General Trends on Testbeds for 5G & Beyond; Testbed Federation Use Cases

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About the European Advanced Networking Test Center

- Independent and vendor-neutral test lab since 1991, commercial since 1999
- Covering fixed and mobile technologies, focusing innovations such as 5G, Open RAN, SDN, NFV, next-gen network security
- Emulating fully realistic large-scale scenarios representative for CSP / MNO deployments
- Adhering to highest quality standards and actively participating in test methods standardization

Network Design, Proof of Concept Testing and Audits for Service Providers

Testing and Certification for Vendors

Acceptance Tests and Audits for Enterprises

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Telecom Testing Today

Operator Requirements and Messages Voiced in Standardization Process

- Agile DevOps model
- Mastering QA process and content
- Coordinated test procedures
- Automated testing environments
- Continuous regression testing

-> All of these are preconditions for federated test beds

Reality in CSPs and MNOs Engineering Departments (in many cases)

- Waterfall model both in procurement and implementation
- Outsourcing large parts of QA cycle; implicitly relying on large manufacturers’ QA processes
- Almost always manual test sessions
- Infrequent testing cycles, mostly at RfI / RfP time
Telecom Technology Challenges for Quality Assurance

Network disaggregation

- 5G Service-based architecture
- Network functions virtualization (NFV)
- Multi-layer management of Software-Defined Networks (SDN)
- Open RAN: Radio network disaggregation
- Broadband access: Control and user plane separation
- Cloud and Edge computing: distributed workload placement

Network application (NetApp) integration

- 5G NetApps require tight integration with network layer
- Extremely diverse application space, domain-specific QA
What is Possible Today?

Network Virtualization Layer Automation

Source: Test Automation DevOps and CI/CD, China Mobile, LFN April 2020 Virtual Technical Event
What is Possible Today?

5GVINNI: Example of 5G Network Layer TaaS

- 4 Main Facilities
- Common test orchestration
- End-to-end tests 5GC, RAN, NFV platform, services
- Automation of functional and performance tests
NetApp Integration Challenges

V2X – Example of NetApp Architecture

Source: NGMN V2X White Paper v1.0, 17-06-2018
NetApp Integration Challenges

5GASP NetApp Deployment Architecture

**Use Cases**

- **Cloud**
  - Automotive
    - AUTO-V: Vehicle Route Optimizer in a Virtual OBU with interdomain support and privacy preserving
  - Cross-vertical
    - CROSS-V: Autonomous Vehicle Teleoperations / Remote Driving
  - PPDR vertical
    - PPDR-V: 5G Network Resilience and Privacy in the International Public Safety Operations

**MEC**

- Automotive
  - vOBU Provisioning Module
  - vRSU Provisioning Module
  - Multi-domain Migration Module
  - V2C/C2V RT Communication Module
  - Remote Human Driving Module
  - PPDR M2M Module

**NetApp**

- Privacy Analyzer NetApp
- ITS Station NetApp
- Efficient MEC Handover NetApp
- 5G IOPS NetApp

**Integration Challenges**

5GASP NetApp Deployment Architecture
5GASP QA Architecture and DevOps Lifecycle
What Makes Lab Testing Efficient?
Sample Environment
Different View on Test Bed Federation:
Testing Integration Pipeline

Collaboration of all stakeholders provides benefits to improve quality assurance

Open source testing
Commercial ecosystem testing
Industry-wide Test Programs
Operator-led individual testing

Integration level increases from unit testing to end-to-end service testing
Upstreaming test execution reduces cost and efforts
Upstreaming test plans over time increases quality and enables automation

Deployment
Why Certification?

- Reduce Network Operator Testing Efforts (Upstream Quality Assurance)
- Speed Up Platform and Service Deployment (Create Dependable Framework)
- Improve Quality of Integrated (Multi-Vendor) Solutions

Diagram:
- Equipment Manufacturers
- Test Tool Vendors
- Network Operators
  - Open Source Projects
  - System Integrators
  - Test Labs
Certification Programs – Goals of Industry Parties

- All of these are valid reasons; however, they are in conflict

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<tr>
<th>Industry Group</th>
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<tr>
<td>Manufacturers</td>
<td>Recognize product quality as marketing differentiator</td>
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<td>Enable customer short-listing in RfP responses</td>
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<td>Keep requirements low and support self-certification to avoid barrier to sales</td>
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<td>Network operators</td>
<td>Rely on certificates as an RfP selection criteria</td>
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<td>Offload internal testing efforts</td>
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<td>Buy off-the-shelf test tools implementing automated certification procedures</td>
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<td>Test tool vendors</td>
<td>Implement certification test procedures as part of products</td>
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<td>Focus on test tool strengths as competitive differentiation</td>
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<td>Test labs</td>
<td>Conduct certification testing as a service</td>
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<td>Keep requirements high to provide real benefit to operators</td>
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<td>Interest in 3rd party certification rather than self-certification</td>
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Network layer testing automation is progressing well
Application layer (NetApp) integration is challenging
Telco industry has not adopted standards for test automation and federation yet
Some telco industry forums focus on certification or badging programs for marketing rather than technical reasons

EANTC suggestions for standards bodies and industry forums:
Increase peer review and industry buy-in for important standardization efforts
Lead and improve focus on technology-specific QA goals (quality awareness)
Thank you for your interest!

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