**SA WG2 Meeting #S2-142E S2-2008741r02**

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**Source: China Mobile, China Unicom, NTT DOCOMO, Huawei, ZTE, CATT, NEC**

**Title: Conclusion for key 1 and key 2 of new NF**

**Document for: Approval**

**Agenda Item: 8.4**

**Work Item / Release: FS\_eNS\_Ph2/ Rel-17**

*Abstract: c*

# 1. Introduction



In conclusion, it is preferred to introduce a new NF todo quota management of key issue 1&2 in normative work.

# 2. Text Proposal

It is proposed to capture the following changes in TR 23.700-40.

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

7.1 Evaluation on solutions of KI#1

From all 10 solutions proposed for KI#1 (Solution #1, #2, #3, #4, #8, #9, #15, #18, #19, #38), some may have a complete solution and some not. But overall, we can summarize that there are three main functionalities for supporting quota management on the maximum number of UEs as described below.

- **NW Slice quota information storage functionality:** This functionality is responsible for storing a NW Slice quota information, which includes one or more of the following information:

- The maximum number of UEs for the S-NSSAI.

- **NW Slice quota management functionality:** This functionality is responsible for managing and updating NW Slice quotas of the maximum number of UEs in a S-NSSAI, which includes one or more of the following functionalities:

- Monitoring for counting, collecting and updating the number of UEs that have been registered for a S-NSSAI that is subject to the network slice quota management.

- **NW Slice quota enforcement functionality:** This functionality is responsible for enforcing a network slice SLA, which includes one or more of the following functionalities:

- Accept or reject the UE registration request in a S-NSSAI by taking the network slice quota and the current monitored number of the registered UEs into account.

- In case of rejection, the function may provide a rejection cause and a back-off timer.

Centralized Quota check vs Distributed Quota Check: In a centralized quota check, the NW Slice quota enforcement functionality checks every new UE registration against the quota at one centralized quota enforcement point. In a distributed quota check, the quota that is a subset of S-NSSAI quota is distributed to one or more NW Slice quota enforcement functionalities and where every new UE registration is checked against the quota of one or more distributed quota enforcement points. For each distributed quota enforcement points, when the distributed quota are consumed then the NW Slice quota enforcement functionality checks against the quota of NW Slice quota management functionality for additional instructions.

Editor's note: It is FFS whether the NW Slice quota enforcement functionality is distributed or centralized.

Table 7.1-1 illustrates 5GS system impacts for all solutions proposed for the KI#1. Moreover, it also compares where to place the afore-mentioned network slice quota functionalities in the 5G system.

**Table 7.1-1: Key impacts of the solutions**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **UE** | **RAN** | **5GC CN Impact** | | | | | | **Notes** |
|  | **Impact** | **Impact** | **Existing NF (Note 8)** | | | **New NF or new service operation in existing NF** | | |  |
|  |  |  | **NW Slice Quota Storage** | **NW Slice Quota management** | **NW Slice Quota Enforce** | **NW Slice Quota Storage** | **NW Slice Quota Managment** | **NW Slice Quota Enforce** |  |
| **Sol#1** | Yes | No | UDR,  PCF | PCF | PCF  AMF(back-off timer handling) | - | - | - | (Note 1) (Note 5) |
| **Sol#2** | Yes | No | - | - | AMF | NSQ | | NSQ | (Note 1) (Note 5)  (Note 7) |
| **Sol#3** | Yes | No | NSSF | NSSF | NSSF,  AMF | - | - | - | (Note 1) (Note 5) |
| **Sol#4** | Yes | No | NWDAF | | AMF, PCF (roaming case) | - | - | - | (Note 1) (Note 5) |
| **Sol#8** | Yes | No | O&M,  AMF | O&M,  AMF | OAM  AMF | - | - | - | (Note 1) (Note 2) (Note 5) |
| **Sol#9** | Yes | No | UDM,  NWDAF | NWDAF, CHF | AMF | - | - | - | (Note 1) (Note 5) |
| **Sol#15** | Yes | No | - | - | AMF | - | - | - | (Note 3) |
| **Sol#18** | No | No | SQM(NSSF for global)  AMF for local- | AMF  NSSF | AMF | - | | - | (Note 4) (Note 5)  (Note 7) |
| **Sol#19** | No | No | NWDAF | | - | QCF | | QCF  QEF | (Note 4) (Note 6)  (Note 7) |
| **Sol#38** | No | No | CHF | CHF | AMF,  CHF | - | - | - | (Note 5)  (Note 9) |
| NOTE 1: Solution requires a UE to support a (new/existing) rejection cause and a (new/existing) back-off timer due to the network slice quota has been reached.  NOTE 2: Solution has an impact on O&M to support either a network slice quota monitoring and/or a network slice quota distribution (if any). Multi-vendor case is unclear on how it works.  NOTE 3: Solution only addresses the aspect of back-off timer to be sent to the UE for network slice quota enforcement.  NOTE 4: Solution does not describe whether the UE should be aware of a rejection cause due to a network slice quota has been reached.  NOTE 5: Solution requires a change in both the H-PLMN and the V-PLMN to support a network slice quota monitoring and a network slice quota enforcement.  NOTE 6: No descriptions of roaming aspect  NOTE 7: Although the solution proposes a new NF, this new NF could also be deployed together with an existing NF. In such case, no new NF is needed.  NOTE 8: Even when the existing NF is reused, the new NF service may need to be introduced.  NOTE 9: Solution requires a AMF to support a (new/existing) rejection cause due to the network slice quota has been reached. | | | | | | | | | |

From Table 7.1-1 above, one can derive a commonality among those solutions as following:

- No solutions require changes in RAN.

- All solutions propose to store an information related to the network slice quota information in the CN and the UE is not aware of it.

- All solutions propose to monitor the number of UEs accessing a network slice in the CN and to enforce the quota in the CN. Difference among those solutions are a) where to store the network slice quota information, b) where to place the network slice quota management and the network slice quota enforcement. There are two main approaches, one is to put them into an existing 5GC network function or introducing a new network function/new service operation to be deployed in the existing 5GC network function.

- Almost all solutions imply some form of interaction by the AMF with another function which performs the counting.

Furthermore, there are some other aspects that we could also draw some remarks, for example,

- Rejection cause + Back-off timer: When a network slice quota in terms of number of UEs is overflown, a CN NF sends a rejection to the UE requesting for a S-NSSAI. To suppress further signalling load for a subsequent request for the same S-NSSAI, the CN NF may provide a back-off timer to the UE. The CN NF responsible for sending a rejection for the requested S-NSSAI and optionally the back-off timer for the rejected S-NSSAI is the AMF. It is up to the Stage-3 to determine whether a new rejection cause and a back-off timer or an existing rejection cause and a back-off timer should be used.

7.2 Evaluation on solutions of KI#2

From all 13 solutions proposed for KI#2 (Solution #5, #6, #7, #8, #9, #10, #11, #18, #19, #32, #35, #36, #38), some may have a complete solution and some not. It is noted that Sol#35 describes a solution for KI#2 on a different aspect, i.e. considering a service type associated with the PDU Session to be established and use it for differentiation of service(s) and even for prioritization of granting a PDU Session when the status of slice is close to the quota limitation. Since Sol#35 could be put on top of any other solutions, Sol#35 is then not listed for comparison below.

Looking at all these solutions for KI#2, we can summarize that there are three main functionalities for supporting quota management on the maximum number of PDU Sessions as described below.

- **NW Slice quota information storage functionality:** This functionality is responsible for storing a NW Slice quota information, which includes one or more of the following information:

- The maximum number of PDU Sessions for the S-NSSAI.

- **NW Slice quota management functionality:** This functionality is responsible for managing and updating NW Slice quotas of the maximum number of PDU Sessions in a S-NSSAI, which includes one or more of the following functionalities:

- Monitoring for counting, collecting and updating the number of PDU Sessions that have been established in a S-NSSAI that is subject to the network slice quota management.

- **NW Slice quota enforcement functionality:** This functionality is responsible for enforcing a network slice SLA, which consists one or more of the following functionalities:

- Accept or reject the PDU Session Establishment Request for the S-NSSAI by taking into account the network slice quota and the current monitored number of established PDU sessions.

- In case of rejection, the function may provide a rejection cause and a back-off timer.

Centralized Quota check vs Distributed Quota Check: In a centralized quota check, the NW Slice quota enforcement functionality checks every new PDU Session request against the global S-NSSAI quota at one centralized quota enforcement point. In a distributed quota check, the local quota that is a subset of global S-NSSAI quota is distributed to one or more NW Slice quota enforcement functionalities and where every new PDU Session request is checked against local quota of one or more distributed quota enforcement points. Only when the Local quota is reached then the NW Slice quota enforcement functionality checks against the global quota for additional instructions.

Editor's note: It is FFS whether the NW Slice quota enforcement functionality is distributed or centralized.

Table 7.2-1 below shows an overview of key impacts of all solutions and in particular where the above functions are placed in the 5G system.

**Table 7.2-1: Key impacts of the solutions**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **UE** | **RAN** | **5GC CN Impact** | | | | | | **Notes** |
|  | **Impact** | **Impact** | **Existing NF (Note 8)** | | | **New NF or new service operation in existing NF** | | |  |
|  |  |  | **Information Storage** | **Quota Management** | **Quota Enforce** | **Information Storage** | **Quota Management** | **Quota Enforce** |  |
| **Sol#5** | Yes | No | NWDAF | | SMF, PCF (roaming case) | - | - | - | (Note 1) (Note 5) |
| **Sol#6** | Yes | No | UDR,  PCF | PCF | PCF, SMF | - | - | - | (Note 1) (Note 5) |
| **Sol#7** | Yes | No | UDR, PCF | PCF | PCF, SMF(back-off timer handling) | - | - | - | (Note 1) (Note 5) |
| **Sol#8** | Yes | No | O&M, AMF | O&M, AMF | O&M  AMF | - | - | - | (Note 1) (Note 2) (Note 5) |
| **Sol#9** | Yes | No | UDM,  NWDAF | NWDAF, CHF | AMF | - | - | - | (Note 1) (Note 5) |
| **Sol#10** | Yes | No | - | - | SMF | NSQ | | - | (Note 1) (Note 5)  (Note 7) |
| **Sol#11** | Yes | No | NRF | NRF | AMF | - | - | - | (Note 1) (Note 5) |
| **Sol#18** | No | No | SQM(NSSF), AMF- | SQM(NSSF), AMF-- | AMF |  | | - | (Note 4) (Note 5)  (Note 7) |
| **Sol#19** | No | No | NWDAF | | - | QCF | | QCF  QEF | (Note 4) (Note 6)  (Note 7) |
| **Sol#32** | No | No | SMF | NF | | NF | | | (Note 4)  (Note 6) |
| **Sol#38** | No |  | CHF | CHF | SMF, CHF | - | - | - | (Note 5)  (Note 9) |
| NOTE 1: Solution requires a UE to support a (new/existing) rejection cause and a (new/existing) back-off timer due to the network slice quota has been reached.  NOTE 2: Solution has an impact on O&M to support either a network slice quota monitoring and/or a network slice quota distribution  NOTE 3: Solution only addresses the aspect of back-off timer to be sent to the UE for network slice quota enforcement.  NOTE 4: Solution does not describe whether the UE should be aware of a rejection cause due to a network slice quota has been reached.  NOTE 5: Solution requires a change in both the H-PLMN and the V-PLMN to support a network slice quota management and a network slice quota enforcement.  NOTE 6: No descriptions of roaming aspect.  NOTE 7: Although the solution proposes a new NF, this new NF could be deployed together with existing NF. In such case, no new NF is needed.  NOTE 8: Even when the existing NF is reused, the new NF service may need to be introduced.  NOTE 9: Solution requires a SMF to support a (new/existing) rejection cause due to the network slice quota has been reached. | | | | | | | | | |

From Table 7.2-1 above, one can derive a commonality among those solutions as following:

- No solutions require changes in RAN.

- All solutions propose to store an information related to the network slice quota information in the CN and the UE is not aware of it.

- All solutions propose to monitor the number of PDU Sessions associated with a network slice in the CN and to enforce the quota in the CN. Difference among those solutions are a) where to store the network slice quota information, b) where to place the network slice quota management and the network slice quota enforcement. There are two main approaches, one is to put them into an existing 5GC network function or introducing a new network function/new service operation to be deployed in the existing 5GC network function.

- Almost all solutions imply some form of interaction of the SMF or AMF with another function which performs the counting.

Furthermore, there are some other aspects that we could also draw some remarks, for example,

- Rejection cause / Back-off timer: When a network slice quota in terms of number of PDU Sessions is reached, and a CN NF sends a rejection to the UE's PDU Session Establishment Request for the network slice. To suppress further signalling load for a subsequent request of the network slice, the CN NF may provide a back-off timer to the UE. It is up to the Stage-3 to determine whether a new rejection cause and a back-off timer or an existing rejection cause and a back-off timer should be used.

\* \* \* \* Second of changes \* \* \* \*

8.1 Interim conclusion for Key Issue #1

To enable a 5GS to support network slice related quota on the maximum number of UEs, no change is required in the RAN. The following new functionalities in the 5GS are needed:

- Storing of network slice related quota information: If a network slice is subject to a network slice quota checking on a maximum number of UEs, it is assumed that the O&M should have for this network slice a) the information of the quota of maximum number of UEs. To enable the network slice related quota enforcement, this information is configured and stored to one or more network functions in 5GC.

- Managing and updating the network slice related quota on maximum number of UEs registered for the network slice: This functionality is part of the 5GC and it manages the NW Slice quota of maximum number of UEs in a S-NSSAI, monitors the current number of UEs being registered for the network slice subject to a network slice quota checking.

- Enforcing the network slice related quota on the maximum number of UEs: This functionality is part of the 5GC and it controls the registration request on the S-NSSAI subject to the quota management by accepting or rejecting the request on the S-NSSAI. In case of rejection, the function may provide a rejection cause and optionally with a back-off timer.

- An new NF is defined to support the storing of network slice related quota information and managing and updating the network slice related quota. The new NF can be deployed as standalone or co-located with other NF e.g. NSSF, PCF.

NOTE: Whether to use an existing rejection cause and a back-off timer or a new rejection cause and a back-off timer, this is to be determined in Stage-3.

8.2 Interim conclusion for Key Issue#2

To enable a 5GS to support network slice related quota on the maximum number of PDU Sessions, the following new functionalities in the 5GS are needed:

- Storing of network slice related quota information: If a network slice is subject to a network slice quota management on a maximum number of PDU Sessions, it is assumed that the O&M should have for this network slice a) the information of the quota of maximum number of PDU Sessions. To enable the network slice related quota enforcement, this information is configured and stored to one or more network functions in 5GC.

- Managing and updating the network slice related quota on maximum number of PDU Sessions established in a S-NSSAI: This functionality is part of the 5GC and it manages the NW Slice quota of maximum number of PDU Sessions in a S-NSSAI, and updates the current number of PDU Sessions successfully established in the network slice subject to a network slice quota checking on a maximum number of PDU Sessions.

- Enforcing the network slice related quota on the maximum number of PDU Sessions: This functionality is part of the 5GC and it controls the establishment of PDU session of a S-NSSAI subject to the quota management by accepting or rejecting the request. In case of rejection, the function may provide a rejection cause and optionally with a back-off timer.

NOTE: Whether to use an existing rejection cause and back-off timer or a new rejection cause and back-off timer, this is to be determined in Stage-3.

- An new NF is defined to support the storing of network slice related quota information and managing and updating the network slice related quota. The new NF can be deployed as standalone or co-located with other NF e.g. NSSF, PCF.

- Both centralized and distributed quota enforcement shall be supported.

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