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ОБЗОР РЕШЕНИЙ ДЛЯ МОБИЛЬНОГО ОПЕРАТОРА

CELLULAR NETWORK TEST PRODUCT PORTFOLIO

RAN,CORE,IMS test in the lab at scale

- Used before and after service rollout
- Automatable for continuous regressions
- Validate scale and performance
- Wrap-around or end-to-end

Modular, highly scalable, high performance

Available as SW-only as well (VE)

GUI driven test configuration

Stateful traffic

XGS-12HS/SD

XAir2

PerfectStorm

XGS2-HS

6GHz Radio Head

IxLoad VE

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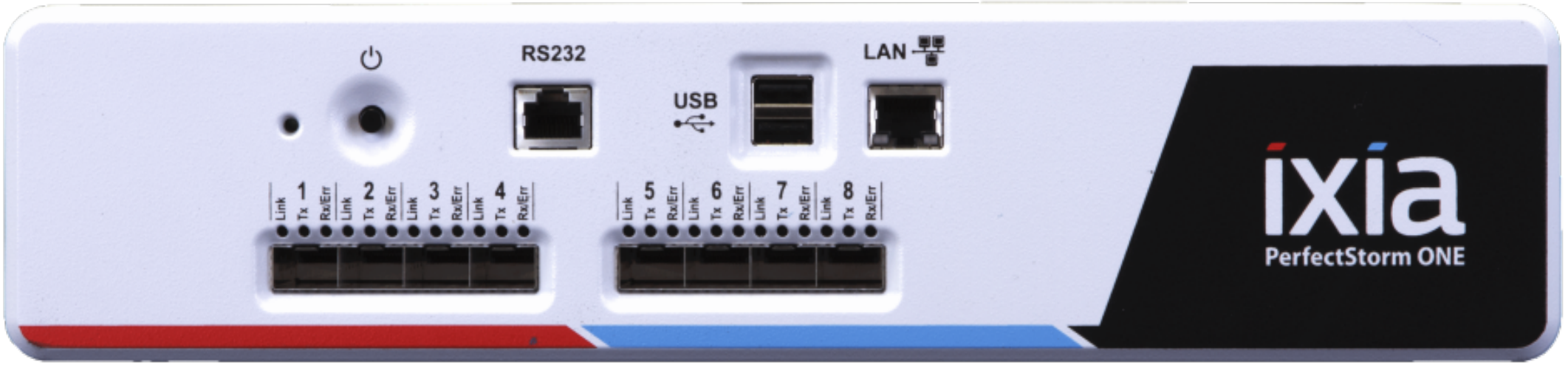
PORTABLE APPLIANCES



PerfectStorm ONE 8 ports SFP+ L4-7

- 1,10,40,100G ports with fan-out technology
- Same performance equal to separate load module
- Flexible HW licensing, can start from 2 ports with future field upgrades
- Can run ixLoad and Breakingpoint SW for wireless and security testing in same platform

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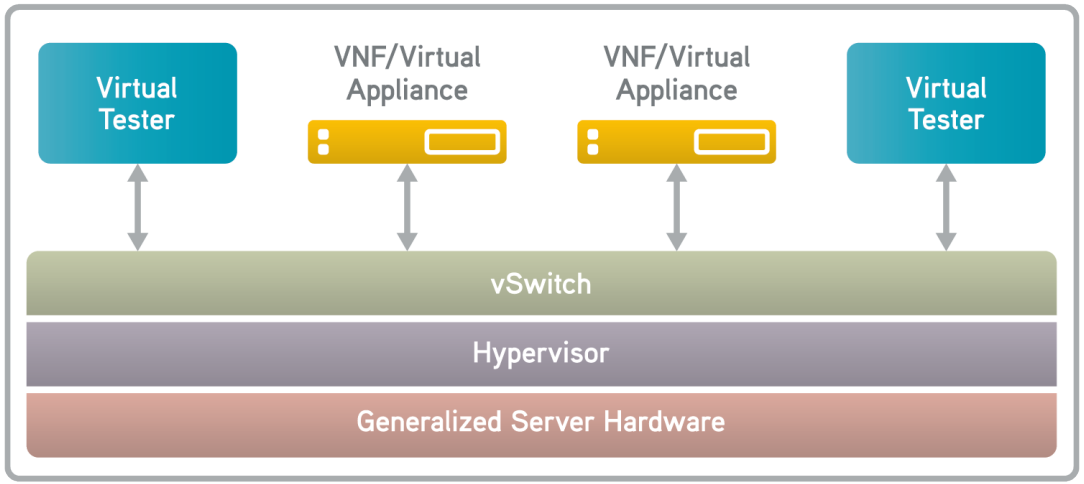
VIRTUAL PORTS

- Fast POC, prove competitive advantage
- Low cost and great for projects with short timeframe
- Enables HW, VM/VNF, cloud appliances testing
- Performance linear scale with license units (1/10G)
- Floating licensing, central license server
- PCI-PT, SR-IOV, DPDK acceleration
- Fast deployment with wizard
- Subscription (1 month / 1 year) or permanent licensing

IxLoad VE

IxNetwork VE

BreakingPoint VE



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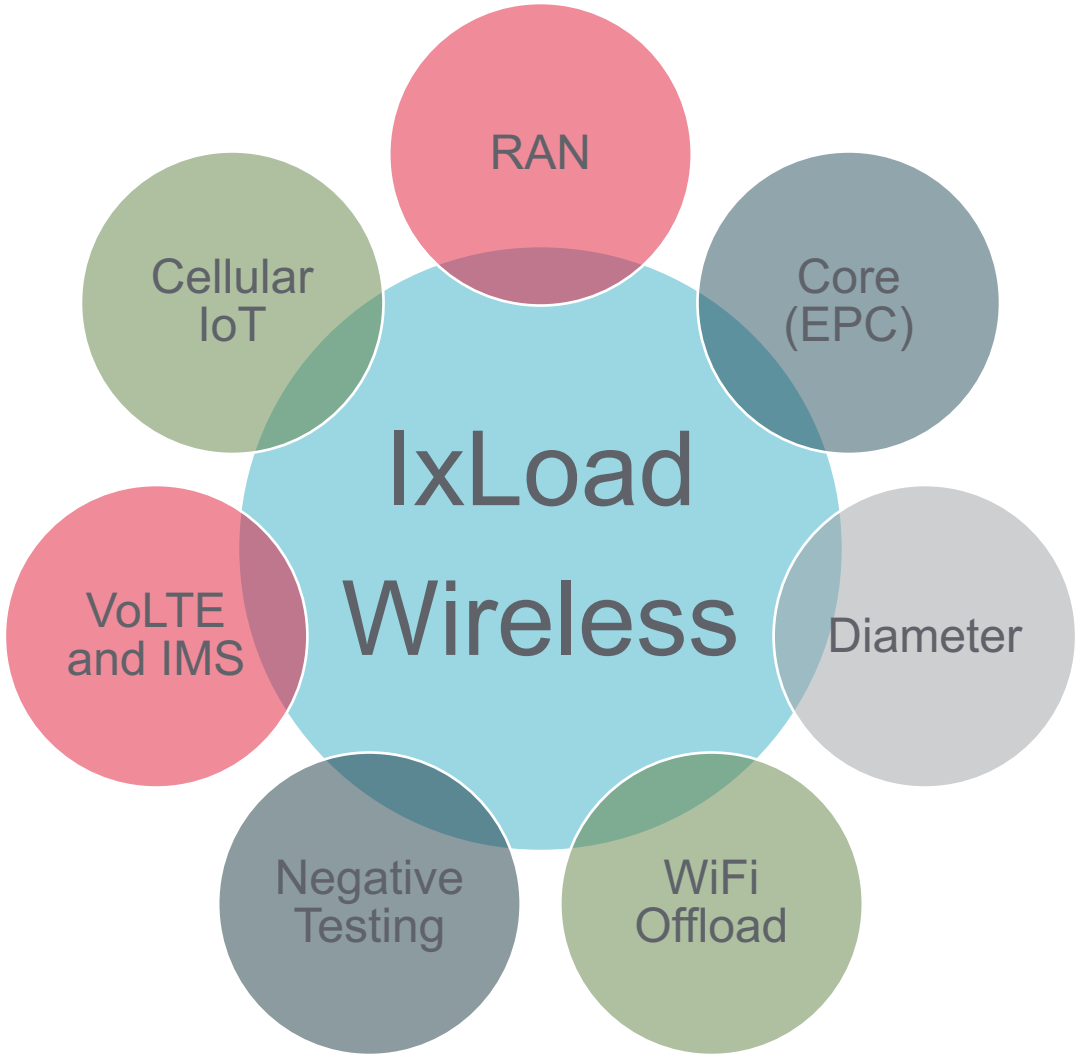
ISG CELLULAR NETWORK 4G TEST SOLUTION

- **Single Product**
  - Can emulate and test the entire cellular network, from Radio Access to the IMS Core, including Diameter and WiFi Offload
  - With custom hardware or software-only (VE)
- **Realism**
  - Advanced subscriber modeling for complex call models
  - Highly configurable VoLTE and Diameter solutions
  - Easy to use
- **High Performance and Scalability**
  - Line-rate, state-full, real traffic generation
  - Emulate an entire country with one 12U chassis
  - Ixia's HW or SW-only



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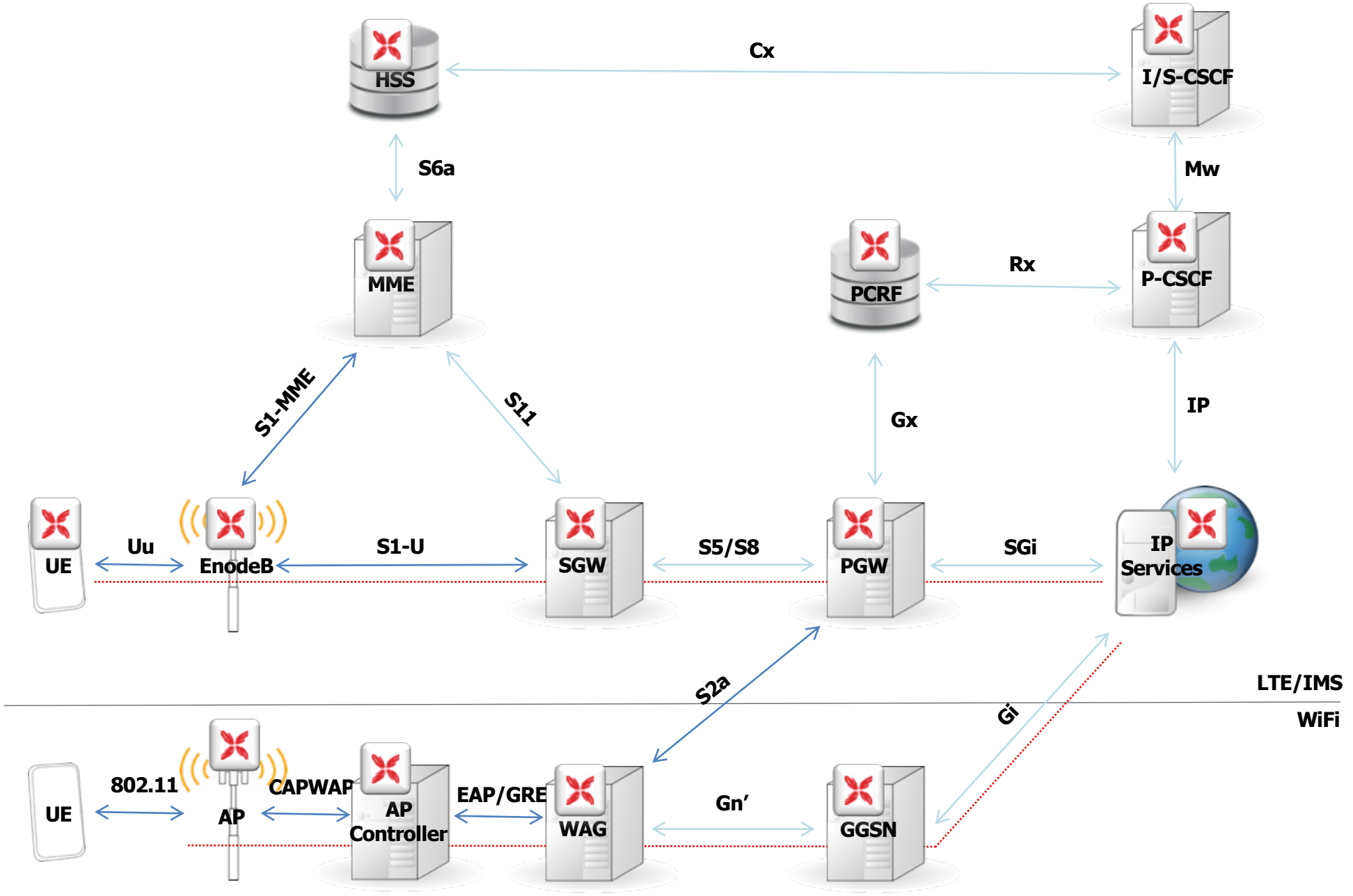
END-2-END TESTING



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НАГРУЗОЧНОЕ ТЕСТИРОВАНИЕ С IXLOAD WIRELESS

IXLOAD - KEY SOLUTION BENEFITS

Single Product

- IxLoad can emulate and test Applications, Video and Voice delivery, including LTE, IMS Core, and Wi-Fi offload
- Available both with dedicated hardware and software-only (VE)

Realism

- Advanced subscriber modeling for complex call models
- Flexible flows

High Performance and Scalability

- Line-rate, stateful, real traffic generation
- Emulate an entire country with one Ixia Chassis

Multiplay Service Delivery Over Wired & Wireless Networks

Application Delivery | Video Delivery | Wireless | Security | Voice Delivery

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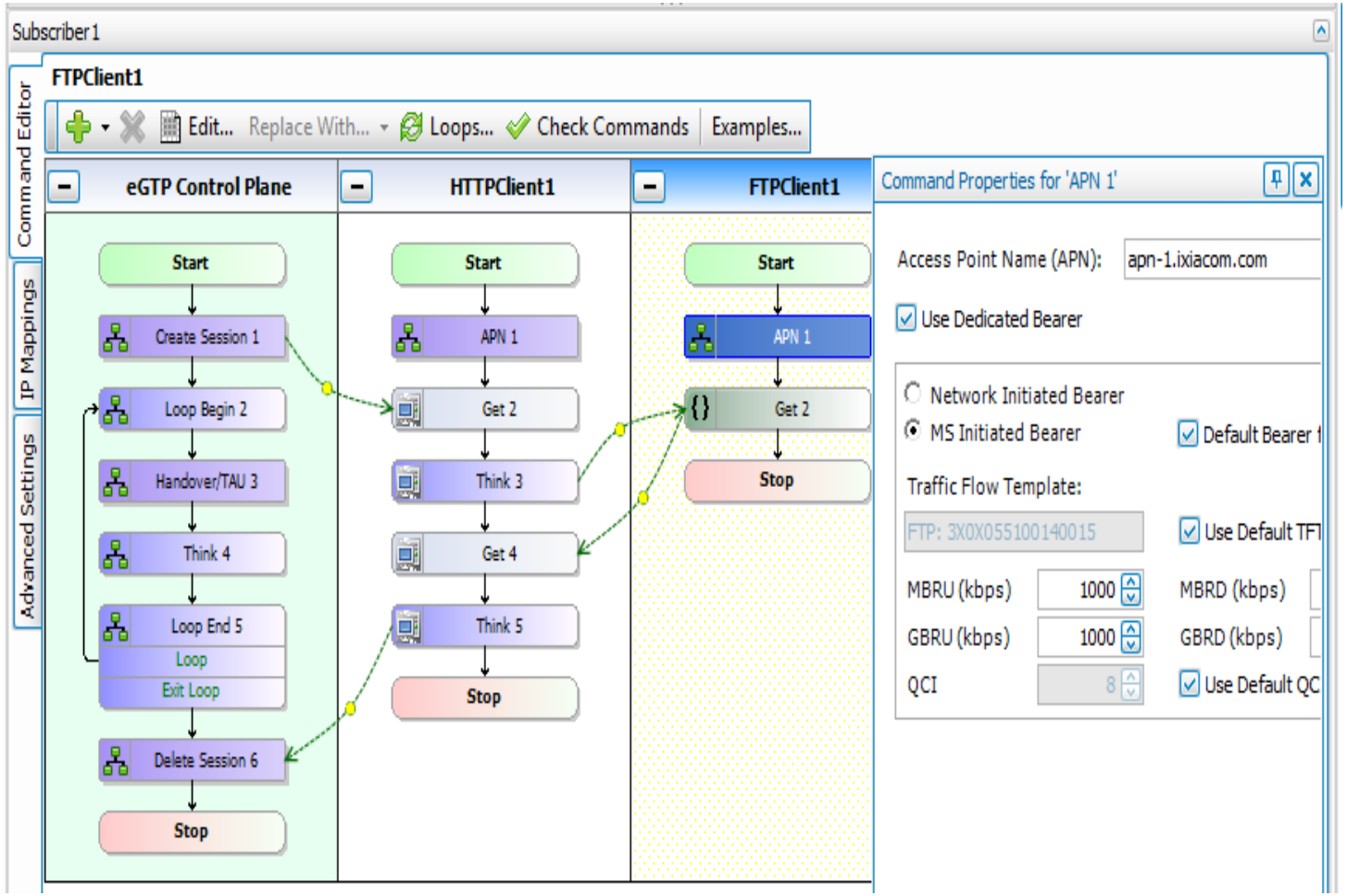
TEST DESIGN – REALISTIC SUBSCRIBER MODELING

Precise control of subscriber behavior:

- TAU, IDLE, handover, paging
- Default and dedicated bearer usage
- Synchronize between Application Traffic and Wireless subscriber actions



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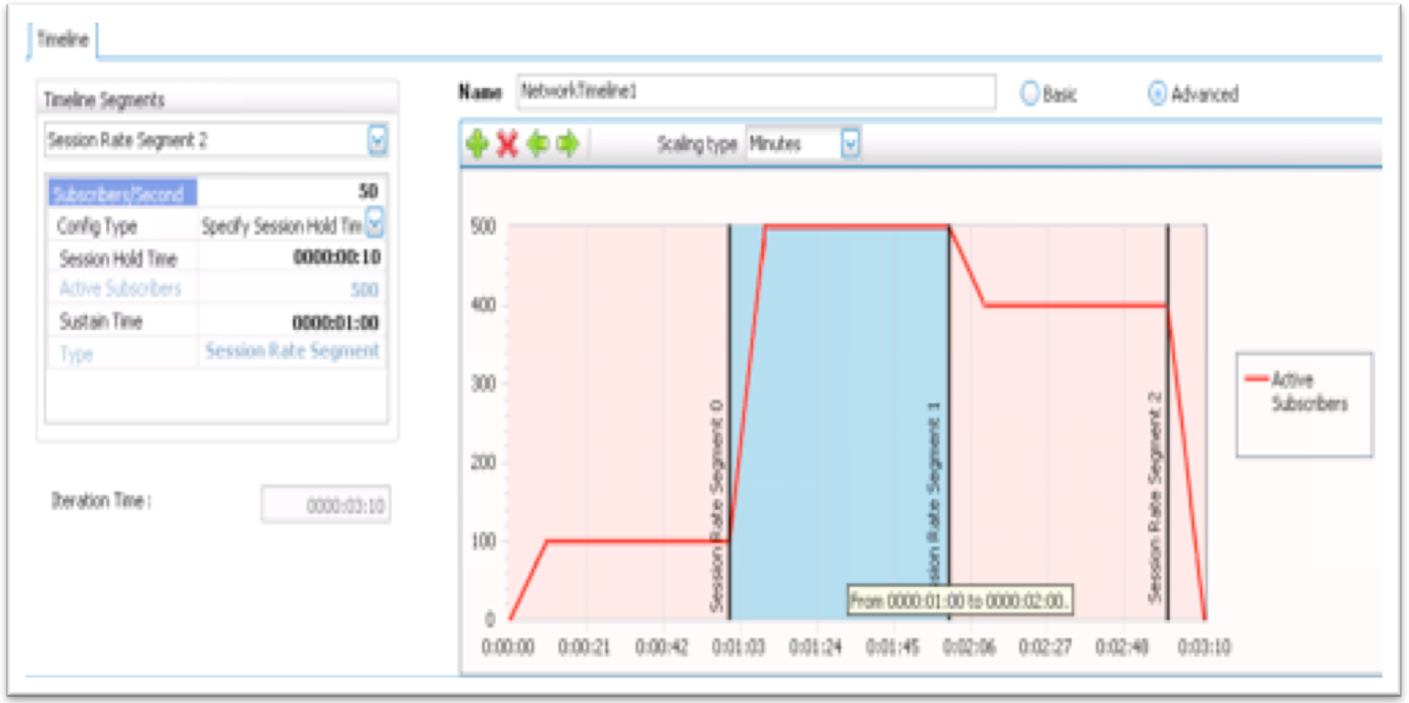
TEST DESIGN – SET TEST OBJECTIVES AND TIMELINE

- BHCA tests with constant and deterministic control plane activity
- Each activity can have its own multiple objectives:
  - Subs/sec (BHCA)
  - Handovers/sec
  - TAUs/sec
- Define session duration or amount of subscribers
- Throughput, Connections per Second (and many more) objectives for each type of Traffic
- Objectives can be modified on the fly while test is running



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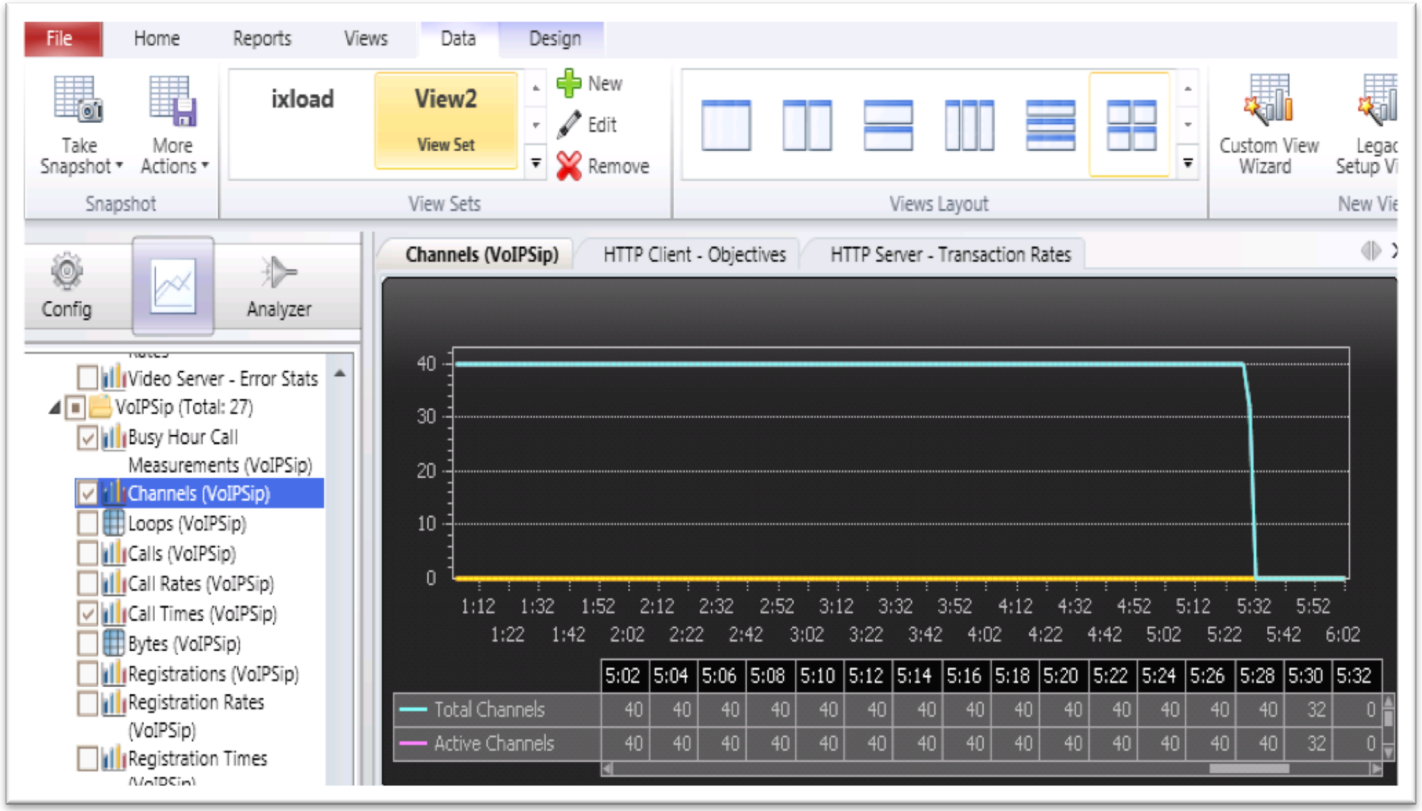
REAL-TIME STATISTICS

- Extensive real-time statistics (hundreds of stats for each emulated entity)
  - With CSV exporting and also automation TCL/REST APIs
- Multi-service per-flow/subscriber QoE
  - Analyze the impact of services on a per session basis
  - Set filters on statistics based by specifying conditions in order to isolate errors and failures
- Flexible views and custom graphs



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OVER THE TOP (OTT) VIDEO SERVICES

- Comprehensive OTT video client emulations – Flash, HLS, Silverlight, HDS and DASH
- Create realistic scenarios with user behavior to seek and pause/resume playback
- Use adaptive streaming to model real device behavior that considers network bandwidth to upshift or downshift automatically
- Complete application-level metrics include manifest and video/audio fragments + VQmon QoE metrics

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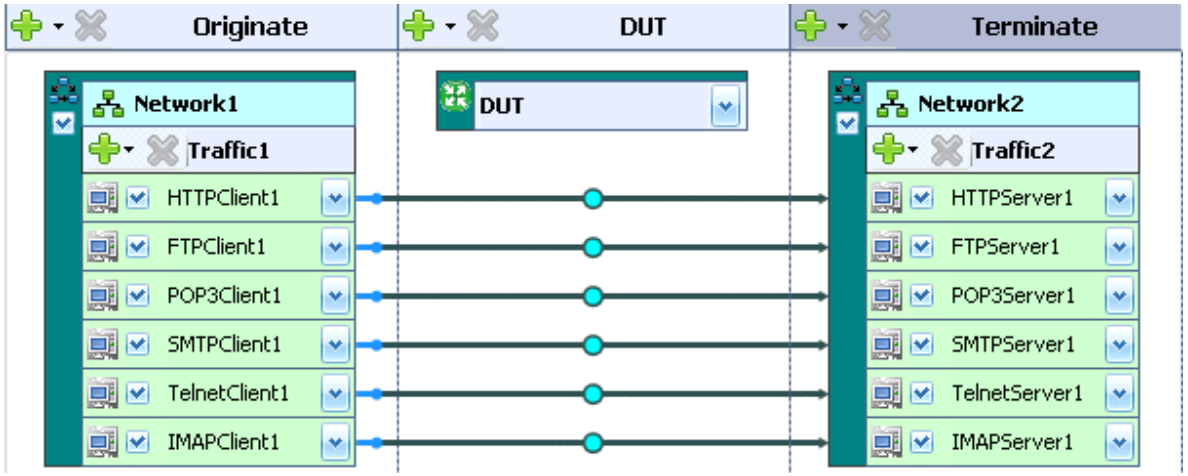
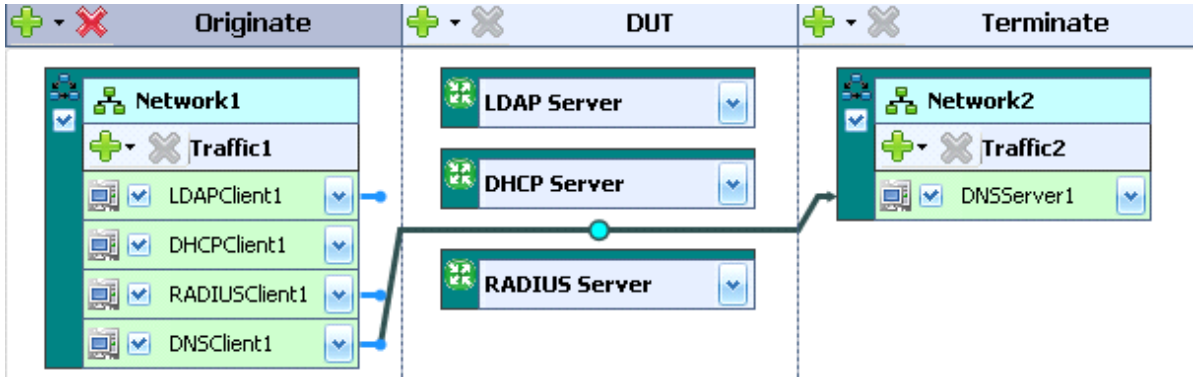
ТЕСТИРОВАНИЕ WEB & DATA

- HTTP, SSL/TLS, HTTP/2, FTP, Email, БД
- Работа через прокси и NAT
- Payload = реальные файлы
- Статистики QoE
- Воспроизведение трафика из pcap L2-L4





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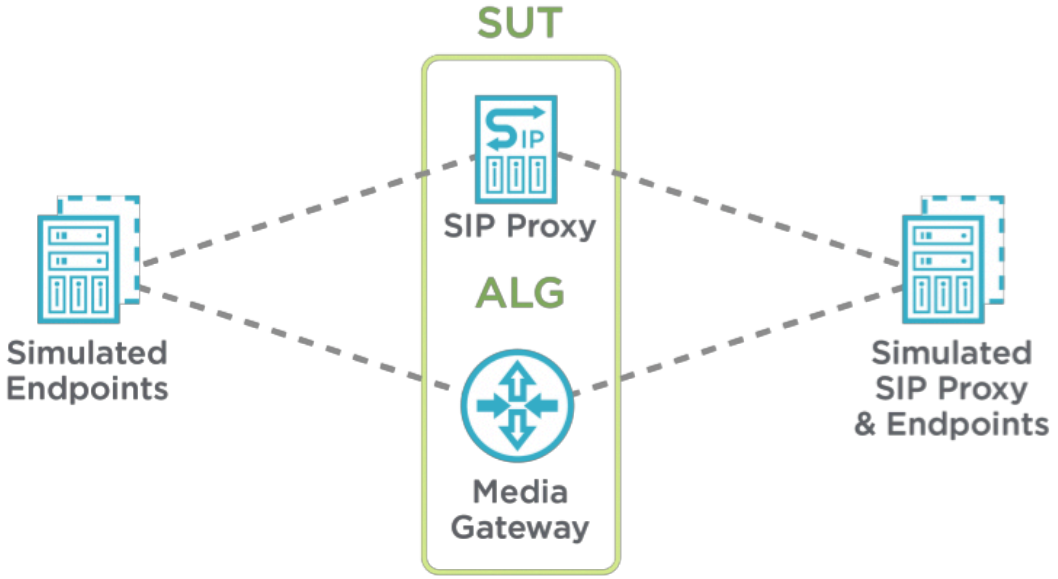
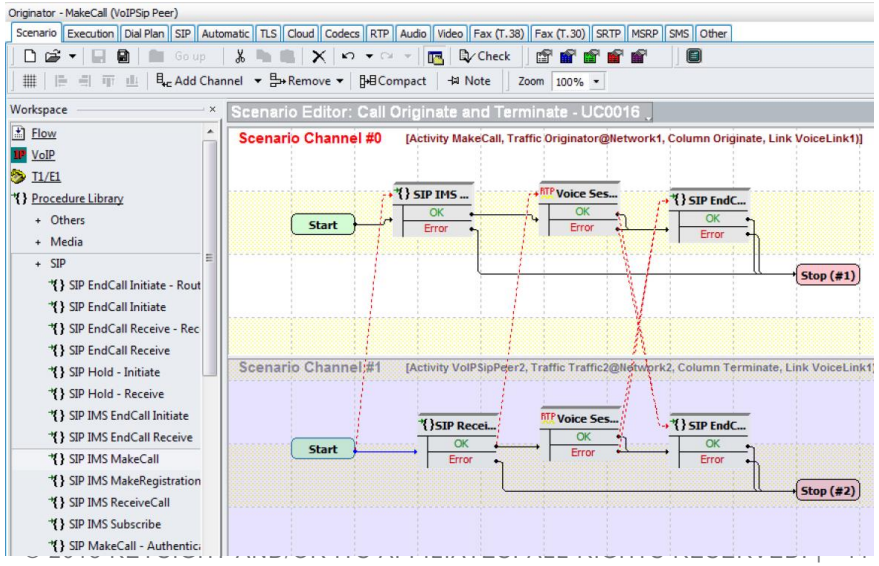
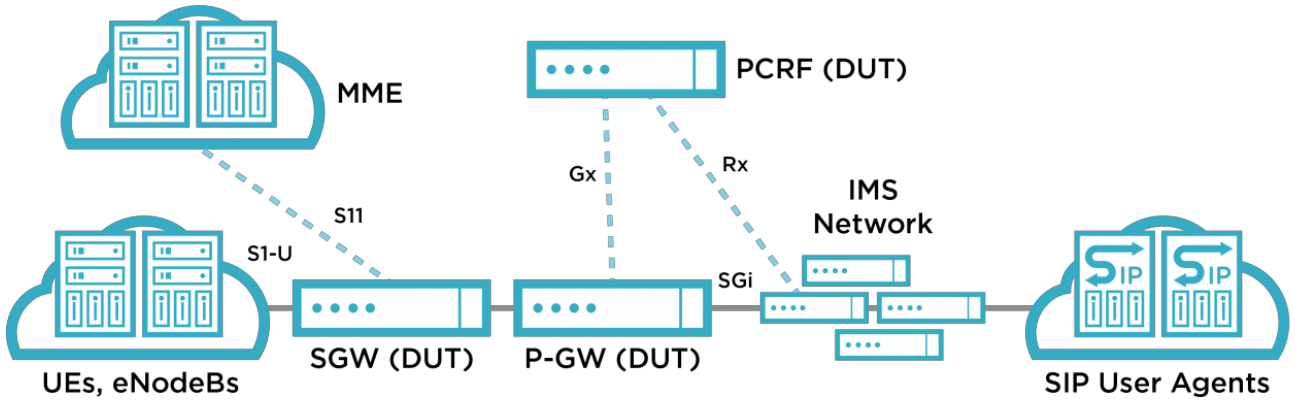
ТЕСТИРОВАНИЕ VOIP IMS & VOLTE

- SIP, MGCP, H.248, SKINNY, RTP/SRTP
- Все необходимые кодеки + факс T.38
- UDP, TCP, TLS, WebSocket, Secure WebSocket
- MOS: E-Model, POLQA, PESQ
- Графический редактор callflow
- DTMF, ВКС, SMS







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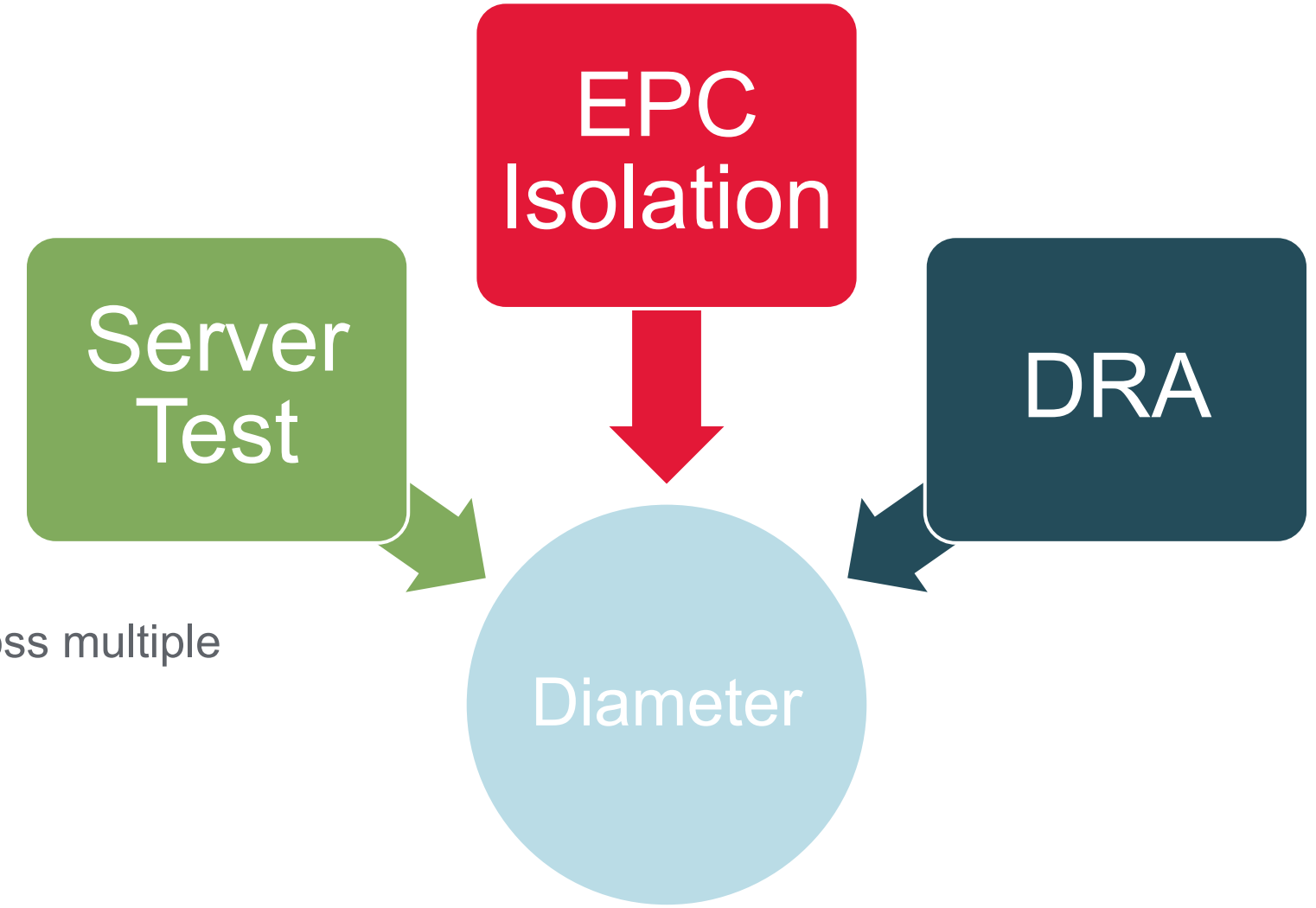
IXLOAD DIAMETER

DIAMETER TESTING SCENARIOS



- Functional testing
- Coordinated simulation across multiple interfaces or nodes
- Negative scenarios
- Conformance testing
- Performance

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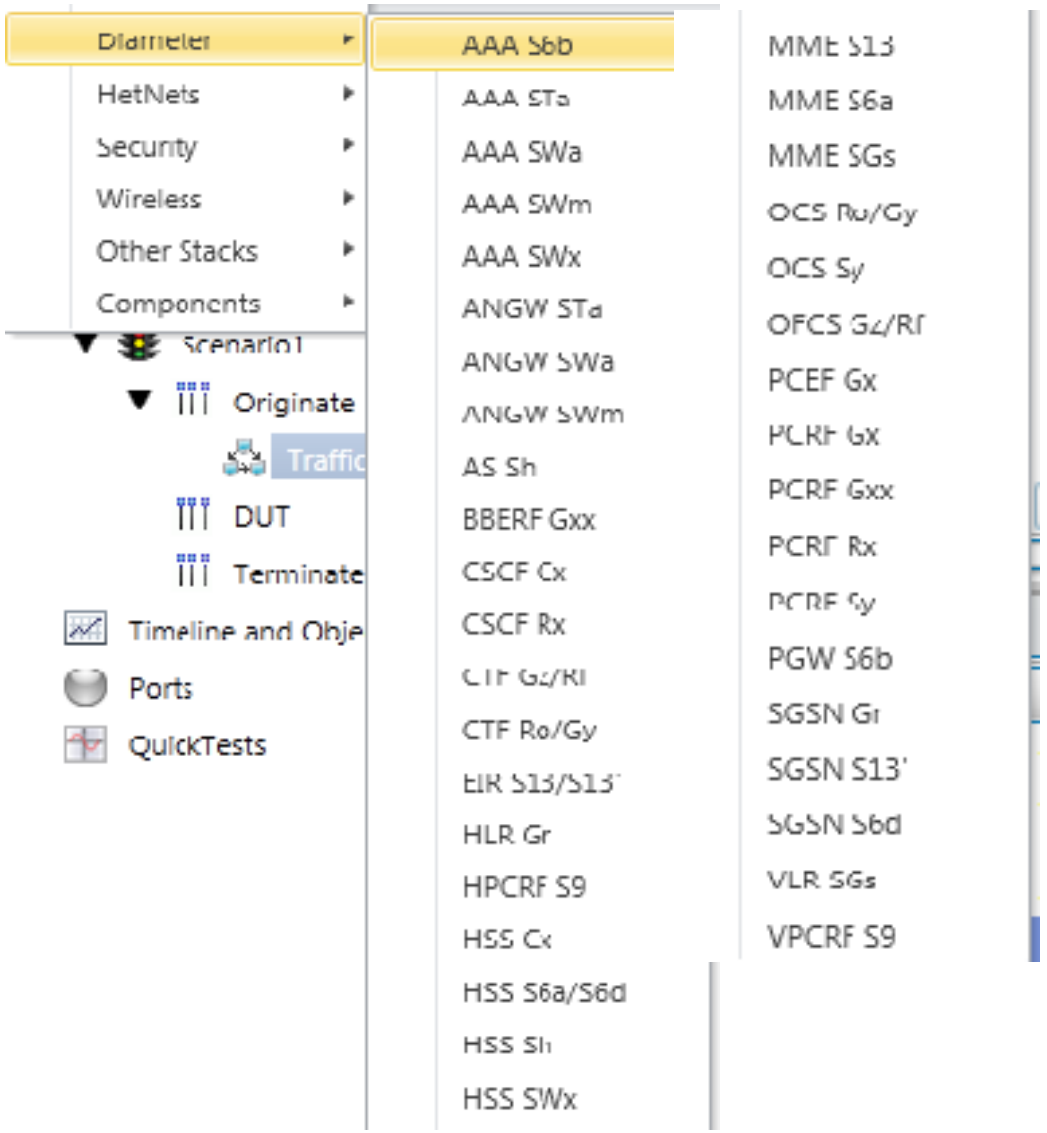
DIAMETER INTERFACE SUPPORT

1. S6a - HSS and MME
2. S6d - HSS and SGSN
3. Gx - PCRF and PCEF
4. Ro/Gy - PCEF and OCS
5. S6b - AAA and PGW
6. Rx - CSCF and PCRF
7. STa - AAA and ANGW
8. Sh - HSS and AS
9. Cx - CSCF and HSS
10. Sy - OCS and PCRF
11. SWm – **AAA and ePDG (Evolved Packet Data Gateway)**
12. SWa - **AAA and AN GW (Access Network GW for untrusted non-3GPP)**
13. Rf/Gz - PGW and OFCS; OFCS and CSCF
14. Gr/Gr' – SGSN and HLR
15. SGs – MME and VLR
16. S9 – V-PCRF and H-PCRF
17. SWx/Wx – AAA and HSS
18. S13/S13' – MME and EIR; SGSN and EIR
19. Gxx (Gxc & Gxa) - SGW and PCRF; AN GW and PCRF
20. Sd – PCRF and TDF
21. AAA Radius – Client and Server
22. Ga – OFCS and CDF Client (SGSN, PGW, SGW)
23. 3GPP Radius – AAA Server and ANGW
24. D/D' – MSC and HLR
25. E – MSC/VLR and GMSC/SMSC
26. T4, Tsp, T6a, SGd/Gdd – IoT interfaces



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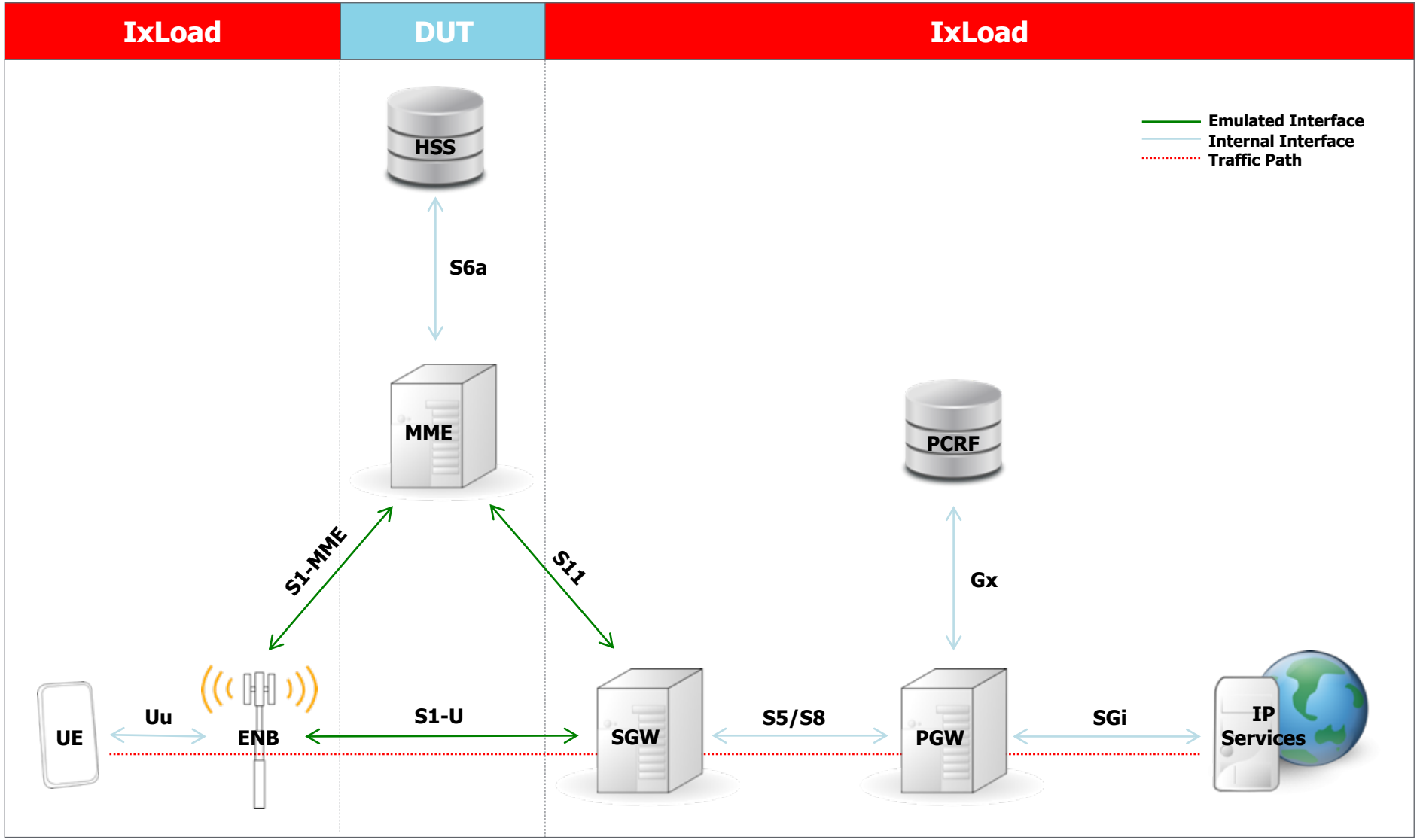
ТЕСТИРОВАНИЕ: 4G ЯДРО

LTE CORE – MME ISOLATION



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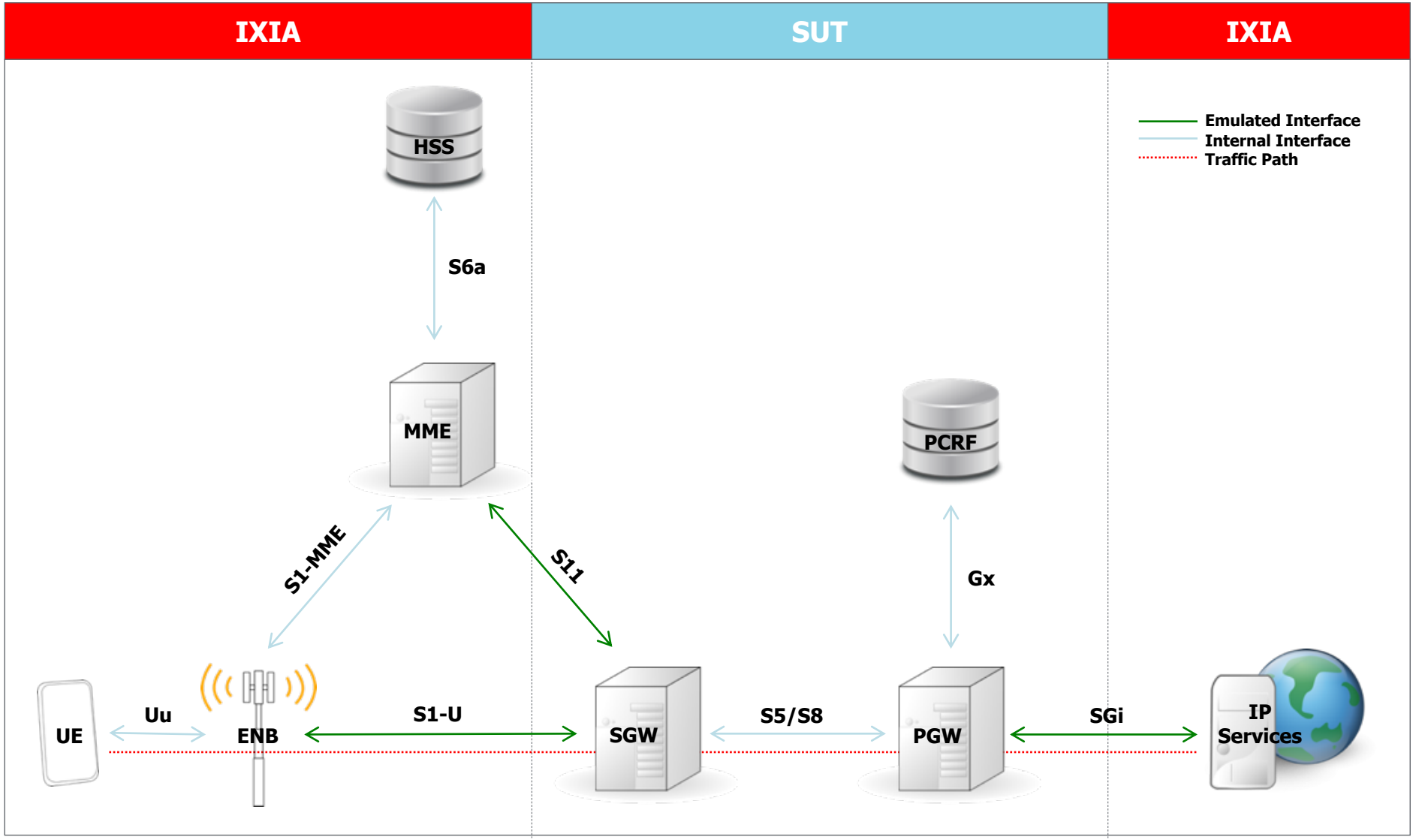
LTE CORE – S/PGW TESTING



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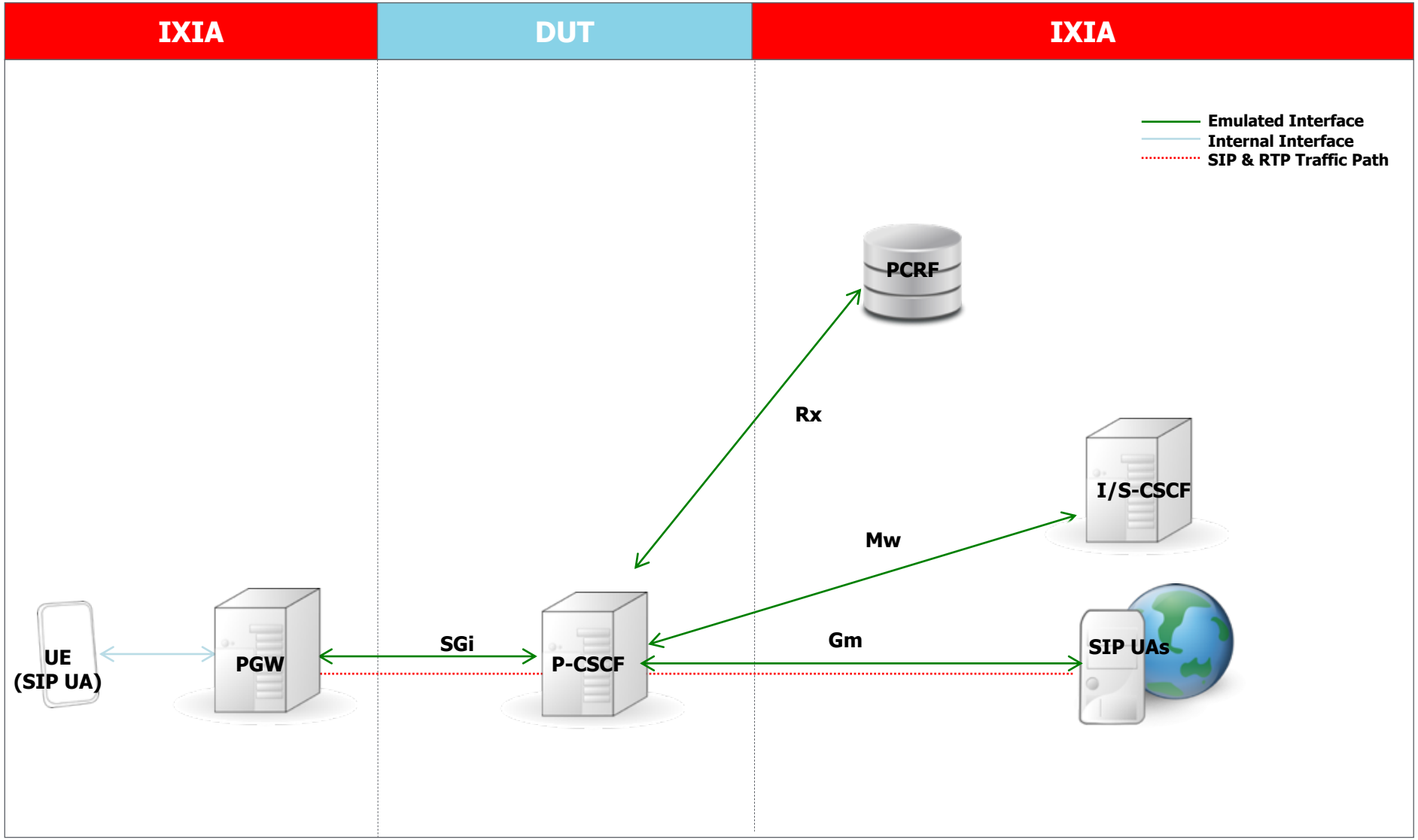
IMS – P-CSCF ISOLATION TEST



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ТЕСТИРОВАНИЕ CELLULAR IOT

ISG CELLULAR IOT - USE CASES

ISOLATE NODES & OPTIMIZE PERFORMANCE

Mixed environment Test
Simulate regular and IoT UEs

Validate new interfaces/interop
S1-Lite, S11u

Benchmark Performance
Simulate thousands UEs over the Radio (Uu) or millions in the Core

Validate Power Saving
PSM and eDRX mechanisms

End2End testing
Diameter eMTC, IP Services

Automation
Speeds up testing

IMPROVE QUALITY

SPEED UP TIME TO MARKET

AVOID FAILURES

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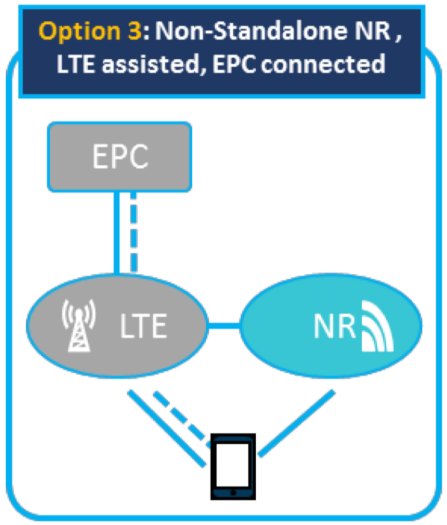
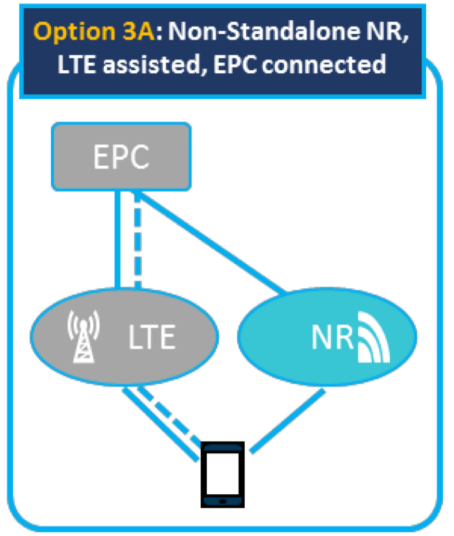
НА ПУТИ К 5G: NSA АРХИТЕКТУРА OPTION 3X

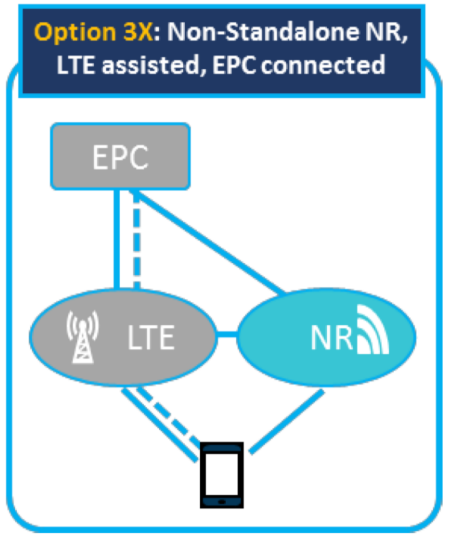
DUAL CONNECTIVITY – OPTION 3X

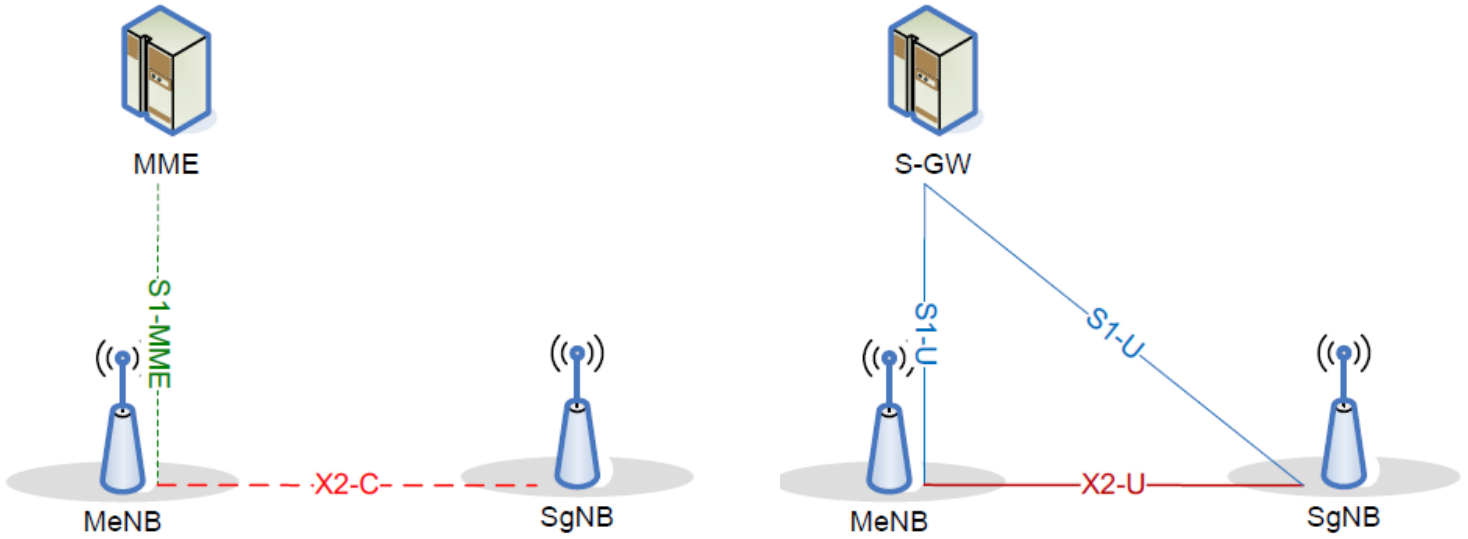
Control Plane: The involved core network entity is the MME. S1-MME is terminated in MeNB and the MeNB and the SgNB are interconnected via X2-C

User Plane: X2-U interface is the user plane interface between MeNB and SgNB, and S1-U is the user plane interface between MeNB and S-GW









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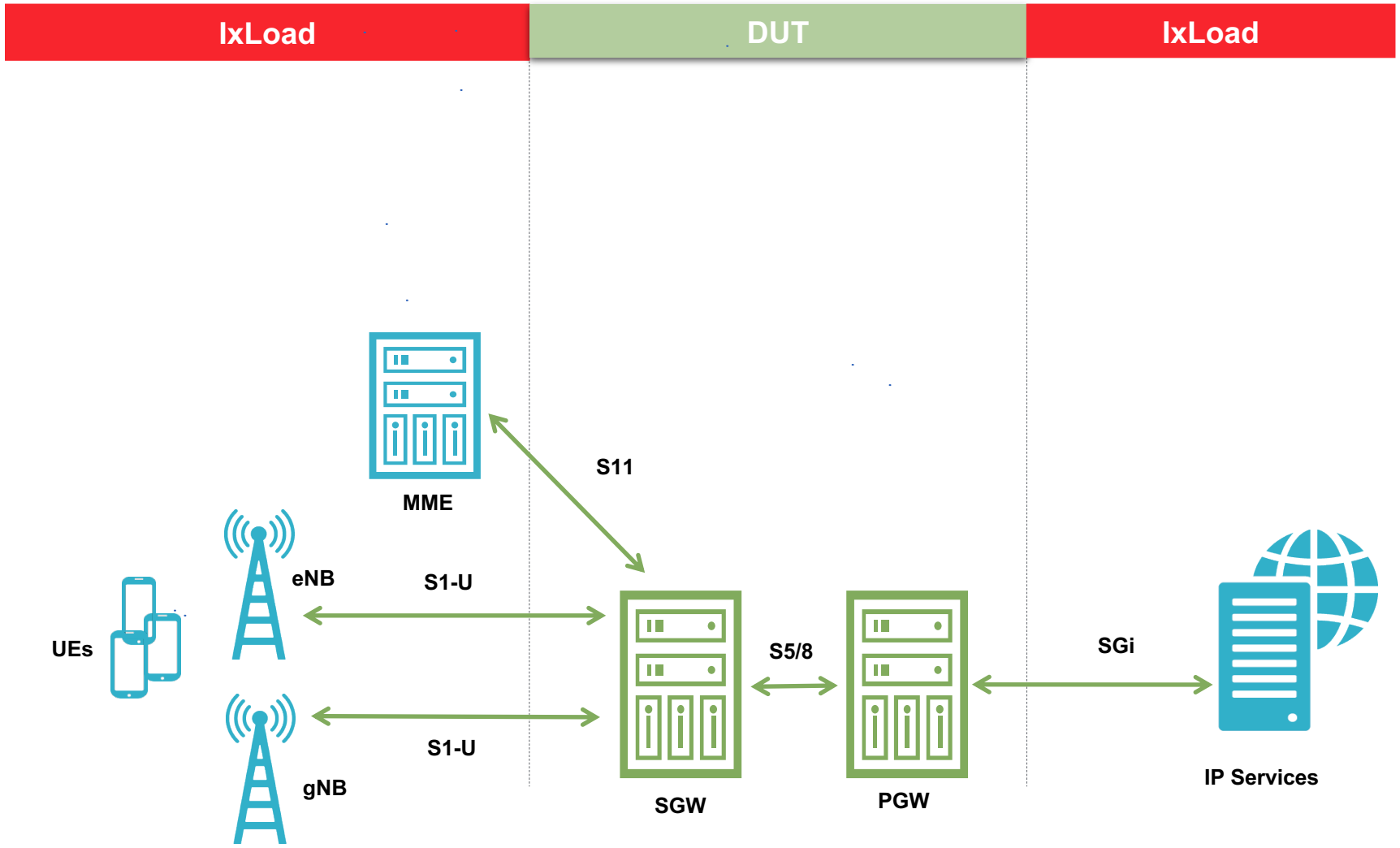
OPTION 3X TESTING: DUT=S/PGW



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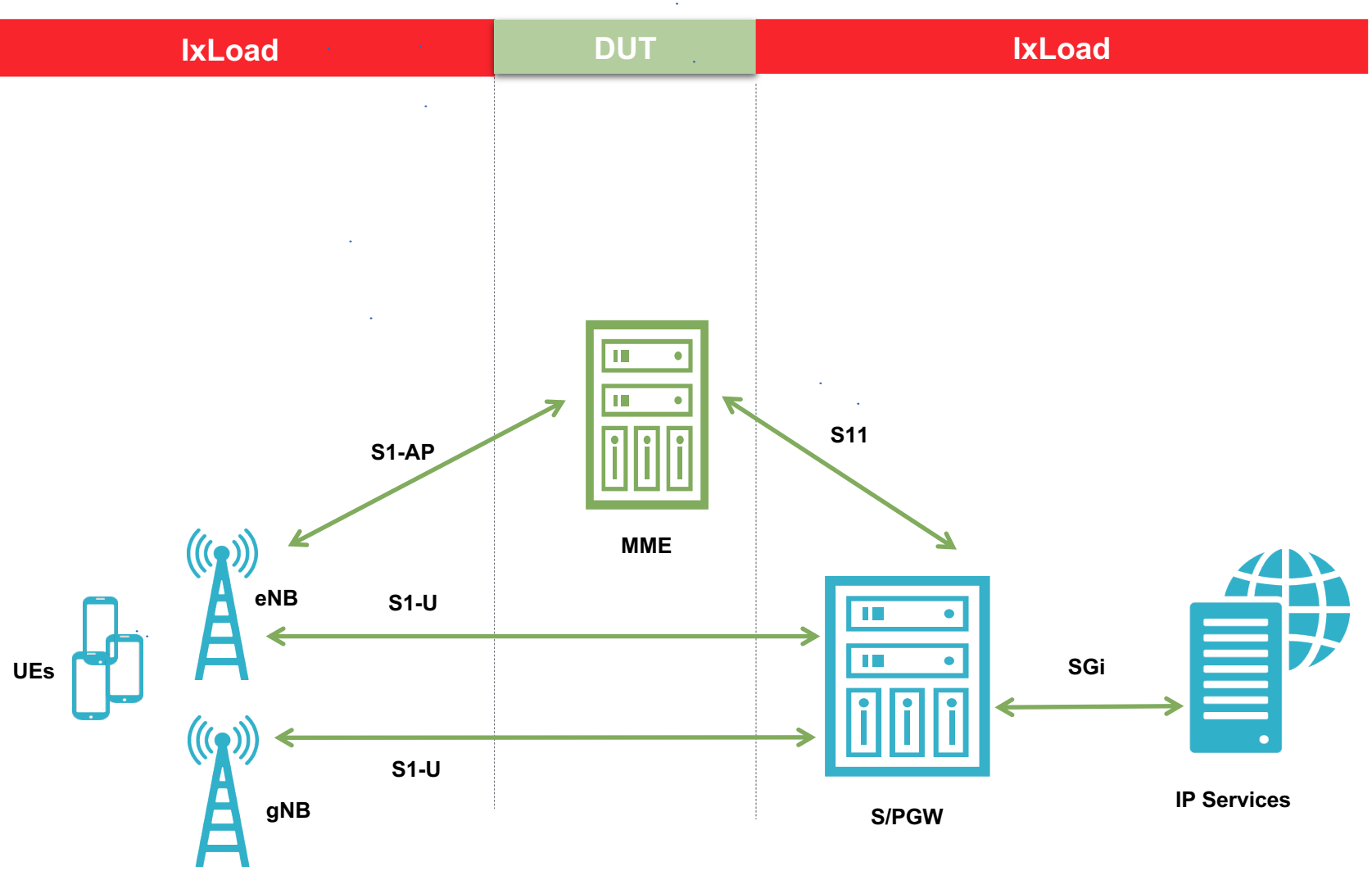
OPTION 3X TESTING: DUT=MME ISOLATION



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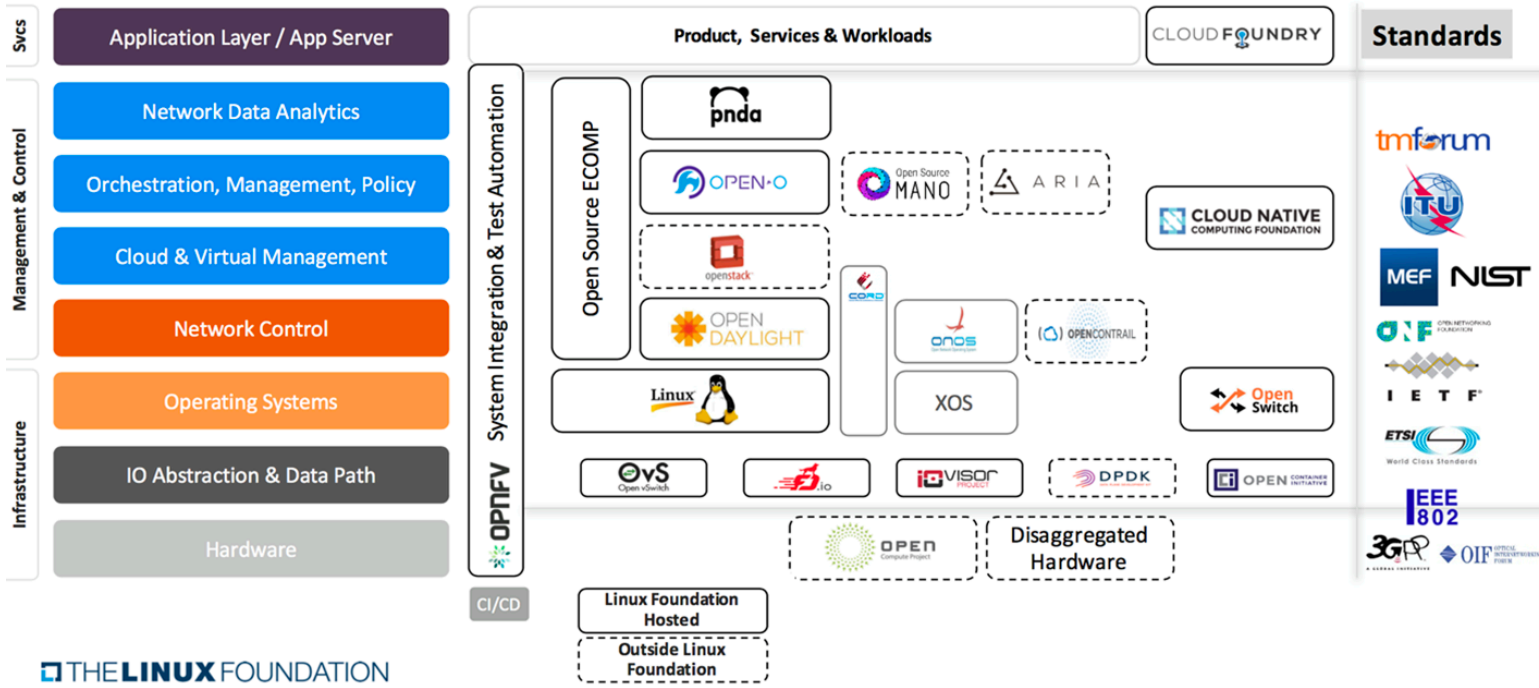
ТЕСТИРОВАНИЕ: 5G ЯДРО

THE NETWORK REVOLUTION

Packet core network softwarization

Benefits

- "Cost flexibility"
  - Removing hardware over-provisioning - on-demand software provisioning, pay per use
  - AI to analyze traffic patterns and optimize resource allocations
- More reliable – reduces single point of failure, better error recovery
- Dynamic scaling – cloud-native design of the 5G Packet Core follows Cloud Scale industry practices



Challenges

- Brand new technologies
- Brand new architecture
- More vendors = Higher Complexity and Risk

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The 5G System Architecture

The architecture has two visual representation:

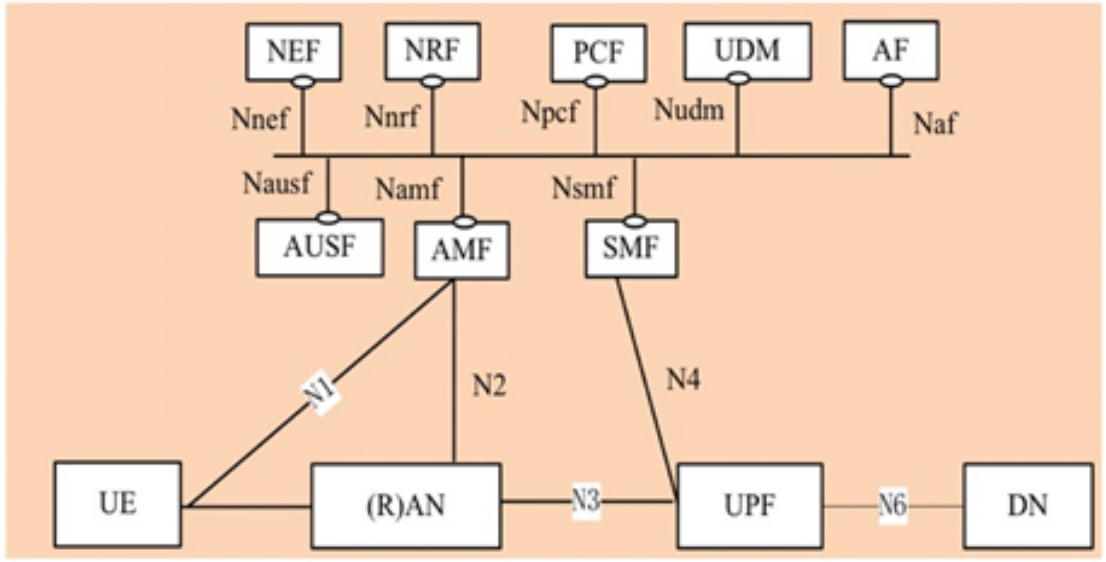

Figure 1: 5G System Service-based architecture

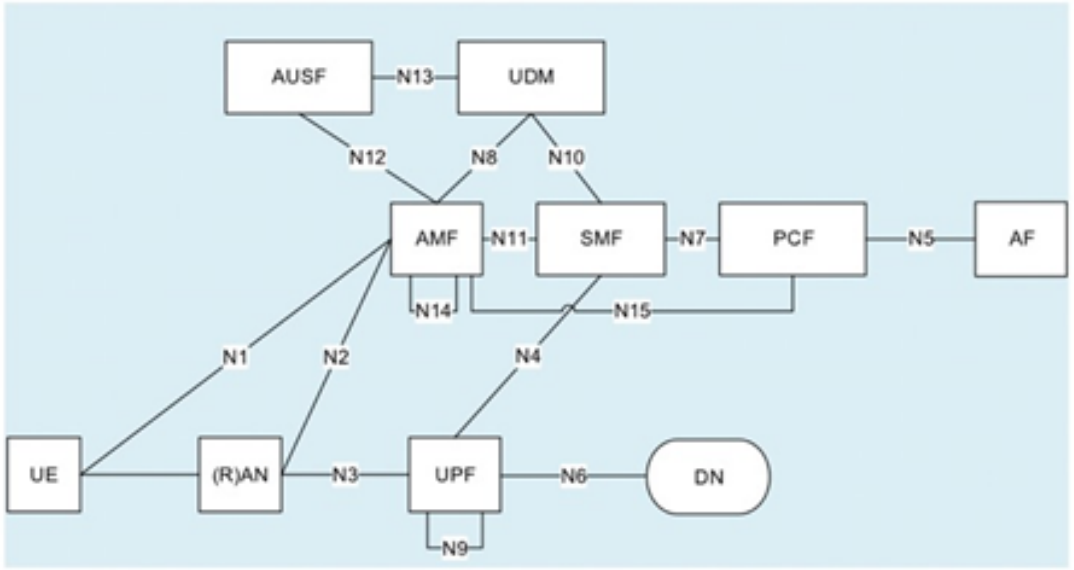

Figure 2: 5G System Architecture in reference point representation

It is intended that within 5GC CP NFs exhibit their functionality via service-based interfaces, so that the NF services can be flexibly used by other authorized NFs. The NF services will be derived from e2e information flows for 5G system.

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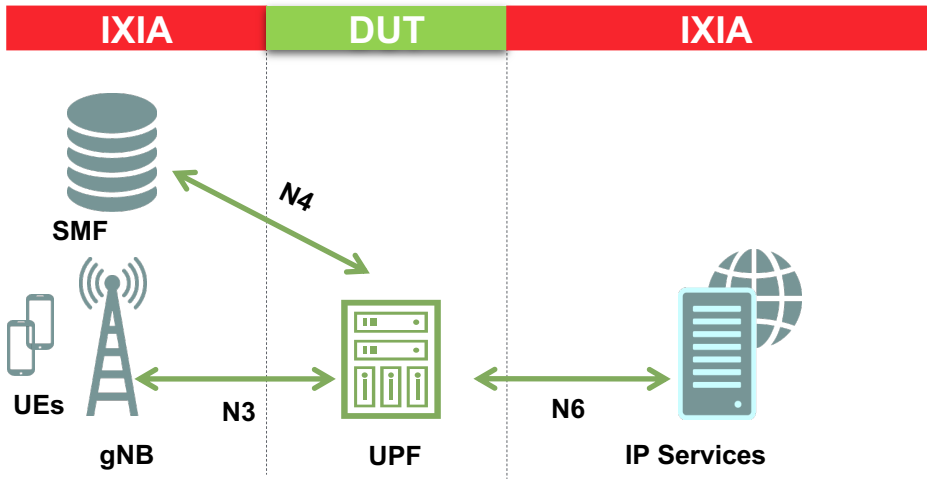
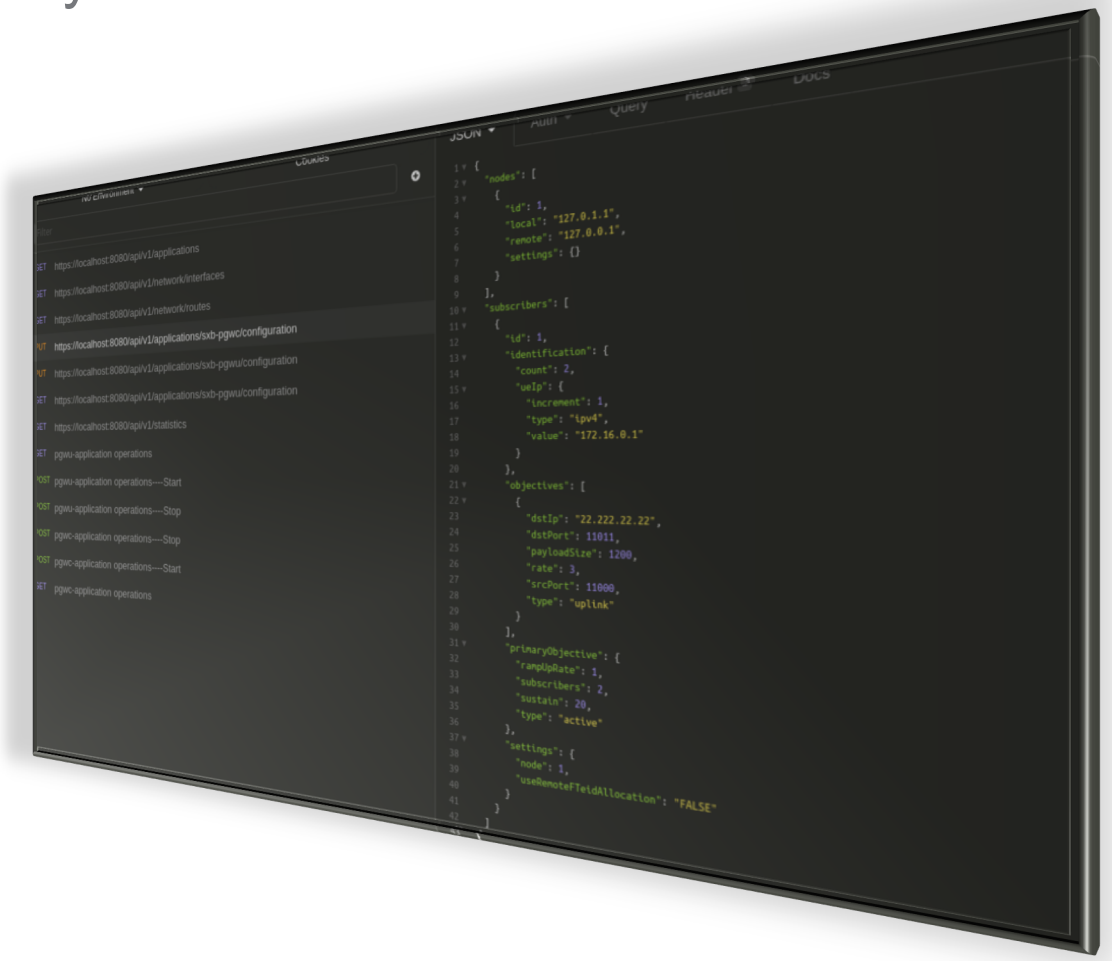
FIRST 5G PACKET CORE
HIGH SCALE NETWORK SOLUTION

Operators gain real-time insight into Quality of service

- Highest capacity and performance
  - All virtualized
  - Up to 7 million sessions / VM
- Native service with REST APIs
- Flexible design





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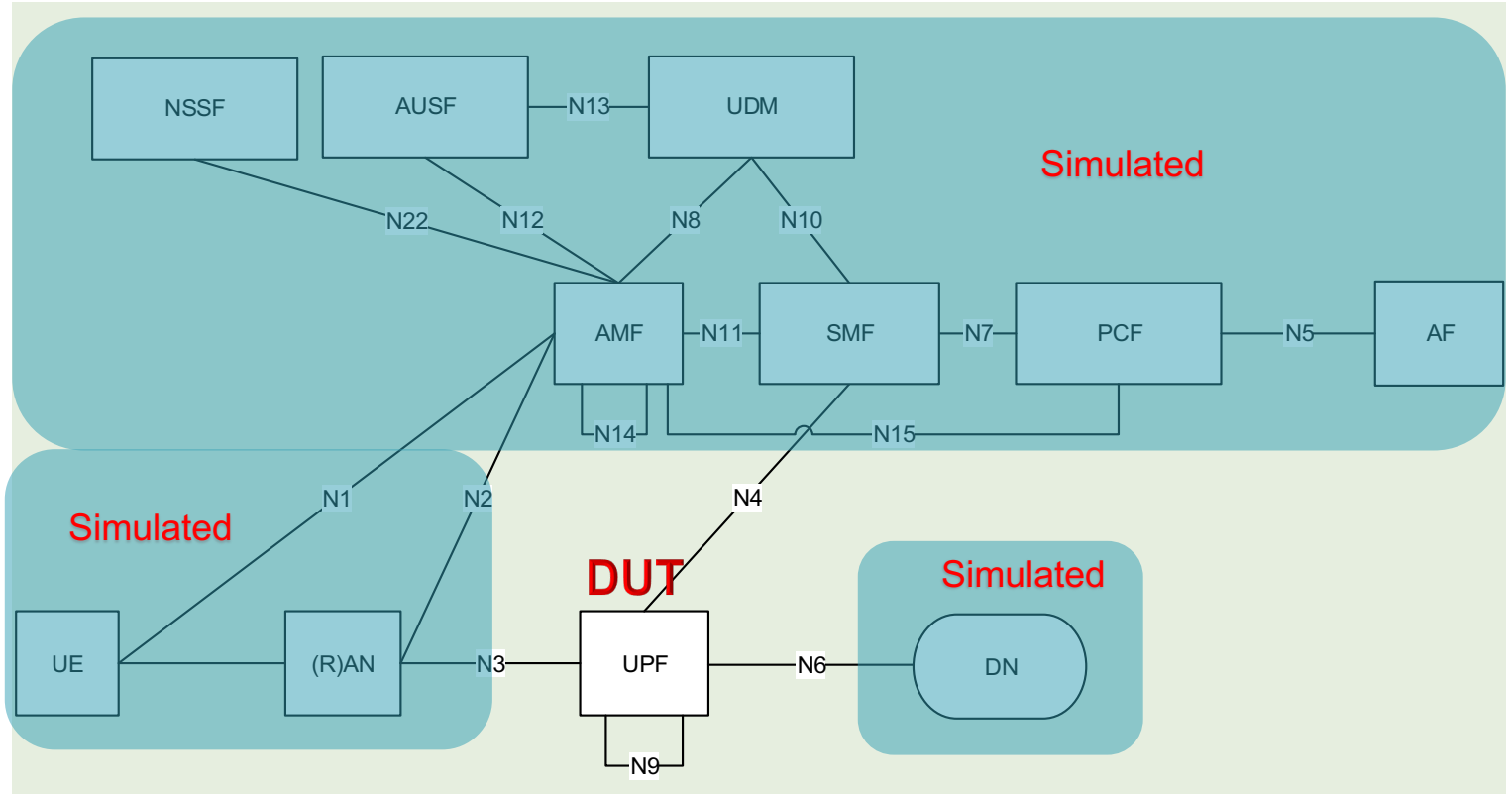
5GC USECASES: UPF ISOLATION



- Focused on UP capacity and performance
- VM and HW platforms
- Coordinated simulation of interfaces: N3 & N4 & N6
- QoS enforcement & QoS detective support

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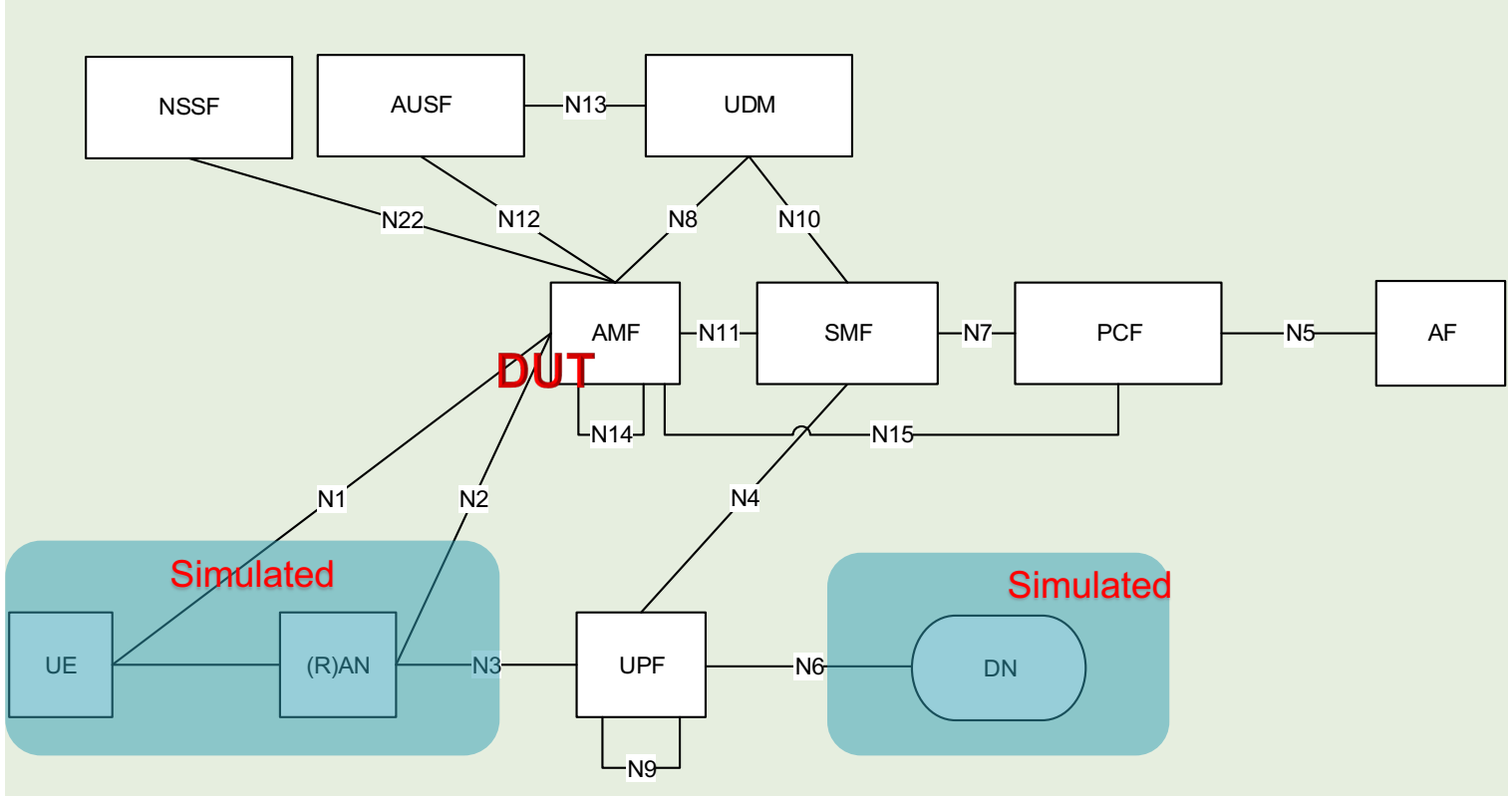
5GC USECASES: AMF ISOLATION



- Focused on ControlPlane NG-AP (N2) capacity
- Thousands of gNBs
- AMF testing on N1, N2 without SBA wraparound

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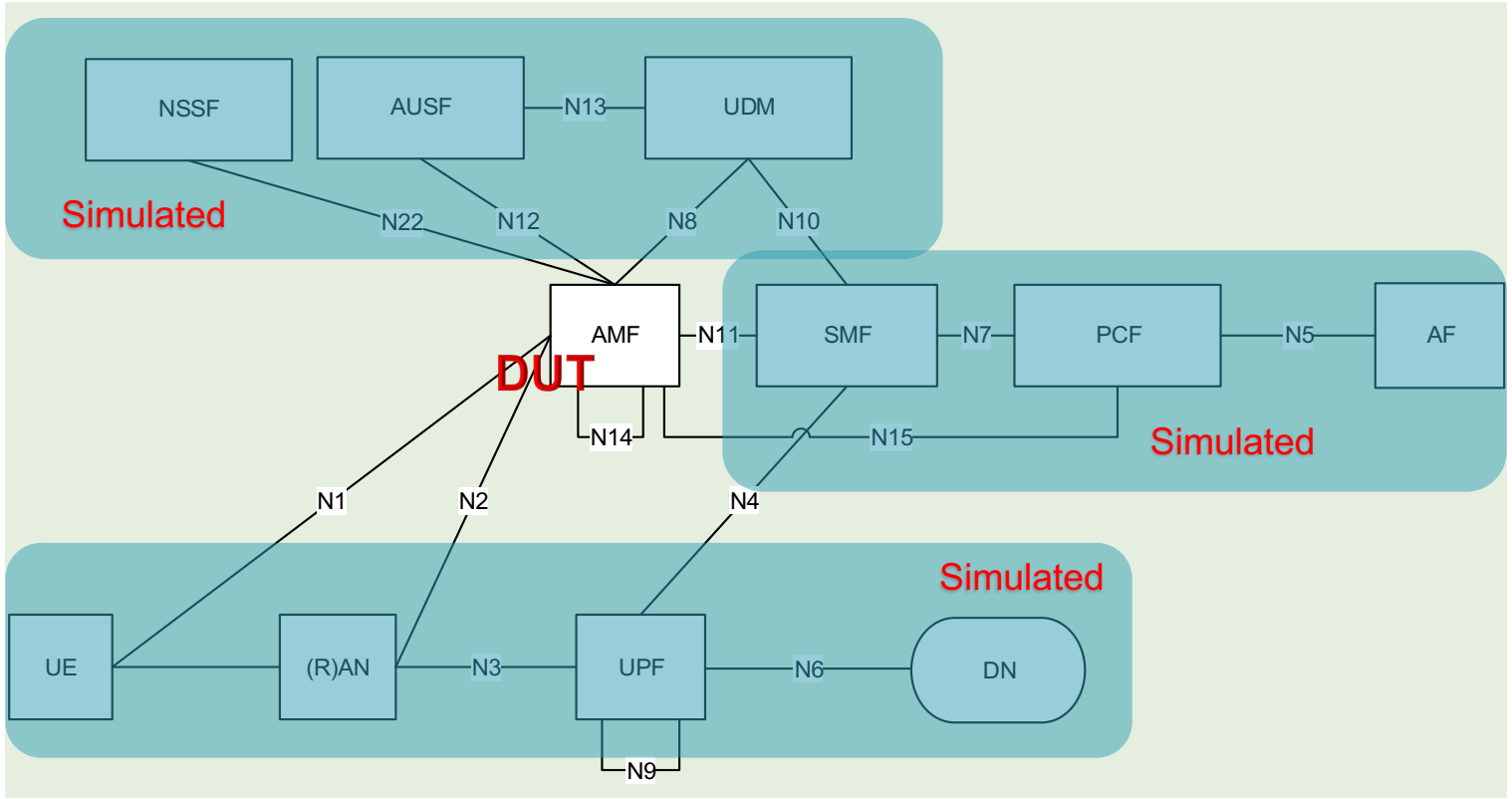
5GC USECASES: AMF ISOLATION



- Focused on ControlPlane functional and capacity
- AMF validation with SBA wraparound
- Coordinated simulation of N1/N2, N8, N11, N12, N15, Nnrf

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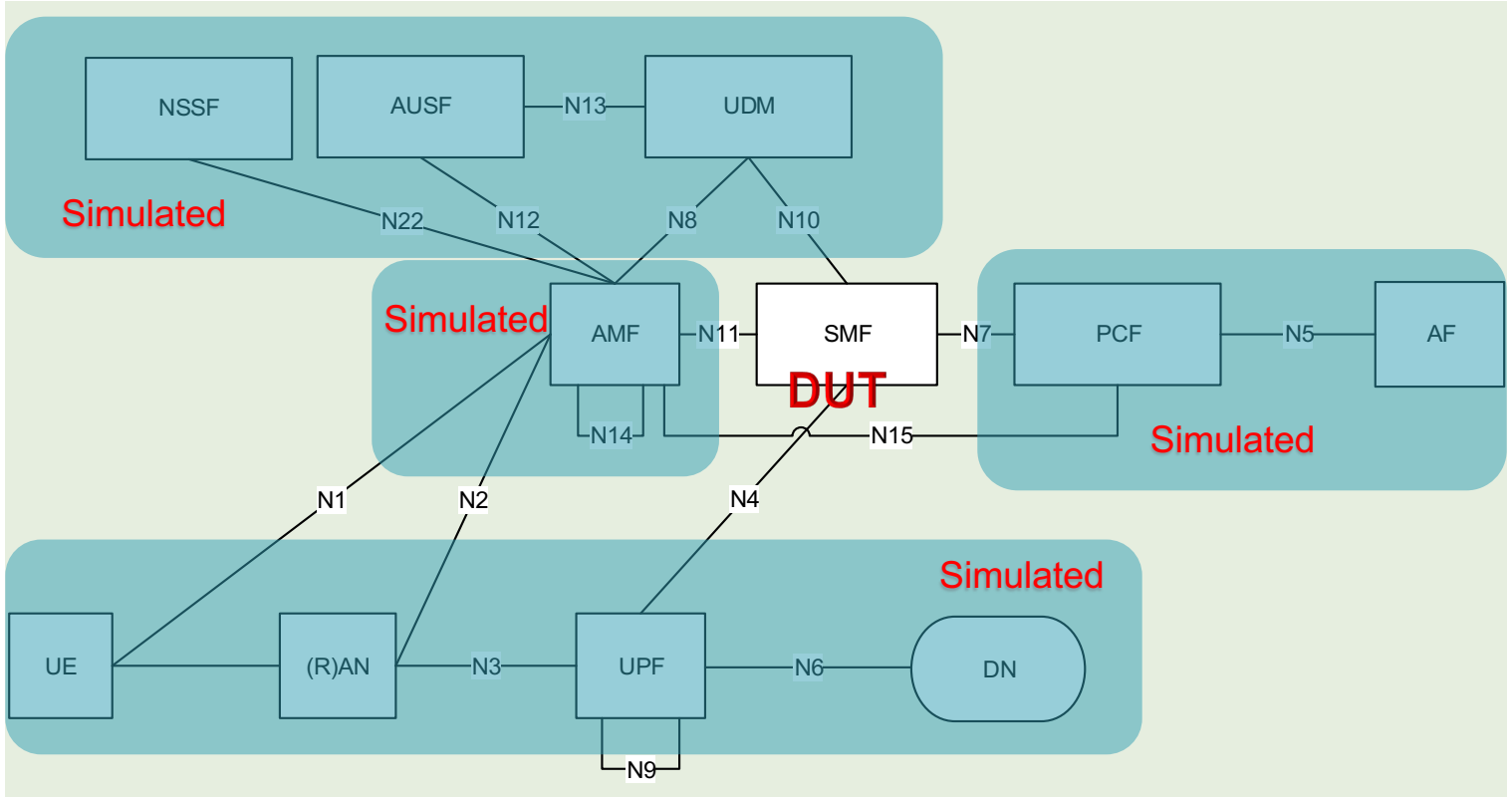
5GC USECASES: SMF ISOLATION



- Focused on ControlPlane functional and capacity
- SMF validation with SBA wraparound
- Coordinated simulation of N4, N7, N10, N11, N15, Nnrf

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ТЕСТИРОВАНИЕ RAN

XGS12 Chassis

XGS2 Chassis

X100 Appliance

Perfect Storm (IP L4-7 generator)

Xair (IP to CPRI conversion)

Radio Head (CPRI to Radio conversion)

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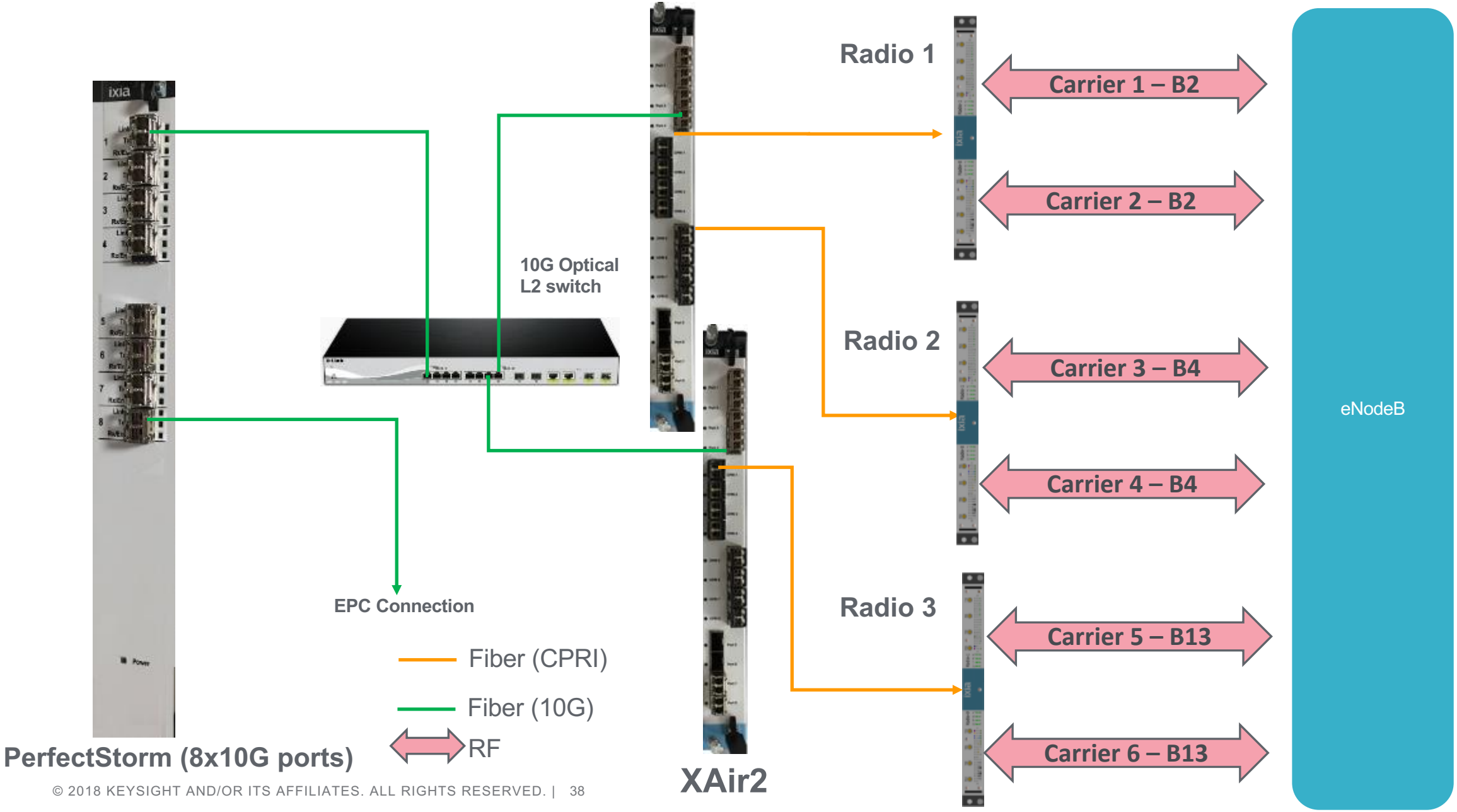
REAL WORLD USE CASE - 6 CARRIERS (6000 UES) WITH ENODEB



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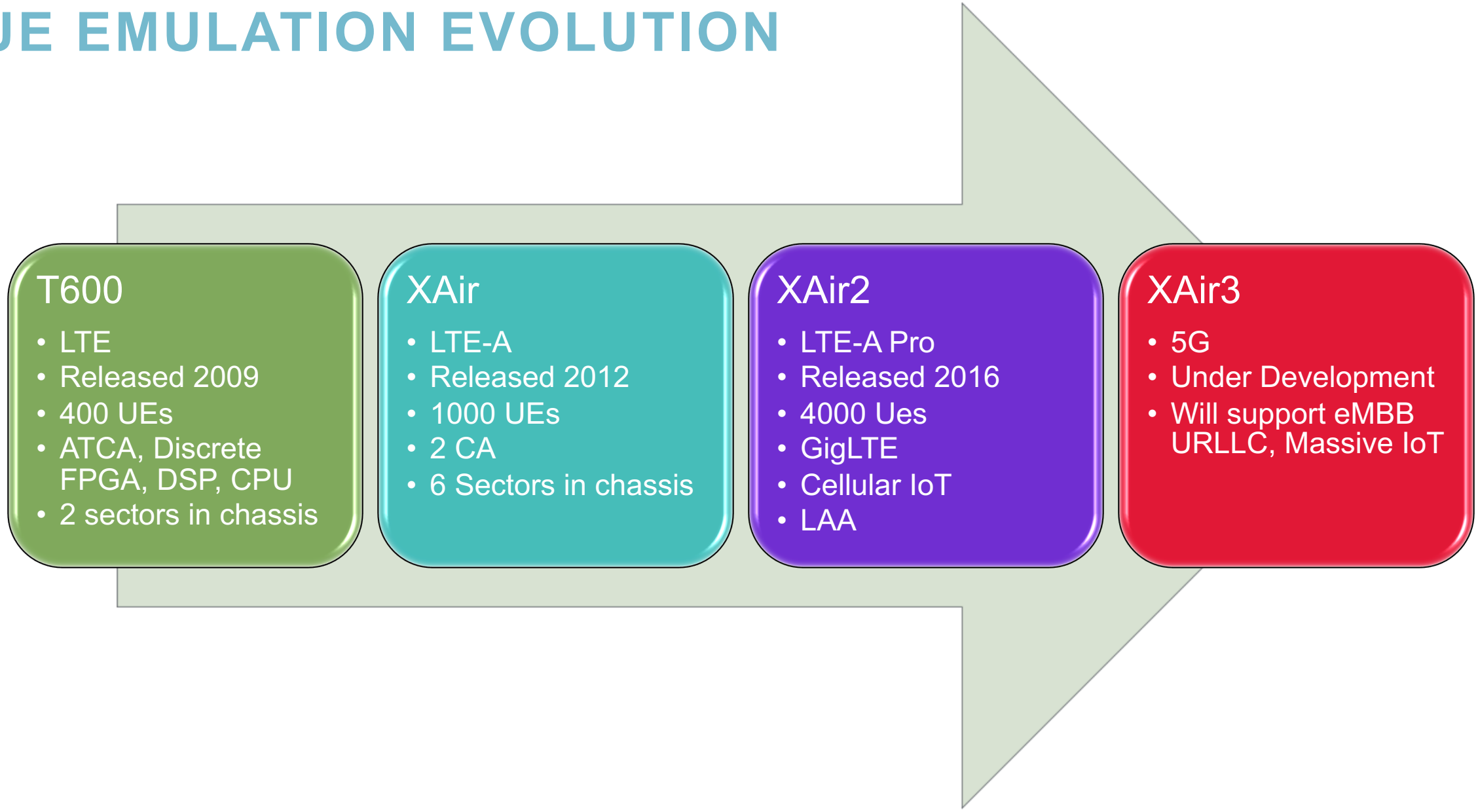
UE EMULATION EVOLUTION



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4G UE EMULATION

XAir2

- Rich, realistic UE Emulation
- 4000 emulated UEs per blade
- Modular architecture allows for massive scale
- 4CA, 4x4MIMO, 256QAM, TM9 supported
- All bands 400MHz–5900MHz supported, FDD&TDD
- Cellular IoT (CAT-M1 and Cat-NB1) supported
- LAA
- Flexible and scalable traffic emulation (Data and VoLTE)
- EPC and IMS Emulation for wrap-around testing

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XAIR3 - BASEBAND PROCESSING PLATFORM

- Industry-best processing power for UE Emulation
- Hosts the Baseband PHY channels
- Same hardware for
  - ✓ Single UE to 1000s of UEs
  - ✓ Sub 6GHz and mmWave
  - ✓ NSA or SA
- Software configurable for 100, 200, 400MHz bandwidths
- Support for 2x2, 4x4, 8x8 MIMO and Mu-MIMO
- Support for Baseband based fading

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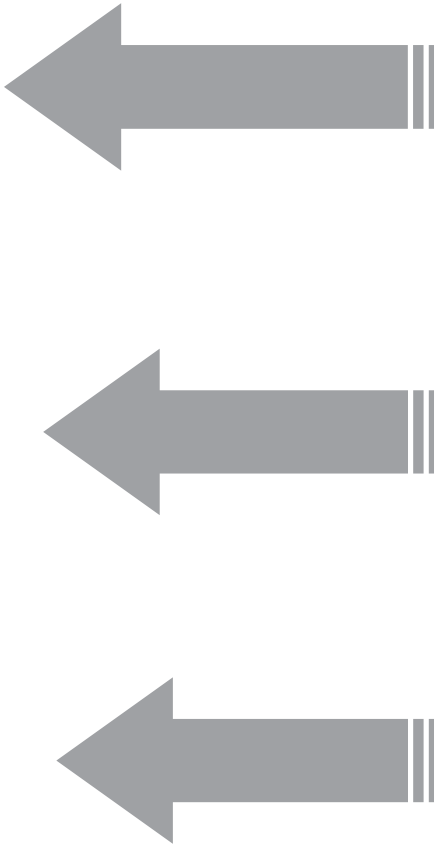
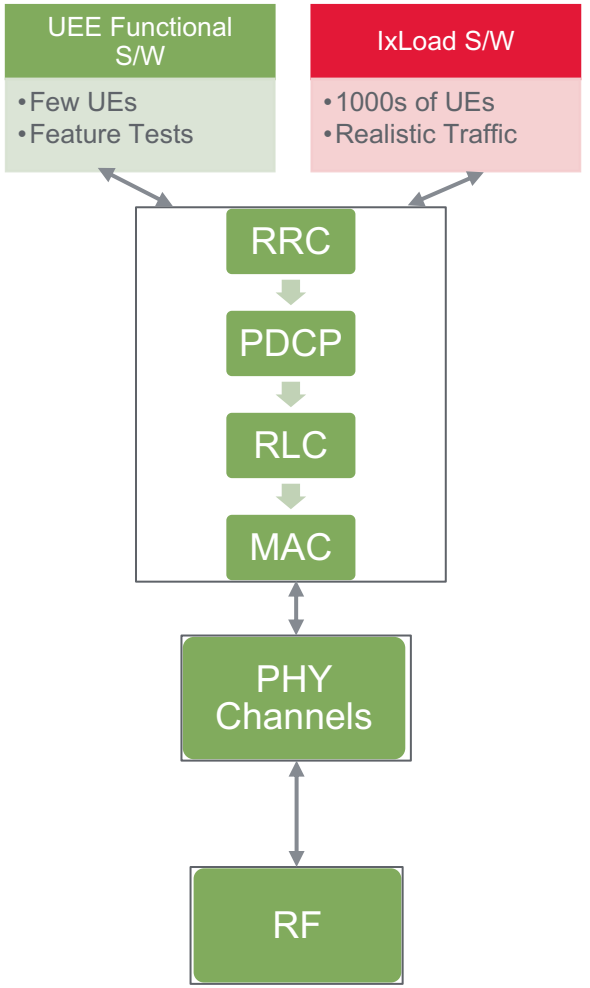
5G UE EMULATOR: SW & HW COMPONENTS

XAir3/Baseband

RH Sub6 GHz





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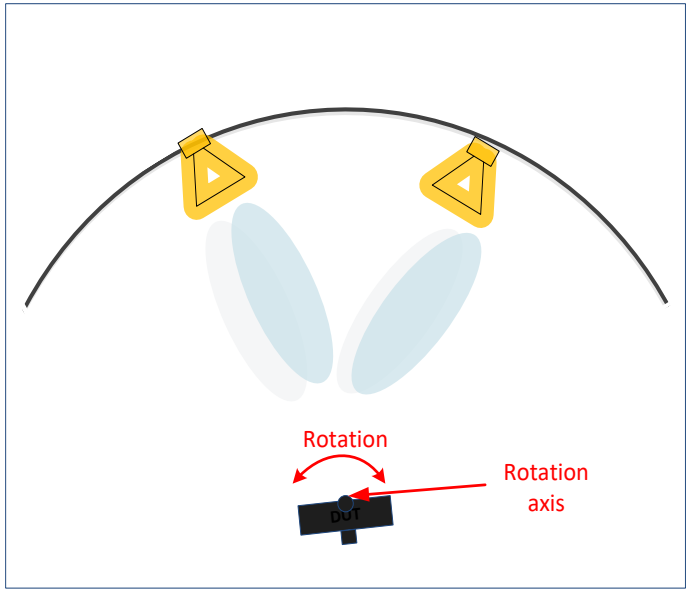
mmW SOLUTION



- 4 spatial layers
- Chamber 120 deg
- 2 dual polarized horns (probes)

- 28/39 GHz mmW Heads

- Channel Fading – optional
  - HW Based Propsim or SW Based Baseband in the UEE
  - Supported channel models:
    - 3GPP TR 38.901 mapped to 2 probes
    - User defined

L2+ SW – Virtualized or Appliance

XAir3 BaseBand Processor

Sub-6GHz Radio up to 4x4 MIMO

- 5G
  - 100, 200, 400 Mhz
  - 4CA (4 x 100 MHz)
  - Sub-6GHz
- 4G – Additional XAir2 for NSA
  - Cabled LTE anchor

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