
Network Virtualization & the Internet2 Innovation Platform
To keep our community at the “tip of the spear”, how can we support network virtualization?
Dale Finkelson
INTERNET2®

Internet2 Mission

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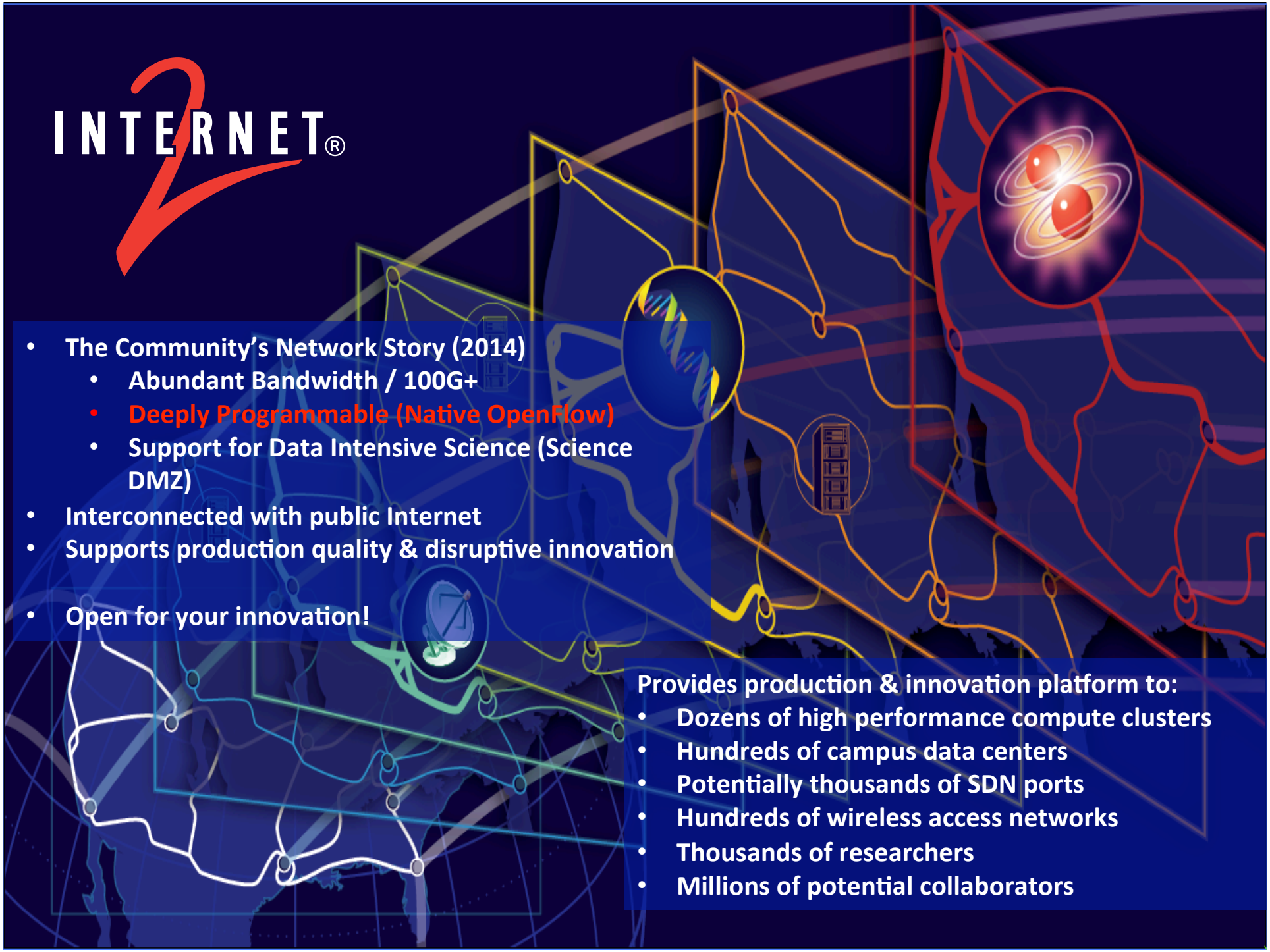
University Corporation for Advanced Internet Development


INTERNET®
• 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.

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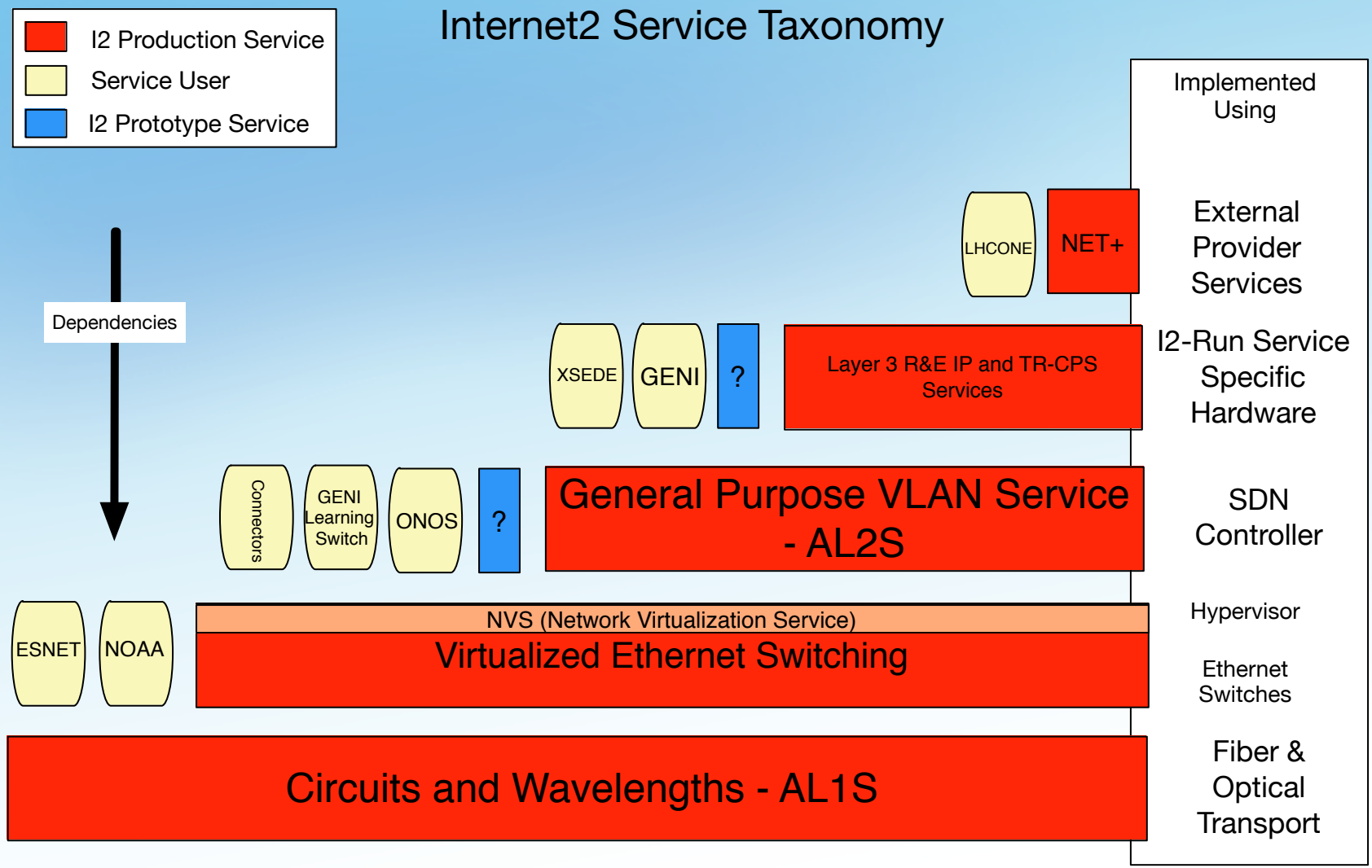
Internet2 Service Taxonomy



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

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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

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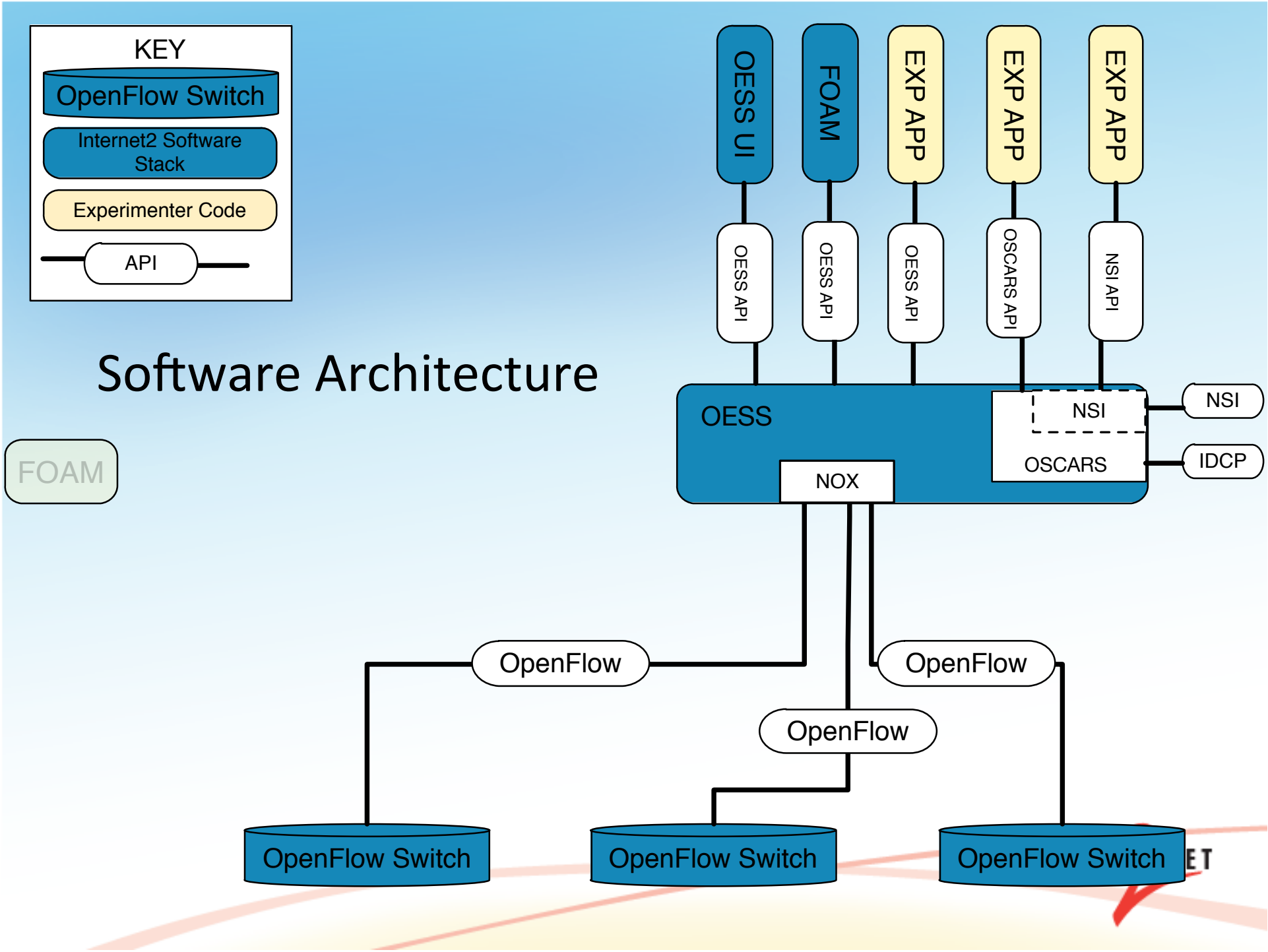
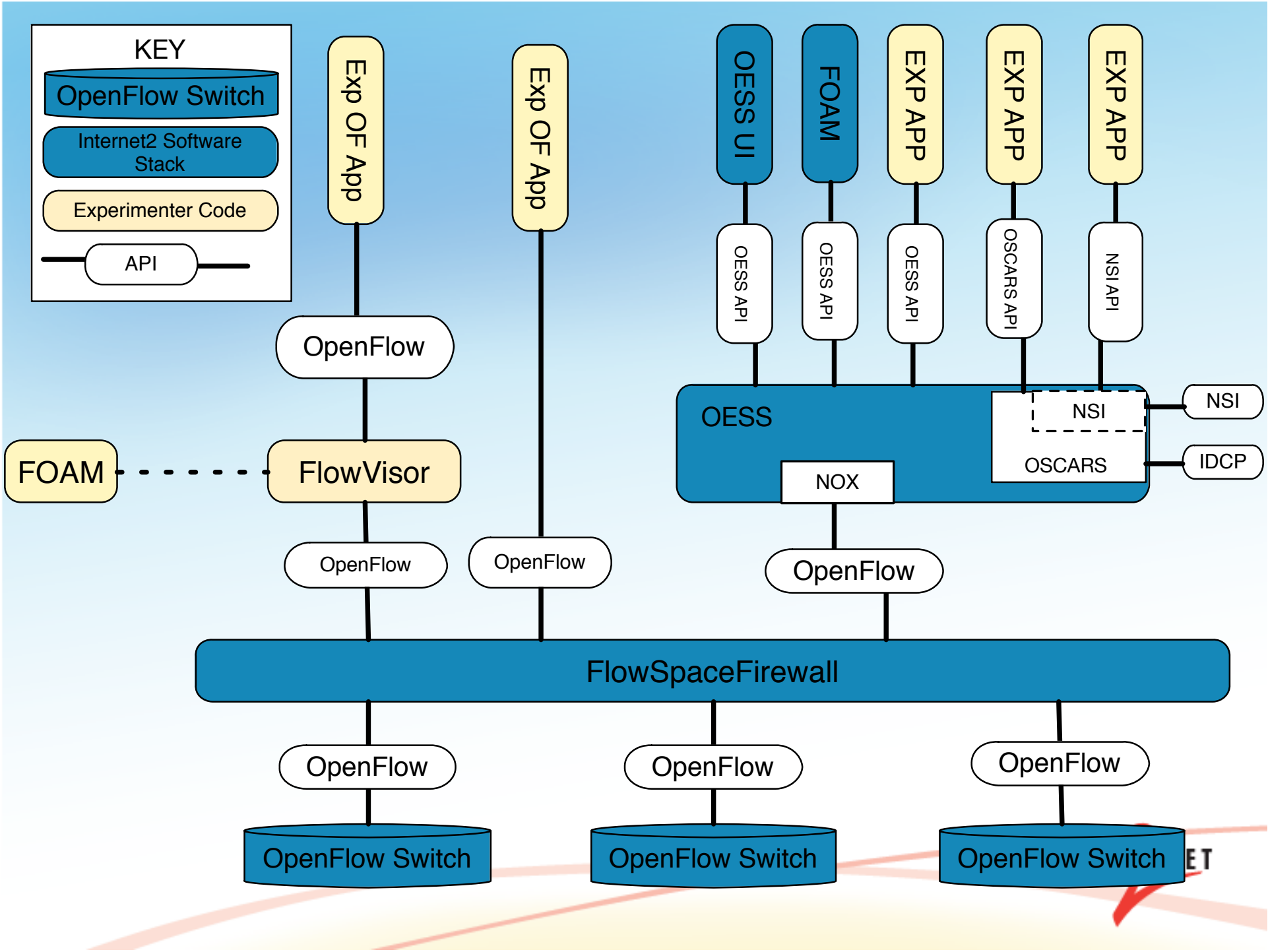
Software Architecture




KEY
OpenFlow Switch
Internet2 Software Stack
Experimenter Code
API
Exp OF App
Exp OF App
OESS UI
FOAM
EXP APP
EXP APP
EXP APP
OESS API
OESS API
OESS API
OSCARS API
NSI API
OpenFlow
OESS
NSI
OSCARS
NSI
IDCP
FOAM
FlowVisor
NOX
OpenFlow
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FlowSpaceFirewall
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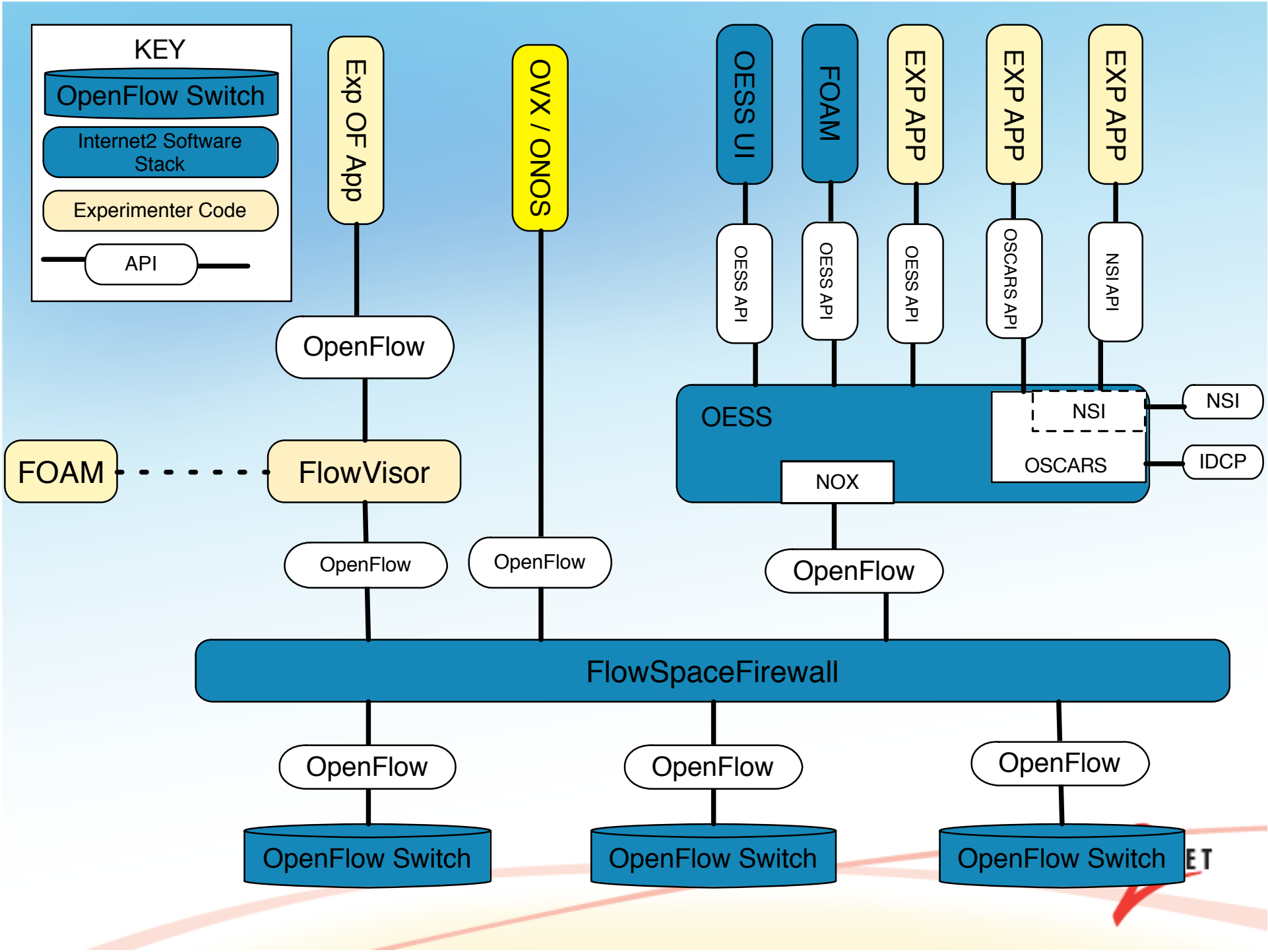
OpenFlow Switch


KEY
OpenFlow Switch
Internet2 Software Stack
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API
Exp OF App
OVX / ONOS
OESS UI
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EXP APP
EXP APP
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NSI API
OpenFlow
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OSCARS
IDCP
FOAM
FlowVisor
NOX
OpenFlow
OpenFlow
OpenFlow
FlowSpaceFirewall
OpenFlow
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OpenFlow Switch
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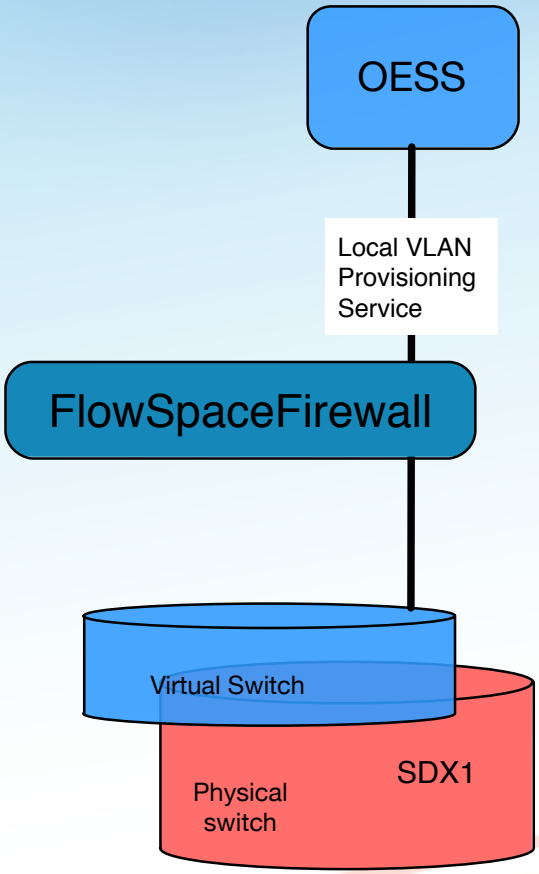
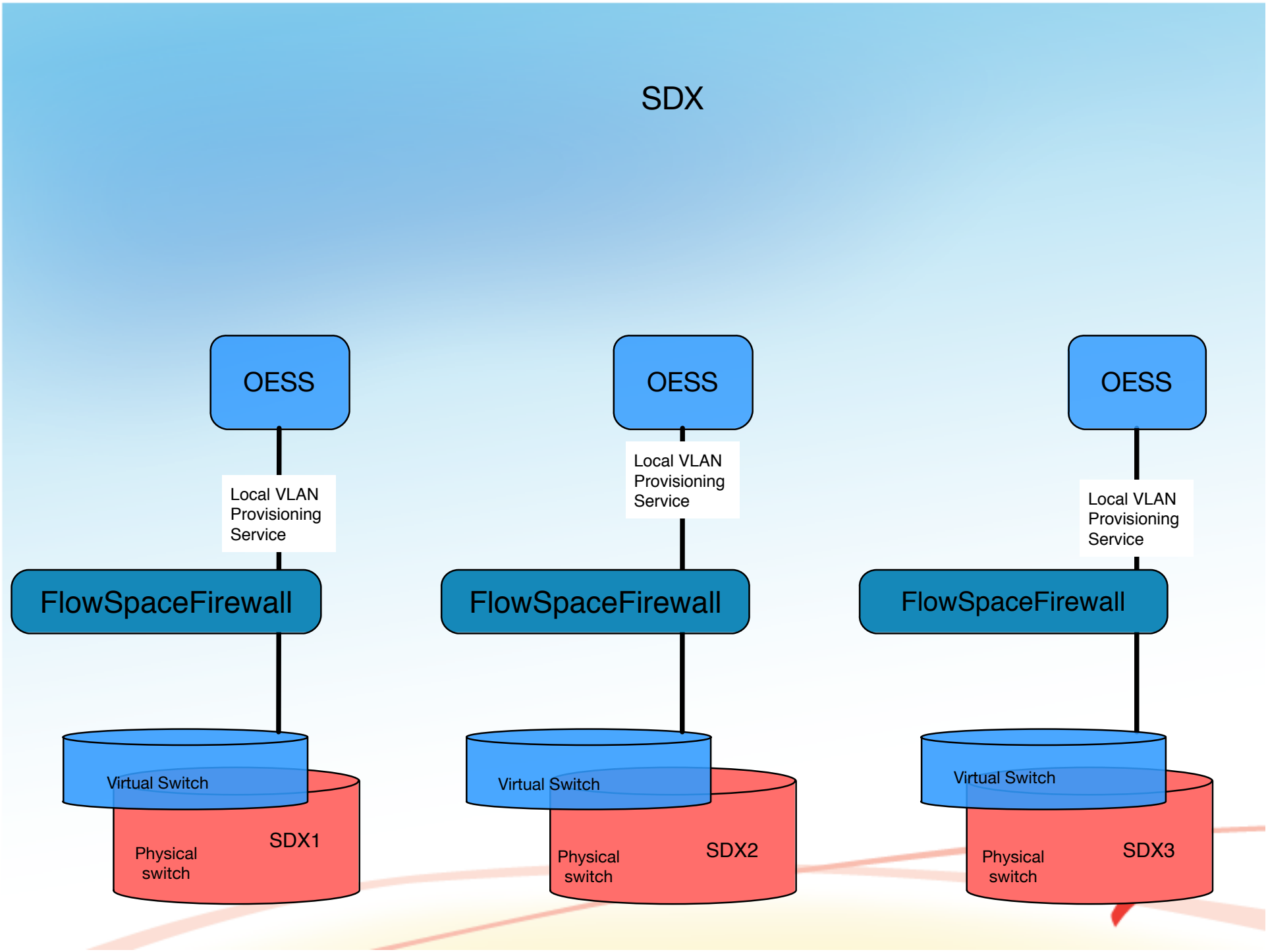
OpenFlow Switch

SDX


OESS
Local VLAN
Provisioning
Service
FlowSpaceFirewall
Virtual Switch
SDX1
Physical
switch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Local VLAN Provisioning Service
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FlowSpaceFirewall
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Virtual Switch
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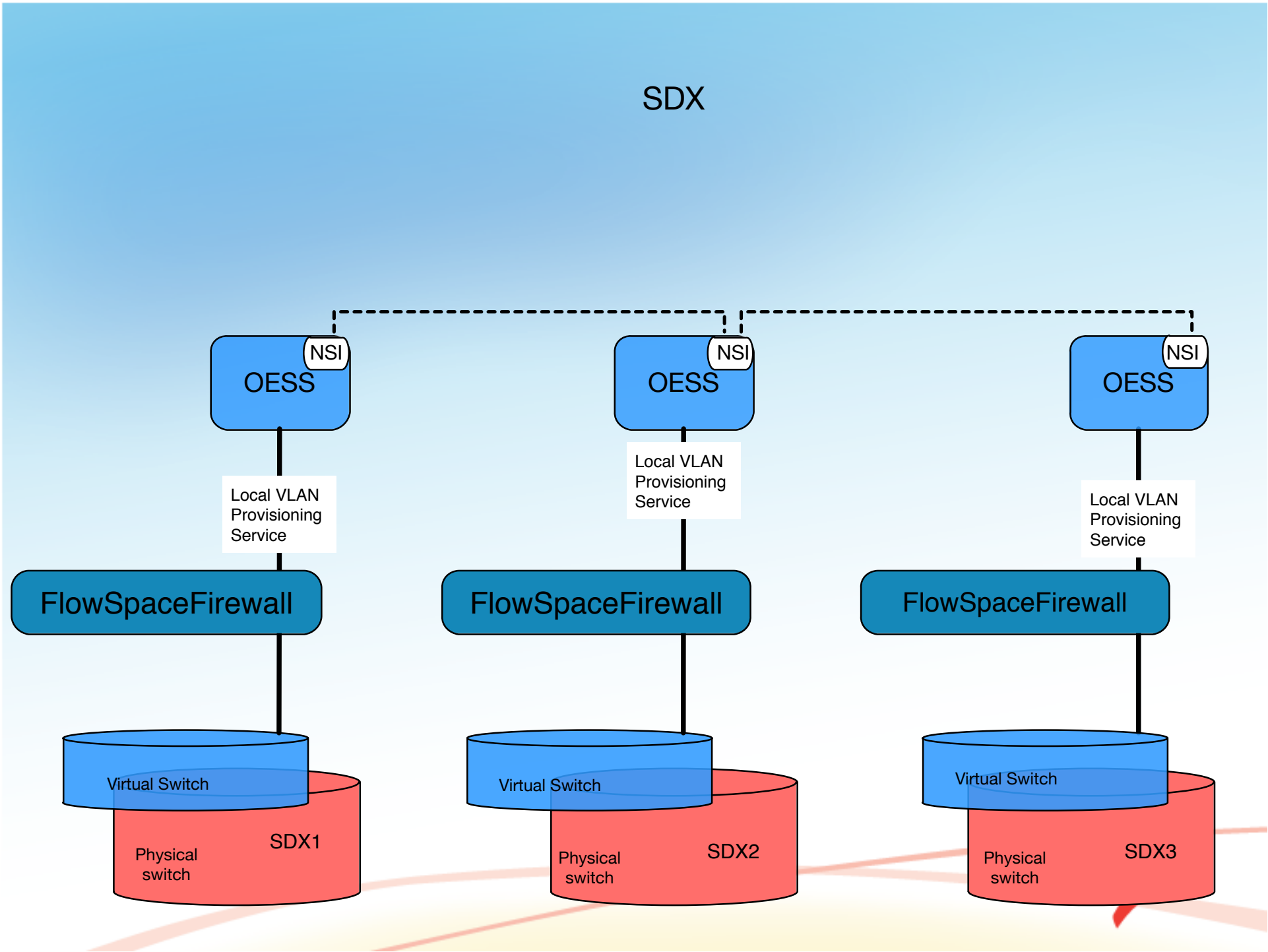
SDX2
Physical switch
SDX3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Virtual Switch
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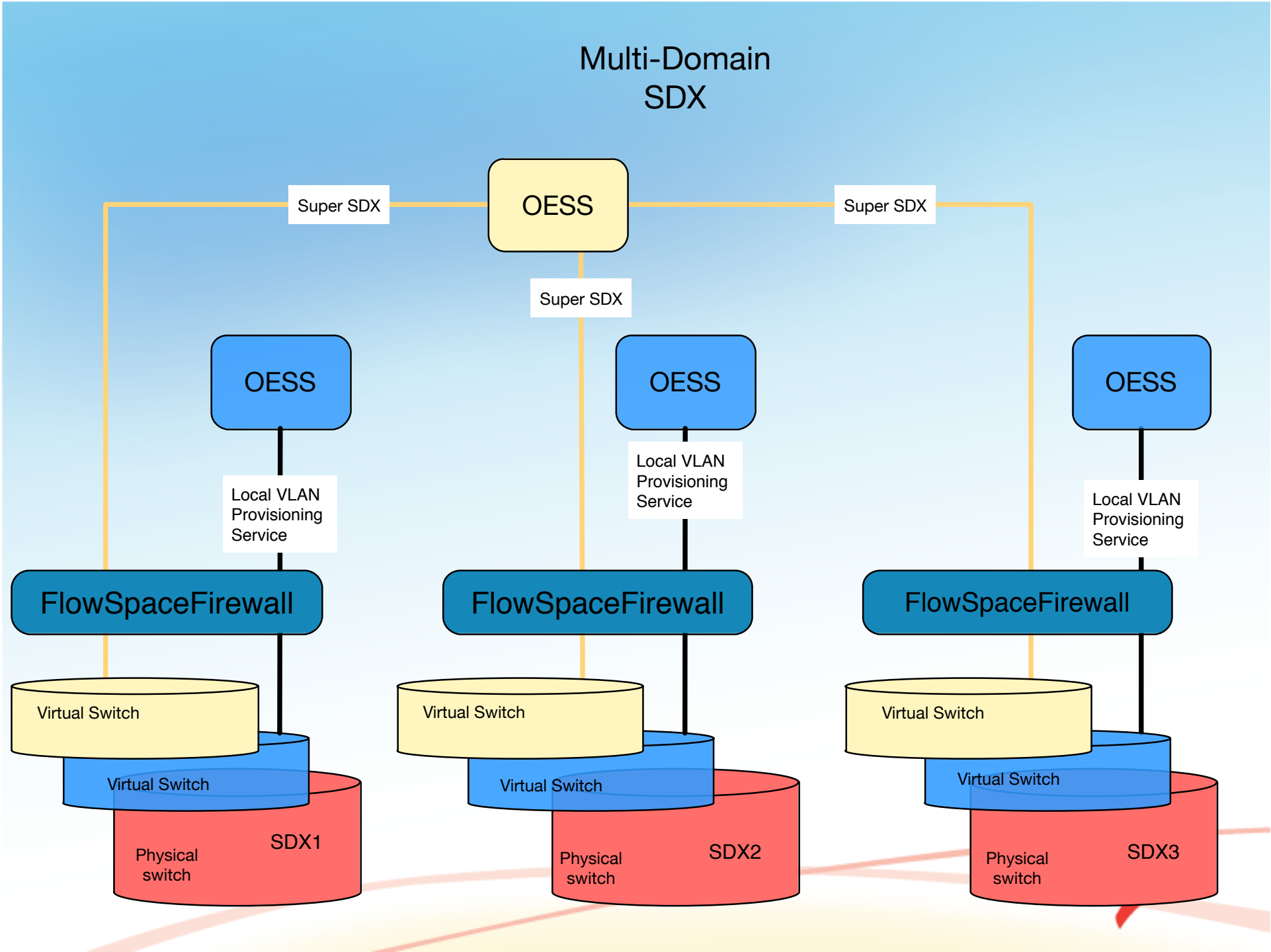
Multi-Domain
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FlowSpaceFirewall
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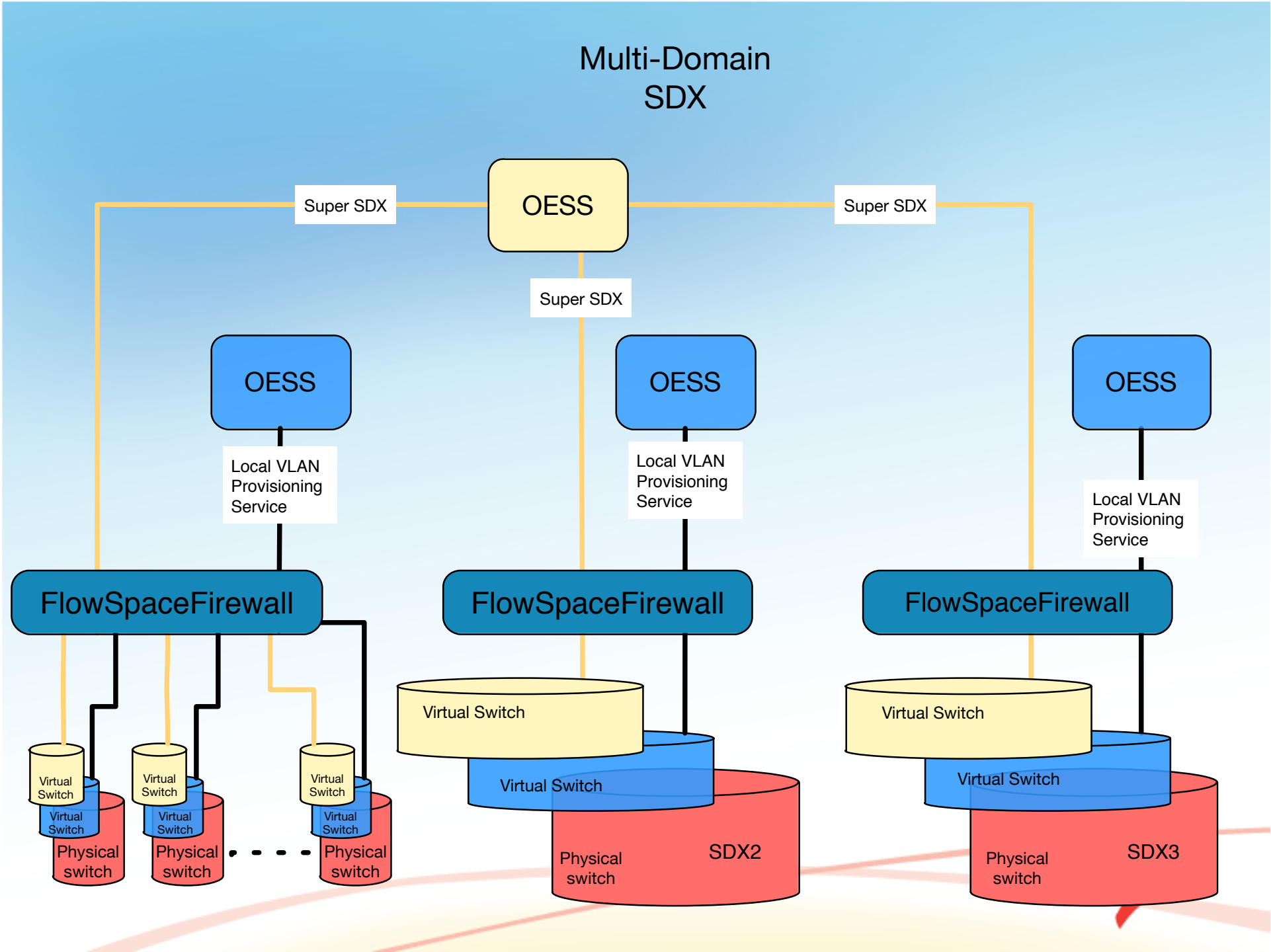
Multi-Domain
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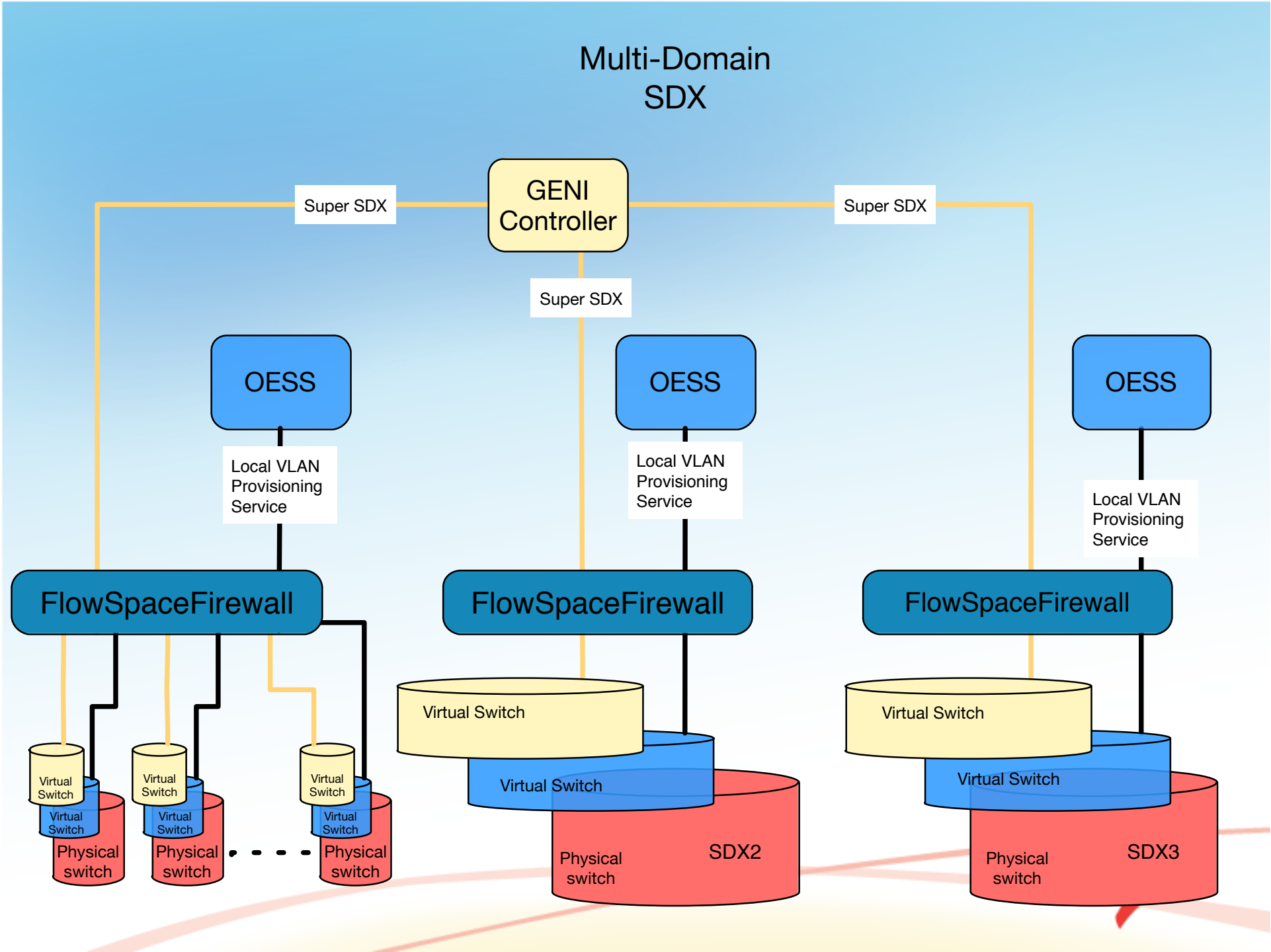
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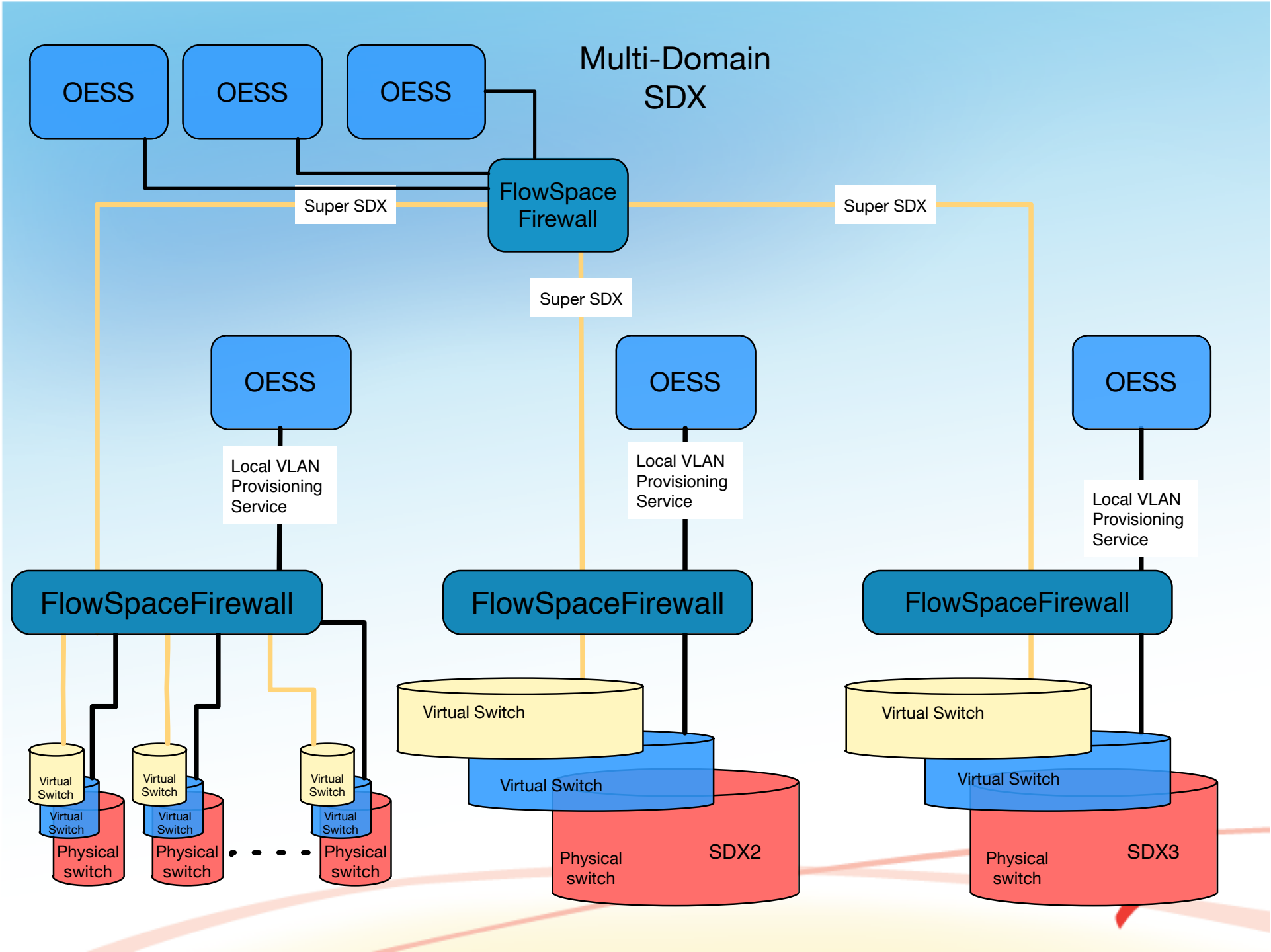
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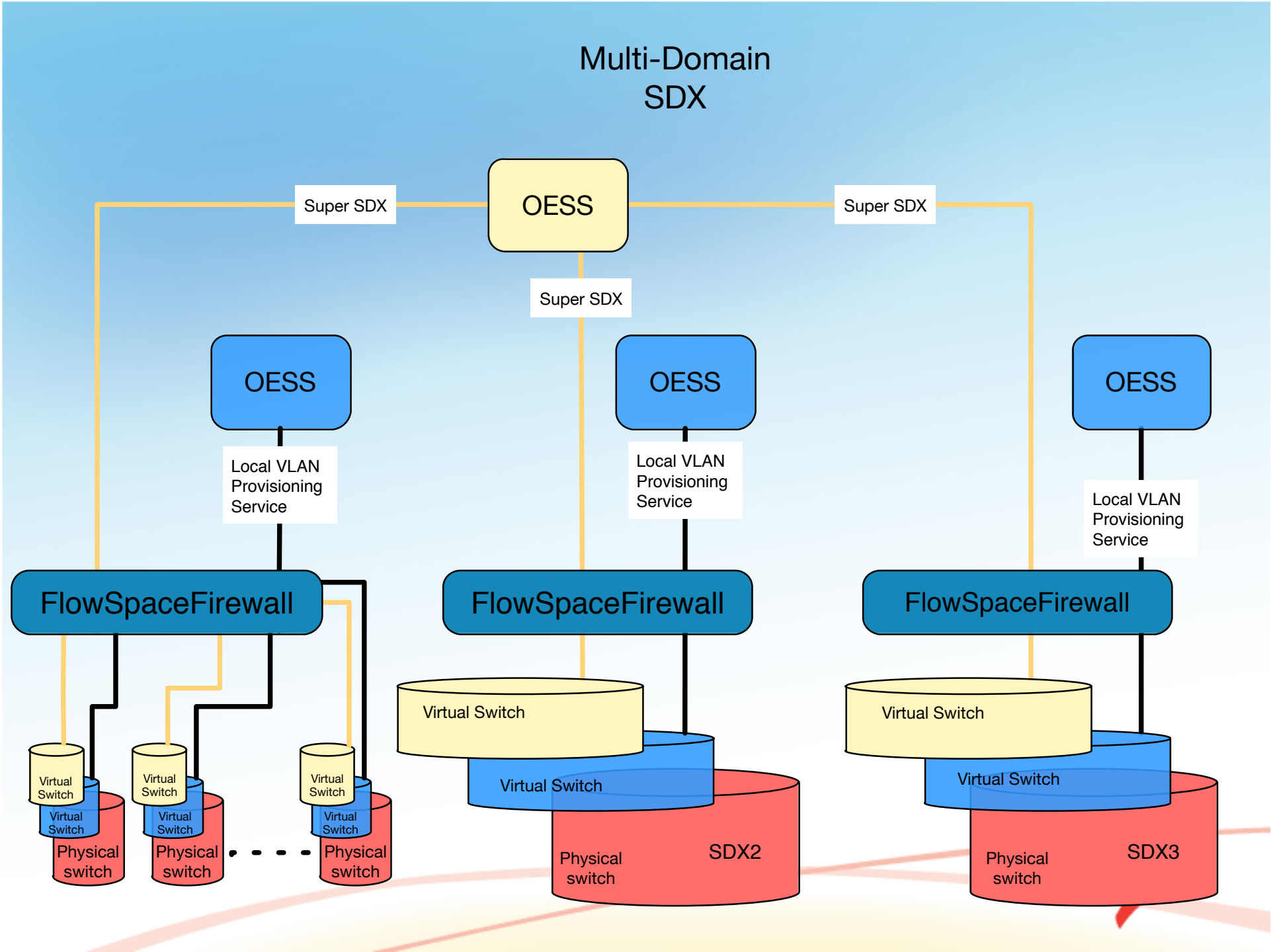
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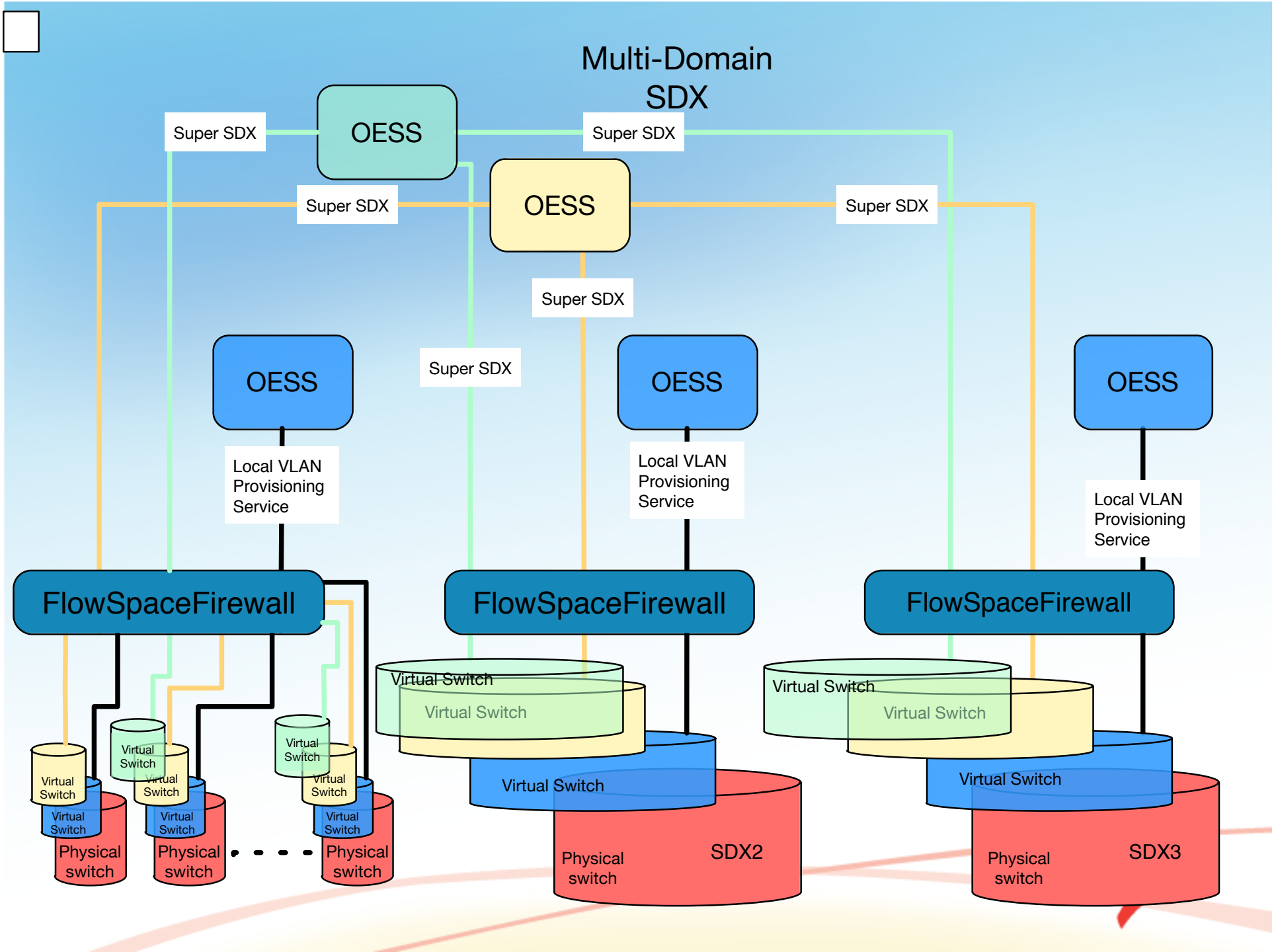
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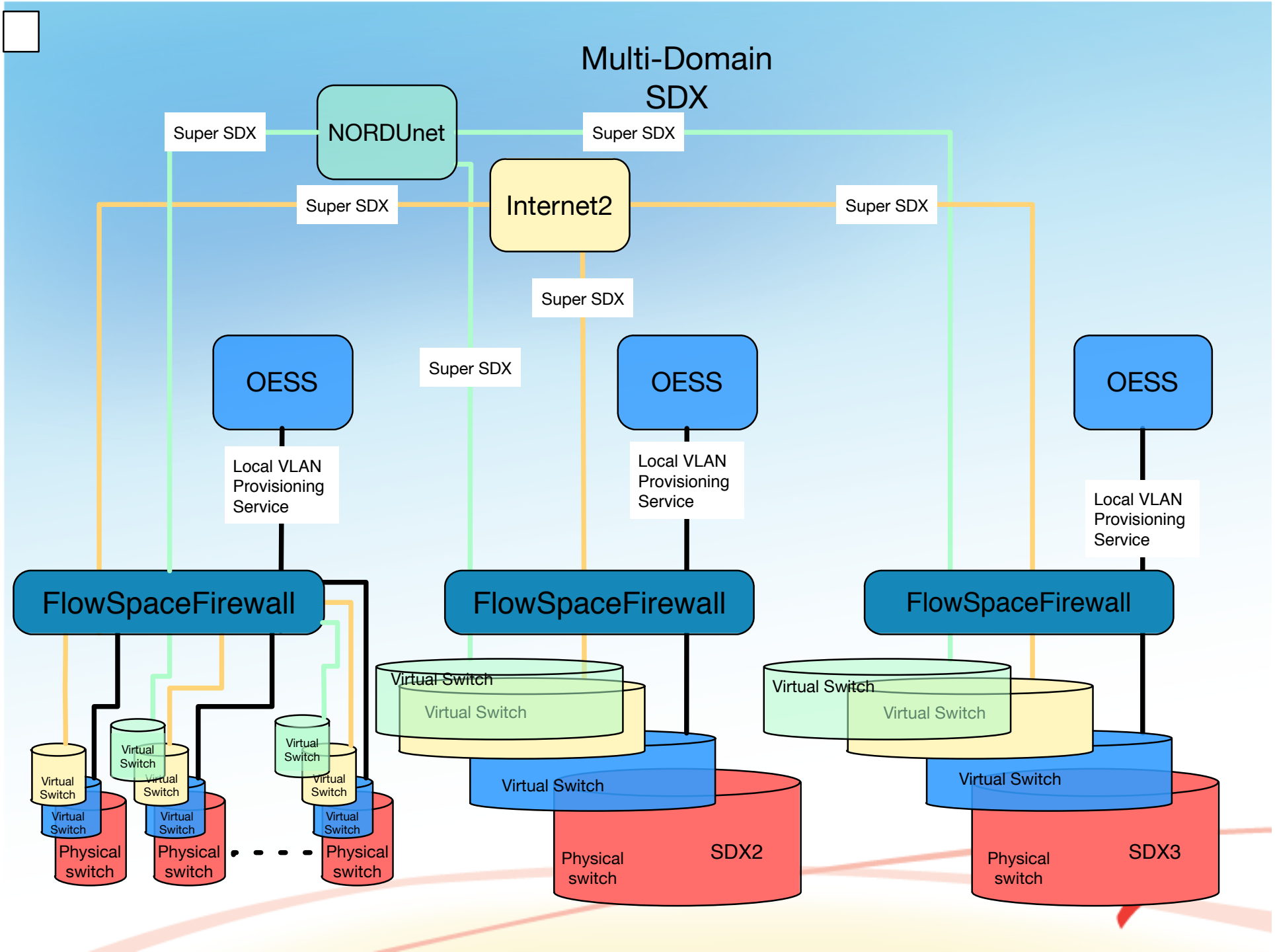
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Documentation

- 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

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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