**SA WG2 Meeting #13S2-20xxxxx**

 (revision of S2-2000932)

**Source: Apple**

**Title: Solution for Key Issue #1: Maximum number of UEs per Network Slice**

**Document for: Approval**

**Agenda Item: x.x**

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

*Abstract: This contribution proposes a solution for Key Issue #1 – Support of Network slice related quota on maximum number of UEs in TR 23.700-40.*

# 1. Introduction

Key issue #1 is about to study whether and how to support the quota on the maximum number of UEs concurrently registering for a network slice defined by an S-NSSAI.

*START of CHANGE*

## 6.X Solution #X: Registration count Management

### 6.X.1 Introduction

This solution is for *Key Issue #1 – Support of Network slice related quota on maximum number of UEs*.

The solution proposes the introduction of NSQM (Network Slice Quota Management) function which is used for maintaining the quota for the maximum number of UEs allowed in the network or a network slice, as well as number of UEs currently registered in the network or in a network slice.

### 6.X.2 Functional Description

NSQM keeps track of the number of UEs registered in the network, or the number of UEs registered to a certain S-NSSAI. The NSQM provides the current count and the available quota to the AMF when a new UE tries to register to the network or a S-NSSAI. The AMF takes the final decision for the registration of the UE to the S-NSSAI.

Figure 6.X.2-1 shows the addition of the NSQM to the reference architecture:



Figure 6.X.2-1 – Addition of NSQM to the reference architecture

NOTE: Some network functions are excluded from the figure for easier reference.

### 6.X.3 Procedures

#### 6.X.3.1 Registration Count management - success case

The procedure in Figure 6.X.3.1-1 shows the success case when there is quota available for a UE to register to a S-NSSAI.



Figure: 6.X.3.1-1 – Registration count management by NSQM - success case

1. The UE sends the Registration Request to the AMF with the S-NSSAI included in the Requested S-NSSAI. The AMF detects that the S-NSSAI present in the "Requested S-NSSAI" is subject to quota management.

2-3. The AMF retrieves the address of the NSQM from the NRF.

4. The AMF queries the available quota from the NSQM for the S-NSSAI before accepting the Registration Request by sending a Nnsqm\_RegistrationCount\_UECheck\_Request message to the NSQM.

5. The NSQM checks its database for the registration quota availability for the S-NSSAI.

6. The NSQM has quota available to accept the registration of a new UE to the S-NSSAI. The NSQM sends a success code to the AMF in the Nnsqm\_RegistrationCount\_UECheck\_Response message.

7. On receiving the success code, the AMF acknowledges the Registration Request of UE in step 1. The AMF sends the Registration Accept message to the UE with the S-NSSAI present in the "Allowed S-NSSAI". Success code can be an output value, e.g. a "Result" binary flag with value 1 can indicate quota availability in the Nnsqm\_RegistrationCount\_UECheck\_Response message.

#### 6.X.3.2 Registration Count management - failure case

The procedure in Figure 6.X.3.1-2 shows a failure case when there is no quota available for a UE to register to a S-NSSAI.



Figure: 6.X.3.1-2 – Registration count management by NSQM - failure case

1. The UE sends the Registration Request to the AMF with the S-NSSAI included in the Requested S-NSSAI. The AMF detects that the S-NSSAI present in the "Requested S-NSSAI" is subject to quota management.

2-3. The AMF retrieves the address of the NSQM from the NRF.

4. The AMF queries the available quota from the NSQM for the S-NSSAI before accepting the Registration Request by sending a Nnsqm\_RegistrationCount\_UECheck\_Request message to the NSQM.

5. The NSQM checks its database for the registration quota availability for the S-NSSAI.

6. The NSQM has no quota available to accept the registration of a new UE to the S-NSSAI. The NSQM sends a failure code to the AMF in the Nnsqm\_RegistrationCount\_UECheck\_Response message.

7: On receiving the failure code, the AMF acknowledges the Registration Request of UE in step 1. The AMF sends the Registration Accept message to the UE with the S-NSSAI present in the "Rejected S-NSSAI" field. Success code can be an output value, e.g. a "Result" binary flag with value 0 can indicate no quota availability in the Nnsqm\_RegistrationCount\_UECheck\_Response message.

#### 6.X.3.3 NSQM based proactive addition of UE to a slice (Rejected S-NSSAI to Allowed S-NSSAI)

The procedure in Figure 6.X.3.3-1 defines the case when NSQM proactively informs the AMF that quota has become available after a UE has deregistered from the S-NSSAI.



Figure: 6.X.3.3-1 – NSQM based Proactive addition of UE to a slice (Rejected S-NSSAI to Allowed S-NSSAI)

1. A UE has been deregistered with the AMF. The AMF updates the NSQM about the deregistration of the UE from the S-NSSAI. The AMF can also inform the NSQM about a UE performing deregistration after a timer expiry to avoid a ping-pong effect.

2. The NSQM decrements the quota and checks if any quota is available for the S-NSSAI.

3. The NSQM informs the AMF whenever quota becomes available for more UE(s) to be added to a S-NSSAI.

4. The AMF acknowledges the request from the NSQM.

5. The AMF takes the decision which UE(s) to add to fill the available quota for the S-NSSAI.

NOTE: Decision taken by AMF on which UE(s) to add to fill the available quota for the S-NSSAI could be based on vendor implementation.

6. The AMF sends a Configuration Update Command message to the UE(s) with "Allowed S-NSSAI" containing the S-NSSAI which was rejected earlier due to unavailable quota.

7: The UE sends a Configuration Update Complete message after updating its "Allowed S-NSSAI" list.

8-10: These steps are the same as in the subclause 6.X.3.1 steps 4-6.

### 6.X.4 Impacts on existing entities and interfaces

- A new network function to be added for maintaining the quota for the maximum number of UEs allowed in the network or a network slice.

- AMF <--> NSQM communication should be defined.

*End of CHANGES*