Open Broadband
May 20th, 2022

Paving the way to controller-led, automated and autonomous software defined access networks (SDAN)

Kurt Pynaert, Nokia

# Broadband Zero – Nokia's portfolio strategy

Zero left behind
Connect everyone and everything

Zero limits
Innovative technologies for new use cases and business models

Zero touch
Automate and optimize the network

mmWave

Digital Campus

SW-defined acces

5G Fixed Wireless

App-enabled devices

Domain controllers

Wi-Fi

Fiber access

Network design and build

5G transport

25G

Predictive care

Cloud integration

Open APIs and interfaces
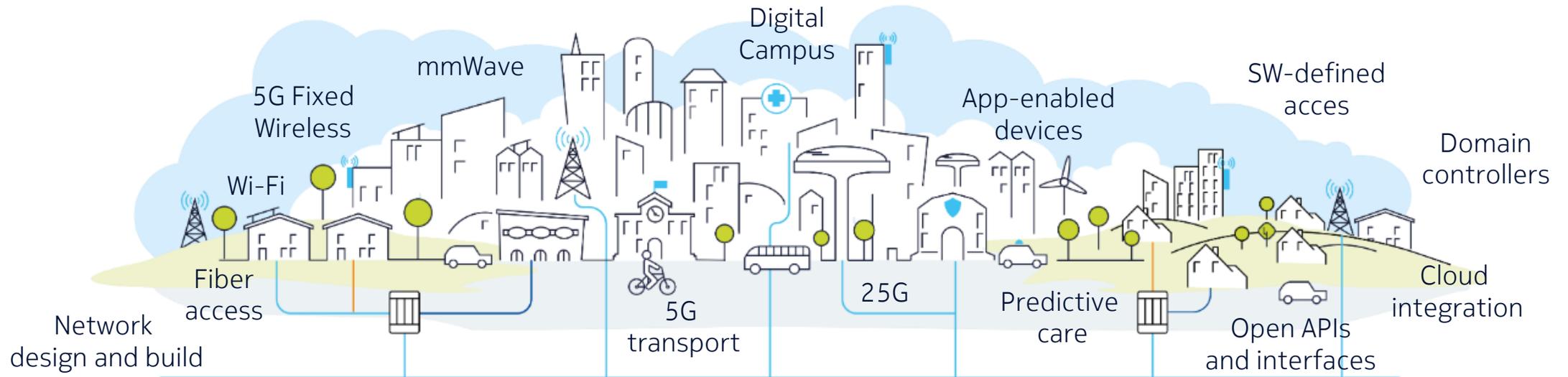
Zero waste
Delivering the benefits of broadband while minimizing environmental impact

SDN is Network Automation

SDN is a method to enable a very high degree of **automation** in your entire network!

| More intelligent, programmable and open automated network | Reduce operational costs and improve the networking experience | Instruct the physical and virtual network to do tasks with machine learning and analytics | End-to-end solutions with increased intelligence & automation |

Self-optimized coverage & capacity

Smart Network Fabric

Access

Humans & Machines

Massive-Scale Access

Converged Edge Cloud

Software-defined, end-to-end, Open and multi-vendor

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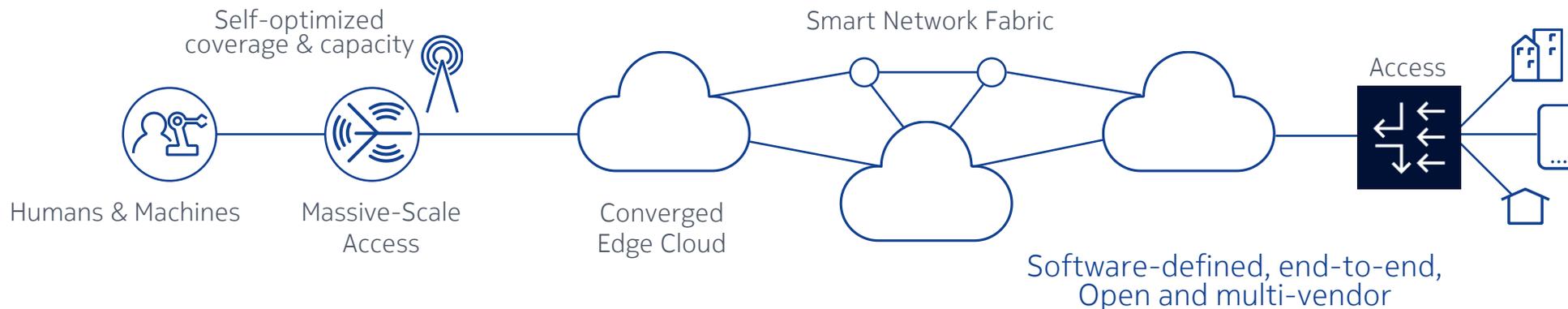
Future readiness – the future is very different from the past

	Past	Future
Solutions	**Technology-driven**	**Society/Value-driven**
Driver	**Consumer** (BW)	**+ Industry 4.0, e-health …** (Latency & SLA, 5G Services)
Architecture	**Centralized**	**Distributed** (dense & scale)
Software	**Monoliths w/ limited APIs**	**Modular w/ Open API**
Standards	**Definitive**	**Iterative & Open**
Investment	**Singular** (Operator only)	Singular and/or **Shared** (InP/VNO, NH, NaaS, MT)
Flexibility	**Limited** (Provisioned)	**Large** (Software definable)
Sharing	**Static and Limited** (HW VPNs)	**Dynamic and Infinite** (Network Slices)
Innovation Speed	**Per annum/decade** (new Services)	**Per month/week** (new Apps)

(*) NH: Neutral Host, MT: Multi-Tenant

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Technology and architecture enablers for open broadband

One Fiber Access

1

Broadband access for all: residential, business, MxH, enterprises, 5G services, Industry 4.0 applications

Controller-led networks

2

Intent-based networking, abstraction & automation, closed-loop automation, and programmability

Network Slicing - NaaS

3
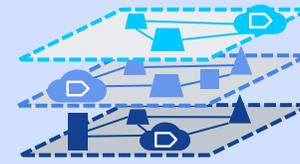
Open Access | E2E slicing

Multiple logically isolated networks with purposed SLA, individual logical networks for new use-cases

Cloud-native µServices

Modular micro-services-based architectures, with in-service NetDevOps, and automated CICD pipelines

4
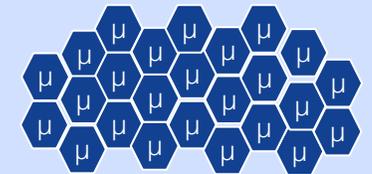
API-ification, standards

5

API-ification

Open API architecture and controller platform with a vendor-agnostic experience. **Standardization is key!**

Apps and AI/ML

Cognitive operations integrated in the controller for autonomous networking. Onboarding your apps.

6
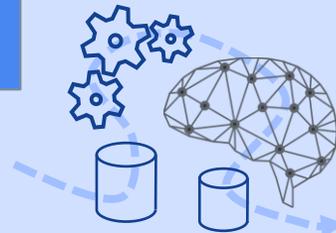
Converged Access Edge

The emergence of the edge cloud for low latency, traffic optimization, edge apps, with one access (FMC)

7

E2E Orchestration

A new breed of end-to-end service orchestration and assurance including end-to-end network slicing

8

E2E service operations

Access | Transport | Core | Cloud

broadband forum | tmforum | ETSI

tmforum | ETSI

Technologies enabling extreme automation, TCO improvements and revenue generation
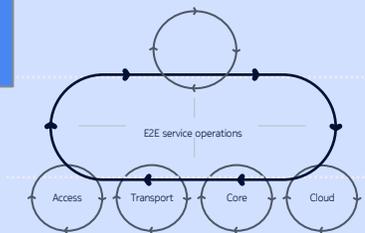
One fiber access – open broadband access
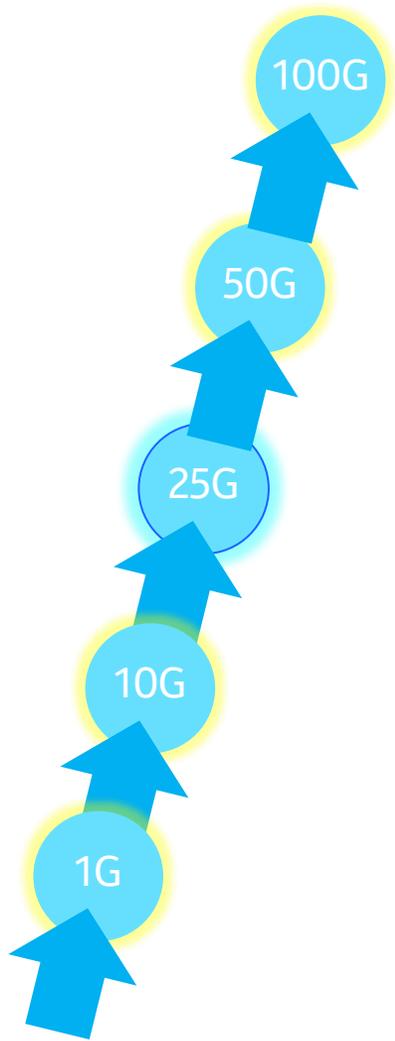
Virtualized and software-defined access

- Controller-led access network with closed-loop automation and cognitive operations
- Scaled with cloud elasticity, with different cloud deployment models
- Flexibly programmable for resource optimization, services and network slicing

100G
50G
25G
10G
1G

Open SDN APIs

SDN Controller

SD-OLT
SD-OLT
SD-OLT

Altiplano

Lightspan

PON

up to 40 km (going to 60km)

NG CO and Edge

Ultra-capacity long reach fiber access

- PON capacity for residential, business, enterprises and MxH (anyhaul)
- PON supports 5G services and Industry 4.0 applications, TSN readiness
- 40/60 km reach enables OLT centralization, CO consolidation, and Edge

One ubiquitous access delivered over long fibers

A controller – what is it and what does it do
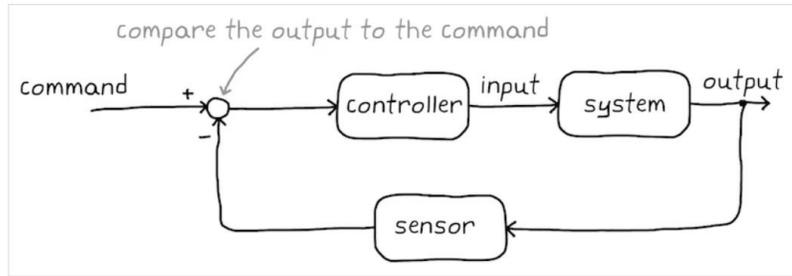
Control engineering (the command is the intent)

1 **Abstraction**
via Intent-based networking (IBN)

Intent-based

Closed-loop automation (CLA)

2 **Programing** the Network

API-ification

3 Network **Virtualization**
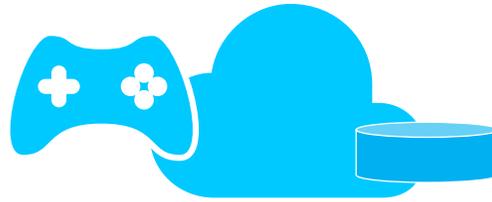
4 SDN Control Plane

5 **Streaming Telemetry, Sensors**

From open-loop systems to closed-loop systems with closed-loop automation and autonomics
Control engineering applied on networks

Network as a combination of
- Physical network functions (PNF)
- Virtual network functions (VNF)
- Cloud-native functions (CNF)

Vendor agnostic

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Intent-based networking
Abstracting and automating the network

Intent

Define business goals & policies
Service and resource objectives

Translate to configs and policies
Hide the technology details
Check integrity,
incl. transactional integrity

Abstraction

Vendor agnostic

Translation

Monitor & Heal
Meet the SLA of the intent (the service)
Recommend changes
Automated and/or assisting corrective actions
Scale & Optimize

Self-healing

Programming

Automation   Always-on

Activation

Closed-loop

Assurance
service and resource

Insights   Monitor   Cognitive

Analytics   Health   AI/ML

Configure network functions,
and apply policies
Distribute network functions
e.g. in function of latency (edge) and scale

Data collection
Sensors
Streaming Telemetry
Network events

Network of PNF/VNF/CNF

An automated and autonomous network that monitors, optimizes, scales and heals itself

Nokia embraces and complies to Cloud CO

broadband forum

- ✓ **Domain Orchestrator** as a technology-agnostic function offering generic Design, Orchestration, Inventory and Assurance capabilities. CCO DO typically conforming to TMF APIs.

- ✓ **Access SDN Management & Control** layer cater for the technology-specifics. The SDN Controller is providing an abstract view of the Access Network towards the Orchestrator and is responsible for resource control and automation operations within the domain.

Nokia Altiplano as Access SDN M&C

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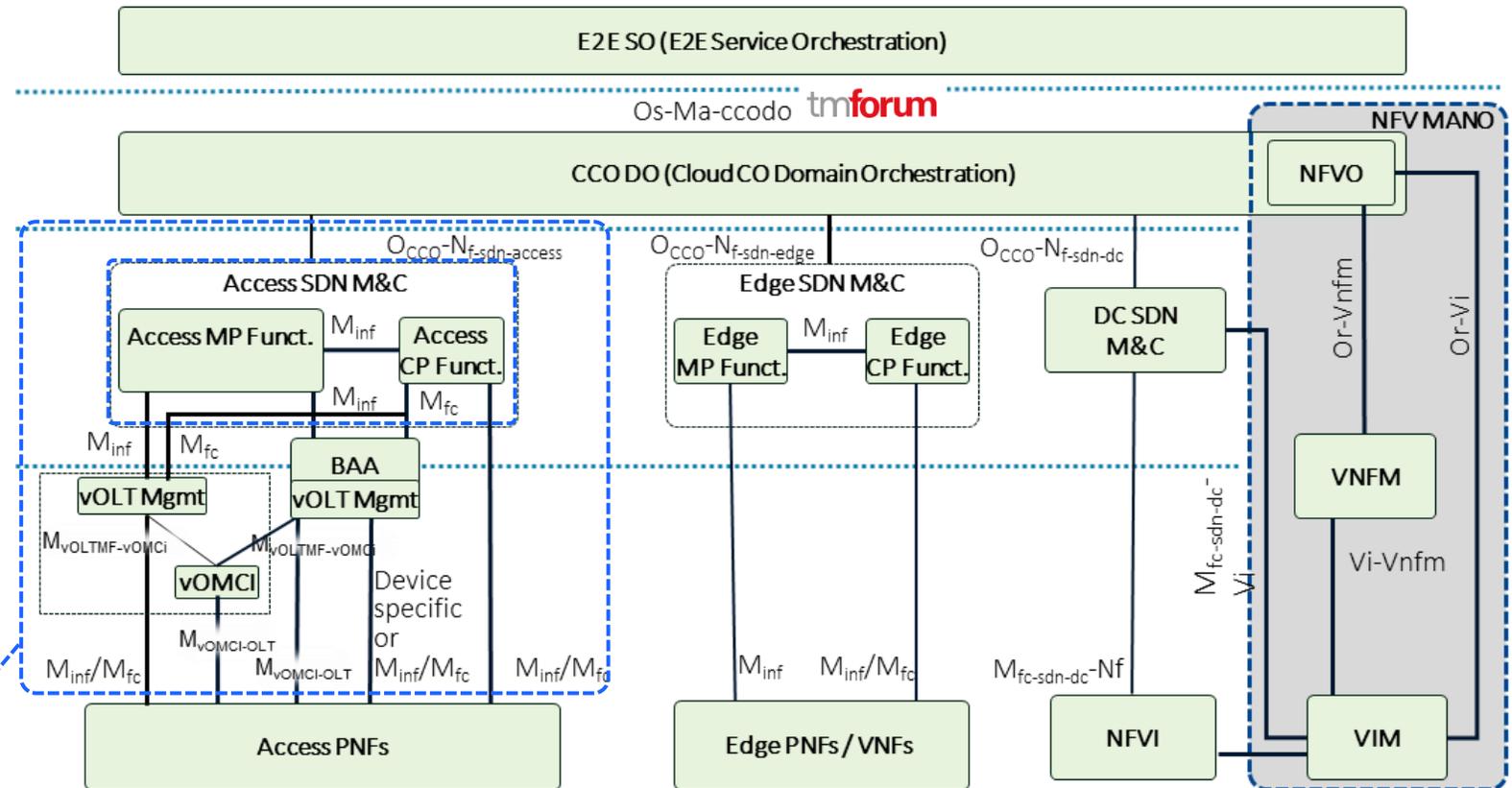
BBF Cloud CO open standard ensures multi-vendor interop
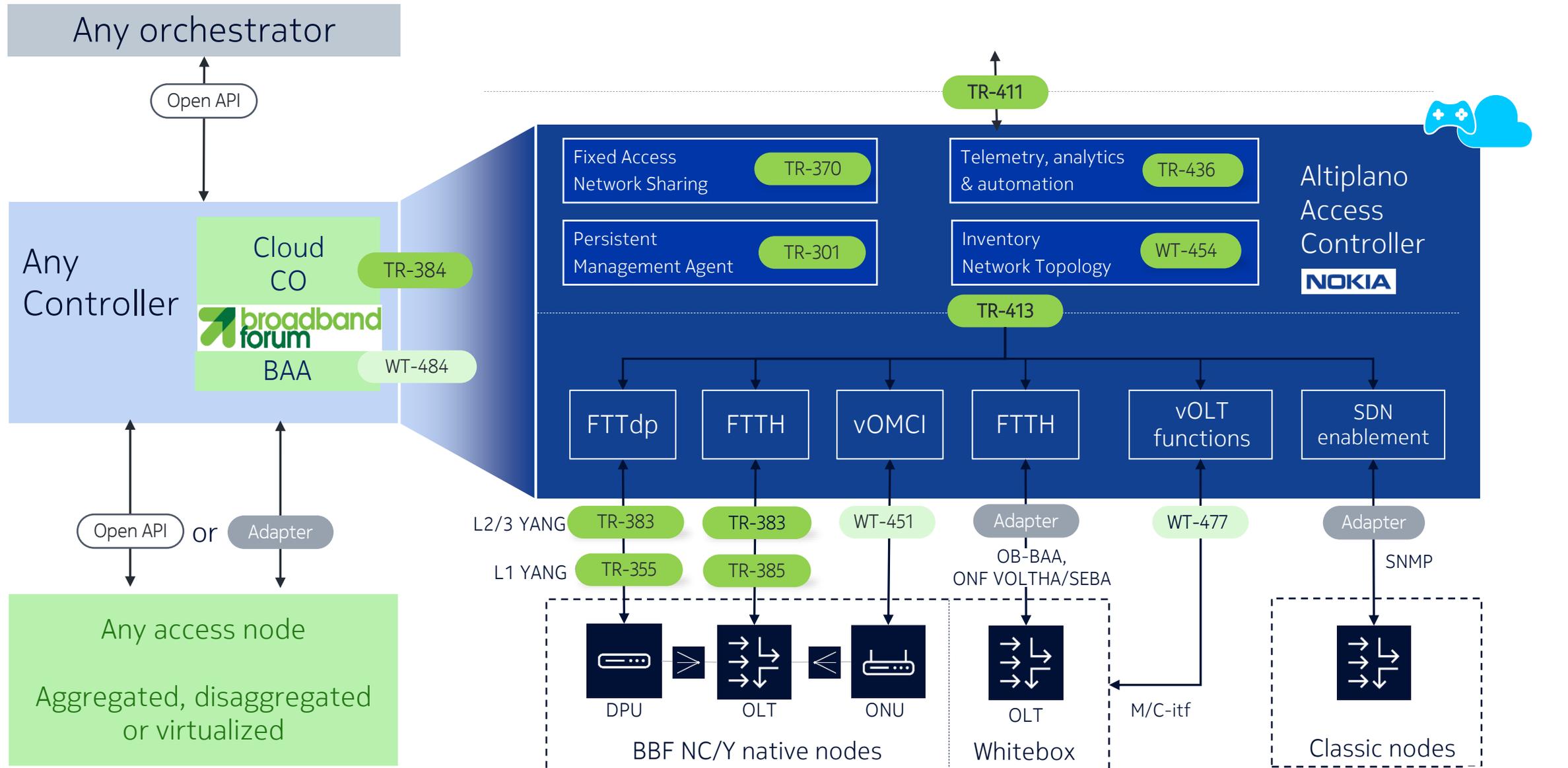
Nokia conducting proof-of-concepts with 3rd parties (suppliers) and operators
Testing the maturity of native NC/Y, multi-vendor, 3rd pty OLT, vOLT (WT-477)

Column 1: BBF

broadband forum — **BBF**

Any orchestrator

Open API — TR-411

TR-384

SDN M&C (controller)

Cloud CO — broadband forum — BAA

WT-484

TR-413

TR-383

TR-385

WT-451

Open API **or** Adapter **or** WT-477

TR-413 — Adapter

VOLTHA — VIRTUAL OLT HARDWARE ABSTRACTION

Adapter

Any access node
Aggregated, disaggregated or virtualized

Column 2: BBF compliant

NOKIA — **BBF compliant** — broadband forum

Any orchestrator

TR-411 — Open API

Altiplano Access Controller NOKIA
Reference Access SDN M&C for BBWF demo's (since 2018)

TR-413 — TR-413 — OB-BAA — TR-413

WT-477 — Adapter

Native NC/Y (no adapter)

OB-BAA

TR-413 — Lightspan NOKIA

TR-413 — Other Vendor

Whitebox X

Column 3: ONF – SEBA - VOLTHA

ONF – SEBA - VOLTHA

Any orchestrator

ONF — SEBA

BBF-Adapter — TR-413

VOLTHA — VIRTUAL OLT HARDWARE ABSTRACTION

Native NC/Y (no adapter)

Adapter — Adapter

VOLTHA OLT Adapter

TR-413 — Lightspan NOKIA

Lightspan NOKIA

Whitebox X

An open controller – develop and onboard your own applications
From closed to open systems that enable augmentation of the architecture

Mix and match best-in-class apps

Your Own Apps
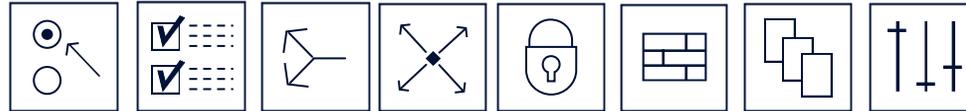
Hot-deployable apps (micro-services)
In-Service-Software-Upgrade (ISSU)
SW campaign management

Open API
Open message bus
Custom workflows and intents (IBN)

Partner program & developer portal

SDN M&C
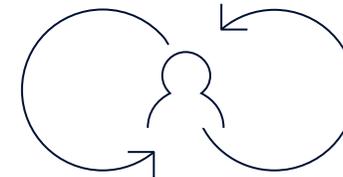
Cloud-native
Micro-services
DevOps paradigm

Open platform with rich set of pre-integrated applications & services

Traditional, SDN-enabled chassis-based and/or disaggregated access nodes
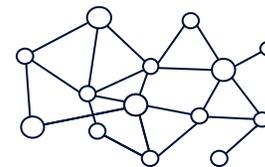
Multi-vendor networks
Single-pane-of-glass

TCO analysis - trade-off between flexibility and the TCO
# Nokia supports chassis-based and disaggregated access (SDAN POD) solutions

Traditional access networks

Static, monolithic and proprietary

OSS

EMS

EMS | EMS | EMS

SW
SW
SW

SW
SW
SW

SW
SW
SW
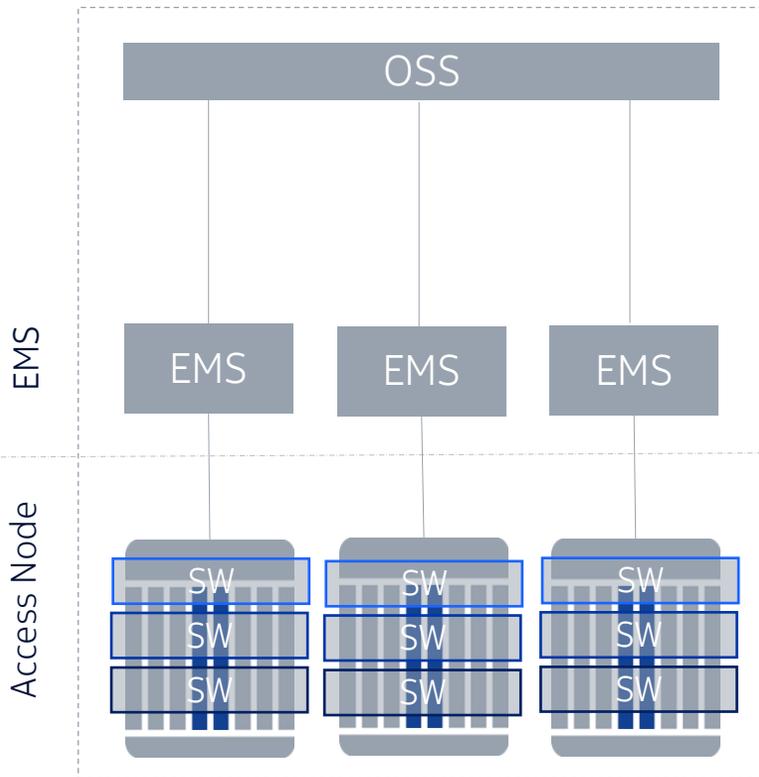
Software defined access networks

Dynamic control, highly modular, disaggregated, open and standardized

One MV Controller

NG-OSS

Controller

Open, standard and Native

Disaggregated Virtualized SW (vOLT)

SW

SW

Open and Adapted

Adaptors

TR-413

Higher power (+22..36%) ↑

Flexibility @ cost

Disaggregated HW (pOLT)

SW

SW

SW

x1.5 in space

x3 in power

Lower density ↓

Higher TCO ↑

Nokia chassis-based

Nokia SDAN POD

White-box
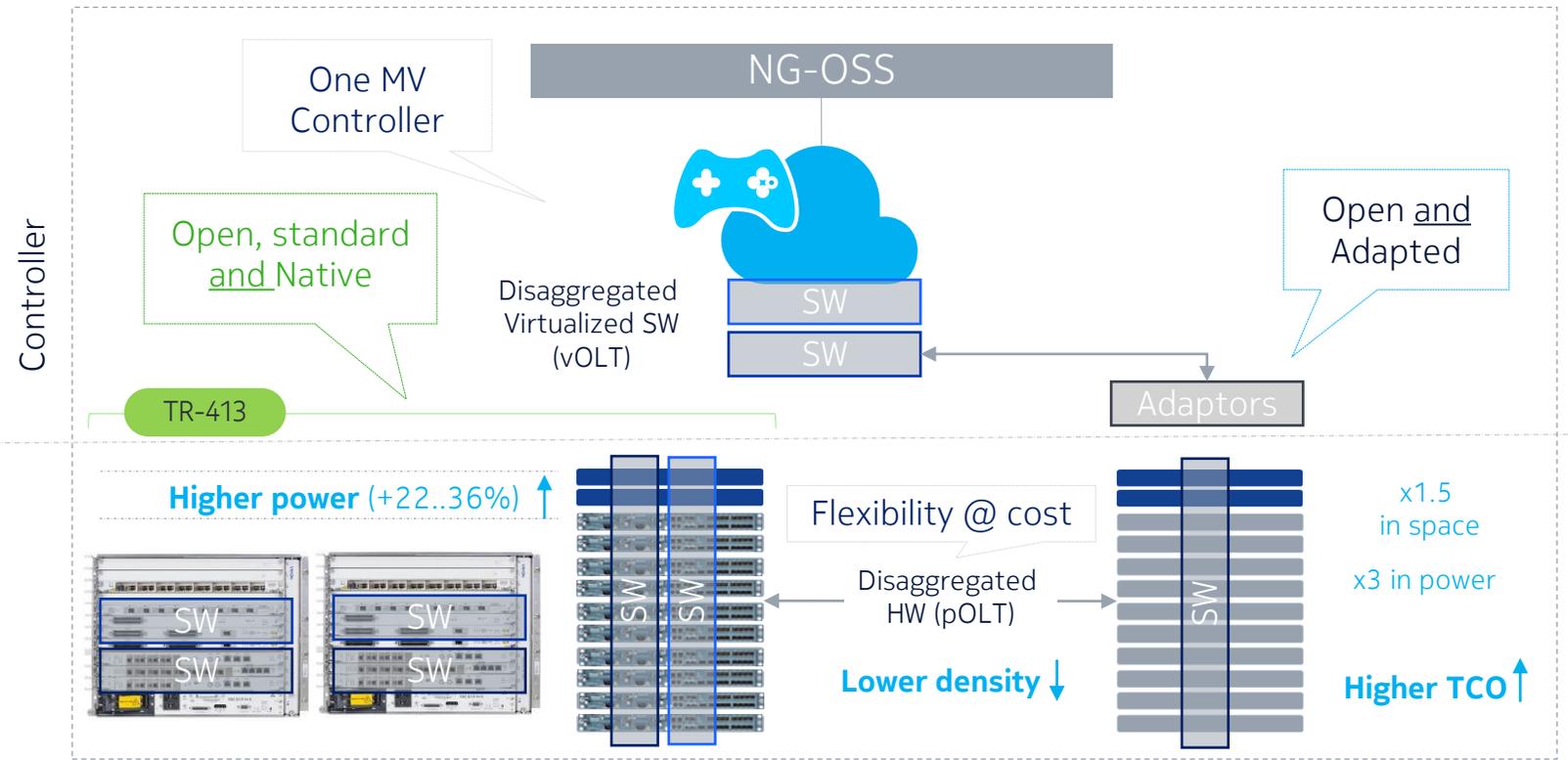
Chassis-based best suited for high-density centralized deployments
Lowest power/sub

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Key takeaways

1. SDN is a method to enable a very high degree of automation in your entire network!

2. Prepare for the future --- a paradigm shift with cloud-native software defined networks

3. Paving the way to controller-led autonomous and automated networks

4. The intent-based networking paradigm is gaining traction in all network domains

5. Standardization is key! more important with highly modular architectures (# integration points go up)

6. Productization and integration efforts to be factored in (ifo. maturity, deploy-ability and operability)

7. Evaluate the TCO holistically (ifo. maturity, flexibility, integration costs, density, power, supply lock-in)

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THANK YOU

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