

NREN Software Defined Data-Center(SDDC)

A Critical Foundation for Advanced Research and
Future Services in Africa.

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Introduction:

SDN :

- an approach to design, build and manage networks by separating network's control (brains) and forwarding (muscle) planes
- enables network control to become directly programmable
- supports abstraction of underlying infrastructure for applications and network services.

NFV :

- focusses on optimising network services – managing and orchestration of virtual network functions (VNFs)
- approach to overcome the limitation of hardware based appliances

Terminologies:

Many terms in use:

SDN, NFV, VNF, VXLAN, ACI, NSX, SD-WAN, SDDC, Openstack, Openflow, Orchestration, data, plane, control plane, white box switch, Open vSwitch etc

- Data plane – forwards packets to the next hop
- Control plane – decides where traffic is sent
- SD-WAN – Similar to SDN, a controller providing centralised control plane functions with white-box routers. Provides dynamic flow control, policy control
- ACI – Cisco's version of SDN (sort of)
- White box switch – generic switch usually running a Linux based OS, The SDN Controller uses Openflow (or another south-bound API) to program the forwarding table of the white box switches
- SDN – Physical separation of control and data planes in network elements, resulting in centralised network management
- NFV – abstracts logical network from the physical

Terminologies Contd:

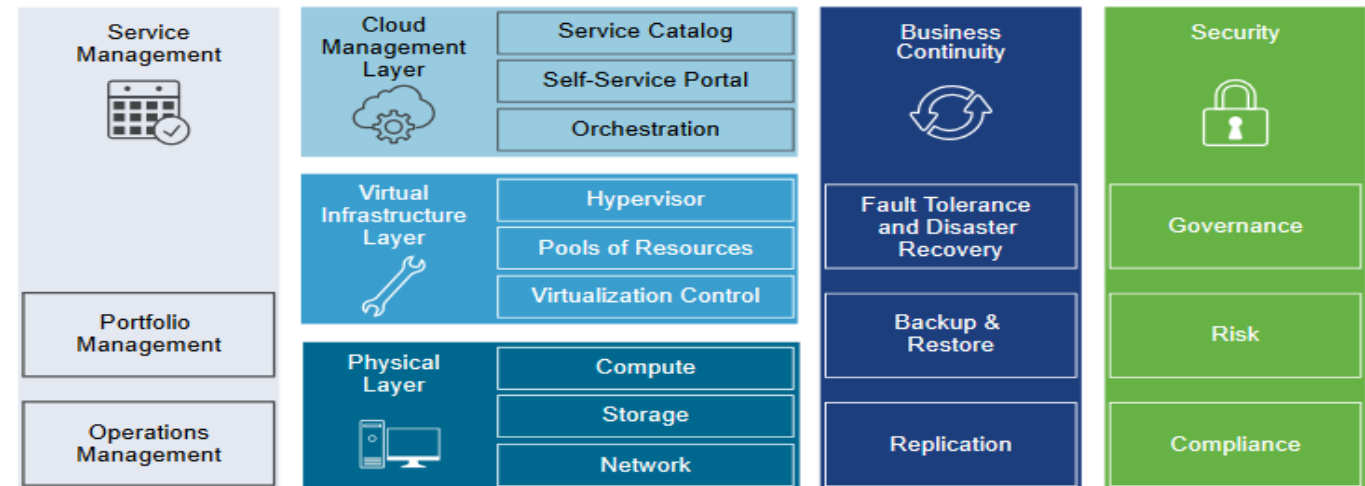
- VxLAN – an encapsulation protocol used to transport of L2 datagrams over L3/4 (UDP)
- Openstack – a cloud o/s that manages pools of compute, storage and network resources
- NSX – VMWare's SDN & NFV - NSX embeds network functionality that is typically handled in hardware directly into the hypervisor, separating logical and physical networks.
- SDN controller – the brains of the network, the application that acts as a control point in the SDN network, manage flow control to the switches/routers (south-bound APIs) e.g. OpenDaylight
- SDN Northbound APIs are also used to integrate the SDN Controller with automation stacks, such as Puppet and Chef, as well as orchestration platforms, such as OpenStack, vCloud Director or CloudStack.
- Openflow – protocol that the SDN controller uses to talk to switches and routers (virtual and physical)
- OVS (Open vSwitch) – virtual switch used by hypervisors for network traffic to/from VMs – used by all Linux based HVs and programmed from the SDN controller using Openflow

Software Defined Data-Center (SDDC):

- Leverage on virtualised technologies to separate hardware infrastructure to offer compute and network services
- Resources (compute, storage & networks) are abstracted are represented in software form

Major Components of SDDC are :

- SDN – Software Defined Network
- Software Define Storage
- Virtual Computing platforms – Citrix, KVM, Openstack ,VMWare etc



SDDC has changed the way enterprise IT deploys and access applications by driving more functions into the Cloud.

<http://pubs.vmware.com/vmware-validated-design-40/topic/com.vmware.ICbase/PDF/vmware-validated-design-40-sddc-architecture-design.pdf>

SDN Architecture:

Controllers:

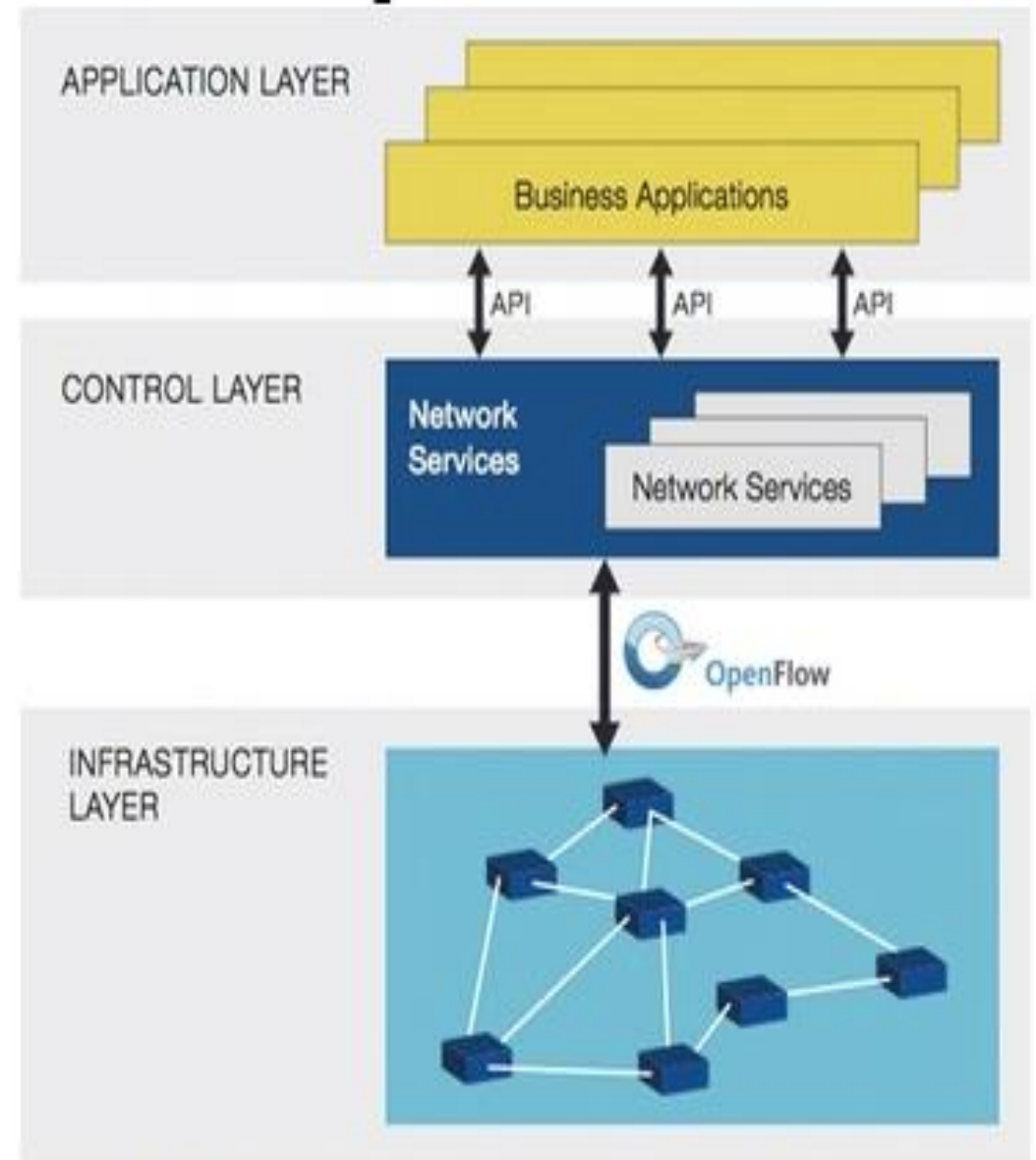
- Brains of the network
- Centralized view and controls forwarding plane - switches and routers

Southbound API's:

- Relays control information to hardware infrastructure – switches, routers etc
- First standard southbound API – OpenFlow
- Cisco uses Cisco OpFlex for ACI

Northbound API's:

- Relays applications and business instructions to control plane
- Helps to shape traffic and deploy services



Software Defined Networking (SDN) Framework

Standards:

Industry Standards

SDN



Open Networking Foundation (ONF)

www.opennetworking.org

NFV

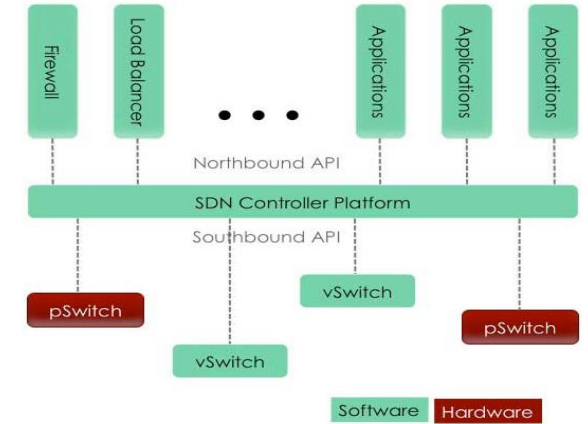


European Telecommunications Standards
Institute (ETSI)

<http://www.etsi.org/technologies-clusters/technologies/nfv>

SDN Northbound API:

- Critical component of SDN environment – Not a one size fits all like OpenFlow or OpFlex
- Communicates between the SDN Controller and Service and Applications running over the network
- No standard as it presently has various interfaces into :
 - Higher instance abstraction e.g applications
 - Traditional network services e.g firewalls, Load balancers etc
 - Orchestration across resources e.g Openstack



Why Northbound API is the future of SDN :

- Not constrained to hardware lifecycle timelines
- Most future applications and services depends on Northbound API's
 - automating network services – security, traffic engineering, multi-tenancy, management etc
 - orchestration – customer service orders e.g GEANT bandwidth on demand project http://www.geant.net/Services/ConnectivityServices/Pages/Bandwidth_on_Demand.aspx

SDDC Benefits:

- Large portions of the Data-Center is re-usable and re-allocated between projects or clients due to virtualizations
- Automation – reduces time to provisioning services and management.
- Orchestration - Self-Service, Self –provisioning based on customers requests.
- Agility & Flexibility
- Reduced Energy Consumption & Cost
- Data-Center infrastructure Scale up or Down on Demand
- Security – centralized control over hosted data and infrastructure.

Use case:

University Research Project as a customer needs to purchase connectivity between two African Universities to transfer research data:

- Connectivity required for 2 weeks every month for 12 months
- E2E connection should be available, reliable and secure

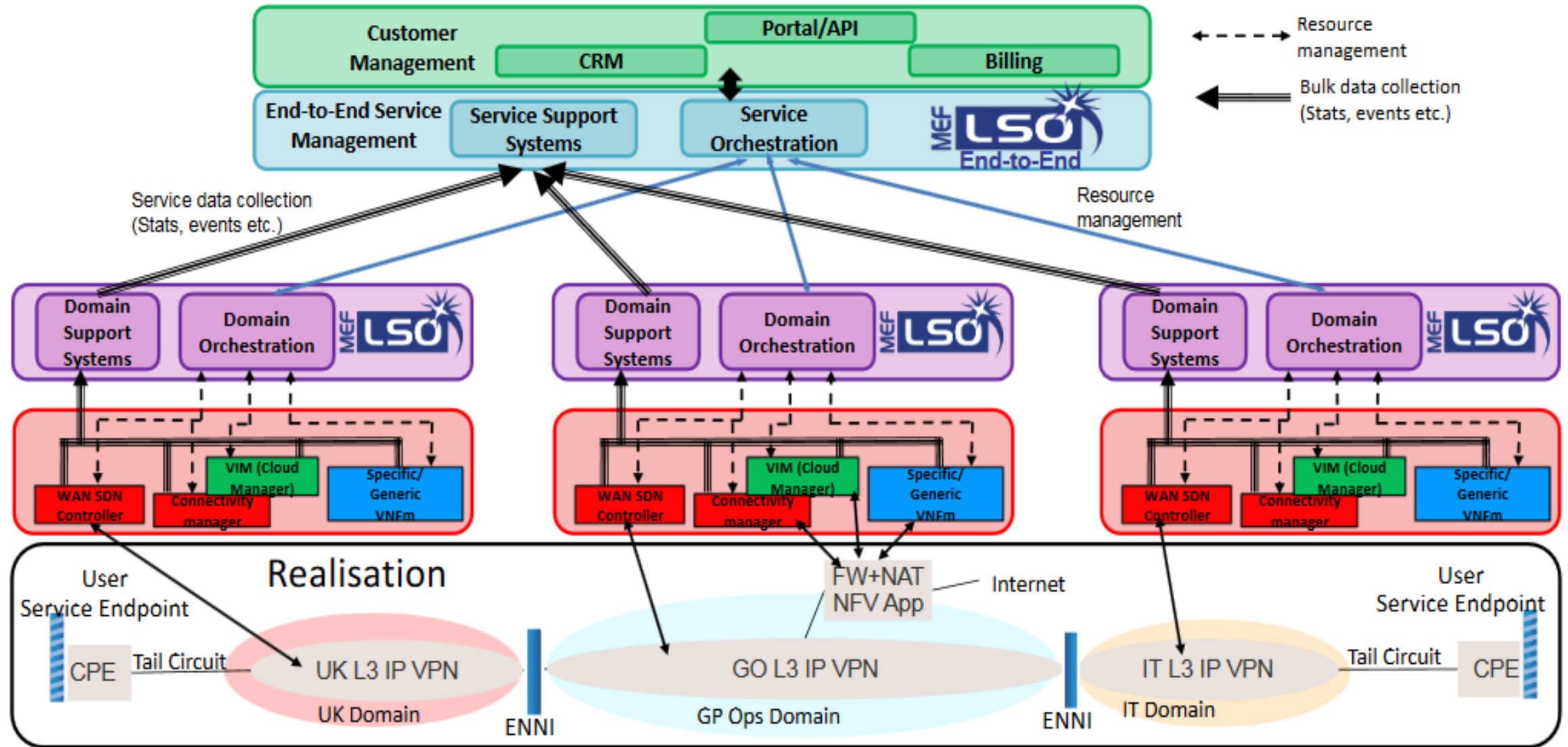
E2E service comprises several parts:

- Existing dedicated access link between local Universities and NREN network
- Specific L3 VPN across separate local Universities NRENs and WACREN networks
- Virtualized firewall & NAT application services
- Valid customer service request

Use case Workflow:

- Customers use dedicated portal to describe request.(friendly GUI and/or API)
- Customer Management systems pass end-to-end customer service request to Service Orchestrator.
 - Uses APIs to fully describe the entire customer service request.
- Service Orchestrator uses published domain capabilities to decompose into specific requests for each domain.
 - Uses APIs to describe the services required from each relevant domain.
- Service Orchestrator coordinates inter-domain connectivity service ‘stitching’.
- Domain Orchestrator uses local knowledge to decompose into specific request for each control entity (e.g. cloud manager, SDN controller, VNFM/VNF etc.)
 - APIs dependent on control capabilities needed
 - Domain service availability is delegated to the domain (fault handling, performance management etc.).
 - Service performance and status streamed back to the originating Service Orchestration instance (enabling it to provide a service view to customer portal)
- Cloud API compliant to ETSI NFV etc.
- SDN controller NBI API
- SDN SBI e.g Openflow or OpFlex

Use case Example:



Thank You – Q&A

Additional Slides - SDN:

- Separates the control plane from the data plane in network elements
- SDN controllers provide the control and management functions
- 'White box' switches provide the data plane, with flow tables provided by the controller based on Openflow protocol from the ONF
- Openflow – an open API providing a standard interface to enable programming the data plane of switches
- SDN controller uses Openflow or other southbound API to program the forwarding table of 'white box' switches
- Because it operates on flows, OpenFlow provides very granular control, enabling the network to respond to real-time changes at the application, user and session levels.
- OpenFlow controls how traffic should flow through network devices based on parameters such as usage patterns, application needs, service-level agreements and cloud resources.

Additional Slides - NFV:

- Until now, network functions have been provided by physical appliances, e.g. switches, routers, firewalls, load-balancers
- Running these functions as virtual appliances in a VM greatly reduces costs
- Permits orchestration of the network from a central location, simplifying management, reducing risk, increasing agility
- Most vendors now have a virtual appliance offering
- NFV can be achieved independently from SDN