**3GPP TSG-RAN WG5 Meeting # R5-210106r1**

**Electronic Meeting, February 22 – March 5, 2021**

**Agenda item:** 4.2.1

**Source:** China Mobile

**Title: Proposal for introduction of a** New Study Item on 5G NR UE full stack testing for Network Slicing

**Document for:** Discussion and endorsement

1. Introduction

5G Network Slicing is one of the most distinctive features provided by 5G NR and is key to meet diversified services requirements in 5G era. With the introduction of 5G network slicing technology, operators will be able to provide network capabilities with different functional characteristics, which will provide e.g. "exclusive" network for users with different KPI requirements to ensure a high-quality of service and meet differentiated scenario requirements. Users can enjoy more amazing application products, which will further stimulate the development of new industry applications as well as personal applications. Besides, 5G network slicing can also help to achieve the goal of improving the efficiency of network resource utilization, optimizing the network construction investment of operators, and building a flexible and agile 5G network.

The user experience resulting from the use of 5G network slicing is critical for commercial success, and therefore testing the operation of 5G network slicing is necessary to ensure consistent predictable behaviour. To enable testing the 5G UEs supporting network slicing as they are used in the field the application layer at the device side needs to be included in the testing, as URSP based network slice selection and traffic routing procedures are based on traffic descriptor components (see TS 24.526) passed on by the application layer to the UE protocol stack. The traffic descriptor components that are passed onto the UE protocol stack to be used as a base for the network slice selection when a specific application requests a PDU session are configured within the device. There are no test cases that ascertain that the UE behaves in a consistent and conformant manner when it is configured with a set of traffic descriptor components to be used when an application wishes to communicate over a PDU session and the PDU session establishment in the device is triggered directly from the application layer using the configured set of traffic descriptor components. The test cases for application layer and device implementation specific functionality, e.g. UE policies for URSP, matching UE application to URSP, requesting suitable network slices, are currently outside of the scope being developed by 3GPP RAN5. Suitable test interfaces and test procedures to support the implementation and inter-operability / consistency of network slicing for smart devices are required.

The Rel-15 CT WI 5GS\_Ph1-CT has been 99% completed at CT#82 (June 2018) and Rel-16 CT WI eNS has been 100% completed at CT#88 (December 2019). As stated in the LS from NGMN and GTI (see R5-210018), there is a strong industry demand to define the test methods and test procedures that include the full related UE application layer in the testing of the network slice selection functionality for 5G UE supporting network slicing.

RAN5 has only defined following protocol test cases of NSSAI handling during registration, which is still far away from enough to meet the industry needs on 5G NR UE supporting Network Slicing Test.

* 9.1.4.1 Generic UE configuration update / New 5G-GUTI, NITZ, registration requested, Network slicing indication, New Allowed NSSAI / acknowledgement from the UE
* 9.1.5.1.3 Initial registration / 5GS services / NSSAI handling
* 9.1.5.1.3a Initial registration / 5GS services / NSSAI handling / NSSAI Storage
* 9.2.5.1.2 Initial registration / 5GS services / NSSAI handling

Considering the industry needs, there still lack of test cases as below:

* URSP
* application layer and device implementation specific functionality profiling of 3GPP standardized protocols/features
* Network Slicing interworking support from EPC to 5GC (Rel-16) , still absent and need to complete in TS 38.523-1
* Network Slicing based authentication and authorization (Rel-16) , still absent and need to complete in TS 38.523-1

As shown above, the test cases for Rel-16 Network Slicing interworking support from EPC to 5GC and Network Slicing based authentication and authorization are still absent and need to be completed in TS 38.523-1. **For URSP and application layer and device implementation specific functionality profiling of 3GPP standardized protocols/features test cases, they are also still absent but impossible to be fit into the existing TS 38.523-1.** So it is justified now to initiate a dedicated SI to create TR/TS for 5G NR UE supporting Network Slicing tests and to start the study on the comprehensive solution for it in 3GPP RAN WG5 to meet the market requirements in time.

# 2. Study Item Objective

The objective of the proposed Study Item is:

* To study how to define test procedures that will allow the full stack testing of a 5G NR UE supporting network slicing. The test procedures for full stack testing of the network slicing functionality, e.g. how the UE uses configurations matching UE application to traffic descriptor components to select S-NSSAI, will be provided.
* To study how to define test procedures that will allow the service performance testing of a 5G NR UE supporting network slicing. The test procedures for performance testing of the network slicing service, e.g. application layer throughput and latency, will be provided.

The term "full stack" above means multilayer combined performance of the following layers:

1 UE’s Radio link protocol data processing performance (PHY, MAC, RLC, PDCP)

2 UE’s Radio link protocol signalling processing capability (RRC, NAS)

3 UE’s TCP/IP processing performance

4 UE’s Internet Application processing performance

It is expected that an embedded client application can be installed on the UE. This is considered the default mode of testing as it provides an accurate simulation of real life usage.

Below is a proposed structure of the new 5G NR UE supporting Network Slicing measurement section(s):

* Scope
* References
* Definitions, symbols and abbreviations
* General
	+ Introduction of key parameters to be used
		- TD (Traffic Descriptor)
		- URSP (UE Routing Selection Policy)
		- S-NSSAI (Single Network Slice Selection Assistance Information)
		- ……1
	+ Test environment configuration
	+ General procedure
* Test procedures for 5G UE supporting Network Slicing (align with RAN5 test case structure)
	+ Test procedures for URSP configuration and mapping between applications and network slices
		- URSP configuration
		- URSP update
		- Association between application and PDU session based on DNN
		- Association between application and PDU session based on APP ID
		- Association between application and PDU session based on FQDN
		- ……1
	+ Test procedures for Network Slicing Service Performance, including application layer throughput, latency, etc.
		- Throughput performance at application layer with specific network slices
		- Data transmission latency at application layer with specific network slices
		- ……1
* Annex

NOTE 1: The Study Item should take into account industry recommendation from relevant organizations such as GSMA, NGMN and GTI pending on RAN5’s decision on a case by case basis.

As stated above, this new TR will give the industry a whole picture on how to implement the comprehensive application layer test for 5G NR UE supporting network slicing. For the application layer test cases, the test procedures will be studied and defined in this new TR in detail and will align with RAN5 test case structure.

Just like we need to involve FTP APP to implement the application layer throughput test in“Study on 5G NR UE Application Layer Data Throughput Performance”(FS\_UE\_5GNR\_App\_Data\_Perf), for the application layer test cases for network slicing, "APP simulators" may be involved to simulate the uniform App behaviour in application layer, e.g. uniform packet size, packet type, packet interval, etc. Based on uniform and simulated App behaviour, the purpose of application layer test is to verify:

* + the mapping between application service and network slicing according to the corresponding URSP
	+ the service performance in application layer with network slicing configured

**An example of test procedure**

Test scenario:

APP ID is used to identify different Applications. Suppose there are 2 different applications installed in the same smart device. The APP ID of the 1st application is App1, while the APP ID of the 2nd application is App2.

Suppose App1 has subscribed specific network slicing with S-NSSAI=1 which applies for ultra low latency scenario and/or low throughput, while App2 has subscribed specific network slicing with S-NSSAI=2 which applies for normal latency scenario and/or high throughput.

Suppose the UE has 2 PDU sessions configured and established at the same time. App1 routes packets through PDU Session 1 to the network slicing with S-NSSAI=1, while App2 routes packets through PDU Session 2 to the network slicing with S-NSSAI=2.

The test purpose is to verify that

1. UE could support the URSP configuration via signalling during registration.
2. When application is initiated by user, UE could recognize the Application according to APP ID=App1 or APP ID=App2.
3. UE could associate this application with APP ID=App1 to network slicing S-NSSAI=1 and request the corresponding PDU session 1 establishment. Or UE could associate this application with APP ID=App2 to network slicing S-NSSAI=2 and request the corresponding PDU session 2 establishment.
4. UE could route the packets from application with APP ID=App1 by the corresponding PDU session 1 with network slicing S-NSSAI=1 to SS. Or UE could route the packets from application with APP ID=App2 by the corresponding PDU session 2 with network slicing S-NSSAI=2 to SS.
5. UE could route the packets to the correct network sliceing when 2 PDU sessions have been configured and established at the same time. The service performance of application, tagged with APP ID=app1 and configured with network slicing S-NSSAI=1, could meet expectation, e.g. data transmission latency and/or throughput in application layer for application with APP ID=App1 configured with S-NSSAI=1 is lower than application with APP ID=App2 configured with S-NSSAI=2.

The test will NOT require a UE to reveal how the mapping from application to Network Slicing. The URSP contains the Traffic Descriptor (TD) of application and the S-NSSAI of corresponding Network Slicing. During the test, there will be a hypothetical URSP for test provided as the test configuration by the test system. The test purpose is to verify whether the UE could support the URSP configuration via signalling during registration following the CT core specification requirements. Also the test purpose is to verify whether the UE could implement the mapping correctly to route the packets from application to the correct Network Slicing as per the hypothetical URSP. As for the implementation details of mapping inside the UE can be kept as agnostic for the test.

**Proposal 1**: RAN5 to initiate a dedicated SI to study how to define test procedures that will allow the full stack testing of a 5G NR UE supporting Network Slicing.

**Proposal 2**: RAN5 to create TR to document the findings of the study above on how to implement 5G NR UE full stack testing for Network Slicing.

3. Conclusion

It is proposed that RAN5 discusses and agrees to the following proposals as a guideline for defining 5G NR UE full stack testing for Network Slicing:

**Proposal 1**: RAN5 to initiate a dedicated SI to study how to define test procedures that will allow the full stack testing of a 5G NR UE supporting Network Slicing.

**Proposal 2**: RAN5 to create TR to document the findings of the study above on how to implement 5G NR UE full stack testing for Network Slicing.

4. References

 [1] 3GPP TS 23.003: "Numbering, addressing and identification".

[2] 3GPP TS 23.501: "System Architecture for the 5G System; Stage 2".

[3] 3GPP TS 23.503: "Policy and Charging Control Framework for the 5G System; Stage 2"

[4] 3GPP TS 24.501: "Non-Access-Stratum (NAS) protocol for 5G System (5GS); stage 3".

[5] 3GPP TS 24.526: "UE policies for 5G System (5GS); Stage 3"

[6] 3GPP TS 38.331: "NR; Radio Resource Control (RRC); Protocol Specification".

[7] 3GPP TS 38.508-1: "5GS; User Equipment (UE) conformance specification; Part 1: Common test environment"