**3GPP TSG-WG SA2 Meeting #143E e-meeting  *S2-210xxxx***

Elbonia, 24 Feb – 09 Mar, 2021 (revision of S2-210xxxx)

**Source: Lenovo, Motorola Mobility**

**Title: Principles of operation of Network Slice Quota Access Control (NSQAC)**

**Document for: Discussion and agreement**

**Agenda Item: 8.4.2**

**Work Item / Release: eNS\_ph2 / Rel-17**

*Abstract: Further conclusions are needed about the principles of operation of the new NF (e.g. NSQAC) to support network slice access control.*

# 1. Introduction

The study on eNS\_Ph2 (see TR 23.700-40) conclude the following:

"*A new NF is defined to support the storing of network slice information (i.e., the maximum number of UEs allowed to be served by a network slice), and managing, updating and enforcing the network slice information for the purpose of network slice access control*…"

For the purpose of this document, the new Network Function is called Network Slice Quota Access Control (NSQAC).

There are several solutions in the TR 23.700-400 describing to specify a new NF which to control and manage the access control for a Network Slice based on the quota of UEs or PDU Sessions using the Network Slice:

* Solution 2 (proposing NSQ): the slice quota is preconfigured in the NSQ by the OAM system. The AMF request the NSQ for the slice availability during each Registration procedure. The NSQ maintains a list of UE Ids that are registered with that network slice. The NSQ accepts or rejects new registrations.
* Solution 18 (proposing SQM): the slice quota can be preconfigured by OAM, or can be provisioned by the AF. The SQM allocates a local quota (which is part of a global quota) for each AMF. The AMF starts rejecting the new UEs based on the local quota and the AMF notifies the SQM that the local quota reached.
* Solution 19 (proposing QCF): the slice quota is preconfigured in the QCF by the OAM system. The QCF maintains a global quota and assigns a local quota to Quota Enforcement Function (QEF, which can be co-located in AMF, SMF, etc.).

This contribution attempts to discuss and propose some principles for the NSQAC functionality.

# 2. Discussion

The following principles/aspects are discussed in this paper.

## 2.1 NSQAC configuration

From the solutions documented in the TR 23.700-400 and considering further options, the NSQAC can be made aware about the slice quota via the one of the following options:. This seems a logical option. It should be analysed whether further options need to be specified:

1. pre-configured by the OAM system: this is proposed by all solutions documented in TR 23.700-400.
2. The AF can configure or update the slice quota (documented in Solution 18).
3. The CHF can configure or update the slice quota.

Having into consideration that the GST parameters are sent and processed in the OAM system, it seems natural that the OAM system configures the NSQAC.

The question is whether further options should be specified. Configuring the NSQAC from the AF may result in conflict between the slice quota stored in the OAM system and the slice quota sent from the AF. Therefore it is propose to not standardize this option. As the CHF would be involved in the network slice charging, it may be considered as a valid option that the CHF may configure the slice quota in the NSQAC. There can be a differentiation between the quotas configured by the CHF (i.e. charging quotas) and the quotas configured by the OAM system (i.e. access control quotas).

**Proposal 1: It is proposed to specify the principles in 1) and 3) above, i.e. the NSQAC aware about the slice quota via pre-configuration by the OAM system or via configuration from the CHF.**

## 2.2 NSQAC and AMF/SMF discovery

Another aspect to be discussed is how the NSQAC and the enforcement NFs (e.g. AMF) discover each other and initiate the communication. There are several options:

1. As per Solution 2 and 18, the AMF initiates the check with the NSQAC when the very first UE performs Registration procedure and wants to register with the S-NSSAI.
2. Upon instantiation of the AMF, the AMF is configured that the A-NSSAI is a subject of slice quota restrictions, so the AMF initiates NSQAC discovery using NRF.
3. Upon instantiation/configuration of the NSQAC to control the slice quota of an S-NSSAI, the NSQAC starts the discovery of all AMFs which serve the S-NSSAI. Also, the NSQAC can use existing NRF services, e.g. to subscribe for notifications if a new AMF starts serving the S-NSSAI.

In the option 1), it is not clear what happens if all UE registered with the S-NSSAI deregister from this S-NSSAI, i.e. shall the AMF request the NSQAC to delete this AMF from its list. In order to avoid such per-UE level Network function discovery, it is proposed to agree on option 3). Also, option 3) relies on existing NRF services.

**Proposal 2: It is proposed to specify the principle in 3), i.e. the NSQAC initiates the discovery of all NFs of certain type (e.g. AMFs) which serve the S-NSSAI.**

## 2.3 Services offered by the NSQAC

One important aspect, which has not been concluded in the study phase, is which services are offered by the NSQAC.

There are 2 main functionalities to be performed by the NSQAC: A) to collect information about the current status of the network slice controlled parameter (e.g. registered UEs or established PDU Sessions) and B) to initiate or terminate the network slice access control when the slice quota is reached.

* For collecting to collect information about the current status of the network slice controlled parameter, it is generally considered that subscribe/notify service is more efficient. As described in Solution 19, the NSQAC may assign a local reporting quota to quota to the AMF. The AMF will report the number of UEs when the local quota is reached. The NSQAC can adjust the reporting local quotas assigned to all reporting AMFs, i.e. some AMFs having higher-load may receive a higher reporting quota, whereas other under-loaded AMFs may receive lower quota. There are known mechanism to control the granularity of reporting, which can be re-used.
* For the network slice access control enforcement, the NSQAC may user the Notification operation to initiate or terminate the enforcing NFs (e.g. AMF) to apply rejections of new entrants (e.g. new UEs or new PDU Sessions).

The Fig. 1 shows a high-level signalling flow of the services offered by the NSQAC.

The Fig. 1 shows also a distributed deployment for NSQAC, i.e. by introducing the vNSQAC. The vNSQAC can be deployed in the same PLMN or in other PLMNs (e.g. in roaming case).

Editor's Note: The details for the vNSQAC and the interaction with the NSQAC are FFS.



Figure 1: call flows for distributed slice access control

We think that the following steps can be specified:

1. The NSQAC is configured by the OAM with some of the following parameters:

* the S-NSSAIs which are subject of quota management
* which S-NSSAI parameters to are controlled.
* The quota of the S-NSSAI parameter.

2. The NSQAC discovers the enforcing NF (e.g. AMFs) which server the S-NSSAI. The NSQAC can also subscribe with the NRF to be informed if new AMFs are instantiated.

3. The NSQAC collects the current status of controlled slice attributes.

For example, the service operation can be: Namf\_EventExposure\_Subscribe request (sliceID=S-NSSAI-1, Attribute=[UE/PDU Session], EventID=ReportingQuota).

Note that the AMF already may implement an EventExposure service to expose the number of UEs registered in the AMF. The only difference is that here, the UEs registered to an S-NSSAI are monitored in the AMF.

4. The enforcing NFs (AMF/SMF) or vNSQAC subscribe with NSQAC to be informed when the quota is reached.

For example, the service operation can be: Nnsqac\_EventExposure\_Subscribe request (SliceID=S-NSSAI-1, EventID=SliceQuotaReached, AttributeID)

5. The NSQAC notifies the AMF/SMF or vNSQAC if the subscribed event (e.g. the slice quota is reached) has occurred.

When the current status of the monitored parameter falls bellow the quota, the NSQAC notifies the AMF/SMF that the slice resources are available again.

For example the service operation can be: Nnsqac\_EventExposure\_Notify (Slice=S-NSSAI-1, EventID=SliceQuotaReached).

The AMF/SMF start applying the network slice access restriction, if the slice quota has been reached.

6. The AF may subscribe with NSQAC to be notified when a quota status is reached

**Proposal 3: The NSQAC relies on the following services:**

1. **The NSQAC performs NF discovery of the reporting NFs (e.g. AMF) for a specific S-NSSAI;**
2. **The NSQAC request to subscribe for EventExposure from the reporting NFs to collect the current information. The granularity of reporting may be based on local quotas requested by the NSQAC.**
3. **The** **NSQAC offers EventExposure service to the enforcing NFs to notify them when the slice quota has been overrun or underrun.**
4. **The NSQAC offers EventExposure service to AFs.**

# 3. Conclusion

It is proposed to discuss and agree on the Proposals 1, 2 and 3 above.