**3GPP TSG SA WG2 Meeting #146E *S2-2105744r03***

**Elbonia, August 16 – 27, 2021 *(Revision of S2-20xxxxx)***

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| *CR-Form-v12.0* | | | | | | | | |
| **CHANGE REQUEST** | | | | | | | | |
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|  | **23.502** | **CR** | **2970** | **rev** | **-** | **Current version:** | **17.1.0** |  |
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| *For* [***HE******LP***](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:*** | KI#1KI#2 – NSACF Service operation name update | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Source to WG:*** | ZTE | | | | | | | | | |
| ***Source to TSG:*** | SA2 | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Work item code:*** | eNS\_Ph2 | | | | |  | ***Date:*** | | | 2021-08-08 |
|  |  | | | |  | |  | | |  |
| ***Category:*** | **F** |  | | | | | ***Release:*** | | | Rel-17 |
|  | *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-12 (Release 12)* *Rel-13 (Release 13) Rel-14 (Release 14) Rel-15 (Release 15) Rel-16 (Release 16)* | |
|  |  | | | | | | | | | |
| ***Reason for change:*** | | CT4 sends LS(S2-2105257) to request the update on the NSACF service operation name. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Summary of change:*** | | The NSACF service name and service operations are updated per CT4 request | | | | | | | | |
|  | |  | | | | | | | | |
| ***Consequences if not approved:*** | | The NSACF service name is ambiguous. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Clauses affected:*** | | 5.2.21.1,5.2.21.2.1, 5.2.21.2.2, 5.2.21.2.3, 5.2.21.2.4, 4.2.11.2, 4.2.11.3, 4.2.11.4, 4.2.11.5.1 | | | | | | | | |
|  | |  | | | | | | | | |
|  | | **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:*** | |  | | | | | | | | |

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\* First change \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

### 5.2.21 Network Slice Admission Control Function (NSACF) services

#### 5.2.21.1 General

The following table illustrates the NSACF services.

Table 5.2.21.1-1: List of NSACF services

|  |  |  |  |
| --- | --- | --- | --- |
| Service Name | Service Operations | Operation Semantics | Example Consumer(s) |
| Nnsacf\_NSACl | NumOfUEsUpdate | Request/Response | AMF, |
|  | NumOfPDUsUpdate | SMF |
|  | EACNotify | AMF |
|  |  |  |  |
| Nnsacf\_SliceEventExposure | Subscribe | Subscribe/Notify | NEF |
|  | Unsubscribe |  | NEF |
|  | Notify |  | NEF |
| Nnsacf\_SliceStatus | Retrieval | Request/Response | NEF |

#### 5.2.21.2 Nnsacf\_NSAC services

##### 5.2.21.2.1 General

Service Description: The Nnsacf\_NSAC services control the number of UEs registered with a network slice and the number of PDU Sessions associated with a network slice for the network slices subject to NSAC. The AMF can request the NSACF to check whether the number of UEs registered with a network slice has reached the maximum number of UEs per network slice and the AMF can also request the NSACF to update the number of UEs registered with a network slice. The SMF can request the NSACF to check whether the number of PDU Sessions established on a network slice has reached the maximum number of PDU Sessions per network slice and the SMF can also request the NSACF to update the number of PDU Sessions established on a network slice

##### 5.2.21.2.2 Nnsacf\_NSAC\_NumOfUEsUpdate service operation

**Service Operation name:** Nnsacf\_NSAC\_NumOfUEsUpdate

**Description:** Updates the number of UEs registered with a network slice (e.g. increase or decrease) when the UE registration status for a network slice subject to NSAC has changed. Also, if the number of the UEs registered with the network slice is to be increased and the Early Availability Check (EAC) mode in the NSACF is activated for that network slice (see Nnsacf\_NSAC\_EACNotify service operation), the NSACF first checks whether the number of UEs registered with the network slice has reached the maximum number of UEs per network slice threshold. If the maximum number of UEs registered with the network slice has already been reached, the UE registration for that network slice is rejected. If the EAC is not activated, the NSACF increases or decreases the number of UEs per network slice as per the input parameters below.

**Inputs, Required:** S-NSSAI(s), UE ID (SUPI), access type, update flag.

The S-NSSAI(s) parameter is a list of one or more network slices for which the number of UEs registered with a network slice is to be updated and checked if the maximum number of UEs per network slice threshold has already been reached.

The UE ID is used by the NSACF to maintain a list of UE IDs registered with the network slice. The NSACF also takes access type into account for increasing and decreasing the number of UEs per network slice as described in clause 5.15.11.1 of TS 23.501 [2].

The update flag input parameter indicates whether the number of UEs registered with a network slice is to be:

- increased when the UE registers to a new network slice subject to NSAC. If the UE ID is already in the list of UEs registered with the network slice, the number of UEs registered with the network slice is not increased as the UE has already been counted as registered with the network slice. If the UE ID is not in the list of UE IDs registered with the network slice and the maximum number of UEs registered with the network slice has not been reached yet, the NSACF adds the UE ID in the list of UEs registered with the network slice and increases the number of the UEs registered with the network slice. If the UE\_ID is not in the list of UEs registered with that S-NSSAI and the maximum number of UEs per network slice for that S-NSSAI has already been reached, then the NSACF returns maximum number of UEs per network slice reached result;

- decreased when the UE deregisters for a network slice that is subject to NSAC. The NSACF decreases the number of the UEs registered with the network slice and removes the UE ID from the list of UEs registered with the network slice.

The NSACF may optionally return the current status of the network slice availability (e.g. a percentage out of the max number of UEs registered with a network slice) in the availability status parameter. This information may be used for NSACF signalling and load balancing in case multiple NSACFs are serving the same network slice.

Editor's note: It is FFS how to support in case multi NSACF is supported, e.g. discover the same NSACF, coordination of the local maximum number among NSACF.

**Outputs, Required:** maximum number of UEs per network slice reached, availability status.

##### 5.2.21.2.3 Nnsacf\_NSAC\_EACNotify service operation

**Service Operation name:** Nnsacf\_NSAC\_EACNotify

**Description:** The NSACF is configured with the information about which network slices are subject to NSAC. The NSACF may trigger notification to the AMF to indicate the activation of the Early Availability Check (EAC) mode for a certain network slice which is subject to NSAC when the number of the UEs registered with the network slice is above certain operator defined threshold (e.g. a percentage of the maximum number of UEs allowed to register with the network slice) and the deactivation of the EAC mode when the number of the UEs registered with the network slice is below certain operator defined threshold which may be same or different from the activation threshold.

**Inputs, Required:** S-NSSAI, EAC flag.

The S-NSSAI input parameter is the network slice for which the NSACF activates or deactivates the EAC mode.

The EAC flag input parameter indicates whether the Slice EAC mode is activated or deactivated.

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##### 5.2.21.2.4 Nnsacf\_NSAC\_NumOfPDUsUpdate service operation

**Service Operation name:** Nnsacf\_NSAC\_NumOfPDUsUpdate

**Description:** Updates the number of PDU Sessions established on a network slice (e.g. increase or decrease). Also, if the number of PDU Sessions on the network slice is to be increased, the NSACF first checks whether the number of the PDU Sessions on that network slice has reached the maximum number of PDU Sessions per network slice threshold. If the maximum number of PDU Sessions on the network slice has already been reached, the PDU Session Establishment procedure is rejected.

**Inputs, Required:** S-NSSAI, update flag.

The S-NSSAI parameter is the network slice for which the number of PDU Sessions established on a network slice is to be updated.

The update flag input parameter indicates whether the number of the PDU Sessions established on that network slice is to be increased, for example at PDU Session Establishment procedure or decreased, for example at PDU Session Release procedure.

**Outputs, Required:** maximum number of PDU Sessions per network slice reached, availability status

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\* Second change \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

### 4.2.11 Network Slice Admission Control Function (NSACF) procedures

#### 4.2.11.1 General

The Network Slice Admission Control Function procedures are performed for an S-NSSAI which is subject to Network Slice Admission Control (NSAC) as described in TS 23.501 [2]. If charging needs to be enabled, the NSACF may act as a NF (CTF) and interact with the CHF to support the Event based charging as defined in TS 32.290 [42].

#### 4.2.11.2 Number of UEs per network slice availability check and update procedure

The number of UEs per network slice availability check and update procedure is to update (i.e. increase or decrease) the number of UEs registered with a S-NSSAI which is subject to NSAC. The AMF is configured with the information indicating which network slice is subject to NSAC.



Figure 4.2.11.2-1: Number of UEs per network slice availability check and update procedure

1. If the AMF is not aware of which NSACF to communicate, the AMF performs NSACF discovery as described in clause 6.3.22 of TS 23.501 [2] and in clause 5.2.7.3.2. The AMF triggers the Number of UEs per network slice availability check and update procedure to update the number of UEs registered with a network slice when a network slice subject to NSAC is included in the Allowed NSSAI (i.e. the AMF requests to register the UE with the S-NSSAI) or removed from the Allowed NSSAI for a UE. The trigger event at the AMF also includes the change of Allowed NSSAI in case of inter-AMF mobility. The procedure is triggered in the following cases:

- At UE Registration procedure, according to clause 4.2.2.2.2 (including Registration types of Initial Registration or Mobility Registration Update in inter-AMF mobility in CM-CONNECTED or CM-IDLE state):

- before the Registration Accept in step 21 if the EAC mode is active; or

- after the Registration Accept message if the EAC mode is not active;

- At UE Deregistration procedure, as per clause 4.2.2.3, after the Deregistration procedure is completed;

- At UE Configuration Update procedure (which may result from NSSAA procedure or subscribed S-NSSAI change):

- before the UE Configuration Update message if the EAC mode is active; or

- after the UE Configuration Update message if the EAC mode is not active;

NOTE 1: Depending on the deployment, there may be different NSACF for different S-NSSAI subject to NSAC, and hence, during the registration, AMF triggers the Number of UEs per network slice availability check and update procedure to multiple NSACFs.

2. The AMF sends Nnsacf\_NSAC\_NumOfUEsUpdate\_Request message to the NSACF. The AMF includes in the message the UE ID, access type, the S-NSSAI(s) and the update flag which indicates whether the number of UEs registered with the S-NSSAI(s) is to be increased when the UE has gained registration to network slice(s) subject to NSAC or the number of UEs registered with the S-NSSAI(s) is to be decreased when the UE has deregistered from S-NSSAI(s) or could not renew its registration to an S-NSSAI subject to NSAC.

3. The NSACF updates the current number of UEs registered for the S-NSSAI, i.e. increases or decrease the number of UEs registered per network slice based on the information provided by the AMF in the update flag parameter.

If the update flag parameter from the AMF indicates increase, the following applies:

- If the UE ID is already in the list of UEs registered with the network slice, the current number of UEs is not increased as the UE has already been counted as registered with the network slice. The NSACF creates a new entry associated with this new update and shall also temporarily maintains the old entry associated with previous update. The NSACF removes the old entry upon reception of a request having update flag indicating decrease.

NOTE 2: The use case of having two entries temporarily in the NSACF for the same UE can happen during inter-AMF mobility when there is no UE context transfer and the UE requests to register with S-NSSAI(s) subject to NSAC already used in the old AMF. The old entry in the NSACF is removed by the old AMF.

- If the UE ID is not in the list of UE IDs registered with the network slice and the maximum number of UEs registered with the network slice has not been reached yet, the NSACF adds the UE ID in the list of UEs registered with the network slice and increases the current number of the UEs registered with the network slice. If the UE ID is not in the list of UEs registered with that S-NSSAI and the maximum number of UEs for that S-NSSAI has already been reached, then the NSACF returns a result parameter indicating that the maximum number of UEs registered with the network slice has been reached.

If the update flag parameter from the AMF indicates decrease and if there is only one entry associated with the UE ID, the NSACF removes the UE ID from the list of UEs registered with the network slice for each of the S-NSSAI(s) indicated in the request from the AMF and also the NSACF decreases the number of UEs per network slice that is maintained by the NSACF for each of these network slices. If there are two entries associated with the UE ID, the NSACF removes the old entry and keeps the new entry.

The NSACF takes access type into account for increasing and decreasing the number of UEs per network slice as described in clause 5.15.11.1 of TS 23.501 [2].

4. The NSACF returns the Nnsacf\_NSAC\_NumOfUEsUpdateResponse in which the NSACF includes the S-NSSAI(s) for which the maximum number of UEs per network slice has already been reached along with a result parameter indicating that the maximum number of UEs registered with the network slice has been reached.

At UE Registration procedure, if only some of the S-NSSAIs reached the maximum number of UEs per S-NSSAI, the AMF sends a Registration Accept message to the UE in which the AMF includes the rejected S-NSSAI(s) in the rejected NSSAI list for which the NSACF has indicated that the maximum number of UEs per network slice has been reached, and for each rejected S-NSSAI the AMF includes a reject cause set to 'maximum number of UEs per network slice reached' and optionally a back-off timer.

When for all the Requested S-NSSAI(s) provided in step 2 the NSACF returned the maximum number of UEs per network slice has been reached and if one or more subscribed S-NSSAIs are marked as default in the subscription data and not subject to Network Slice Admission Control, the AMF can decide to include these Default Subscribed S-NSSAIs in the Allowed NSSAI. Otherwise, the AMF rejects the UE request for registration. In the Registration Reject message the AMF includes the rejected S-NSSAI(s) in the rejected NSSAI parameter, and for each rejected S-NSSAI the AMF includes a reject cause to indicate that the maximum number of UEs per network slice has been reached and optionally a back-off timer.

NOTE 3: If the use case requires the UE to remain reachable at all times with at least one slice, it is recommended that at least one of the Subscribed S-NSSAIs is marked as the default S-NSSAI which is not subject to Network Slice Admission Control. This will ensure the UE is able to access to services even when maximum number of UEs per network slice has been reached.

Editor's note: It is FFS whether and how to restrict the signalling sent from the AMFs to the NSACF in case the maximum number of UEs has been reached for prolonged time.

#### 4.2.11.3 Configuration for Early Admission Control (EAC) update procedure

The configuration for Early Admission Control (EAC) update procedure indicates to the AMF the activation or the deactivation of the EAC mode for the S-NSSAI subject to NSAC. EAC mode means that the AMF is required to perform the number of UEs per network slice availability check and update procedure before the S-NSSAI subject to NSAC is included in the Allowed NSSAI and sent to the UE.

Editor's note: It is FFS if an O&M procedure can be used to configure EAC procedure as opposed to the SUBSCRIBE/NOTIFY method.



Figure 4.2.11.3-1: Early Admission Control (EAC) update procedure

1) The number of UEs registered with a network slice subject to NSAC crosses a certain operator defined threshold. The NSACF determines whether to activate or deactivate the EAC mode.

2) The NSACF triggers Nnsacf\_NSAC\_EACNotify operation including the S-NSSAI for which the EAC mode is to be activated or deactivated and a EAC flag set to activated if the number of UEs registered with the network slice is above certain threshold or set to deactivated if the number of the UEs registered with the network slice is below certain threshold.

Editor's note: It is FFS how to trigger the notification without subscription. Also how to determine which AMF is to be notified need be clarified.

3) The AMF uses the EAC flag to decide when to trigger the number of UEs per network slice availability check and update procedure so that delays to the registration procedure and impact to the already allowed network slices are avoided.

If the EAC flag indicates EAC mode activated, the AMF triggers the number of UEs per network slice availability check and update procedure before the Registration Accept step of the registration procedure or before the UE Configuration Update message as in EAC activated mode the NSACF is to check whether the maximum number of UEs per network slice is reached which may impact the allowed S-NSSAI(s) confirmed by the Registration Accept message and the UE Configuration Update message.

If the EAC flag indicates EAC mode deactivated, the AMF triggers the number of UEs per network slice availability check and update procedure after Registration Accept step of the registration procedure or after the UE Configuration Update message as in EAC deactivated mode the NSACF does not check whether the maximum number of UEs per network slice is reached, i.e. no impact is expected to the allowed S-NSSAI(s) confirmed by the Registration Accept message and the UE Configuration Update message.

#### 4.2.11.4 Number of PDU Sessions per network slice availability check and update procedure

The number of PDU Sessions per network slice availability check and update procedure is to update (i.e. increase or decrease) the number of PDU Sessions established on S-NSSAI which is subject to NSAC. The SMF is configured with the information indicating which network slice is subject to NSAC.



Figure 4.2.11.4-1: Number of PDU Sessions per network slice availability check and update procedure

1. The SMF triggers the Number of PDU Sessions per network slice availability check and update procedure for the network slices that are subject to NSAC at the beginning of a PDU Session Establishment procedure (clause 4.3.2.2.1 and clause 4.3.2.2.2) and as a last step of successful PDU Session Release procedure (clause 4.3.4.2 and clause 4.3.4.3).

2. The SMF sends Nnsacf\_NSAC\_NumOfPDUsUpdate\_Request message to the NSACF. The SMF includes in the message the S-NSSAI for which the number of PDU Sessions per network slice update is required and the update flag which indicates that the number of PDUs established on the S-NSSAI is to be increased if the procedure is triggered at the beginning of PDU Session Establishment procedure or indicates that the number of PDU Sessions on the S-NSSAI is to be decreased if the procedure is triggered at the end of PDU Sessions Release procedure.

3. The NSACF updates the current number of PDU Sessions established on the S-NSSAI, i.e. increase or decrease the number of PDU Sessions per network slice based on the information provided by the SMF in the update flag parameter.

If the update flag parameter from the SMF indicates increase the current number of PDU Sessions per network slice and the maximum number of PDU Sessions established on the network slice has not been reached yet, the NSACF increases the number of PDU Sessions for that network slice. If the maximum number of PDU Sessions established on the network slice has already been reached, then the NSACF returns a result parameter indicating that the maximum number of PDU Sessions per network slice has been reached.

If the update flag parameter from the SMF indicates decrease the current number of PDU Sessions per network slice, the NSACF decreases the number of PDU Sessions for that network slice.

4. The NSACF acknowledges the update to the SMF with Nnsacf\_NSAC\_NumOfPDUsUpdateResponse message. If the NSACF returned maximum number of PDU Sessions per network slice reached result, the SMF rejects the PDU Session establishment request with maximum number of PDU Sessions per network slice reached reject cause.

In the case of a PDU Session Establishment failure, the SMF triggers another request to the NSACF with the update flag parameter equal to decrease in order to re-adjust back the PDU Session counter in the NSACF.

Editor's note: It is FFS how to achieve high admission control accuracy.

Editor's note: Whether SMF or AMF interacts with the NSACF is FFS.

#### 4.2.11.5 Network Slice Admission Control Support for Roaming

##### 4.2.11.5.1 NSACF Support for Roaming by VPLMN

For network slice admission control of roaming UEs, a maximum number of allowed UEs per mapped S-NSSAI in HPLMN and/or a maximum number of allowed PDU Sessions in LBO mode per mapped S-NSSAI in HPLMN is allocated to the VPLMN for each S-NSSAI in HPLMN and stored in one NSCAF in the VPLMN responsible for network slice admission control for the S-NSSAI in the HPLMN, subject to NSAC.

Editor's note: Whether it is required to interact V-NSACF and H-NSACF for the NSAC of roaming UEs managed by the HPLMN for 'maximum number of UEs per network slice' is FFS.

The maximum number of UEs registered with a network slice monitoring and enforcement is done in the VPLMN by the NSACF in the VPLMN as per the description in Figure 4.2.11.2-1 with the following differences:

- Step 2, in the Nnsacf\_NSAC\_NumOfUEsUpdateRequest service operation the AMF provides both the S-NSSAI in VPLMN, and the corresponding mapped S-NSSAI in HPLMN to the NSACF in the VPLMN.

- Step 3, the NSACF in the VPLMN performs NSAC for both the S-NSSAI in VPLMN and the corresponding mapped S-NSSAI in HPLMN based on the SLA between VPLMN and HPLMN.

For LBO, enforcement of the maximum number of PDU Sessions established for an S-NSSAI is performed in the VPLMN by the NSACF in the VPLMN as per the description in Figure 4.2.11.4-1 with the following differences:

- Step 2, in the Nnsacf\_NSAC\_NumOfPDUsUpdateRequest service operation the V-SMF provides both the S-NSSAI in VPLMN, and the corresponding mapped S-NSSAI in HPLMN to the NSACF in the VPLMN.

- Step 3, the NSACF in the VPLMN performs NSAC for both the S-NSSAI in VPLMN and the corresponding mapped S-NSSAI in HPLMN based on the SLA between VPLMN and HPLMN.

##### 4.2.11.5.2 NSACF Support for Roaming by HPLMN

For PDU sessions in the home-routed roaming case, the SMF in HPLMN performs network slice admission control for the S-NSSAI(s) subject to NSAC.

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\* End of changes \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*