

Landslide 5G Mobility Testing

Infrastructure Platform for the Evolution to 5G

Introduction

Keysight's Landslide 5G Mobility Testing platform incorporates device emulation and network testing capabilities that expand through various 3GPP releases (Release 13 and onward). The Landslide 5G testing feature set supports validation needs for the entire evolution path to 5G.

The Evolution to 5G

- The next generation of mobile networks, commonly known as 5G, promises a revolution in cellular communications enabling services such as massive IoT, Fixed Wireless Access, and enhanced Mobile Broadband (eMBB).
- Based on completely new radio access, core, and network design (including slicing, separation of control and user plane, and distributed network functions), 5G supports massive density of devices of any kind, operating at increased speeds with minimum latency, while making an efficient use of the network's resources.
- To ensure a successful adoption of this new technology, carriers and equipment manufacturers alike must define an evolution strategy (from 4G extensions and 5G non-standalone to true native 5G), and ensure that the infrastructure can handle the requirements of such an evolution.
- Keysight's Landslide emulates 5G devices and network functions to validate new 5G mobile and core nodes, ensuring their readiness to deliver high-quality 5G services.

In particular, Keysight's Landslide 5G Mobility Testing offers:



1. Extensions to 4G

- High-scale device emulation of all types including IoT devices as defined in the CAT-M and NB-IoT standards supporting PSM and eDRX
- IoT-specific node testing and emulators such as: CIoT Serving Gateway Node (C-SGN), Service Capability Exposure Function (SCEF), and the enhanced-for-IoT Home Subscriber Server (HSS)
- Network slicing testing and emulation in different forms such as Release 13 Dedicated Core (i.e., DECOR)
- Release 14 Control and User Plane Separation (CUPS), nodes testing with supporting node emulators such as SGW-C, SGW-U, PGW-C, PGW-U
- Virtualized-network testing supporting DevOps methodologies for optimized deployment
- Device and service Busy Hour call modeling

2. Non-Standalone 5G

- 4G/5G Dual-connectivity: High-scale 5G device emulation of any kind (e.g., smartphone, IoT, vCPE) with 4G and 5G radio access node emulation (eNodeB, gNB), for dual-connectivity testing as defined by Options 3, 3a, and 3x in 3GPP standards with multiple mobility scenarios
- Combined 5G and non-5G device load generation capability
- 5G to 4G fallback scenario emulation
- 4G to 5G and 5G to 4G S1-U reselection based on service requirements
- Device and service Busy Hour call modeling
- Full 4G Core emulation for 5G RAN and dual-connectivity testing
- gNB-DU emulation for gNB-CU ORAN testing in NSA mode

3. True-Native 5G

- High-scale 5G device and radio access (gNB) emulation to test 5G Core (5GC) with Intra and Inter RAT mobility (including EPS fallback) & VoNR
- High-scale 5G Core nodes testing and emulation (AMF, SMF, UPF) exposing and testing N1, N2, N3, N4, N6, N8, N11 interfaces
- 5G Service nodes testing and emulation (AUSF, CHF, LMF, NEF, NRF, NSSF, PCF, UDM, EIR, SEPP, CBCF, GMLC, UDSF, NSSAAF, UCMF, NWDAF, SLF, SMSF, SCP, UDR, BSF, TWIF) exposing and testing relevant interfaces
- Full 5G Core and content emulation for 5G RAN and device testing
- Support for complex Native CUPS and Native Slicing topologies
- 5G Chaos engineering for CNF Resiliency testing
- Test packages with CI/CD ready, fully automated test cases
- SCAS-compliant Security Testing

System Overview

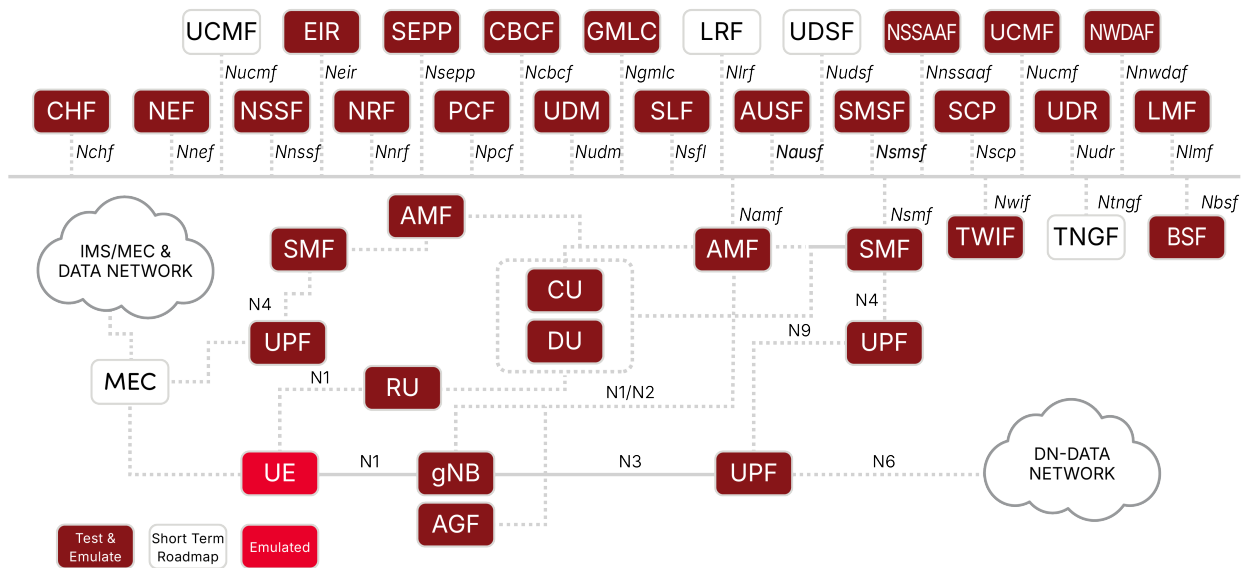


Figure 1. Chart displaying Landslide 5G Mobility Testing system overview

Landslide 5G emulation feature set, capacities, and performance align with the requirements of the evolution towards 5G, in its capacity to emulate millions of devices of all types communicating with the network at rates of tens of thousands of events per second and traffic of 100s of Gigabits per second. With its unique dynamic testing capability, Landslide can test all the 4G and 5G infrastructure nodes in isolation and subsequently change the testing topology to progressively incorporate more nodes to the testbed for a full end-to-end (E2E) network or slice validation.

Complex 5G call modeling scenarios can be created that include specific 5G devices in various stages of activation, deactivation, dual-connectivity, handovers, and 5G data transfers. Carriers can also capture measurements in the live 5G network and replicate them in the lab with Landslide for increased realism in the testbed.

The Landslide Message Editor enables custom variations of messages in key interfaces to allow users complete development of the rapidly changing interfaces from one 3GPP version to another. It is supported on N1, N11 and the 5G SBA interfaces.

In addition to its extensive 5G testing capabilities, Keysight Landslide also offers individual 5G-related node emulators (e.g., gNB, gNB-DU, gNB-CU, AMF, SMF, UPF, AUSF, CHF, LMF, NEF, NRF, NSSF, PCF, UDM, SGW-C, SGW-U, PGW-C, PGW-U, etc.). This emulation option is ideal for lab setups where a 3GPP-compliant node is required to complete a test objective.

Applications

- **Generate** massive scale of device connections and diverse speed traffic patterns to the network as it is expected in 5G
- **Validate** virtual core 5G deployments throughout the entire DevOps lifecycle
- **Verify** compliance up to 3GPP Release 17 of 5G core nodes, interfaces, and service points in isolation prior to network integration
- **Validate** CUPS multi-node deployment per-service scaling and performance
- **Define** network slicing (e.g., Native 5G, EDECOR, DECOR, etc.) based on services requirements and verify correct slice traffic routing
- **Quantify** slices' performance in terms of latency and throughput
- **Validate** support of 5G Location to enhance the offered services (Nlmf and Lpp)
- **Emulate** 5G UEs over Wi-Fi to verify non-3GPP access to the 5G N3IWF and AMF
- **Validate** Intra-5G and I-RAT mobility and Inter-Technology mobility, Xn, N2 Handovers, 5G to 4G and back to 5G mobility, EPS Fallback with N26 support, plus 5G to ePDG Handover
- **Test** Dual-RAN access against different EPCs and network slices
- **Analyze** RAN performance and handoff based on service quality requirements
- **Manipulate** handsets to test RAN or the entire network from device perspective
- **Design** backhaul size and connectivity to support 5G demands
- **Perform** progressive network integration and interoperability of the new 5G nodes
- **Validate** confidentiality (SUPI encryption) and authentication mechanisms (5G AKA/5G EAP-AKA') as defined by 5G's enhanced security requirements
- **Evaluate** optimal number of PDU sessions and their associated serving network slices based on services requirement
- **Verify** mobility behavior under different Session and Service Continuity (SSC) Modes (1, 2, 3)
- **Validate** advanced services such as 5G Roaming, MCPTT, RedCap, NTN, FWA, and FMC
- **Validate** 5G-based private networks based on Standalone Non-Public Networks (SNPN) functionality
- **Test** robustness and resiliency of the AMF and SMF to negative scenarios
- **Design** automated procedures of network function distribution and Local Area Data Network (LADN), around Multi-Access Edge Computing (MEC)
- **Analyze** and monitor quality of 5G services under real-world conditions
- **Characterize** traffic prioritization and resources management policies for 5G in shared networks
- **Verify** compliance, performance, and capacity of ORAN components like gNB-CU & gNB-DU
- **Perform** load testing with busy hour call modeling with real-world traffic and user data
- **Measure** voice and video quality under real-world load conditions
- **Verify** CNF's resiliency to cloud-native impairments and measure impact on 5G service quality
- **Test** lab completion with related emulators: AMF, SMF, UPF, AUSF, CHF, LMF, NEF, NRF, NSSF, PCF, UDM, SEPP, CBCF, GMLC, UDSF, NSSAAF, UCMF, NWDAF, SLF, SMSF, SCP, UDR, BSF, TWIF, SGW-U, SGW-C, PGW-U, EIR, PGW-C, gNB, gNB-DU, gNB-CU, RIC

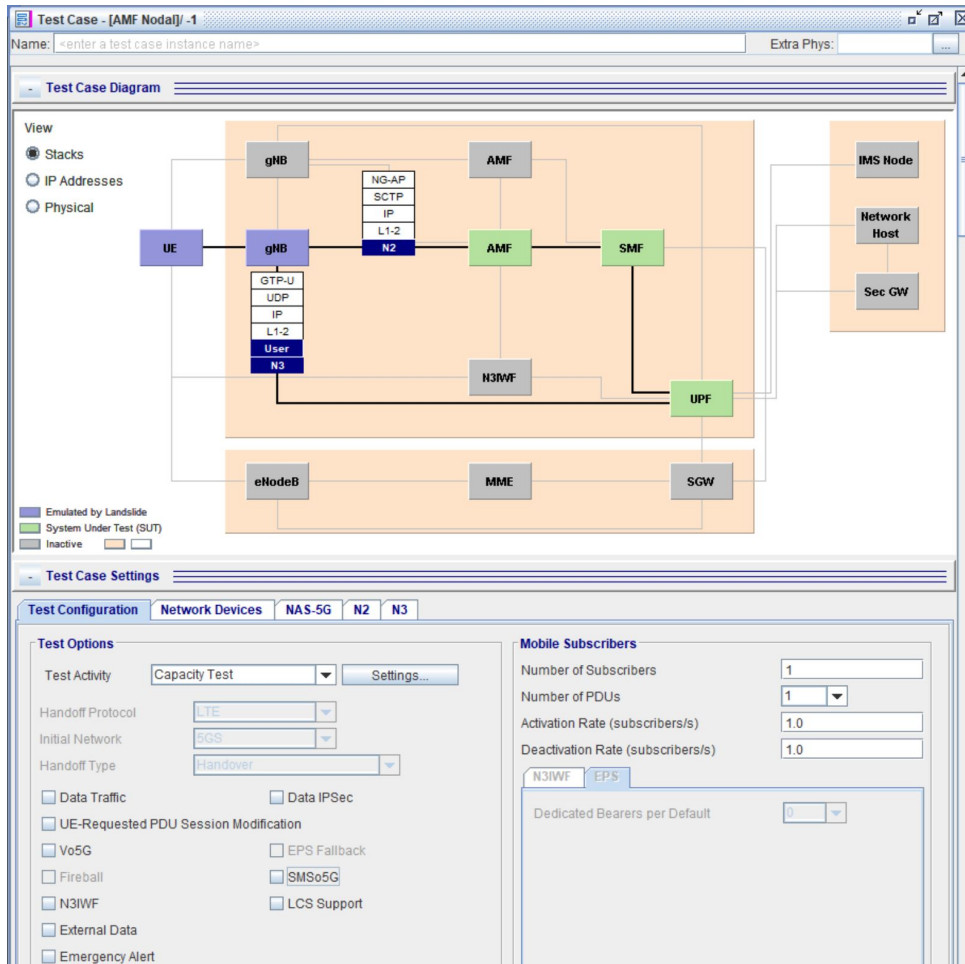


Figure 2. Landslide 5G system screenshot: Test Configuration panel

Table 1. 3GPP 5G Technical Specifications

TS 23.501 v15.3.0	TS 29.244 v16.5.0	TS 29.509 v15.4.0	TS 29.525 v16.7.0	TS 33.501 v15.5.0
TS 23.502 v15.3.0	TS 29.500 v16.0.0	TS 29.509 v16.6.0	TS 29.531 v15.4.0	TS 37.340 v15.2.0
TS 23.502 v16.5.0	TS 29.502 v15.2.1	TS 29.510 v15.4.0	TS 29.540 v16.0.0	TS 38.412 v15.2.0
TS 23.503 v15.3.0	TS 29.503 v15.4.0	TS 29.512 v15.4.0	TS 29.551 v17.1.0	TS 38.413 v16.2.0
TS 24.501 v16.5.0	TS 29.507 v15.4.0	TS 29.514 v16.8.0	TS 29.572 v15.4.0	
TS 24.502 v15.2.0	TS 29.507 v16.7.0	TS 29.518 v15.2.0	TS 29.594 v15.4.0	
TS 29.122 v17.0.0	TS 29.508 v15.4.0	TS 29.519 v17.1.0	TS 32.291 v15.4.0	

Table 2. Ordering Information

Description	Part Number
5G Roaming Test Application	L-APP-060
5G NEF Service Node Test	L-FT-121
5G NRF Service Node Emulation	L-FT-124
5G SMSF Node Emulation	L-FT-126
5G LMF Service Node Test	L-FT-127
5G GMLC Service Node Test	L-FT-129
5G GMLC Service Node Emulation	L-FT-130
5G UDR Service Node Test	L-FT-135
5G UDR Service Node Emulation	L-FT-136
5G BSF Service Node Test	L-FT-139
5G BSF Service Node Emulation	L-FT-140
5G SCP Service Node Test	L-FT-155
5G SCP Service Node Emulation	L-FT-156
5G SLF Service Node Test	L-FT-157
5G SLF Service Node Emulation	L-FT-158
5G Negative testing over SBI	L-FT-162
5G CBCF Service Node Emulation	L-FT-163
5G AMF NGAP Cause Code	L-FT-166
5G Core IE Validation	L-FT-167
5G SBI IE Validation	L-FT-168
5G AGF Node Test	L-FT-172
5G NAS (SM & MM) Cause Codes	L-FT-173
5G SBI mTLS (mutual TLS)	L-FT-175
5G SBI NEF N33 Interface	L-FT-176
5G AGF Node Emulation	L-FT-178
5G NRPPa (NR Positioning Protocol A)	L-FT-179
ORAN F1 Message Editor	L-FT-183
5G SMF Roaming	L-FT-185
5G NWDAF Service Node Test	L-FT-186
5G NWDAF Service Node Emulation	L-FT-187
5G SMF Negative Testing	L-FT-188
5G URLLC testing	L-FT-189
5G NF Set	L-FT-191
5G ATSSS	L-FT-192
5G CBCF Service Node Test	L-FT-207
5G AMF Node Test for Roaming	L-FT-208
5G AMF Node Emulation for Roaming	L-FT-209
5G EoGRE Test	L-FT-212
5G Reduced Capability (RedCap) Device	L-FT-213
5G NTN Test	L-FT-214
5G Roaming PCF Emulation	L-FT-217
5G Roaming SMSF Emulation	L-FT-218
5G AUSF Service Node Emulation	L-FT-294
RAN gNB-CU 5G NSA Test	L-R-APP-080
RAN gNB-CU 5G SA/NSA Emulation	L-R-APP-081
RAN gNB-CU 5G SA Test	L-R-APP-082
RAN non-RT RIC Test	L-R-APP-083
RAN near-RT RIC Test	L-R-APP-084
RAN non-RT RIC Emulation	L-R-APP-085
RAN near-RT RIC Emulation	L-R-APP-086
RAN gNB-CU 5G SA Emulation Add-on	L-R-FT-081
ORAN F1 Message Editor	L-R-FT-183
ORAN E2 Message Editor	L-R-FT-210
ORAN CU SA Nodal Command Mode	L-R-FT-211
ORAN A1 Message Editor	L-R-FT-214
5GC Capacity/Performance Test Library	L-L5AP-001
5GC Compliance Test Library	L-L5AP-002
5GC Security Test Library	L-L5AP-003
ORAN CU Compliance Test Library	L-R-L5AP-004
ORAN CU Capacity/Performance Test Library	L-R-L5AP-005

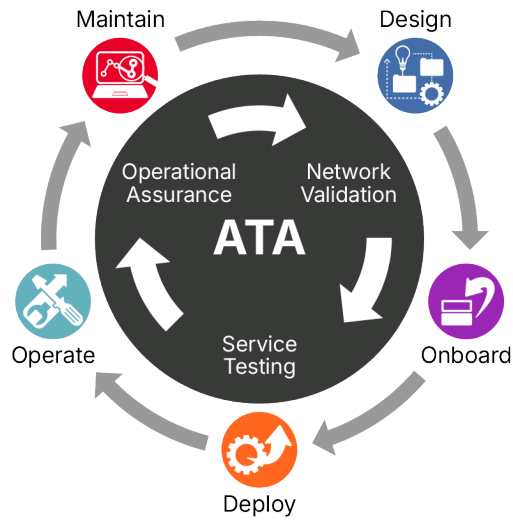


Figure 3. Flywheel chart showing Landslide's evolution path to 5G

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