



OPEN SOURCE NETWORKING DAYS

A Journey of Telco Cloud:

Challenges and Opportunities

Shih-Che Chien / Manager, Chunghwa Telecom Laboratories

Speaker Introduction



- **Experience**

- 2015 – 2018

- Assistant Manager**, Cloud Computing Lab of Chunghwa Telecom

- 2019

- Manager**, Cloud Computing Lab of Chunghwa Telecom

- **Specialization**

- Cloud IaaS Network: **OpenStack, Kubernetes**

- Software-Defined Networking (SDN): **SDN Controller**

- Network Function Virtualization (NFV):
Management and Orchestration (**MANO**), **Telco Cloud**



中華電信研究院
Chunghwa Telecom Laboratories





Telecom Network Evolution

Keep Path with
Megatrend



Telco Challenges & Opportunities

Market Status



New Era Telco cloud

Management,
Orchestration,
Automation



Telecom Network Evolution

Keep Path with
Megatrend

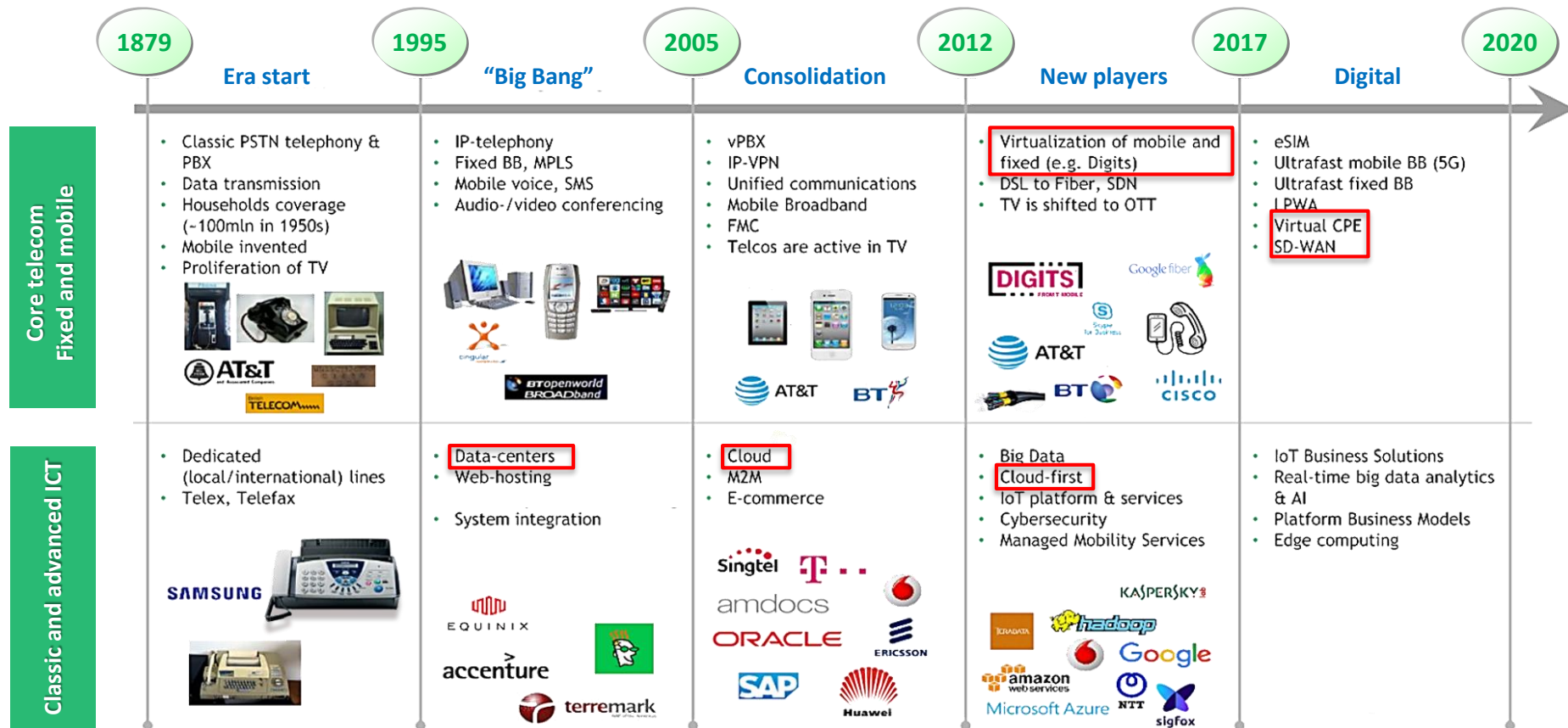
Telco Challenges & Opportunities

Market Status

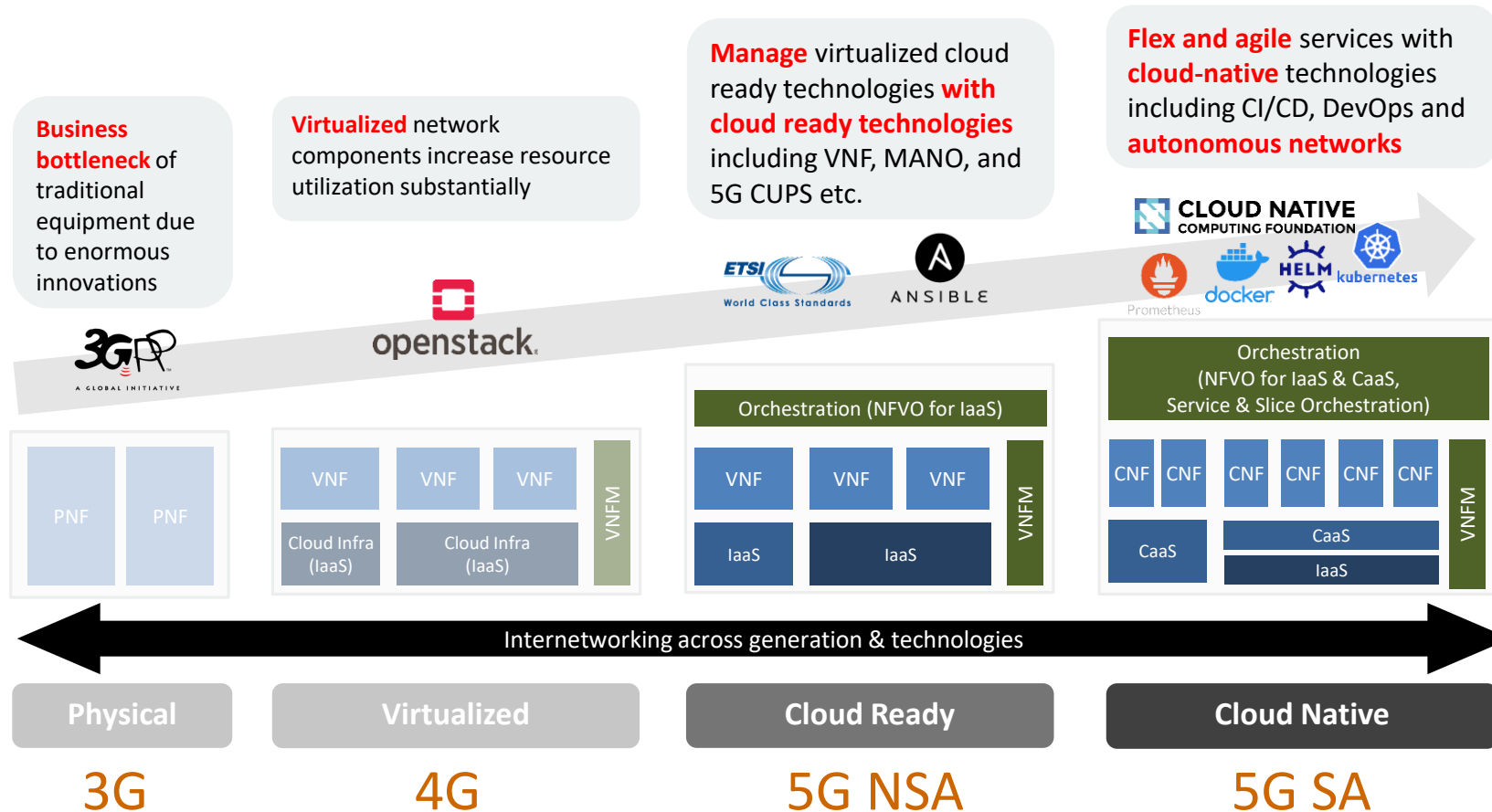
New Era Telco cloud

Management,
Orchestration,
Automation

Digital Era Applications Brings Telecom Evolution



Telco future: **Automation & cloud-native**





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5G Drives New Opportunities



Global Telco Cloud Revenue Will Grow to US\$29.3 Billion by 2025

(with five-year CAGR 27%) --- ABI research 2020

1st wave

eMBB takes the lead



B2C services, high speeds
and high capacity

2nd wave

mMTC incubation



Smart
Building



Smart
Grid

Everything is connected

B2B applications for
industry verticals in early
stage

3rd wave

URLLC applications



Smart
Transportation



Smart
Healthcare

New B2B blue ocean

Applications for industry

• verticals scale up

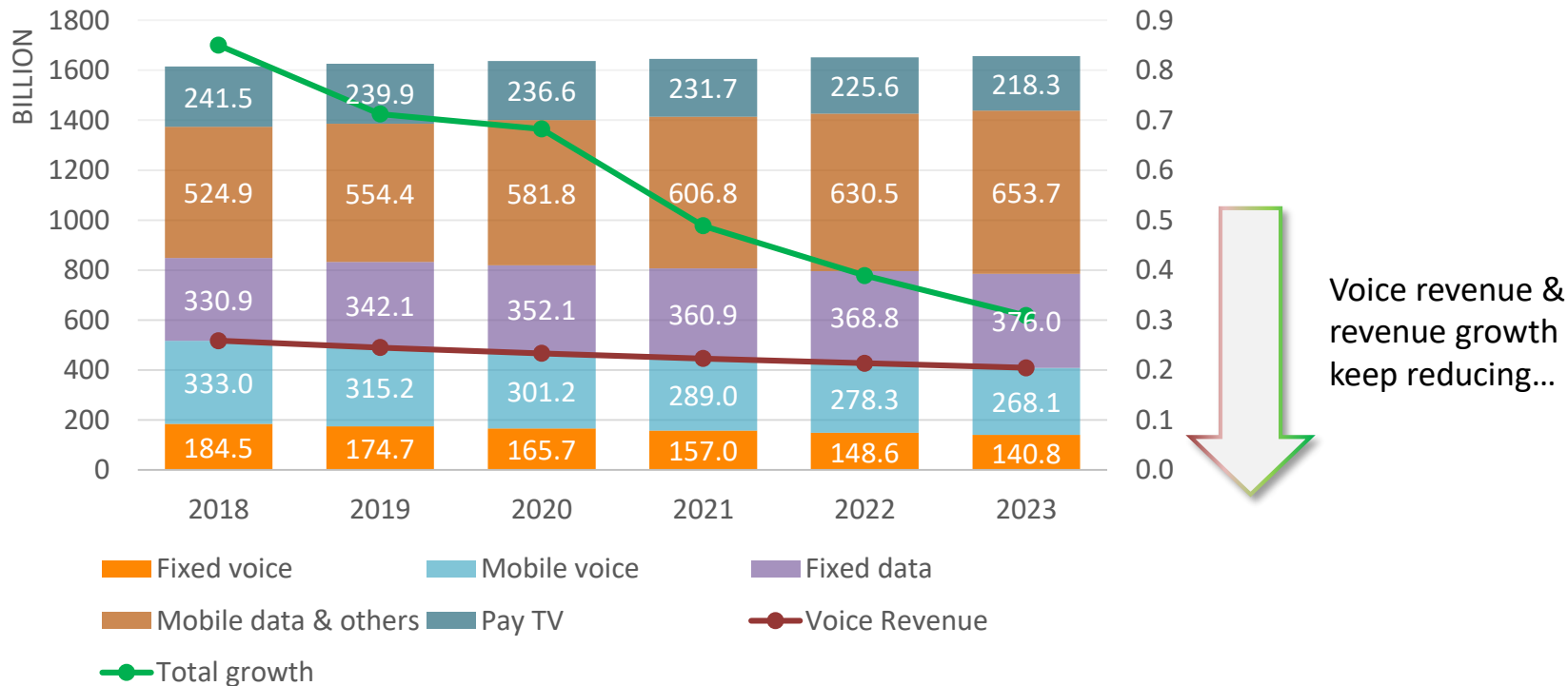
2020, eMBB dominates (video streaming, AR/VR)

2022, scenarios expand, economic value more prominent

... but also **challenges**: Revenue reduction



GLOBAL TELECOM SERVICES REVENUE



... but also **challenges**: Bid for 5G spectrum auction



[CHT capital expenditure surges up more than 26%](#) --- Taipei Times

[Taiwan 5G auction raises \\$4.6B](#) --- Mobile World Live

[Taiwan raises more than TWD 138 billion in 5G spectrum auction](#) --- Telecompaper

Fri, Jan 17, 2020 page12

Chunghwa secures piece of 5G band, eyeing July launch

By Lisa Wang / Staff reporter



Chunghwa Telecom Co (中華電信) plans to launch 5G services in July after securing 90-megahertz (MHz) of the 3.5-gigahertz (GHz) band for NT\$45.68 billion (US\$1.52 billion) during the prolonged and pricey 5G spectrum auction, it said yesterday.

In addition to the “golden 5G band” of 3.5MHz, the nation’s biggest telecom also secured 600MHz of the 28GHz band for NT\$618 million.

... but also **challenges**:

In **competition/collaboration** with IT & OTT service provider



Google

- Google Fiber (FTTP)
- Google Fi (MVNO)
- Google Cloud Platform (GCP)
 - Google Cloud for telecommunications

facebook

- Telecom Infra Project (TIP) founding member
- Open Source Mobile Core Network Project: Magma

 **Microsoft**

- Microsoft Azure
 - Microsoft Azure for Operators
- Acquisition of telecom solution companies such as Affirmed Networks

amazon

- Amazon Web Services (AWS)
 - Telecom solutions
- Proposed acquisition of Boost Mobile

 **Hami Video**
 **myVideo**
 **friDay 影音**
 **CATCHPLAY**
 **prime video**

FOX+ **NETFLIX**

- Telco-build OTT: Hami Video, myVideo...
- Others: Catchplay, prime video...
- Collaboration cases: MOD Netflix, FOX+

Market Status



Private 5G Network

- **MIC**: US\$148b 2019 -> US\$372b 2025 (CAGR 18.5%)
- **Gartner**: **CSPs Will Increasingly Aim 5G Services at Enterprises**
- **ABIresearch** for visionaries: Private Cellular Networks to Generate Over US\$64 Billion in Equipment Revenues by 2030
- **Government-driven top-down policies**
- **QCT** Quantum Cloud Technology **end-to-end solution, Inventec smart factory**

Open RAN

- **ABIresearch** for visionaries: **Early Deployments Indicate Open RAN is Maturing and Will Have 75% Market Share by 2030**
- **Rakuten Mobile** and **NEC** **Begin Production of Open RAN 5G Radio Equipment**
- **Telefonica** works with **Rakuten Mobile** to deploy open RAN in phases

Network Slicing

- **ABIresearch** for visionaries: **5G Slicing Will be a US\$66 Billion Market but First, Telcos Need to Recast Themselves**
- Global 5G Network Slicing Market Report 2020-2025: Enterprise and Industrial Apps will Lead the Network Slicing Market followed by Public Safety
- **MARKETS AND MARKETS**: Network Slicing Market grow from US\$161m to US\$1,284m by 2025 at CAGR 5.15%

Multi-Access Edge Computing

- **FROST & SULLIVAN**: **90% of Industrial Enterprises will Utilize Edge Computing by 2022, MEC market is estimated** to grow from US\$64.1m in 2019 to \$7.23b by 2024 **at CAGR 157.4%**
- **AT&T** **IBM** **team for edge computing and 5G**
- **vodafone** **aws** **tee up 5G mobile edge compute in London**

Global Telco Transformation Status and Trend



Domain 2.0

Fixed-mobile convergence by telco cloud to **75% NFV/SDN utilization** on 2020



50% CAPEX/OPEX saved

- **SDN/NFV** for B2C, B2B, Fixed-mobile & IoT convergence
- IDC: 4K → 1K



Rakuten 5G 2020

- Converge Cisco and RedHat **open infrastructure with NFVI decouple**
- Core Cloud(2), Regional Cloud(2), Edge Cloud(2.5K~3K)



CTNet 2025

- **80% NFV**: vIMS for VoLTE, vEPC & vBRAS for IoT,
- **cloudify business platform**



CUBENet 2.0

- **Three-level telco DC** (Core, region, edge) with **self-build NFVO, VIM**
- 2017/18: Product deployment
- 2019/20: Application extension

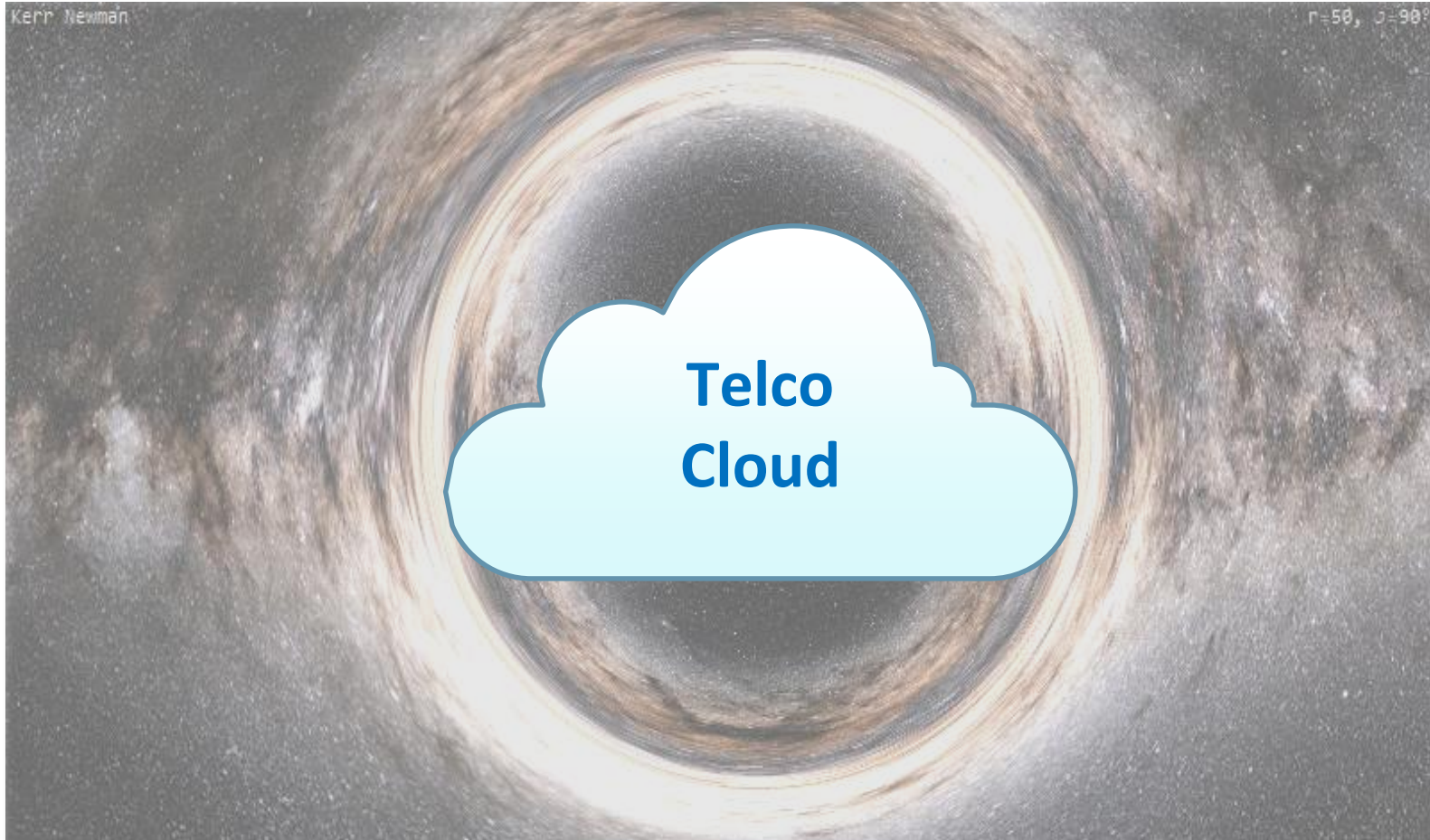


中国移动
China Mobile

NovoNet 2020

- **NFV**: vIMS for VoLTE, NB-IoT
- Core Cloud (50~100), Edge Cloud (1K~3K)

The Singularity – Telco Cloud





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Telco Challenges & Opportunities

Market Status

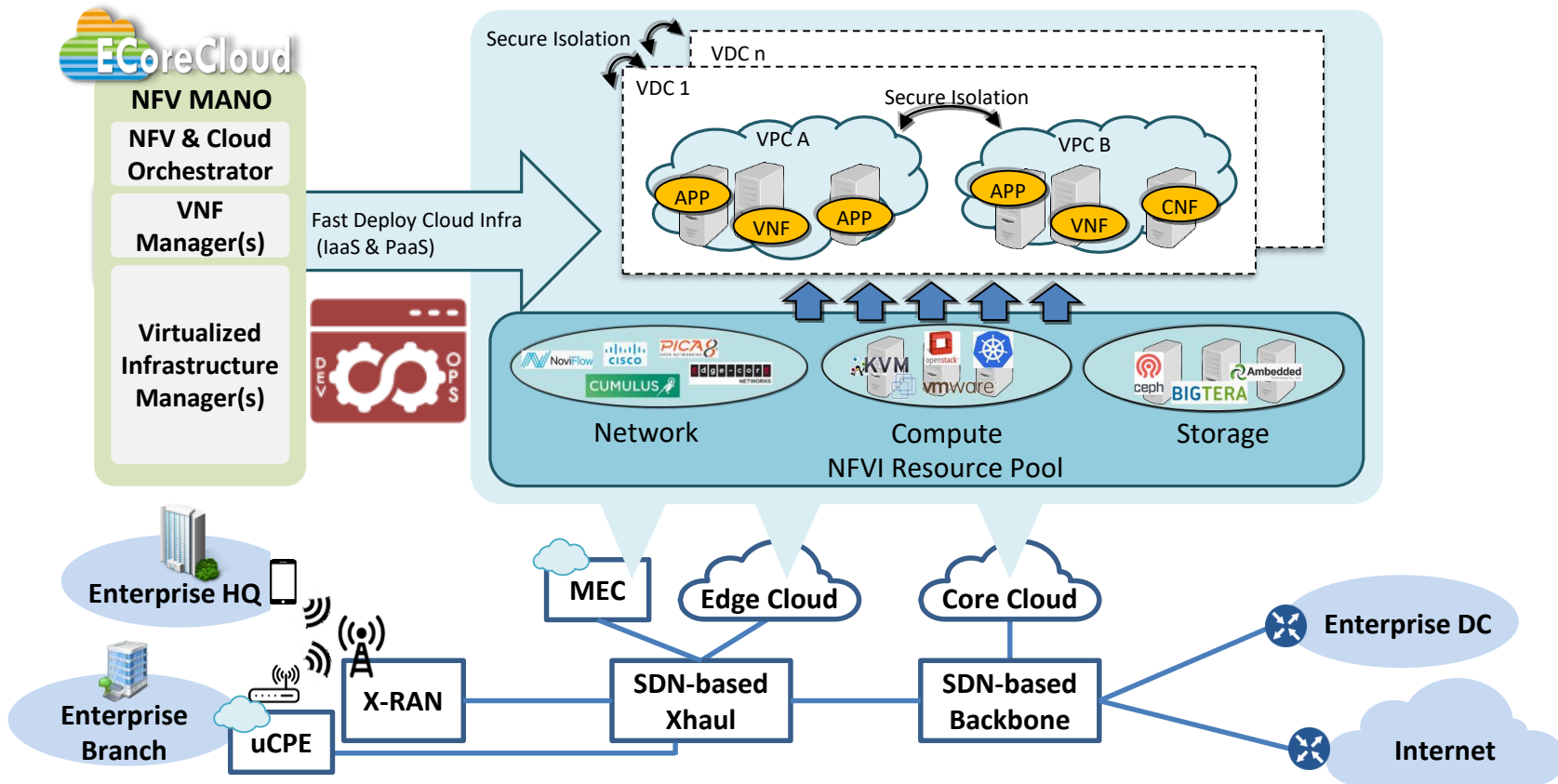


New Era Telco cloud

Management,
Orchestration,
Automation

Telco cloud

- Network **Softwarization & Cloudification**



What does Telco Cloud do

Onboard multi-vendor VNFs

Provide services close to users

Resource allocation

VNFs and CNFs

Network slicing management

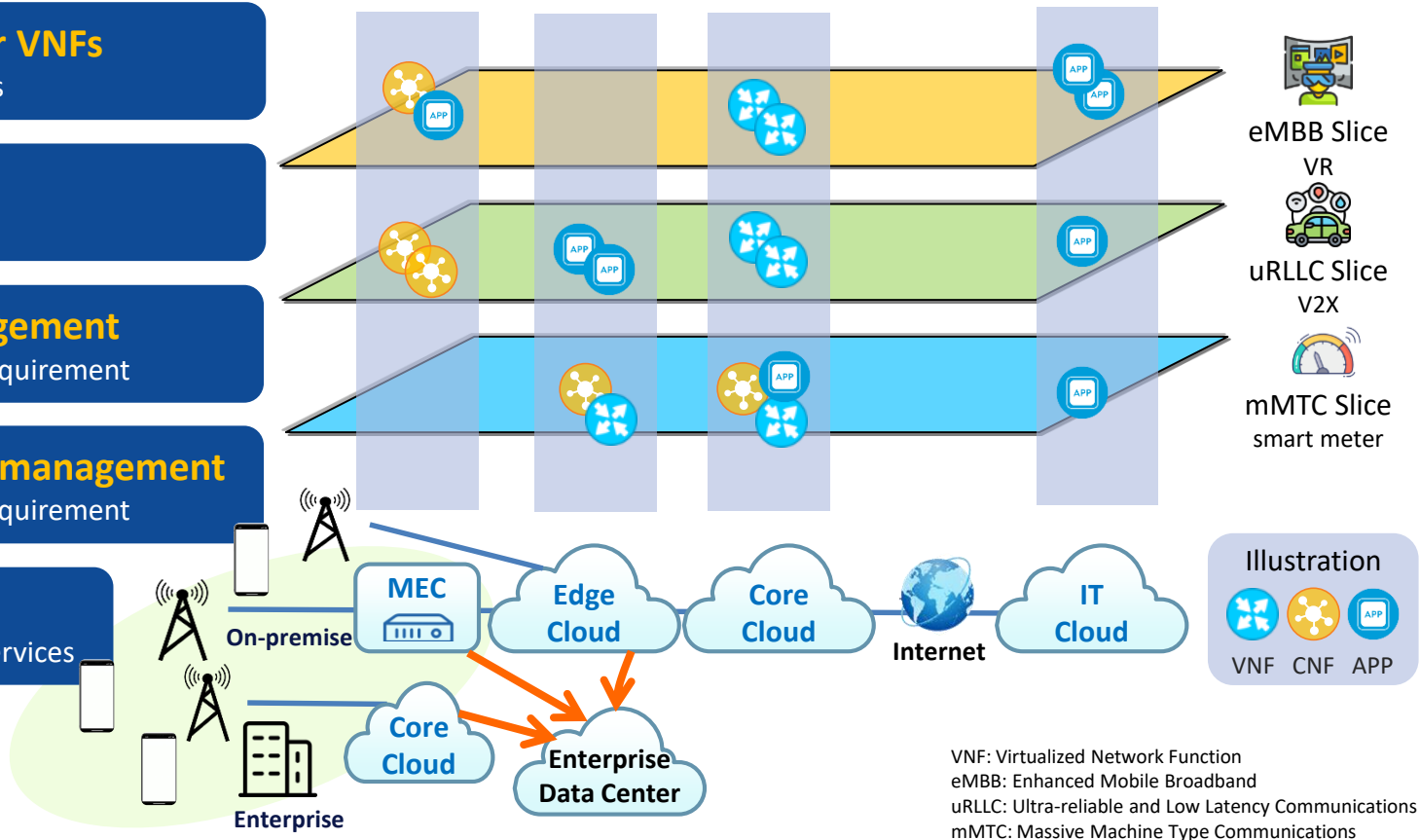
Support innovative services requirement

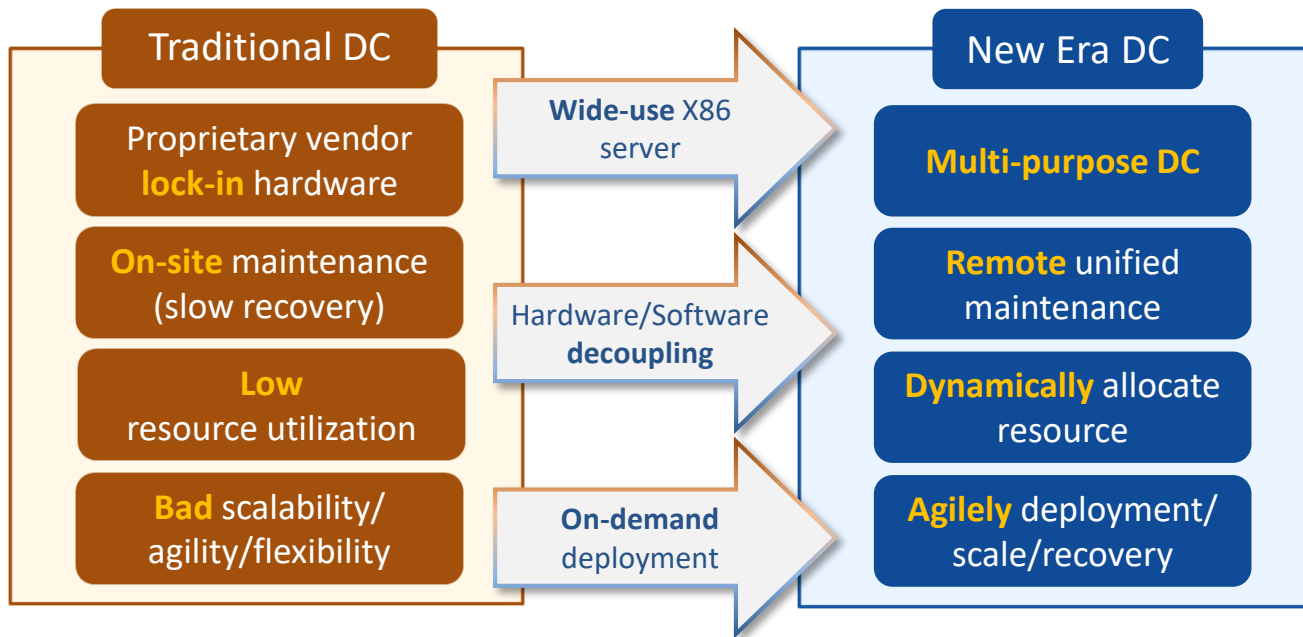
Cross-site data center management

Support innovative services requirement

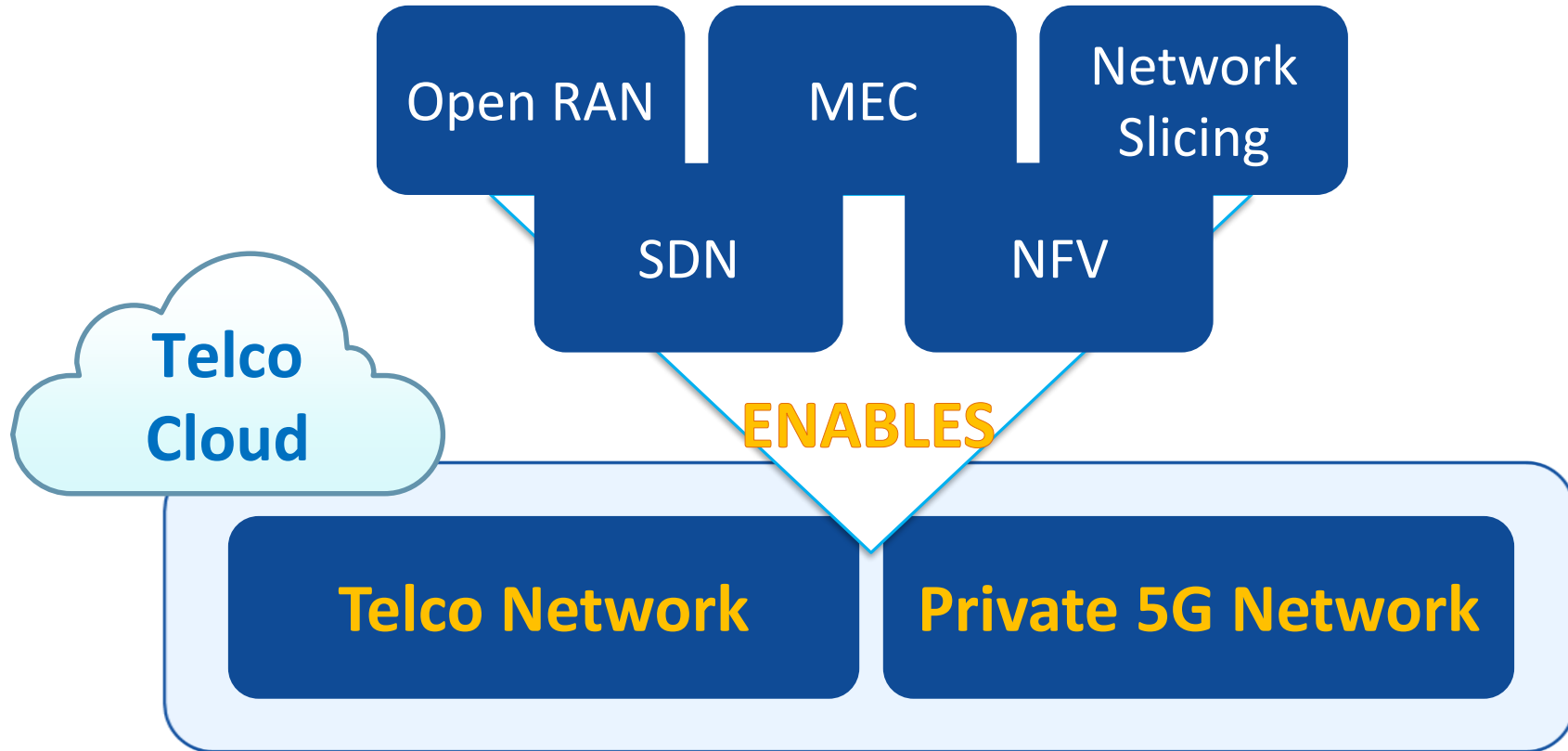
Private 5G Network

Support enterprise network services

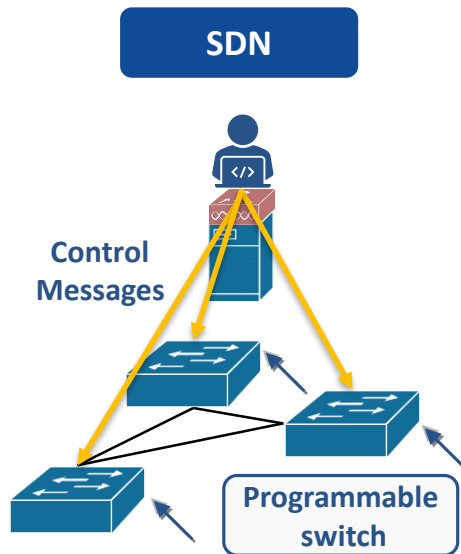




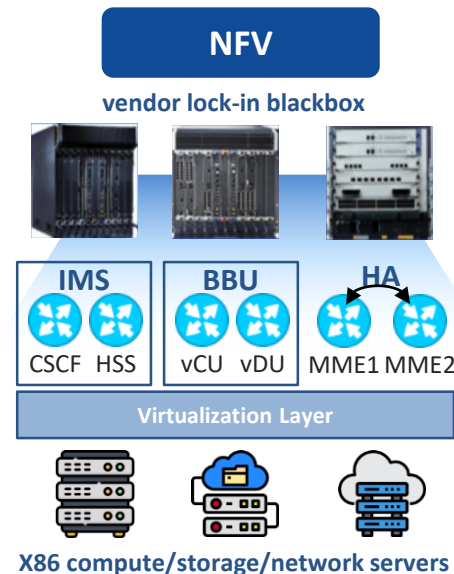
Telco Cloud Key Enablers



5G Network Softwarization



- **Decouple** control plane from data plane
- **Commoditize** routers and switches
- **Programmable** control plane



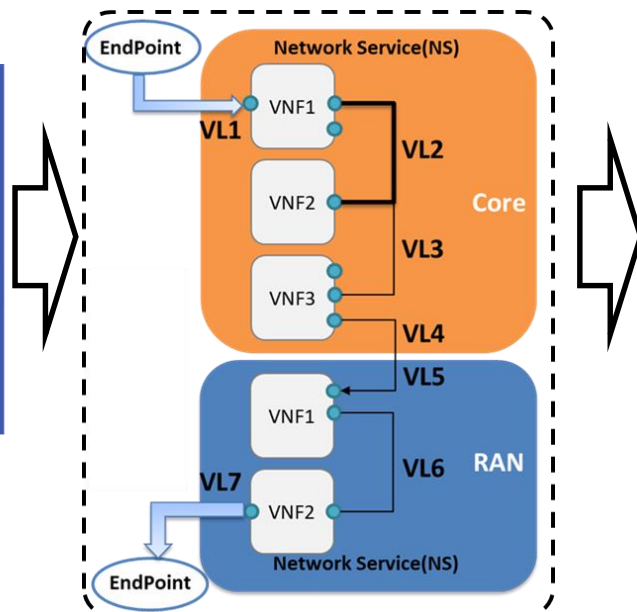
- **Decouple** network elements from underlying hardware
- **Commoditize** Telco specific hardware
- **Programmable** data plane

Illustration

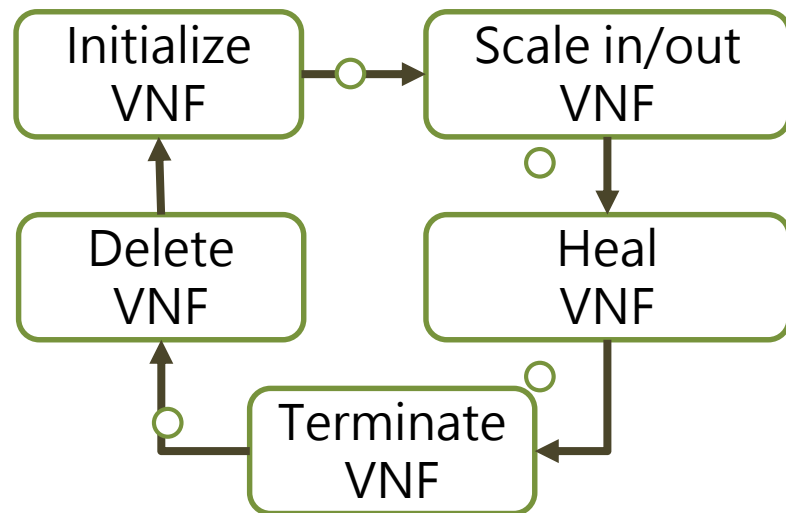


VNF

VNF Onboarding & Life Cycle Management



VNF Package & Onboarding



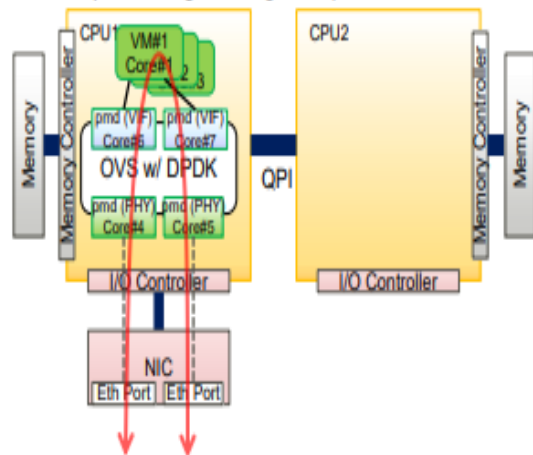
VNF LCM

VNF Accelerate

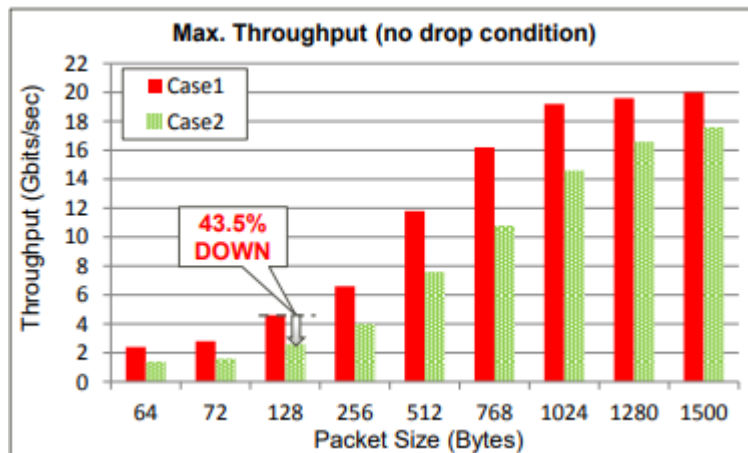
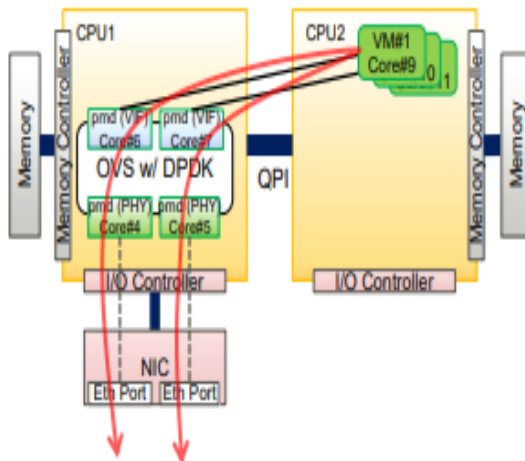


- Intel DPDK 、 SR-IOV 、 PCI-Passthrough 、 Smart NIC 、 FPGA
- VNF with NUMA Resource allocation

Case1: All components are in the same NUMA node
(no flows go through QPI)



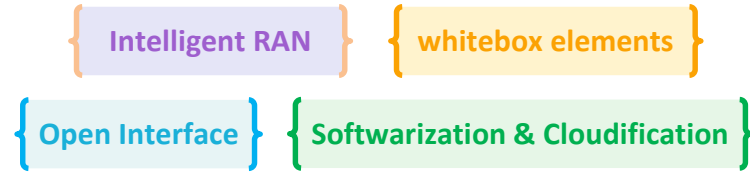
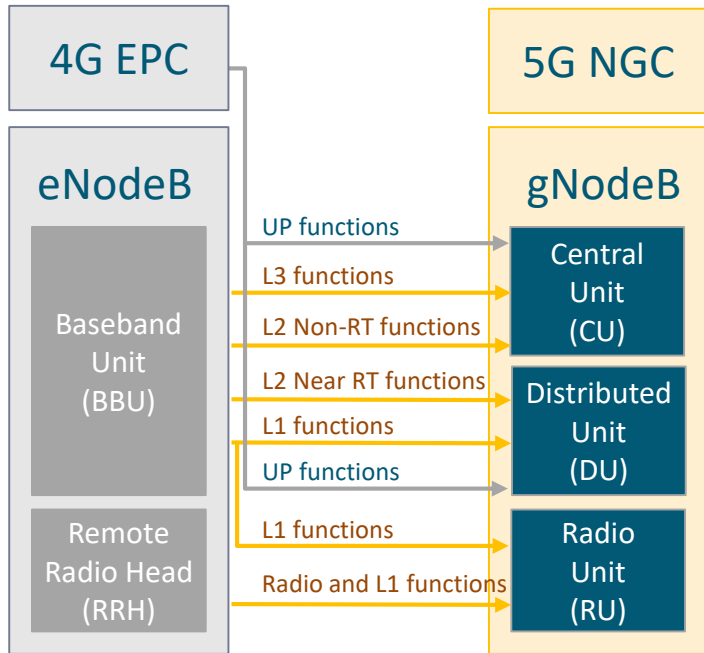
Case2: VMs are running on different node
(flows go through QPI by CPU)






Open RAN and Promoters



RAN Evolution

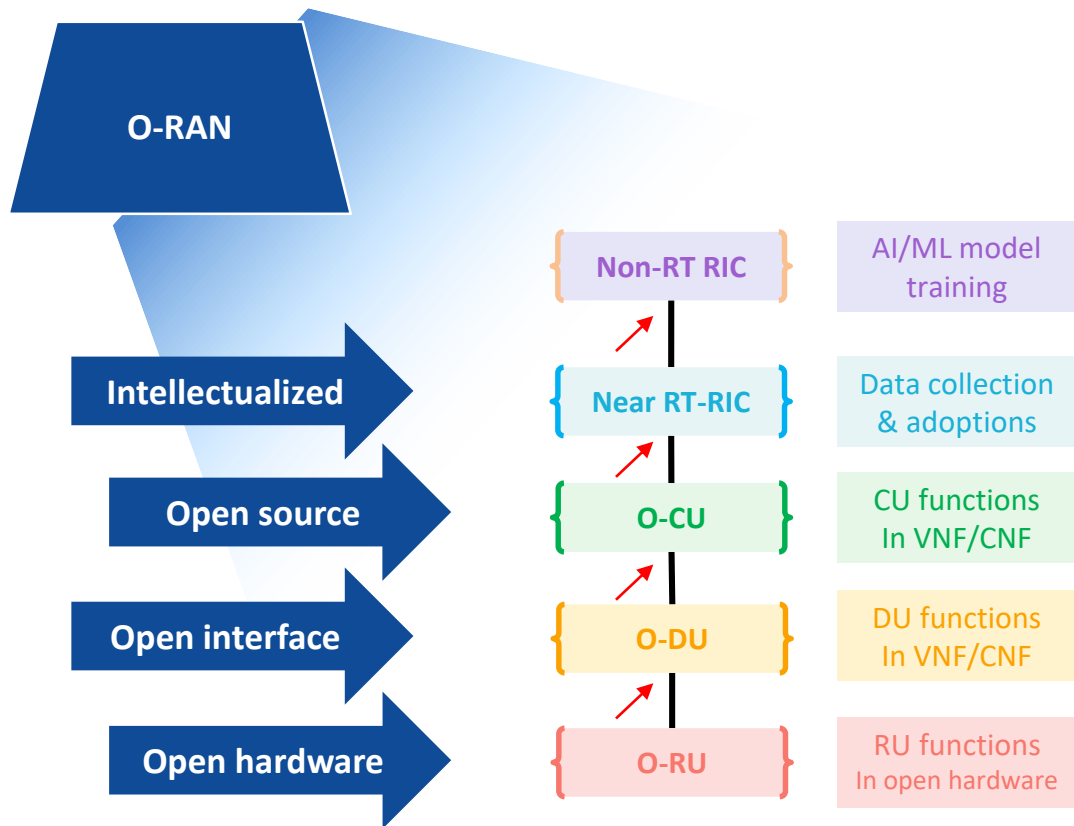
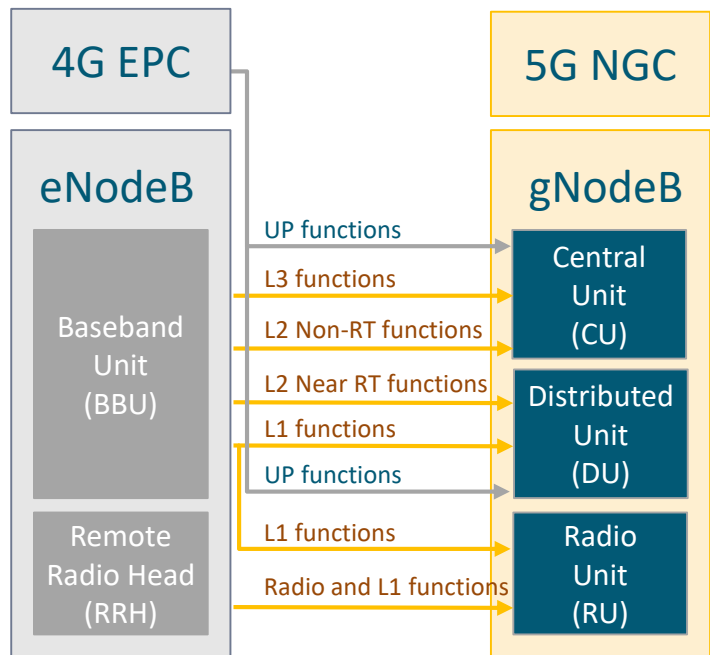


	 TELECOM INFRA PROJECT	 O-RAN ALLIANCE	 Open RAN POLICY COALITION
Start from	2016 Feb	2018 Feb	2020 May
Vision	RAN in decoupled hardware and software on universal platform	Open and Intelligent RAN with standards	Promote RAN policies and signal government support for open and interoperable solutions
Noted Members including vendors	Facebook, Intel, Deutsche Telekom (DT), SKT, Nokia , etc	AT&T, CMCC, DT, NTT DOCOMO, Orange, Nokia , Ericsson , etc	Google, Qualcomm, Facebook, Cisco, Samsung, Rakuten, etc
Taiwan Participants	CHT, Quanta, Sercomm	CHT, ITRI, Sercomm, QCT	QCT

Open RAN to O-RAN



RAN Evolution



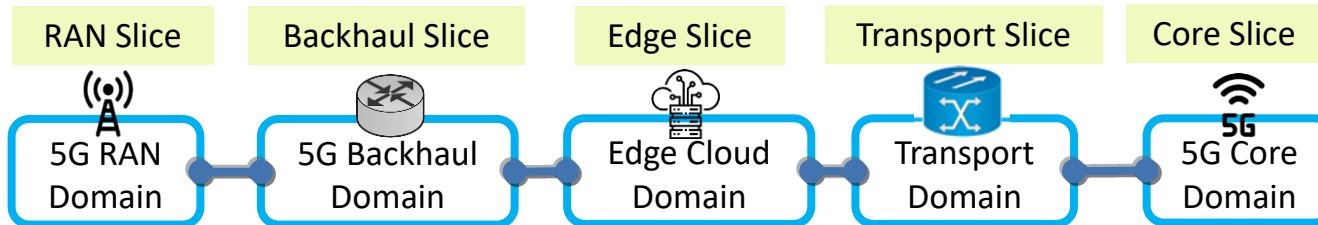
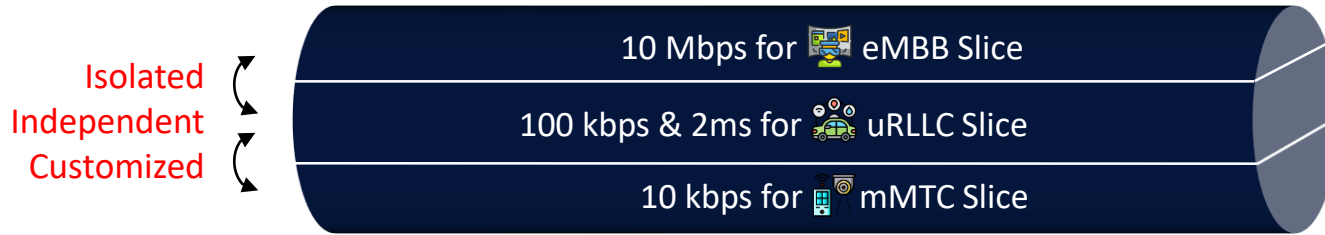
RT: Real Time
RIC: RAN Intelligent Controller

O-CU/O-DU/O-RU: AI: Artificial Intelligence
O-RAN CU/DU/RU ML: Machine Learning

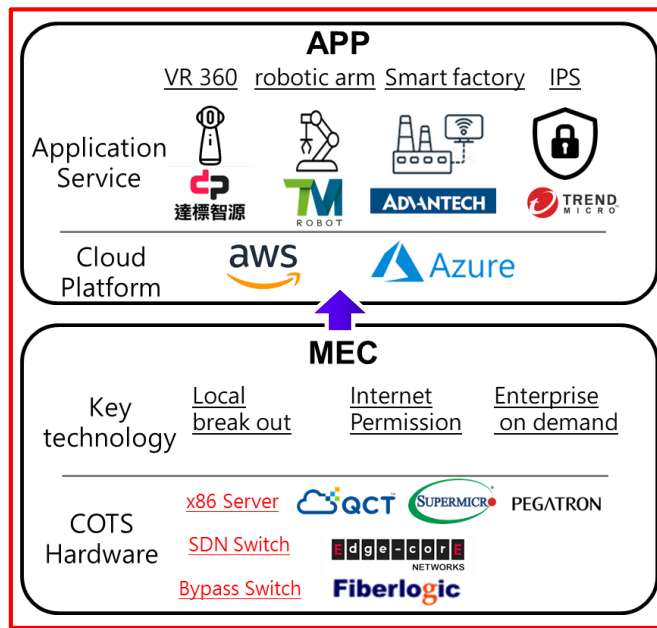
Network Slicing



- Creating multiple virtual networks with certain SLA (Service Level Agreement)
 - Latency, throughput, and etc.
- Through the same physical links to fulfill business requirements



Multi-Access Edge Computing (MEC)



Low latency

Provide services close to users

Improve Reliability/Stability

Faster fault discovery & recovery

High Bandwidth

Support innovative services requirement

High Security

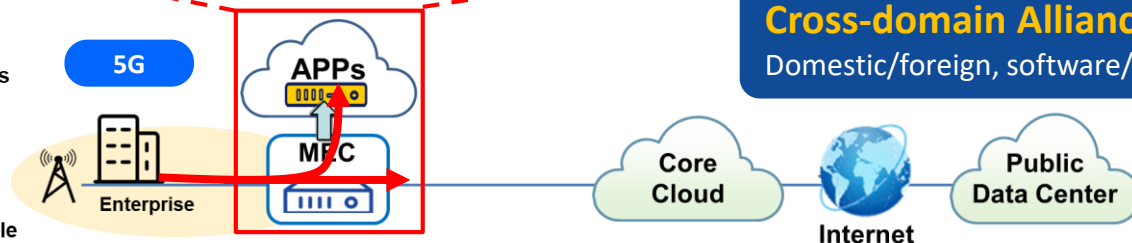
Process and unload data near users

Locally Customized

Support best-fit applications

Cross-domain Alliance

Domestic/foreign, software/hardware



Management and Orchestration Evolution



Tradition

OSS



Siloed



Static



Scheduled



Manual

New Era

NFV MANO

NFV & Cloud
Orchestrator

VNF
Manager(s)

Virtualized
Infrastructure
Manager(s)



End-to-End



Dynamic



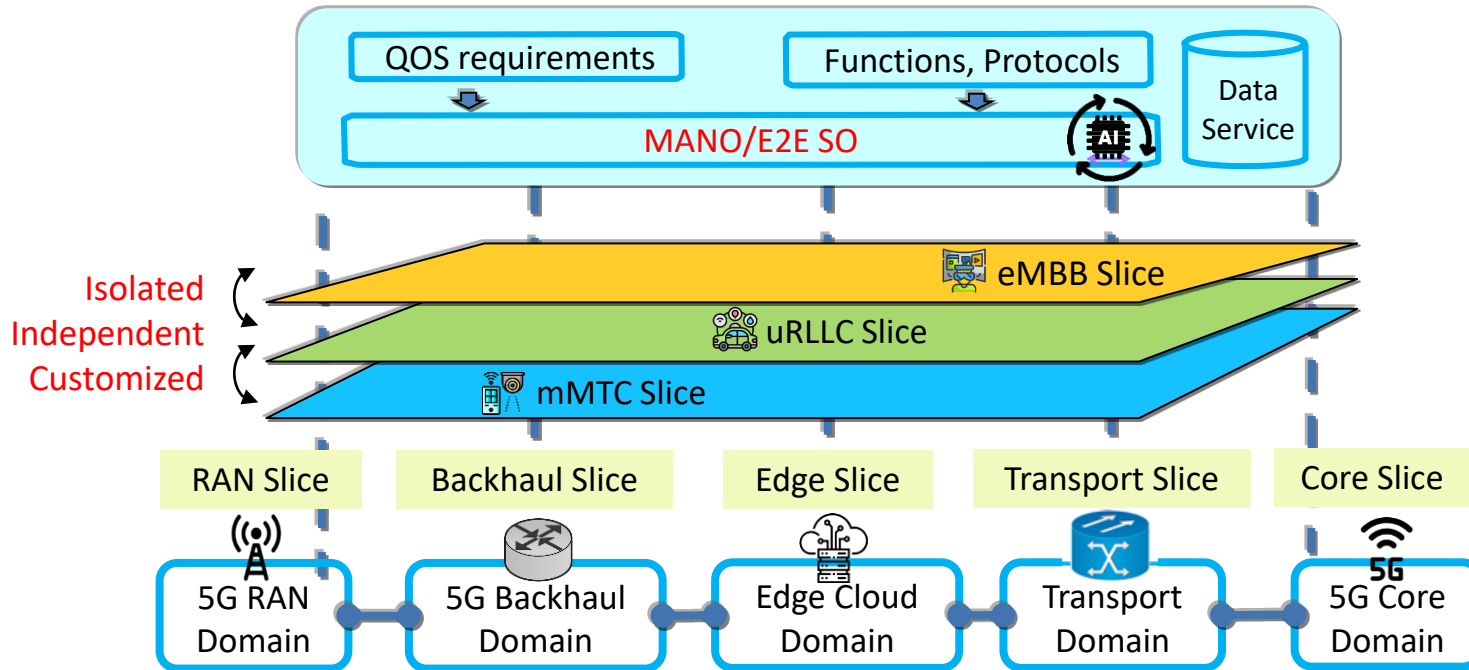
On-Demand



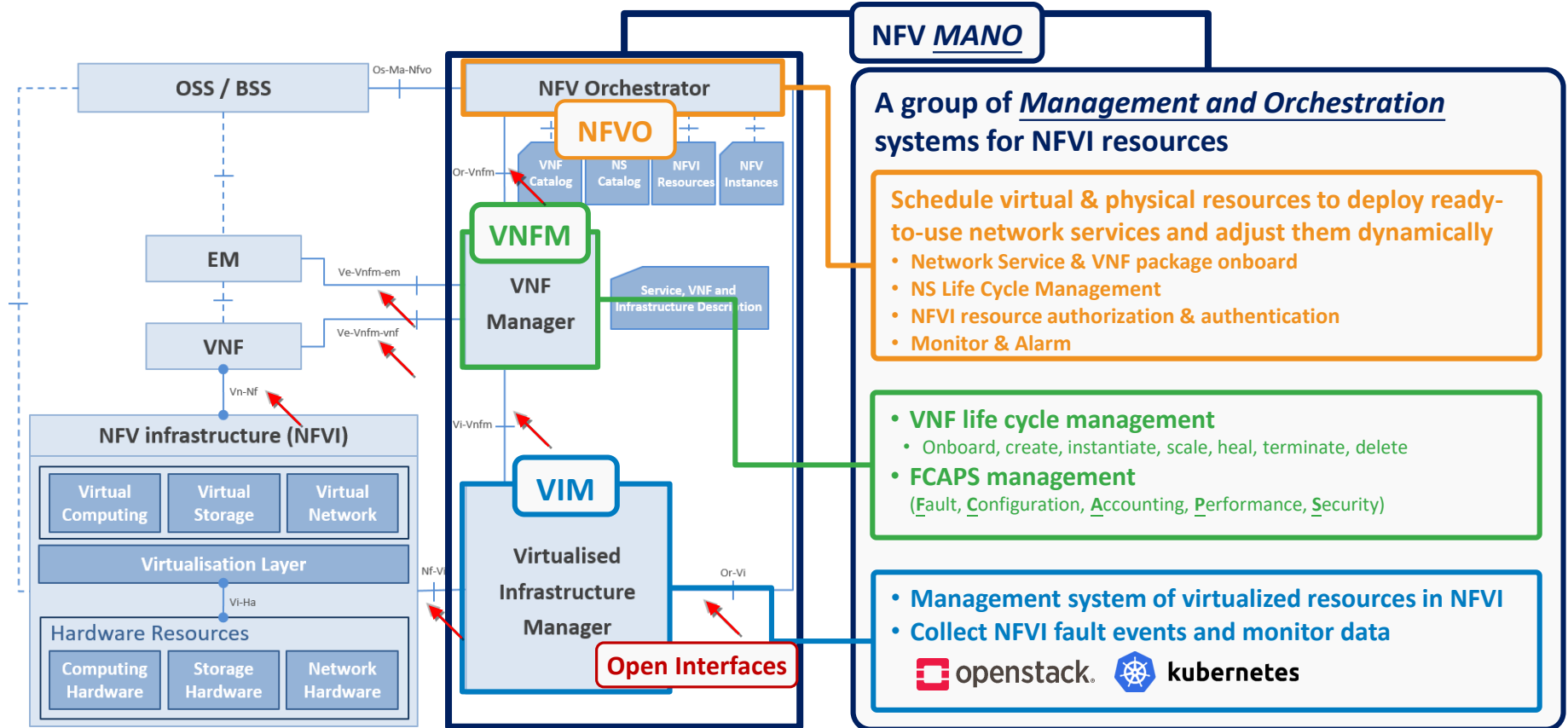
Automated

MANO Paradigm on Network Slicing

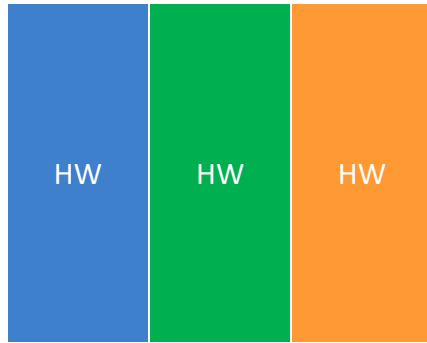
- Use MANO or E2E Service Orchestrator (SO) along with AI/ML tools to create virtual networks for business requirements



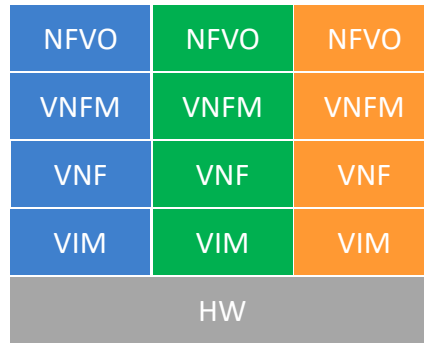
ETSI NFV MANO framework for Telco cloud management



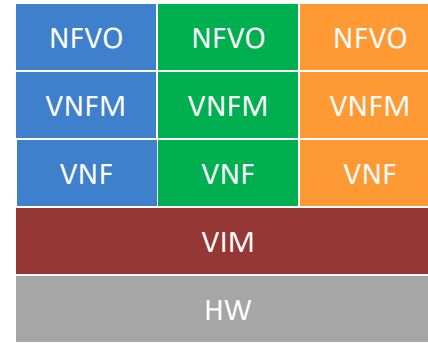
Deployment Strategies



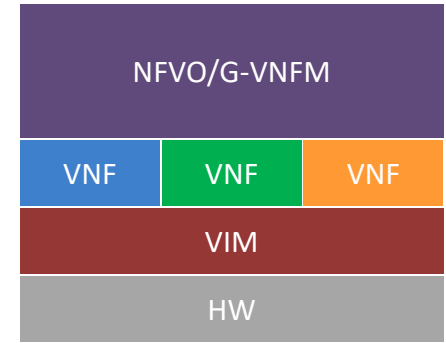
Full stack from single vendor
(Non-decoupled)



Layer 2 decouple
(separate SW & HW)



Layer 3 decouple
(Virtualized layer separate)



Full decouple
(Unified orchestration)

Vendor expectation

Telcos expectation

Profit in short time

Technology evolution



DevOps with MANO



Development



API Specifications Conformance

MANO components provide northbound/southbound APIs without exclusivity

NFVO/VNFM

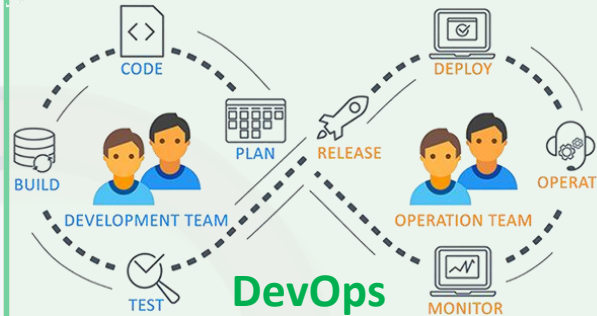
Image, VNFP, VNF LCM, CSAR, FCAPS

EMS/VNF

VNF LCM

Agile

Automation



Operations



VNF LCM Validation

LCM validation on both the credible & self-build MANO system to ensure VNF deployment

Create, Instantiate, Scale, Heal, Terminate, Delete

Continuous Integration (CI)



Developer



Test environment



VNF Validation

- Create test cases corresponding to the VNF



Infrastructure Validation

- Test bare metal capability on compute, storage & network
- Ensure VIM meets ETSI IFA 005/006

Quality Assurance (QA)

Continuous Delivery (CD)



Validation site



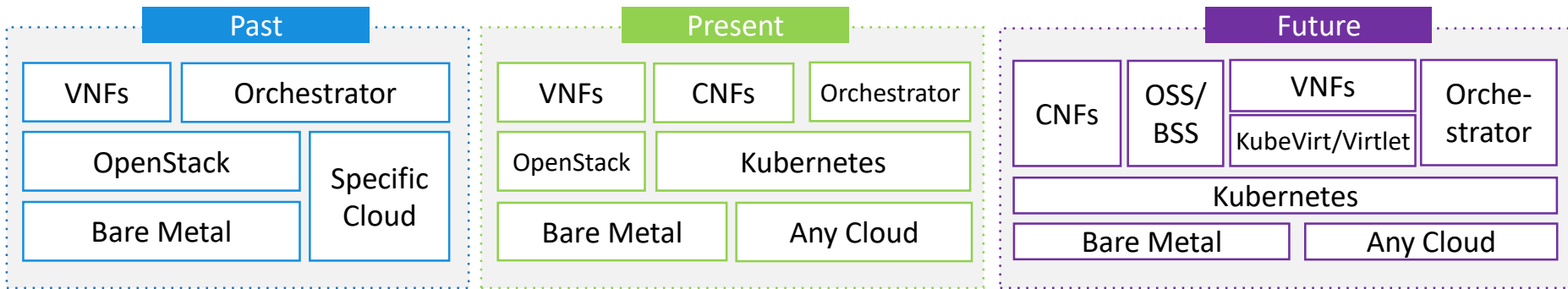
Operator site

LCM: Lifecycle Management

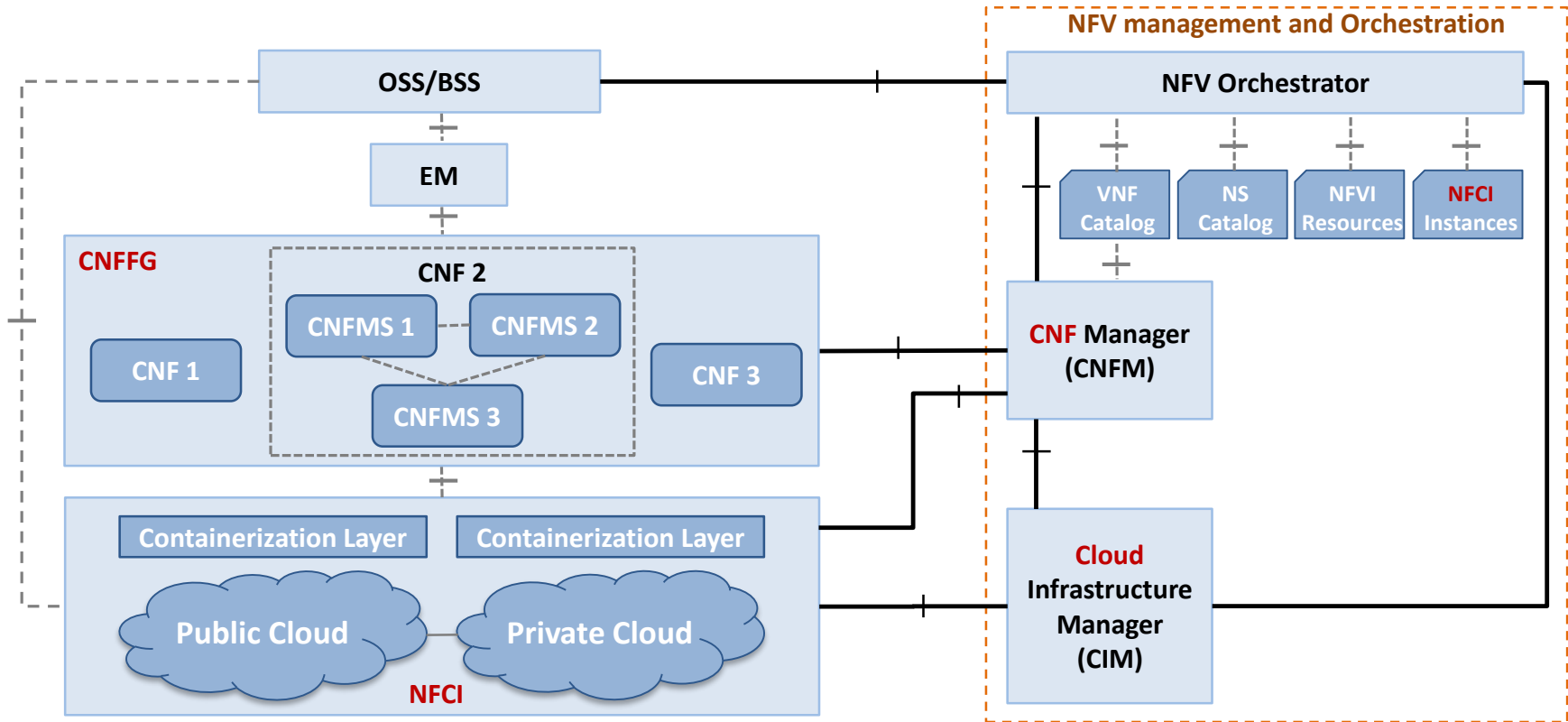
Evolving from VNF to CNF



- Preparing for future network components implemented in Container Network Function (CNF)
 - E.g. 5G standalone (SA) network components

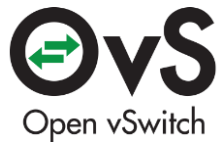


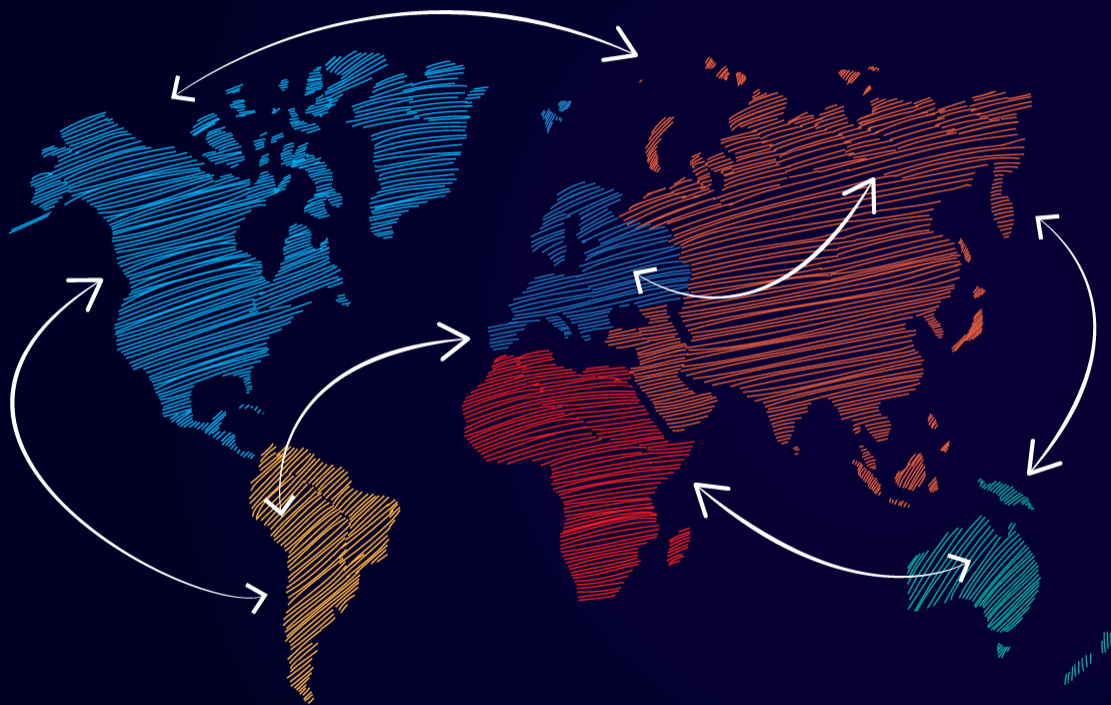
CNF Management: Refer ETSI NFV MANO framework



CNFFG: Cloud Network Function Forwarding Graph
CNFMS: Cloud Network Function Micro Service
NFCI: Network Function Cloud Infrastructure

Openness





Summary



- **Telco challenges**

- Significant revenue reduction from voice business
- High bid for Taiwan 5G spectrum auction
- Telecom vendors' reluctance to openness
- Public Cloud & OTT providers' business extension to 5G services

- **Telco Cloud opportunities**

- Open RAN, private 5G network
- MANO for VNF & CNF
 - Cost reduction: Free from system license fee
 - Master key technologies: Conducive to bridging telco-own systems, launch new services agilely
 - Support applications of vertical industries in private 5G network
 - Uniform platform: Reduce development and maintenance complexity

OPEN SOURCE NETWORKING DAYS

