5G test lab setup for Telcos

wipro

Objectives

This paper has been authored in the context of the setup of 5G Network test labs for Telco Operators.
As telecom networks are moving from 4G to cloud-native 5G, OEM vendors are evolving their products / solutions from legacy to virtualized network functions (VNF).

Because the products are getting virtualized and delivered in agile mode, telco operators are challenged with quicker time-to-market of their products with utmost customer experience. Hence the need of setting up test labs arise to certify multi-vendor VNFs and devices before they are rolled-out in the production network.

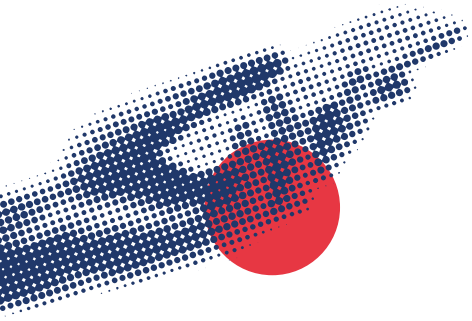
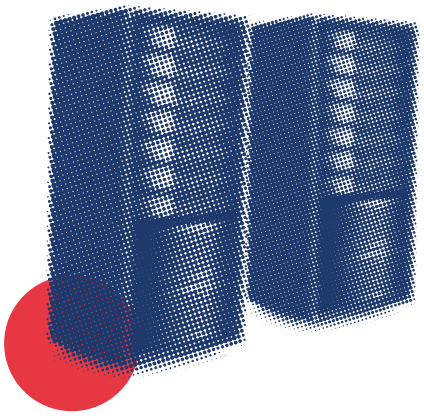


Fig 1 – Agile delivery trends in evolving 5G technologies

The big question, however, revolves around getting the entire test cycle automated. The need of the hour for telco operators is to adopt / enhance a unified network test automation methodology / framework to reduce the lab certification cycle.

Challenges



Since a telco operator has multiple RF bands to operate 5G network across multiple business segments, several test topologies are envisioned with combinations of Local Data Centre, Regional Data Centre, and National Data Centre deployment. A telco operator's biggest challenge is to set up various combinations of Data Centres (NFVi) and test the solution. As the testing scope spans across devices and network applications, multiple test tools / simulators and a test environment need to be setup and maintained.

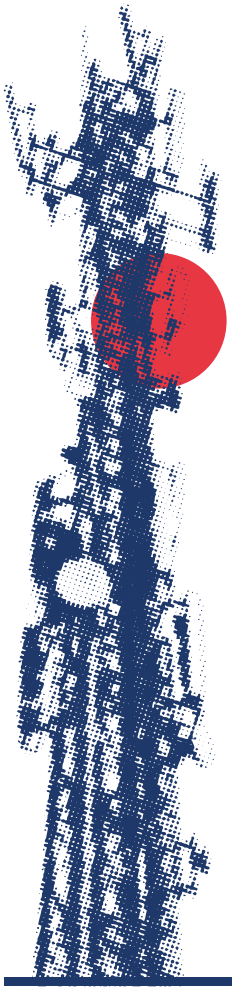
Hence, to address telco operator rollout vision, a single test partner who can set up and maintain various test environments by bringing in the required test tools, and develop an automation framework for faster field rollout, would add a lot of value.

Proposed Test Environment

Based on our prior experience working with multiple telcos, we envision three (3) test environments for a telco operator 5G test lab –

1. NTI / PoC test environment – all preferred 5G OEM & ODM vendors to demonstrate their respective solutions
2. Pre-deployment test environment – integration of multi-OEM vendor solution and E2E services certification in a stable test environment, before field deployment
3. FoA (First Office Application) – integration of multi-OEM vendor solution in Field post the pre-deployment lab verification

Fig 2 – Test environments to realize 5G services



NTI / PoC Testing

As part of the end-to-end solution, the telco operator's preferred OEM vendors will bring their respective solutions and demonstrate them in the telco operator 5G test lab. The objective of this phase: OEM vendors will un-plug plenty of product defects and correct them, complying with telco operator requirements before they offer their product for acceptance in stable pre-deployment testing. This environment is usually unstable as multiple OEM vendors will be working in parallel to test and troubleshoot their solution.

Pre-deployment Testing

In this phase, all components of the telco operator 5G network from multiple OEM vendors will be integrated and tested for end-to-end services and 3GPP standards compliance. The test environment is pre-configured per telco operator production configuration and hence is a stable environment. Typically, pre-deployment certification has the below-mentioned test phases, viz. onboarding, functional testing, performance testing, and services testing from lab entry to lab exit.

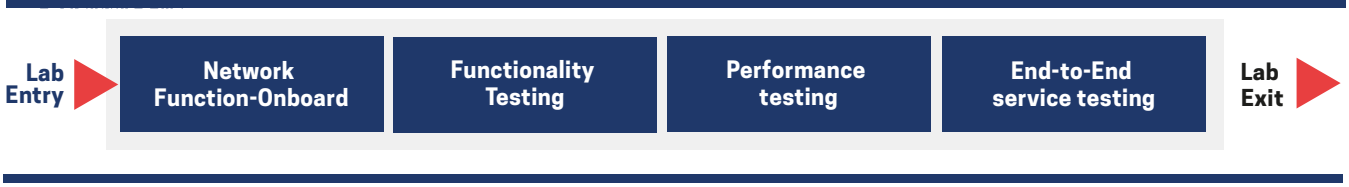


Fig 3 – Lab certification cycle

In every phase of pre-deployment testing, multiple test environments and tools need to be configured, complying with telco operator services.

FoA Testing

Post pre-deployment certification, the 5G solution will be configured in the selected Field environment with Test SIMs and end-to-end services will be verified. This is performed in close coordination with the telco's Operations team. Hence, the test environment is very stable and under the control of the Operations team.

The output of this phase is approval for mass rollout in a telco operator's production network as General Availability.

Test coverage in 5G Test Labs

Telco operator 5G network consists of Telco Cloud, Virtual Network Functions from multiple vendors, Network applications, and End-user devices. As a green-field operator, a telco operator's objective is to integrate all 5G network ecosystems and certify the end-to-end solution in a controlled test lab environment before field deployment to:

- Uncover interoperability issues
- Minimize field defects
- Increase customer experience cycle

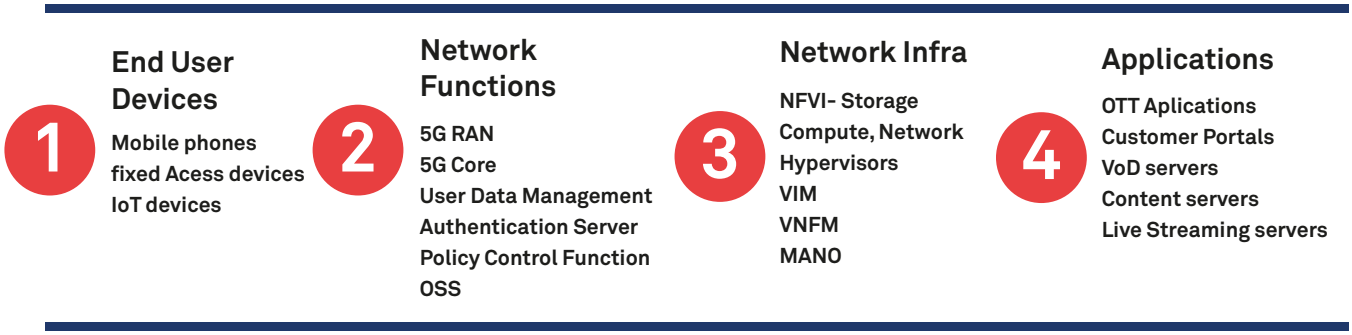


Fig 5 – 5G ecosystem appliances

The various test phases and lab activities covered in 5G test labs are listed below:-

Test Phases:

- New Technology Introduction (NTI) or PoC of new solution
- Acceptance Testing
- E2E Solution Testing
- First Office Application (FoA)Testing

Lab Activities:

- Lab infra setup – active network and passive network
- Lab integration
- NFVi infrastructure integration
- Integration of Network Orchestrator, VNF Managers, and Network Applications
- Lab scheduling and maintenance
- Lab troubleshooting using tools
- Tools maintenance

Test Activities:

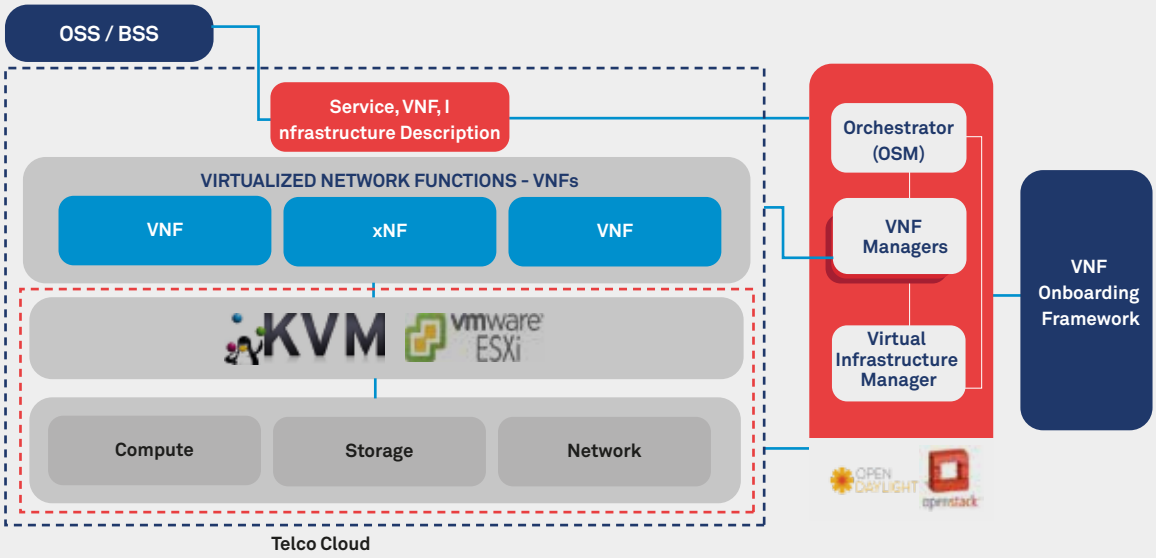
- Multi-vendor VNFs onboarding and certification
- Functional and performance testing of VNFs
- E2E solution certification
- Interoperability of end-user devices (mobiles / tablets / IoT devices, Fixed CPEs etc.)
- Test automation

Network certification

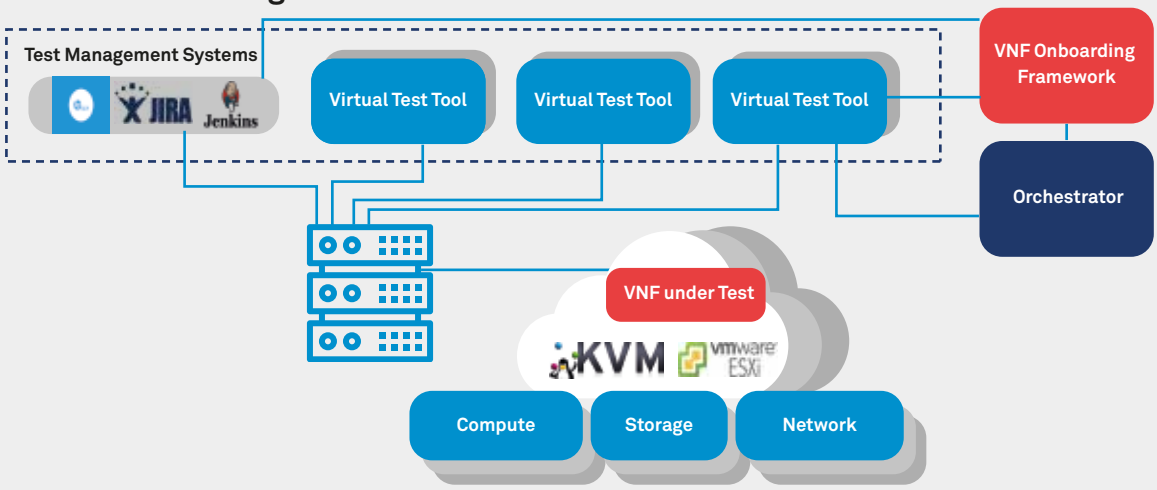
Network certification will integrate all the OEM vendors' solutions, NFVi infrastructure, OSS/Orchestrator, and Network Applications. Since 5G is cloud-native and all network functions are VNF based, Wipro proposes the below test lifecycle for network certification:

- VNF On-boarding
- Functional & Performance Testing
- E2E Services integration testing

Scope - 5G VNF Onboarding on NFVi



Scope - 5G VNF Functionality & Performance Testing



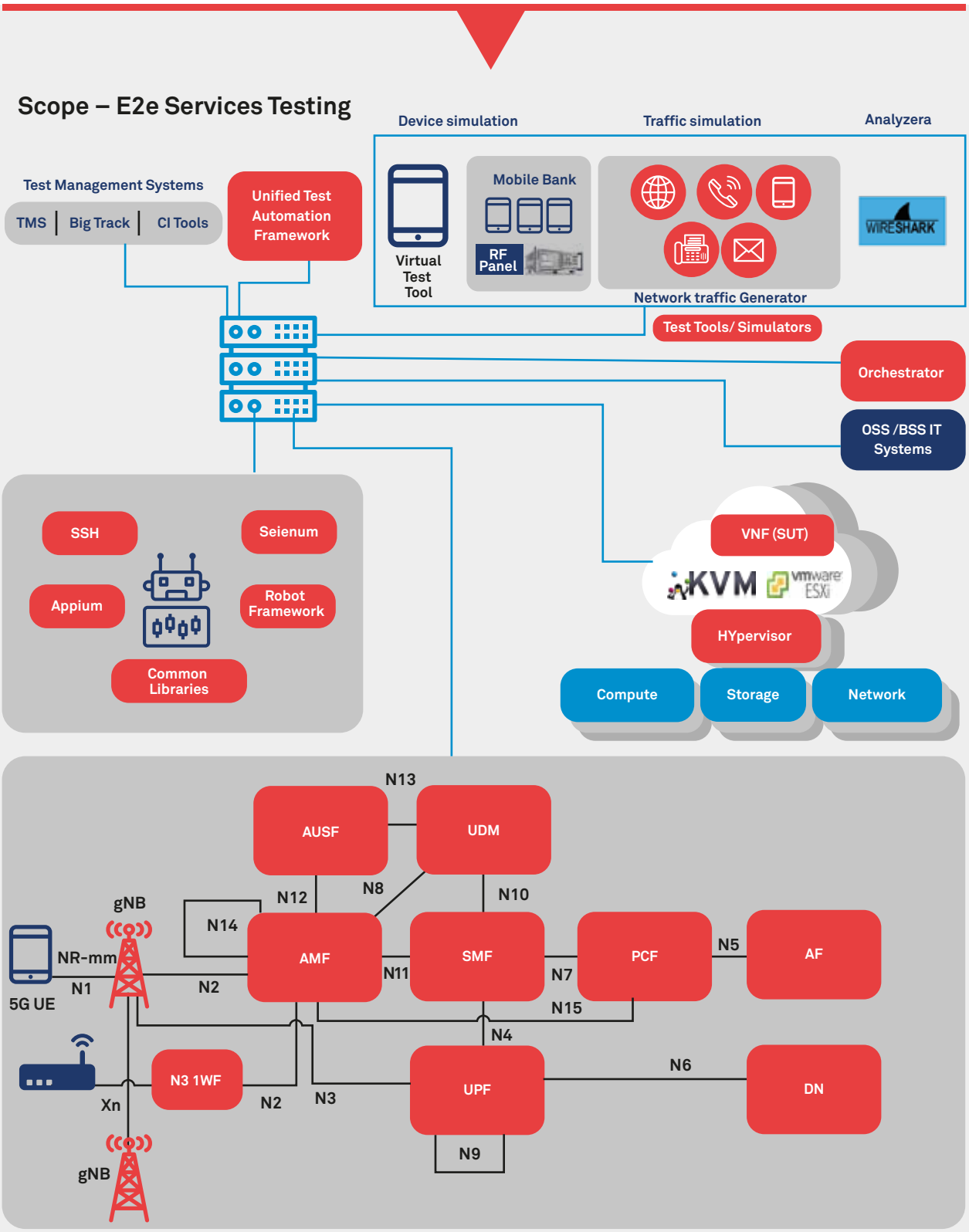
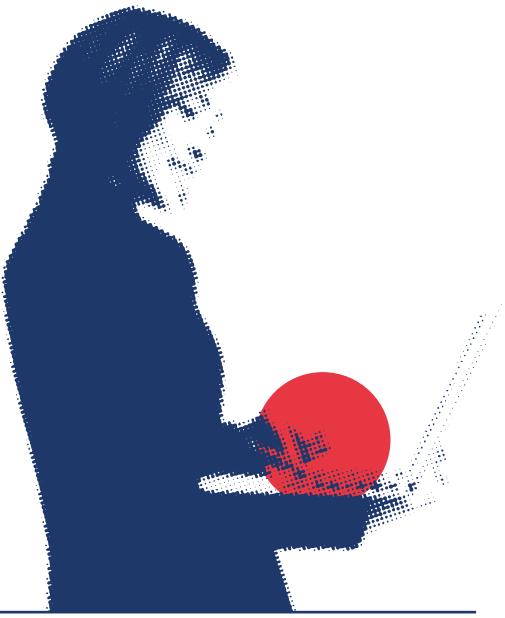


Fig 6 – Phases of network lifecycle certification



- **On-board software build:** The first step of lab entry is the on-boarding of network function software build onto NVFi. Scope of the onboard testing is to pick up the agile delivery builds from the version control server and execute on-boarding scripts. Once the VNF is installed, execute sanity test scripts verifying the basic functionality of the network function before performing the detailed functional testing.
- **Functional testing:** Post the on-boarding sanity testing, the functional test environment with tools and simulators will be used for testing. The framework will trigger the scripts, by activating or spinning the test simulator required for functional testing. At the end of the functional test phase, the framework raises a defect with proper interface logs – Wireshark, and also submits the functional execution report.
- **Performance testing:** Since telco operator services will be measured on their network / services performance, the key ask from lab certification is performance testing of all services and network functions. The required test framework should be capable of spinning the required VNFs, triggering, and controlling the existing traffic test tools (commercial test tools and any open-source traffic tools) in the telco operator lab environment and collect test logs. The test framework will collect, measure, and provide a test report on various KPIs of the services from the dashboard.
- **End-to-end services testing**: In this phase, all the end-user services like service provisioning, activation, call processing, backup/restore etc. are tested. Hence, network and IT integration tests happen during this phase. The test framework should prepare the end-to-end network topology / test environment and integrate VNF-based network functions with the rest of the network ecosystem. The test framework should trigger and control the end-to-end services tests, collect the interface logs, analyze the messages and pass-on the test verdict based on the call requirements. All the required plug-ins of the end-user devices, network devices, and applications need to be supported by the test framework.
- Wipro envisages the below test tools / framework for network certification

Telco Cloud- VIM,NFVM, MANO
OEM vendor VNF
Load Test Tool
User equipment
SIMs
VNF onboarding & Automation framework

Fig 7 : Test tools for network certification

• Wipro also proposes an in-house Unified Test Automation Framework – RAPIDS VEVATO - as one such tool for seamless network test automation. The tool integrates with the telco operator's test lab environment, test tools, and test management systems, as shown below, and performs lab certification activities seamlessly.

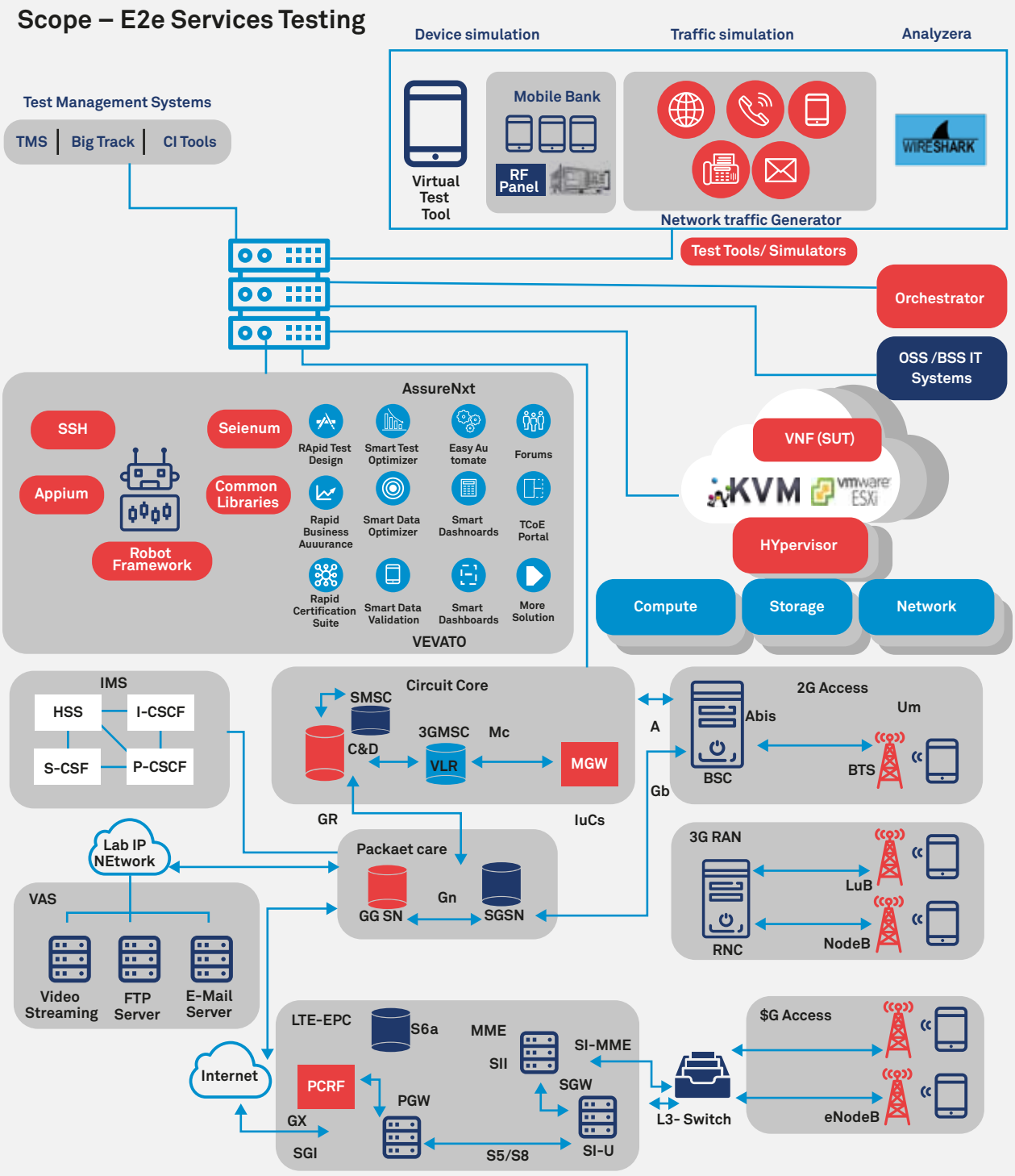
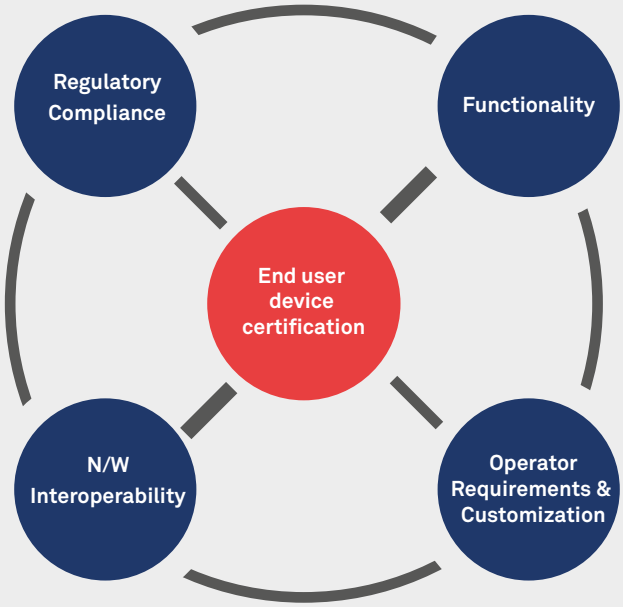


Fig 8 : Connectivity view of Unified Network Test Automation framework

Device Certification

Device certification will cover all ODM vendor products (telco operator chosen/preferred 5G device vendors) certification from a Compliance, Functionality, and Interoperability perspective.



A typical test environment for device certification consists of a simulated network for Regulatory, Functional, and Operator-specific testing. For device interoperability with a telco operator, the above end-to-end network test lab will be proposed.

Fig 9 : End user device certification

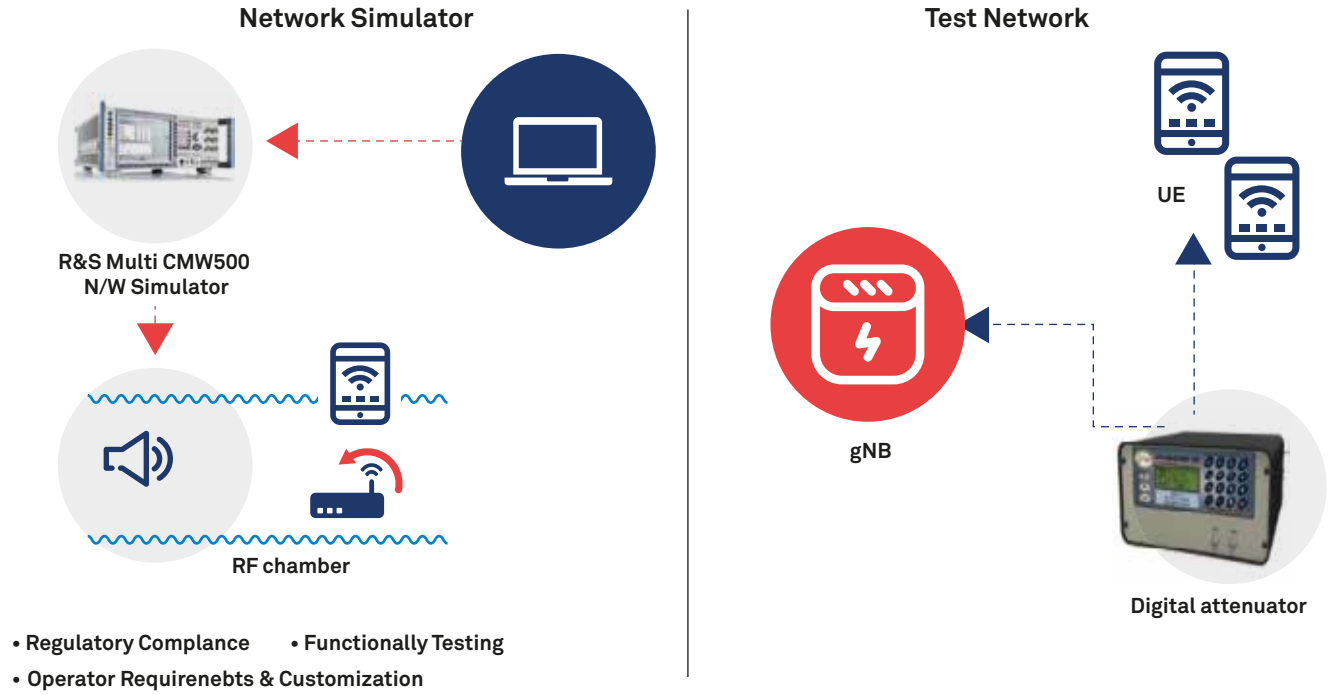


Fig 10 : Test environments required for device certification

Radio Protocol conformance tests
Receiver sensitivity
Data Througput
Power Monitoring
Multi-berer tests
Standard Compliance tests

Fig 11 : Test coverage for device certification

- Wipro envisages the below test tools / framework for device certification

Protocol Tester
Compliance Teaster
RF Fading simuletor
User equipment
SIMs
%g NB
RF chamber

Fig 12 : Test tools for device certification

Conclusion

Since the 5G network involves multiple combinations of cloud-native virtual network functions coupled with multiple deployment options and agile services delivery, telco operators will need a test partner who can set up these test lab combinations with ready-to-use automated test solutions, to ensure shorter lab certification cycles and remain competitive in the market.

In the days to come, telco operators will look for more innovative and commercially viable lab certification models like the l ab-as-a-service model.

About the Author

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He has over 20 years of telecom network testing experience. Ramesh also has working experience with multiple OEM vendors and telco customers ranging from lab integration to field acceptance. He has worked in wireless (2G, 3G, LTE, VoLTE, NFV) and wireline technology products / solutions. His core strength is in setting up test labs and performing functional acceptance testing.

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