5G Network Complexity: Automation is key

2021 Intelligence Maintenance Conference

September 8th, 2021

Bertrand Decocq – Orange Innovation
1. Resilience main challenges
2. 5G architecture is complex
3. Automation is key to operate 5G network: what automation?
4. Key Messages
#1 Resilience main challenges
In 2019, 153 major incidents were reported by 26 EU Member States, generating around 1000 million customer hours lost (number of hours of service interruption x number of customers impacted).

Percentage of lost customer hours by root cause:
- System Failures: 56%
- Human Errors: 26%
- Natural Phenomena: 13%
- Malicious Actions: 5%

Source: Telecom Services Security Incidents 2019, ENISA
5G learned lessons from the past incidents, but is it sufficient...

**User Plan**
New mechanisms allow a real user plan redundancy from an E2E perspective, combining access and core mechanisms.

**NF sets**
NF (Network Function) can be organized as a group of instances to allow load balancing, to react in case of failure of one instance.

**NF informs**
Local or global mechanisms can be launched by an overloaded NF alerting its "neighbors" about its situation: timers, prioritization, ...

**Stateless NF**
States information are stored in a separated database. In case of NF failure, another can take the floor retrieving the information from the database. No impact on the service.

**Dynamicity**
Dynamicity is ensured by restoration mechanisms at 5G level and/or by NF instantiation on the fly at virtual machines or containers level.
...to face these challenges

1. Growing complexity of the network
   - 5G complexity: orchestration, virtualisation, new locations for key functions
   - Multi-access
   - Automation

2. "verticals" requirements
   - Requirements associated with new 5G services are very high in terms of latency, reliability, availability

3. Critical infrastructures interdependencies are growing
   - Electricity/Telecommunications
   - Transport/Telecommunications
   - Industry/Telecommunications...

4. Climate changes
#2 5G architecture is complex
5G Architecture is complex

- eMBB: enhanced Mobile Broadband
- mIoT: massive Internet of Things
- URLLC: Ultra Reliable Low Latency Communication

- Services Orchestration
- Network Functions Orchestration
- Network Functions Management
- Infrastructure Orchestration

Network Slices:
- Slice 1: eMBB
- Slice 2: mIoT
- Slice 3: URLLC

Network Functions:
- Orchestration
- Management
- AI

Network Stages:
- Devices
- Access Networks
- Transport Networks
- Edge/Core Network

- Edge Data Center
- Edge Computing
  - Containers
  - Operating System
  - Infrastructure

- Core Data Center
  - 5G Core
  - Containers
  - Operating System
  - Infrastructure
Slicing

Slice 1: eMBB
Slice 2: mIoT
Slice 3: URLLC

eMBB: enhanced Mobile Broadband
mIoT: massive Internet of Things
URLLC: Ultra Reliable Low Latency Communication
5G Network: Service based architecture
Inside a datacenter

Core Data Center

5G Core

A M S U M D F...

Containers

Operating System

Infrastructure

5G Core

A M S U M D F...

Containers

Operating System

Infrastructure

5G Core

A M S U M D F...

Containers

Operating System

Infrastructure

2021 Intelligence Maintenance Conference
Automation is key to operate 5G network
What automation?
Automation can be based on scripts, on policy rules, on Artificial Intelligence

Automation is required at different level:
- To create a new service/slice
- by translating an intent into a network service
- by checking/complete configuration files
- by instantiating required virtualized functions
- by building service function chain
- by ensuring end-to-end connectivity
- To ensure network evolution
- When upgrading any « network » software
- When adding a node
- To supervise network
- Through anomaly detection, maintenance (preventive/predictive), root cause analysis,…
- Through cockpits with assistant for decision aid
- To validate new functions
- Through functional, performance, resilience, security and E2E tests
- …
Which role for AI in the management of networks and services?

**Information**
- Observe/Describe
  - Characterize normal behavior → Detect anomalies, observe trends, detect context shifts

**Understand/Diagnose**
- Analyze correlations between KPIs
- Analyze the sensitivity of KPIs to parameters
- Determine the most impacting parameters
- Root cause analysis

**Predict/Forecast**
- Forecast an event in the future, such as a congestion
- Predict spatial distribution of metrics based on geolocalized measurements

**Actuation**
- Decide/Act
  - Decision making based on acquired knowledge
  - Online decision: try (and may fail) to enhance future decisions

**Decision support**
- Knowledge creation

**Decision making**
AI for networks: simplified view

- Business Strategy
- Technical Strategy
  - Fault & Performance
  - QoS, QoE, SLAs
  - Orchestration, etc.

Raw data → AI → Model Generation

AI for networks:
- Training...
- Notif, alarm system
- Network Recommendation & Actuation
- Actions feedback
- Act on the network

5G

AI

NW introduction (SDN, NFV)

Access, Core, Content
Example of automation within Orange

Policy Based Management at Orchestration Level
- Policy Engine in ONAP
- Security Rules

Scripting
- Functional Testing
- Continuous Integration (with Open Source tools like Xtesting, Jenkins, Ansible, …)

Artificial Intelligence
- Code Mining to complete configuration files
- Anomaly/Fraud detection
- Root cause Location
- Predictive Maintenance
- Decision entity reputation
- QoE / QoS prediction
Conclusion
Key messages

1. 5G architecture is very complex and introduces many new technologies
2. Automation is key to operate 5G network
3. AI techniques anticipation is a challenge
   1. No data are available: 5G is not yet fully (access+core) deployed
   2. End-to-end lab chains are not ready yet
   3. Location of data collection (at 5G or orchestration level) is not decided yet. It can impact the way to retrieve data.
   4. ...

...
Thank you

“Our greatest glory is not in never falling, but in rising every time we fall.”

Nelson Mandela