# End to End Service Assurance for 5G Network Slicing and Closed Loop Automation

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**T** · · ·  **LIFE IS FOR SHARING.**

# Network slicing promises to address future customer requirements in an efficient and flexible way.

- NW slice: end-to-end logical network that runs on a shared physical infrastructure, capable of providing a negotiated service quality provided in an economical way.

- The technology enabling network slicing is transparent to business customers.

- A NW slice could span across multiple parts of the network (e.g. terminal, access NW, core NW and transport NW) and could also be deployed across multiple operators.

- A network slice comprises dedicated and/or shared resources, e.g. in terms of processing power, storage, and bandwidth and has isolation from the other network slices.

- Slices could be customized in terms of their performance, functionality and operation.



5G networks need to serve customers with very different needs
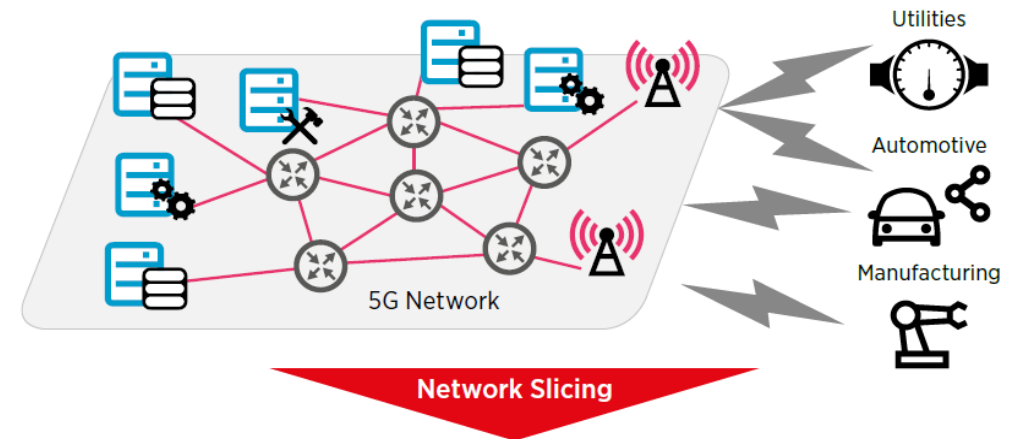
Network Slicing

5G networks subdivided into virtual networks each optimised for one business case

IoT slice    Broadband slice    Low latency slice
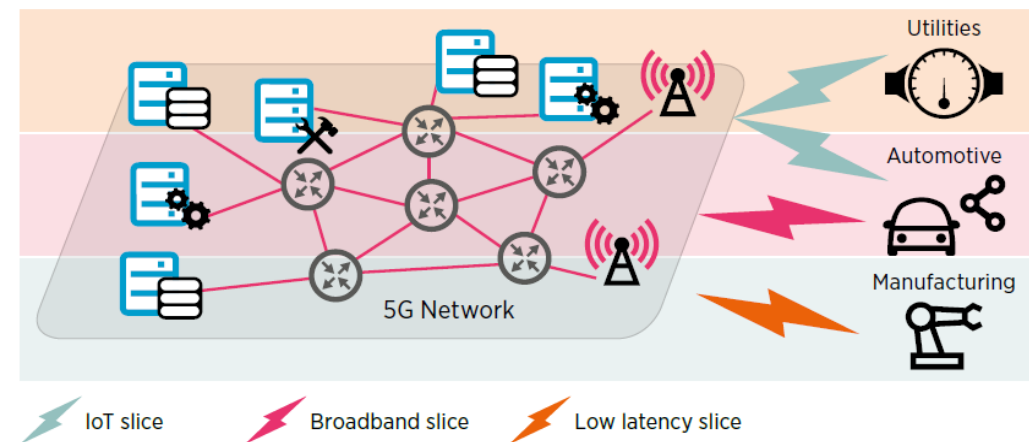
Source: An Introduction to Network Slicing, GSMA

# 5G E2E NW slicing architecture

## Key enabling technologies

1. UE routing for slice selection (URSP)
2. 5G RAN QoS/slicing and low/managed latency
3. Transport slicing for backhaul and SD-WAN
4. Network Capability Exposure
5. 5G campus with NW slicing, CUPS
6. Global NW slicing for B2B connectivity
7. Automated E2E NW slicing orchestration
8. NW Slice Assurance
9. Cloud-native 5G Core
10. BSS for network slicing/QoS product mgmt
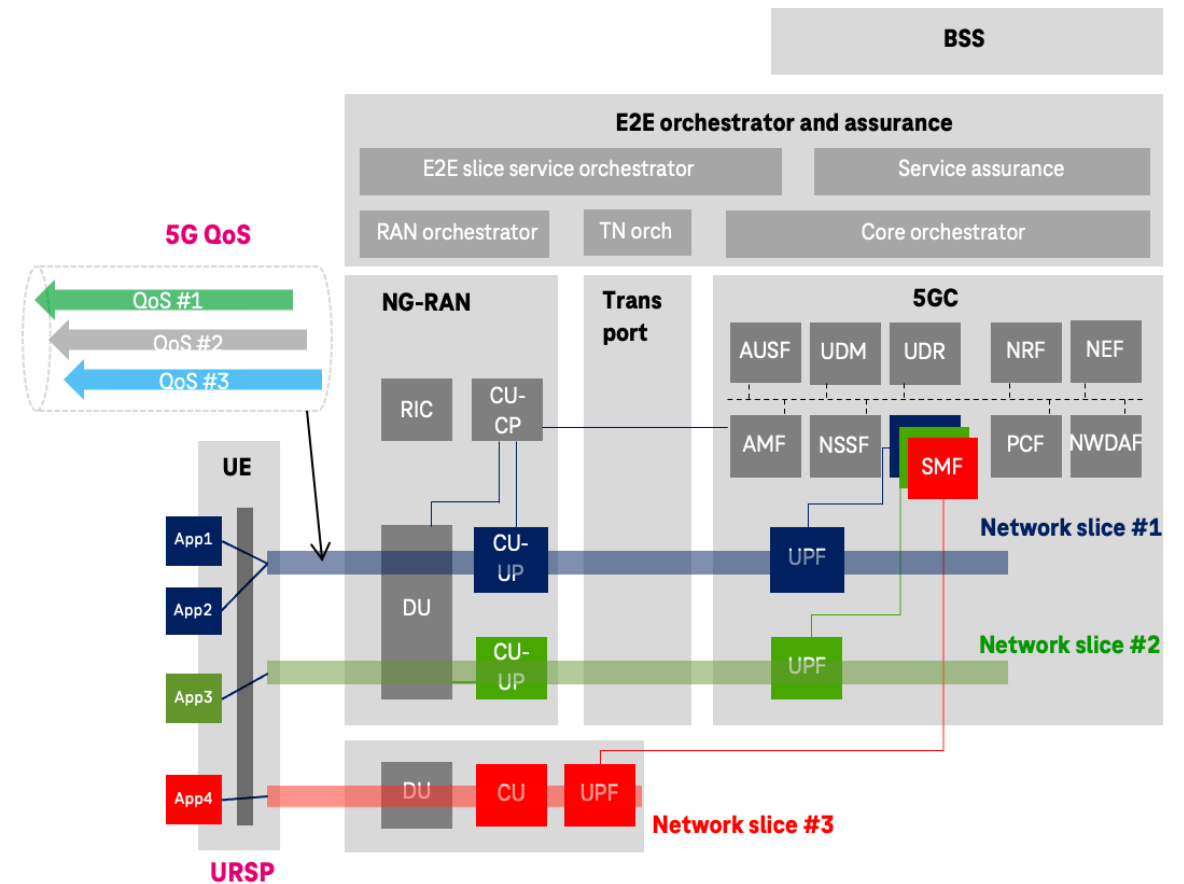
# Need of service assurance for 5G NW Slicing

## Challenges

- One size fits strategy is redundant

- Complexity arises in deploying and maintaining 5G network slices

- Operational challenges – monitoring, availability, scalability and automation

- Service-level agreements (SLAs) requires high levels of visibility for monitoring, enforcement, and reporting

## What Service Assurance offers

- Guaranteed service quality meeting the SLAs for optimal service experience

- SLA compliance and boosting customer trust and loyalty

- Consistent QoS in peak time

- Real-time monitoring, automated deployments and network insights
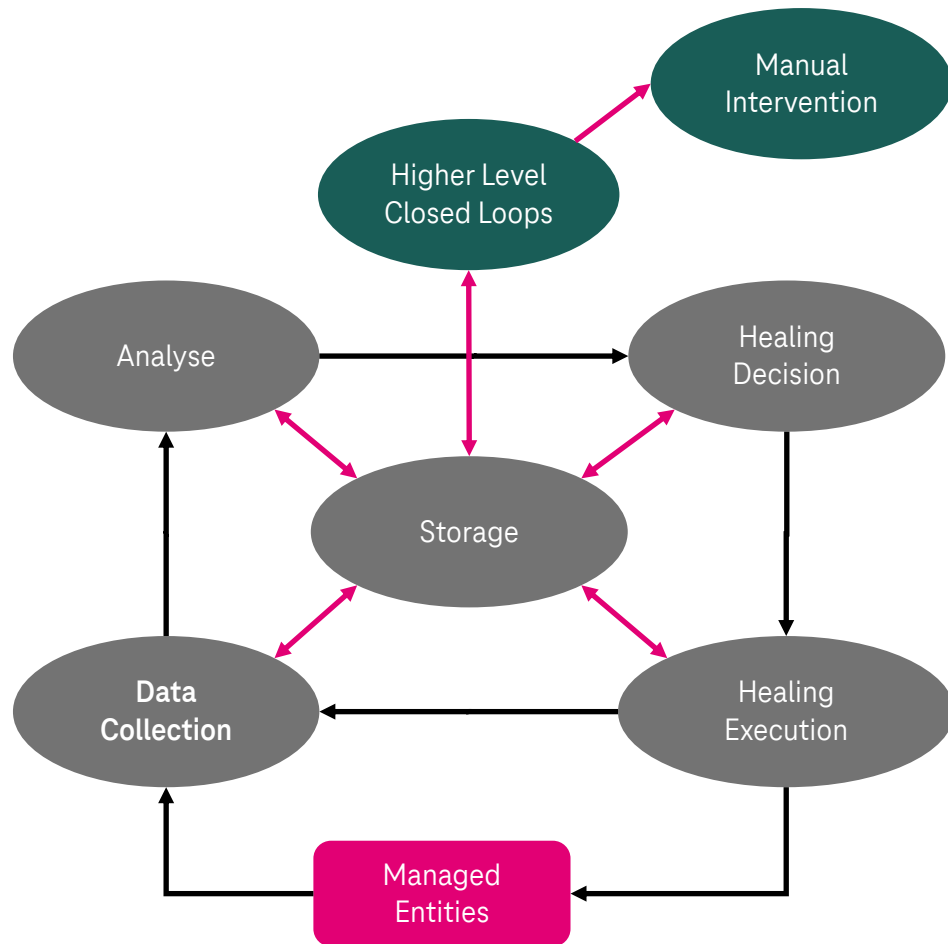
| Cloud Native | Centralised Data | Real-Time | Uses AI and Prediction | Based on Standardised Interfaces |

**The purpose of service assurance is to ensure optimal and guaranteed 5G Network Slice SLA delivery.**

# Principles and characteristics of closed loop assurance



- **Closed Loop principle in service assurance**
  - **Data Collection**
    - Gather data of the managed entities.
    - Normalise the data to agreed formats

  - **Data Analysis**
    - a) Data Aggregation
    - b) Health Condition Analysis
    - c) Root Cause Analysis

  - **Healing Decision**
    - Event trigger to orchestration function to execute the automated healing.
    - Manual intervention if no automated healing can be identified

  - **Healing Execution**
    - Responsibility of the domain- or multi-domain orchestrator which executes the identified healing action.
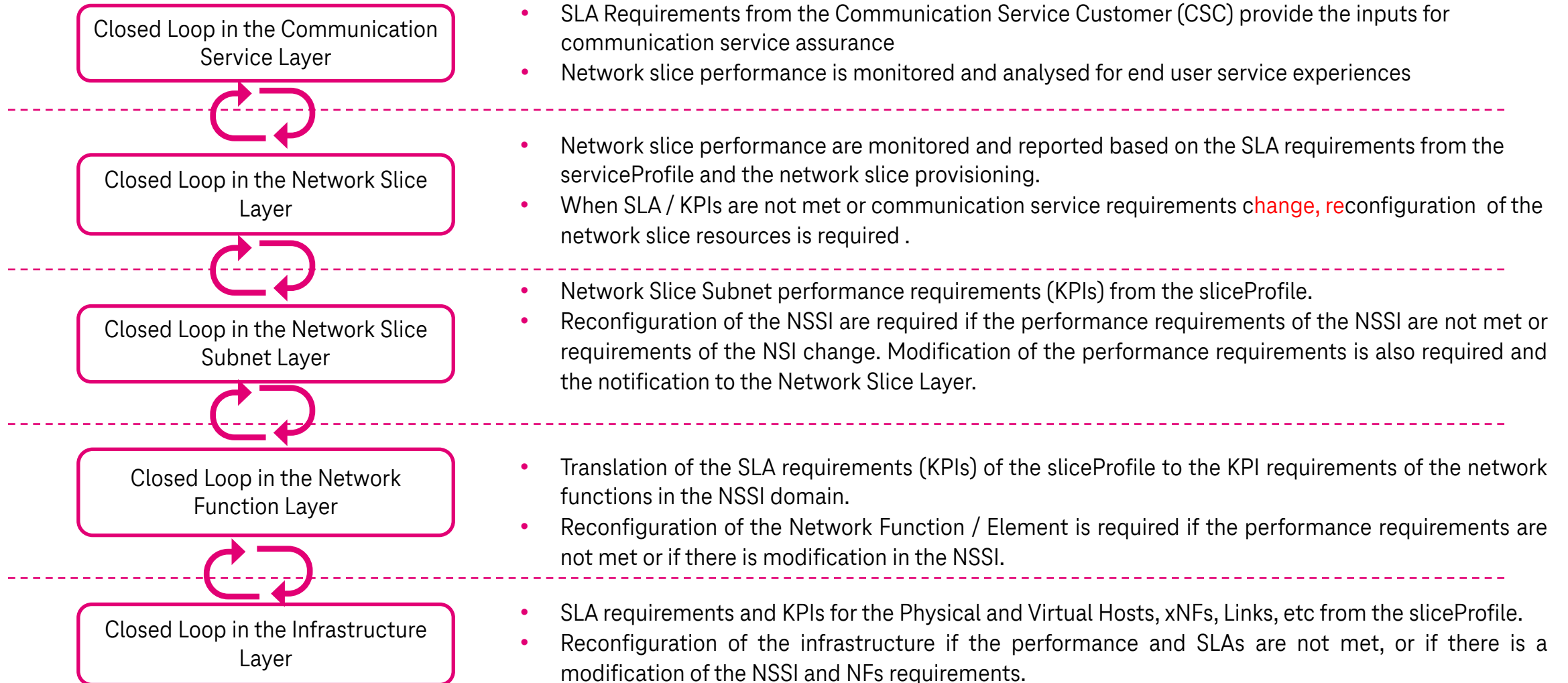
  - **Storage**
    - Central and consistent storage to access data
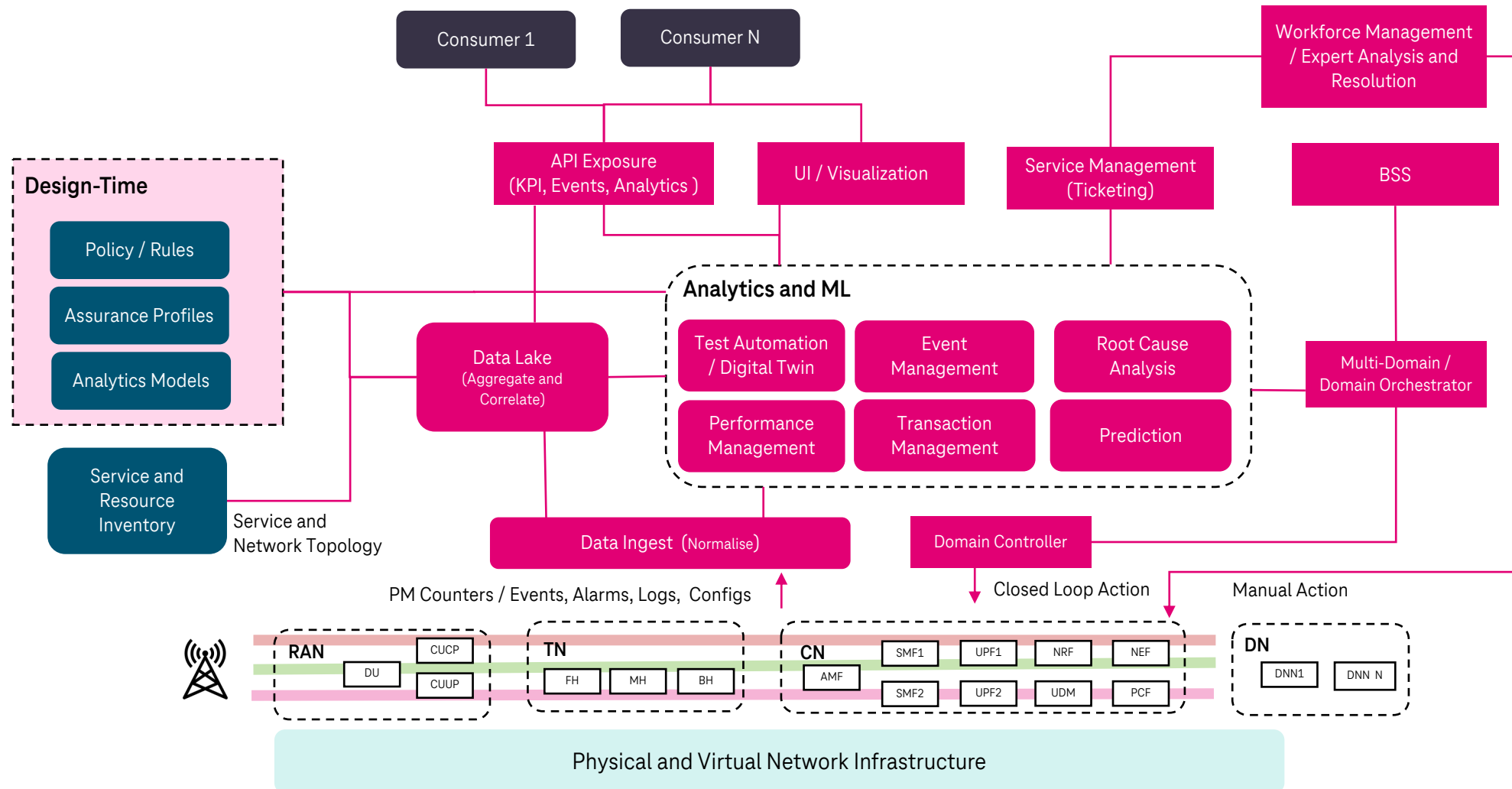
- **Characteristics for closed loop assurance**
  - **Apply closed loops on the lowest possible layer**
  - **Communication is based on event based architecture (EBA)**
  - **Analyse and Healing decision may use rule based or AI / ML**

# Closed Loop in Different Layers

**Closed Loop in the Communication Service Layer**

- SLA Requirements from the Communication Service Customer (CSC) provide the inputs for communication service assurance
- Network slice performance is monitored and analysed for end user service experiences

**Closed Loop in the Network Slice Layer**

- Network slice performance are monitored and reported based on the SLA requirements from the serviceProfile and the network slice provisioning.
- When SLA / KPIs are not met or communication service requirements change, reconfiguration of the network slice resources is required .

**Closed Loop in the Network Slice Subnet Layer**

- Network Slice Subnet performance requirements (KPIs) from the sliceProfile.
- Reconfiguration of the NSSI are required if the performance requirements of the NSSI are not met or requirements of the NSI change. Modification of the performance requirements is also required and the notification to the Network Slice Layer.

**Closed Loop in the Network Function Layer**

- Translation of the SLA requirements (KPIs) of the sliceProfile to the KPI requirements of the network functions in the NSSI domain.
- Reconfiguration of the Network Function / Element is required if the performance requirements are not met or if there is modification in the NSSI.

**Closed Loop in the Infrastructure Layer**

- SLA requirements and KPIs for the Physical and Virtual Hosts, xNFs, Links, etc from the sliceProfile.
- Reconfiguration of the infrastructure if the performance and SLAs are not met, or if there is a modification of the NSSI and NFs requirements.

# 5G E2E NW slicing service assurance architecture



**Consumer 1**

**Consumer N**

**Workforce Management / Expert Analysis and Resolution**

**Design-Time**
- Policy / Rules
- Assurance Profiles
- Analytics Models

**API Exposure (KPI, Events, Analytics )**

**UI / Visualization**

**Service Management (Ticketing)**

**BSS**

**Analytics and ML**
- Test Automation / Digital Twin
- Event Management
- Root Cause Analysis
- Performance Management
- Transaction Management
- Prediction

**Data Lake (Aggregate and Correlate)**

**Multi-Domain / Domain Orchestrator**

**Service and Resource Inventory**

Service and Network Topology

**Data Ingest (Normalise)**

**Domain Controller**

PM Counters / Events, Alarms, Logs, Configs

Closed Loop Action

Manual Action

**RAN** — DU, CUCP, CUUP

**TN** — FH, MH, BH

**CN** — AMF, SMF1, UPF1, NRF, NEF, SMF2, UPF2, UDM, PCF

**DN** — DNN1, DNN N

**Physical and Virtual Network Infrastructure**

# Service assurance profile management function



- Designs and generates the assurance artifacts for the infrastructure, network functions and slices.

- Translate service requirements (SLAs) into Key Performance Indicators (KPIs)

- Define the the performance metrics, events and alarms to be collected from the application, network function and infrastructure layer.

- Define the formulas to derive the KPIs, thresholds and aid in the visualisation

- Define the events for the automated and manual healing

- Define the configuration and the lifecycle management of the PM Jobs for the Network Slice Instance (NSI), Network Slice Subnet Instance (NSSI), Network Functions (NFs) and the infrastructure layer

# Challenges in implementing closed loop assurance

- Real-time monitoring of the network slices

- Live inventory providing a comprehensive, end-to-end view of the service and resources

- Complexity to develop consistent policies across all the domains and layers and it's coordination

- Standardised interfaces are needed to facilitate automation

- Mapping of customer perceived Quality of Experience (QoE) to the Quality of Service (QoS) of the network.

# Conclusion and next steps

- Service Assurance is critical for 5G Network Slicing and enables the fulfilment of the stringent service requirements in a proactive and automated way.

- Key enablers include real-time monitoring, centralised data, live inventory, AI, Standardised Interfaces

- Closed Loop Principle and Characteristics

- Service assurance profile management function as an enabler for design of assurance artifacts and automation

- Validate this architectural framework for the Live Video Production using 5G network slicing



Source: Telekom und RTL Deutschland entwickeln 5G Standalone Lösung für Live Video Produktionen

# Thank you for you attention