



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

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Internet2 Mission



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University
Corporation
for
Advanced
Internet
Development



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- **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**

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General Use Case

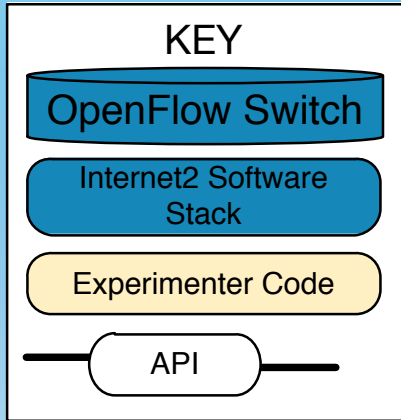
- For most applications run in a campus environment, the traditional routed Layer 3 infrastructure provided by the Internet2 Advanced Layer 3 Service (AL3S) provides all the needed functionality and performance.
- For some applications, the ability to run on a server in a campus environment or on a GENI 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 Implementation

- After careful research into alternatives into OpenFlow-based Hypervisors ...
- Implemented Network Virtualization through FlowSpace Firewall
 - “VLAN Slicer”
 - Resource Protector
- Why not Flowvisor?
 - December 19, 2013 Webinar
 - <http://www.internet2.edu/products-services/advanced-networking/oess/>

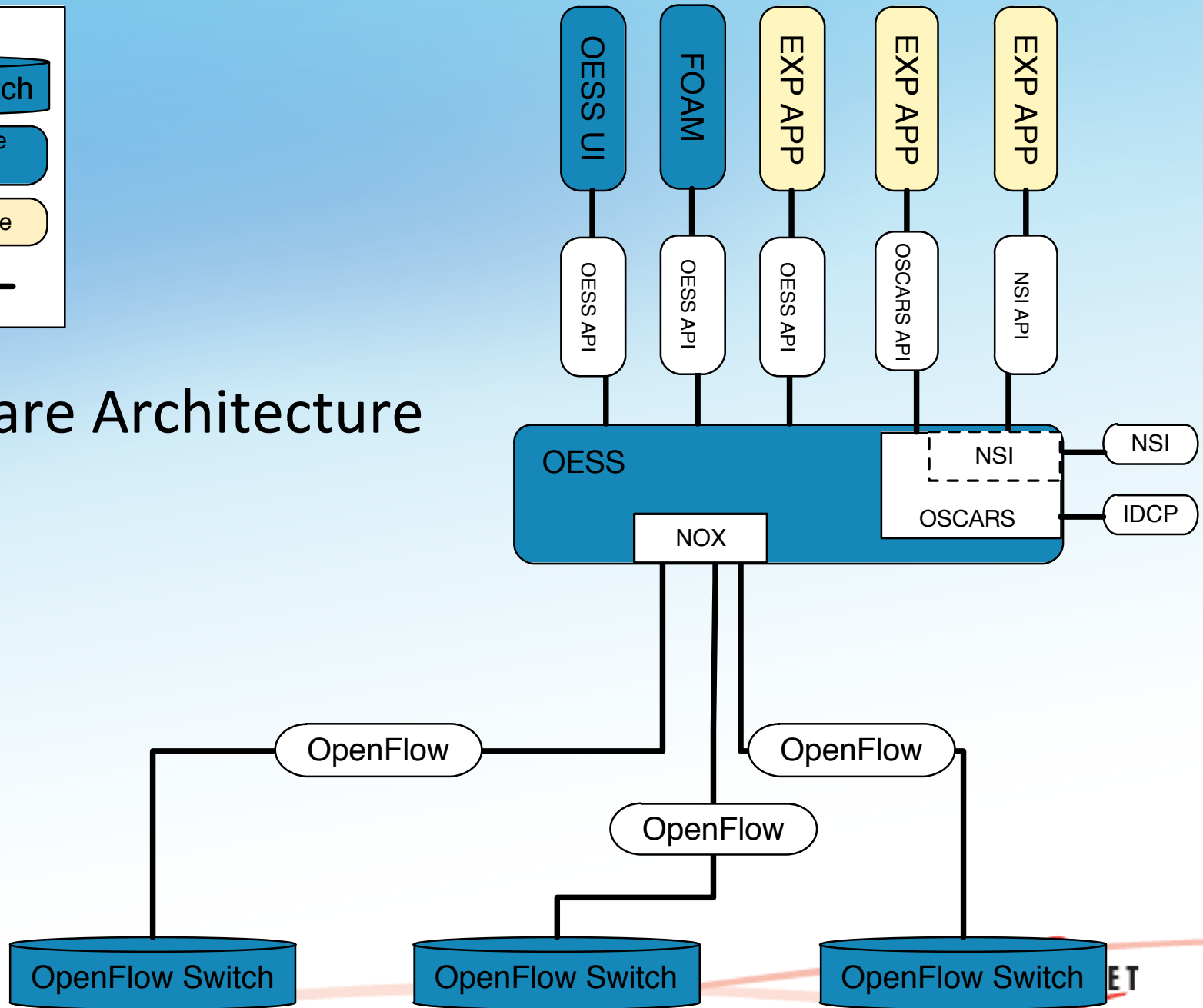
Network Virtualization: Working Definition

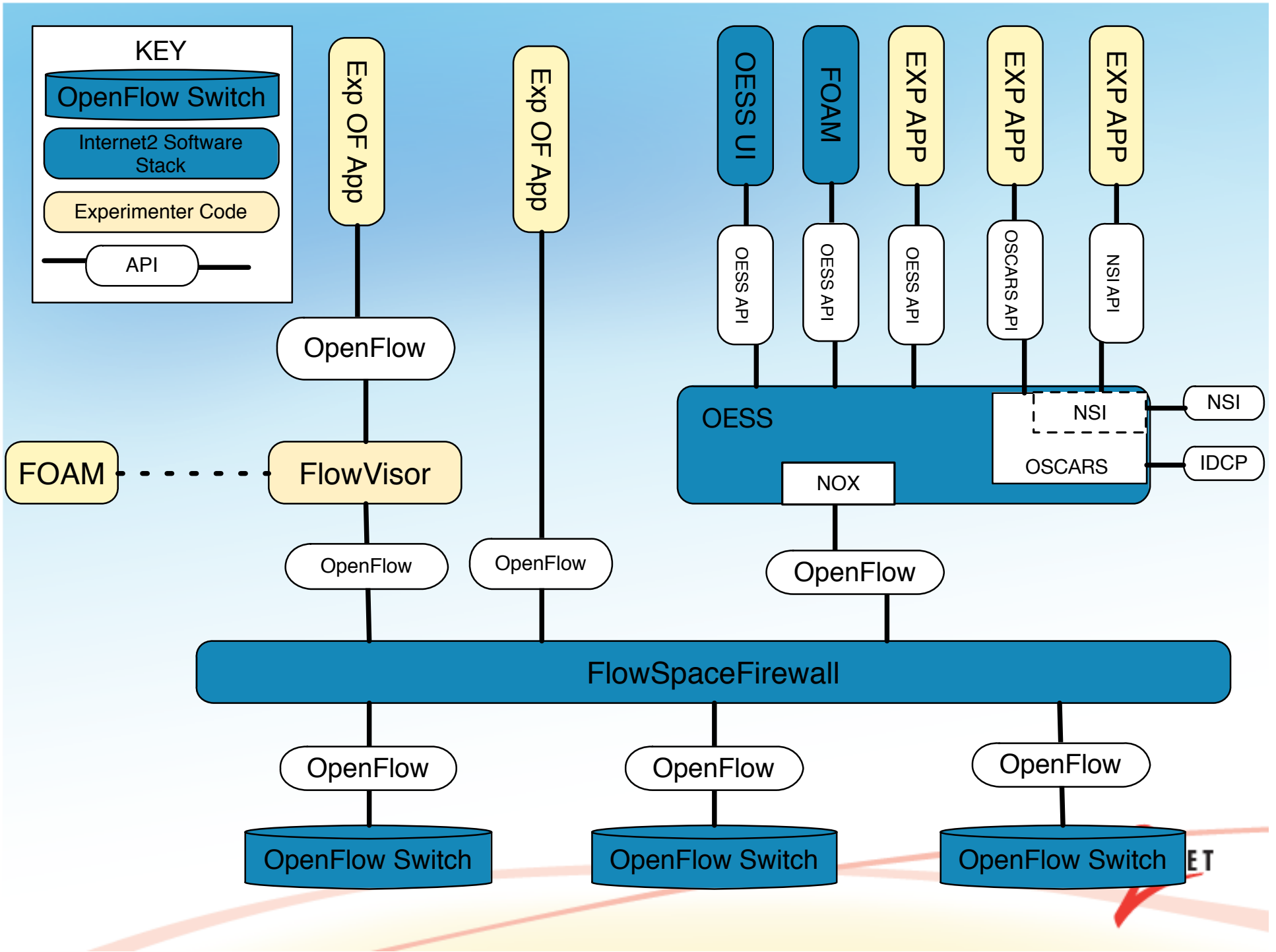
- From a customer perspective, what does the service offer and how it is utilized?
 - The Network Virtualization service/enhancement offers the ability to write a controller and control a slice of the national Layer 2 infrastructure.
 - The customer utilizes the service by operating their own “service” across the Internet2 service.
- From an internal operator perspective, how is the service implemented?
 - An instance of FlowSpace Firewall sits between the Layer 2 switches and other controllers (including those used in production services like AL2S)
- Who are the stakeholders? (e.g. NAOPpag, CIOs, etc.)
 - Decision Makers: Leading CIOs (early adopters of new network services), NAOPpag
 - Informed Parties: Adopters of AL2S
- Who is the target audience?
 - Advanced Networking Community
 - Network Researchers
 - Virtual Organizations
 - Innovative Application Developers
- What are the goals for the service?
 - Supporting network researchers
 - Deployment of private networks
 - Prototyping of new services

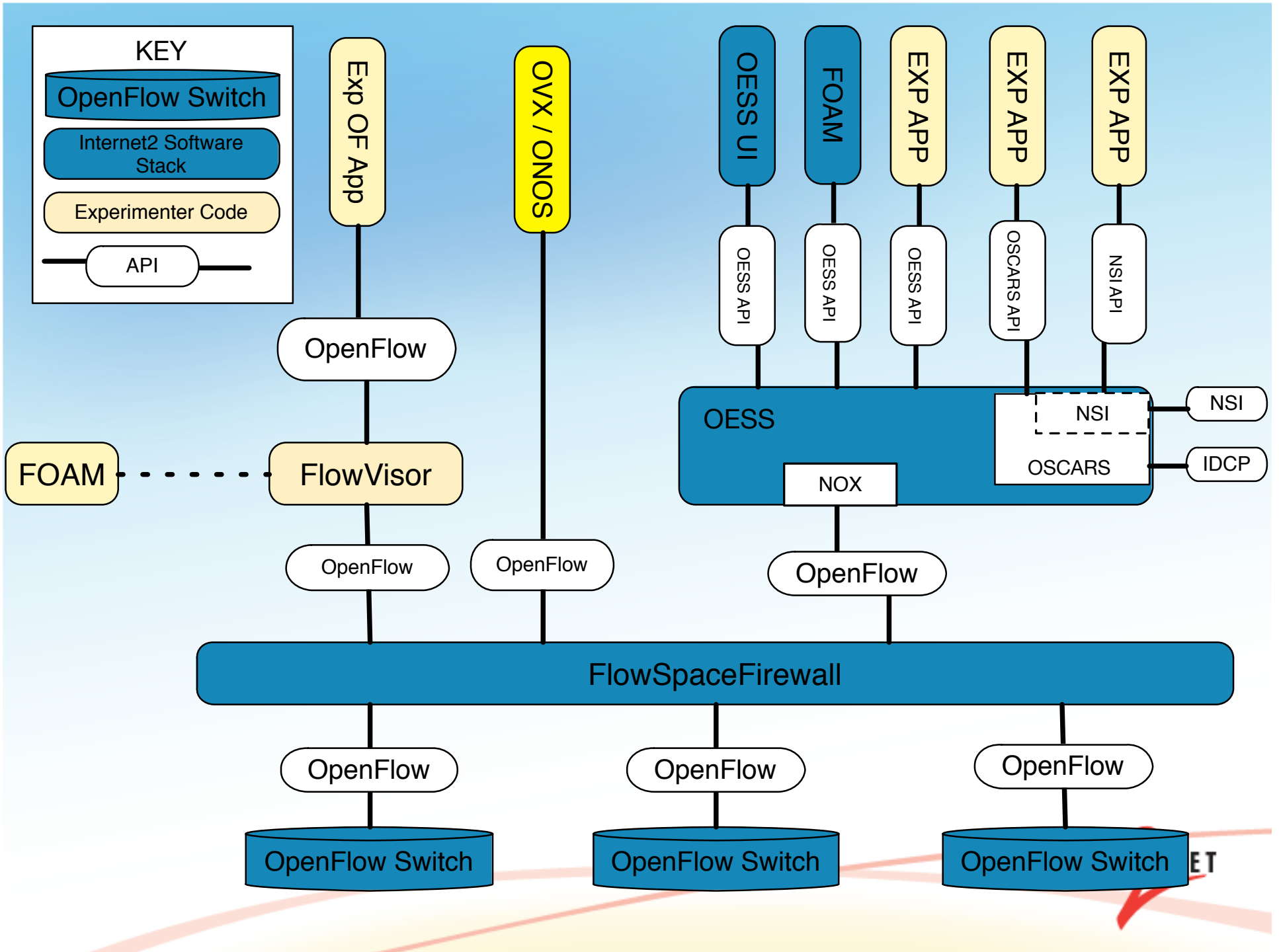


Software Architecture

FOAM



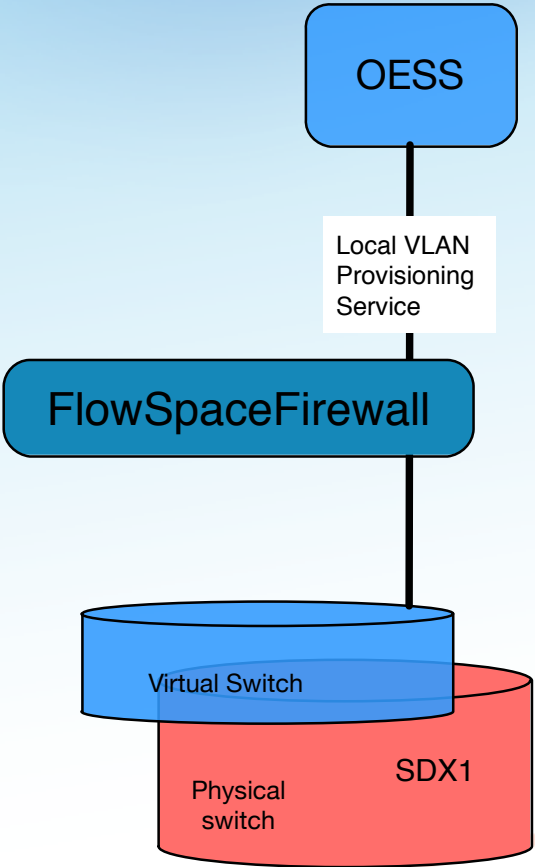




Use Case Examples

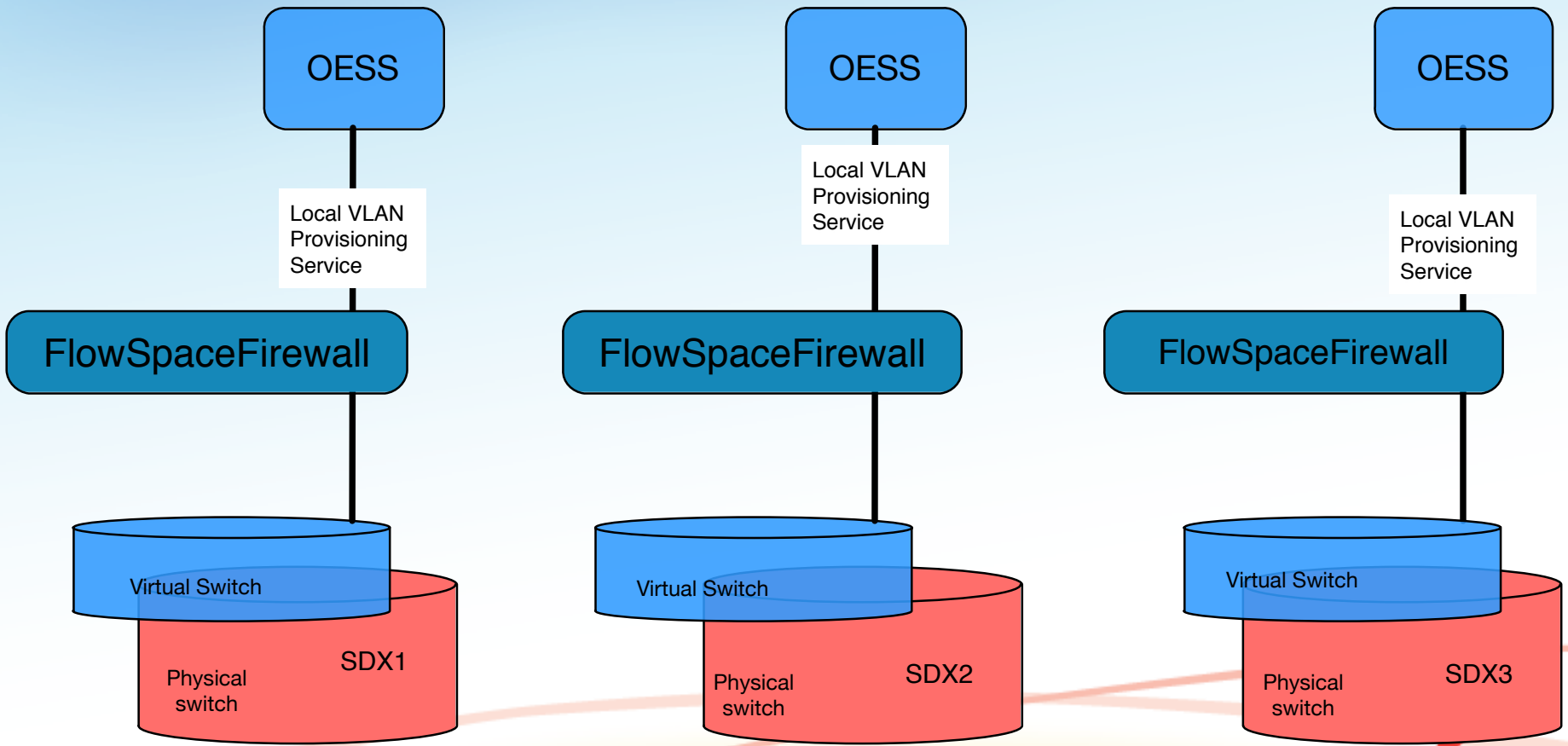
- Production Service Staging
 - GENI wants to move to Stitching v3.0, but Stitching 2.0 is in wide use
 - Set up a slice, deploy a second OESS, deploy new version of FOAM Stitching Aggregator
 - When it's tested and ready, move to the production OESS stack
- Network Research
 - Network researcher has 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

SDX

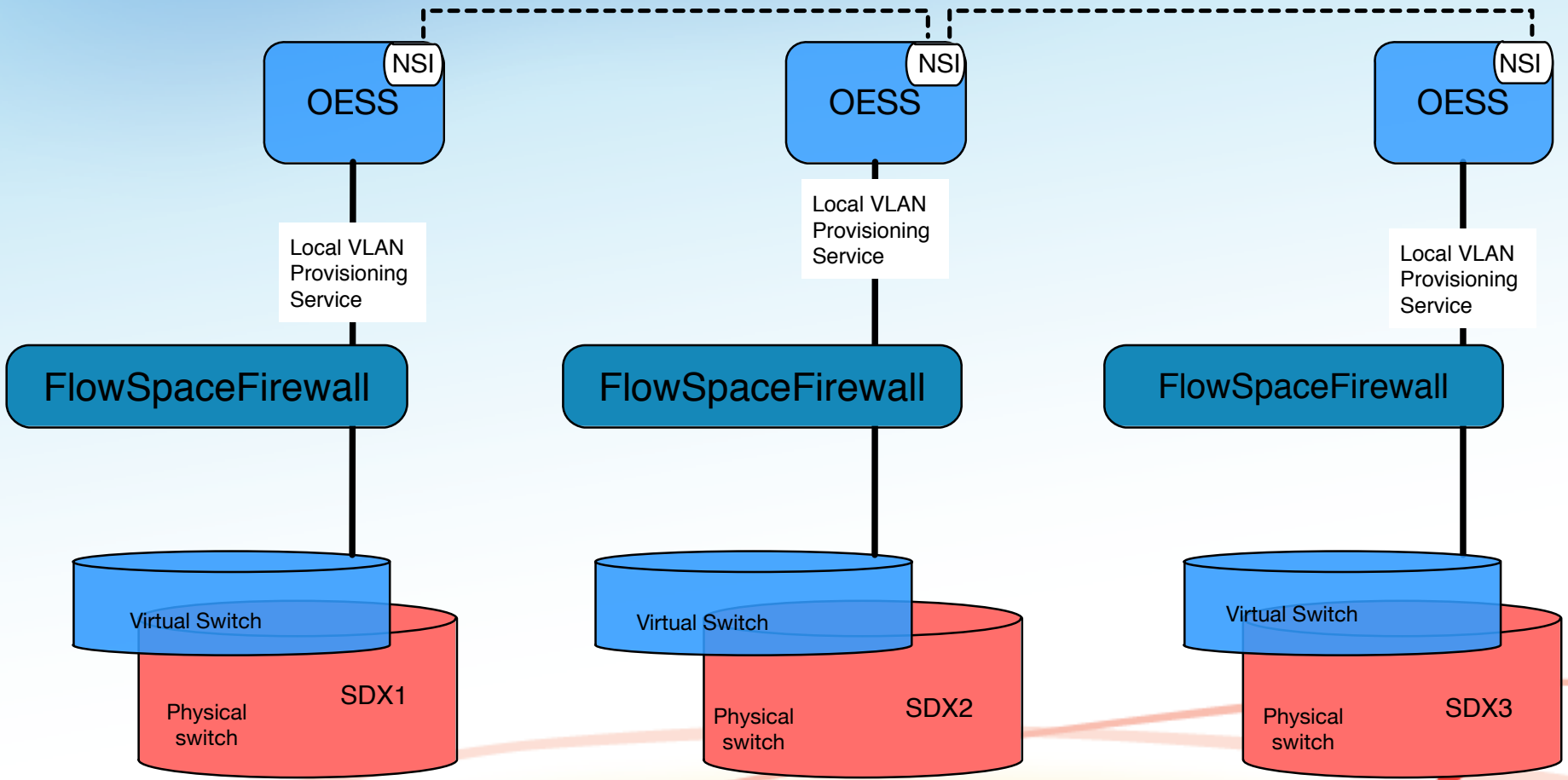


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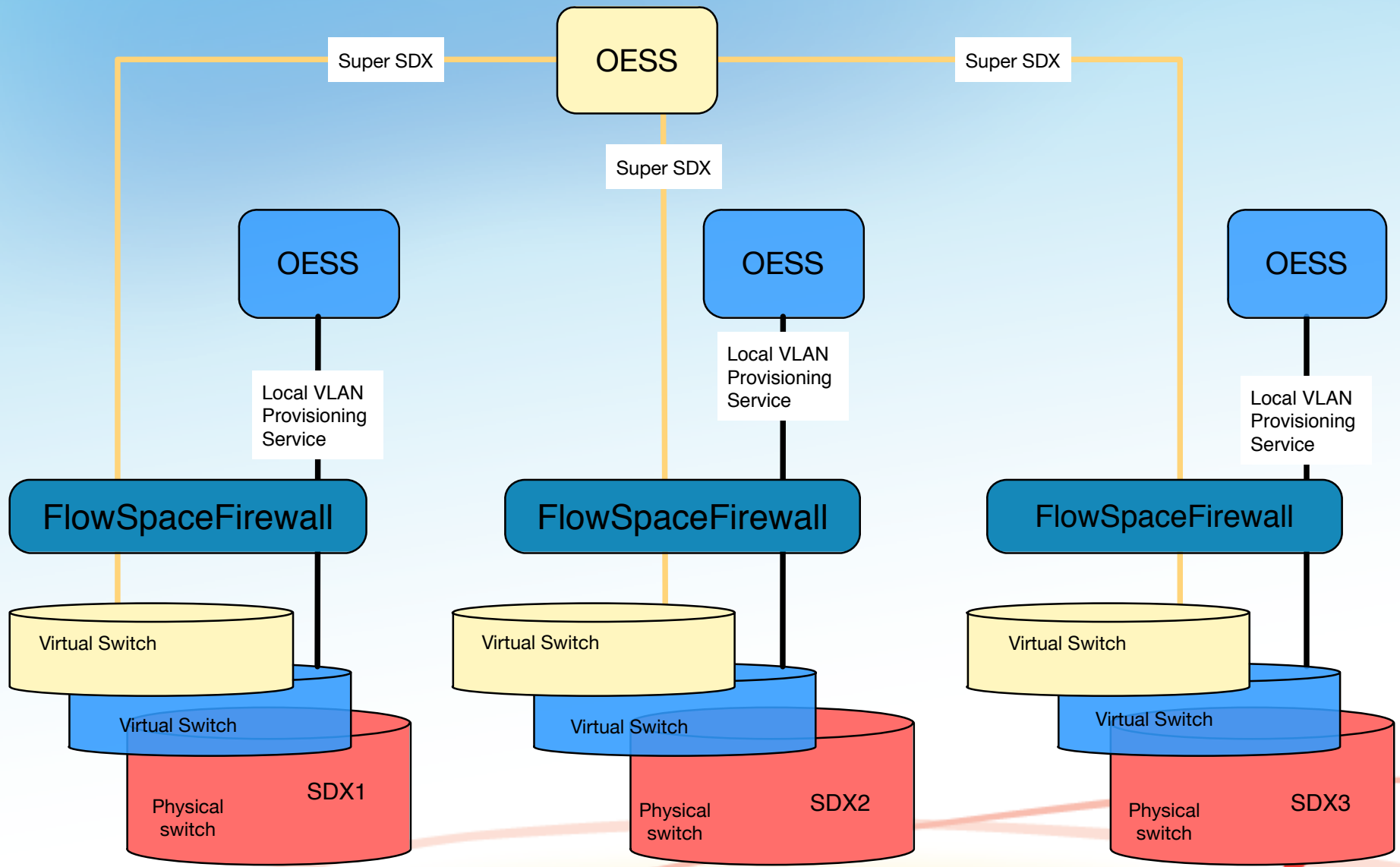
SDX



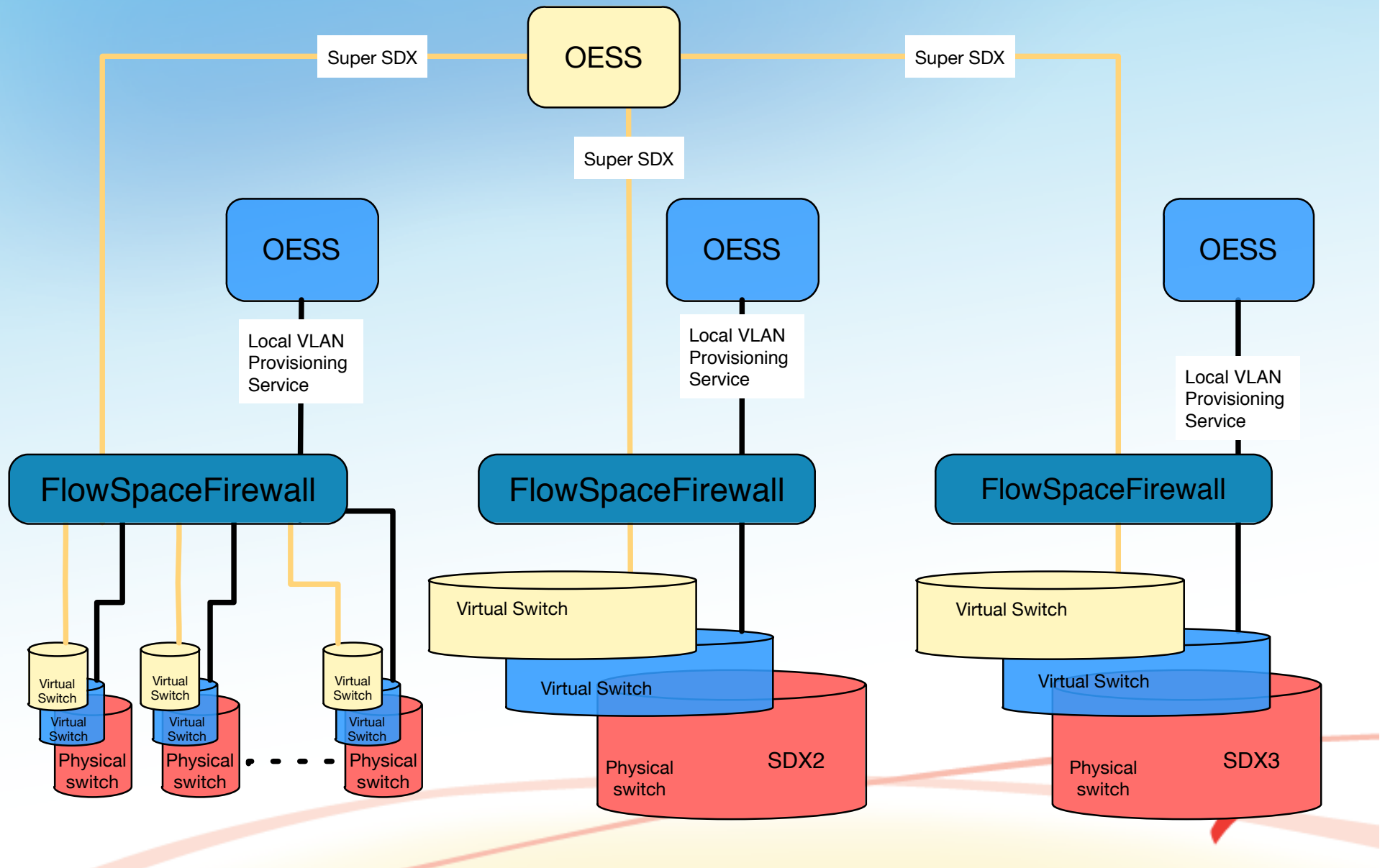
SDX



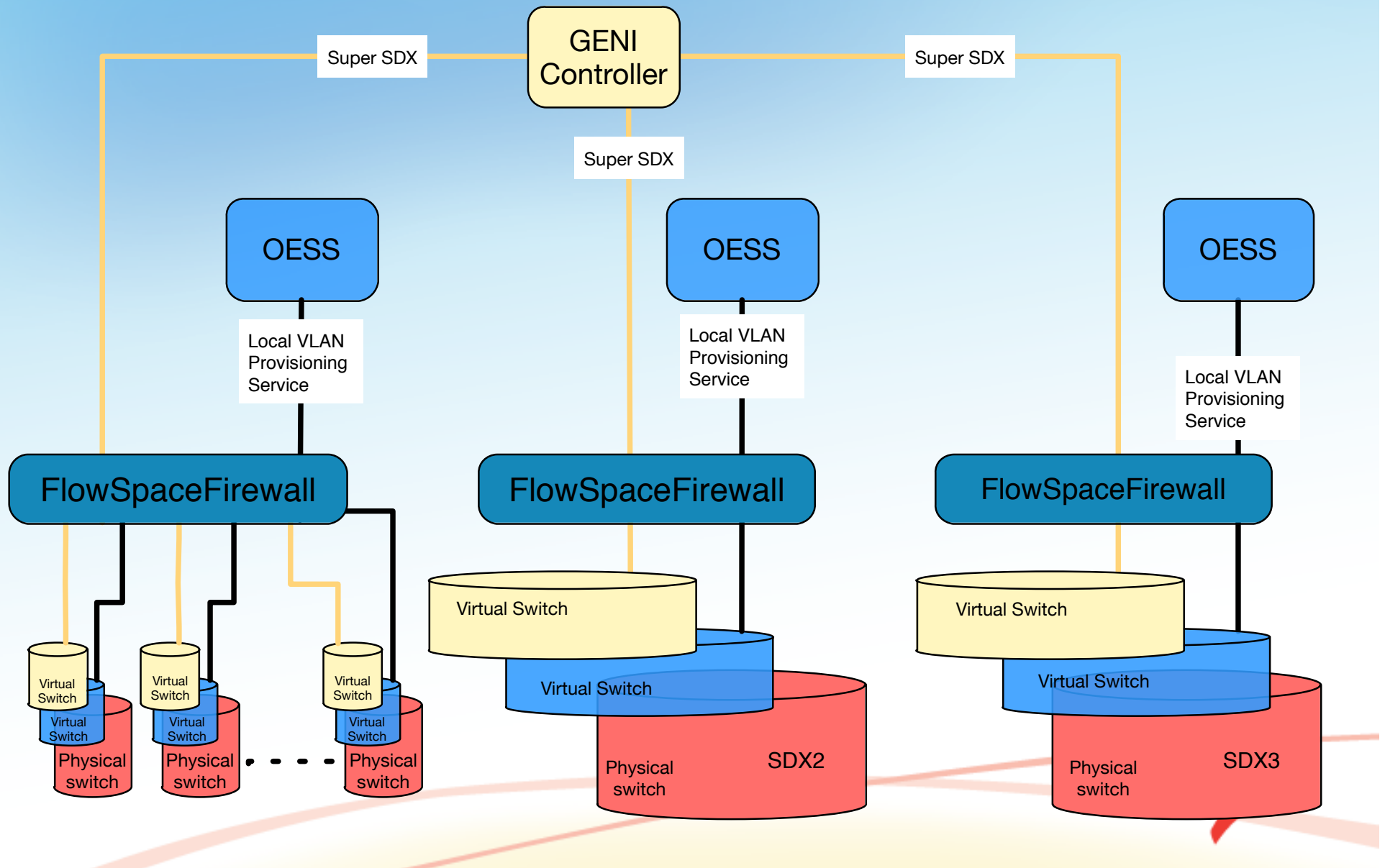
Multi-Domain SDX

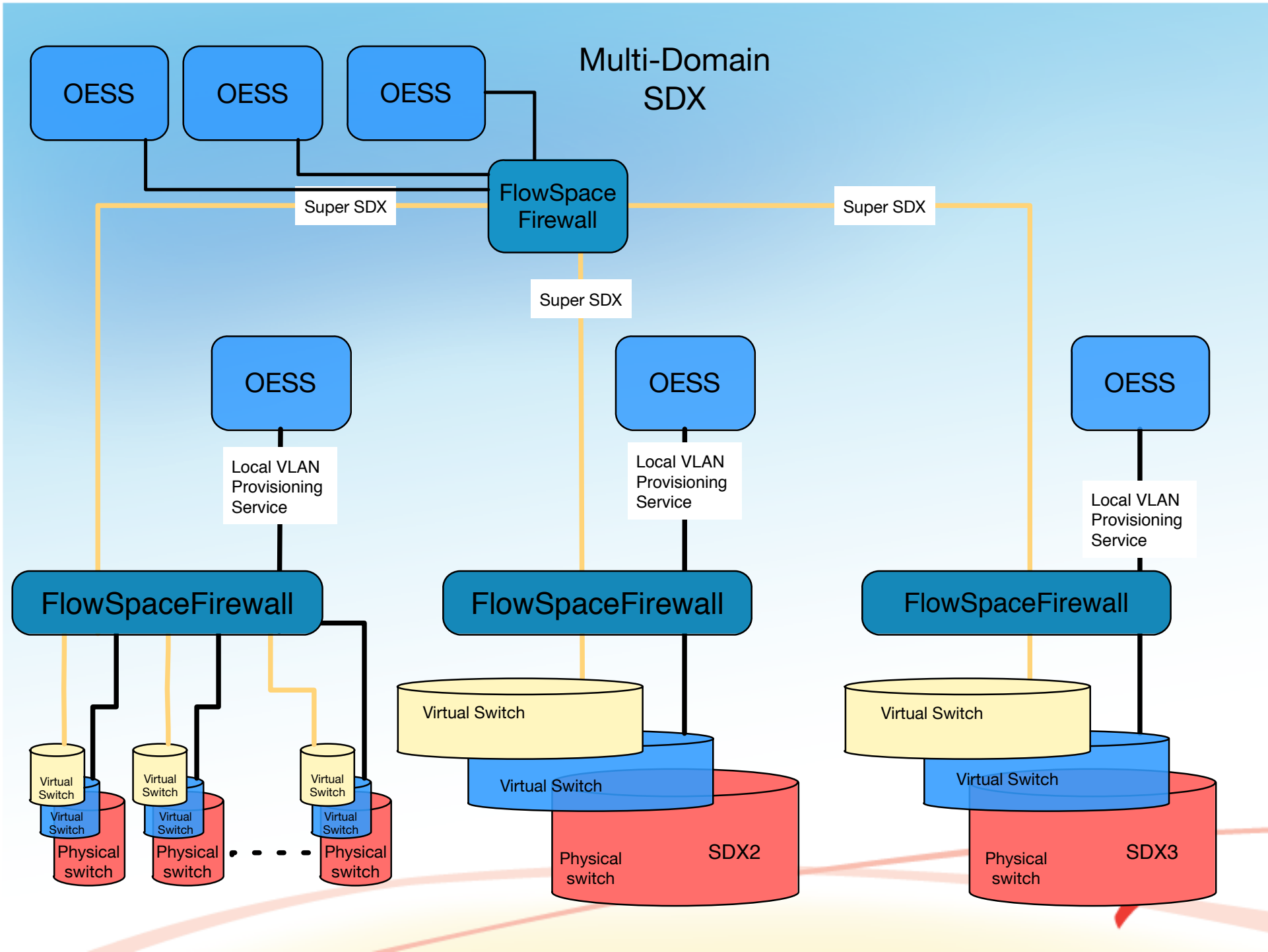


Multi-Domain SDX



Multi-Domain SDX





Documentation

- What is the name of the service? Are there any standard abbreviations?
 - Network Virtualization Service (NVS)
- How is the service being positioned vis-à-vis other services?
 - This underpins *AL2S and*
 - This is core piece of the Internet2 Innovation Platform
 - This provides functionality needed by the advanced networking community
- How is the service documented?
 - Under development (will be on the Internet2 website)
- How is the software documented?
 - <http://globalnoc.iu.edu/software/sdn.html>

Rollout

- What is the proposed plan for launching the service to the community and internally?
 - Initial soft roll-out. Evaluate stability. Slow implementation by early adopters.
 - Webinar to Technical Community
 - June 24th, 4 PM ET
 - Formal rollout October, 2014 at Tech Exchange (Indianapolis)
 - <http://meetings.internet2.edu/2014-technology-exchange/>

Metrics => Analysis and Growth

- How many concurrent customers?
 - Actual?
 - Maximum, given resources?
- What is the typical timeline from first inquiry to deployment?
- What percentage of projects make it onto the Internet2 network?
- What is the prioritization distribution of projects?
- What does availability mean?
 - Problems within the slice due to customer code
 - Problems within the slice due to FSFW implementation
 - Problems in the slice that impact underlying hardware (exposing vendor issues)
 - Problems in the slice
- What is the nature of their effort?
 - Early stage development? (Discouraged ... for now)
 - At –scale national deployment evaluation?
 - Prototype service?
 - Production service?
- What are their resource requirements?
 - FTEs?
 - VMs?
 - VLANs?
 - Flow rules?
 - Etc.
- What new features are required?

Risks and Mitigation

- Risks:
 - We are complicating the software stack that supports AL2S and AL3S. By definition, that introduces risk.
 - There are unknown risks we have not planned for.
- Risk Mitigation:
 - The software has been designed to protect resources.
 - Our testing has been designed to expose resource overconsumption (failures by the software)
 - At 3 AM, we have a plan to back out of low priority services in order to maintain high priority services without waking up managers or developers
 - We have an escalation matrix

What does strong success look like?

- No impact on AL3S availability
- No impact on AL2S availability
- 2 or 3 early adopters rolled-out by 12/31/14
 - including 1 by TechX
- Announcement of network virtualization service at Tech X

Process: Deploying Your Own Controller

- Customer initiates process
 - Open a ticket with noc@net.internet2.edu
 - Fill out questionnaire.
- Internet2 replies with application constraints
 - VLAN Range
 - Constraints on number of flow rules
 - Constraints on rate of flow rule insertion
 - Constraints on rate of Packet-In/Packet-Out events
 - Etc.
- Internet2 tests application
 - Test on iDREAM GENI test lab
 - Test on NDDI
- Internet2 (not the experimenter ... yet) deploys application on Internet2 SDN Substrate. (Internet2 Network Virtualization Service? Name to be determined later.)

What do you need to do ...

- Provide Enough documentation to setup and configure your application
- Provide enough logging (to a file) to be able to debug your application
 - If it breaks we will disable your slice, and send you the log, your slice will not be enabled until the problem is fixed
- Any API (besides OpenFlow) or UI must be secure
- Provide involved and reactive developers
- Application should already have been tested with FlowSpace Firewall to verify it will function properly
 - FlowSpace Firewall does not re-write rules, it allows or denies rules.
 - Your app needs to be able to work on a set of VLANs (and they wont be the same VLAN across all devices)
- Know the FlowSpace you want for your slice
 - Switches
 - EndPoints
 - Number of flows
 - Interfaces

What do we want you to do

- Have well tested, well versioned, and packaged code
- Provide lots of documentation
- Provide lots of configurable logging
- Have a Ticketing/Bug reporting system
- Provide Installation and Operation instructions
- Given the FlowSpace be able to generate the proper Configuration for your application
- Be patient, it's a learning experience for all of us



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