Building the Golden Closed Loop – AI and Networking

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Addressing the Complexity Challenge

• Networks becoming increasingly complex
  o 5G foresees a x10 densification of sites compared to 4G
  o Best user experience demands heterogeneity in access technologies
  o The continuous challenge of centralized proposals, way beyond the usual OTT
  o And not suitable to be managed using traditional operation

• Adapt results from the IT experience in virtualization
  o Acknowledging the differences
    ▪ Topology awareness
    ▪ The conservation principle
    ▪ Openness
    ▪ Integrity and auditability
    ▪ Isolation
  o Exploring new paths

• Towards zero-touch service management
The Essential Automation Closed Loop

- Not such a radical change
  - Automatics have been around for a long time
  - AI as a tool to derive further insights from data and improve policies
  - Extended capabilities, but do not expect Skynet

- The key issues are not in the engine(s)
  - But in the data and action flows
  - Including distribution and placement of the engine(s)
- And in flow management and application

**Network Environment**
- SDN Controller
- NFV Orchestrator
- EMM
- MEC
- Router
- ...

**Legacy solution**

**Data Acquisition**

**Policy Engine**

**Data**

**Actions**

**New Data**

**New Policies**

**AI Engine**

**Actions Scores**

**AI Enhancement**

**Data**

**Legacy solution**

**Network Environment**

**Data Acquisition**

**Policy Engine**

**New Data**

**New Policies**

**AI Engine**

**Actions Scores**

**AI Enhancement**
The Data Stream

• No matter how intelligent: Crap in means crap out
  o Usable: Adaptation (formats, scales…)
  o Sufficient: Topology (sources, aggregators…)
  o Safe: Provenance (origin, timestamps…)
  o Steady: Continuity (pace, availability…)

• Not just data
  o Metadata becomes essential, including semantic mappings
  o What seems to claim for a data stream ontology
  o Not that far away: data modeling is a first step

• An enhanced data fabric seems the logical approach
  o Supporting resource, orchestration and function sources
  o Combining current network monitoring tools and recent telemetry developments

- KAFKA BUS
  - Public Clouds
  - Alarms
  - KPIs
  - Network Service events
The Action Stream

- OAM actions at a wide variety of different domains
  - Challenging, given the current state-of-the-art
- Initial strategies
  - Domain specific
  - Recommendation systems
  - Autonomic protocols
- Capability models
  - Reusable functionality description
  - Abstractions of network element functionalities usable as building blocks
  - Combined to provide more powerful features
  - Registration mechanisms to support CI/CD
  - Inter-domain collaboration for E2E management
The Process in the Loop

• The dialectic way
  o Thesis: Translate intent into action
    ▪ Understanding intent statements
    ▪ Mapping onto technologies
  o Antithesis: Support environment constraints
    ▪ Policies provided by network management
    ▪ The archetypal SLA enforcement
  o Synthesis: Conflict resolution
    ▪ Among action requests
    ▪ And with management constraints

• Audit track and intelligibility
  o The who, the what, the when
  o And the why

• And security
  o Deal with adversarial AIs
  o And consider circuit breakers
The Architectural Mapping

- Networks are critical and naturally distributed systems
  - A distributed AI for managing them
- The nature of distribution
  - Aggregation of knowledge
  - Accumulation of decisions
  - Cooperative vs independent vs selfish
  - Fixed vs mobile vs roaming
- Topologies
  - The mapping on the network topology
  - Depth and breadth
  - Nervous system approaches
- Protocols
  - Specific knowledge and policy exchanges
  - Reuse stream mechanisms
  - Apply good-ole BGP and others of its kin
Trustworthy Datasets

• A serious lack of usable datasets
  o For training or validation
  o Data as an asset
  o Privacy concerns
  o None or limited tagging

• Generation of synthetic datasets
  o Traffic samples generated in a controlled way
  o Configurable mixes of synthetic and real traffic

• And metadata management
  o Different scenarios, from high loads to security threats
  o Training and validation loops

• Relying on Software Network principles
  o Repeatability and reproducibility
  o Controlled variations
A Global Framework for Automation

- Consider zero-touch in new technologies to be deployed: 5G-NR, slicing, edge...
- Integrate existing data and action infrastructures to support streams
- Incorporate processes to support conciliation, auditability, adaptation and security

- A use-case-driven strategy
  - Automated service and network capacity delivery
  - New service modelling and creation
  - Assisted network assurance
  - AI-based issue and fault management
  - Network optimization
A Matter of Balance

- Network heterogeneous and distributed nature and a holistic view of services and infrastructure
  - Topologies, protocols and models for distributed AI elements
- User requirements and operational policies
  - Intent dialectics and elastic policy enforcement
  - Compositional mechanisms to combine requests in multi-tenant environments
- Regulatory matters and security
  - Data sovereignty and identity management for all entities
  - Non-repudiation and accountability
- Closed loop operation and infrastructure criticality
  - Keep humans in the loop, retaining ultimate understanding and control
  - AI intelligibility and security mechanisms to guarantee proper operation
- Sensing and acting
  - Open and extensible mechanisms for data and action streams
  - Converged data models for definition and monitoring
  - Converged control action representations
WE ONLY PAY YOU BECAUSE MONKEYS ARE HARD TO TRAIN AND ROBOTS ARE EXPENSIVE.