of PDU session/QoS flows and the release request of SCG resources. The SN also uses the procedure to request the MN to provide more DRB IDs to be used for SN terminated bearers or to return DRB IDs used for SN terminated bearers that are not needed any longer. The SN also uses this procedure to activate or deactivate the SCG. Figure 10.3.2-2 shows an example signalling flow for SN initiated SN Modification procedure.

1. The SN sends the *SN Modification Required* message including an SN RRC reconfiguration message, which may contain user plane resource configuration related context, other UE context related information and the new radio resource configuration of SCG. The SN may request the SCG to be activated or deactivated. In case of change of security key, the *PDCP Change* *Indication* indicates that an SN security key update is required. In case the MN needs to perform PDCP data recovery, the *PDCP Change* *Indication* indicates that PDCP data recovery is required.

The SN can decide whether the change of security key is required.

NOTE 3a: In case that a MN initiated conditional reconfiguration (e.g. CHO, MN initiated inter-SN CPC or MN initiated inter-SN subsequent CPAC) is prepared, and if any execution of a prepared SN initiated intra-SN CPC or SN initiated intra-SN subsequent CPAC procedure or reconfiguration of the SCG, the SN notifies to the MN via the *SN Modification Required* message. In this case, the steps 2 and 3 are skipped.

NOTE 3b: In case of SN initiated inter-SN CPC or SN initiated inter-SN subsequent CPAC and in case that a candidate SN triggered the SN Initiated SN Modification procedure to include some prepared PSCells (within the candidate cells suggested by the source SN in SN initiated inter-SN CPC or SN initiated inter-SN subsequent CPAC) or to remove some prepared PSCells, the MN may decide to trigger the step 2 towards the source SN.

2/3. The MN initiated SN Modification procedure may be triggered by *SN Modification Required* message, e.g. when an SN security key change needs to be applied.

NOTE 3: For SN terminated bearers to be setup for which PDCP duplication with CA is configured in NR MCG side, the SN allocates up to 4 separate Xn-U bearers and the MN provides a logical channel ID for primary or split secondary path to the SN via the nested MN-initiated SN modification procedure.

4. The MN sends the MN RRC reconfiguration message to the UE including the SN RRC reconfiguration message with the new SCG radio resource configuration.

5. The UE applies the new configuration and sends the MN RRC reconfiguration complete message, including an SN RRC response message, if needed. In case the UE is unable to comply with (part of) the configuration included in the MN RRC reconfiguration message, it performs the reconfiguration failure procedure.

6. Upon successful completion of the reconfiguration, the success of the procedure is indicated in the *SN Modification Confirm* message including the SN RRC response message, if received from the UE.

7. If instructed, the UE performs synchronisation towards the PSCell configured by the SN as described in SN Addition procedure. Otherwise, the UE may perform UL transmission directly after having applied the new configuration.

8. If PDCP termination point is changed for bearers using RLC AM, and when RRC full configuration is not used, the SN Status Transfer takes place between the MN and the SN (Figure 10.3.2-2 depicts the case where a bearer context is transferred from the SN to the MN).

9. If applicable, data forwarding between MN and the SN takes place (Figure 10.3.2-2 depicts the case where a user plane resource configuration related context is transferred from the SN to the MN).

10. The SN sends the *Secondary RAT Data Usage Report* message to the MN and includes the data volumes delivered to and received from the UE as described in clause 10.11.2.

NOTE 4: The order the SN sends the *Secondary RAT Data Usage Report* message and performs data forwarding with MN is not defined. The SN may send the report when the transmission of the related QoS flow is stopped.

11. If applicable, a PDU Session path update procedure is performed.

**SN initiated SN Modification without MN involvement**

This procedure is not supported for NE-DC.



Figure 10.3.2-3: SN Modification – SN initiated without MN involvement

The SN initiated SN modification procedure without MN involvement is used to modify the configuration within SN in case no coordination with MN is required, including the addition/modification/release of SCG SCell and PSCell change (e.g. when the security key does not need to be changed and the MN does not need to be involved in PDCP recovery). The SN may initiate the procedure to configure, modify or release intra-SN CPC or intra-SN subsequent CPAC configuration within the same SN. The SN may initiate the procedure to configure, modify or release intra-SN SCG LTM configuration within the same SN. Figure 10.3.2-3 shows an example signalling flow for SN initiated SN modification procedure without MN involvement. The SN can decide whether the Random Access procedure is required.

1. The SN sends the SN RRC reconfiguration message to the UE through SRB3.

2. The UE applies the new configuration and replies with the SN RRC reconfiguration complete message. In case the UE is unable to comply with (part of) the configuration included in the SN RRC reconfiguration message, it performs the reconfiguration failure procedure.

3. If instructed, the UE performs synchronisation towards the PSCell of the SN as described in SN Addition procedure. Otherwise the UE may perform UL transmission after having applied the new configuration.

**SN initiated Conditional SN Modification without MN involvement (SRB3 is used)**

This procedure is not supported for NE-DC and NGEN-DC.



Figure 10.3.2-3a: SN Modification – SN-initiated without MN involvement and SRB3 is used to configure intra-SN CPC or intra-SN subsequent CPAC.

The SN initiates the procedure when it needs to transfer an NR RRC message to the UE and SRB3 is used to configure intra-SN CPC or intra-SN subsequent CPAC.

1. The SN sends the SN RRC reconfiguration including CPC configuration or subsequent CPAC configuration to the UE through SRB3.

2. The UE applies the new configuration. In case the UE is unable to comply with (part of) the configuration included in the SN RRC reconfiguration message, it performs the reconfiguration failure procedure. The UE starts evaluating the execution conditions for the candidate PSCell(s). The UE maintains connection with the source PSCell and replies with the *RRCReconfigurationComplete* message to the SN via SRB3.

3. If at least one candidate PSCell satisfies the corresponding execution condition, the UE detaches from the source PSCell, applies the stored configuration corresponding to the selected candidate PSCell and synchronises to the candidate PSCell. In subsequent CPAC, the UE keeps the configured subsequent CPAC configuration and evaluates the execution conditions of other candidate PSCells after completion of the subsequent CPAC execution.

4. The UE completes the CPC execution procedure by sending an *RRCReconfigurationComplete* message to the new PSCell.

NOTE X: For a subsequent CPAC configuration, after a PSCell change, if the execution condition of one candidate PSCell is satisfied, the UE executes steps 3-4, e.g. based on the configuration provided in step 1.

**SN initiated SCG LTM without MN involvement (SRB3 is used)**

This procedure is not supported for NE-DC and NGEN-DC.

****

Figure 10.3.2-3b: SN Modification – SN-initiated without MN involvement and SRB3 is used to configure intra-SN SCG LTM

The SN initiates the procedure when it needs to transfer an NR RRC message to the UE and SRB3 is used to configure intra-SN SCG LTM.

1. The SN sends the SN *RRCReconfiguration* including SCG LTM configuration to the UE through SRB3.

2. The UE stores the SCG LTM candidate cell configurations and transmits an *RRCReconfigurationComplete* message to the SN.

3a. The UE [may] performs DL synchronization with candidate cell(s) before receiving the cell switch command.

3b. If requested by the SN, the UE performs early TA acquisition with candidate cell(s) before receiving the cell switch command as specified in clause in 9.2.3.x.2 in TS 38.300 [3].

4. The UE performs L1 measurements on the configured candidate cell(s) and transmits L1 measurement reports to the SN. L1 measurement should be performed as long as apply the RRC Reconfiguration in step 1.

5. The SN decides to execute cell switch to a target cell and transmits a MAC CE triggering cell switch by including the candidate configuration index of the target cell. The UE switches to the target cell and applies the configuration indicated by candidate configuration index.

6. The UE performs the random access procedure towards the target cell, if UE does not have valid TA of the target cell.

7. The UE completes the SCG LTM cell switch procedure by sending *RRCReconfigurationComplete* message to target cell. If the UE has performed a RA procedure in step 6 the UE considers that LTM execution is successfully completed when the random access procedure is successfully completed. For RACH-less LTM, the UE considers that LTM execution is successfully completed when the UE determines that the SN has successfully received its first UL data, as specified in clause in 9.2.3.x.2 in TS 38.300 [3].

NOTE X: The steps 3-7 can be performed multiple times for subsequent SCG LTM using the SCG LTM candidate configuration(s) provided in step 1.

**Transfer of an NR RRC message to/from the UE (when SRB3 is not used)**

This procedure is supported for all the MR-DC options.



Figure 10.3.2-4: Transfer of an NR RRC message to/from the UE

The SN initiates the procedure when it needs to transfer an NR RRC message to the UE and SRB3 is not used.

1. The SN initiates the procedure by sending the *SN Modification Required* to the MN including the SN RRC reconfiguration message.

2. The MN forwards the SN RRC reconfiguration message to the UE including it in the RRC reconfigurationmessage.

3. The UE applies the new configuration and replies with the RRC reconfiguration complete message by including the SN RRC reconfiguration complete message. In case the UE is unable to comply with (part of) the configuration included in the SN RRC reconfiguration message, it performs the reconfiguration failure procedure.

4. The MN forwards the SN RRC response message, if received from the UE, to the SN by including it in the *SN Modification Confirm* message.

5. If instructed, the UE performs synchronisation towards the PSCell of the SN as described in SN Addition procedure. Otherwise the UE may perform UL transmission after having applied the new configuration.

**SN initiated Conditional SN Modification without MN involvement (SRB3 is not used)**

This procedure is not supported for NE-DC and NGEN-DC.



Figure 10.3.2-5: SN Modification – SN-initiated without MN involvement and SRB3 is not used to configure intra-SN CPC or intra-SN subsequent CPAC

The SN initiates the procedure when it needs to transfer an NR RRC message to the UE and SRB3 is not used to configure intra-SN CPC or intra-SN subsequent CPAC.

1. The SN initiates the procedure by sending the *SN Modification Required* to the MN including the SN RRC reconfiguration message with CPC configuration or subsequent CPAC configuration.

2. The MN forwards the SN RRC reconfiguration message to the UE including it in the *RRCReconfiguration* message.

3. The UE replies with the *RRCReconfigurationComplete* message by including the SN RRC reconfiguration complete message. In case the UE is unable to comply with (part of) the configuration included in the SN RRC reconfiguration message, it performs the reconfiguration failure procedure. The UE maintains connection with source PSCell after receiving CPC configuration or subsequent CPAC configuration, and starts evaluating the execution conditions for the candidate PSCell(s).

4. The MN forwards the SN RRC response message, if received from the UE, to the SN by including it in the *SN Modification Confirm* message.

5. If at least one candidate PSCell satisfies the corresponding execution condition, the UE completes the CPC execution procedure by an *ULInformationTransferMRDC* message to the MN which includes an embedded *RRCReconfigurationComplete* message to the selected target PSCell. In subsequent CPAC, the UE keeps the configured subsequent CPAC configuration and evaluates the execution conditions of other candidate PSCells after completion of the subsequent CPAC execution.

6. The *RRCReconfigurationComplete* message is forwarded to the SN embedded in *RRC Transfer* message.

7. The UE detaches from the source PSCell, applies the stored corresponding configuration and synchronises to the selected candidate PSCell.

NOTE X: For a subsequent CPAC configuration, after a PSCell change, if the execution condition of one candidate PSCell is satisfied, the UE executes steps 5-7, e.g. based on the configuration provided in step 2.

**SN initiated SCG LTM without MN involvement (SRB3 is not used)**

This procedure is not supported for NE-DC and NGEN-DC.



Figure 10.3.2-6: SN Modification – SN-initiated without MN involvement and SRB3 is not used to configure intra-SN SCG LTM

The SN initiates the procedure when it needs to transfer an NR RRC message to the UE and SRB3 is not used to configure intra-SN SCG LTM.

1. The SN initiates the procedure by sending the *SN Modification Required* to the MN including the SN *RRCReconfiguration* message with SCG LTM configuration.

2. The MN forwards the SN *RRCReconfiguration* message to the UE including it in the *RRCReconfiguration* message.

3. The UE replies with the *RRCReconfigurationComplete* message by including the SN *RRCReconfiguration Complete* message.

4. The MN forwards the SN RRC response message, if received from the UE, to the SN by including it in the *SN Modification Confirm* message.

5a. The UE [may] performs DL synchronization with candidate cell(s) before receiving the cell switch command.

5b. If requested by the SN, the UE performs early TA acquisition with candidate cell(s) before receiving the cell switch command as specified in clause in 9.2.3.x.2 in TS 38.300 [3].

6. The UE performs L1 measurements on the configured candidate cell(s) and transmits L1 measurement reports to the SN. L1 measurement should be performed as long as apply the RRC Reconfiguration in step 1.

7. The SN decides to execute cell switch to a target cell and transmits a MAC CE triggering cell switch by including the candidate configuration index of the target cell. The UE switches to the target cell and applies the configuration indicated by candidate configuration index.

8. The UE sends an *ULInformationTransferMRDC* message to the MN which includes an embedded *RRCReconfigurationComplete* message to the target cell.

9. The UE performs the random access procedure towards the target cell, if UE does not have valid TA of the target cell.

10. The UE completes the SCG LTM cell switch procedure by sendingany UL transmission to target cell. If the UE has performed a RA procedure in step 9 the UE considers that LTM execution is successfully completed when the random access procedure is successfully completed. For RACH-less LTM, the UE considers that LTM execution is successfully completed when the UE determines that the SN has successfully received its first UL transmission, as specified in clause in 9.2.3.x.2 in TS 38.300 [3].

NOTE X: The steps 3-7 can be performed multiple times for subsequent SCG LTM using the SCG LTM candidate configuration(s) provided in step 1.

## 10.4 Secondary Node Release (MN/SN initiated)

\*// skip unrelated part //\*

### 10.4.2 MR-DC with 5GC

The SN Release procedure may be initiated either by the MN or by the SN and is used to initiate the release of the UE context and relevant resources at the SN. The recipient node of this request can reject it, e.g., if an SN change procedure is triggered by the SN.

In case of CPA, inter-SN CPC or inter-SN subsequent CPAC, this procedure may be initiated either by the MN or the candidate SN, and it is used to cancel all the prepared PSCells at the candidate SN and initiate the release of related UE context at the candidate SN.

**MN initiated SN Release**



Figure 10.4.2-1: SN release procedure - MN initiated

Figure 10.4.2-1 shows an example signalling flow for the MN initiated SN Release procedure.

1. The MN initiates the procedure by sending the *SN Release Request* message.

2. The SN confirms SN Release by sending the *SN Release Request Acknowledge* message. If appropriate, the SN may reject SN Release, e.g., if the SN change procedure is triggered by the SN.

NOTE 00: If CPA, inter-SN CPC or inter-SN subsequent CPAC is configured, upon reception of the *SN Release Request Acknowledge* message the MN cancels all CPAC or subsequent CPAC with the target candidate SN(s).

2a. When applicable, the MN provides forwarding address information to the SN.

NOTE 0: The MN may send the *Xn-U Address Indication* message to provide forwarding address information before step 2.

3/4. If required, the MN indicates in the MN RRC reconfiguration message towards the UE that the UE shall release the entire SCG configuration. In case the UE is unable to comply with (part of) the configuration included in the MN RRC reconfiguration message, it performs the reconfiguration failure procedure.

NOTE 1: If data forwarding is applied, timely coordination between steps 1 and 2 may minimize gaps in service provision, this is however regarded to be an implementation matter.

5. If PDCP termination point is changed to the MN for bearers using RLC AM, the SN sends the *SN Status Transfer* message.

6. Data forwarding from the SN to the MN may start.

7. The SN sends the *Secondary RAT Data Usage Report* message to the MN and includes the data volumes delivered to and received from the UE as described in clause 10.11.2.

NOTE 1a: If data forwarding is applied, the order the SN sends the *Secondary RAT Data Usage Report* message and starts data forwarding with MN is not defined i.e., step 7 can take place before step 6. The SN does not need to wait for the end of data forwarding to send the *Secondary RAT Data Usage Report* message.

8. If applicable, the PDU Session path update procedure is initiated.

9. Upon reception of the *UE Context Release* message, the SN releases radio and C-plane related resources associated to the UE context. Any ongoing data forwarding may continue.

**SN initiated SN Release**



Figure 10.4.2-2: SN release procedure - SN initiated

Figure 10.4.2-2 shows an example signalling flow for the SN initiated SN Release procedure.

1. The SN initiates the procedure by sending the *SN Release Required* message which may contain inter-node message to support delta configuration.

2. If data forwarding is requested, the MN provides data forwarding addresses to the SN in the *SN Release Confirm* message. The SN may start data forwarding and stop providing user data to the UE as early as it receives the *SN Release Confirm* message.

NOTE 1b: If CPA, inter-SN CPC or inter-SN subsequent CPAC is configured, upon reception of the *SN Release Required* message the MN cancels all CPAC or subsequent CPAC with the target candidate SN(s).

3/4. If required, the MN indicates in the MN RRC reconfiguration message towards the UE that the UE shall release the entire SCG configuration. In case the UE is unable to comply with (part of) the configuration included in the MN RRC reconfiguration message, it performs the reconfiguration failure procedure.

NOTE 2: If data forwarding is applied, timely coordination between steps 2 and 3 may minimize gaps in service provision. This is however regarded to be an implementation matter.

5. If PDCP termination point is changed to the MN for bearers using RLC AM, the SN sends the *SN Status Transfer* message.

6. Data forwarding from the SN to the MN may start.

7. The SN sends the *Secondary RAT Data Usage Report* message to the MN and includes the data volumes delivered to and received from the UE as described in clause 10.11.2.

NOTE 3: If data forwarding is applied, the order the SN sends the *Secondary RAT Data Usage Report* message and starts data forwarding with MN is not defined i.e., step 7 can take place before step 6. The SN does not need to wait for the end of data forwarding to send the *Secondary RAT Data Usage Report* message.

8. If applicable, the PDU Session path update procedure is initiated.

9. Upon reception of the *UE Context Release* message, the SN releases radio and C-plane related resources associated to the UE context. Any ongoing data forwarding may continue.

## 10.6 PSCell change

In MR-DC, a PSCell change does not always require a security key change.

If a security key change is required, this is performed through a synchronous SCG reconfiguration procedure towards the UE involving random access on PSCell and a security key change, during which the MAC entity configured for SCG is reset and RLC configured for SCG is re-established regardless of the bearer type(s) established on SCG. For SN terminated bearers, PDCP is re-established. In all MR-DC options, to perform this procedure within the same SN, the SN Modification procedure as described in clause 10.3 is used, setting the *PDCP Change Indication* to indicate that a S-KgNB (for EN-DC, NGEN-DC and NR-DC) or S-KeNB (for NE-DC) update is required when the procedure is initiated by the SN or including the *SgNB Security Key* / *SN Security Key* when the procedure is initiated by the MN. In all MR-DC options, to perform a PSCell change between different SN nodes, the SN Change procedure as described in clause 10.5 is used.

If a security key change is not required (only possible in EN-DC, NGEN-DC and NR-DC), this is performed through a synchronous SCG reconfiguration procedure without security key change towards the UE involving random access on PSCell, during which the MAC entity configured for SCG is reset and RLC configured for SCG is re-established regardless of the bearer type(s) established on SCG. For DRBs using RLC AM mode PDCP data recovery applies, and for DRBs using RLC UM no action is performed in PDCP. For SRB3 PDCP may discard all stored SDUs and PDUs. Unless MN terminated SCG or split bearers are configured, this does not require MN involvement. In this case, if location information was requested for the UE, the SN informs the MN about the PSCell change (as part of location information) using the SN initiated SN modification procedure independently from the reconfiguration of the UE. In case of MN terminated SCG or split bearers, the SN initiated SN Modification procedure as described in clause 10.3 is used, setting the *PDCP Change Indication* to indicate that a PDCP data recovery is required. If the MN subscribes to PSCell changes to retrieve the SCG UE history information, the SN informs the MN about the SCG UE history information using the SN initiated SN modification procedure when the SCG UE history information changes.

A Conditional PSCell Change (CPC) is defined as a PSCell change that is executed by the UE when execution condition(s) is met. The UE starts evaluating the execution condition(s) upon receiving the CPC configuration, and stops evaluating the execution condition(s) once PSCell change or PCell change is triggered. Intra-SN CPC without MN involvement, inter-SN CPC initiated either by MN or SN are supported.

The following principles apply to CPC:

- The CPC configuration contains the configuration of CPC candidate PSCell(s) and execution condition(s) and may contain the MCG configuration for inter-SN CPC, to be applied when CPC execution is triggered.

- An execution condition may consist of one or two trigger condition(s) (see *CondEvent*, as defined in TS 38.331 [4] or TS 36.331 [10]). Only single RS type and at most two different trigger quantities (e.g. RSRP and RSRQ, RSRP and SINR, etc.) can be used for the evaluation of CPC execution condition of a single candidate PSCell.

- Before any CPC execution condition is satisfied, upon reception of PSCell change command or PCell change command, the UE executes the PSCell change procedure as described in clause 10.3 and 10.5 or the PCell change procedure as described in clause 9.2.3.2 in TS 38.300[3] or clause 10.1.2.1 in TS 36.300 [2], regardless of any previously received CPC configuration. Upon the successful completion of PSCell change procedure or PCell change procedure, the UE releases all stored CPC configurations.

- While executing CPC, the UE is not required to continue evaluating the execution condition of other candidate PSCell(s) or PCell(s).

- Once the CPC procedure is executed successfully, the UE releases all stored conditional reconfigurations (i.e. for CPC and for CHO, as specified in TS 38.300 [3] or TS 36.300 [2]).

- Upon the release of SCG, the UE releases the stored CPC configurations.

- MN can inform SN of the maximum number of conditional reconfigurations the SN is allowed to configure for SN initiated CPC including both intra-SN and inter-SN CPC.

CPC configuration in HO command, in PSCell addition/change command or within any conditional reconfiguration (i.e CPA, CPC or CHO configuration) is not supported.

An SCG L1/L2-Triggered Mobility (LTM) is defined as a PSCell cell switch procedure that the network triggers via MAC CE based on L1 measurements. Only intra-SN SCG LTM without MN involvement is supported.

10.19 Conditional Handover with Secondary Node

\*// skip unrelated part //\*

### 10.19.2 MR-DC with 5GC

The Conditional Handover with Secondary Node procedure is used for configuration and execution of CHO with SN or CHO with candidate SCG(s). This procedure includes the cases where the SN is kept, changed or added. If the SN is kept, the UE context at the SN is kept. If the SN is changed, the UE context at the source SN is moved to the target SN.

CHO with candidate SCG(s) is not supported for NE-DC and NGEN-DC.



Figure 10.19.2-1: Conditional Handover with Secondary Node procedure

Figure 10.19.2-1 shows an example signaling flow for Conditional Handover with Secondary Node.

NOTE 1: For a CHO without SN change, the source SN and the target SN shown in Figure 10.19.2-1 are the same node.

NOTE 2: For a CHO with SN addition, the source SN and steps involving the source SN in Figure 10.19.2-1 are ignored.

1. The source MN starts the conditional handover procedure by initiating the Xn Handover Preparation procedure including MCG configuration and, if the UE is configured with an SCG, SCG configuration. The source MN includes the (source) SN UE XnAP ID, SN ID, the UE context in the (source) SN and the Conditional Handover Information Request IE in the *Handover Request* message. In case of CHO with candidate SCG(s), the source MN provides the maximum number of conditional reconfigurations that the candidate MN can prepare for the UE in the *Handover Request* message.

NOTE 3: In case of the CHO with/without SN change or CHO with candidate SCG(s), the source MN may trigger the MN-initiated SN Modification procedure (to the source SN) to retrieve the current SCG configuration, if configured, before step 1.

2. If the candidate MN decides to keep the UE context in the SN, the candidate MN sends the *SN Addition Request* message to the SN including the SN UE XnAP ID as a reference to the UE context in the SN that was established by the source MN. If the candidate MN decides to change the SN allowing delta configuration, the candidate MN sends the *SN Addition Request* message to the candidate SN including the UE context in the source SN that was established by the source MN. Otherwise, the candidate MN may send the *SN Addition Request* message to the candidate SN including neither the SN UE XnAP ID nor the UE context in the source SN that was established by the source MN. Within the *SN Addition Request* message, the candidate MN also includes the CHO related information, i.e., the source MN ID and the MN UE XnAP ID in the source MN, in order to indicate that the SN Addition Preparation procedure is triggered in relation to a CHO and to enable the SN to identify requests related to the same UE. In case of CHO with candidate SCG(s), the candidate MN provides the maximum number of PSCells that the candidate SN can prepare for the UE in the *SN Addition Request* message. The candidate MN also provides the candidate PSCells recommended by the candidate MN via the latest measurement results for the candidate SN(s) to choose and configure the candidate SCG cell(s).

NOTE 3a: The target MN and other potential target MNs may trigger the SN Addition Preparation procedure to the same (target) SN.

NOTE 3b: The source MN may initiate additional Xn Handover Preparation procedures towards the same or other target MNs. Based on each Xn Handover Preparation procedure, each target MN may decide to trigger SN Addition Preparation procedure.

3. The (candidate) SN replies with the *SN Addition Request Acknowledge* message. The (candidate) SN may include the indication of the full or delta RRC configuration.

NOTE 4: In CHO with SCG configuration, it is up to the candidate MN implementation to make sure that the CG-Config provided from the (candidate) SN can be used in all CHO preparations.

NOTE 4a0: In case of CHO with candidate SCG(s), the (candidate) SN assigns the same data forwarding addresses for multiple data forwarding requests from different target MNs and the (candidate) SN indicates to the target MN direct data forwarding path availability with the source SN and/or source MN, if applicable.

3a. For the SN terminated bearers using MCG resources, the candidate MN provides Xn-U DL TNL address information in the *Xn-U Address Indication* message.

4. The candidate MN includes within the *Handover Request Acknowledge* message the MN RRC reconfiguration message to be sent to the UE in order to perform the conditional handover, and may also provide forwarding addresses to the source MN. If PDU session split is performed in the target side during handover procedure, more than one data forwarding addresses corresponding to each node are included in the *Handover Request Acknowledge* message. The candidate MN indicates to the source MN that the UE context in the SN is kept if the candidate MN and the SN decided to keep the UE context in the SN in step 2 and step 3. In case of CHO with candidate SCG(s), the candidate MN includes a list of one or more (candidate) SNs in *Handover Request Acknowledge* message with the PDU Session admission results, data forwarding addresses and list of prepared PSCells for each prepared (candidate) SN. The candidate MN also indicates to the source MN the parameters of the execution condition of the candidate PSCell.

NOTE 4ax2: In case of CHO with candidate SCG(s), the candidate MN indicates direct data forwarding path availability between the target node and the source SN in per PDU session granularity in the *Handover Request Acknowledge* message, if applicable.

NOTE 4a0: Steps 1-4 may be produced in several instances, each instance initiated with a separate Handover Preparation procedure (step 1). The order of messages belonging to separate instances is not defined.

4a. The source MN sends the *Xn-U Address Indication* message to the (source) SN. This *Xn-U Address Indication* message notifies conditional handover to the (source) SN, which may decide to perform, if applicable, early data forwarding for SN-terminated bearers, together with the sending of an *Early Status Transfer* message to the source MN.

NOTE 4a: Separate Xn-U Address Indication procedures may be initiated to provide different forwarding addresses of the prepared conditional handovers. In this case, it is up to the source MN and SN implementations to make sure that the *Early Status Transfer* message(s) from the source SN, if any, is forwarded to the right target MN. The Xn-U Address Indication procedure may further be initiated to indicate to the (source) SN to stop already initiated early data forwarding for some SN-terminated bearers, if they are no longer subject to data forwarding due to the modification or cancellation of the prepared conditional handovers.

5. The source MN sends an RRC reconfiguration message to the UE, including the CHO configuration, i.e. a list of RRC reconfiguration\* messagesand associated execution conditions, in which each RRC reconfiguration\* message contains an MCG configuration and possibly an SCG configuration in the RRC reconfiguration\*\* message received from the candidate SN in step 3. For each configuration of CHO with candidate SCG(s), the source MN provides an execution condition for the candidate PCell and an execution condition for the candidate PSCell. Besides, each RRC reconfiguration\* message contains an MCG configuration and an SCG configuration in the RRC reconfiguration\*\* message received from the candidate SN in step 3.

NOTE X: In case of CHO with candidate SCG(s), the source MN can provide multiple CHO configurations for the same candidate PCell (i.e. without SCG configuration or with a SCG configuration of different candidate PSCell).

6. The UE applies the RRC reconfiguration message received in step 5, stores the CHO configuration and replies to the MN with an RRC reconfiguration complete message.

7/8. The UE maintains connection with the source MN and, if the UE is configured with a PSCell, with the source PSCell, after receiving CHO configuration, and starts evaluating the execution condition for the candidate PCell(s) and if any, the execution condition for the candidate PSCell(s).

* If at least one candidate PCell satisfies the corresponding execution condition and the associated candidate PSCell satisfies the corresponding execution condition, the UE detaches from the source MN, applies the stored corresponding configuration for that selected candidate PCell and the associated candidate PSCell, synchronises to that candidate PCell, and completes the RRC handover procedure by sending RRC reconfiguration complete\* message to the target MN. The UE includes an embedded SN *RRCReconfigurationComplete*\*\* message for the target SN, and information enabling the target MN to identify the target SN of the selected candidate PSCell.
* Else if at least one candidate PCell satisfies the corresponding execution condition for the candidate PCell and there is no associated execution condition for an PSCell, the UE detaches from the source MN, applies the stored corresponding configuration for that selected candidate PCell and, if included, the associated PSCell, synchronises to that candidate PCell and completes the RRC handover procedure by sending RRC reconfiguration complete\* message to the target MN. If the stored configuration for the selected candidate cell includes an SCG configuration, the UE includes an embedded SN *RRCReconfigurationComplete*\*\* message for the target SN.
* The UE releases the stored CHO configurations after successful completion of the RRC handover procedure.

NOTE 5: In case the target SN includes the indication of the full RRC configuration, the MN performs release of the SN terminated radio bearer configuration and release and add of the NR SCG configuration part towards the UE.

9. If configured with bearers requiring SCG radio resources, the UE synchronizes to the (target) SN.

NOTE 6: The order the UE performs Random Access towards the MN (step 7) and performs the Random Access procedure towards the (target) SN (step 9) is not defined.

10. If the RRC connection reconfiguration procedure was successful, the target MN informs the (target) SN via *SN Reconfiguration Complete* message.

11. The target MN sends the *Handover Success* message to the source MN to inform that the UE has successfully accessed the target cell. In CHO with candidate SCG(s), the target PSCell ID may also be included in the *Handover Success* message.

12a/b. The source MN sends *SN Release Request* message to the (source) SN including a Cause indicating MCG mobility. The source MN indicates to the (source) SN that the UE context in SN is kept, if it receives the indication from the target MN. The (source) SN acknowledges the release request.

12c. The source MN sends *XN-U Address Indication* message to the (source) SN to transfer data forwarding information. More than one data forwarding addresses may be provided if the PDU session is split in the target side.

12d. The source MN sends the *Handover Cancel* message toward the other signalling connections or other candidate MNs, if any, to cancel CHO for the UE.

12e/f. If the target MN is configured with other candidate PCell(s) associated with other candidate SN(s) than the target SN, the target MN sends the *SN Release Request* message(s) to the corresponding candidate SN(s). Other candidate MN(s) send(s) the *SN Release Request* message(s) to other candidate SN(s), if configured. The other candidate SN(s) acknowledges the release request.

13a. The (source) SN sends the *Secondary RAT* *Data Usage Report* message to the source MN and includes the data volumes delivered to and received from the UE over the NR/E-UTRA radio as described in clause 10.11.2.

NOTE 7: The order the source SN sends the *Secondary RAT Data Usage Report* message and performs data forwarding with MN/target SN is not defined. The SN may send the report when the transmission of the related QoS is stopped.

13b. The source MN sends the *Secondary RAT Data Usage Report* message to AMF to provide information on the used NR/E-UTRA resource.

14. For bearers using RLC AM, the source MN sends the *SN Status Transfer* message to the target MN, including, if needed, SN Status received from the source SN. The target MN forwards the SN Status to the target SN, if needed.

15. If applicable, data forwarding takes place from the source side (i.e. source MN or source SN). If the SN is kept, data forwarding may be omitted for the SN terminated bearers or QoS flows kept in the SN.

16-19. The target MN initiates the Path Switch procedure*.* If the target MN includes multiple DL TEIDs for one PDU session in the *Path Switch Request* message, multiple UL TEID of the UPF for the PDU session should be included in the *Path Switch Ack* message in case there is TEID update in UPF.

NOTE 8: If new UL TEIDs of the UPF for SN are included, the target MN performs MN initiated SN Modification procedure to provide them to the SN.

20. The target MN initiates the UE Context Release procedure towards the source MN.

21. Upon reception of the *UE Context Release* message from source MN, the (source) SN releases C-plane related resources associated to the UE context towards the source MN. Any ongoing data forwarding may continue. The SN shall not release the UE context associated with the target MN if the UE contest kept indication was included in the *SN Release Request* message in step 12a.

### 10.19.x CHO with candidate SCG(s)

A CHO with candidate SCG(s) is defined as a PCell change with PSCell addition/change that is executed by the UE when the execution conditions for both PCell and the associated PSCell are met. The UE starts evaluating the execution conditions for candidate PCell(s) and candidate PSCell(s) simultaneously upon receiving the CHO with candidate SCG(s) configuration, and stops evaluating the execution conditions once PCell change or PSCell change is triggered. The UE does not execute CHO with candidate SCG(s) until the execution conditions for both PCell and the associated PSCell are met.

## 10.X Subsequent Conditional PSCell Addition or Change

A Subsequent Conditional PSCell Addition or Change (subsequent CPAC) is defined as a conditional PSCell addition or change procedure that is executed after a PSCell addition, a PSCell change or an SCG release based on pre-configured subsequent CPAC configuration of candidate PSCell(s) without reconfiguration and re-initiation of CPC/CPA. The UE keeps the configured subsequent CPAC configuration and evaluates the execution conditions of candidate PSCells after completion of a PSCell addition or a PSCell change. Intra-SN subsequent CPAC, inter-SN subsequent CPAC initiated either by MN or SN are supported.

The following principles apply to subsequent CPAC:

- For MN initiated subsequent CPAC, the MN initially triggers the candidate cell preparation of subsequent CPAC procedure and generates the execution conditions for CPA execution and initial CPC execution.

- For SN initiated subsequent CPAC, the source SN initially triggers the candidate cell preparation of subsequent CPAC procedure and generates the execution conditions for initial CPC execution.

- For both MN and SN initiated subsequent CPAC, the candidate SN generates the execution conditions for the following execution of the subsequent CPAC when the candidate SN prepares the candidate SCG configuration(s) for candidate PSCell(s).

- The subsequent CPAC configuration contains the configuration of candidate PSCell(s), execution conditions for both the initial CPAC execution and the following subsequent CPAC execution, and may contain the MCG configuration (to be applied when CPAC execution is triggered), the reference configuration and the security update configuration.

- The subsequent CPAC configuration for CPA or inter-SN CPC candidate PSCell(s) is provided in MN format. The subsequent CPAC configuration for intra-SN CPC candidate PSCell(s) is provided in MN format or SN format. It’s up to the source SN to decide which format to be used for intra-SN subsequent CPAC.

- For one UE, the subsequent CPAC configuration for all CPC candidate PSCells (including inter-SN and/or intra-SN) is provided in the same format, i.e., either MN format, or SN format. If the configured CPC candidate PSCell(s) includes at least one inter-SN CPC candidate PSCell, the subsequent CPAC configuration can only be provided in MN format. If only intra-SN CPC candidate PSCell(s) is configured, the subsequent CPAC configuration can be provided in either MN format or SN format.

- Each candidate PSCell configuration can be provided as delta configuration on top of a reference configuration, which is used to form a complete candidate cell configuration. Only one reference configuration is supported.

- The MN generates the MCG part of the reference configuration (if any), while the SN (source or candidate) generates the SCG part of the reference configuration. The MN can request an SCG reference configuration from any one of the involved SNs.

- The network explicitly configures a subsequent CPAC configuration for the current serving PSCell if the network wants to use that PSCell as a candidate PSCell for subsequent CPAC.

- The network always explicitly releases the subsequent CPAC configuration for candidate PSCells after an inter-MN PCell change.

- Upon the release of SCG, the UE releases the stored subsequent CPAC configuration in SN format.

- A candidate PSCell configuration for CPA can be used for the subsequent CPC execution, but with different execution conditions of the candidate PSCell.

- The subsequent CPAC configuration with CPA execution condition(s) maintained after SCG release can be used for the subsequent CPA execution.

- Upon inter-SN subsequent CPAC execution, the UE uses a first unused sk-Counter value for S-KgNB generation, based on the per-SN pre-configured sk-Counter value list.

- Upon PCell change, PSCell change or SCG release, if the subsequent CPAC configuration is maintained, the UE also maintains the unused sk-Counter values.

**MN initiated subsequent CPAC**

The subsequent CPAC procedure is initiated by the MN for inter-SN subsequent CPAC configuration and CPA or inter-SN CPC execution.



Figure 10.X-1: Inter-SN subsequent CPAC - MN initiated

Figure 10.X-1 shows an example signalling flow for the inter-SN subsequent CPAC initiated by the MN:

1/2/3/4. The MN initiates the inter-SN subsequent CPAC by requesting the candidate SN(s) to allocate resources for the UE by means of the SN Addition procedure, indicating that the request is for subsequent CPAC. The MN also provides the candidate cells recommended by MN via the latest measurement results for the candidate SN(s) to choose and configure the SCG cell(s), provides the upper limit for the number of PSCells that can be prepared by each candidate SN, and provides a list of KSN and associated sk-Counter values for each candidate SN. In the SN Addition procedure, the MN also includes the information of other candidate SN(s), and for each candidate SN, a list of cells recommended by the MN via the latest measurement results for the candidate SN to select the PSCell(s) for the execution of the subsequent CPAC. Within the list of cells as indicated within the measurement results indicated by the MN, the candidate SN decides the list of PSCell(s) to prepare (considering the maximum number indicated by the MN) and, for each prepared PSCell, the candidate SN decides other SCG SCells and provides the new corresponding SCG radio resource configuration to the MN in an NR *RRCReconfiguration*\*\* message contained in the *SN Addition Request Acknowledge* message with the prepared PSCell ID(s). For each prepared PSCell, the candidate SN also decides the list of PSCell(s) and associated execution conditions proposed for the execution of the subsequent CPAC. If data forwarding is needed, the candidate SN provides data forwarding addresses to the MN. The candidate SN may also propose data forwarding to the MN or other candidate SN(s) for subsequent CPAC. The candidate SN includes the indication of the complete or delta RRC configuration with respect to the reference SCG configuration. For the prepared PSCell(s) and the proposed PSCell(s) for the execution of the subsequent CPAC, the candidate SN can either accept or reject each of the candidate cells listed within the measurement results indicated by the MN, i.e. it cannot configure any alternative candidates.

The MN may select one of the candidate SN(s) and requests providing the reference configuration as part of the SN Addition procedure. Once obtained, the MN provides the reference configuration to other candidate SN(s).

NOTE 1: If the UE was configured with SN-1 in Dual Connectivity operation (i.e. SN-1 is the source SN), then the MN starts the subsequent CPAC operation with SN-1 via the MN-initiated SN Modification procedure instead of the SN Addition procedure.

NOTE 2: If the UE was configured with SN-1 in Dual Connectivity operation (i.e. SN-1 is the source SN), then the MN may trigger the MN-initiated SN Modification procedure to SN-1 to retrieve the current SCG configuration or request a reference configuration for the subsequent CPAC, and to allow provision of data forwarding related information before step 1.

NOTE 3: If applicable, the MN stores the data forwarding addresses and data forwarding proposals provided from all the candidate SN(s).

5. For SN terminated bearers using MCG resources, the MN provides Xn-U DL TNL address information in the *Xn-U Address Indication* message to the candidate SN(s).

6/7. If the lists of prepared PSCells received from the candidate SN(s) in steps 2 and 4 are different than the lists of proposed PSCells, e.g., when not all proposed PSCells were accepted by the candidate SN(s), the MN may initiate the SN Modification procedures towards all the candidate SN(s) to inform them about the updated lists of prepared PSCells in other candidate SN(s). If requested, the candidate SN(s) sends an SN Modification Request Acknowledge message and if needed, provides the updated candidate SCG configurations and/or the execution conditions for the execution of the subsequent CPAC to the MN.

8. The MN sends to the UE an *RRCReconfiguration* messageincluding the subsequent CPAC configuration, i.e. a list of *RRCReconfiguration\** messagesand associated execution conditions for the subsequent CPAC, in which each *RRCReconfiguration\** messagecontains the SCG configuration in the *RRCReconfiguration\*\** messagereceived from one of the candidate SN(s) in steps 2 and 4, and possibly an MCG configuration. Besides, the *RRCReconfiguration* message can also include an updated MCG configuration, e.g., to configure the required conditional measurements. The *RRCReconfiguration* message also includes a security update configuration and may also include a reference configuration.

9. The UE applies the *RRCReconfiguration* message received in step 8, stores the subsequent CPAC configurationand replies to the MN with an *RRCReconfigurationComplete* message. In case the UE is unable to comply with (part of) the configuration included in the *RRCReconfiguration* message, it performs the reconfiguration failure procedure.

11. The UE starts evaluating the execution conditions. If the execution conditionof one candidate PSCell is satisfied, the UE applies *RRCReconfiguration\** message corresponding to the selected candidate PSCell, and sends an MN *RRCReconfigurationComplete\** message, including an *RRCReconfigurationComplete\*\** message for the selected candidate PSCell, and information enabling the MN to identify the SN of the selected candidate PSCell. The *RRCReconfigurationComplete\** message may also include the sk-Counter value associated with the selected candidate PSCell if a new sk-Counter value is selected.

12. The MN informs the SN of the selected candidate PSCell that the UE has completed the reconfiguration procedure successfully via *SN Reconfiguration Complete* message, including the *RRCReconfigurationComplete\*\** message. If the sk-Counter value is received by the *RRCReconfigurationComplete\** message, the MN also indicates the received sk-Counter value to the SN.

13. The UE performs synchronisation towards the PSCell indicated in the *RRCReconfiguration\** message applied in step 11. The order the UE sends the MN *RRCReconfigurationComplete\** message and performs the Random Access procedure towards the SCG is not defined. The successful RA procedure towards the SCG is not required for a successful completion of the RRC Connection Reconfiguration procedure.

14. If PDCP termination point is changed to the SN for bearers using RLC AM, and when RRC full configuration is not used, the MN sends the *SN Status Transfer* message.

15. For SN terminated bearers or QoS flows moved from the MN, dependent on the characteristics of the respective bearer or QoS flow, the MN may take actions to minimise service interruption due to activation of MR-DC (Data forwarding).

16. If data forwarding is needed, the MN may send the *Xn-U Address Indication* message to the selected candidate SN. The SN may decide to perform, if applicable, early data forwarding for SN-terminated bearers, together with the sending of an *Early Status Transfer* message to the source MN.

NOTE 4: Separate Xn-U Address Indication procedures may be initiated to provide different forwarding addresses of the prepared subsequent CPAC. In this case, it is up to the MN and the candidate SN implementations to make sure that the *Early Status Transfer* message(s) from the selected SN, if any, is forwarded to the right other candidate SN.

18. The UE starts evaluating the execution conditions. If the execution conditionof one candidate PSCell is satisfied, the UE applies *RRCReconfiguration\** message corresponding to the selected candidate PSCell, and sends an MN *RRCReconfigurationComplete\** message, including an *RRCReconfigurationComplete\*\** message for the selected candidate PSCell, and information enabling the MN to identify the SN of the selected candidate PSCell. The *RRCReconfigurationComplete\** message may also include a sk-Counter value associated with the selected candidate PSCell if a new sk-Counter value is selected.

19. The MN informs the SN of the selected candidate PSCell that the UE has completed the reconfiguration procedure successfully via *SN Reconfiguration Complete* message, including the *RRCReconfigurationComplete\*\** message. If the sk-Counter value is received by the *RRCReconfigurationComplete\** message, the MN also indicates the received sk-Counter value to the SN.

20. The UE performs synchronisation towards the PSCell indicated in the *RRCReconfiguration\** message applied in step 18. The order the UE sends the MN *RRCReconfigurationComplete\** message and performs the Random Access procedure towards the SCG is not defined. The successful RA procedure towards the SCG is not required for a successful completion of the RRC Connection Reconfiguration procedure.

21/22/23. The MN triggers the MN initiated SN Modification procedure to inform the last serving SN to stop providing user data to the UE, to switch to the prepared state, and if applicable, to allow provisioning of new data forwarding addresses. If applicable, the MN triggers the Xn-U Address Indication procedure to inform the last serving SN the address of the SN of the selected candidate PSCell, to start late data forwarding.

24/25. If PDCP termination point is changed for bearers using RLC AM, and when RRC full configuration is not used, the SN sends the *SN Status Transfer* message to MN, which the MN sends then to the SN of the selected candidate PSCell, if needed.

26. If applicable, data forwarding from the last serving SN takes place. It may be initiated as early as the the last serving SN receives the early data forwarding address in step 17.

27. If data forwarding is needed, the MN may send the *Xn-U Address Indication* message to the selected candidate SN. The SN may decide to perform, if applicable, early data forwarding for SN-terminated bearers, together with the sending of an *Early Status Transfer* message to the source MN.

NOTE 5: Separate Xn-U Address Indication procedures may be initiated to provide different forwarding addresses of the prepared subsequent CPAC. In this case, it is up to the MN and candidate SN implementations to make sure that the *Early Status Transfer* message(s) from the selected SN, if any, is forwarded to the right other candidate SN.

**SN initiated subsequent CPAC**

The subsequent CPAC procedure is initiated by the SN for inter-SN subsequent CPAC configuration and inter-SN CPC execution.



Figure 10.X-2: Inter-SN subsequent CPAC - SN initiated

Figure 10.X-2 shows an example signalling flow for the inter-SN subsequent CPAC initiated by the SN-1:

1. The source SN (i.e. SN-1) initiates the inter-SN subsequent CPAC procedure by sending the *SN Change Required* message, which contains a subsequent CPAC initiation indication. The message also contains candidate node ID(s) and may include the SCG configuration (to support delta configuration), and contains the measurements results which may include cells that are not subsequent CPAC candidates. The message also includes a list of proposed PSCell candidates recommended by the source SN, including execution conditions for the initial evaluation, the upper limit for the number of PSCells that can be prepared by each candidate SN, and may also include the SCG measurement configurations for subsequent CPAC (e.g. measurement ID(s) to be used for subsequent CPAC).

2/3/4/5. The MN requests each candidate SN(s) to allocate resources for the UE by means of the SN Addition procedure(s), indicating the request is for subsequent CPAC, and the measurements results which may include cells that are not subsequent CPAC candidates received from the source SN to the candidate SN, and indicating a list of proposed PSCell candidates to the candidate SN(s) received from the source SN, but not including execution conditions. The MN also includes the information of other candidate SN(s), and for each candidate SN, a list of proposed PSCell candidates recommended by the source SN for the candidate SN to select the PSCell(s) for the execution of the subsequent CPAC. The MN also provides the upper limit for the number of PSCells that can be prepared by each candidate SN and provides a list of KSN and associated sk-Counter values for each candidate SN. Within the list of PSCells suggested by the source SN, the candidate SN decides the list of PSCell(s) to prepare (considering the maximum number indicated by the MN) and, for each prepared PSCell, the candidate SN decides other SCG SCells and provides the new corresponding SCG radio resource configuration to the MN in an NR *RRCReconfiguration*\*\* message contained in the *SN Addition Request Acknowledge* message with the prepared PSCell ID(s). For each prepared PSCell, the candidate SN also decides the list of PSCell(s) and associated execution conditions proposed for the execution of the subsequent CPAC. If data forwarding is needed, the candidate SN provides data forwarding addresses to the MN. The candidate SN may also propose data forwarding to the MN or other candidate SN(s) for subsequent CPAC. The candidate SN includes the indication of the complete or delta RRC configuration with respect to the reference SCG configuration. For the prepared PSCell(s) and the proposed PSCell(s) for the execution of the subsequent CPAC, the candidate SN can either accept or reject each of the candidate cells suggested by the source SN, i.e. it cannot configure any alternative candidates.

The MN may select one of the candidate SN(s) and requests providing the reference configuration as part of the SN Addition procedure. Once obtained, the MN provides the reference configuration to other candidate SN(s).

NOTE 1: The MN may trigger the MN-initiated SN Modification procedure (to the source SN) to request a reference configuration for the subsequent CPAC before step 2.

NOTE 2: If applicable, the MN stores the data forwarding addresses and data forwarding proposals provided from all the candidate SN(s) and the source SN.

6. For SN terminated bearers using MCG resources, the MN provides Xn-U DL TNL address information in the *Xn-U Address Indication* message to the candidate SN(s).

7/8. If the lists of prepared PSCells received from the candidate SN(s) in steps 3 and 5 are different than the lists of proposed PSCells, e.g., when not all proposed PSCells were accepted by the candidate SN(s). the MN may initiate the SN Modification procedures towards the source SN and all the candidate SN(s) to inform them about the updated lists of prepared PSCells in other candidate SN(s). If requested, the source SN or the candidate SN(s) sends an SN Modification Request Acknowledge message and if needed, provides the updated candidate SCG configurations and/or the execution conditions for the execution of the subsequent CPAC for the prepared PSCell to the MN.

9. The MN sends to the UE an *RRCReconfiguration* messageincluding the subsequent CPAC configuration, i.e. a list of *RRCReconfiguration\** messagesand associated execution conditions for the subsequent CPAC, in which each *RRCReconfiguration\** messagecontains the SCG configuration in the *RRCReconfiguration\*\** messagereceived from one of the candidate SN(s) in steps 3 and 5, and possibly an MCG configuration. Besides, the *RRCReconfiguration* message can also include an updated MCG configuration, as well as the NR *RRCReconfiguration\*\**\* message generated by the source SN, e.g., to configure the required conditional measurements. The *RRCReconfiguration* message also includes a security update configuration and may also include a reference configuration.

10. The UE applies the *RRCReconfiguration* message received in step 9, stores the subsequent CPAC configurationand replies to the MN with an *RRCReconfigurationComplete* message, which can include an NR *RRCReconfigurationComplete\*\*\** message. In case the UE is unable to comply with (part of) the configuration included in the *RRCReconfiguration* message, it performs the reconfiguration failure procedure.

11/12. If an SN RRC response message is included, the MN informs the source SN with the SN *RRCReconfigurationComplete\*\*\** message via *SN Change Confirm* message. If step 7 and 8 towards the source SN are skipped, the MN will indicate the candidate PSCells accepted by each candidate SN to the source SN in the *SN Change Confirm* message.

The MN sends the *SN Change Confirm* message towards the source SN to indicate that subsequent CPAC is prepared, and in such case the source SN continues providing user data to the UE. If early data forwarding is applied, the MN informs the source SN the data forwarding addresses as received from the candidate SN(s), the source SN, if applicable, together with the Early Status Transfer procedure, starts early data forwarding. The PDCP SDU forwarding may take place during early data forwarding. In case multiple candidate SNs are prepared, the MN includes a list of Target SN ID and list of data forwarding addresses to the source SN.

NOTE 3: The Xn-U Address Indication procedure may further be invoked to indicate to the source SN to stop already initiated early data forwarding for some PDCP SDUs if they are no longer subject to data forwarding due to the modification or cancellation of the prepared conditional PSCell change.

NOTE 4: For the early transmission of MN terminated split/SCG bearers, the MN forwads the PDCP PDU to the candidate SN(s).

13. The UE starts evaluating the execution conditions. If the execution conditionof one candidate PSCell is satisfied, the UE applies *RRCReconfiguration\** message corresponding to the selected candidate PSCell, and sends an MN *RRCReconfigurationComplete\** message, including an *RRCReconfigurationComplete\*\** message for the selected candidate PSCell, and information enabling the MN to identify the SN of the selected candidate PSCell. The *RRCReconfigurationComplete\** message may also include the sk-Counter value associated with the selected candidate PSCell if a new sk-Counter value is selected.

14. The MN informs the SN of the selected candidate PSCell that the UE has completed the reconfiguration procedure successfully via *SN Reconfiguration Complete* message, including the *RRCReconfigurationComplete\*\** message. If the sk-Counter value is received by the *RRCReconfigurationComplete\** message, the MN also indicates the received sk-Counter value to the SN.

15. The UE performs synchronisation towards the PSCell indicated in the *RRCReconfiguration\** message applied in step 13. The order the UE sends the MN *RRCReconfigurationComplete\** message and performs the Random Access procedure towards the SCG is not defined. The successful RA procedure towards the SCG is not required for a successful completion of the RRC Connection Reconfiguration procedure.

16/17/18. If the source SN is configured as a candidate SN, the MN triggers the MN initiated SN Modification procedure to inform the source SN to stop providing user data to the UE, to switch to the prepared state, and if applicable, to allow provisioning of new data forwarding addresses. If applicable, the MN triggers the Xn-U Address Indication procedure to inform the source SN the address of the SN of the selected candidate PSCell, to start late data forwarding. If the source SN is not configured as a candidate SN, the MN triggers the MN initiated SN Release procedure to inform the source SN to stop providing user data to the UE, and triggers the Xn-U Address Indication procedure to inform the source SN the address of the SN of the selected candidate PSCell and if applicable, starts late data forwarding.

19/20. If PDCP termination point is changed for bearers using RLC AM, and when RRC full configuration is not used, the SN sends the *SN Status Transfer* message to MN, which the MN sends then to the SN of the selected candidate PSCell, if needed.

21. If applicable, data forwarding from the source SN takes place. It may be initiated as early as the the source SN receives the early data forwarding address in step 12.

22. If data forwarding is needed, the MN may send the *Xn-U Address Indication* message to the selected candidate SN. The SN may decide to perform, if applicable, early data forwarding for SN-terminated bearers, together with the sending of an *Early Status Transfer* message to the source MN.

NOTE 5: Separate Xn-U Address Indication procedures may be initiated to provide different forwarding addresses of the prepared subsequent CPAC. In this case, it is up to the MN and the candidate SN implementations to make sure that the *Early Status Transfer* message(s) from the selected SN, if any, is forwarded to the right other candidate SN.

24. In subsequent evaluation and execution phase, the similar steps as steps 13~23 are performed.

END OF CHANGES