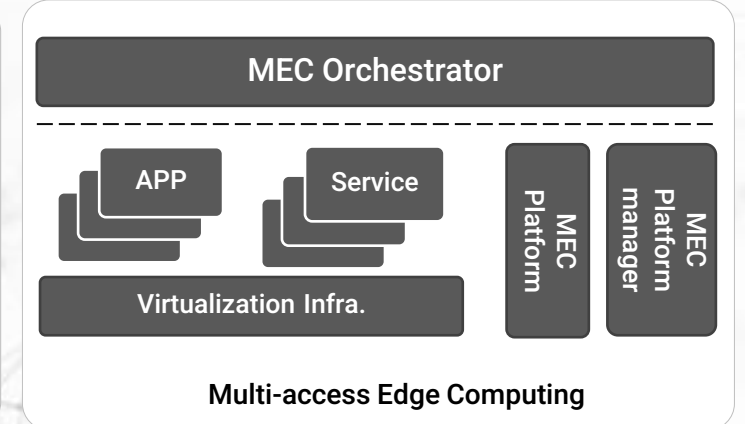
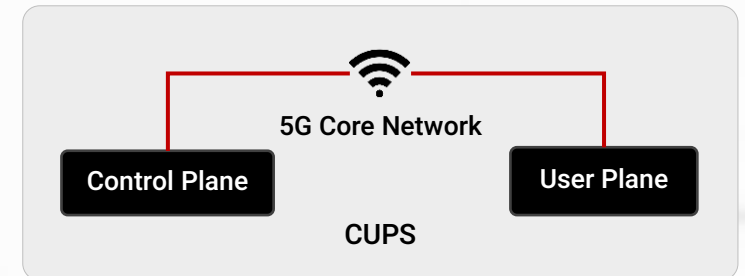
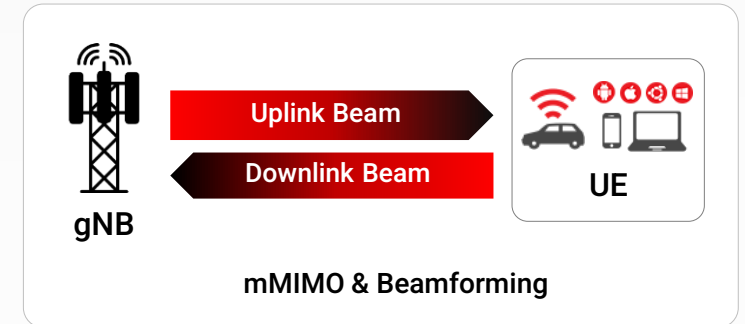
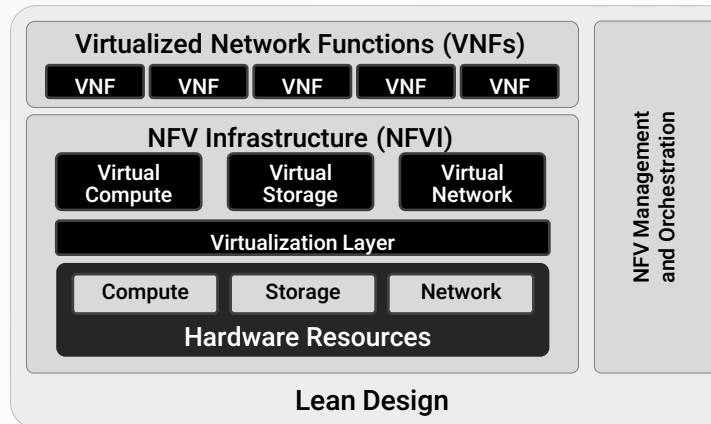
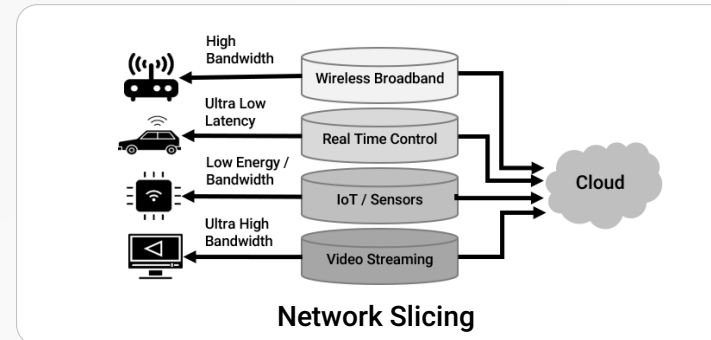
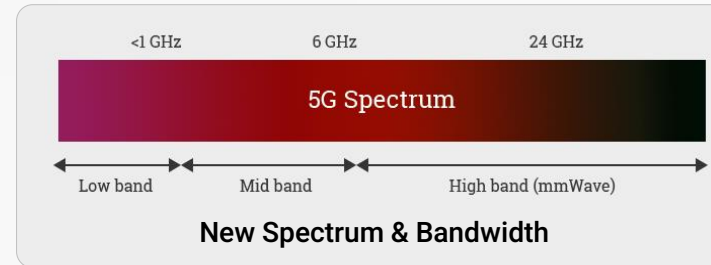


Testing and Analysing 5G Networks

What is 5G and why we need it ?

Driving **innovation, competition,** and **cost effective solutions**

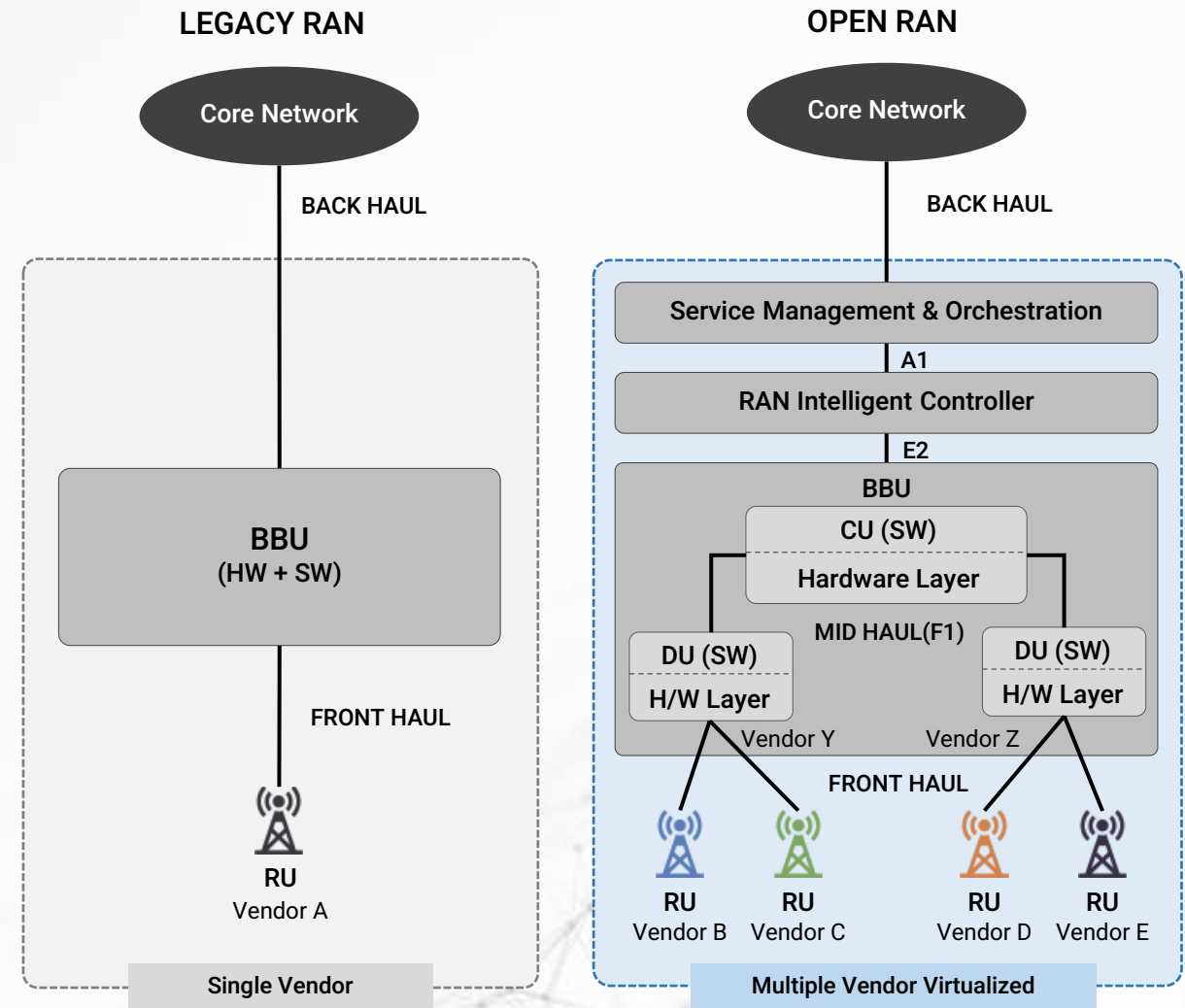
- Amalgamation of various technology
- Differential treatment for different types of network traffic
- Dynamic discovery of network functions
- MEC and PODs providing services, storage, and computing on network edge
- Multi-vendor, software centric network solution
- Cost effective way of creating private 5G core (NPN) - Private 5G



What is O-RAN and its role in 5G ?

- A true separation of the Radio network
- Disaggregation of the Radio Network to split CU and DU functions
- Introduction of Midhaul between CU and DU
- Service Management and Orchestration
- Enabling different Radio technologies to inter-operate
- Optimal utilisation of radio wave
- Uniform security mechanism

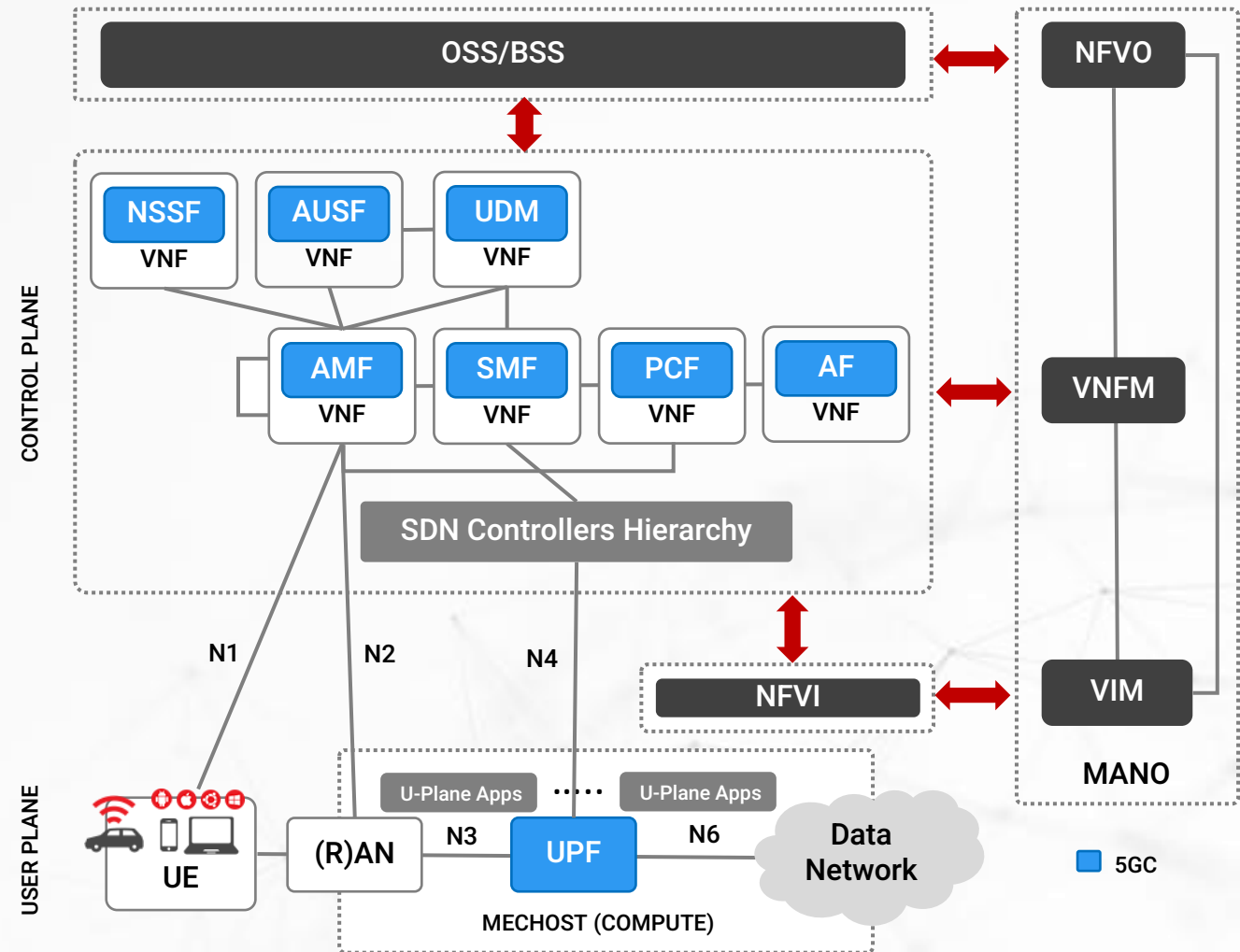
Disaggregated radio network enabling multi-vendor solution and driving **cost down**



Disaggregation and Virtualization in 5G ecosystem

- Cost-effective scalable Access and Core network
- Division of hardware resources into functions that can be controlled by software
- SDN, Control & Data plane separation
- Load balanced micro service based architecture
- Everything virtualized, software defined, and containerized all managed by Orchestrators

Demands Network Automation for Test Assurance, Deployment, Monitoring, and Operating

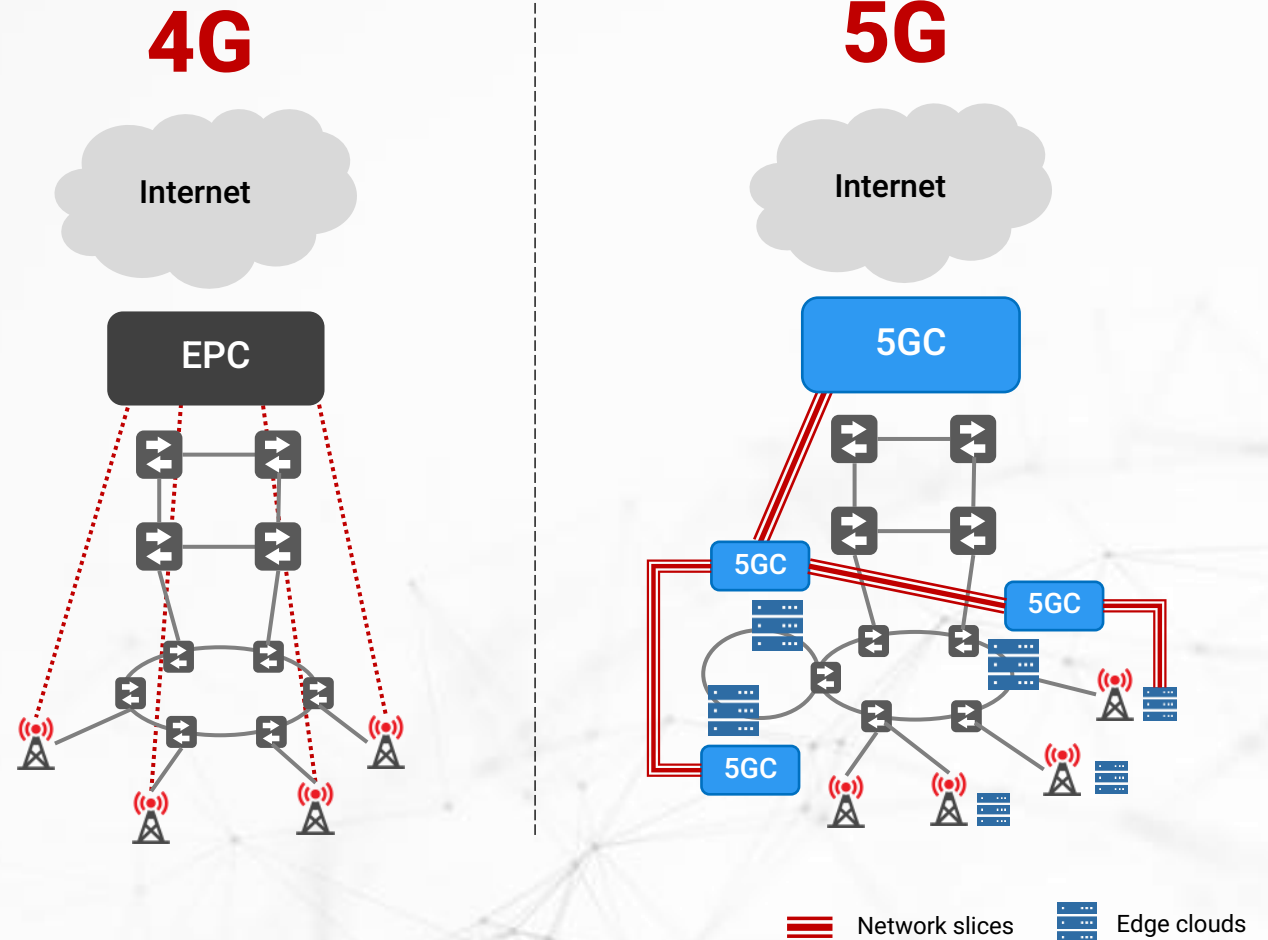


Testing and Analyzing 5G Networks

What's new in 5G:

- End to end complex use cases testing involving various types of NF
- Migration from monolithic node to micro service base NFs
- Emulation and verification of numerous scalable deployment scenarios
- Validation for CUPS, NSA, and SA architecture
- Test for different network slice, node selection, and functionality
- Functional, Conformance, and Performance testing

Multi-vendor NF interoperability, application specific **use cases**, KPI against various **infrastructure**, on-demand **scalability**

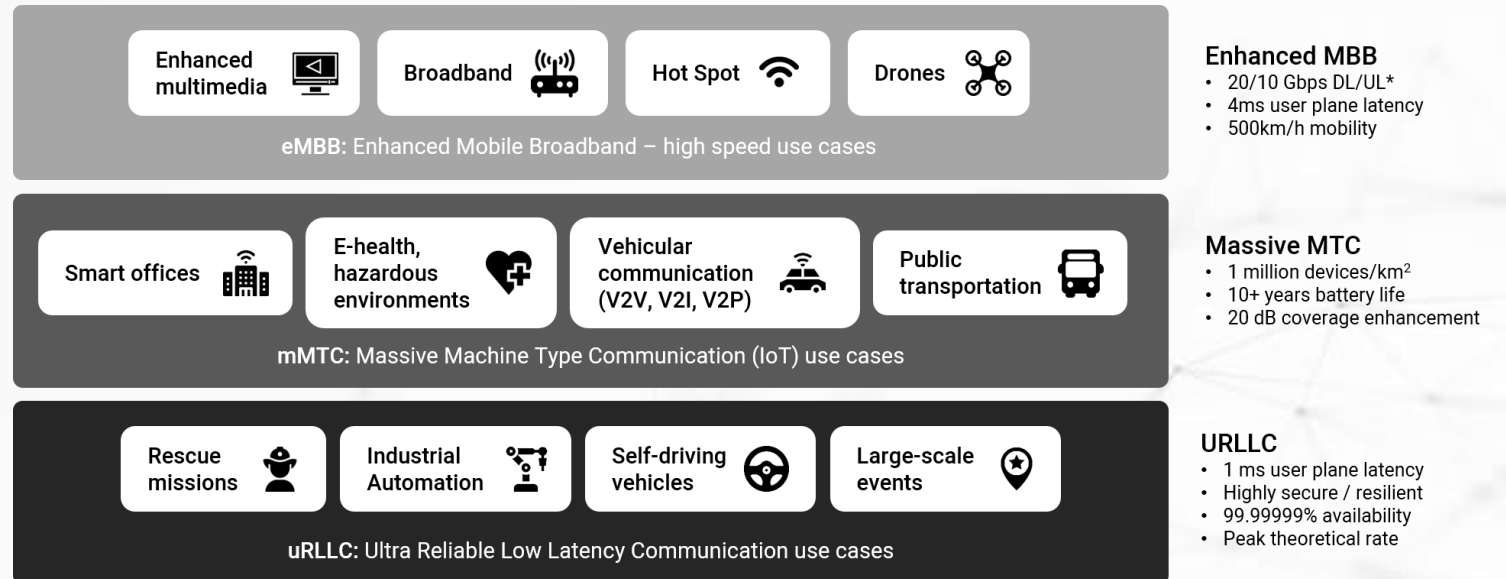


Integration and Testing challenges of 5G Network

Test suites for all **5G use-cases** - **high throughput, sub-millisecond latency, massive connections, and enhanced video services**

What is needed:

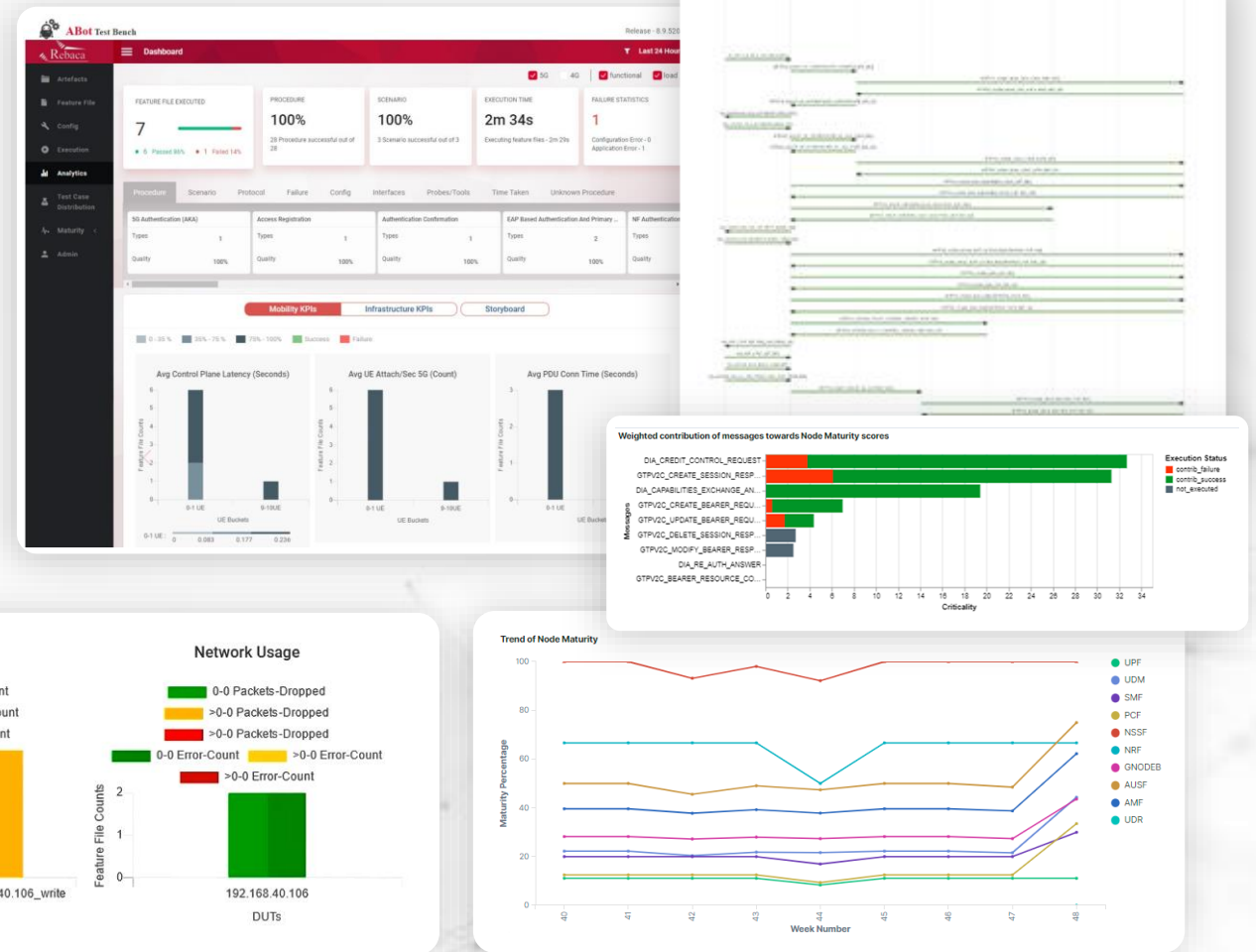
- Automated Service assurance and performance monitoring
- Third party API for rapid integration
- Validate both functional and performance over control and data plane.
- Support Dynamic Slice testing against different traffic type
- Ease of adding application functions testing
- Test script mapped to technical specification
- Automated generation of Test Scripts



Importance of Analytics for 5G Testing, Deployment, and Operation

DevOps based approach with continuous testing, analysis, integration, and deployment

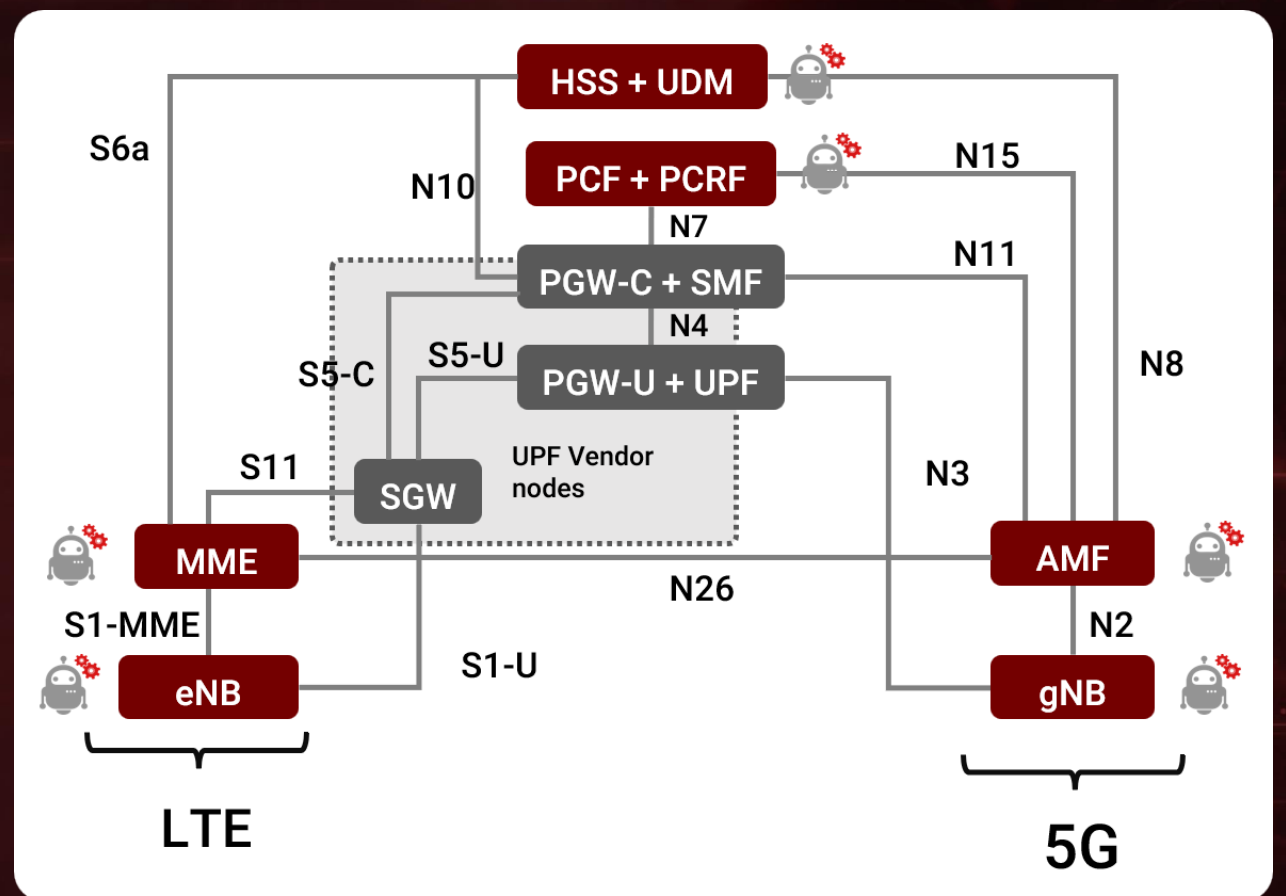
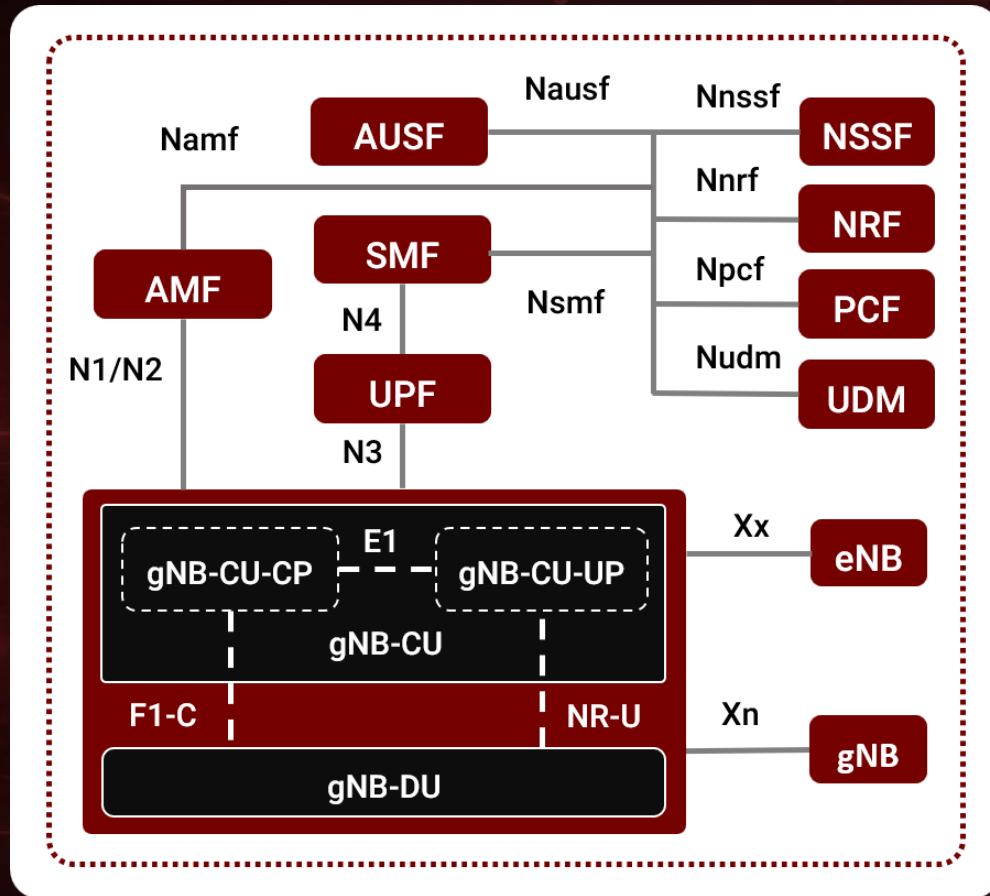
- Understanding the test results with **Root Cause Analysis**
- Deep analysis of **Logs, traces, KPIs**, etc.
- Classify **test authoring error, configuration error** or **application failure**
- Deriving **System/Infra KPIs** and **Mobility statistics** and analyzing them
- Generating **build analytics**





ABot

**Cloud native 4G/5G and ORAN
Network Protocol Tester**



MEC/Pods compatible Light Weight Protocol Stacks
for emulating any 4G/5G/ORAN components

Traffic characteristics analysis along with video traffic slicing support

High Bandwidth Video Streaming



Max First Buffer Duration
323 ms

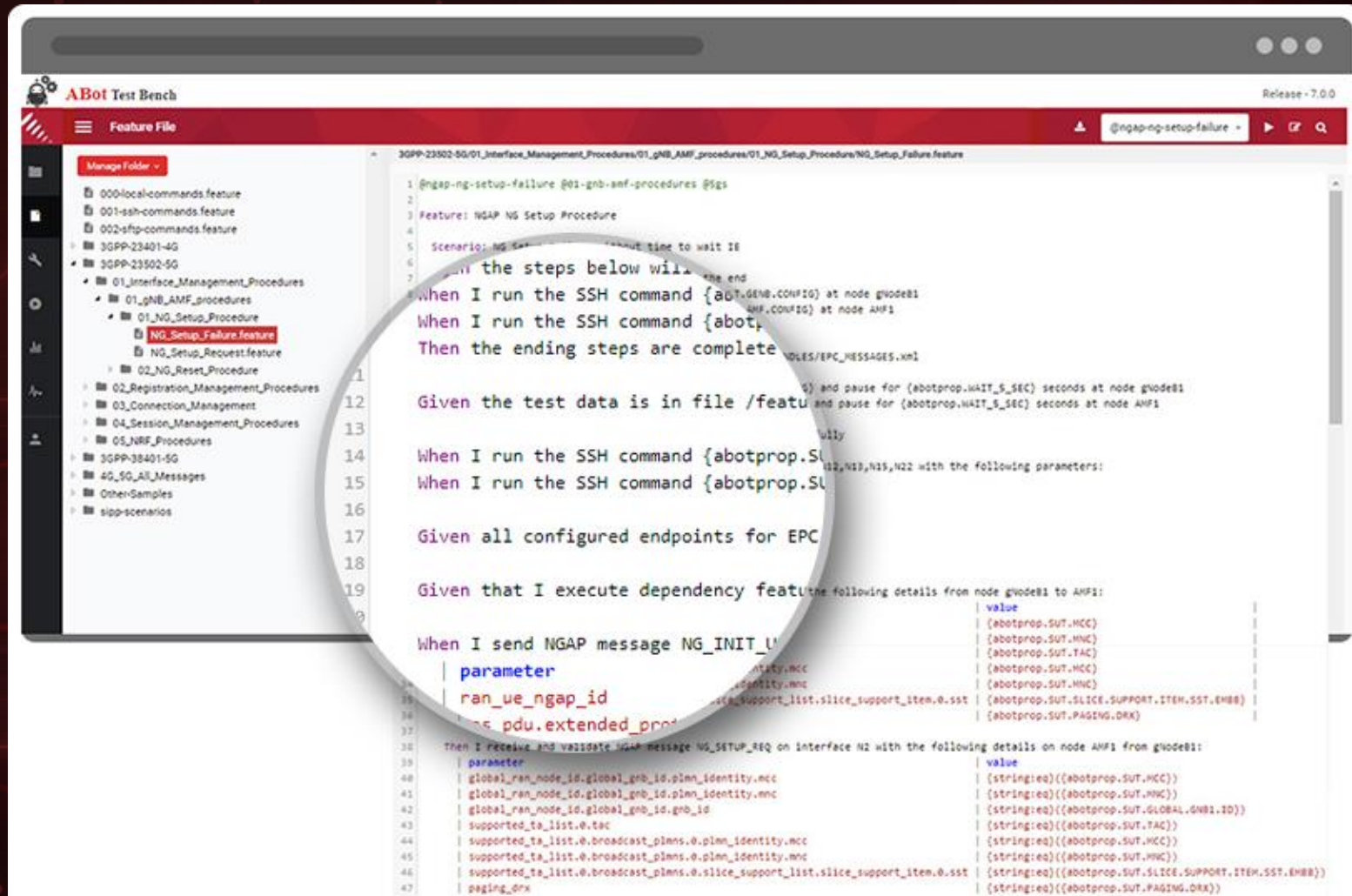
Max Total Buffer Duration
312.00 ms

Low Bandwidth Video Streaming

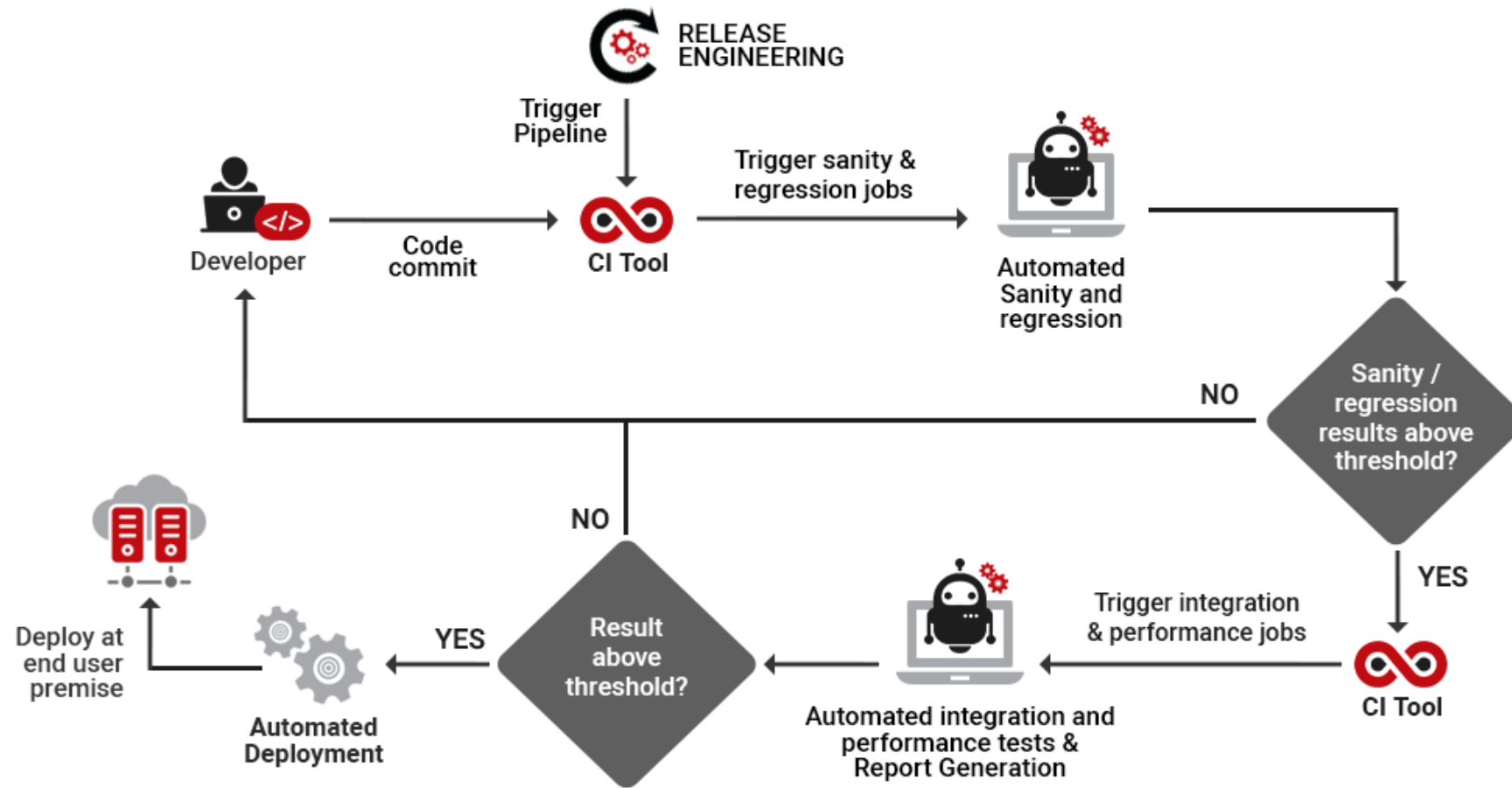


Max First Buffer Duration
184 ms

Max Total Buffer Duration
2.48 s



Provides extensive testing coverage on 5G /ORAN with english like test scripts
those are easy to modify , deploy, verify, debug to maintain a network.



CI/CD Support
for continuous testing, development & integration

The screenshot displays the 'Execution' window of the ABOT Test Bench. It features two real-time monitoring graphs:

- Transaction Counts:** A line graph showing the number of transactions over time. The y-axis ranges from 0 to 600. The x-axis shows timestamps from 14:15:40 to 14:15:50. The legend includes HSQL_GMT, IMEI, PDR_PDI, SPONG_SMT, and IMEI01.
- Uplink/Download Bandwidth:** A line graph showing bandwidth usage in Kbps. The y-axis ranges from 0 to 100K. The x-axis shows timestamps from 14:15:40 to 14:15:50. The legend includes HSQL_download, IMEI_download, PDR_PDI_download, SPONG_SMT_download, and SPONG_SMT_upload.

Below the graphs, a terminal window shows the command prompt and the execution of the test bench, displaying various system parameters and the start of the test run.

ABot Test Bench Release - 8.9.520a0

Dashboard Last 24 Hour

5G 4G Functional Load

FEATURE FILE EXECUTED

7 ■ 6 Passed 85% ■ 1 Failed 15%

PROCEDURE

100%
28 Procedure successful out of 28

SCENARIO

100%
3 Scenario successful out of 3

EXECUTION TIME

2m 34s
Executing feature files - 2m 29s

FAILURE STATISTICS

1
Configuration Error - 0
Application Error - 1

Procedure Scenario Protocol Failure Config Interfaces Probes/Tools Time Taken Unknown Procedure

5G Authentication (AKA)	Access Registration	Authentication Confirmation	EAP Based Authentication And Primary...	MF Authentication
Types: 1	Types: 1	Types: 1	Types: 2	Types:
Quality: 100%	Quality: 100%	Quality: 100%	Quality: 100%	Quality:

Mobility KPIs **Infrastructure KPIs** **Storyboard**

0-25% 26%-75% 76%-100% Success Failure

Avg Control Plane Latency (Seconds)

Feature File Counts

0-1 UE 9-10 UE

UE Buckets

0 0.083 0.177 0.236

Avg UE Attach/Sec 5G (Count)

Feature File Counts

0-1 UE 9-10 UE

UE Buckets

Avg PDU Conn Time (Seconds)

Feature File Counts

0-1 UE 9-10 UE

UE Buckets

[illegible]

Log Details

Procedure Summary

Param	Value
global_nen_node_id global_gpb_id plmn_identity_msc	608
global_nen_node_id global_gpb_id plmn_identity_msc	90
global_nen_node_id global_gpb_id gpb_id	12697203

Board

whvOfcs: NAME1, AMB1, POW1, UPF1, PCF1, SPONGE, SMF1, SMF1, PCRF1, AP1, HSS1, HSS1, UDM1, ENCODE1, NEF1, AMF1, NSGF1, ONCDER1, UDM1, SMF1, AUSF1, PCRF1, PCRF1, SPONGE, SMF1 and UDM1

AMETER, GTPVOC, S1AP, PCRF and GTPVOC are failing 9.14% of the time

ion failure [Assertion failed: Protocol Stack inactivity Timeout (NODE bhoed1) not responding. ...] was observed in 1 feature file

coverage in 14.2% in N10, 20.00% in N17, 23.58% in S1, NAME1, 25.00% in K1, 33.33% in S11, 34.00% in S15-S16, 37.50% in S1A, 40.00% in N11, 42.22% in N1, N12, 43.75% in N16, 50.00% in S2, 57.14% in N13, 71.43% in N14, 75.00% in NAME1, 80.00% in N12, 100.00% in N11, 100.00% in N13, 100.00% in S1, 100.00% in S11 and 100.00% in N22 interfaces

bers

subscribers on AMB1 N1, N2, 10 subscribers on AMB1 N11, 10 subscribers on AMB1 N12, 10 subscribers on AMB1 N15, 10 subscribers on AMB1 N16, 10 subscribers on AUSF1 N12, 10 subscribers on PCRF1 N15, 10 subscribers on SMF1 N11, 10 subscribers on SMF1 N14, 10 subscribers on UDM1 N10, 10 subscribers on UDM1 N13, 10 subscribers on UPF1 N1, 10 subscribers on UPF1 N14, 10 subscribers on gboed1 N1, N2 and 10 subscribers on gboed1 N1 were supported under load

procs of 10 subscriber on GTPVOC, 10 subscriber on HTTPV2, 10 subscriber on NSAF and 10 subscriber on PCRF were executed

Study network behavior models against real time production traffic patterns and analyzes the behavior needed for anomaly detection.

[illegible]

The screenshot displays the 'Kubernets_dashboard_monitoring' page with the following sections:

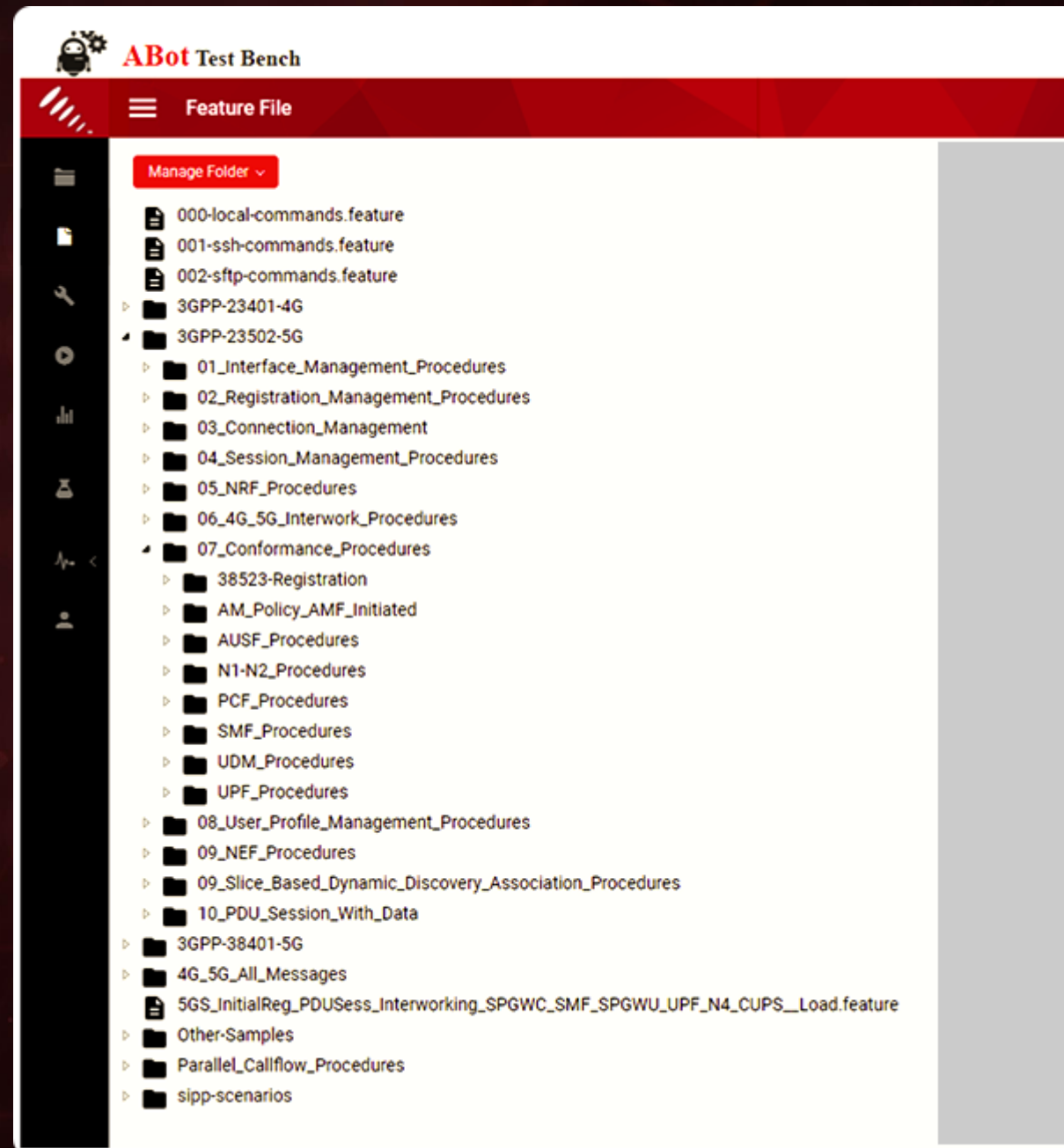
- Network I/O pressure:** A line graph showing network I/O pressure over time, with a significant spike at the end of the period.
- Total usage:** Three gauges showing resource usage percentages:
 - Cluster memory usage: 14%
 - Cluster CPU usage (1m avg): 6.87%
 - Cluster filesystem usage: 15.29%
 Below each gauge is a table with 'Used' and 'Total' values.
- Pods CPU usage:** A line graph showing pods CPU usage (1m avg) over time. A legend on the right lists various pod names and their CPU usage values.
- System services CPU usage:** A gauge showing system services CPU usage.
- Containers CPU usage:** A line graph showing containers CPU usage (1m avg) over time. A legend on the right lists various container names and their CPU usage values.
- All processes CPU usage:** A gauge showing all processes CPU usage.
- Pods memory usage:** A line graph showing pods memory usage over time. A legend on the right lists various pod names and their memory usage values.
- System services memory usage:** A gauge showing system services memory usage.
- Containers memory usage:** A line graph showing containers memory usage over time. A legend on the right lists various container names and their memory usage values.
- All processes memory usage:** A gauge showing all processes memory usage.
- Pods network I/O:** A line graph showing pods network I/O over time.

The screenshot shows a Grafana dashboard with the following components:

- Header:** Includes the Grafana logo, the text "2019-10-10", and a search bar.
- Top Row:**
 - Analyzed Issues:** A table with columns for "Analyzed Issues", "Status", and "Count". It shows a single entry for "2019-10-10" with a status of "Analyzed" and a count of 1.
 - Number of Subscribers per Day:** A line chart showing the number of subscribers over time. The x-axis represents time, and the y-axis represents the number of subscribers. A single data point is visible at 2019-10-10.
- Middle Row:**
 - PDB connection Time per DB - Top 10:** A table showing the top 10 databases by connection time. The columns are "Database", "Time", and "Status". The data shows a single entry for "2019-10-10" with a time of 10.000000 and a status of "Analyzed".
 - Negative Time per DB - Top 10:** A table showing the top 10 databases by negative time. The columns are "Database", "Time", and "Status". The data shows a single entry for "2019-10-10" with a time of 10.000000 and a status of "Analyzed".
- Bottom Row:**
 - Avg/Global/Range/Status:** A table showing the average, global, range, and status for the top 10 databases. The columns are "Database", "Avg", "Global", "Range", and "Status". The data shows a single entry for "2019-10-10" with an average of 10.000000, a global of 10.000000, a range of 10.000000, and a status of "Analyzed".
 - Avg/Global/Range/Status:** A table showing the average, global, range, and status for the top 10 databases. The columns are "Database", "Avg", "Global", "Range", and "Status". The data shows a single entry for "2019-10-10" with an average of 10.000000, a global of 10.000000, a range of 10.000000, and a status of "Analyzed".

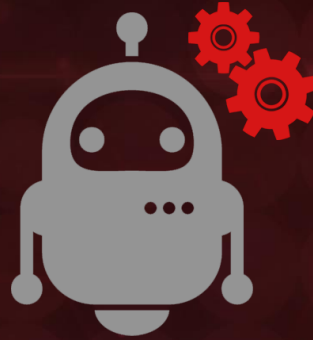
Correlation between Network Function performance and its infrastructure/mobility KPIs
and provides root-cause analysis for each use.

Plethora of 3GPP Chapter wise 4G/5G/ORAN Test case coverage



The screenshot displays the ABot Test Bench interface. At the top, there is a logo of a robot head with gears and the text "ABot Test Bench". Below this is a red header bar with a hamburger menu icon and the text "Feature File". On the left side, there is a vertical sidebar with various icons representing different test categories. The main area shows a tree view of test cases under the heading "Manage Folder". The tree structure is as follows:

- 000-local-commands.feature
- 001-ssh-commands.feature
- 002-sftp-commands.feature
- 3GPP-23401-4G
 - 01_Interface_Management_Procedures
 - 02_Registration_Management_Procedures
 - 03_Connection_Management
 - 04_Session_Management_Procedures
 - 05_NRF_Procedures
 - 06_4G_5G_Interwork_Procedures
 - 07_Conformance_Procedures
 - 38523-Registration
 - AM_Policy_AMF_Initiated
 - AUSF_Procedures
 - N1-N2_Procedures
 - PCF_Procedures
 - SMF_Procedures
 - UDM_Procedures
 - UPF_Procedures
 - 08_User_Profile_Management_Procedures
 - 09_NEF_Procedures
 - 09_Slice_Based_Dynamic_Discovery_Association_Procedures
 - 10_PDU_Session_With_Data
- 3GPP-38401-5G
- 4G_5G_All_Messages
- 5GS_InitialReg_PDUSess_Interworking_SPGWC_SMF_SPGWU_UPF_N4_CUPS_Load.feature
- Other-Samples
- Parallel_Callflow_Procedures
- sipp-scenarios



Thank You

To know more about ABot visit www.rebaca.com