**3GPP TSG-RAN WG2 Meeting #127 R2-2407604**

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

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| *CR-Form-v12.3* | | | | | | | | |
| **CHANGE REQUEST** | | | | | | | | |
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|  | **37.340** | **CR** | **0399** | **rev** | **2** | **Current version:** | **18.2.0** |  |
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| *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)*.* | | | | | | | | |
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| ***Proposed change affects:*** | UICC apps |  | ME | **X** | Radio Access Network | **X** | Core Network |  |

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| ***Title:*** | Miscellaneous corrections for mobility enhancements | | | | | | | | | |
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| ***Source to WG:*** | ZTE Corporation, Ericsson | | | | | | | | | |
| ***Source to TSG:*** | R2 | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Work item code:*** | NR\_Mob\_enh2-Core | | | | |  | ***Date:*** | | | 2024-08-29 |
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| ***Category:*** | **F** |  | | | | | ***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-17 (Release 17) Rel-18 (Release 18) Rel-19 (Release 19)  Rel-20 (Release 20)* | |
|  |  | | | | | | | | | |
| ***Reason for change:*** | | To address some miscellaneous clarification/editorial changes:   1. According to the current text in section 10.2.3 and 10.6, the execution of CPA or CPC will trigger the UE to release all stored conditional reconfigurations, but the subsequent CPAC configuration should not be released. 2. After the completion of subsequent CPAC execution, the UE shall replace the previous execution conditions with the execution conditions for the following execution of susequent CPAC and evaluate the new execution conditions. In the procedural text for intra-SN subsequent CPAC without MN involvement, it’s uncelar which execution condition is to be evaluated. 3. It’s agreed that “*A UE which reports LTM capability without 45-1 may not perform L1 measurement reporting, and it is up to network implementation how to trigger the LTM execution*.” at last meeting. But the L1 measurement and reporting is described as a mandatory step in the current procedural texts and figures for SCG LTM. 4. The SN secuirty key update can be applied for SN initiated intra-SN subsequent CPAC with MN involvement, but the description of related operation is missed in the current procedural text. 5. For SN initiated intra-SN subsequent CPAC with MN involvement, the description about evaluation of execution conditions after completion of the subsequent CPAC execution is repeated in step 7 and NOTE 14. 6. The description of subsequent CPAC is missed or unclear in some texts.   To merge changes proposed in R2-2407091.  To cature agreements on inter-node coordination for L1 measurement related UE capabilities made in RAN2#127. | | | | | | | | |
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| ***Summary of change:*** | | 1. Clarified that the UE releases all stored conditional reconfigurations except for subsequent CPAC once the CPA or CPC procedure is executed successfully in section 10.2.3 and 10.6. 2. Clarified that the UE evaluates the execution conditions for the following execution of subsequent CPAC after completion of the subsequent CPAC execution in the procedure text for intra-SN subsequent CPAC without MN involvement in section 10.3.2. 3. Updated the description for L1 measurement and reporting as a optional step, and change the solid line to dashed line for L1 measurement report in the figures for SCG LTM in section 10.3.2. 4. Added the description about SN security key update in the procedural text of SN initiated subsequent CPAC with MN involvement in section 10.20. 5. Removed the unclear and redundant description about evaluation of execution conditions after completion of the subsequent CPAC execution in step 7 for SN initiated subsequent CPAC with MN involvement in section 10.20. 6. Added “subsequent CPAC” in some texts in section 10.3.2. 7. Updated figures for intra-SN subsequent CPAC without MN involvement in section 10.3.2 to add “subsequent CPAC execution”. 8. Updated some texts to clarify messages used for subsequent CPAC configurations in section 10.20. 9. The occurrences of “inter-SN subsequent CPAC” are updated to just “subsequent CPAC”. For descriptions related to that a candidate PSCell in another candidate SN is configured, it has then instead been clarified that subsequent CPAC is configured for a PSCell in another SN than the current serving SN (refer to R2-2407091). 10. Captured the inter-node coordination on L1 measurement in section 7.3.   **Impact Analysis**  Impacted 5G architecture options:  NR-DC  Impacted functionality:  SCG LTM; Subsequent CPAC  Inter-operability:  1. If the network is implemented according to the CR and the UE is not, there is no inter-operability issue.  2. If the UE is implemented according to the CR and the network is not, there is no inter-operability issue. | | | | | | | | |
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| ***Consequences if not approved:*** | | There are still some ambiguity and editorial errors in the specification. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Clauses affected:*** | | 7.3, 10.2.3, 10.3.2, 10.4.2, 10.6, 10.20 | | | | | | | | |
|  | |  | | | | | | | | |
|  | | **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:*** | | R2-2406417  R2-2407586 | | | | | | | | |

*Start of Change*

## 7.3 UE capability coordination

In (NG)EN-DC and NE-DC, the capabilities of a UE supporting MR-DC are carried by different capability containers. Some MR-DC related capabilities are in the MR-DC container e.g. MR-DC band combinations, while other MR-DC related capabilities are contained in the E-UTRA and NR capability containers e.g. feature sets as described in TS 38.300 [3]. The MR-DC capabilities in the MR-DC container need to be visible to both MN and SN, while the capabilities in the E-UTRA and NR containers only need to be visible to the node of the concerned RAT.

In NR-DC, all NR-DC related capabilities are in the NR capability container and are visible to both MN and SN.

When retrieving MR-DC related capabilities, the MN shall provide an MR-DC filter that affects the MR-DC related capabilities in MR-DC, E-UTRA and NR capability containers. When using different *UE capability enquiry* messages to retrieve the different containers, the MN shall employ the same MR-DC filter in all enquiry messages. In the E-UTRA RRC UE capability enquiry, the MR-DC filter is also used for retrieval of NR capabilities i.e. there is in fact one MR-DC/NR filter (while there is a separate filter for E-UTRA capabilities). Furthermore, the MN stores the retrieved capabilities and the corresponding filter, used to retrieve those capabilities, in the core network for later use.

For the UE capabilities requiring coordination between E-UTRA and NR (i.e. band combinations, feature sets and the maximum power for FR1 the UE can use in SCG) or between NR MN and NR SN (i.e. band combinations, feature sets and the maximum power for FR1 and FR2), it is up to the MN to decide on how to resolve the dependency between MN and SN configurations. The MN then provides the resulting UE capabilities usable for SCG configuration to the SN, including the list of allowed MR-DC band combinations and feature sets, and the SN indicates the selected band combination and feature set to the MN. When subsequently reconfiguring the SCG, the SN should inform the MN whenever the band combination and/or feature set it selected for the SCG changes (i.e. even if the selection concerns a band combination and feature set that is allowed). As part of an SN initiated SN modification, the SN may also indicate the desired UE capabilities usable for SCG configuration (e.g. a band combination and a feature set) outside those allowed by the MN (i.e. it may re-negotiate the UE capabilities for SCG configuration), and it is up to the MN to make the final decision whether to accept or reject the request. If the MN accepts the request, the MN may provide the resulting UE capabilities e.g. by indicating the allowed band combinations and feature sets. If MN accepts but does not provide resulting UE capabilities, SN assumes the UE capabilities usable for SCG configuration are updated in accordance with the modification it requested. Otherwise, the MN rejects the request by sending X2/Xn refuse message.

In EN-DC and MR-DC with 5GC, the MN may provide the UE radio capability ID to the SN. For EN-DC, the SN may retrieve the UE Radio Capability information associated to a UE radio capability ID from the MN. For MR-DC with 5GC, the SN may retrieve the UE radio capability information associated to a UE radio capability ID from the 5GC.

For MUSIM operation, when the UE is configured to operate in NR-DC in Network A (as described in TS 38.300 [3]), the MN may indicate the temporary capability restriction to the SN based on the temporary capability restrictions indicated by the UE.

For LTM operation, the MN indicates the maximum number of LTM candidate configurations the SN is allowed to configure for SCG LTM, to ensure that UE capabilities are not exceeded. The SN can also request the MN for a new value of the maximum number of allowed LTM candidate configurations to configure for SCG LTM, and it is up to the MN whether to accommodate the SN request. If the SN receives from the MN a new value for the maximum number of LTM candidate configurations, it is SN responsibility to ensure that its configured LTM candidate configurations to comply with the new limit.

For the LTM related UE capabilities about L1 measurements requiring coordination between the MN and the SN, it is up to the MN to decide on how to resolve the dependency between MN and SN configurations and ensure that the UE capabilities are not exceeded. The MN then provides the resulting UE capabilities about L1 measurements usable for SCG configuration to the SN. The SN can also request a new value for such UE capabilities for L1 measurements, and it is up the the MN whether to accommodate the SN request. If the SN receives from the MN a new value for such UE capabilities for L1 measurements, it is SN responsibility to ensure that its configured L1 measurement configurations to comply with the new limit.

*Next Change*

## 10.2 Secondary Node Addition

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### 10.2.3 Conditional PSCell Addition

A Conditional PSCell Addition (CPA) is defined as a PSCell addition that is executed by the UE when execution condition(s) is met. The UE starts evaluating the execution condition(s) upon receiving the CPA configuration, and stops evaluating the execution condition(s) once PSCell addition or PCell change is triggered.

The following principles apply to CPA:

- The CPA configuration contains the configuration of CPA candidate PSCell(s), execution condition(s) and may contain the MCG configuration, to be applied when CPA 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 a 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 CPA execution condition of a single candidate PSCell.

- Before any CPA execution condition is satisfied, upon reception of PSCell addition command or PCell change command, the UE executes the PSCell addition procedure as described in clause 10.2.1 or 10.2.2, 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 CPA configuration. Upon the successful completion of PSCell addition procedure or PCell change procedure, the UE releases the stored CPA configuration.

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

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

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

*Next Change*

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

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### 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 subsequent CPAC, this procedure is used to modify CPA, inter-SN CPC or subsequent CPAC configuration within the same candidate SN. In case of CPA, inter-SN CPC or 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 subsequent CPAC, this procedure is used to configure, modify or release intra-SN CPC or 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. This procedure can also be used to support coordination between the MN and the SN for managing the configuration and reporting of QoE measurements and/or RAN visible QoE measurements in NR-DC.

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. In case of coordination between the MN and the SN on QoE and/or RAN visible QoE measurement configuration and reporting, the *SN Modification Request* message may contain the *QMC Coordination Request* IE.

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. In case of coordination between the MN and the SN on QoE and/or RAN visible QoE measurement configuration and reporting, the *SN Modification Request* *Acknowledge* message may contain the *QMC Coordination Response* IE.

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. In case of coordination between the MN and the SN on QoE and/or RAN visible QoE measurement configuration and reporting, the *SN Modification Required* message may contain the *QMC Coordination Request* IE.

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 subsequent CPAC) is prepared, and if any execution of a prepared SN initiated intra-SN CPC or SN initiated intra-SN subsequent CPAC without MN involvement procedure or reconfiguration of the SCG, the SN notifies 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 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 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. In case of coordination between the MN and the SN on QoE and/or RAN visible QoE measurement configuration and reporting, the *SN Modification Confirm* message may contain the *QMC Coordination Response* IE.

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 for the following execution of subsequent CPAC after completion of the subsequent CPAC execution.

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

NOTE 5: 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 candidate configurations to the UE through SRB3.

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

3a. The UE performs DL synchronization with LTM candidate cell(s) before receiving the cell switch command, as specified in clause 9.2.3.5.2 in TS 38.300 [3].

3b. The UE may perform UL synchronization with LTM candidate cell(s) before receiving the cell switch command, as specified in clause 9.2.3.5.2 in TS 38.300 [3].

4. The UE performs L1 measurements on the configured LTM candidate cell(s) and transmits L1 measurement reports to the SN, if the L1 measurement configuration in *RRCReconfiguration* is received in step 1. The UE starts to perform L1 measurements once the L1 measurement configuration is applicable.

5. The SN decides to execute cell switch to a target cell and transmits an LTM cell switch command MAC CE triggering cell switch by including a target configuration ID and other related information for the target cell, as specified in clause 9.2.3.5.2 in TS 38.300 [3]. The UE switches to the target cell and applies the candidate configuration indicated by the target configuration ID.

6. The UE performs the random access procedure towards the target cell, if the 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 cell switch execution is successfully completed when the UE determines that the target cell has successfully received its first UL data, as specified in clause 9.2.3.5.2 in TS 38.300 [3].

NOTE 6: The steps 3-7 can be performed multiple times for subsequent SCG LTM cell switch execution 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 or subsequent CPAC 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 for the following execution of subsequent CPAC 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 7: 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 candidate configurations.

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

3. The UE stores the SCG LTM candidate configurations and replies with the *RRCReconfigurationComplete* message by including the SN *RRCReconfigurationComplete* 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 performs DL synchronization with LTM candidate cell(s) before receiving the cell switch command, as specified in clause 9.2.3.5.2 in TS 38.300 [3].

5b. The UE may perform UL synchronization with LTM candidate cell(s) before receiving the cell switch command, as specified in clause 9.2.3.5.2 in TS 38.300 [3].

6. The UE performs L1 measurements on the configured LTM candidate cell(s) and transmits L1 measurement reports to the SN, if the L1 measurement configuration in *RRCReconfiguration* is received in step 2. The UE starts to perform L1 measurements once the L1 measurement configuration is applicable.

7. The SN decides to execute cell switch to a target cell and transmits an LTM cell switch command MAC CE triggering cell switch by including a target configuration ID and other related information for the target cell, as specified in clause 9.2.3.5.2 in TS 38.300 [3]. The UE switches to the target cell and applies the candidate configuration indicated by the target configuration ID.

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

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

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

11. The UE completes the SCG LTM cell switch procedure by sendingan UL transmission to target cell. If the UE has performed a RA procedure in step 10 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 9.2.3.5.2 in TS 38.300 [3].

NOTE 8: The steps 5-11 can be performed multiple times for subsequent SCG LTM cell switch execution using the SCG LTM candidate configuration(s) provided in step 2.

*Next Change*

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

[…]

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

NOTE 00a: If subsequent CPAC is configured, upon reception of the *SN Release Acknowledge* message from the source SN, the MN may retain the subsequent CPAC configuration or cancel the subsequent CPAC configuration. If the MN maintains the subsequent CPAC configuration, it should provide suitable execution conditions for the evaluation of the subsequent CPAC.

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 or inter-SN CPC is configured, upon reception of the *SN Release Required* message the MN cancels all CPAC with the target candidate SN(s).

NOTE 1c: If subsequent CPAC is configured, upon reception of the *SN Release Required* message from the source SN, the MN may retain the subsequent CPAC configuration or cancel the subsequent CPAC configuration. If the MN maintains the subsequent CPAC configuration, it should provide suitable execution conditions for the evaluation of the subsequent CPAC.

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.

*Next Change*

## 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]) except for subsequent CPAC.

- 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 LTM is defined as a PSCell cell switch procedure that the network triggers via MAC CE. Only intra-SN SCG LTM without MN involvement is supported.

*Next Change*

## 10.20 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 (conditional) PSCell addition, a (conditional) PSCell change, a PCell 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 (unless the network indicates to release it) and evaluates the execution conditions of candidate PSCells (if provided for the following execution of subsequent CPAC) after completion of a PSCell addition, a PSCell change, a PCell change or an SCG release.Subsequent CPAC configuration can be initiated either by the MN or by the SN.

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 the initial execution of subsequent CPAC (e.g. CPA or CPC).

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

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

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

- The subsequent CPAC configuration can be included within an MN or an SN RRC message. A subsequent CPAC configuration that is included in an MN RRC message can be used for candidate PSCell(s) for CPA, for intra-SN or inter-SN candidate PSCell(s) for CPC. A subsequent CPAC configuration that is included in an SN RRC message can only be used for intra-SN candidate PSCell(s) for CPC.

- For one UE, the subsequent CPAC configurations for all candidate PSCells (including inter-SN and/or intra-SN) are included within either MN RRC message(s) or SN RRC message(s). It is up to OAM configuration to ensure only MN RRC message(s) or only SN RRC message(s) are used.

- Each candidate PSCell configuration is provided as a delta configuration on top of a reference configuration or a complete configuration. Only one reference configuration is supported.

- The MN generates the MCG part of the reference configuration (if any), while the SN 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 autonomously releases the stored subsequent CPAC configuration in SN format. Upon the release of SCG, the UE releases or maintains the stored subsequent CPAC configuration in MN format according to the network indication.

- The same candidate PSCell configuration can be used for CPA execution and 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 subsequent CPAC execution to a different SN, the UE uses the first unused sk-Counter value for S-KgNB generation, based on the per-SN pre-configured sk-Counter value list for that SN, if any.

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

- The UE autonomously releases the subsequent CPAC configuration upon RRC re-establishment and upon RRC release.

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

- The UE is not required to continue evaluating the execution conditions of other subsequent CPAC candidate PSCell(s) when PSCell change/addition or PCell change is triggered.

**MN initiated subsequent CPAC**

The subsequent CPAC procedure is initiated by the MN for subsequent CPAC configuration and subsequent CPAC execution.



Figure 10.20-1: Subsequent CPAC - MN initiated

Figure 10.20-1 shows an example signalling flow for the subsequent CPAC initiated by the MN:

1/2/3/4. The MN initiates the subsequent CPAC for candidate PSCell(s) in other candidate SN(s) 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 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 following execution of 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 following execution of 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 may include an indication that the SCG radio resource configuration of a prepared PSCell is a complete configuration, i.e. that it is not a delta configuration with respect to the SCG reference configuration. For the prepared PSCell(s) and the proposed PSCell(s) for the following execution of 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 SCG reference configuration as part of the SN Addition procedure. Once obtained, the MN provides the SCG 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) and the MN decides to configure the SN-1 as a candidate SN for the subsequent CPAC, 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 SCG 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. For each candidate SN, the MN may initiate the SN Modification procedure towards the candidate SN to inform the prepared PSCells in other candidate SN(s), e.g., when not all proposed PSCells by this candidate SN for the following execution of subsequent CPAC were prepared by the candidate SN(s). If requested, the candidate SN sends an *SN Modification Request Acknowledge* message and if needed, provides the updated candidate SCG configuration(s) and/or the execution conditions for the following execution of 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 initial execution of subsequent CPAC and execution conditions for the following execution of 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 source 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.

10. In case of SN terminated bearers, early data forwarding may take place. For the early data forwarding of SN terminated bearers, the MN forwards the PDCP SDU to the candidate SN(s). For the early transmission of MN terminated split/SCG bearers, the MN forwards the PDCP PDU to the candidate SN(s).

NOTE 3a: If the UE was configured with SN-1 in Dual Connectivity operation (i.e. SN-1 is the source SN), the MN may send the *Xn-U Address Indication* message 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 MN. Separate Xn-U Address Indication procedures may be invoked to provide different forwarding addresses of the prepared subsequent CPAC. In this case, it is up to the MN and the source SN implementations to make sure that the EARLY STATUS TRANSFER message(s) from the source SN, if any, is forwarded to the right other candidate SN. 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 SN-terminated bearers if they are no longer subject to data forwarding due to the modification or cancellation of the prepared subsequent CPAC.

11. The UE starts evaluating the execution conditions for the initial execution of subsequent CPAC. 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 (i.e. the selected candidate SN) 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 Reconfiguration procedure.

NOTE 3b: If the UE was configured with SN-1 in Dual Connectivity operation (i.e. SN-1 is the source SN), the steps 14-16 in Figure 10.20-2 are executed before the step 14 in this figure.

14. If PDCP termination point is changed to the SN for bearers using RLC AM, 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).

16-19: If applicable, a PDU Session path update procedure is triggered by the MN.

20-21. 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 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 candidate SN, if any, is forwarded to the right other candidate SN.

22. The UE starts evaluating the execution conditions for the following execution of subsequent CPAC. 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.

23. 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.

24. The UE performs synchronisation towards the PSCell indicated in the *RRCReconfiguration\** message applied in step 22. 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 Reconfiguration procedure.

NOTE 4a: If the selected candidate PSCell that the UE executed in the step 22 belongs to the same last serving SN, the steps 10-11 in the Figure 10.20-3 are executed instead of the steps 25-30 in this figure.

25/26/27. 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 based on the data forwarding proposals of the MN and the selected candidate SN. 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.

28/29. If PDCP termination point is changed for bearers using RLC AM, 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.

30. 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 21.

31: The source 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 4b: 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 bearer is stopped.

32-36: If applicable, a PDU Session path update procedure is triggered by the MN.

37-38. 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 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 selected candidate SN implementations to make sure that the *Early Status Transfer* message(s) from the selected candidate SN, if any, is forwarded to the right other candidate SN.

NOTE 5a: The steps 22-38 can be performed multiple times for the following execution of subsequent CPAC, using the subsequent CPAC configuration provided in step 8.

**SN initiated subsequent CPAC**

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



Figure 10.20-2: Subsequent CPAC - SN initiated

Figure 10.20-2 shows an example signalling flow for the subsequent CPAC initiated by the source SN:

1. The source SN (i.e. SN-1) initiates the subsequent CPAC procedure for candidate PSCell(s) in other (candidate) SN(s) 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 an SCG reference 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). The source SN may also propose data forwarding to the MN or other candidate SN(s) for subsequent CPAC.

2/3. 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 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 following execution of 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 following execution of 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 may include an indication that the SCG radio resource configuration of a prepared PSCell is a complete configuration, i.e. that it is not a delta configuration with respect to the SCG reference configuration. For the prepared PSCell(s) and the proposed PSCell(s) for the following execution of 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 SCG configuration as part of the SN Addition procedure. Once obtained, the MN provides the reference configuration to other candidate SN(s).

NOTE 6: 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, if not provided in step 1.

NOTE 7: If applicable, the MN stores the data forwarding addresses and data forwarding proposals provided from all the candidate SN(s) and the source SN.

NOTE 7a: The MN may decide to reconfigure the source SN as a candidate SN. In this case, the descriptions in the above steps 2-3 apply the same with the source SN, except that it is the MN that provides the list of proposed PSCell candidates for the source SN (as a candidate SN), and that the MN-initiated SN modification procedure is used with the source SN instead of the MN-initiated SN addition procedure. In the subsequent steps, the descriptions for any candidate SN also apply the same to the source SN (as one of candidate SN(s) for the subsequent CPAC) unless explicitly stated otherwise.

4. 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).

5/6. The MN may indicate the candidate PSCells accepted by each candidate SN to the source SN via SN Modification Request message before it configures the UE, e.g., when not all candidate PSCells were accepted by the candidate SN(s). If requested, the source SN sends an SN Modification Request Acknowledge message and if needed, provides an updated measurement configuration and/or the execution conditions for the initial execution of subsequent CPAC to the MN.

For each candidate SN, the MN may initiate the SN Modification procedures towards the candidate SN to inform the prepared PSCells in other candidate SN(s), e.g., when not all proposed PSCells by this candidate SN for the following execution of subsequent CPAC were prepared by the candidate SN(s). If requested, the candidate SN sends an *SN Modification Request Acknowledge* message and if needed, provides the updated candidate SCG configuration(s) and/or the associated execution conditions for the following execution of subsequent CPAC of the list of PSCell(s) to the MN.

7. 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 initial execution of subsequent CPAC and execution conditions for the following execution of 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 3, 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.

8. The UE applies the *RRCReconfiguration* message received in step 7, 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.

9/10. 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 5 and 6 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 address(es), 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 8: 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 subsequent CPAC.

NOTE 9: For the early transmission of MN terminated split/SCG bearers, the MN forwads the PDCP PDU to the candidate SN(s).

11. The UE starts evaluating the execution conditions for the initial execution of subsequent CPAC. 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 (i.e. the selected candidate SN) 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 Reconfiguration procedure.

NOTE 9a: If the selected candidate PSCell that the UE executed in the step 13 belongs to the same last serving SN, the steps 10-11 in the Figure 10.20-3 are executed instead of the steps 14-19 in this figure.

14/15/16. 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 based on the data forwarding proposals of the MN and the selected candidate SN. 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.

17/18. If PDCP termination point is changed for bearers using RLC AM, 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.

19. 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 10.

20. The source 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 9b: 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 bearer is stopped.

21-25: If applicable, a PDU Session path update procedure is triggered by the MN.

26-27. 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 MN.

NOTE 10: 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 candidate SN, if any, is forwarded to the right other candidate SN.

NOTE 11: The steps 11-27 can be performed multiple times for the following execution of subsequent CPAC, using the subsequent CPAC configuration provided in step 7. In step 11, the UE starts evaluating the execution conditions for the following execution of subsequent CPAC, instead of the execution conditions for the initial execution of subsequent CPAC.

**SN initiated intra-SN subsequent CPAC with MN involvement**

This procedure is initiated by the SN for intra-SN subsequent CPAC with MN involvement.



Figure 10.20-3: Intra-SN subsequent CPAC - SN initiated with MN involvement

Figure 10.20-3 shows an example signalling flow for intra-SN subsequent CPAC initiated by the SN with MN involvement:

1. The SN initiates the conditional SN modification procedure by sending the *SN Modification Required* message, which contains an intra-SN subsequent CPAC initiation indication. The message includes a list of PSCell(s) to prepare and associated execution conditions proposed for the initial execution of subsequent CPAC and execution conditions proposed for the following execution of subsequent CPAC, and for each prepared PSCell, the SN decides SCG SCells and provides the new corresponding SCG radio resource configuration to the MN in an NR *RRCReconfiguration\*\** message contained in the *SN Modification Required* message. The SN may include an indication that the SCG radio resource configuration of a prepared PSCell is a complete configuration, i.e. that it is not a delta configuration with respect to the reference SCG configuration.

2/3. The MN initiated SN Modification procedure may be triggered by *SN Modification Required* message, e.g. if an SN security key change needs to be applied, the MN may provide a list of KSN and associated sk-Counter values to the SN.

NOTE 12: 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 to the UE an *RRCReconfiguration* message including the subsequent CPAC configuration, i.e. a list of *RRCReconfiguration\** messagesand associated execution conditions for the initial execution of subsequent CPAC and execution conditions for the following execution of subsequent CPAC, in which each *RRCReconfiguration\** messagecontains the SCG configuration in the *RRCReconfiguration\*\** message received from the SN in step 1 and possibly an MCG configuration. Besides, the *RRCReconfiguration* messagecan also include an updated MCG configuration, as well as the NR *RRCReconfiguration\*\**\* message generated by the SN, e.g., to configure the required conditional measurements. The *RRCReconfiguration* message may also include a reference configuration and a security update configuration.

5. The UE applies the *RRCReconfiguration* message received in step 4, 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.

6. If an SN RRC response message is included, the MN informs the SN with the SN *RRCReconfigurationComplete\*\*\** message via *SN Modification Confirm* message. The MN sends the *SN Modification Confirm* message towards the SN to indicate that subsequent CPAC is prepared.

7. The UE starts evaluating the execution conditions for the initial execution of subsequent CPAC. If the execution conditionof one candidate PSCell is satisfied, the UE applies *RRCReconfiguration\** message corresponding to the selected candidate PSCell, and sends an *RRCReconfigurationComplete\** message, including an *RRCReconfigurationComplete\*\** message for the selected candidate PSCell, and information enabling the MN to identify 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.

8. If the RRC connection reconfiguration procedure was successful, the MN informs the SN of the selected candidate PSCell via *SN Reconfiguration Complete* message, including the SN *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.

9. The UE synchronizes to the PSCell indicated in the *RRCReconfiguration\** message applied in step 7.

10. If PDCP termination point is changed for bearers using RLC AM, the SN Status Transfer takes place between the MN and the SN (Figure 10.20-3 depicts the case where a bearer context is transferred from the SN to the MN).

11. If applicable, data forwarding between MN and the SN takes place (Figure 10.20-3 depicts the case where a user plane resource configuration related context is transferred from the SN to the MN).

12. 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 13: 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.

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

NOTE 14: The steps 7-13 can be performed multiple times for the following execution of subsequent CPAC, using the subsequent CPAC configuration provided in step 4. In step 7, the UE starts evaluating the execution conditions for the following execution of subsequent CPAC, instead of the execution conditions for the initial execution of subsequent CPAC.

**SN initiated intra-SN subsequent CPAC without MN involvement (SRB3 is not used)**

The procedure follows the steps described in figure 10.3.2-5.

**SN initiated intra-SN subsequent CPAC without MN involvement (SRB3 is used)**

The procedure follows the steps described in figure 10.3.2-3a.

*End of Change*