3GPP TSG SA WG2#164 S2-240xxxx

Maastricht, 19-23 August 2024 (revision of)

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| *CR-Form-v12.2* | | | | | | | | |
| **CHANGE REQUEST** | | | | | | | | |
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|  | **23.501** | **CR** | **-** | **Rev** | **-** | **Current version:** | **19.0.0** |  |
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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 |  | Radio Access Network |  | Core Network | **X** |

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| ***Title:*** | Support of Slice change based on AF request. | | | | | | | | | |
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| ***Source to WG:*** | KDDI, Nokia?, ZTE? | | | | | | | | | |
| ***Source to TSG:*** | SA2 | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Work item code:*** | TEI-19 | | | | |  | ***Date:*** | | | 2024-08-08 |
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| ***Category:*** | **B** |  | | | | | ***Release:*** | | | Rel-19 |
|  | *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)* | |
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| ***Reason for change:*** | | This CR introduces text to enable to trigger a slice replacement within a set of subscribed network slices. Two options are introduced to enable a slice replacement to accommodate the variety of operators’ preferences. The solution is;   1. The AF can directly or be mediated by a NEF request the AMF to replace a certain network slice with another one within the UE subscription.   Or   1. If the S-NSSAI does not match the service parameters provisioned by the AF, the PCF for the UE subscribes the service parameters from the UDR and initiates an AM Policy Association Modification procedure to replace the S-NSSAI of the PDU Session with the S-NSSAI matching the UE policy information.   **Outcome from CC on 8th Aug 2024;**  It was discussed whether proposed solution options could be included in this TEI.  Option 1: AF -> (NEF->) UDM -> AMF  Option 2: AF -> (NEF->) UDR/UDM -> PCF -> AMF  This CR introduces text changes for option 2 in clause 5.15.19. | | | | | | | | |
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| ***Summary of change:*** | | Introduce the ability to trigger slice change by an AF for UEs supporting the Rel-18 Network slice replacement, by reusing this feature. | | | | | | | | |
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| ***Consequences if not approved:*** | | Lack of the support of AF-requested slice change in the 5GS | | | | | | | | |
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| ***Clauses affected:*** | | 5.15.19 | | | | | | | | |
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|  | | **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:*** | |  | | | | | | | | |
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| ***This CR's revision history:*** | |  | | | | | | | | |

*FIRST CHANGE*

### 5.15.19 Support of Network Slice Replacement

The Network Slice Replacement feature is used to temporarily replace an S-NSSAI with an Alternative S-NSSAI when an S-NSSAI becomes unavailable or congested in the 5GC or based on operator policy taking e.g. subscriber’s requirement and/or the third party’s requirement changes into account. The Network Slice Replacement may be triggered in the following cases:

- If the NSSF detects that an S-NSSAI becomes unavailable or congested (e.g. based on OAM or NWDAF analytics output), the NSSF sends network slice availability notification for the S-NSSAI to the AMF. The notification may include an Alternative S-NSSAI which can be used by the AMF to replace the S-NSSAI and congestion mitigation information if the S-NSSAI is congested. The NSSF notifies the AMF when the S-NSSAI is available again.

- If the PCF detects that an S-NSSAI becomes unavailable or congested for a UE (e.g. based on OAM or NWDAF analytics output), the PCF sends access and mobility related policy notification to the AMF. The notification may include an Alternative S-NSSAI which can be used by the AMF to replace the S-NSSAI. The PCF notifies the AMF when the S-NSSAI is available again for the UE.

- If an AF has requested a change that results into the PCF triggering a policy-based Network Slice Replacement the PCF the PCF sends access and mobility related policy notification to the AMF, including an Alternative S-NSSAI which can be used by the AMF to replace the S-NSSAI.

- The OAM sends notification to AMF when an S-NSSAI becomes unavailable or congested (and also when this S-NSSAI becomes available again) and provides the Alternative S-NSSAI to AMF and the OAM may provide congestion mitigation information if the S-NSSAI is congested.

Editor's Note: the rest of this clause is not updated but updates are expected to show the impact of a AF-requested Slice change on the feature (including which S-NSSAIs are considered for subscription data etc.) changes are also expected in 23.501 to show how a slice change triggered by the AF can result is slice change also for non supporting UEs.

The network slice associated with the Alternative S-NSSAI is assumed in this specification to have NS-AoS to be covering at least the NS-AoS of the replaced network slice. If the UE moves to a cell where the replaced S-NSSAI is not supported, but still within the NS-AoS of the Alternative S-NSSAI, the AMF removes the replaced S-NSSAI from the Allowed NSSAI (if the S-NSSAI was in the Allowed NSSAI) and from the Partially Allowed NSSAI (if the UE moves out of the RA also).

If the replaced S-NSSAI is subject to area restrictions, the AMF indicates to the SMF that the PDU Session is subject to area restrictions for the replaced S-NSSAI and the AMF and the SMF then apply the area restriction for the replaced S-NSSAI as described in clause 5.15.17 or clause 5.15.18 and the SMF additionally deactivates the PDU Session when the UE is OUT of AoI.

NOTE 1: It is recommended to use a network slice associated with the Alternative S-NSSAI that is able to support requirements for the services that the replaced network slice supports. It is further recommended in particular that the Alternative S-NSSAI supports at least the DNNs supported in the replaced S-NSSAI.

NOTE 2: The AMF can, by using the UE's presence in the AoI for the replaced S-NSSAI, prevent the UE from obtaining service in the Alternative network slice in cells outside the NS-AoS of the replaced network slice but within the NS-AoS of the Alternative network slice if the Alternative network slice NS-AoS exceeds the NS-AoS of the replaced network slice.

Based on the notification above from NSSF or PCF or OAM, the AMF may determine that an S-NSSAI is to be replaced with Alternative S-NSSAI. For roaming case, the AMF subscribes the network slice availability notification of the HPLMN S-NSSAI from the NSSF in VPLMN and the NSSF in VPLMN subscribes the notification from NSSF in the HPLMN as described in clause 5.15.6.

If the notification is from NSSF or OAM, and reason for the replacement is due to congestion, the notification includes additional congestion mitigation information. The details of the congestion mitigation information from NSSF and how the congestion mitigation information is used by the AMF is described in clause 5.2.16.3.3 of TS 23.502 [3].

NOTE 3: It is recommended that, the operator configures to use only one option, i.e. OAM, PCF or NSSF, for determining an Alternative S-NSSAI and triggering the Network Slice Replacement for S-NSSAI.

The AMF uses the Alternative S-NSSAI received in the notification from the NSSF, or from OAM or from the PCF. If the NSSF or PCF or OAM do not provide an Alternative S-NSSAI in the notification, the AMF uses an Alternative S-NSSAI based on local configuration. The Alternative S-NSSAI shall be supported in the UE Registration Area. If AMF cannot determine the Alternative S-NSSAI for the S-NSSAI, e.g. OAM or NSSF doesn't provide Alternative S-NSSAI and there is no Alternative S-NSSAI in the AMF local configuration, the AMF may further interact with the PCF to determine the Alternative S-NSSAI. The event trigger in AMF for interacting with PCF is described in clause 6.1.2.5 of TS 23.503 [45].

If the Alternative S-NSSAI is subject to NSSAA, the Alternative S-NSSAI shall only be used for UEs for which the Alternative S-NSSAI is included in the Subscribed S-NSSAIs. In this case, the AMF performs the NSSAA procedure for the Alternative S-NSSAI as described in clause 5.15.10 before the AMF triggers Network Slice Replacement as specified below.

The UE indicates the support of Network Slice Replacement feature during the UE Registration procedure. For supporting UE in CM-CONNECTED state and if there is a PDU Sessions in the UE context associated with the S-NSSAI that needs to be replaced over an Access Type, the AMF additionally provides the Alternative S-NSSAI for this S-NSSAI in the Allowed NSSAI over the same Access Type and in the Configured NSSAI, if not included yet, and the mapping between S-NSSAI(s) to Alternative S-NSSAI(s) to the UE in UE Configuration Update message as follows:

- for non-roaming UEs, the AMF provides the mapping of the S-NSSAI to the Alternative S-NSSAI to the UE.

NOTE 4: In the non-roaming case, the Alternative S-NSSAI does not have to be a Subscribed S-NSSAIs, as the replaced S-NSSAI is always a subscribed S-NSSAI.

- for roaming UEs when the VPLMN S-NSSAI has to be replaced by a VPLMN Alternative S-NSSAI, the AMF provides the mapping of the VPLMN S-NSSAI to the Alternative VPLMN S-NSSAI to the UE.

- for roaming UEs when the HPLMN S-NSSAI has to be replaced by an Alternative HPLMN S-NSSAI, the AMF provides the mapping of the HPLMN S-NSSAI to the Alternative HPLMN S-NSSAI to the UE.

NOTE 5: In the roaming cases, the Alternative HPLMN S-NSSAI does not have to be one of the Subscribed S-NSSAIs as the replaced HPLMN S-NSSAI is always part of the Subscribed S-NSSAIs.

The AMF provides the mapping of the S-NSSAI to the Alternative S-NSSAI over the access the AMF wants to trigger Network Slice Replacement. The UE stores the received mapping information together with the received Access Type and only uses it over that access.

Since Network Slice Replacement applies independent of Access Type, when the replacement occurs, the same Alternative S-NSSAI mapping to the replaced S-NSSAI is provided over the Access Types where the replaced S-NSSAI is in the Allowed NSSAI.

If the replaced S-NSSAI cannot be kept in the Allowed NSSAI or Partially Allowed NSSAI, the AMF additionally removes the Alternative S-NSSAI from the Allowed NSSAI or Partially Allowed NSSAI if the Alternative S-NSSAI is only used for Network Slice Replacement.

At mobility between AMFs, the source AMF provides, to the new AMF, the Alternative S-NSSAI and the mapping of the replaced S-NSSAI to the Alternative S-NSSAI in the UE context. When an S-NSSAI is subject to Network Slice Replacement, the new AMF compares the Requested NSSAI with the received UE context and updates the UE which misses the mapping of the replaced S-NSSAI to the Alternative S-NSSAI.

For the supporting UE when the UE has a NAS signalling connection, i.e. it is CM-CONNECTED or it has become CM-CONNECTED, e.g. through a Service Request procedure or through a UE registration procedure, if the AMF determines that the S-NSSAI is to be replaced and there is a PDU Session associated with the S-NSSAI in the UE context (see also NOTE 3), the AMF sends the mapping of the S-NSSAI to the Alternative S-NSSAI to the UE in the UE Configuration Update message or in the Registration Accept message.

NOTE 6: It is left to AMF local policy whether to send the mapping of the S-NSSAI to the Alternative S-NSSAI to the UE when there is no PDU session associated with the S-NSSAI or wait and send the mapping of the S-NSSAI to the Alternative S-NSSAI to the UE when the UE establishes a PDU Session associated with the S-NSSAI.

When the S-NSSAI is replaced by the Alternative S-NSSAI, the UE associates both of the replaced S-NSSAI and the Alternative S-NSSAI with the PDU session. The UE procedure for associating applications to PDU session based on URSP described in clause 6.6.2.3 of TS 23.503 [45] and establishing a PDU session described in clause 5.15.5.3 is based on the replaced S-NSSAI (not based on Alternative S-NSSAI).

During a new PDU Session establishment procedure for a S-NSSAI,

- if the UE has received together with the Allowed NSSAI a mapping of the S-NSSAI to an Alternative S-NSSAI, the UE shall provide both the Alternative S-NSSAI and the S-NSSAI in the PDU Session Establishment message. When the AMF receives the Alternative S-NSSAI and the S-NSSAI in the PDU Session Establishment message, the AMF uses SMF Selection Subscription data of the replaced S-NSSAI and selects a suitable SMF supporting Network Slice Replacement and the Alternative S-NSSAI and verifies the Alternative S-NSSAI and the S-NSSAI based on the UE context and includes both the Alternative S-NSSAI and the S-NSSAI to the SMF in Nsmf\_PDUSession\_CreateSMContext service operation.

- if the UE has not yet received with the Allowed NSSAI a mapping of the S-NSSAI to the Alternative S-NSSAI, the UE provides only the S-NSSAI in the PDU Session Establishment message. If the AMF determines that the requested S-NSSAI is to be replaced with the Alternative S-NSSAI and if the UE supports Network Slice Replacement, the AMF performs UE Configuration Update procedure to reconfigure the UE with the Alternative S-NSSAI. The AMF continues the PDU Session establishment procedure with the Alternative S-NSSAI and uses SMF Selection Subscription data of the replaced S-NSSAI and selects a suitable SMF supporting Network Slice Replacement and the Alternative S-NSSAI. The AMF provides both the Alternative S-NSSAI and the S-NSSAI to the SMF in Nsmf\_PDUSession\_CreateSMContext service operation.

The SMF proceeds with the PDU Session establishment using the Alternative S-NSSAI and the received DNN. The SMF retrieves subscription data by using the replaced S-NSSAI and the DNN. The SMF uses replaced S-NSSAI value when the SMF registers the PDU Session to the UDM. The SMF sends the Alternative S-NSSAI to NG-RAN in N2 SM information and to UE in PDU Session Establishment Accept message.

NOTE 7: It is assumed that the operator configures their network so that the Alternative S-NSSAI is selected to ensure that the selected SMF by using the Alternative S-NSSAI supports necessary capabilities according to the replaced S-NSSAI subscription data.

For existing PDU Session associated with an S-NSSAI that is replaced with the Alternative S-NSSAI, after the AMF sends mapping of the S-NSSAI to the Alternative S-NSSAI to the supporting UE in UE Configuration Update message, the AMF sends updates to the SMF of the PDU Session, e.g. triggering Nsmf\_PDUSession\_UpdateSMContext service operation, that the PDU Session is to be transferred to Alternative S-NSSAI and includes the Alternative S-NSSAI as follows (see details in clause 4.3.3 of TS 23.502 [3]):

- If the SMF determines that the PDU Session is to be retained (e.g. if the anchor UPF can be reused with the alternative S-NSSAI and SSC mode 1), the SMF sends the Alternative S-NSSAI to the UPF in the N4 message, to the NG-RAN in N2 message and to the supporting UE in PDU Session Modification Command message. The S-NSSAI provided to the (R)AN and to the UPF is the Alternative S-NSSAI.

- If the SMF determines that the PDU Session is to be re-established, the SMF sends the Alternative S-NSSAI to the supporting UE either in PDU Session Modification Command if the PDU Session is of SSC mode 3, or in PDU Session Release if the PDU Session is of SSC mode 2 or SSC mode 1, to trigger the re-establishment of the PDU Session. The UE includes both, the S-NSSAI and the Alternative S-NSSAI in the PDU Session Establishment message.

During registration procedure, the Requested NSSAI may include Alternative S-NSSAI(s) that are not subscribed S-NSSAI(s). In addition to the behaviour described in clause 5.15.5.2.1, the AMF verifies if S-NSSAI(s) in the Requested NSSAI are either subscribed S-NSSAI(s) or Alternative S-NSSAI(s) in UE context and based on the verification, the AMF determines whether to update the UE configuration.

When the AMF is notified that the S-NSSAI is available again (e.g. the congestion of the S-NSSAI has been mitigated), if the AMF has configured the supporting UE with the Alternative S-NSSAI, and the AMF determines for the UE in CM-CONNECTED state to use the replaced S-NSSAI again, the AMF reconfigures the supporting UE (e.g. by using UE Configuration Update procedure or in the next registration procedure) to use the replaced S-NSSAI again by removing the mapping of the replaced S-NSSAI to Alternative S-NSSAI and removing the Alternative S-NSSAI from the Allowed NSSAI if the Alternative S-NSSAI is only used for the Network Slice Replacement. The AMF also removes the Alternative S-NSSAI from the Configured NSSAI if the Alternative S-NSSAI is not one of the Subscribed S-NSSAIs and the Alternative S-NSSAI is not used in any Access Type. If the UE is in CM-IDLE, the AMF can wait until the UE in CM-CONNECTED state as described in clause 5.23. When the UE establishes a NAS signalling connection, e.g. through a Service Request procedure or through a UE registration procedure, the AMF reconfigures the UE.

If there is an existing PDU Session associated with the Alternative S-NSSAI for the S-NSSAI being available again or not congested anymore, the AMF updates the SMF(s) of the PDU Session(s), by Nsmf\_PDUSession\_UpdateSMContext service operation, causing the PDU Session to be transferred to the replaced S-NSSAI. The event trigger in SMF for interacting with PCF is described in clause 6.1.3.5 of TS 23.503 [45].

- If the SMF determines that the PDU Session is to be retained (e.g. if the anchor UPF can be reused with the replaced S-NSSAI and SSC mode 1), the SMF sends the replaced S-NSSAI i.e. does not include Alternative S-NSSAI to the UPF in the N4 message, to the NG-RAN in N2 message and to the supporting UE in PDU Session Modification Command message. The S-NSSAI provided to the (R)AN and to the UPF is the replaced S-NSSAI.

- If the SMF determines that the PDU Session is to be re-established, the SMF sends the replaced S-NSSAI (i.e. does not include Alternative S-NSSAI) to the supporting UE either in PDU Session Modification Command if the PDU Session is of SSC mode 3, or in PDU Session Release if the PDU Session is of SSC mode 2 or SSC mode 1, to trigger the re-establishment of the PDU Session. The UE includes the replaced S-NSSAI in the PDU Session Establishment message.

During a handover procedure, if an S-NSSAI has to be replaced with an Alternative S-NSSAI, the handover procedure (including any PDU session associated with the S-NSSAI to be replaced) shall continue unaffected by the Network Slice Replacement. Any Network Slice Replacement for the S-NSSAI shall not take place during the handover.

During NSSAA re-authentication procedure for an S-NSSAI, if the S-NSSAI has to be replaced with Alternative S-NSSAI, the AMF shall continue with the NSSAA procedure unaffected by the Network Slice Replacement and the AMF executes the Network Slice Replacement after the NSSAA procedure is completed.

If NSAC for maximum number of PDU sessions is configured for the replaced S-NSSAI and/or the Alternative S-NSSAI, the SMF performs NSAC by interacting with the NSACF of the replaced S-NSSAI and/or the NSACF of the Alternative S-NSSAI based on operator determined policies configured in the SMF (e.g. for the increase of Alternative S-NSSAI and the decrease of replaced S-NSSAI).

*End of CHANGES*