**3GPP TSG-SA5 Meeting #140-e *S5-216380rev1***

**e-meeting, 15 - 24 November 2021**

**Source: Lenovo, Motorola Mobility, CMCC**

**Title: Automated operational testing**

**Document for: Approval,**

**Agenda Item: 6.5.5**

# 1 Decision/action requested

***Please approve***

# 2 References

# 3 Rationale

*Operational testing may in the straightforward case be automated subject to meeting certain KPIs. If this is supported, then the entire chain for the operator from the new NF delivery to the roll-out in an operational environment replacing an older version of the NF becomes possible.*

# 4 Detailed proposal

Start of changes

6.2 Operational testing

6.2.1 Description

The Network Slicing feature in 5G provides telecom operators the capability to support multiple logical networks on the common physical network infrastructure. Each of these Logical networks will cater to different services and might have different operational requirements spanning across domains. Therefore, in addition to the 5G feature, it is important for operators to have the flexibility to manage these logical networks independently. Cloud Native based platform and tools which are widely used in the IT world has inbuilt frameworks for agile and flexible deployment. These platforms are increasingly becoming the de-facto choice for 5G Telecom Products. This highlights the importance of bringing many Cloud Native benefits like CI-CD that are essential for automation and flexibility of 5G networks. CI-CD automates and integrates the development phase, testing phase and deployment phase to improve feature velocity. Enabling CI-CD in 5G networks which includes the most transaction-intensive and time-sensitive RAN network functions is still a challenge. Dynamic software upgrades and live testing of 5G software components in production environment without service interruptions remains the main challenge that need to be solved for enabling CI-CD in 5G networks.

The ability to test the upgraded network nodes in the operational network will increase the agility of 5G networks. Slicing and virtualization can be used to assist in live testing. A test network slice instance or a test NF can be created/deployed, using the upgraded network functions, for testing purpose. The basic principles of the operational testing are:

* Test network slice instance or test NF creation with appropriate information e.g., test cases, test duration, target network nodes etc.
* Automatic UE selection: The set of UEs to be assigned to the test network slice instance or the test NF instance can be selected and updated over time to minimize the adverse effects of testing. The UEs can be selected based on any network or UE characteristics, such as current load of the network, location of the network nodes mobility or dual connectivity etc.
* Deployment location selection for the upgraded node: The location of the upgraded node can be selected to minimize the adverse impact of testing. The location of the Networks nodes that needs to be upgraded and tested can be selected based on load conditions of the Network nodes at a given location. The location of the node can also be based on the availability of UEs for testing in each location.

Furthermore, such operational testing could be further automated. When a new version of NF is delivered to the operator that has passed all tests and can now be rolled out into the operational network the roll out could be combined with operational testing. This means that the new NF could be installed in the operational network without being initially being used at all. If the installation proceeds correctly then a small portion of the cases (examples: UEs or events or requests) that were handled by the old NF version can now automatically be assigned to the new NF version. If the new NF performs well and no failures occur further entities could incrementally be assigned to the new NF till eventually the old NF has no cases to handle and is rendered redundant. At this point the old NF could be uninstalled and removed from the operational network. In case of error or insufficient performance the system rolls-back to the old NF.

6.2.2 Requirements

**REQ-CICD-FUN-1** The 3GPP Management system shall be able to support testing the upgraded software in the live network.

**REQ-CICD-FUN-1** The 3GPP Management system shall be able to support creating/deploying a slice for testing the upgraded network functions in the live network.

**REQ-CICD-FUN-1** The 3GPP Management system shall be able to support selecting appropriate UE(s) to be assigned to the test slice minimizing the service impacts, if any.

**REQ-CICD-FUN-1** The 3GPP Management system shall be able to support selecting appropriate location for the upgrade network functions deployment minimizing the service impacts, if any.

REQ-CICD-FUN-5: The 3GPP Management system should support configurations that enable the automated roll-out of new NFs into the operational environment while performing operational tests.

REQ-CICD-FUN-5: The 3GPP Management system should support the roll-back of new NFs to the previous version in an operation environment.

6.2.3 Solution Alternate 1 – Test utilizing slicing

6.2.3.1 Overview

The solution involves creating/instantiating a test entity (NSI, NSSI or a NF) exclusively for testing purpose triggered by a software upgrade procedure. The test entity will include information related with the testing including Managed Function to be tested, test duration, test case etc.

The appropriate UE(s) are assigned to this test entity minimizing the service impacts. UEs can be selected based on the location of the network nodes where the upgraded software is to be deployed. UEs can also be selected based on the UE characteristics like UE mobility and UE capabilities like dual connectivity or can just be percentage of available UEs

The location of the networks nodes that needs to be upgraded and tested can be selected based on load conditions of the Network nodes at a given time. The location of the node can also be based on (not limited too) the availability of UEs for testing in each location.

6.2.3.2 Details

The solution requires the ability to indicate that a particular test entity instance is meant for testing purpose. This will include enabling information like list of nodes to be tested, test duration, procedures (e.g., rrc connection setup, handover etc) to be tested etc.

Once the test network entity is instantiated, the UE(s) can be assigned to this entity. The UEs selected for testing can be:

- Based on UE capability

- Carrier aggregation, Dual connectivity capability.

- Based on UE characteristics

- Based on User Mobility (which can be determined based on UEmobilityLevel).

- Based on UE RRC\_State (which can be determined based on the UE history information stored with the operator)- Percentage of available UE

The testing location of the new node can be critical in terms of minimizing the service experience and maintain better use experience. Selection of deployment location of the test software in the field can be based on

- the availability of radio and cloud resources;

- the availability of UE selected; and

- any other operator defined restrictions.

6.2.x Solution for automated roll-out

The operator may configure a “roll-out plan” for any new version of a 3GPP NF. The roll-out plan may contain the following information

* The increments to assign cases (example: UEs, requests etc) to the new version of the NF. For example in case a new version of NSSF is available: As a first increment 10% of the request for slice selection could go to the new version of the NSSF, in a second increment this could be increased to 20%.
* The conditions or thresholds to be met by the system to change from on increment to the next. For example: if there are no errors in the New version of the NSSF for the next 30 days move the increment 2.
* Other performance KPIs
* Conditions that signal a failure and may require a roll-back of the new NF. For example: Significantly higher drop rate for UEs assigned by the new version of the NSSF.

Based on such a roll-out plan and on being triggered by the conditions in the network the 3GPP management may configure the cases in the core network. For example: the selection of NSSF probability could be configured in the NRF.

End of changes