Network Functions Virtualization (NFV): Promises and Progress

CELTIC Event

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Objective

RAD

- Brief Update on the NFV development

- Outline Distributed NFV Approach

- Discuss NFV for business services

Outline

- Brief Update on NFV Progress

- Introducing Distributed NFV for Enterprise Services

- NFV at the Customer Edge

NFV: Network Functions Virtualization

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NFV advocates virtualizing network functionalities - performing service-provider networking functions using software hosted on general-purpose server infrastructure

In IT, there has been a major trend towards **virtualization**

- Creation of a virtual machine (VM) that acts like an independent physical computer (or other hardware device)

Network Functions Virtualization (NFV) applies virtualization to **network functionality**

- Replacing proprietary hardware NEs with software running on COTS (Commercial Off-The-Shelf) platforms housed at various locations, for example, Data Centers

NFV Activities

- October 2012 – *Call for Action* NFV White Paper by 13 major carriers
- January 2013 – ETSI NFV Industry Specifications Group (ISG)
- October 2013 – the NFV ISG released first five specifications
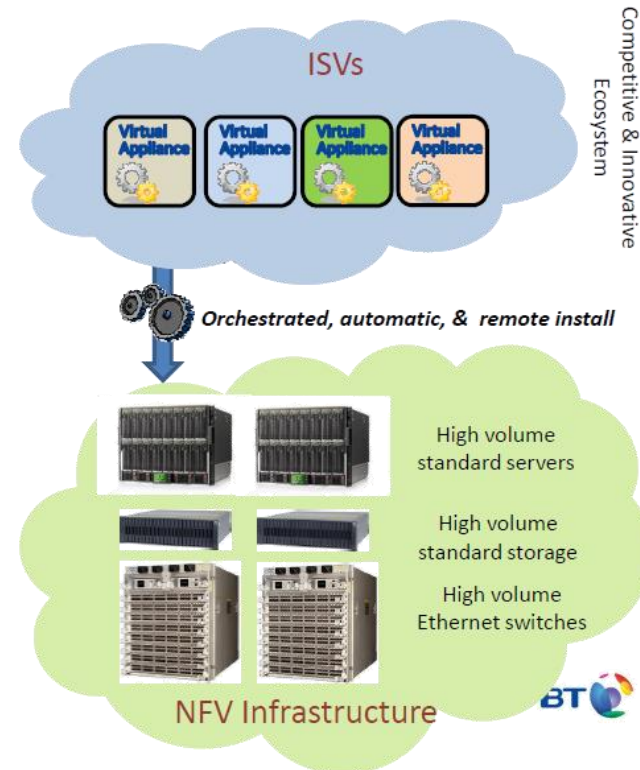- October 2013 – NFV White Paper ver.2 by 25 carriers
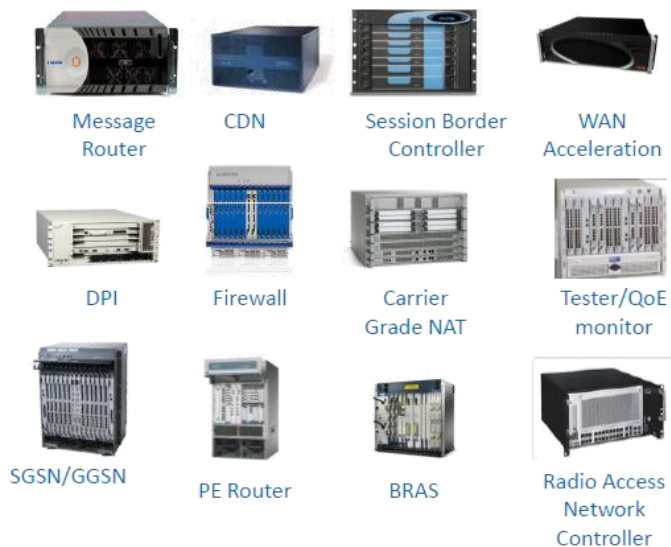
Potential NFV Advantages

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Rapid deployment, upgrading, and turn-off of network functionalities

Reduced costs with standard servers in comparison to dedicated vendor-specific networking hardware

Potential to combine multiple network functions on a single server platform

Ability to flexibly locate network functionality whenever and wherever it is most effective or less expensive

NFV: From Technology to Carrier-Grade Solutions

Operations

Economics/Business

Technology

Time
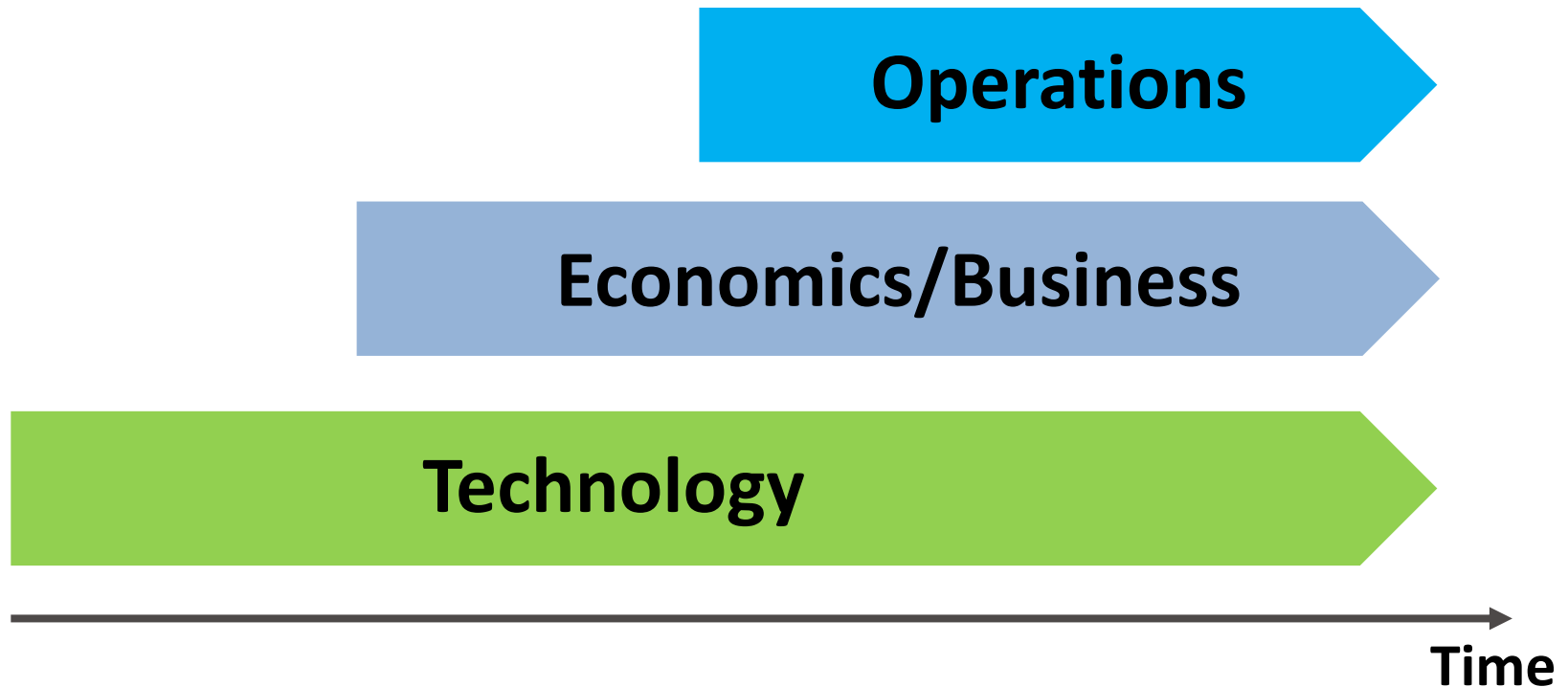
- Major challenges
  - Migration of the existing infrastructure including OSS
  - Service quality assurance
  - And many more...

Outline

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Expanding the NFV Implementation Scope

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Mobile Services

- Addressing and facilitating migration to LTE/LTE advanced
- Functionality: ePC, Gi-LAN, IMS, …
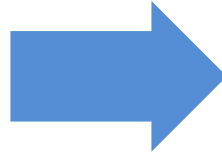
Networks and Enterprise Services

- New network capabilities and value-added services

Major Drivers: Agility & Costs

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As *plain vanilla* connectivity (VPN) services are commoditized

- Strong competition (alternative, utelco, …)

Moving up the value chain: agility is a must: new network functionalities, new value added capabilities

- Strong competition from the OTT service providers

Operations cost management

- Reducing cost for existing services
- Setting appropriate cost levels for new services

Capex saving…

NFV: The Distributed Model

The most prevalent approach to NFV concentrates functions in centrally-located Data Centers (DC)

Distributed NFV allows Service Provider controlled functions to reside anywhere - including at the customer premises
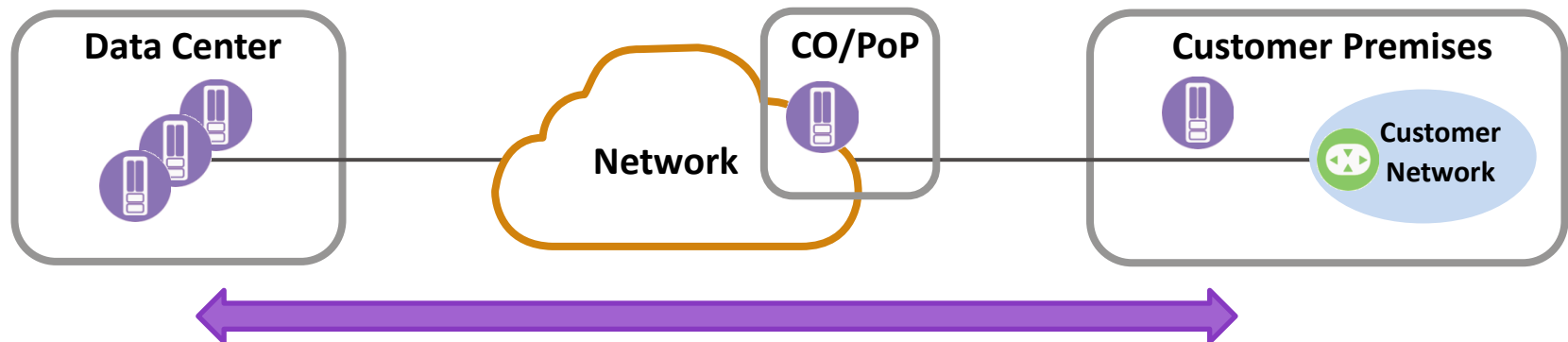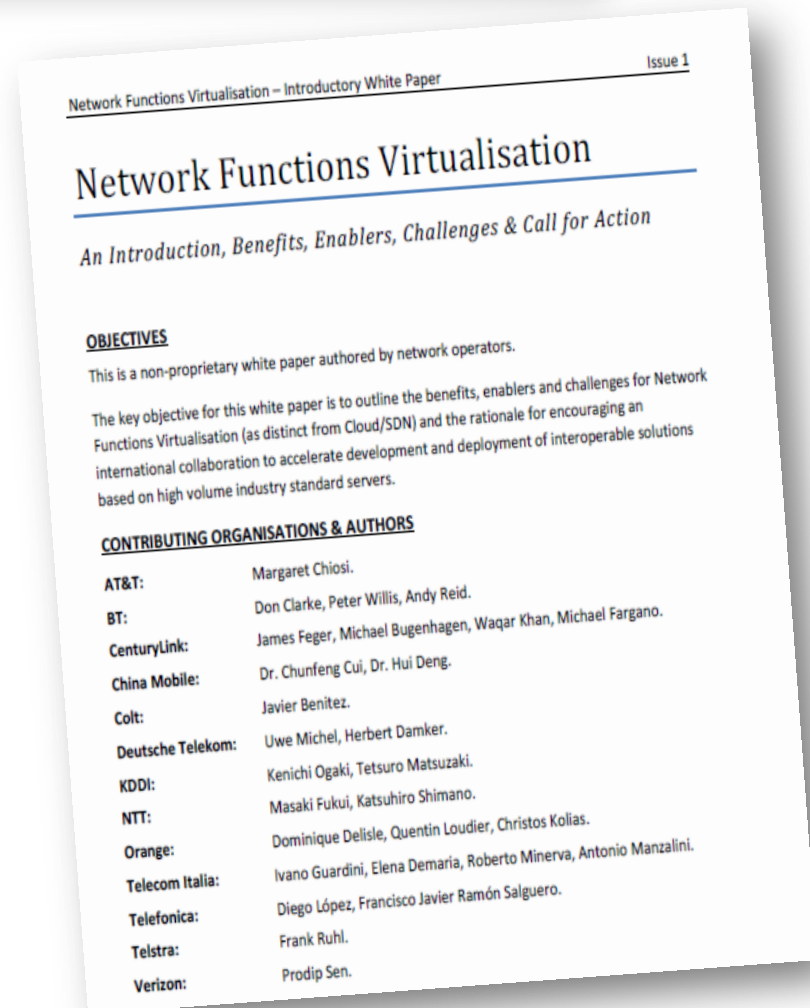
The D-NFV Approach: From *the* NFV White Paper…

Explicitly declared from the very beginning in the introductory NFV White Paper

*"…Leverage standard IT virtualization technology to consolidate many network equipment types onto industry standard high volume servers, switches and storage that can be located in **DCs, Network Nodes and in the end-user premises."***

...To New Documents of ETSI NFV Industry Specification Group

- *Terminology*: Network Point of Presence

  - A location where a Network Function is implemented... Examples of NPOP locations include central offices, **customer premises**, mobile devices, and data centers

- *End-to-End Architecture*: One of the NFV objectives is to ensure greater flexibility in assigning VNFs to hardware

  - Software to be located at the most appropriate places, e.g., at **customer premises,** at network PoP, in central offices or data centres.

D-NFV **=** Data Center **+** Network **+** CO/PoP **+** Customer Premises — Customer Network
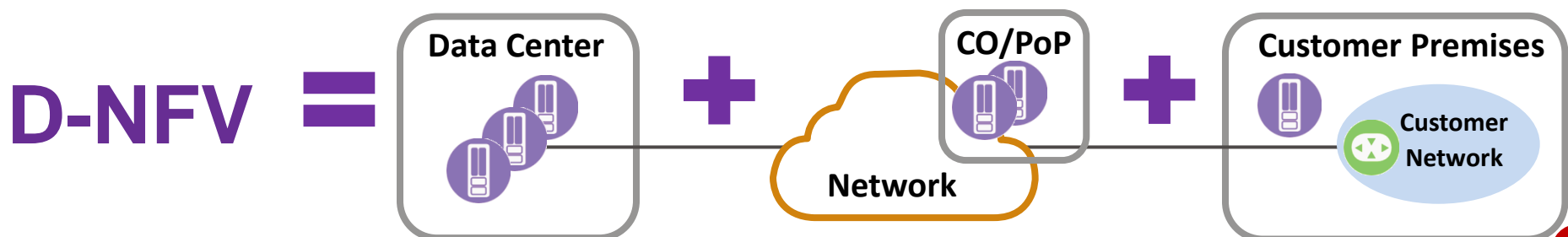
Why *Distributed* NFV?

Distributed NFV bucks the trend of hosting all functionalities in centrally-located Data Centers. But…

Why just a *classical* central cloud model is not good enough?
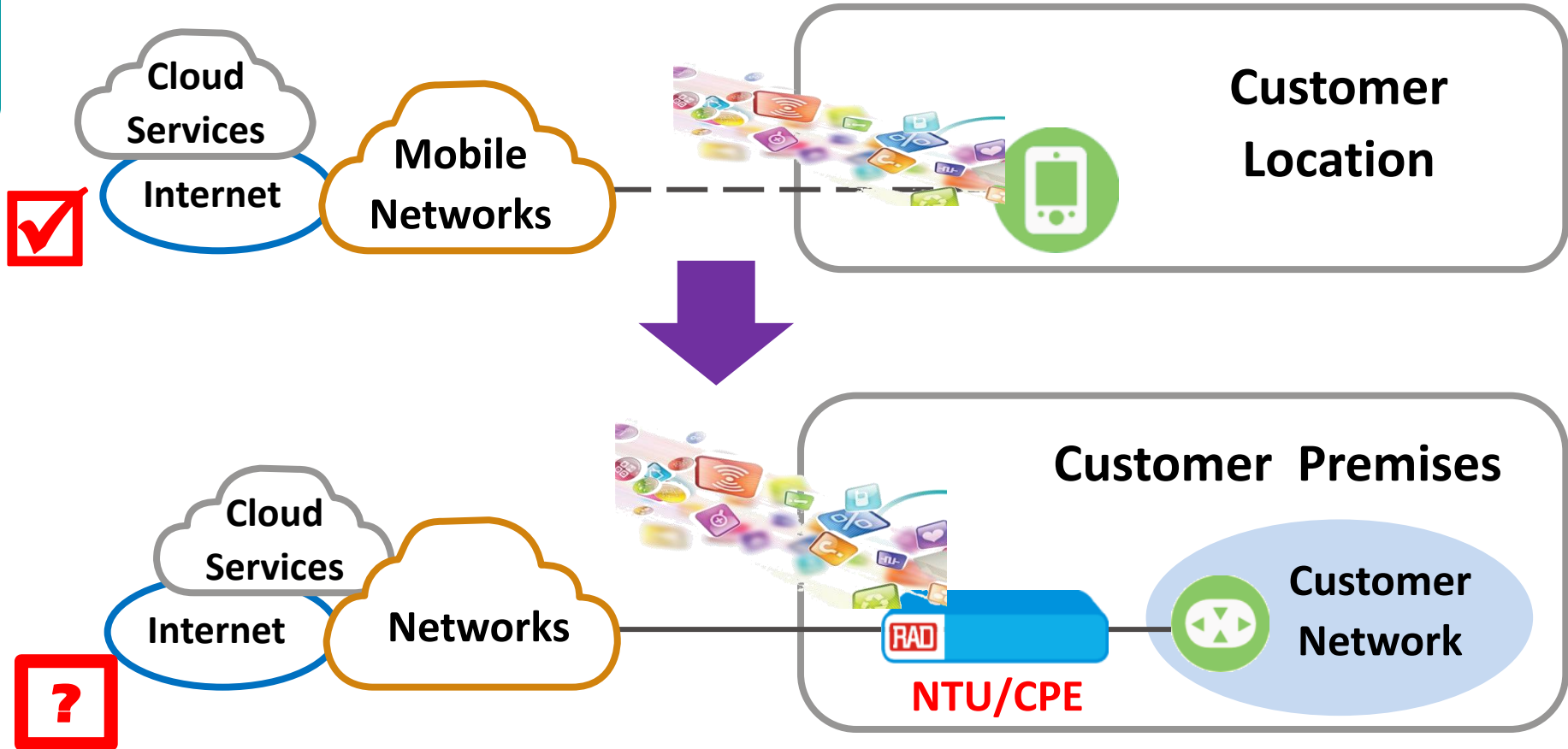
What are the criteria that make the D-NFV case?

- **Functions Feasibility**

- **Performance**
  - Accuracy, effective service chaining

- **Privacy Conformance**

- **Costs**
  - Networking
  - Compute/IT resources

Outline

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Functions Agility: A Service Provider's Dream?

Applications

- Network functionality: diagnostics tools, firewall, …
- Value-added services: IP telephony, encryption, …

How to Make It Happen?

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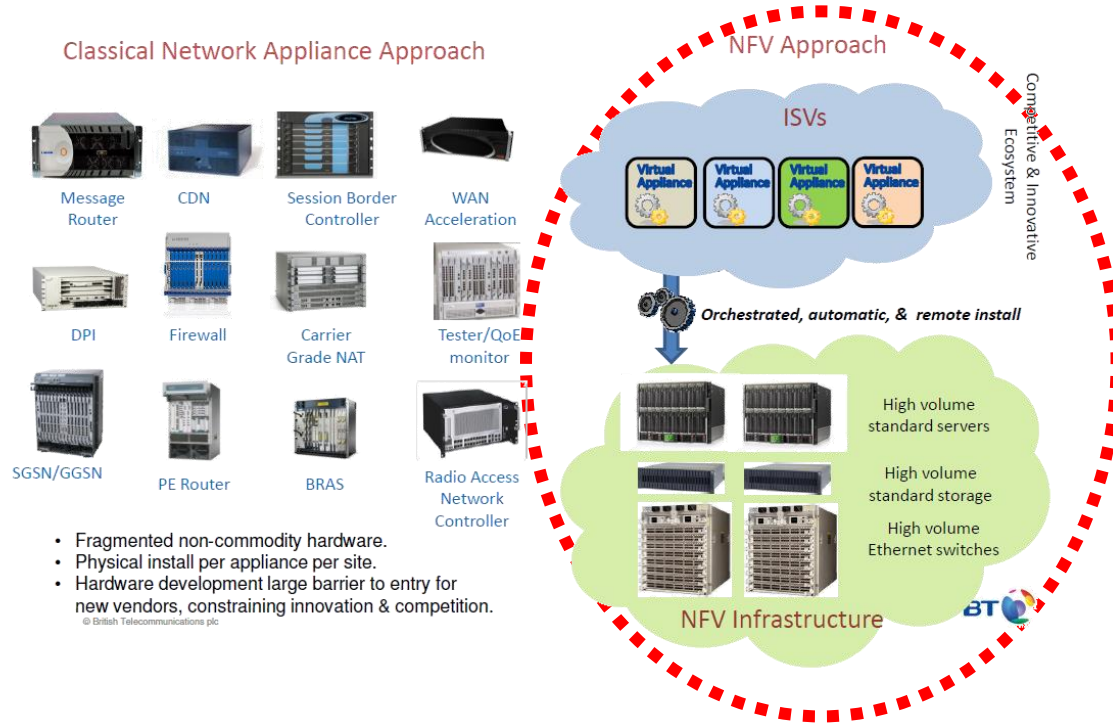- Network Functions Virtualization (NFV)

"Application Store"

+

- Virtual Machine (VM) Infrastructure

Platform

NFV: Feeding the "Application Store"

- Riding the wave: NFV facilitates virtualization

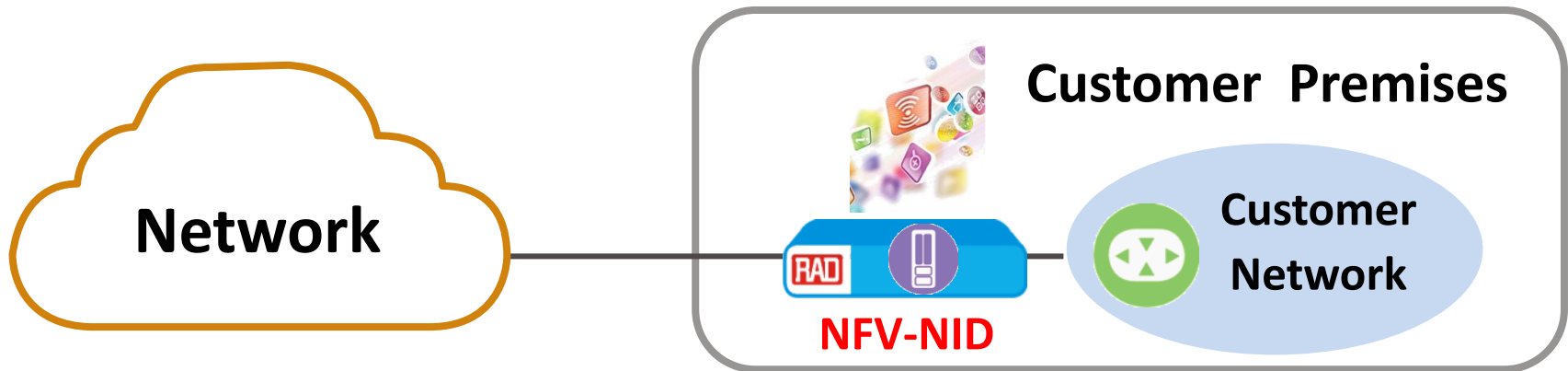- Fine granularity of *atomic* functions – not per device with integrated (embedded) SW

- Running by a common VM infrastructure

The Smart~~phone~~ NID/CPE

The solution that integrates SP-controlled network termination and virtual machine hosting:

L2/L3 NID with integrated standard x86 platform

Network

Customer Premises

Customer Network

NFV-NID

- Application examples (open to 3rd-party ISV)
  - Firewall
  - Analyzing tools (TCPdump, Wireshark]
  - Application awareness
  - IP telephony
  - WAN optimization

Virtualization of the CPE

Virtualization **of** the CPE by re-locating CPE functionality into the network (PE, DC, cloud)

- Replace vendor-specific **embedded** functionality with…

- … a next-generation customer site device, paired with **virtualized** functionality running in the network

  - some functionalities (OAM, QoS) remaining at the customer site

Addressed in the NFV ISG "Use Cases" document (Oct'13)
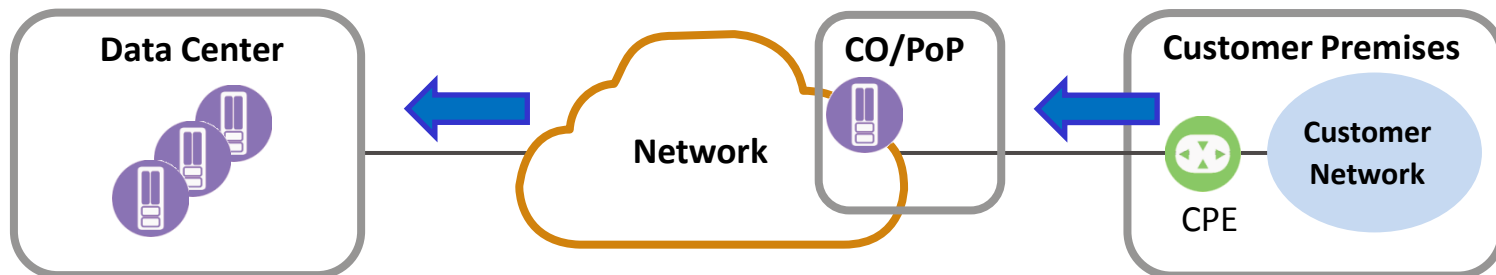
"Centripetal" NFV: From the customer site towards the network

Virtualization in the CPE: Distributed NFV

RAD

Enabling virtualization **in** the CPE by hosting VNFs for D-NFV implementation

- Placing NFV at the most appropriate places
  - *Appropriateness based on: **feasibility, performance, cost, policy***

- Functions virtualization without re-location
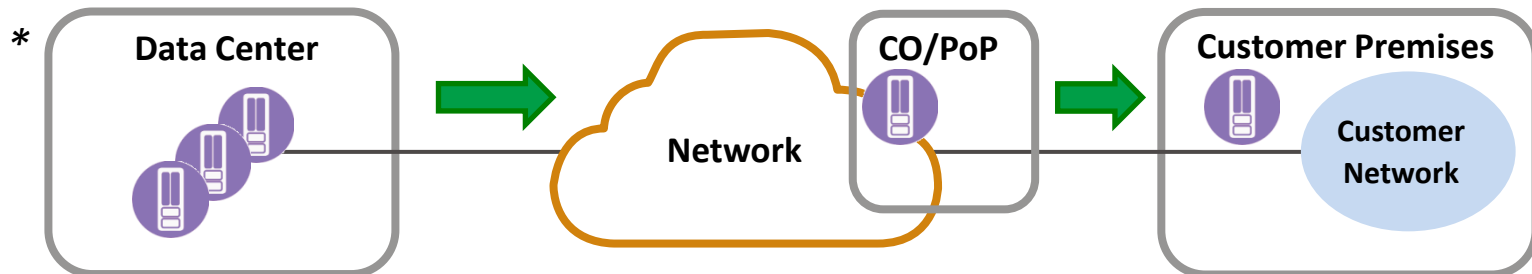
"Centrifugal" NFV: From the network towards the customer site

D-NFV Physics: Resultant Force

Once embedded functionalities are virtualized:

- Customer site functionalities are free to move towards the (data) center

- Functionalities conventionally located at the (data) center are free to move towards the customer premises
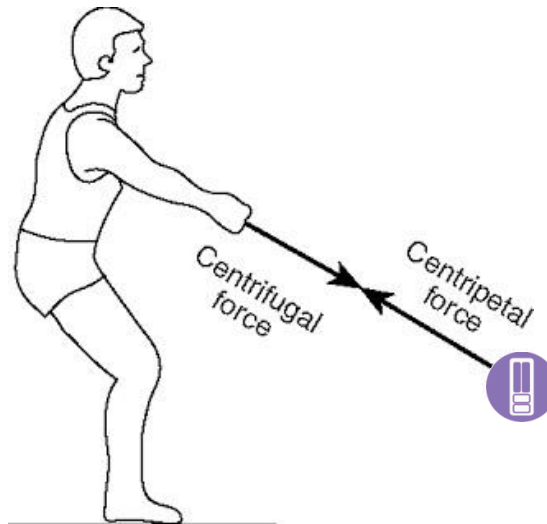
The New NFV Architecture

- The device converges three physical and virtual entities:

  1. NTU (as an integral part of the network infrastructure)

  2. Standard visrtualization infrastructure with KVM hypervisor

  3. App VMs (SW apps) that runs as VMs, optionally with chaining

- VLAN-based forwarding and mirroring to the VM infrastructure
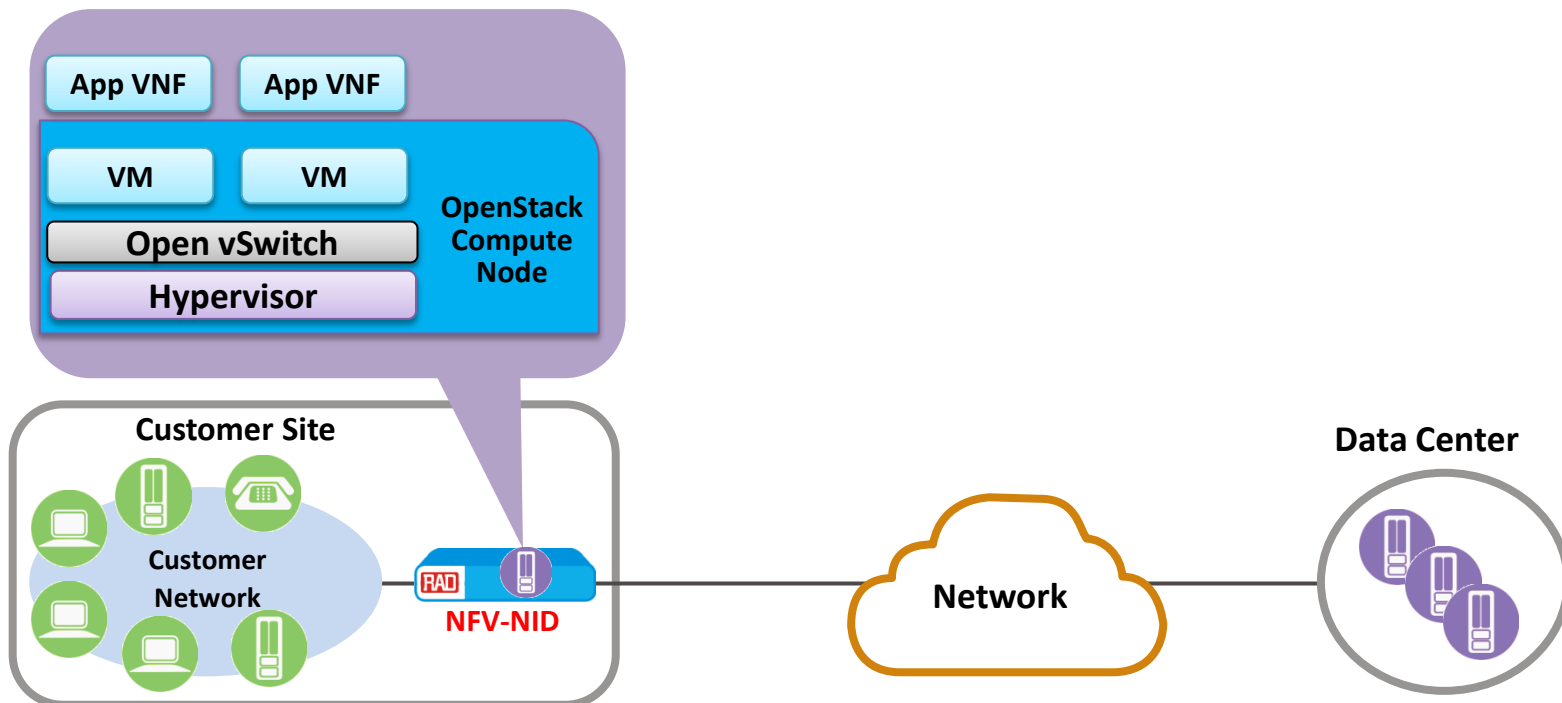
Applications Ecosystem

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- Firewall
- Content / Web filtering
- IPS
- Virus detection
- Encryption

Security

- WAN optimization
- Router
- Application Awareness
- WiFi controller

Networking

- IP-PBX
- VoIP GW
- FAX
- Video
- Caching
- SBC

Unified Communications

- Traffic analyzers
- Troubleshooting applications

Testing Tools

- Business intelligence
- CRM
- Accounting

General Applications

- TWAMP
- RAD APM
- Application performance

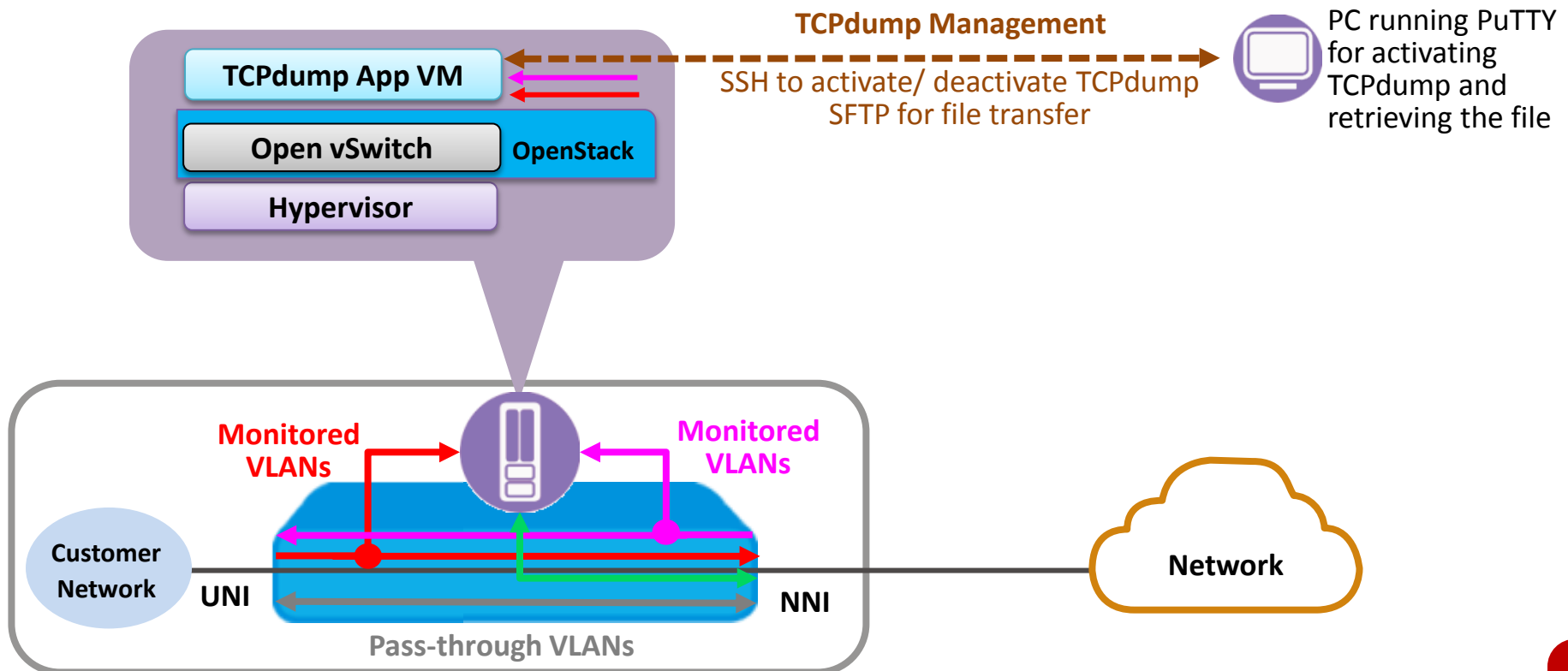Performance Monitoring

VNF Case: Firewall

- 1 Gbps firewall app (Fortinet FortiGate)
- Data paths are directed to the VM per VLAN
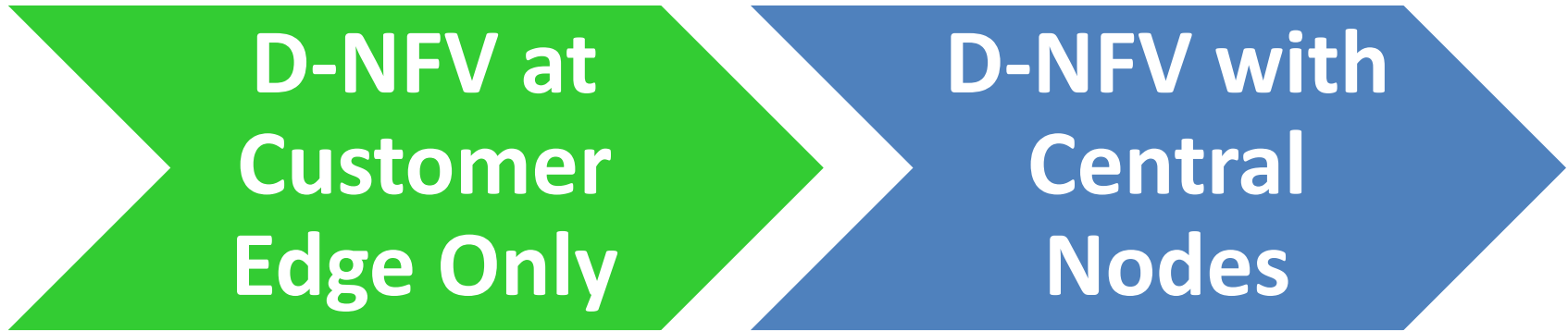- Local filtering at customer firewall maximizes upstream BW

Firewall App VM

Open vSwitch **OpenStack**

Hypervisor

Firewall Management

Firewall VLANs

Firewall VLANs

Customer Network UNI

NNI **Network**

Pass-through VLANs
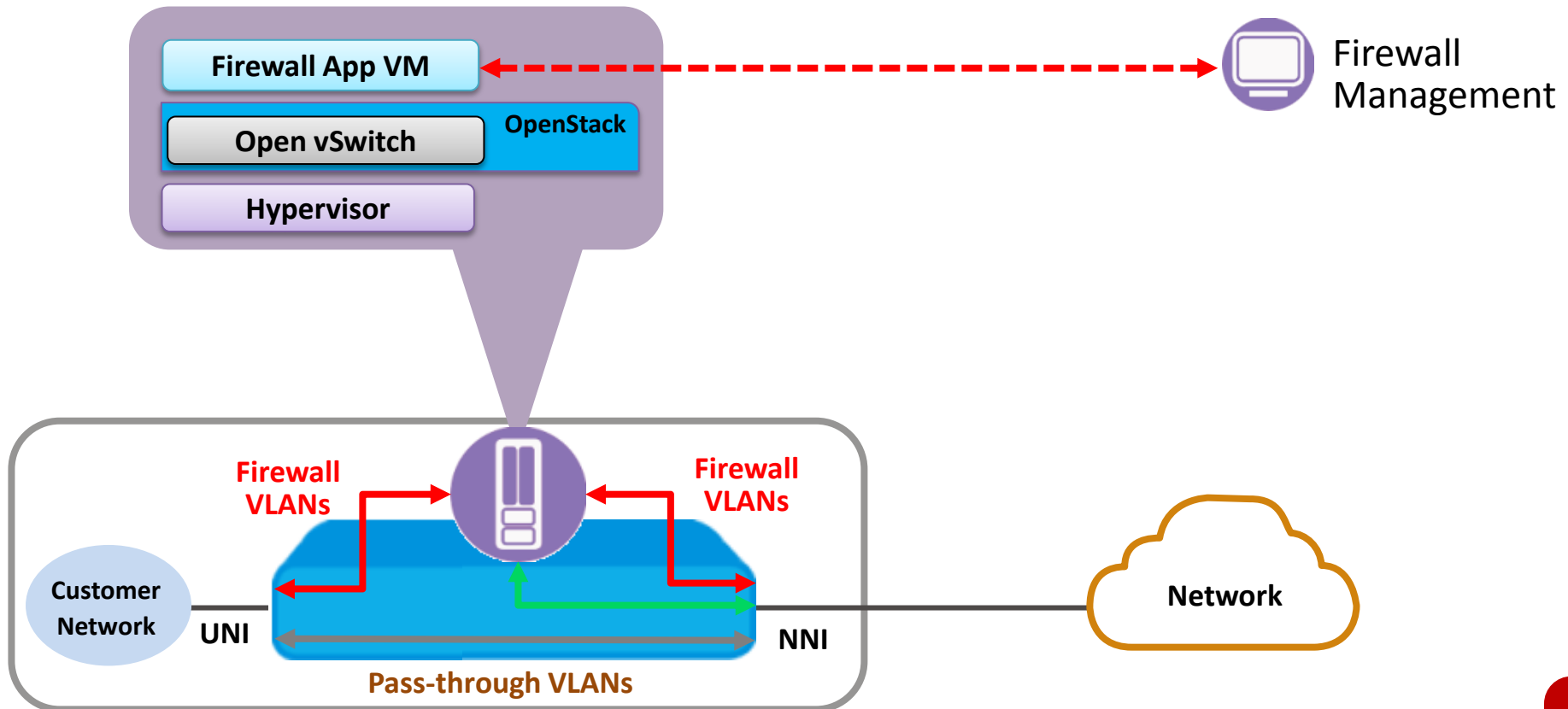
VNF Case: TCPdump Tool

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- Tcpdump monitors traffic to analyze network behavior, performance and applications.

- Hardware forwarding with Flow Mirroring ensures VM does not introduce delay and is not a bottleneck

TCPdump Management

PC running PuTTY for activating TCPdump and retrieving the file

SSH to activate/ deactivate TCPdump
SFTP for file transfer

TCPdump App VM

Open vSwitch   **OpenStack**

Hypervisor

Monitored VLANs

Monitored VLANs

Customer Network

UNI

Network

NNI

Pass-through VLANs

D-NFV: Phased Deployment

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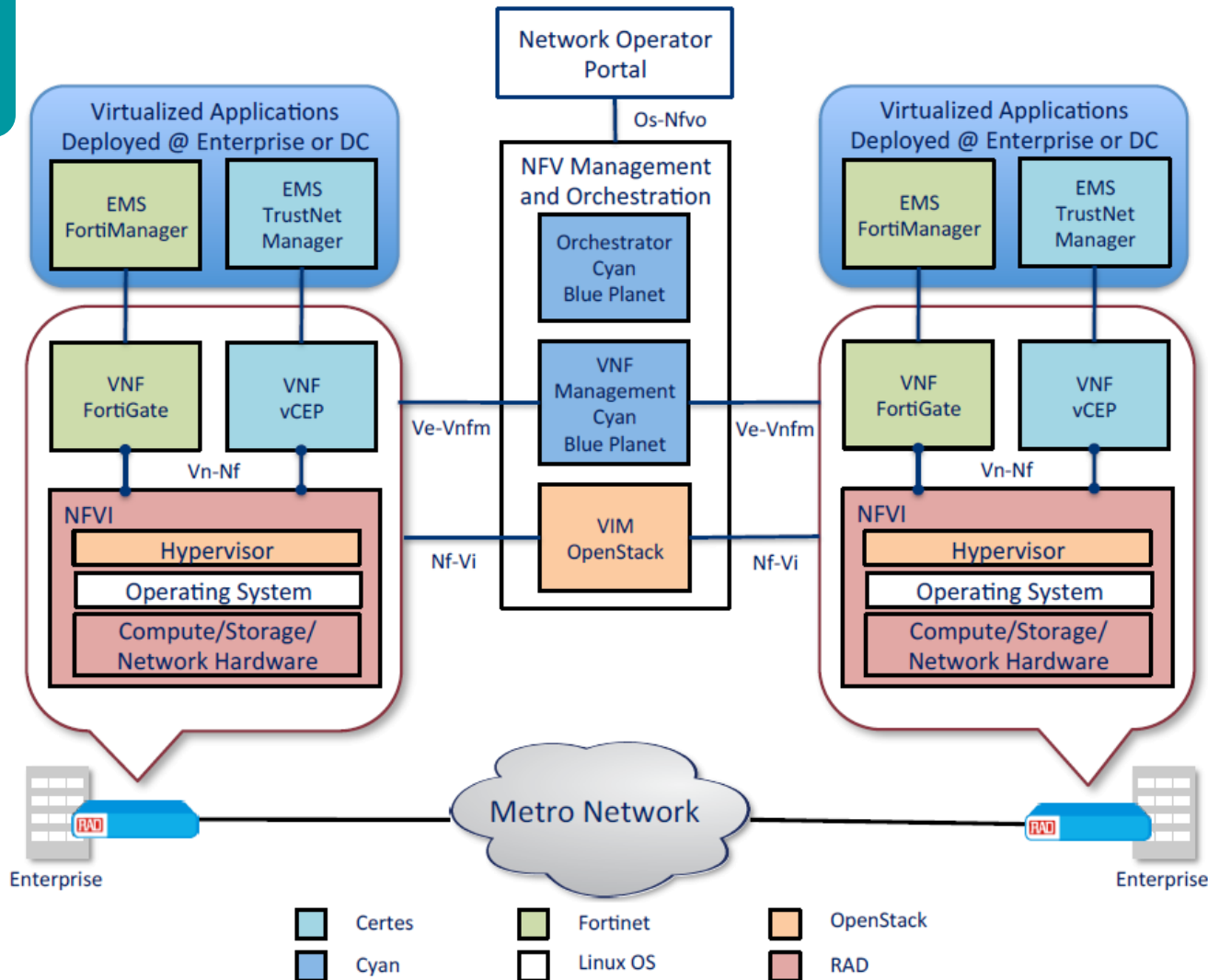

D-NFV at Customer Edge Only

D-NFV with Central Nodes

Initial Deployment
Centerless D-NFV Solutions

Full-Scale Deployment
VNF implementation at network nodes and DC, if justified

Network

Customer Premises

Customer Network

Multi-vendor D-NFV: ETSI NFV ISG PoC

- Phase 1: Customer Edge D-NFV solution
- Carrier sponsor – CenturyLink
- Vendor participants: RAD, Cyan, Fortinet, Certes

Converging Networking and Cloud/IT Resources and Services

RAD

Ships in the Night	Bundling: Ships in the Day	Integration	Convergence

Separate DC-based IT/compute and network services
 - "Internal" Data Center solutions (virtualization, orchestration, SDN)
 - Regular managed networks to customers

Packaging IT/Cloud and network resources

Integrated orchestration of cloud IT/compute and network resources, with elastic networking

Programmable virtualized IT/cloud and network resources with unified orchestration

To Sum Up: xHead Evolution

BELLheads   Vs.   **NETheads**   Vs.   **ITheads**

To Sum Up

- NFV: Not just centralized implementation

- NFV Implementation: still many challenges

- NFV/SDN: great areas for collaborative R&D projects

- CELTIC-Plus Program: Facilitating further progress

Thank You For Your Attention

www.rad.com