Security Level:

Building a Better Connected World,
ROADS to a Better Future

Network Telemetry Framework and Application Scenarios

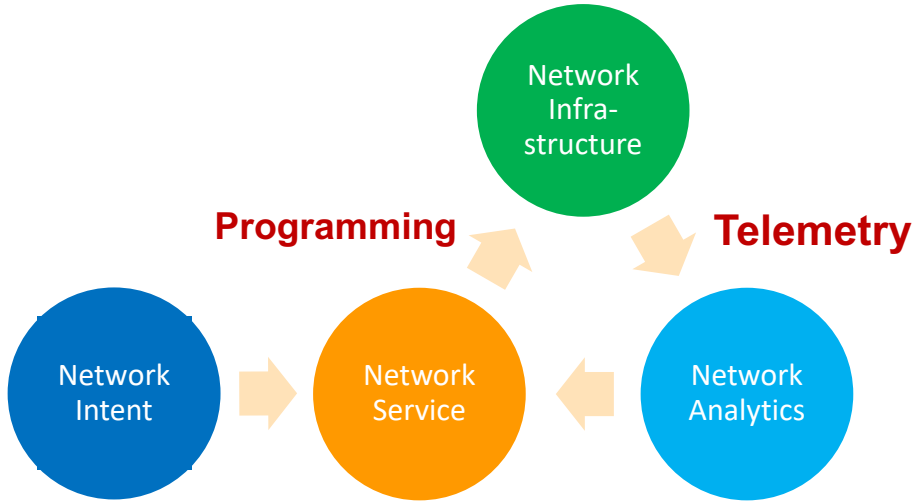
SwiNOG #35 – May 8th 2019

Challenges of Today's Networks

- **Networks become more and more complex**
  - Cloud, 5G, IoT, virtualization, VPN, slicing, …
- **Users/Applications are sensitive to network performance**
  - Bandwidth, latency, jitter, packet drop, network churn, …
- **Need better network visibility for**
  - Network Monitoring and Troubleshooting
  - Network Provisioning and Planning
  - Network Security
- **Yet old OAM tools are outdated**
  - Slow and un-scalable
  - Lack of application level visibility
  - Lack of automation tools

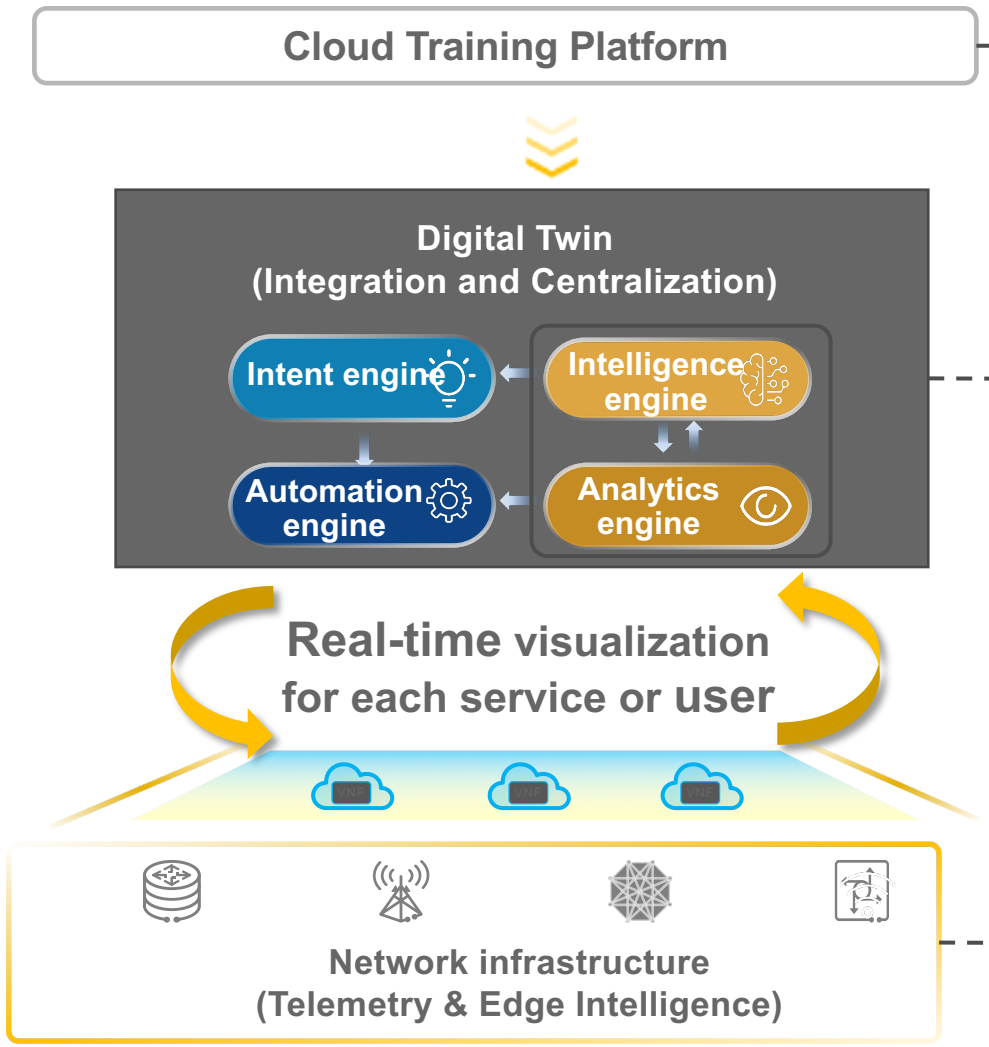
Challenges of Future Networks

- **Network management and services evolve to be intent/policy-driven and automated**
  - Reduce manual labor
  - Improve agility and performance
  - Optimize resource efficiency



- **Network visibility & analysis through telemetry is essential to realize intent-driven autonomous networks**
  - Intents/policies need to be continuously monitored and verified
  - Telemetry can provide rich, reliable and real-time data and build a close-loop network service management system.
  - Big data + Machine learning will change the way to manage the Network

Huawei Autonomous Driven Networking High Level Architecture



Cloud Intelligence

- **Cloud based training center:** data lake + training center

Local Intelligence

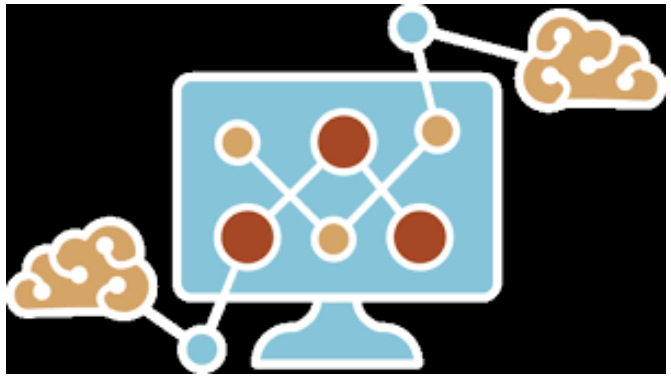
- **AIOps:**
  - Big Data + Machine learning based operation , anomaly detection/root cause analysis/prediction
- **Use cases for multi scenarios:**
  - Data Center / Campus / SDWAN / Access Network / Optical Network

Telemetry & Edge Intelligence

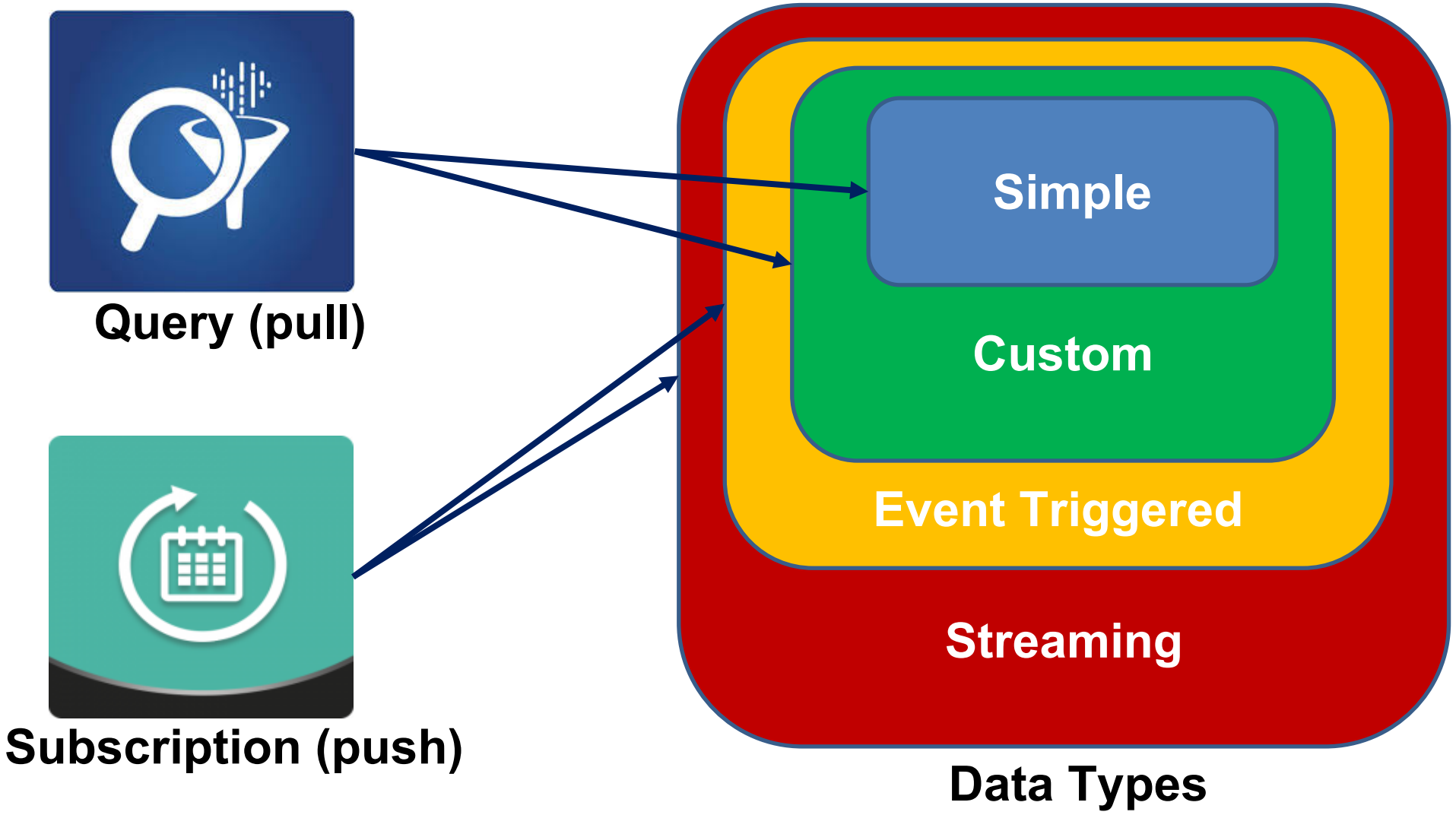
- **Telemetry:** Real-time data analysis
- **Edge Intelligence**: Built-in AI Chips to do edge intelligence, saving costs

Network Telemetry Defined

- **Acquire and use network data remotely**
  - Data for visualization, analysis, and action
- **Three different perspectives**
  - Data acquiring mechanisms
  - Data objects
  - Function components



Telemetry Data Acquiring Mechanisms



Telemetry Data Objects

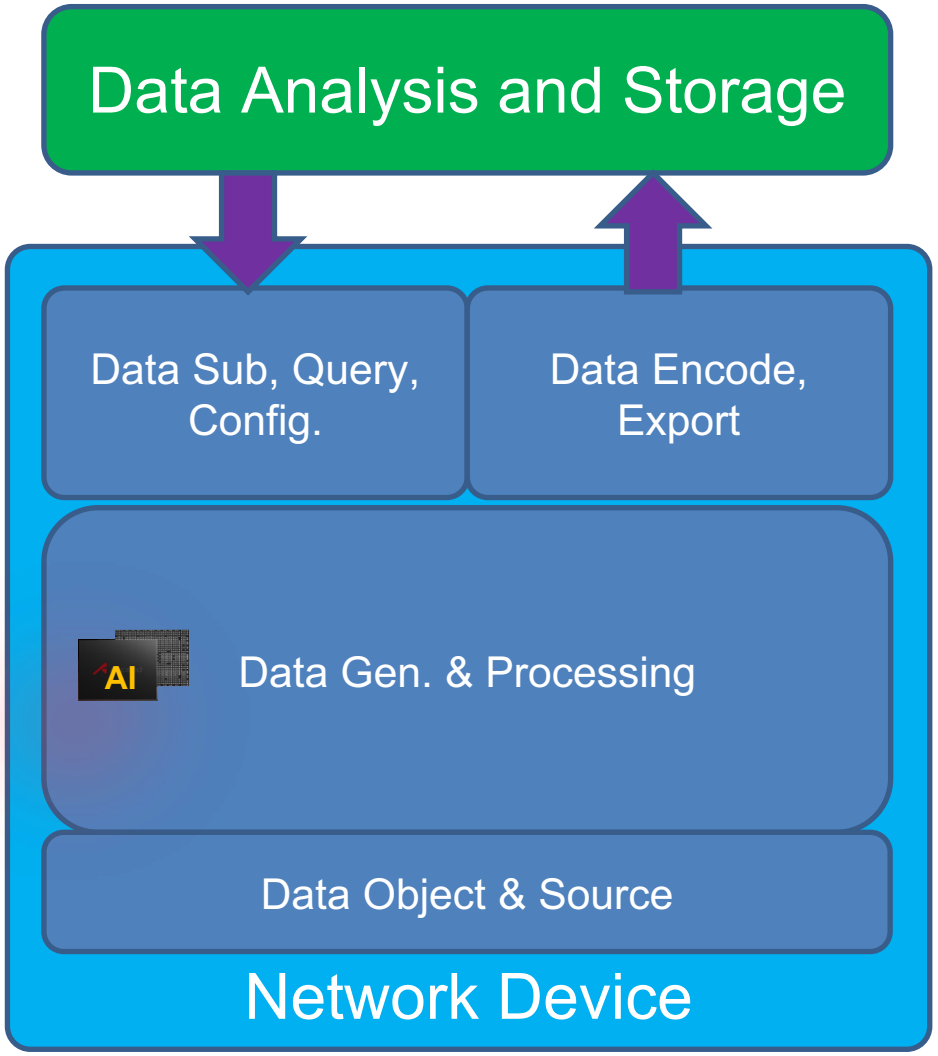
Different monitoring entity & object

Different data source

Different data export location

Management Plane	Device config. & op. status	Main control CPU	NETCONF, gRPC, UDP
Control Plane	PDU, RIB, FIB	Main control CPU, LC CPU, FWD chip	BMP
Data Plane	User traffic	LC CPU, FWD Chip	in-situ OAM, sFLOW
External Data	Social event, App info	Terminals, Servers	

Telemetry Function Components



- Data Analysis and Storage
  - Data requirement
  - Data sharing, distribution, and processing
- Data Subscription, Query, and Configuration
  - Interface for data request and model
- Data Encode and Export
  - Interface for telemetry data output
- Data Generating and Processing:
  - Raw data generating (Traditional)
  - **Device built-in AI chipset**, Embedded AI Capability which provide local intelligence on devices (New Generation of Devices)
- Data Object and Source:
  - Data source

Embedded AI Chip

CloudEngine 16800

Highly efficient AI chip

- 8 TFLOPS

Dual-channel high-performance CPU server

iLossless algorithm ™

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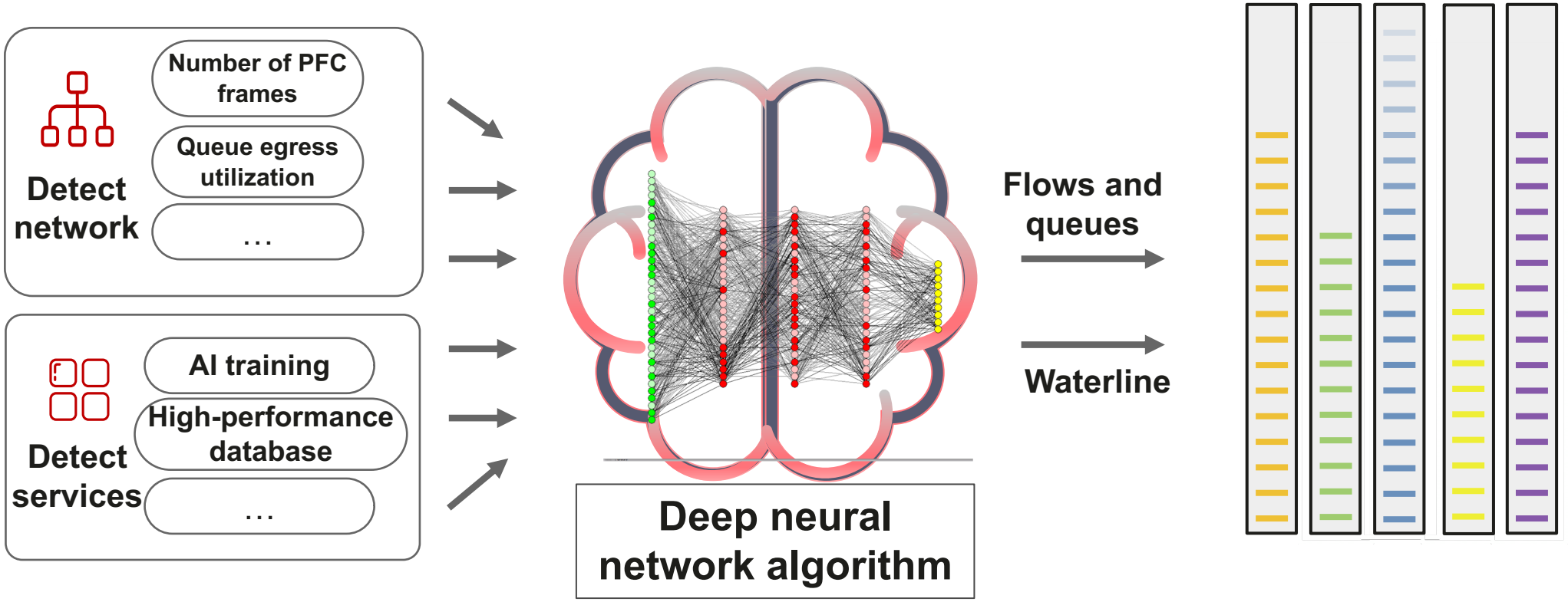
Unique Intelligent Lossless Switching Algorithm

Per-flow service detection

Millions of flows and ten thousands of queues

Intelligent and optimal matching of flows and queues



<10 us E2E latency

0 packet loss

100% throughput

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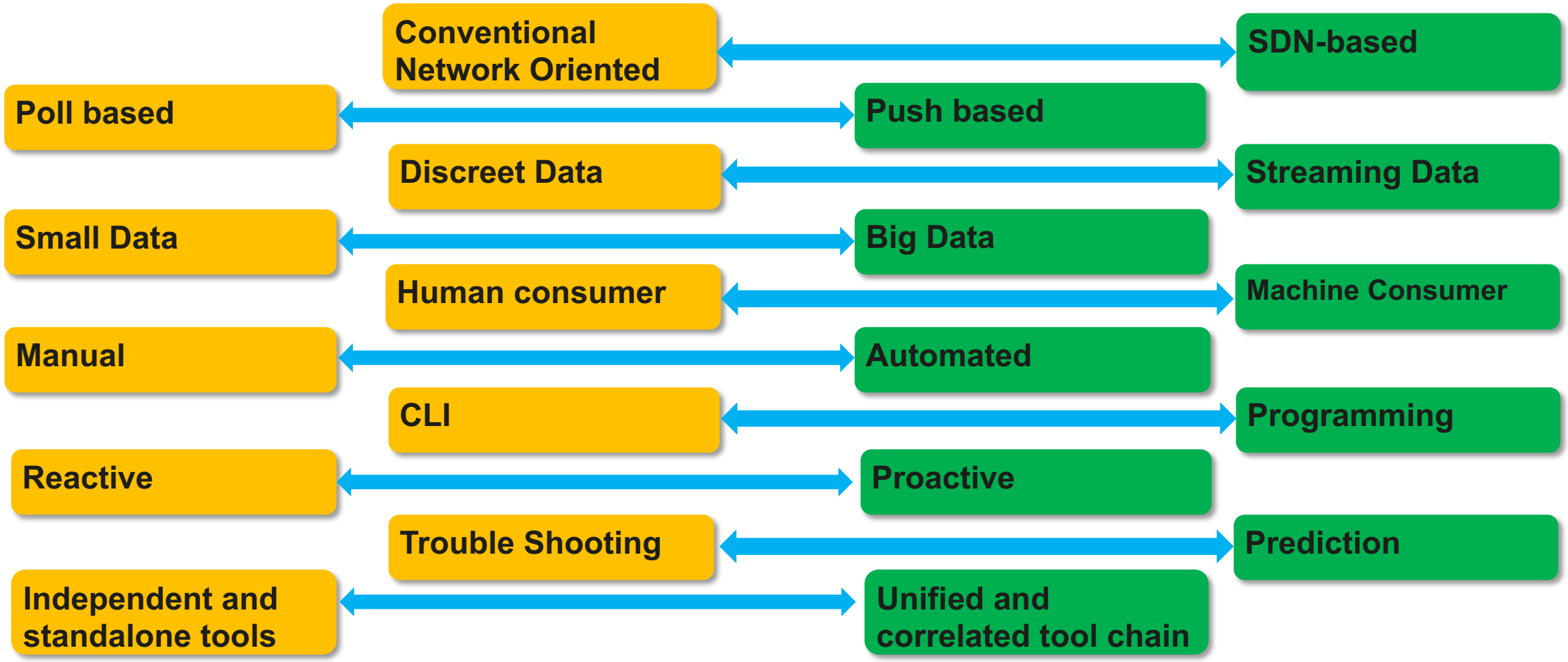
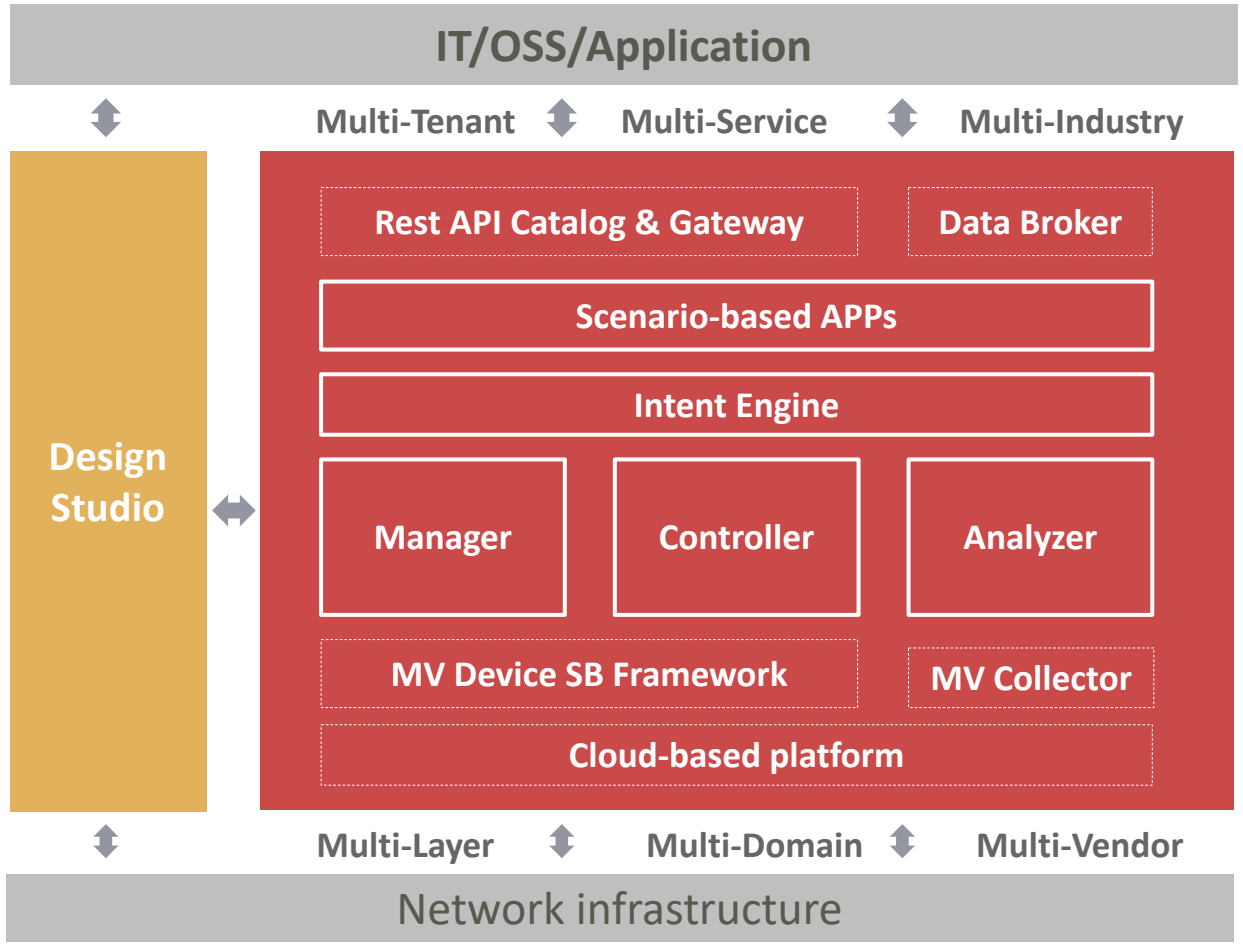
Evolution of Network Telemetry



Local Intelligence: Target Architecture and Value Proposition



Network Automation

Intent driven, Model based

Multi-layer, Multi-domain, Multi-vendor

Network Intelligence

Big data and AI based

Predictive maintenance

Agile Integration

Programmable Design studio

Open Rest API and Kafka Data Broker

Zero-touch Operations

Scenario-based APP

Across Manager, Controller, Analyzer

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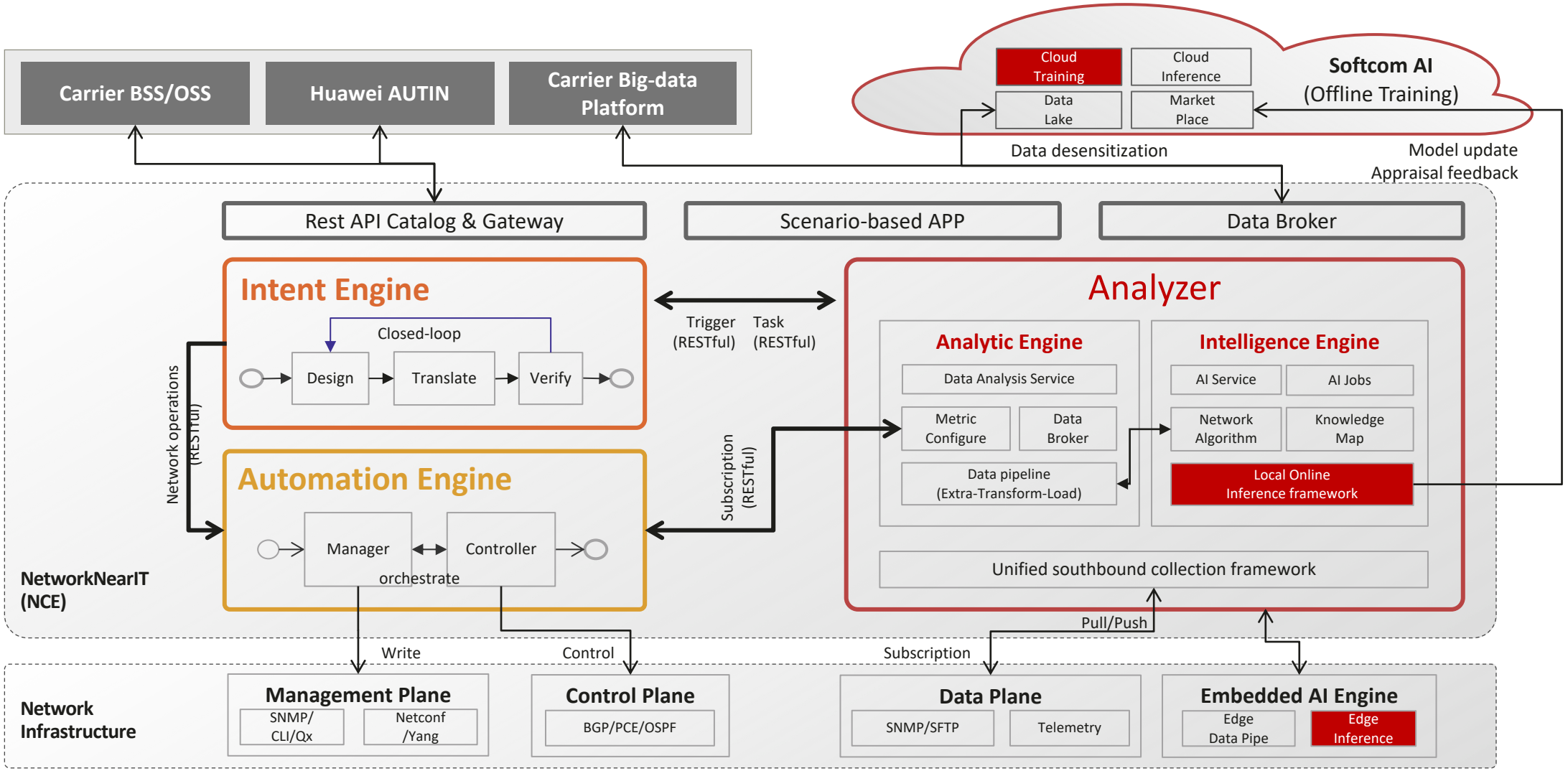
Fit NCE into Carrier ICT Landscape for Bigger Closed-loop



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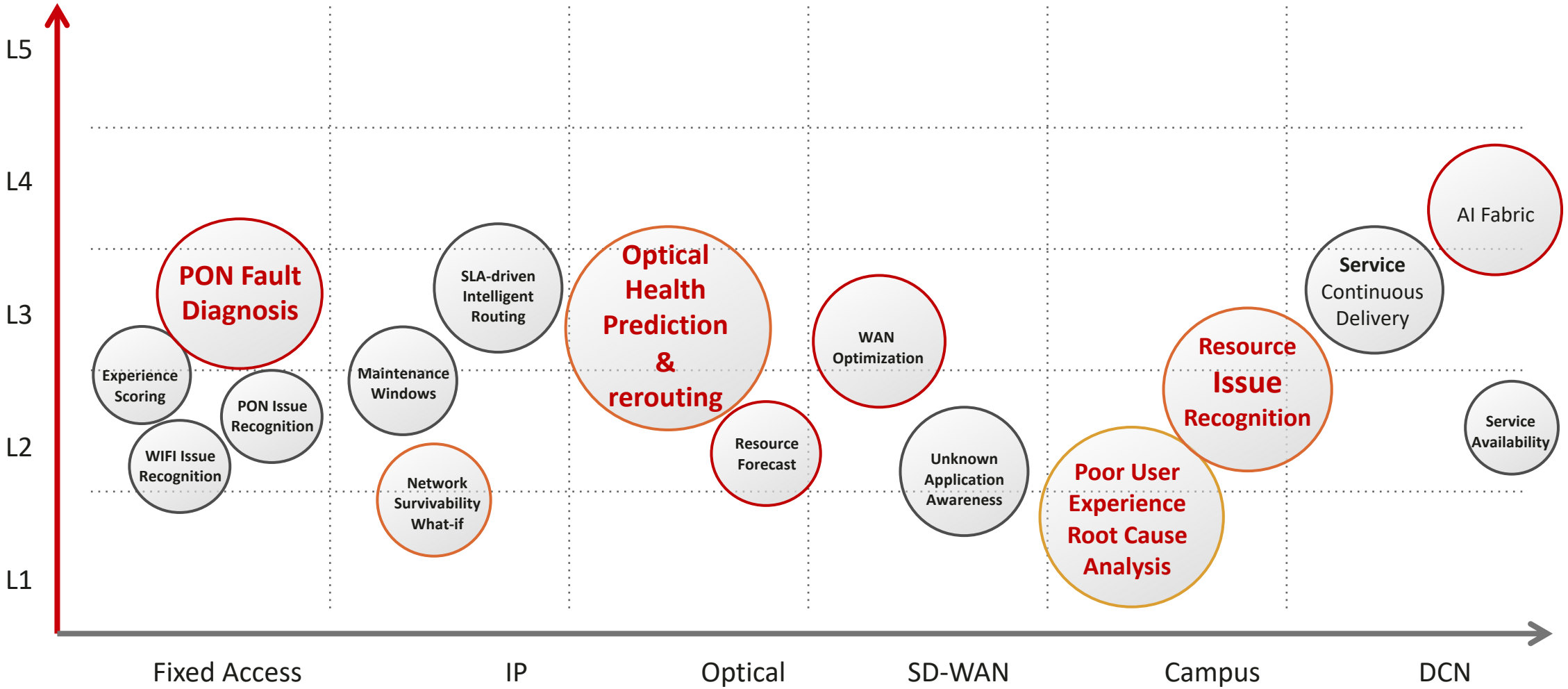
Huawei NCE Scenario-based Cases At-a-Glance



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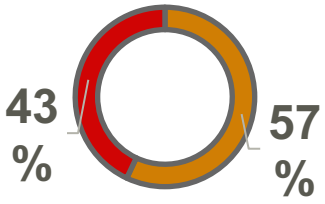
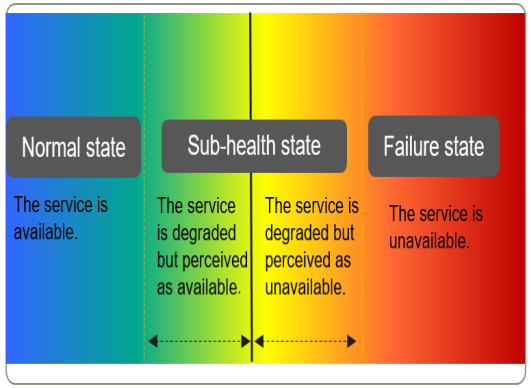
Scenario 1: Optical Health Predictive Maintenance

Distribution of fiber cut causes



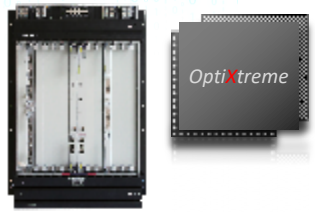
- Fiber degradation
- Fiber interruption

Typical process of service degradation to an outage



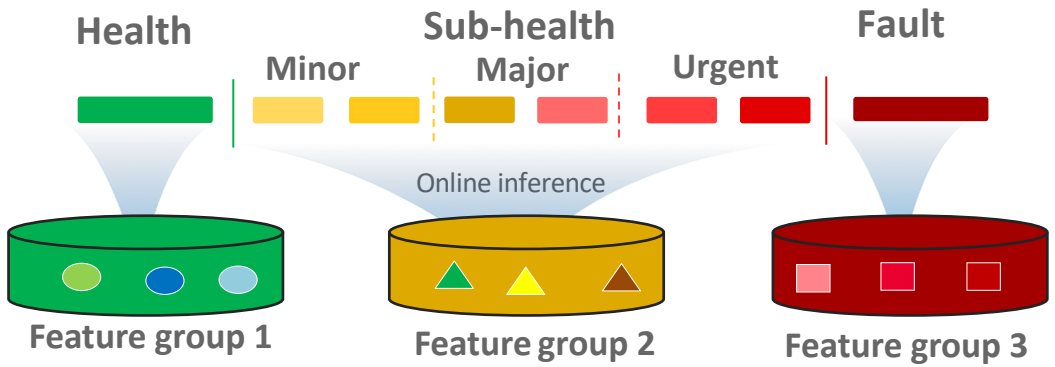
Network Cloud Engine

Local online Interference

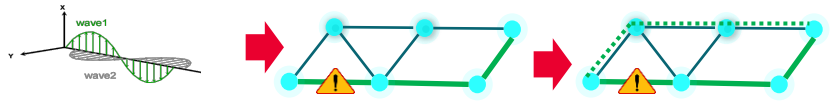


Edge intelligence

Degradation Prediction by Pattern recognition



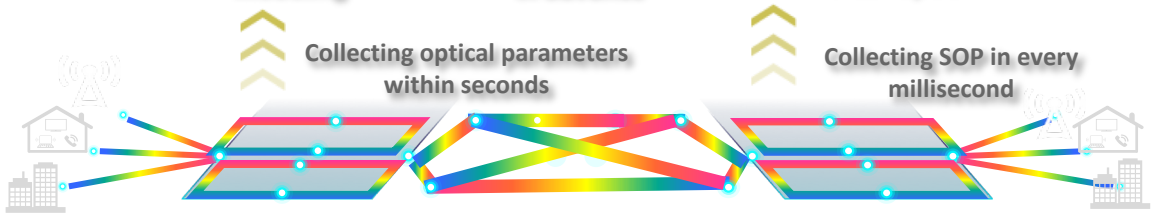
Interruption Protection by predictable rerouting



Pattern recognition based on SOP modeling

Interruption prediction 200ms in advance

Establishing protection route before interruption



SOP: State of Polarization

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Optical Service Health Predictive Analytics

Scenario 2: PON Fault Diagnosis and Root Cause Analysis

Call center/NOC

Pain analysis: According to the complaint by users, 25%-40% is caused by PON optical paths.

- **Difficult to distinguish the user power off and optical path interruption**
- **Difficult to identify slow Internet access caused by poor optical path quality.**
- **The interruption area cannot be distinguished.**

Big data collection

1000+ Parallel thread processing

Feature extraction

Million-level global fault library

Root Cause Analysis

10+ Fault Mode Identification, Accuracy 80%

Responsibility division

The first AI O&M algorithm

ONT offline

Interrupted ?

Powered off ?

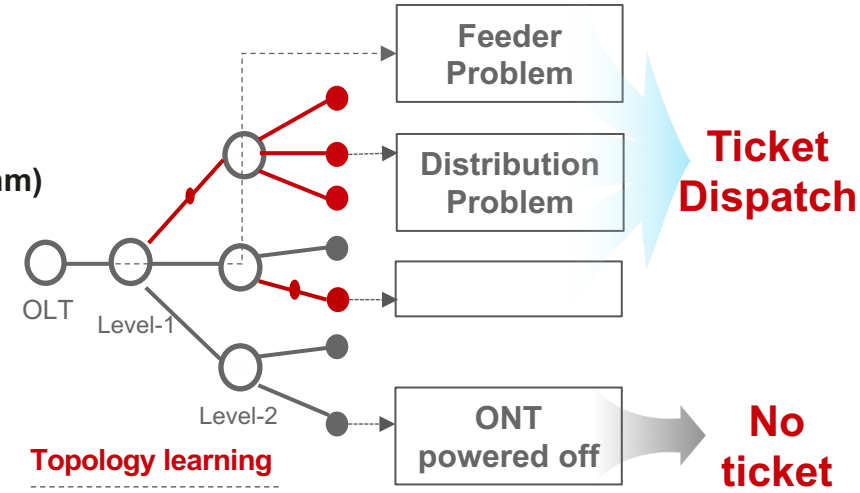
interrupted

(Based on the algorithm)

Poor optical path

Unaware

- Weak light (Maybe Loose connector)
- Weak light (Maybe aging fiber connector)
- ....



Identification of Interruption / Poor Quality Issues

Automatic fault demarcation based on AI algorithm

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ODN Fault Real-time Awareness & Demarcation

Scenario 3: Poor WiFi User Experience Root Cause Analysis

Background

Traditional solutions face difficulty in identifying users with poor experience. Professional engineers need to visit sites for troubleshooting, and problems cannot be reproduced.

Requirements

The network can identify clients with poor experience and provide root cause analysis.

Key technology:

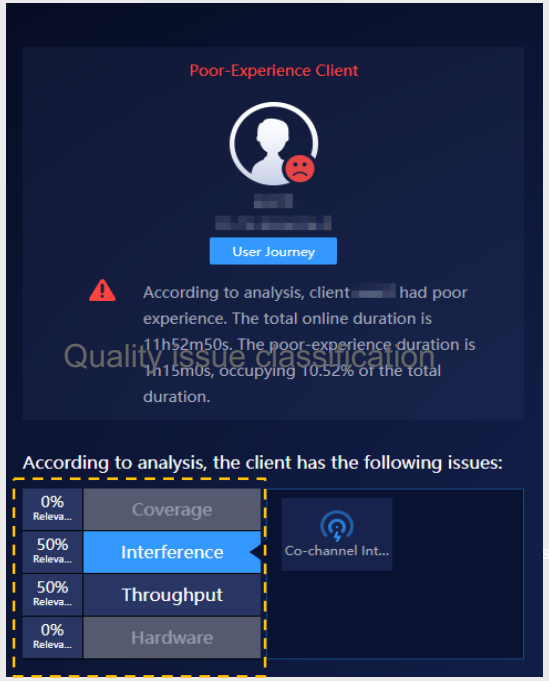
Identification of poor-QoE users:

Based on historical KPIs of clients, the system uses the dynamic learning algorithm to learn the indicator deterioration threshold, and determines the locations of QoE clients.

Root cause analysis:

Quality issues are classified. The system performs correlative analysis based on big data and automatically identifies KPIs that affect user experience.

Case:
Using CampusInsight, an O&M engineer of a company found a poor-QoE client. The proportion of poor QoE time was 10.52%.



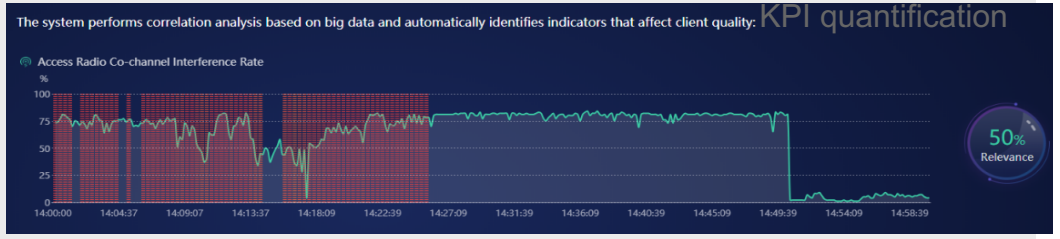
Problem details:
The user experience in each time segment was analyzed and it was found that the latency of the client was constantly high.

Client quality display

Root cause identification:
Information related to the time segments where user experience was poor was sampled. It was found that the Co-channel Interference of the terminal was the key cause.

Network KPI analysis

KPI quantification



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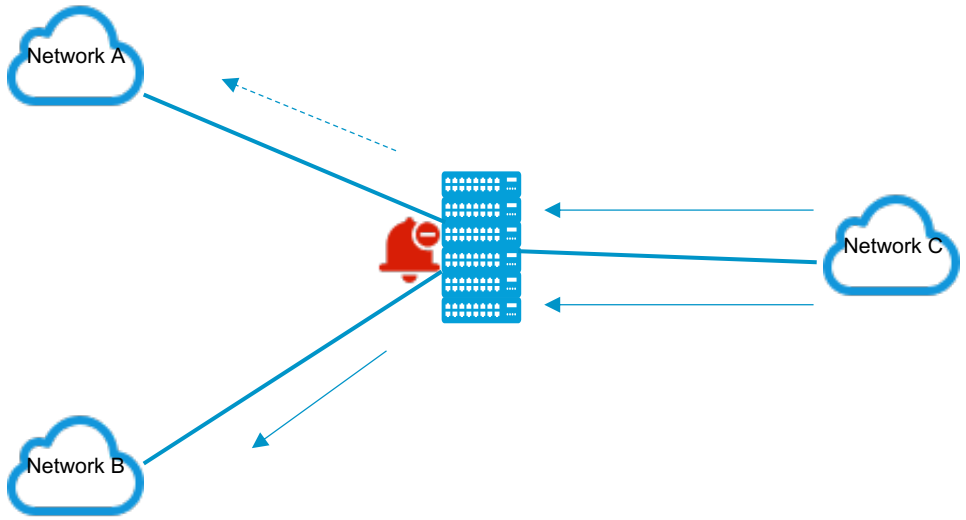
Use Case

Correlative Analysis of Clients with Poor Experience

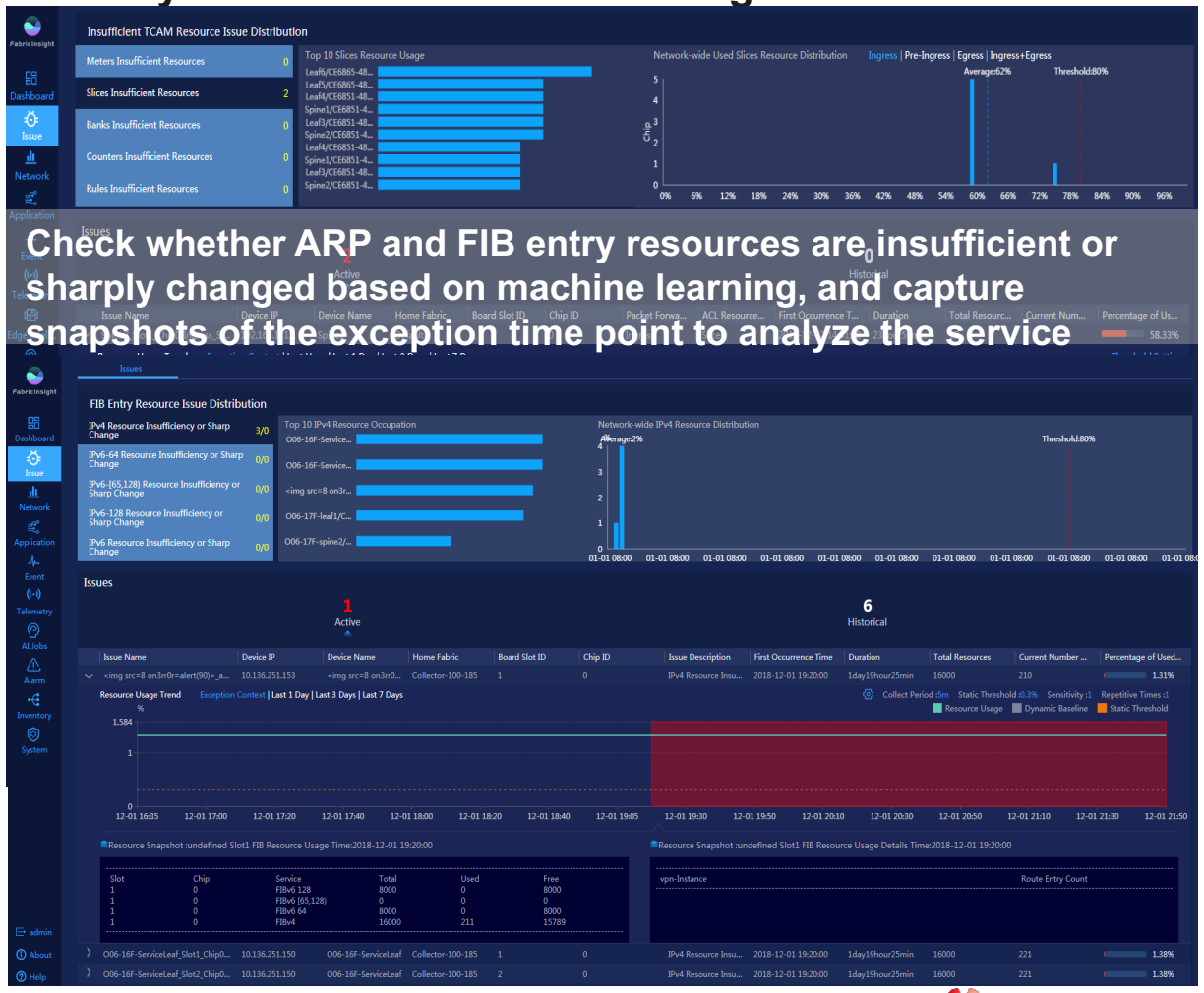
Scenario 4: Proactive Detection of Network Resource Issues



Challenges to traditional O&M:

- Device entry insufficiency issues cannot be detected in time. Once a resource insufficiency issue occurs, users have to manually log in to the device and view the resource usage distribution, leading to low troubleshooting efficiency.
- Entry resource changes cannot be proactively identified to check whether the changes are normal.

- **Check whether TCAM resources are sufficient, and capture snapshots of the exception time point to analyze the service resource usage distribution**



- **Check whether ARP and FIB entry resources are insufficient or sharply changed based on machine learning, and capture snapshots of the exception time point to analyze the service**

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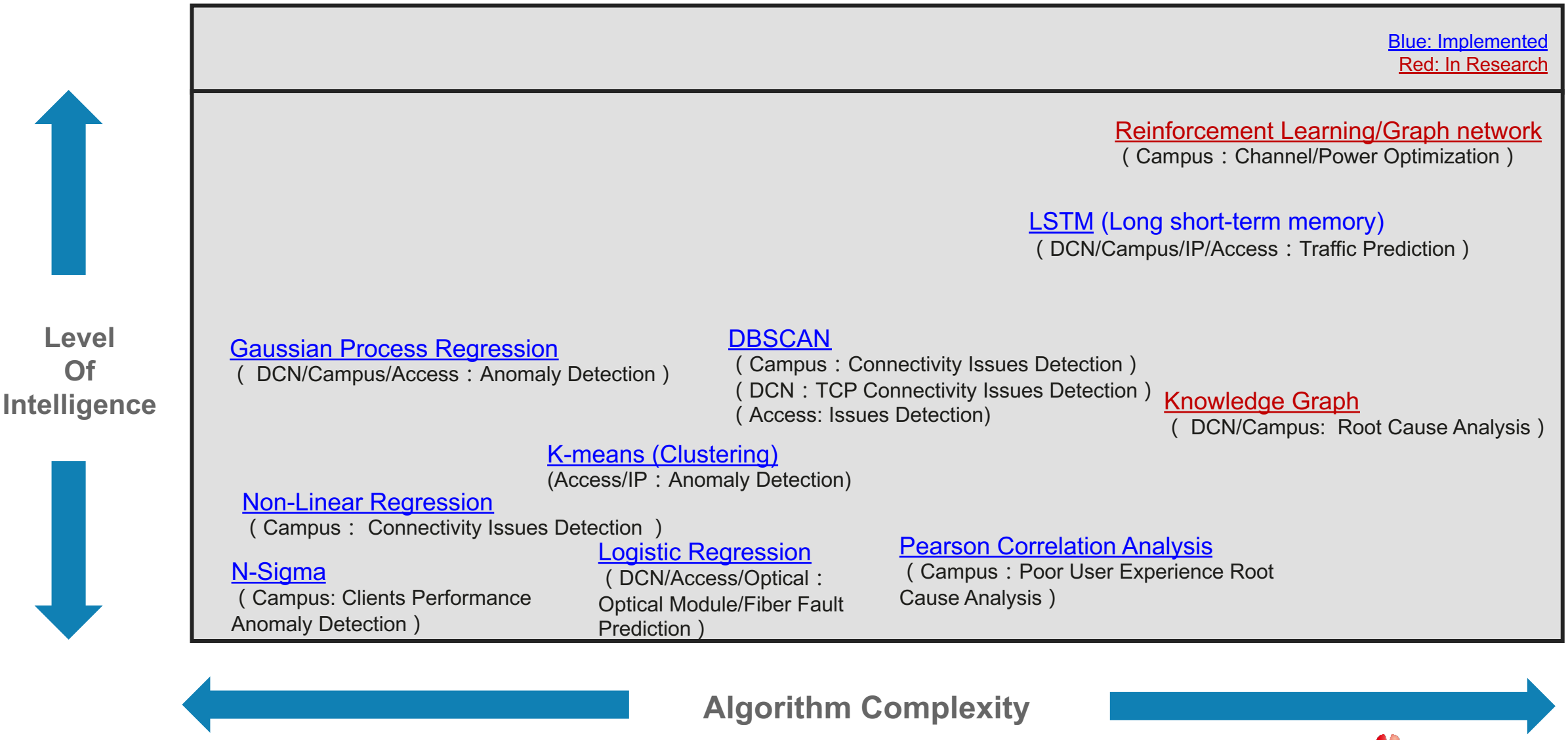
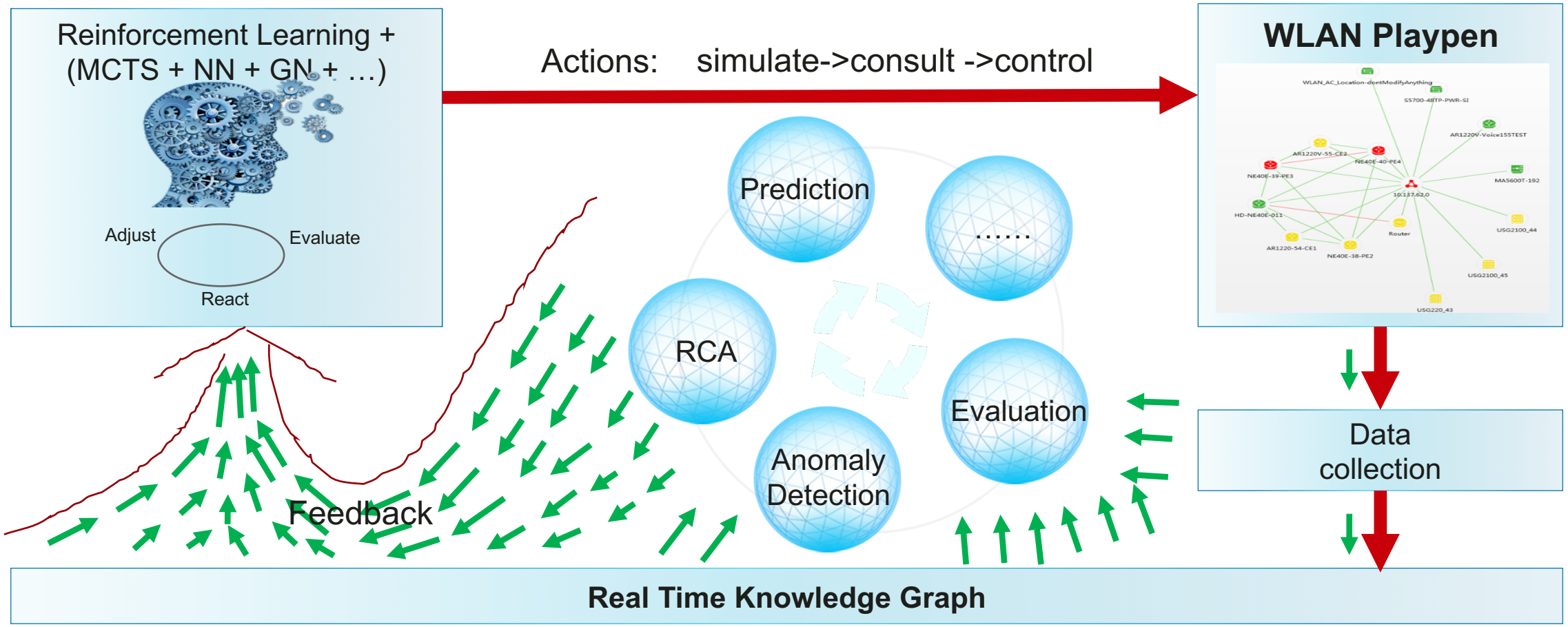
Abnormal Network Behavior Identification

The AI Algorithms Used in NCE



Self Healing Networking Vision



Simulation: **play and grow ->** consult**: event/alarm, optimization suggestion, visualization ->**

Control: **self healing/continuous optimization/etc.**

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Future Challenges

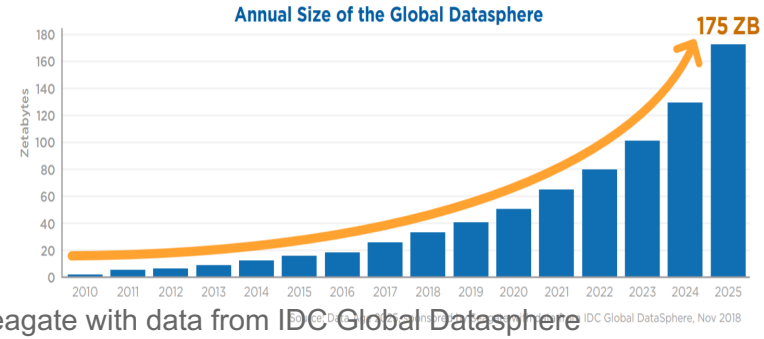
One-track algorithms **evolve to generalization**

Most of the AI algorithms are **highly specialized, generalizing** beyond experience (data category) is still **untouchable** to AI. The challenge is more serious in the **highly specialized Telecom industry.**

Advanced Algorithms **face old silo systems**

The final goal is to build a closed-loop automation system. How all the various network parts **evolve together** is a big challenge.

Massive Data Growth demands new way of data **collection & measure**



Source: Data Age 2025, sponsored by Seagate with data from IDC Global Datasphere

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FUTURE
START

Thank you.

把数字世界带入每个人、每个家庭、
每个组织，构建万物互联的智能世界。

Bring digital to every person, home and organization for a fully connected, intelligent world.

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