



# *Network Virtualization & the Internet2 Innovation Platform*

*To keep our community at  
the “tip of the spear”,  
how can we support  
network virtualization?*

*Eric Boyd - Senior Director, Strategic Projects*



# Internet2 Mission



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University  
Corporation  
for  
Advanced  
Internet  
Development

# INTERNET<sup>2</sup>

- The Community's Network Story (2014)
  - Abundant Bandwidth / 100G+
  - **Deeply Programmable (Native OpenFlow)**
  - Support for Data Intensive Science (Science DMZ)
- Interconnected with public Internet
- Supports production quality & disruptive innovation
- Open for your innovation!

Provides production & innovation platform to:

- Dozens of high performance compute clusters
- Hundreds of campus data centers
- Potentially thousands of SDN ports
- Hundreds of wireless access networks
- Thousands of researchers
- Millions of potential collaborators

# Network Virtualization Use Case

- For most applications run in a campus environment, the traditional routed Layer 3 infrastructure provided by the Internet2 Advanced Layer 3 Service (AL3S) provides all the needed functionality and performance.
- For some applications, the ability to run on a server in a campus environment or on a GENI Rack, connected by a Layer 2 VLAN, should suffice.
- For a few advanced applications, particularly in the network research arena, there is a need to run their own controller on a virtual network.

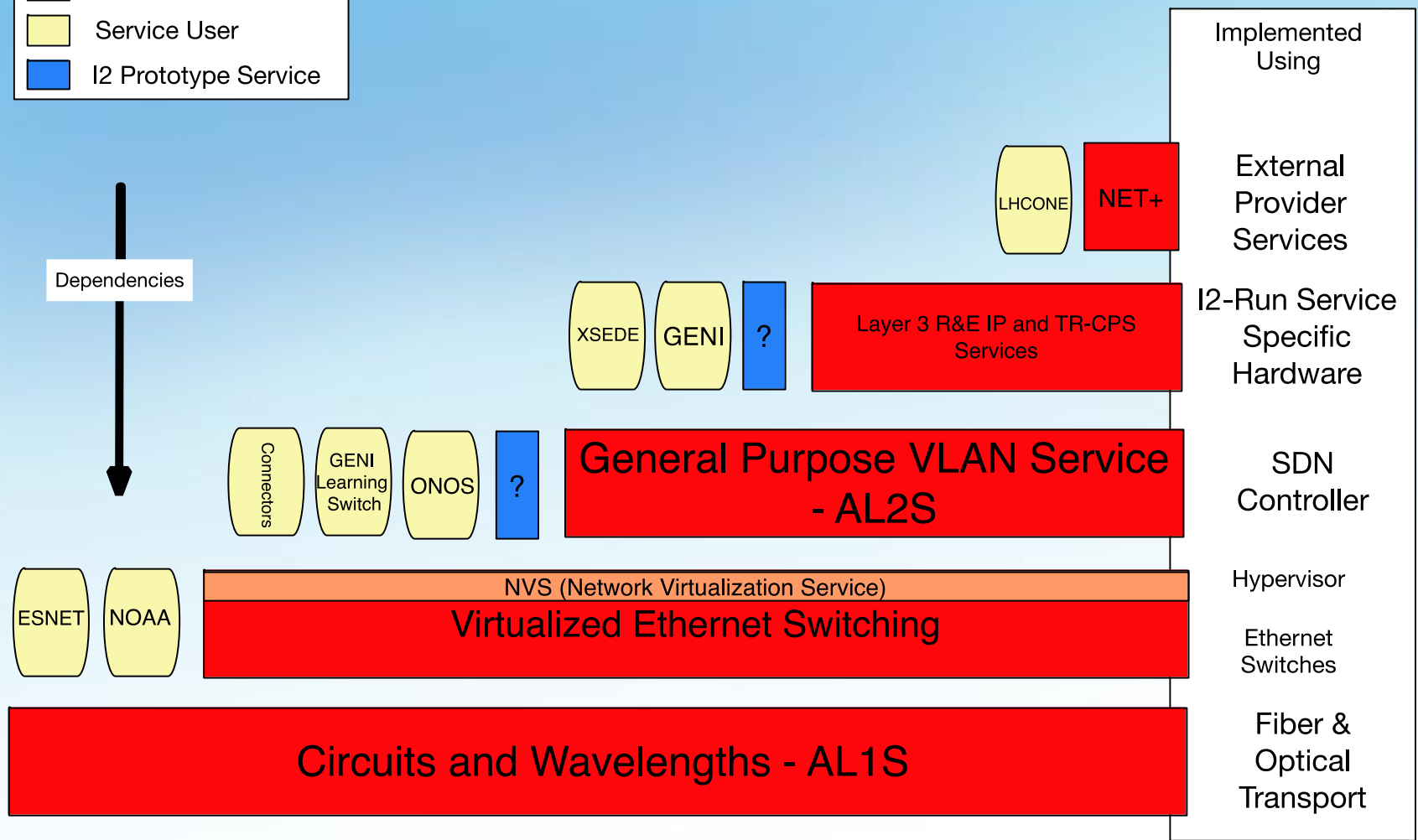


# Network Virtualization Roll-Out

- After a soft roll-out this summer, Internet2 plans to roll out support for Network Virtualization at this fall's Technology Exchange
- Being able to build virtual networks will enable:
  - Rapid prototyping of advanced applications
  - Rapid prototyping of new network services
  - Rapid advancement of network research
- Network virtualization experiments are already underway
  - Prototyping IP over SDN solution (no routers!)
  - Prototyping cloud-based services
  - Prototyping multi-domain virtual networks
  - Etc.

# Internet2 Service Taxonomy

	I2 Production Service
	Service User
	I2 Prototype Service



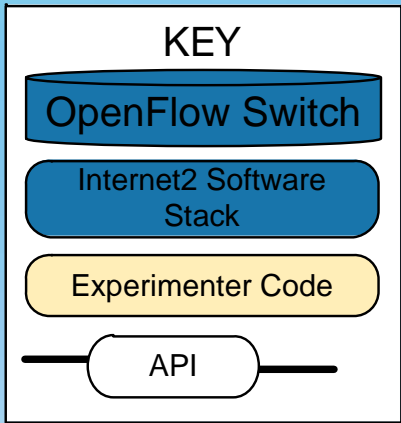
# What does the service enable?

- Opportunity to deploy your own controller on the national backbone
- Slice of the national backbone resources (e.g. VLAN range, flow table subset, etc.)
- Ability to create a persistent nationwide service using a fraction of the national backbone

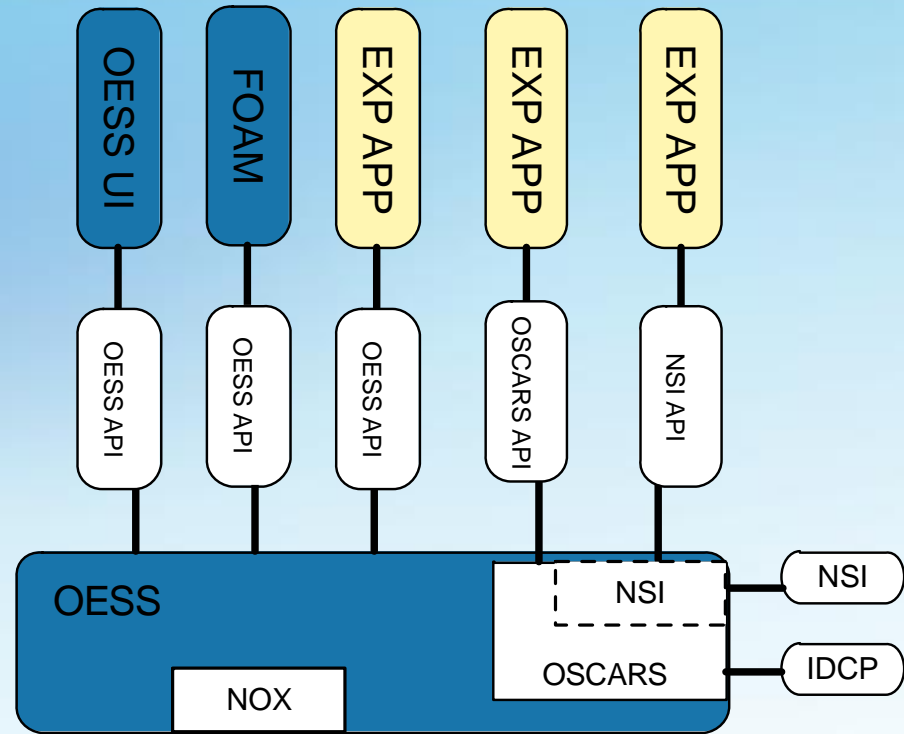
# Use Case Examples

- Production Service Staging
  - GENI wants to move to Stitching v3.0, but Stitching 2.0 is in wide use
  - Set up a slice, deploy a second OESS, deploy new version of FOAM Stitching Aggregator
  - When it's tested and ready, move to the production OESS stack
- Network Research
  - Network researcher has a better idea how to do networking
  - Set up a slice, deploy new network controller, write paper
- Service Prototyping
  - Look at alternatives to AL3S
  - Implement a route server that speaks OpenFlow on southbound interface with no routers
  - Deploy in a slice, begin peering with other domains
  - Evaluate efficacy, operational savings
  - Over time transition to new service
- Private Networks
  - Want something akin to Atlantic Wave, original vision for LHCONE, or GENI Virtual Network
  - Set up a distributed SDX across multiple domains

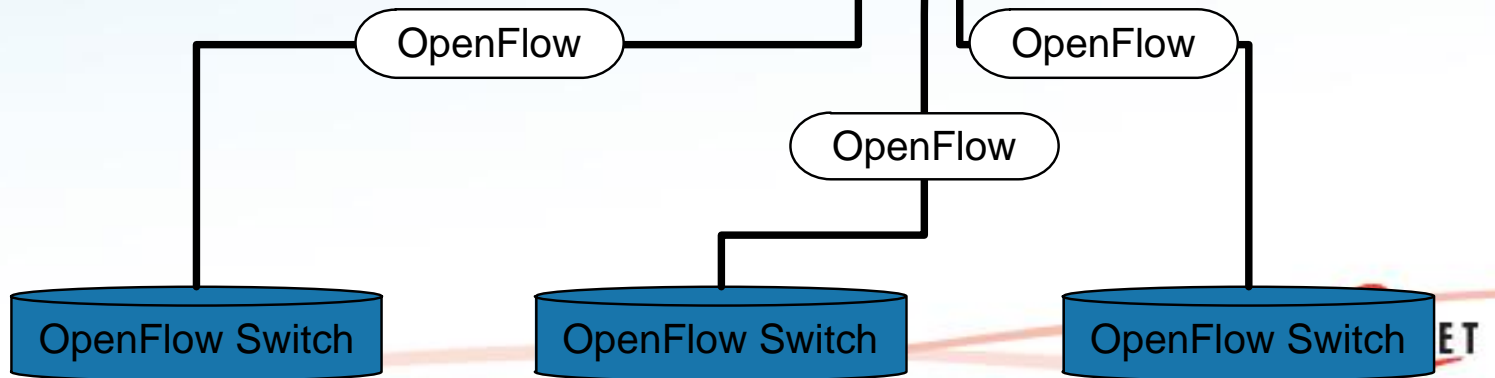


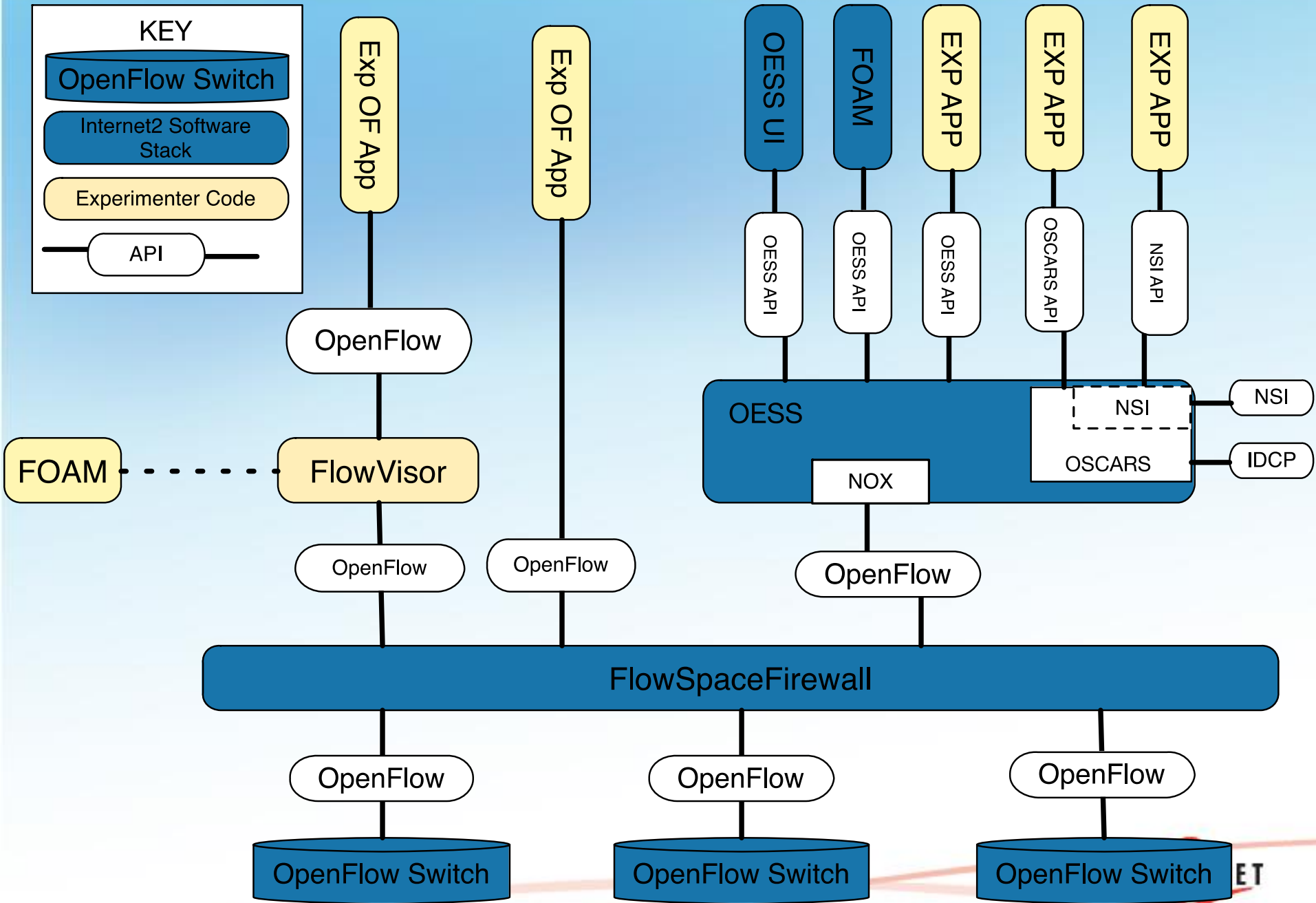
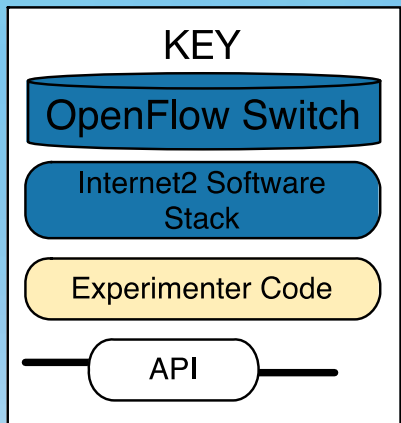


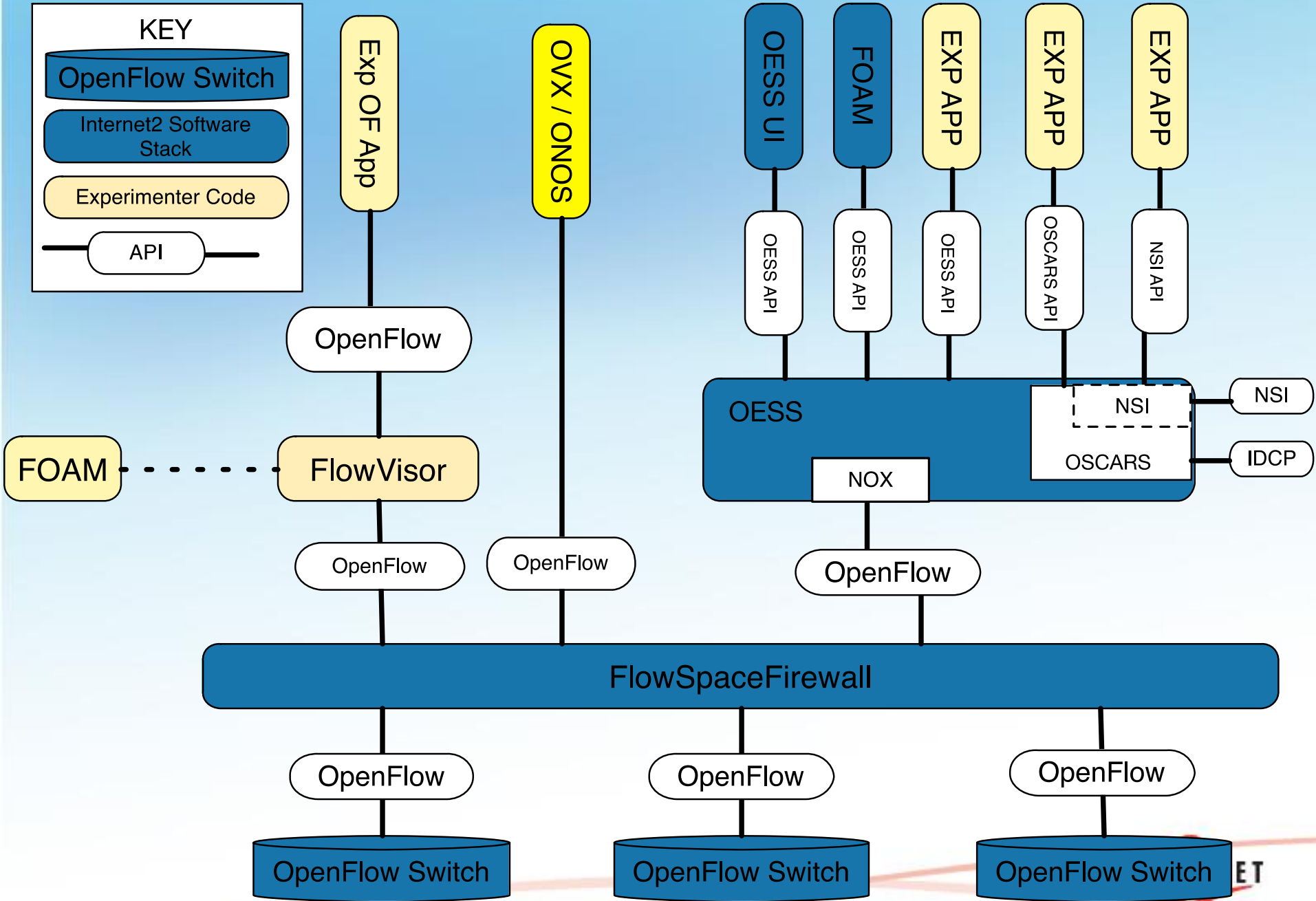
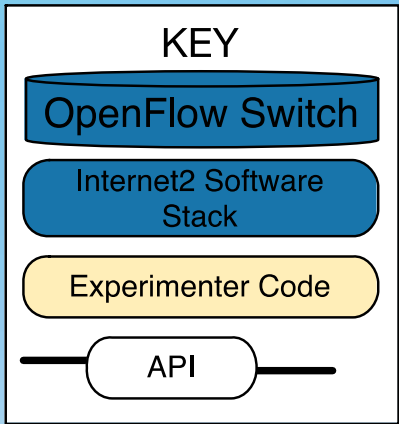
# Software Architecture



FOAM







# SDX



Local VLAN  
Provisioning  
Service

A white rectangular box with a black border representing the Local VLAN Provisioning Service, connected to the OESS component.

FlowSpaceFirewall

A dark blue rounded rectangular box representing the FlowSpaceFirewall component.

Virtual Switch

A blue cylindrical box representing the Virtual Switch component.

Physical  
switch

A red cylindrical box representing the Physical switch component.

SDX1

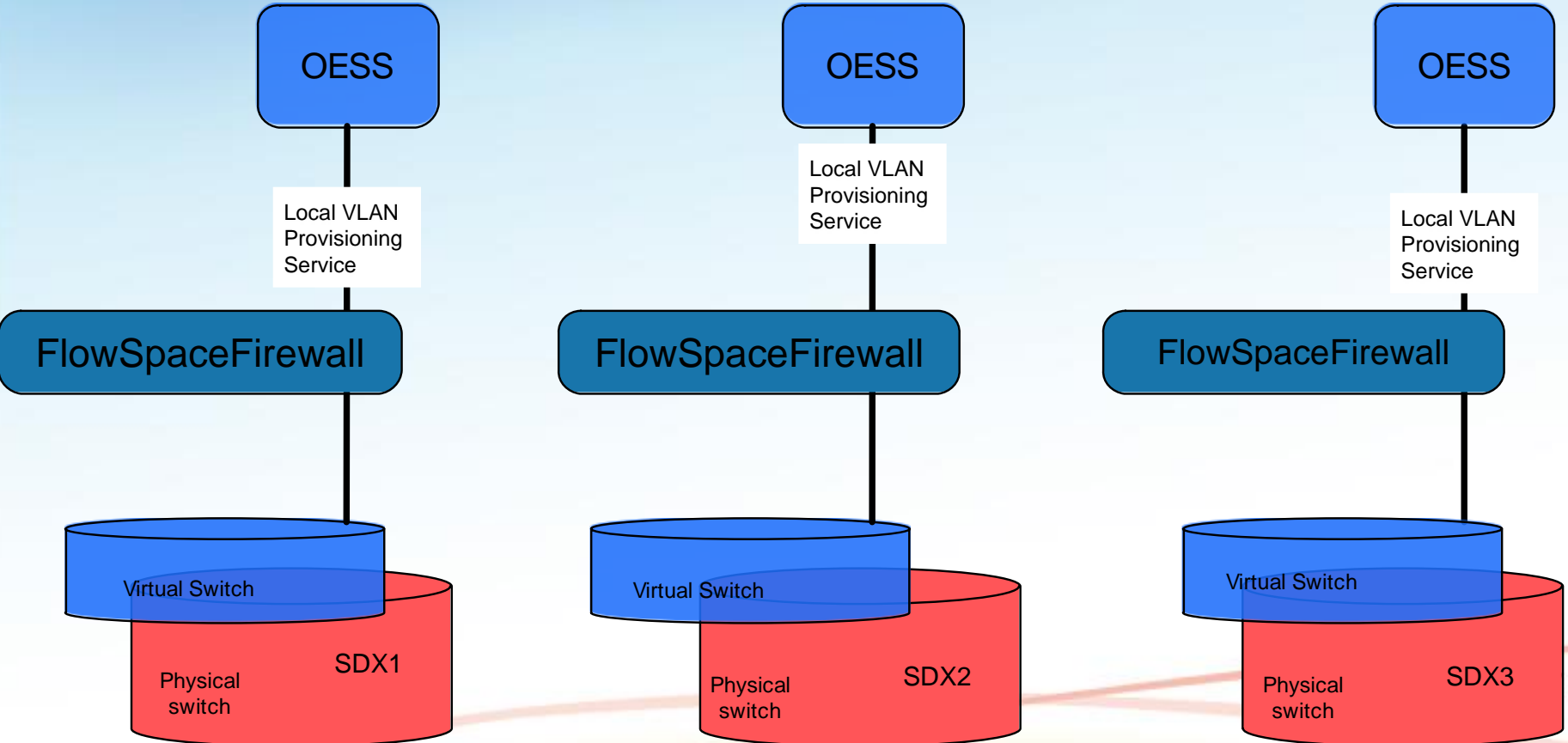
The label SDX1 is positioned to the right of the Physical switch component.

INTERNET



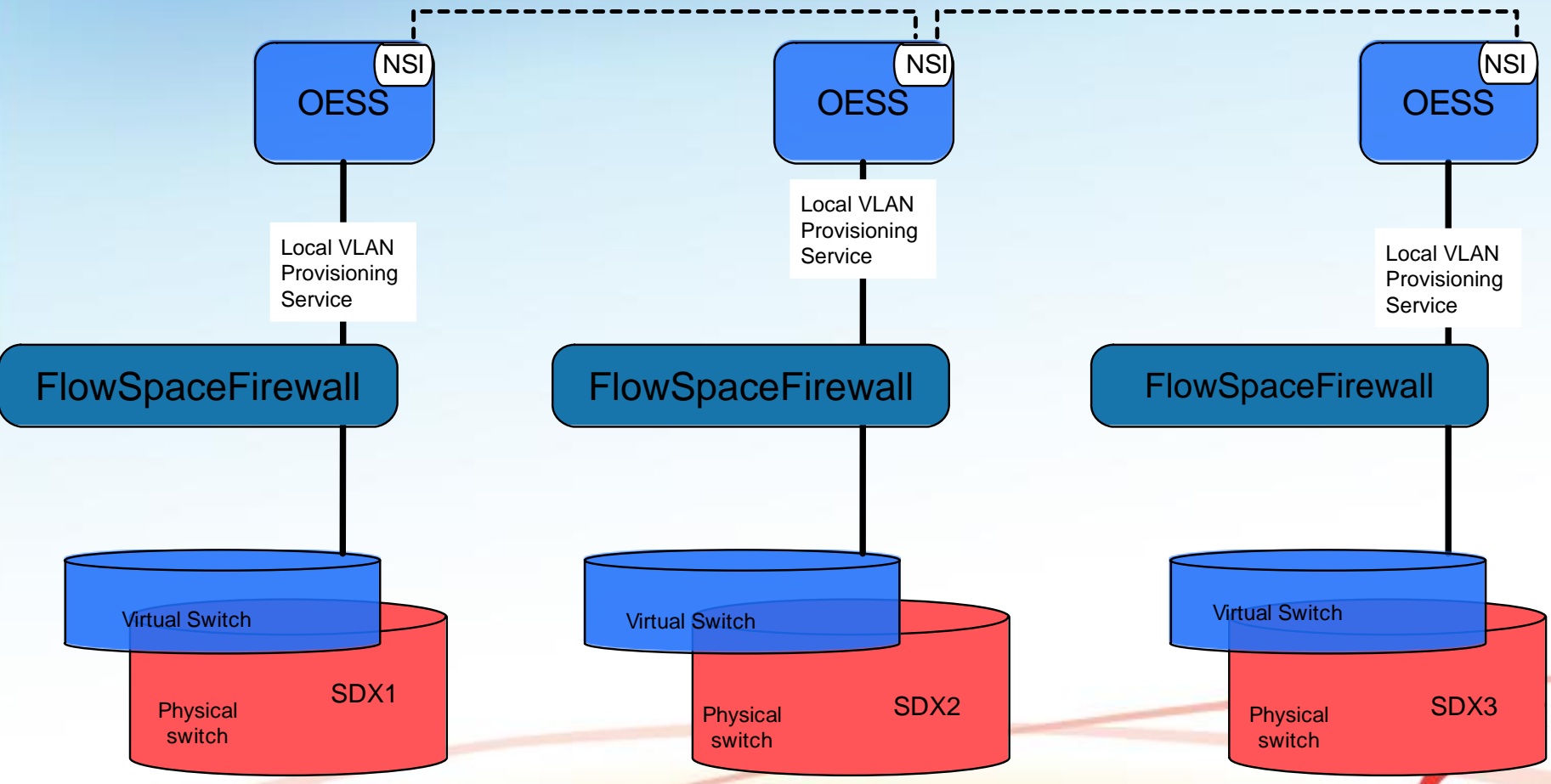
The word INTERNET is written in a bold, black, sans-serif font. A large, stylized red number '2' is superimposed over the letters 'E' and 'T'.

# SDX

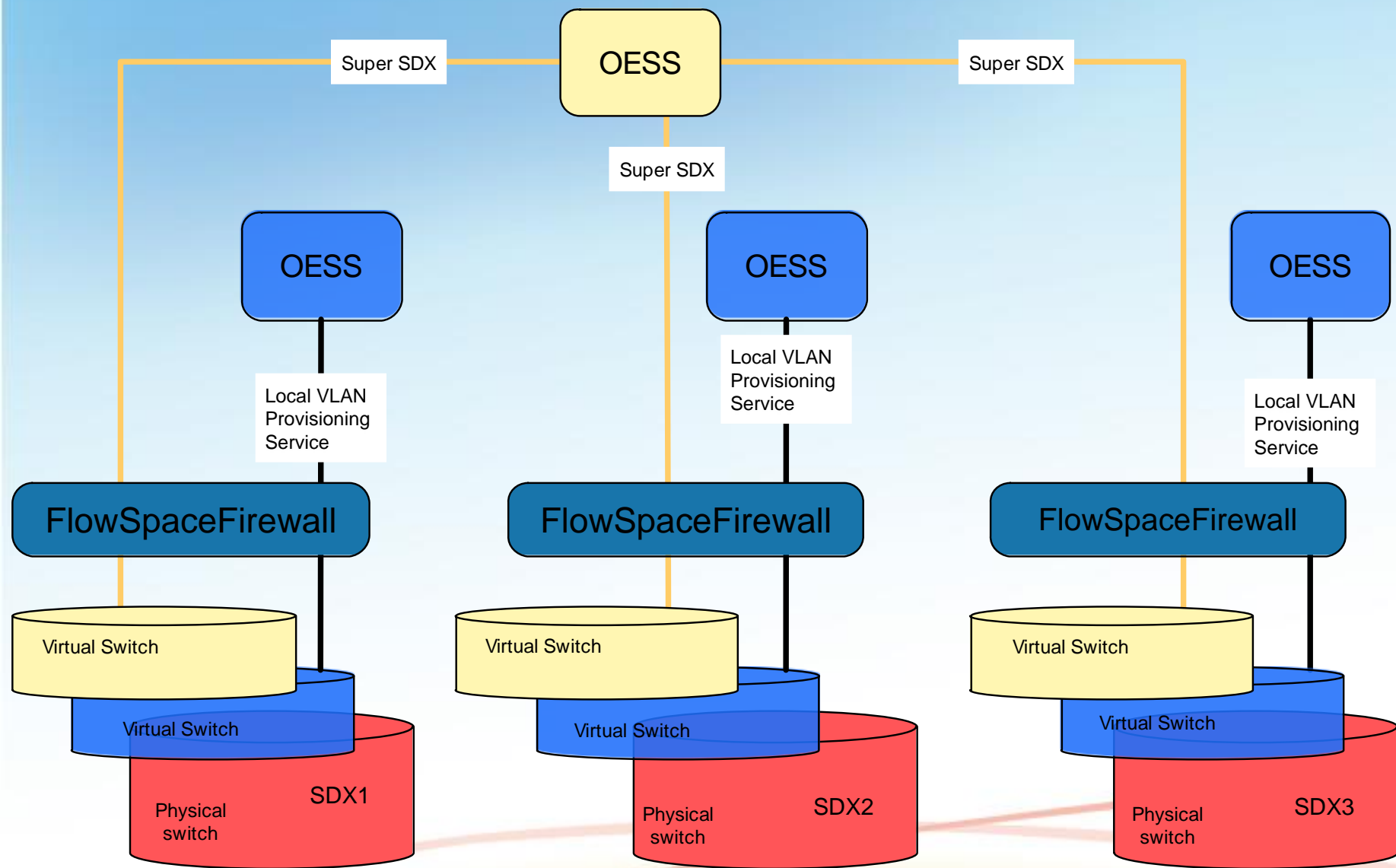




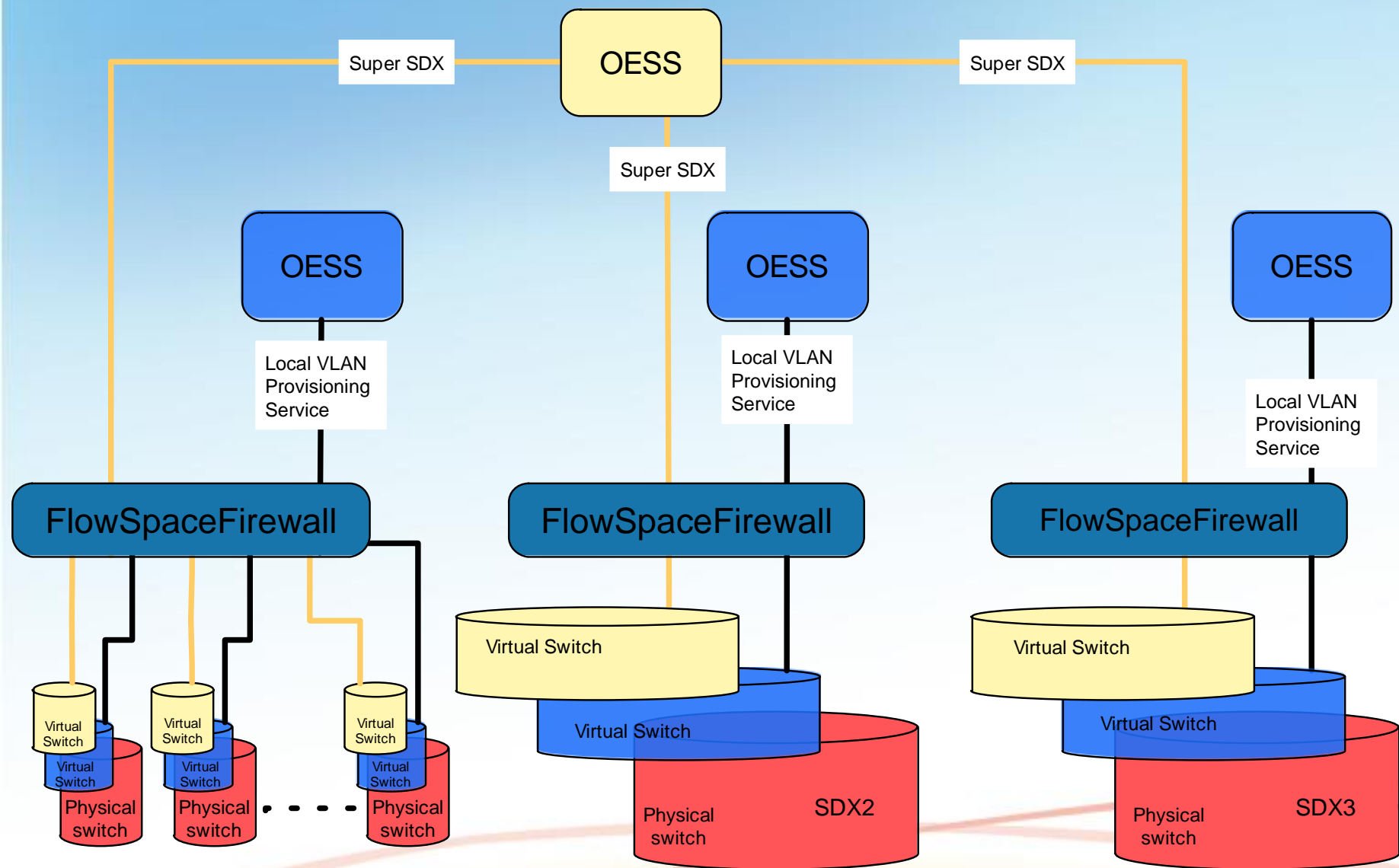
# SDX



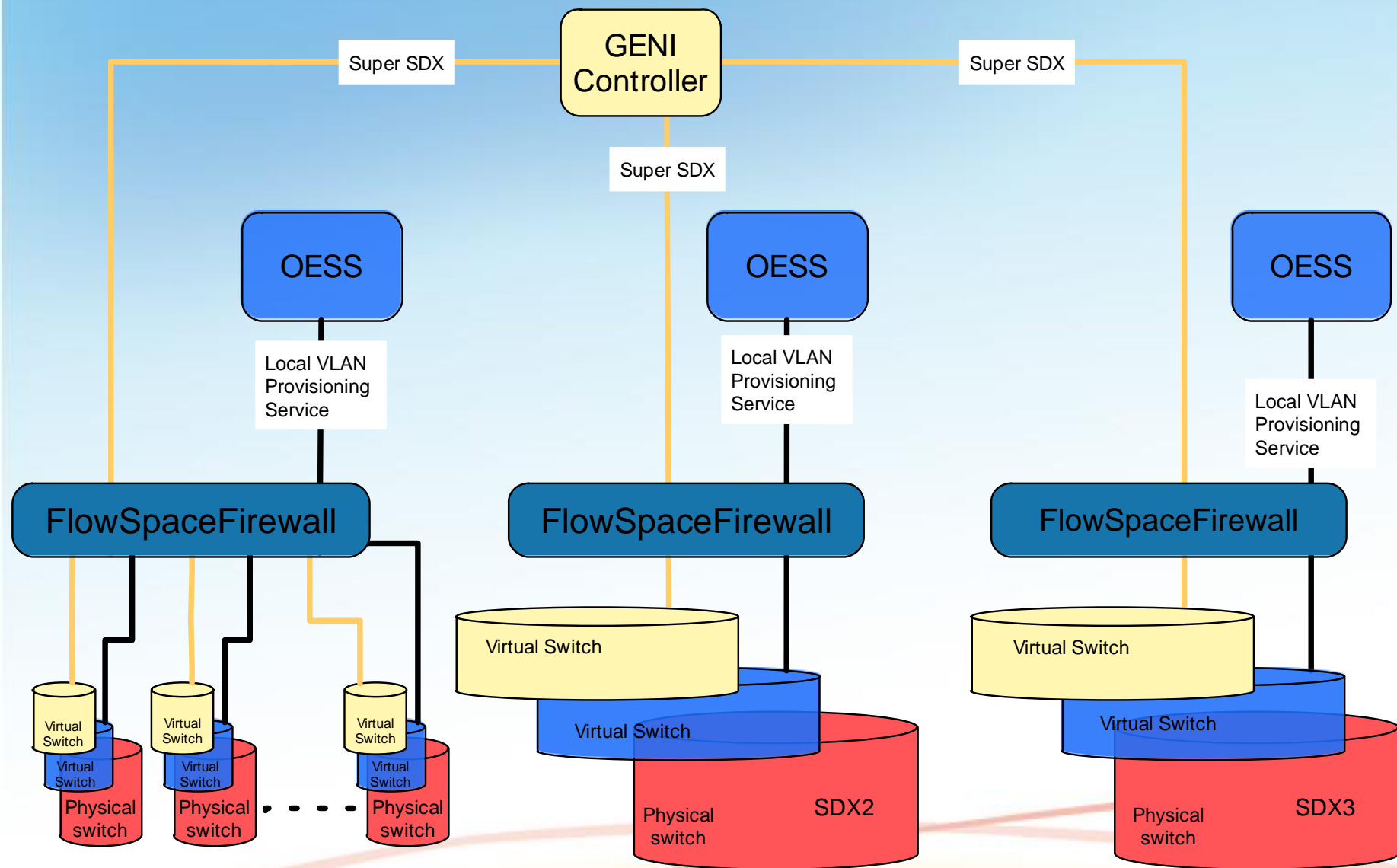
# Multi-Domain SDX



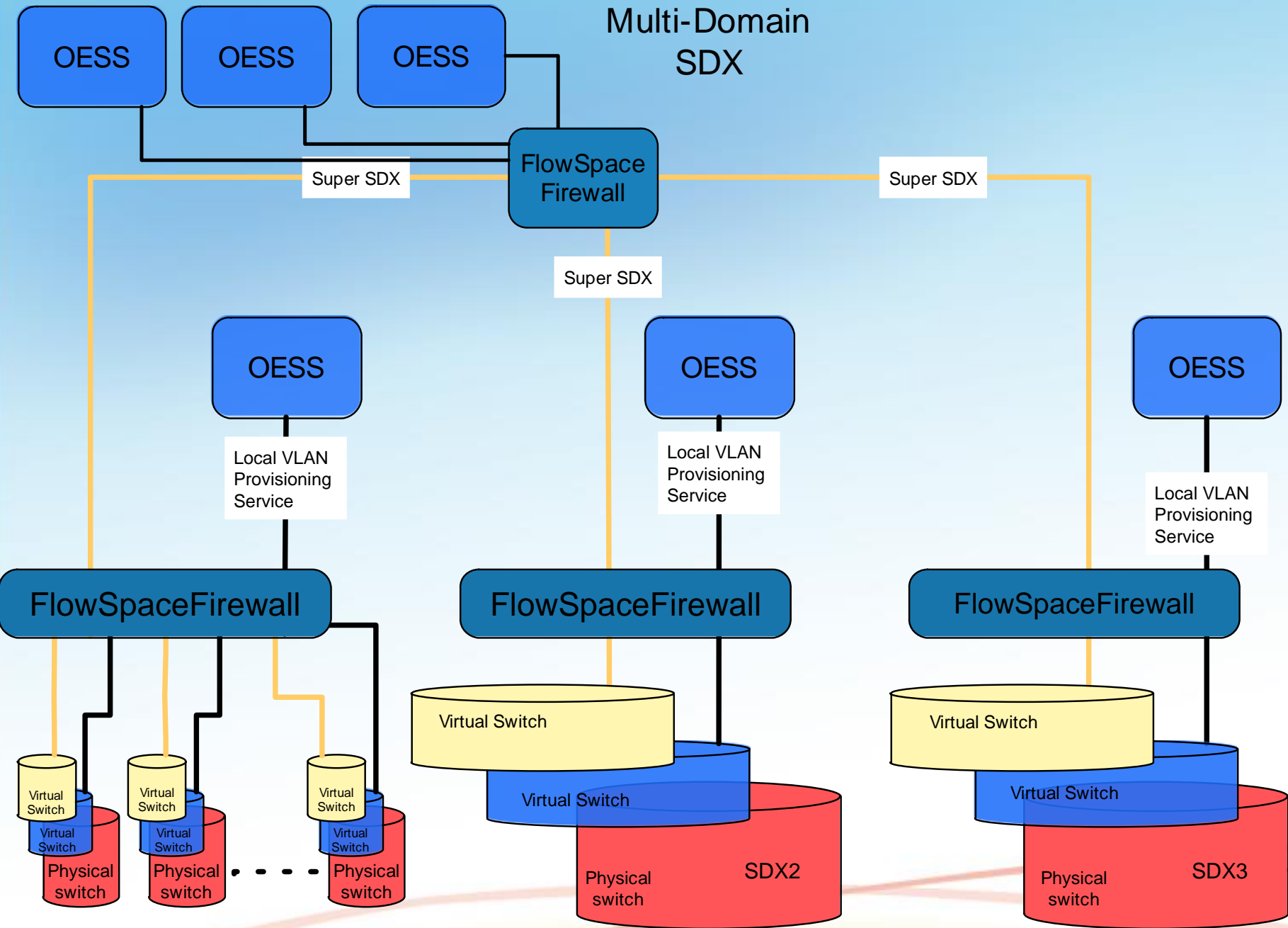
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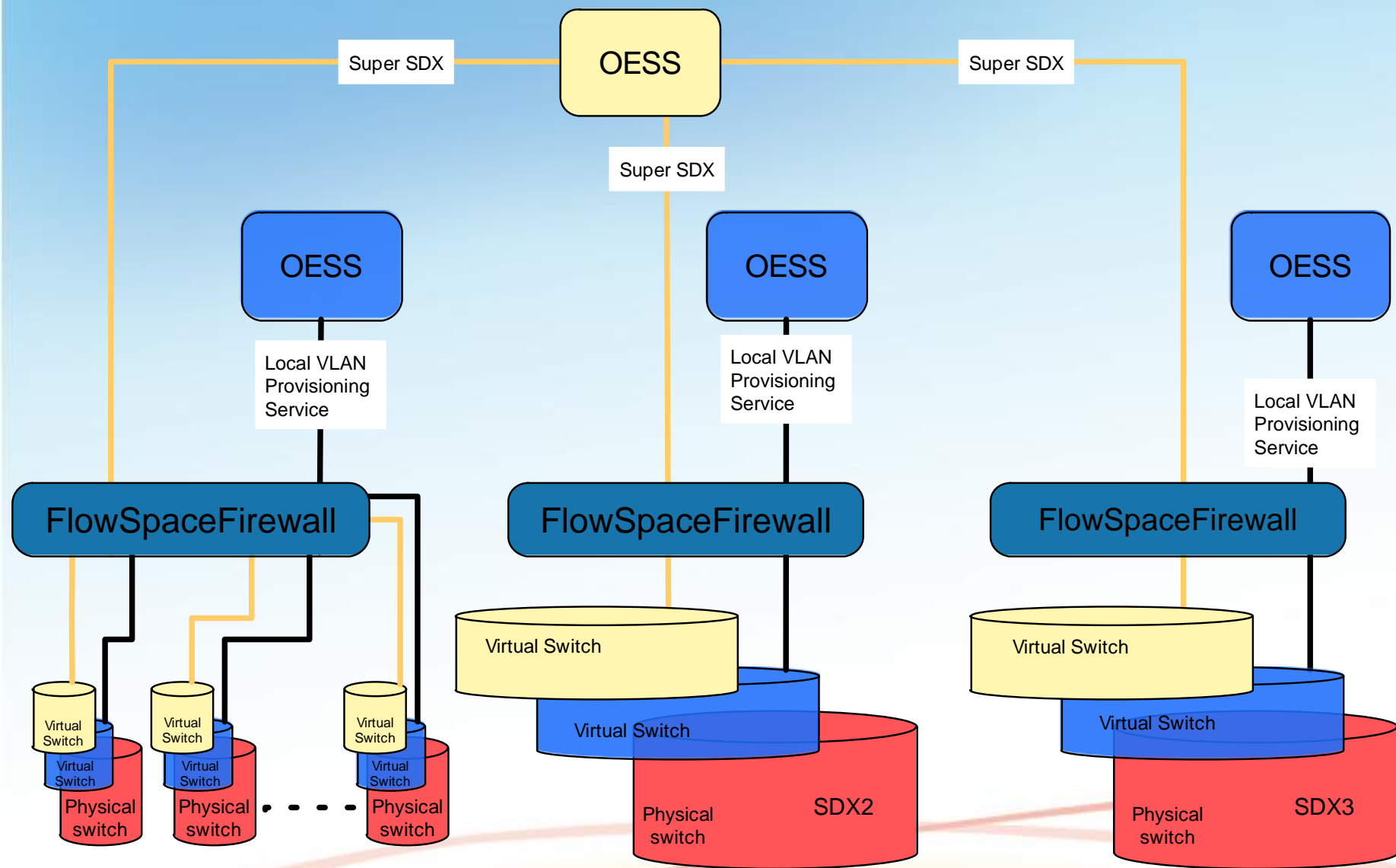


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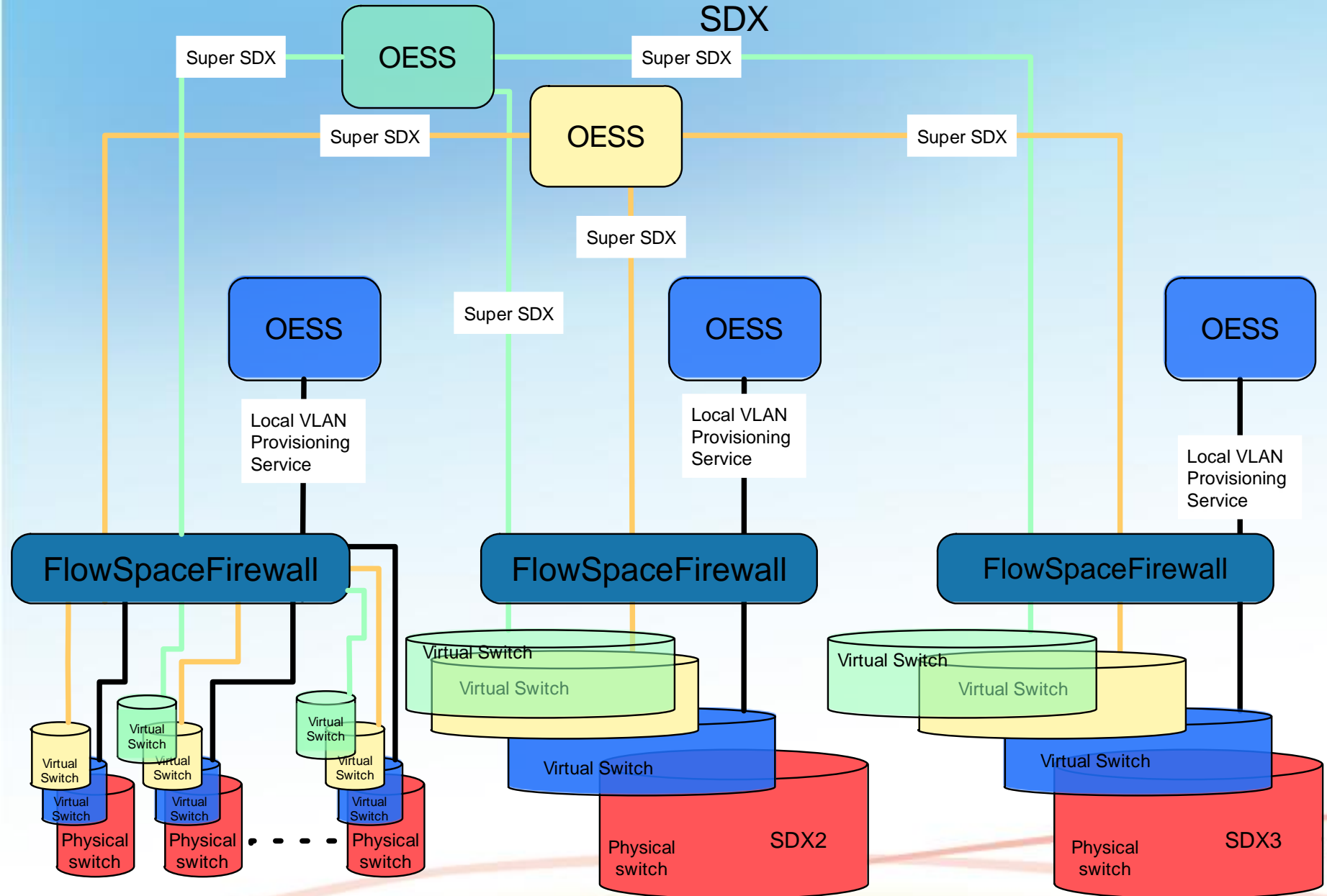




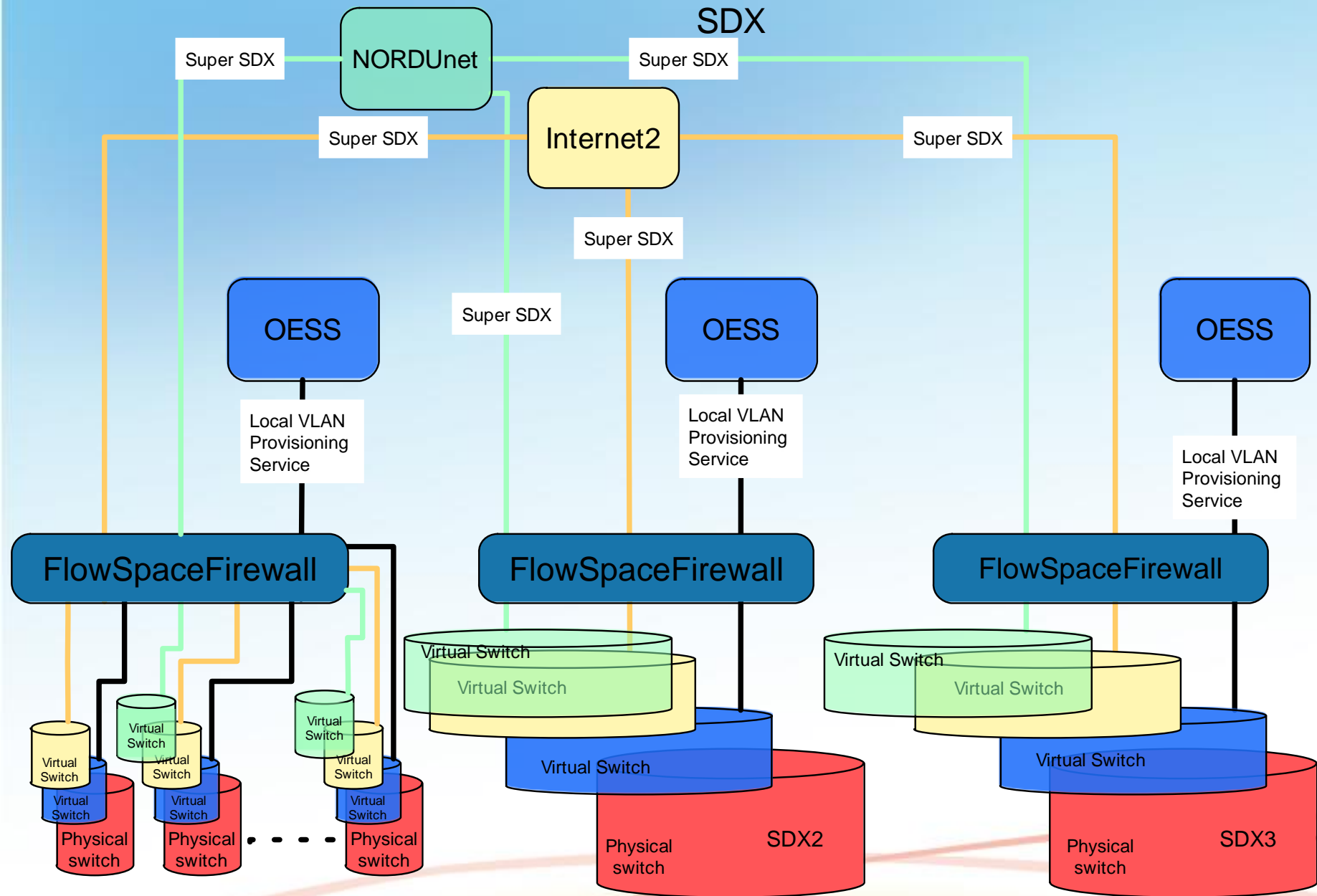
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