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BoR (16) 16

SDN, NV & NFV in broadband networks

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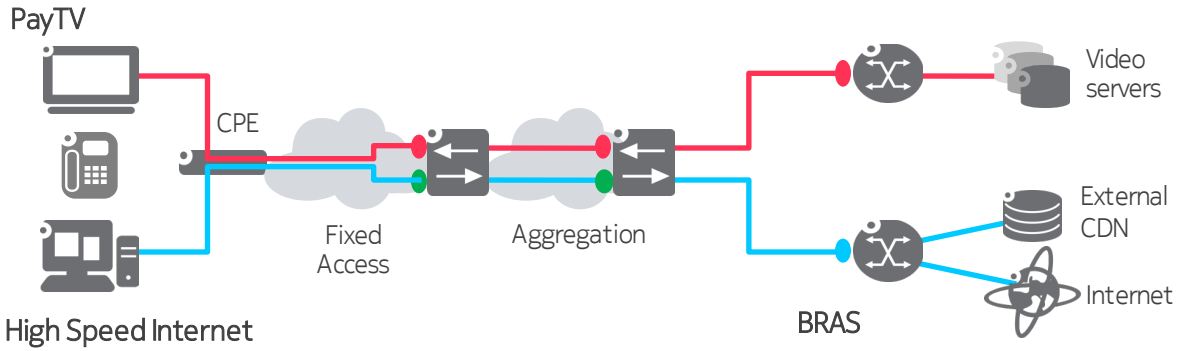
State of the Art

Differentiated services

- IP television
- IP telephony
- High-speed Internet



Limits of service configuration

- Automation dependent on network capabilities:
  - per-user service provisioning
  - global traffic capacity provisioning
- Fixed mapping of services to resources
- No differentiation “over the top”
- Network open to wholesaling but single ownership and configuration

Statically defined services and semi-static provisioning

Access Programmability and Control

Introduction of programmability

- Leverage network programmability to reach service flexibility and agility
  - to roll out / upgrade services
  - dynamically allocate resources to demand and congestions
- Software-defined networking + Network function virtualization
  - Dynamically convert service policy into hardware configuration – End-to-end-intelligence
- Use network resources efficiently

Challenges to reach programmability

- Network operations segmented to teams and tools
- Limited support of standard open interfaces to control hardware
- Lack of flexibility to change and move network function

Virtualization of access network comes from programmability of its resources

The Meaning of SDN

According to ONF in SDN:

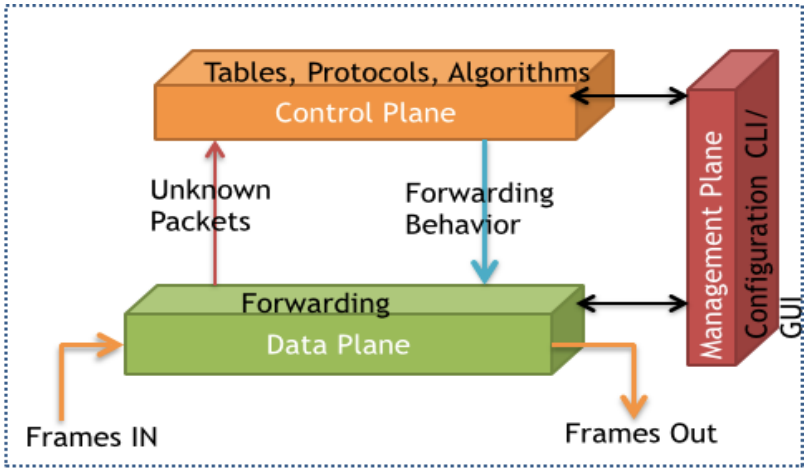
- The control plane and data plane are decoupled
- OpenFlow protocol connects the control and data plane.
- Network intelligence and state are logically centralized - software controller.

There is a general agreement that SDN
is about the programmability of networks
by means of separation of the control and data planes

- SDN = network programmability = automation and abstraction
- SDN ≠ NFV

What is SDN about?

- SDN redefines the relationship between network devices and control software

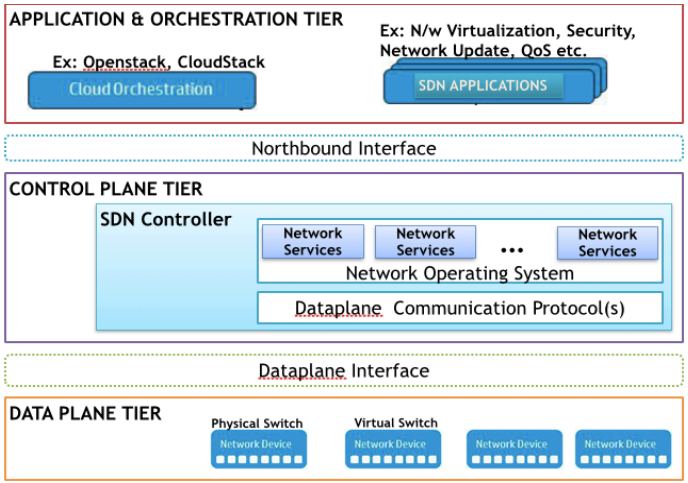


- SDN is about the control and having sufficient abstraction to support the provision of novel services in the network

SDN Controller

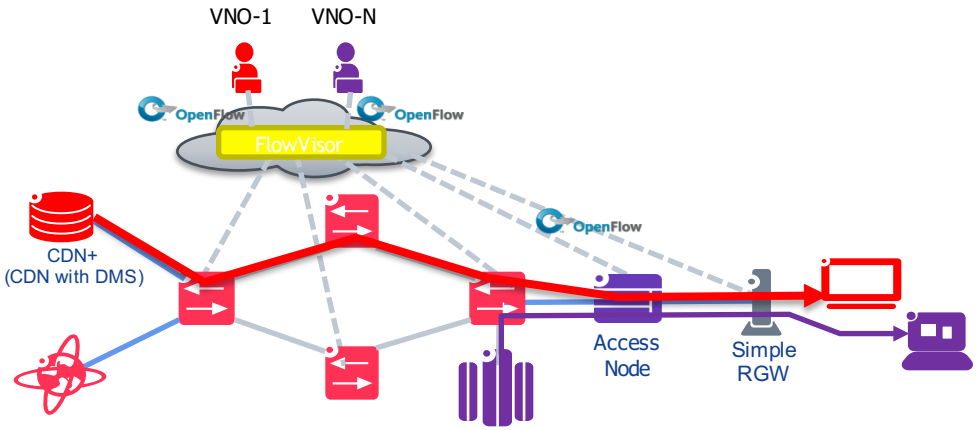
Central point of network intelligence

- enables the control logic to be designed and operated on a global network view
- manages the network directly by configuring the packet-handling mechanisms
- can represent network as logically separate slices (today core network, data center)



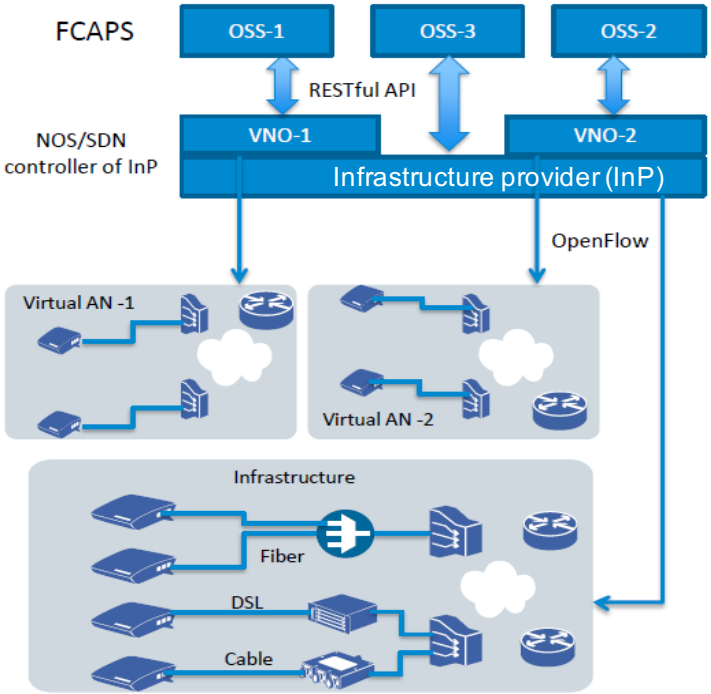
Access Network Virtualization - Slicing

- Traditional slicing with VLAN
- SDN – new slicing paradigm
  - A network hypervisor splits and controls a virtual network.
  - Each slice is isolated from other slices (e.g. different wavelength)
- Some example applications:
  - Multiple Virtual Network Operators (VNO) an Open Access solution
  - Enterprises with slices for different classes of service



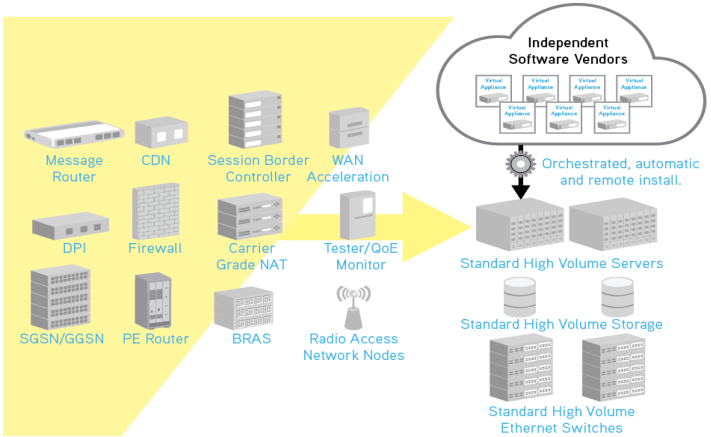
Access Network Unbundling with SDN

- Open access beyond bitstream unbundling
- Use SDN to enable:
  - Level of control similar to physical unbundling
  - Flexibility of deployment similar to bitstream unbundling
- Requires access network resource virtualization and separation
  - Changes in hardware and software practice
  - Separate capacities (memory, process, firmware)
- Requires new management paradigm and mechanisms



Network Function Virtualization (NFV)

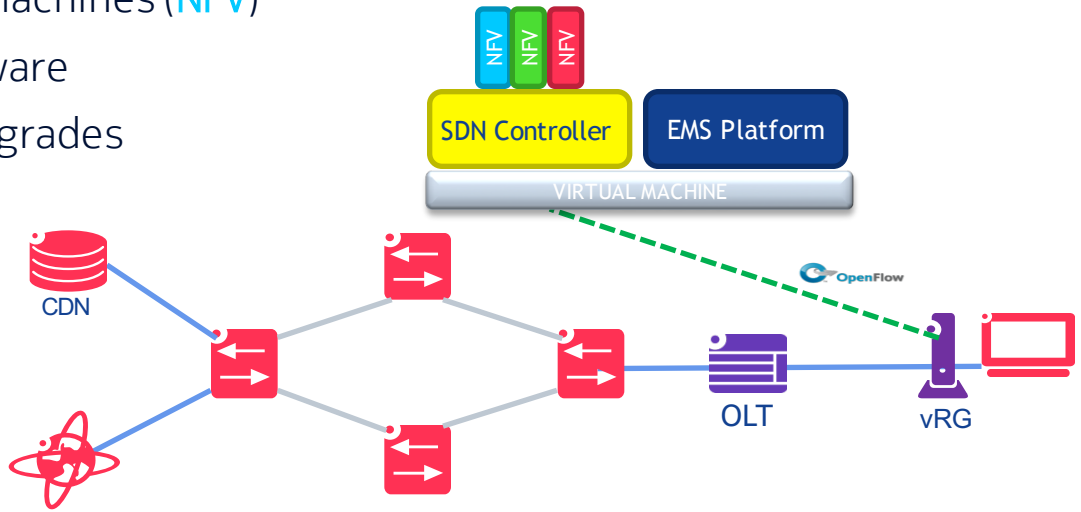
- Evolution of IT virtualization technology to consolidate many network equipment types onto standard high volume servers, switches and storage.
- Realization of network functions in software to run on standard server hardware.
- Software can be moved to, or run at, various locations in the network as required.
- NFV is a concept different from network slicing but both can be used together.



SDN+NFV: Virtual Residential Gateway

Combine SDN Controller and vRG application with EMS

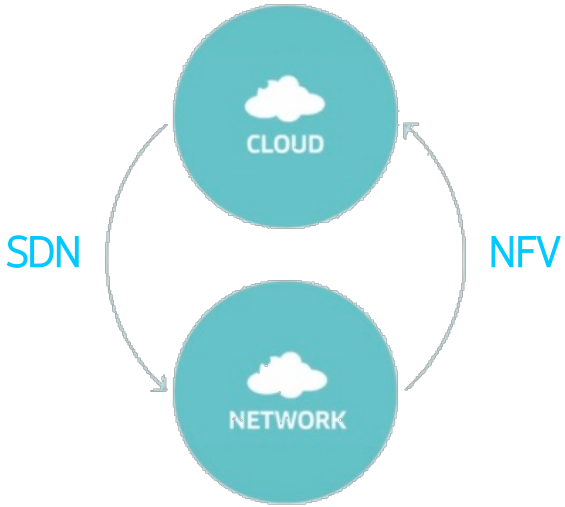
- SDN Controller learns about network topology and capabilities from EMS
- Control protocol based on e.g. OpenFlow
- Multiple applications in virtual machines (NFV)
- Features are not linked to hardware
- More rapid software/feature upgrades
- New functional capabilities



The Paradigm Shift: Software Defined Networks (SDN)

NETWORK PROGRAMMABILITY AND SERVICE CREATION

SCALE THE BUSINESS



CREATE & MANAGE VIRTUAL NETWORK FUNCTIONS (VNFs)

SCALE THE NETWORK

AND NETWORK FUNCTION VIRTUALIZATION (NFV)

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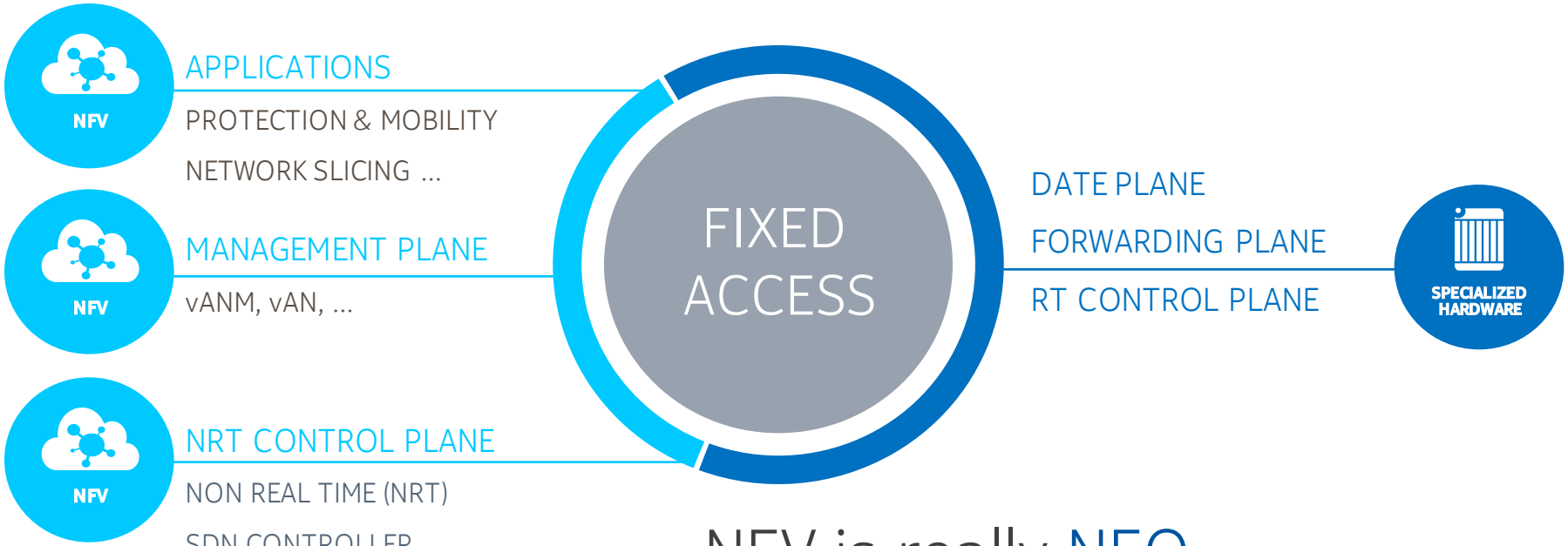
Fixed Access: What to Virtualize?



NFV is really NFO

(Network Function Optimization)

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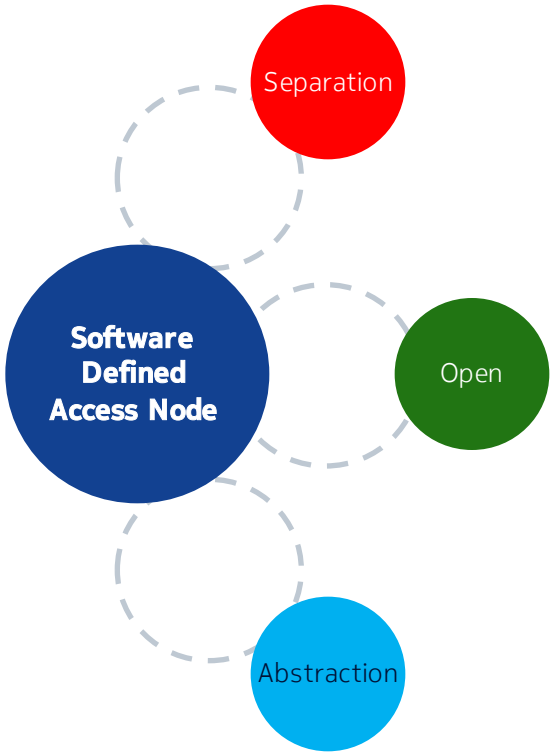
Software Defined Access Node: What is it?



Separation of control plane from forwarding plane

- Decouples hardware development cycle from software development cycle
- Reduces development and testing time
- Programmable forwarding behavior allows new services to be introduced without changing hardware

Open configuration, management and control

- YANG to model SD AN
- Netconf for configuration and notifications
- OpenFlow for control of forwarding behavior
- Enables multivendor network management systems
- Gives operators end to end control

Abstraction

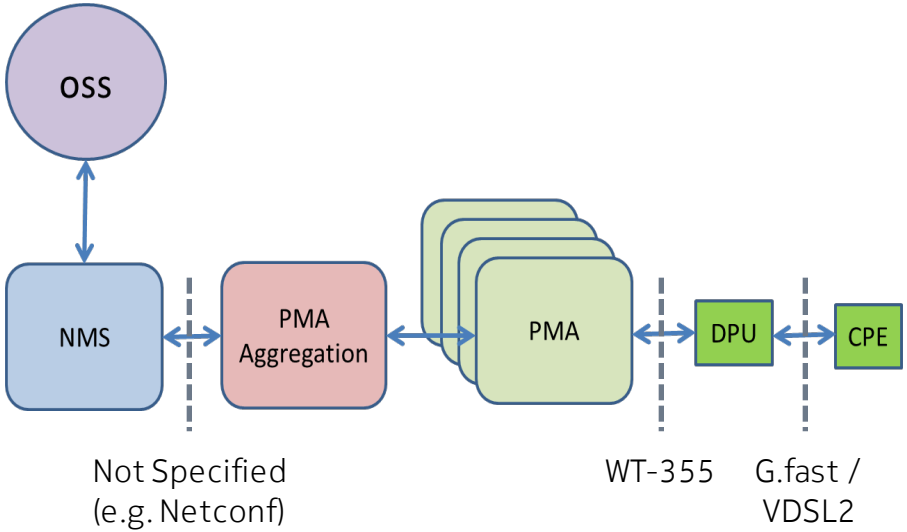
- Hides details of distributed access network making it easier to manage and control
- Network hypervisor allows slicing of the access network for different virtual network operators or types of customers or types of service

SDN is Being Applied to Fixed Access Networks

Broadband Forum

DPUs will be modeled in YANG and managed using NETCONF

- **TR-301 –** Architecture and Requirements for Fiber to the Distribution Point (ALU Editor)
- **WT-355 -** YANG Modules for FTTdp Management



Access Nodes

- **WT-358** – Requirements for Support of SDN in Access Nodes (OLTs, DSLAMs)
- **WT-368** – YANG Models for Access Nodes being defined in WT-358

PMA = Persistent Management Agent

- One instance per DPU
- Required because reverse-powered DPU may be offline

SDN and NFV will Foster Service Competition

- From a regulatory standpoint, NFV and SDN transformation today occur at non regulated network segments (core and aggregation).
- NFV and SDN both improve service quality including for specialized services which require guaranteed bandwidth and latency. The upcoming net neutrality guidelines should not hamper the capacity of the industry to invest and innovate through virtualization of networks.
- SDN could be in the future extended to fixed access networks and provide a level of control similar to physical unbundling combined with a flexibility similar to bitstream.
- SDN and NFV through virtualization of the home environment and the access network could improve the cost structures and business models of wholesalers' networks, and at the same time serve new customer segments (OTT, new media, M2M and IoT).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