SDN, NFV and Cloud

An Overview of Current Trends in the Networking Industry

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SDN

Software
Defined
Networking

THE PROBLEM

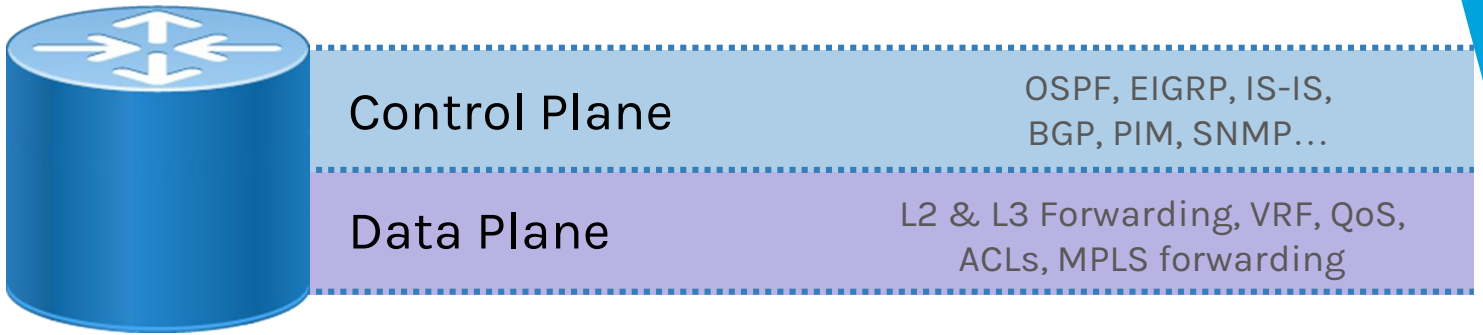
What is SDN really trying to solve?

Two Main Issues

- Networks are Device-Centric.
- Network Devices are Hard to Configure

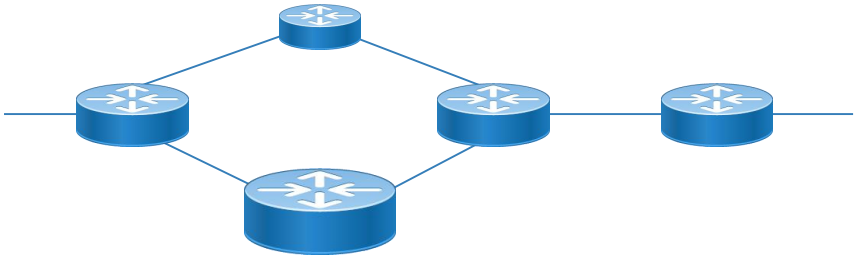
Networks are Device-Centric

- **Routers Today…**
  - Compute routes in CPU (RIB)
  - Push best route to the hardware (FIB)
  - Switch packets very fast based on destination address



Networks are Device-Centric

- **Routers Today…**
  - Every device has its own view of the network
  - Every device makes an independent forwarding decision



Networks are Device-Centric

PROs

- Scale very well (BGP)
- Are self-healing
- Are reliable and predictable

CONs

- Narrow hop-by-hop view
- Uncertainty beyond next hop
- Multiple levels of reconvergence
- All decisions based on “Destination IP”
- Very difficult to take into account other info
- Only fixed, non-adaptive metrics
- Difficult to extend or enhance
- In general, very hard to innovate

Devices are Hard to Configure

- **Network Devices Today…**
  - Networks are configured device by device
  - Configuration is manual
  - Configuration via Command-Line Interface (CLI)
  - Hard to keep configuration consistent
  - Hard to maintain software version consistency

Devices are Hard to Configure

- **Network Devices Today…**
  - Very difficult to automate
  - Lack of proper APIs and interfaces
  - Existing config mechanisms very hard to consume by software
    - SNMP is very “Read” oriented, hard to configure things
    - CLI inconsistent across software versions
    - NMS tools forced to use telnet & screen scraping
      - Ugly
      - Inefficient
      - Error prone

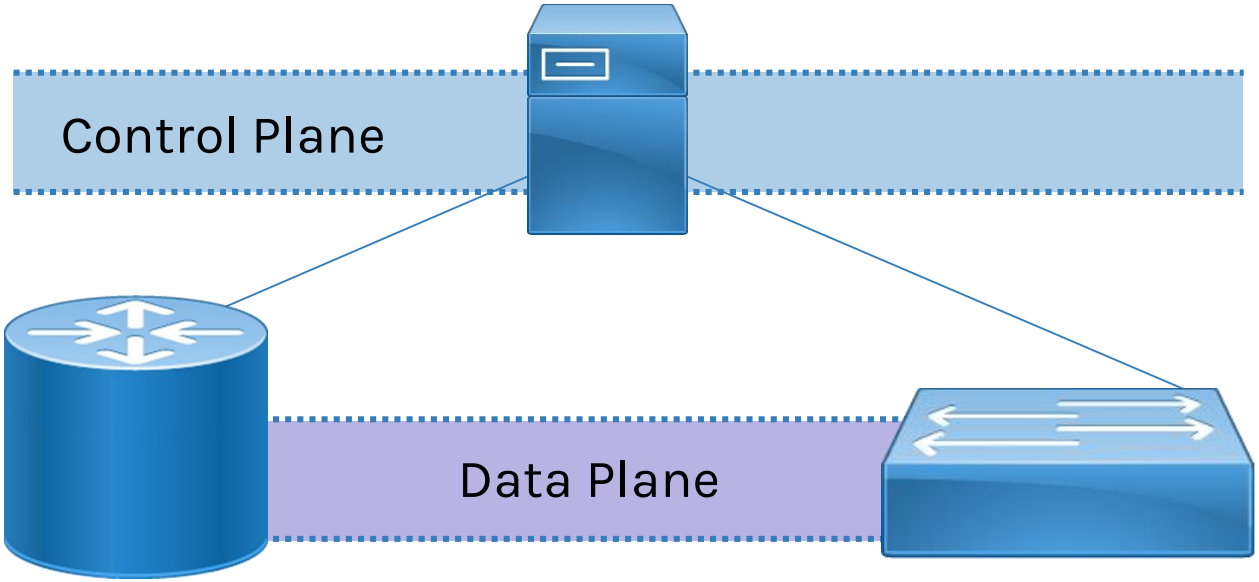
POSSIBLE SOLUTIONS

How are we solving the problem?

Software-Defined Networking

- **What is it?**
  - The latest cool thing in the networking industry
  - "*SDN is a new approach to designing, building, and managing networks that separates the network's control (brains) and forwarding (muscle) planes to better optimize each*".

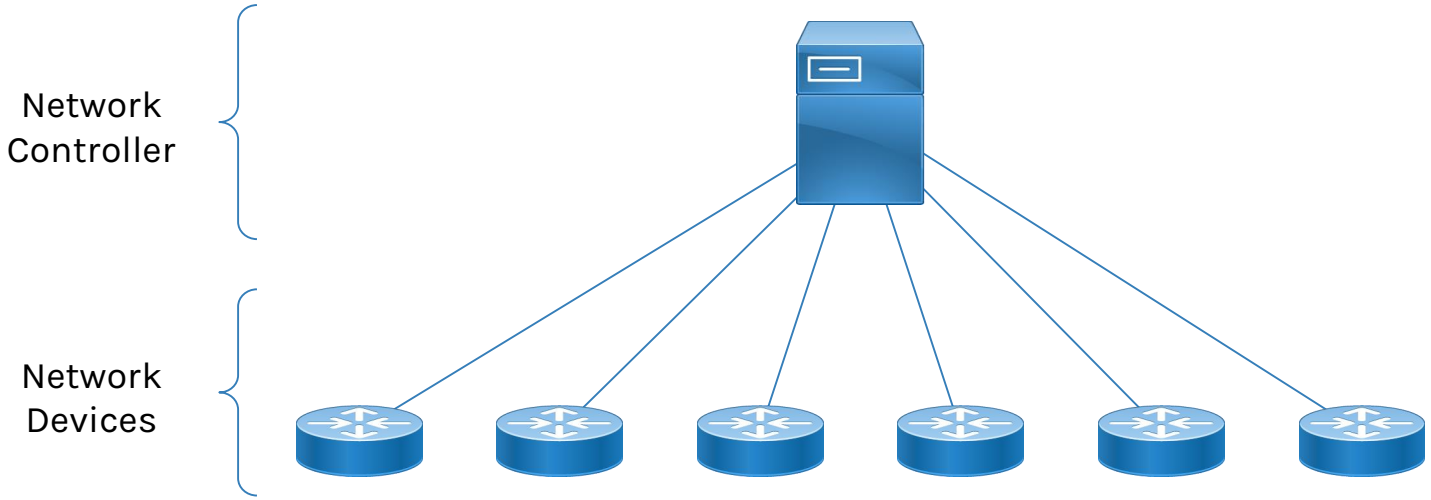
Routers and Switches



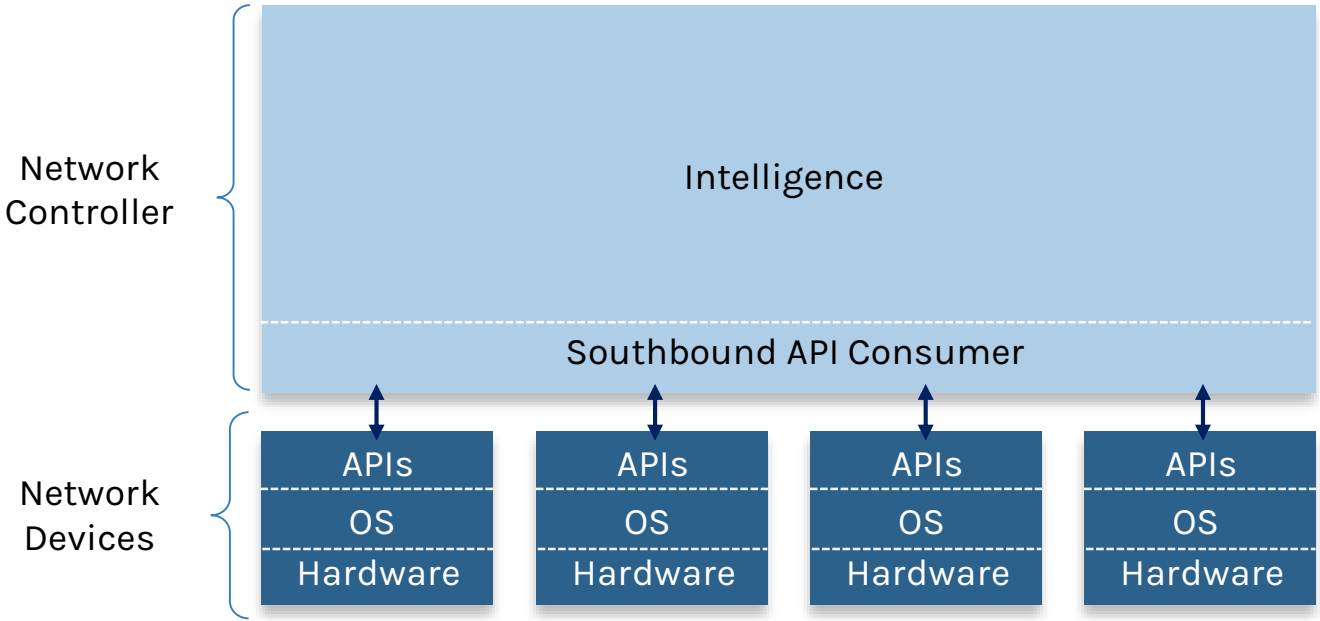
Why Separate Both?

- **Faster Innovation**
  - Control logic is not tied to hardware.
  - HW and SW evolve independently.
- **Network-wide View**
  - Easier to observe the network and make decisions.
- **Flexibility**
  - If the HW manufacturer doesn’t want to implement the features I need, I can do it myself.

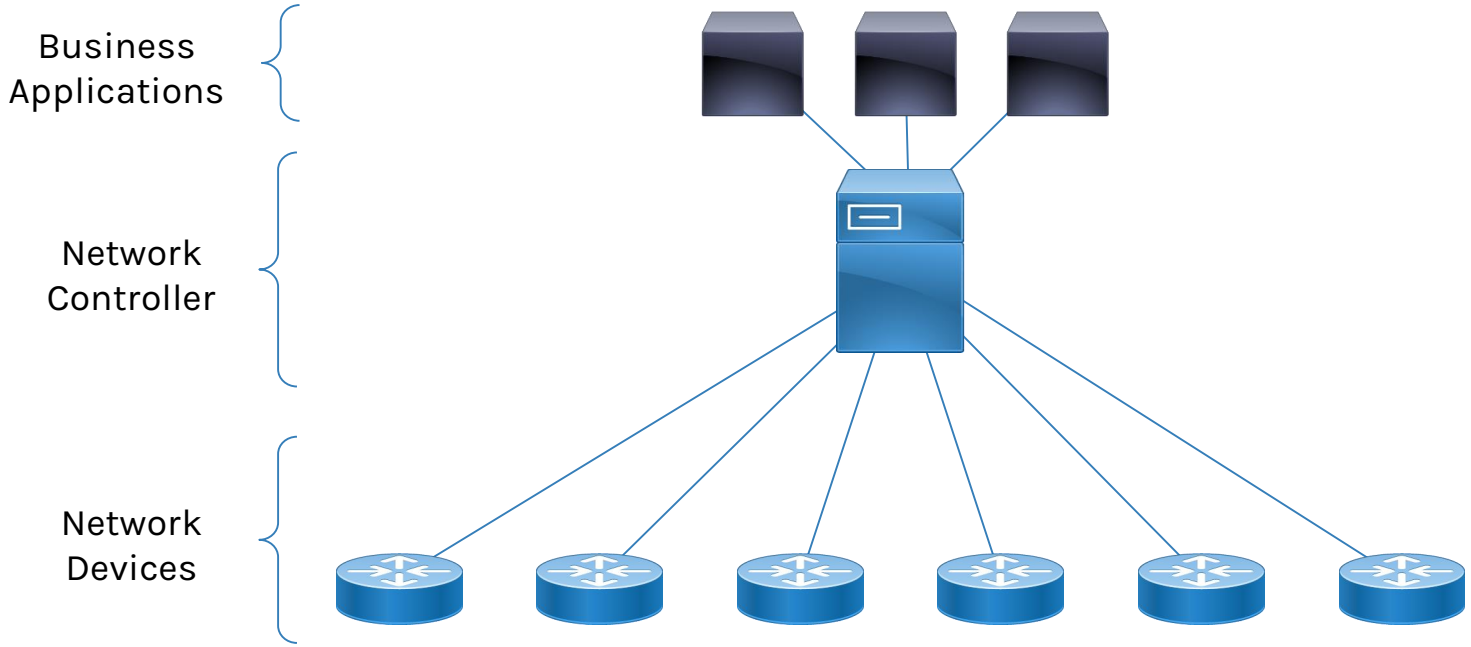
SDN Architecture



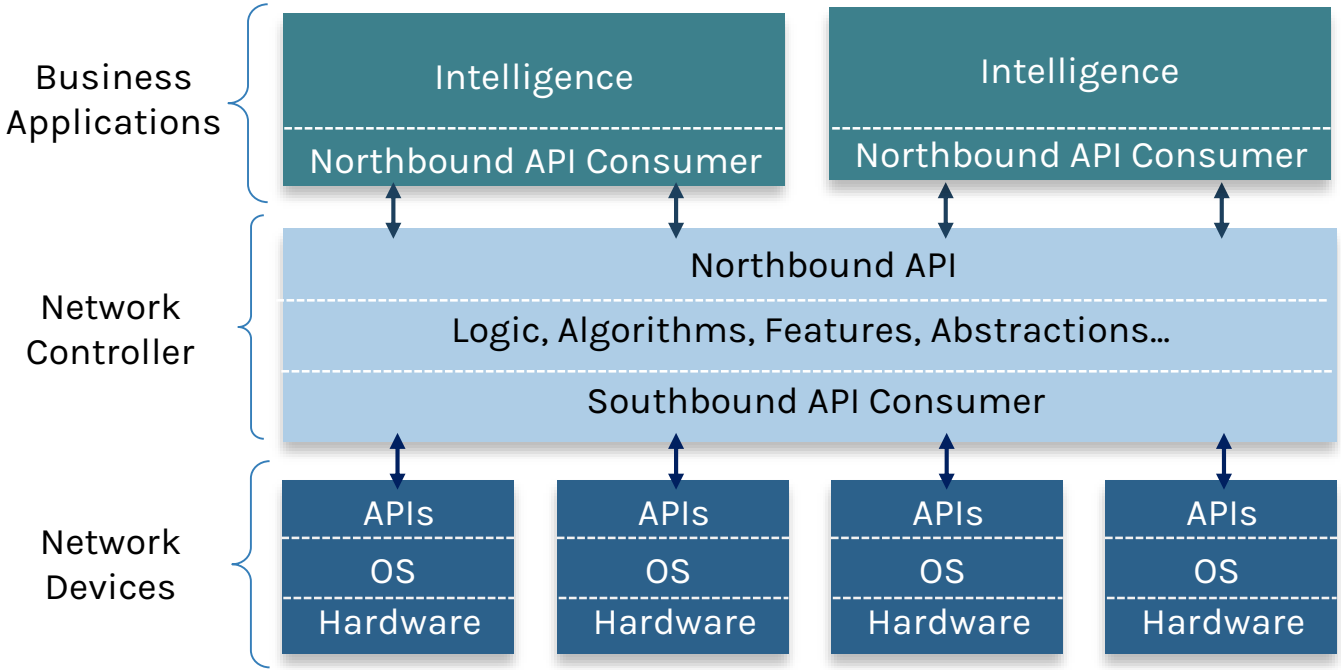
SDN Architecture



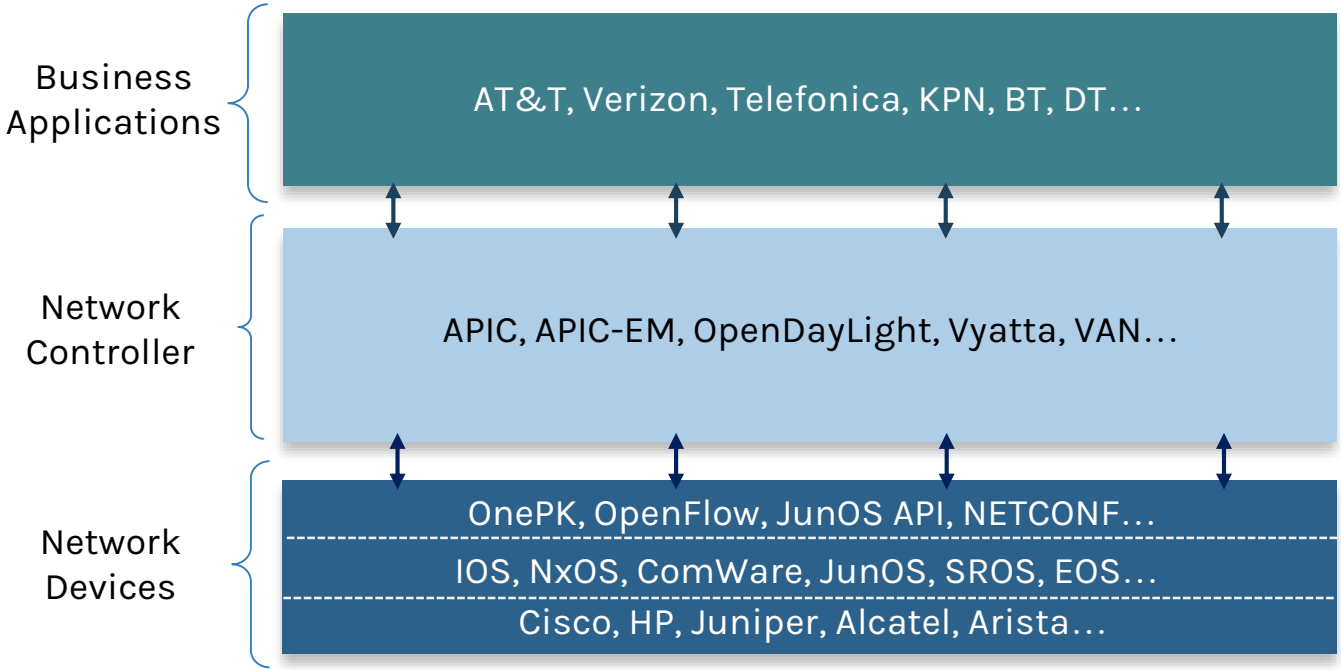
SDN Architecture



SDN Architecture

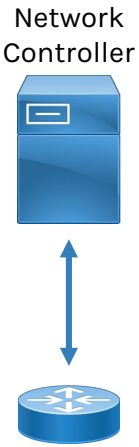


SDN Architecture

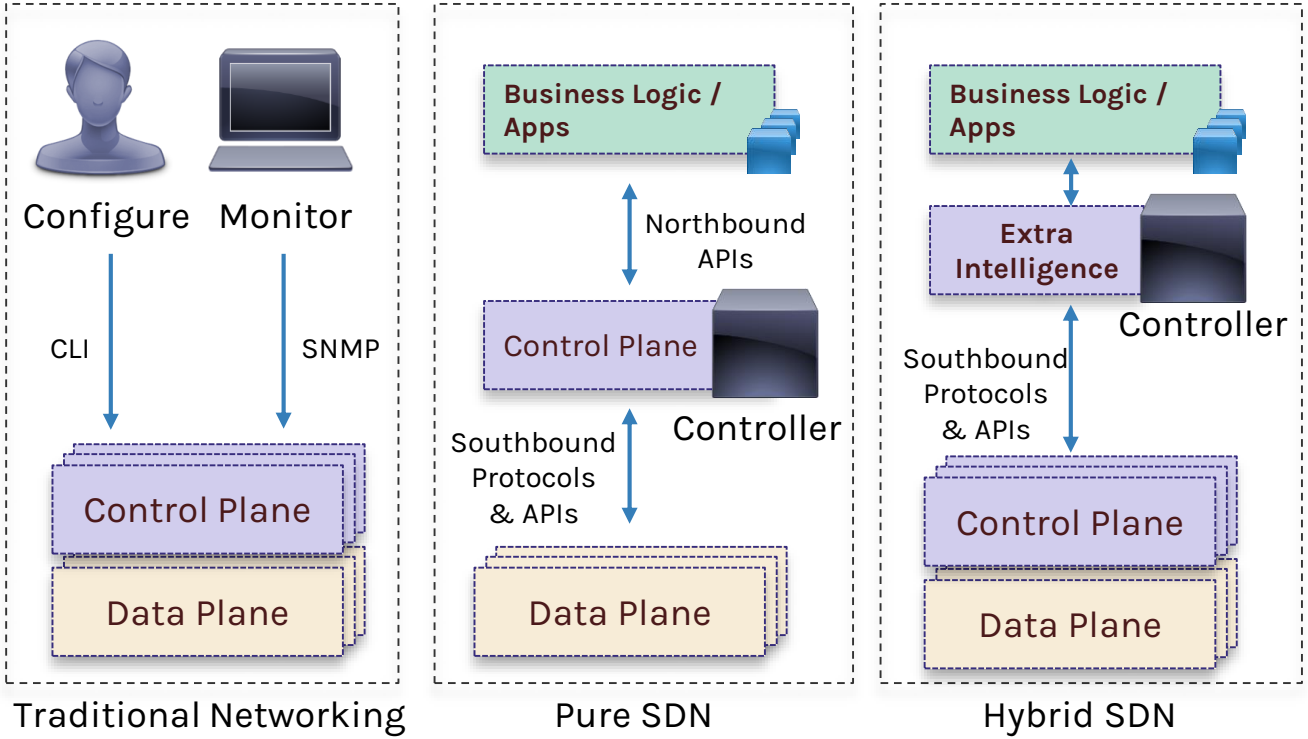


Common Operations Available

- **Configuration**
  - Pull or push configuration to the device
- **Statistics**
  - Obtain real-time statistics
  - Notice relevant events on the network
  - Polling devices / Async Notifications
- **Traffic**
  - Divert or copy packets to the controller
  - Inject or re-inject (same or different interface)
  - Drop



SDN Deployment Modes



2.

NFV

Network
Function
Virtualisation

THE PROBLEM

Why do we need Network Function Virtualisation?

Two Main Issues

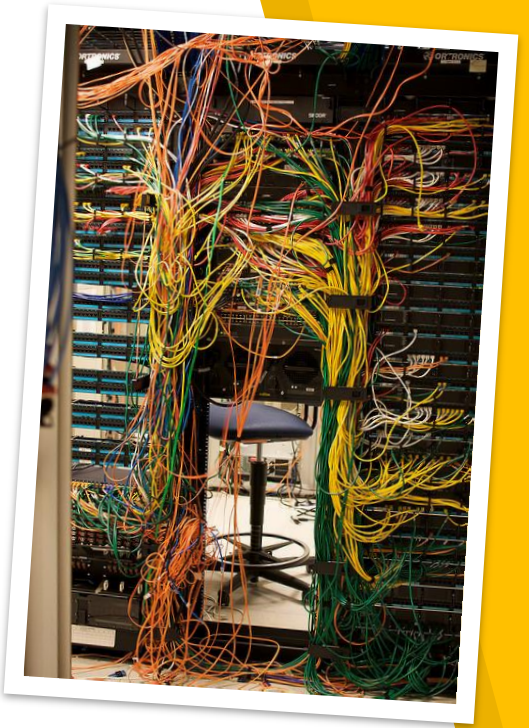
- Devices are heterogeneous and expensive.
- Devices are hard and slow to deploy.

Heterogenous and Expensive Devices

- **Heterogeneous**
  - Different vendors.
  - Different form factors.
  - Different deployment models.
- **Expensive**
  - Vendors charge a premium for their special-purpose hardware.
  - The fact that they are “physical” products increases cost per se.

Devices are Hard and Slow to Deploy

- **New Services often require...**
  - Racking new devices.
  - Laying out new cabling.
  - Performing initial config manually.
- **Work at the Datacenter...**
  - Requires physical presence.
  - Qualified Engineers (different profiles)
  - Security & Safety procedures.
  - Maintenance windows.



POSSIBLE SOLUTION

How are we solving the problem?

Separate Function from Hardware

- **Run network functions in commodity HW**
  - Network functions implemented in Software.
  - Running on top of standard x86 platforms.
    - As Virtual Machines
    - Inside containers
    - Directly on the baremetal
- **Applicable for a number of functions**
  - Firewalls, IDS, Routers, Load Balancers, Proxies…

Virtual Network Functions

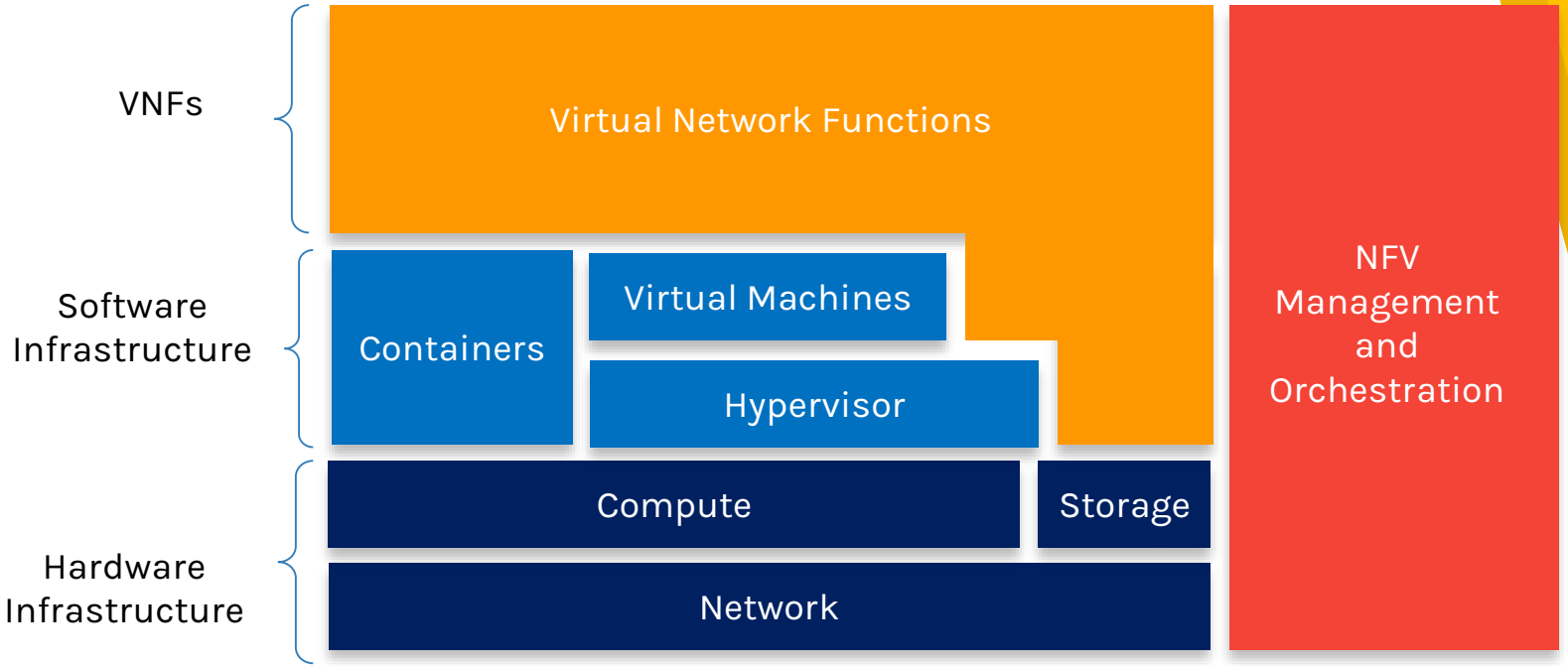
PROs

- Homogenous Datacenter
- No need to deploy physically everytime.
- SW is generally cheaper than HW
- Faster to deploy new devices
- Cheaper redundancy
- Easier multi-tenancy

CONs

- Performance limitations
- More complex traffic flows
- Harder to implement security controls

NFV Architecture



3.
Cloud

Public, Private
& Hybrid Cloud
Environments

THE PROBLEM

What do we need the Cloud for?

Two Main Issues

- Deploying IT services is difficult and slow.
- The cost of IT doesn’t necessarily match the growth of the business.

IT is Difficult and Slow

- **Professional IT is complex**
  - Requires highly skilled engineers, not always available.
  - In mature companies, there are a lot of politics involved (different departments, responsibilities, etc).
- **Markets change faster than ever**
  - Need to put new services on the market faster than the local IT can handle.

Cost of IT **scales differently**

- **Big investments upfront**
  - IT infrastructure is expensive and must be paid. upfront, even when there is zero revenue.
  - Scaling up when there is growth is slow.
  - Scaling down is almost impossible.
  - Environment is always either overprovisioned or underprovisioned.
- **IT needs to be more agile**
  - Need to grow and shrink dynamically as needed.
  - Pay as you grow.

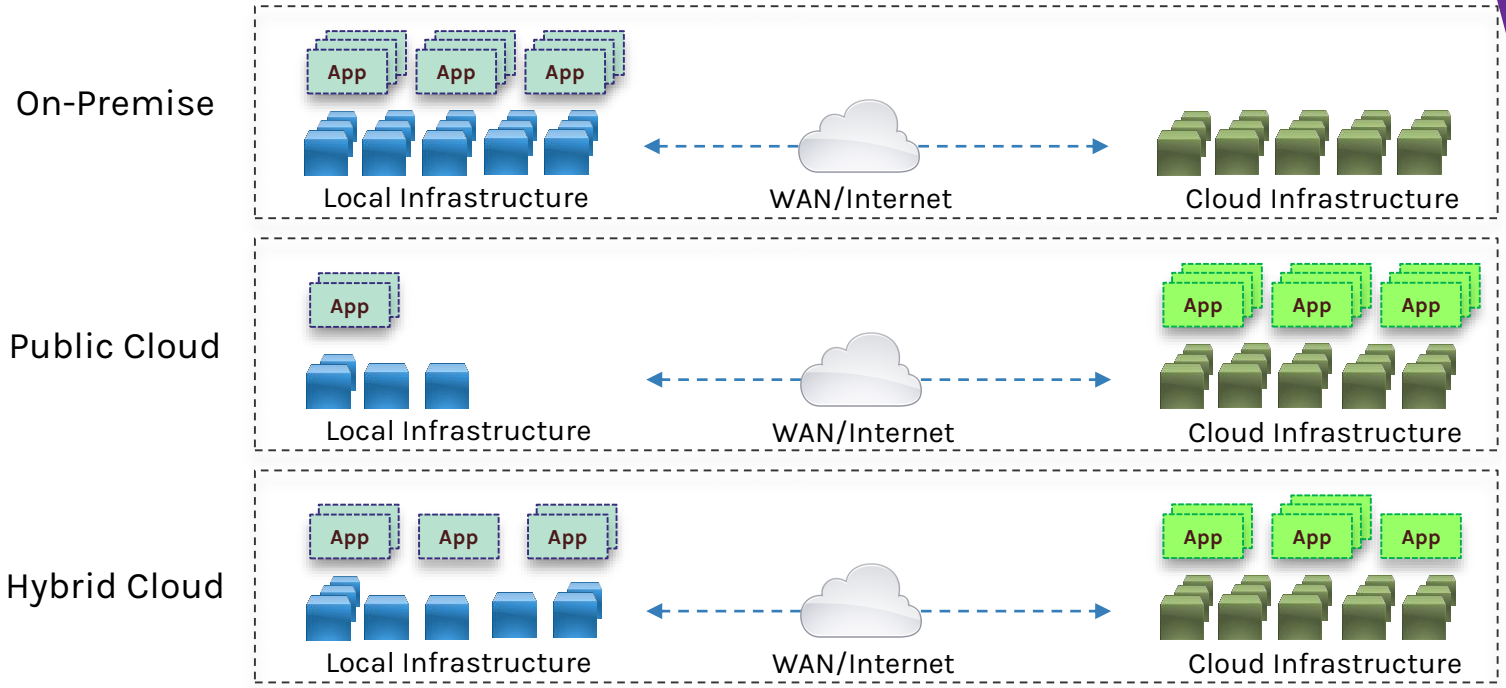
POSSIBLE SOLUTION

How are we solving the problem?

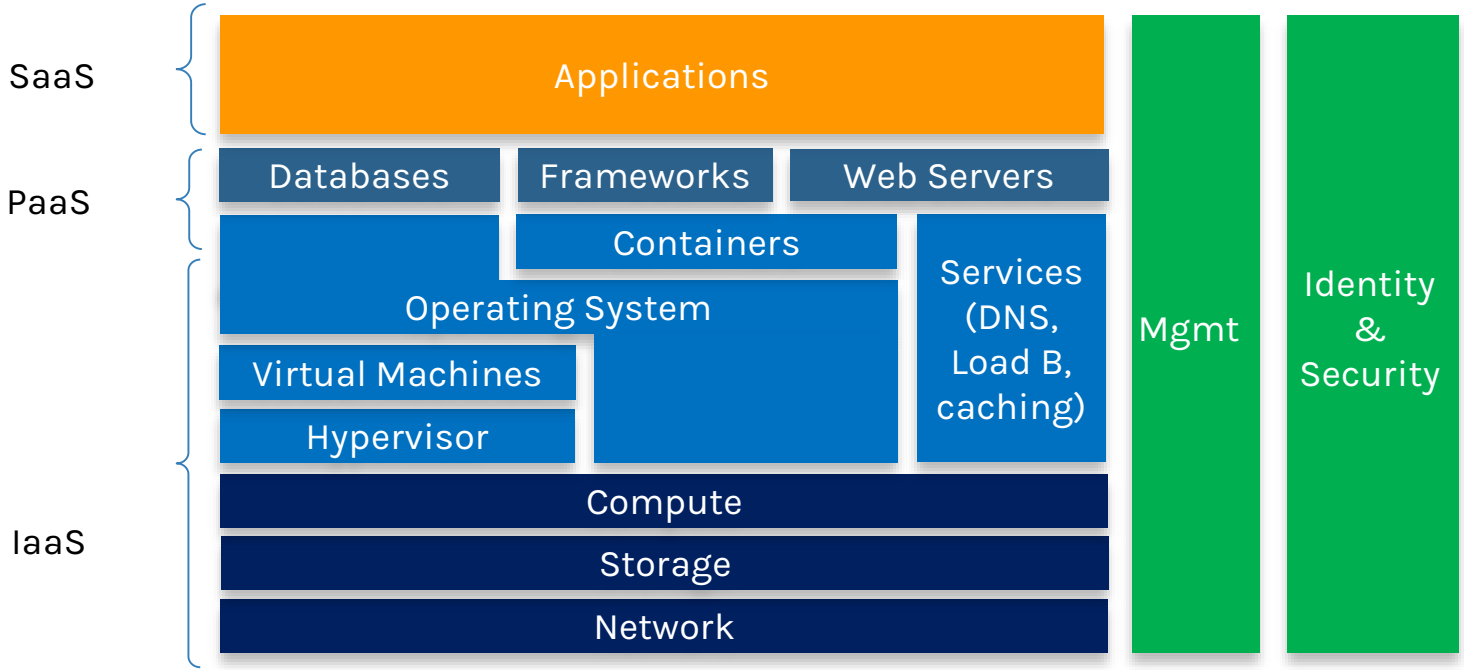
Cloud **Environments**

- **Run my IT on someone else's infrastructure**
  - Rely on specialised companies to provide the IT infrastructure needed.
  - Rely on their know-how.
  - Rely on their 24/7 support services.
  - Concentrate on business applications, not the rest of the stack.
  - Pay IT as an utility bill.

Cloud Deployment Modes



Cloud Offerings

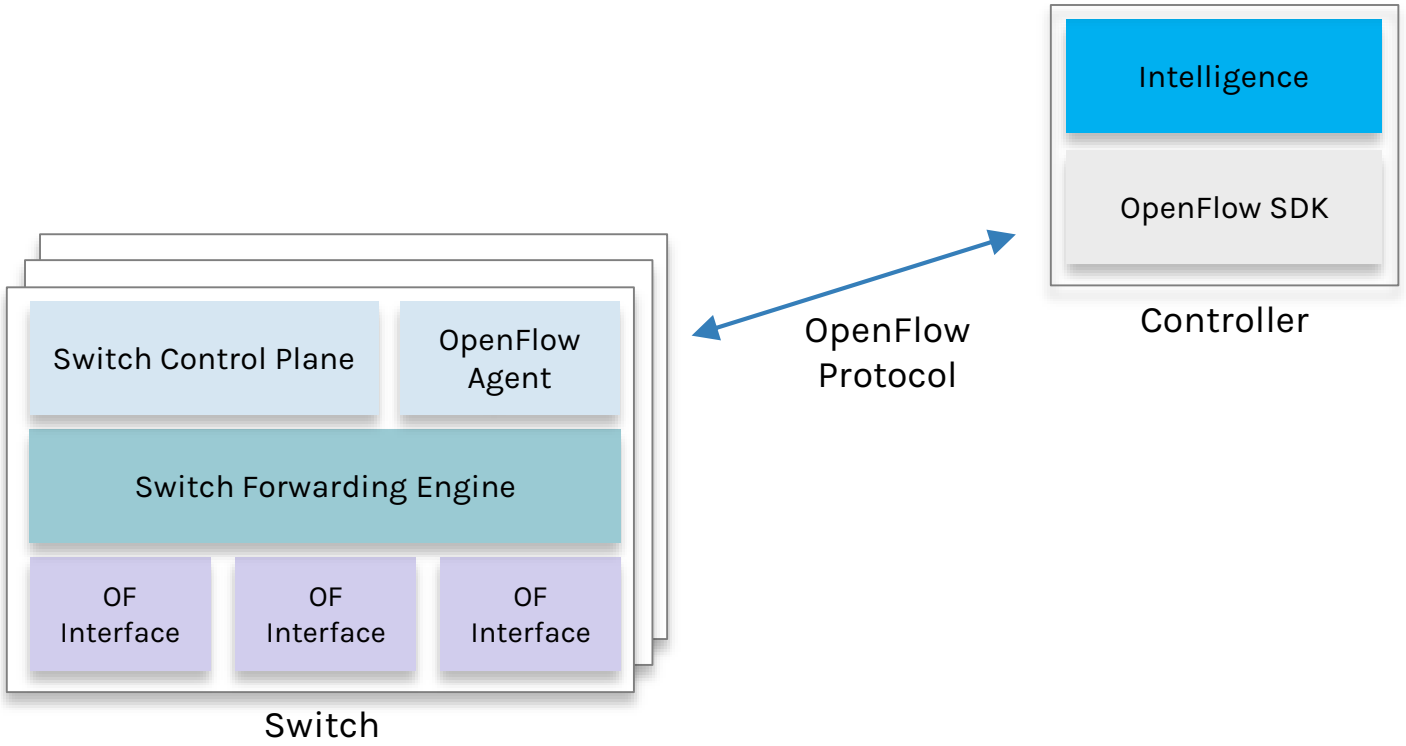


4.

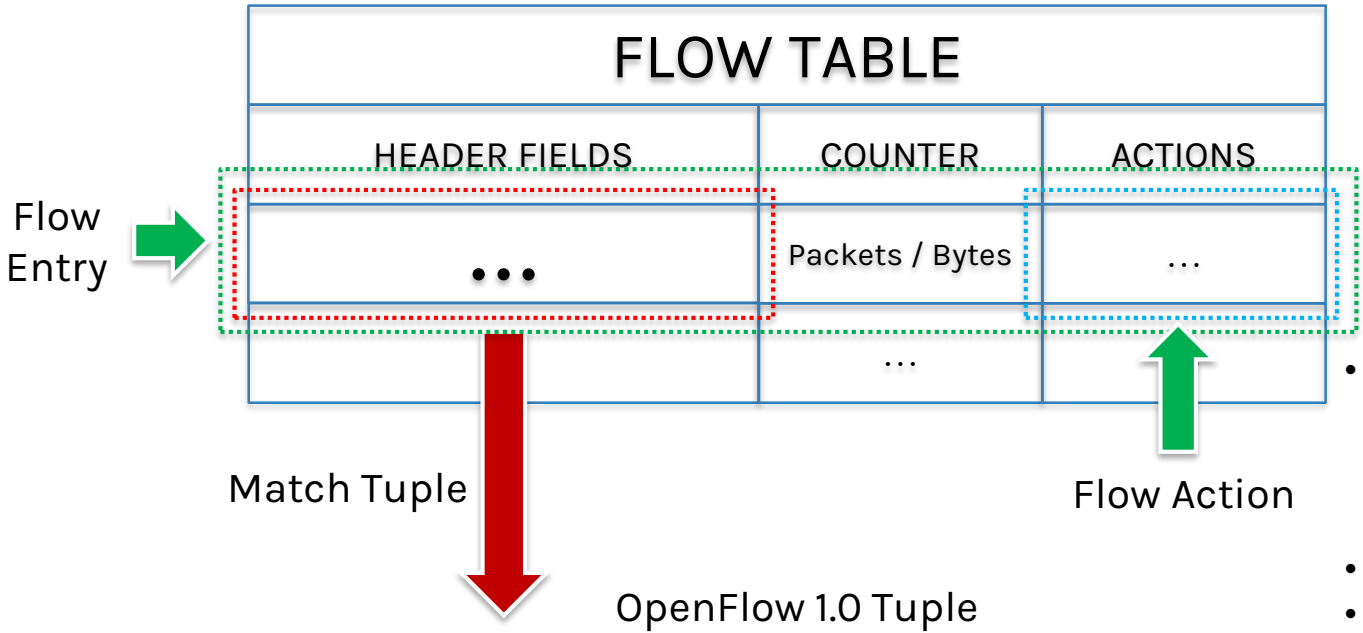
Use Cases

Use Cases and
Real-life
Technologies

Programmable Forwarding: OpenFlow

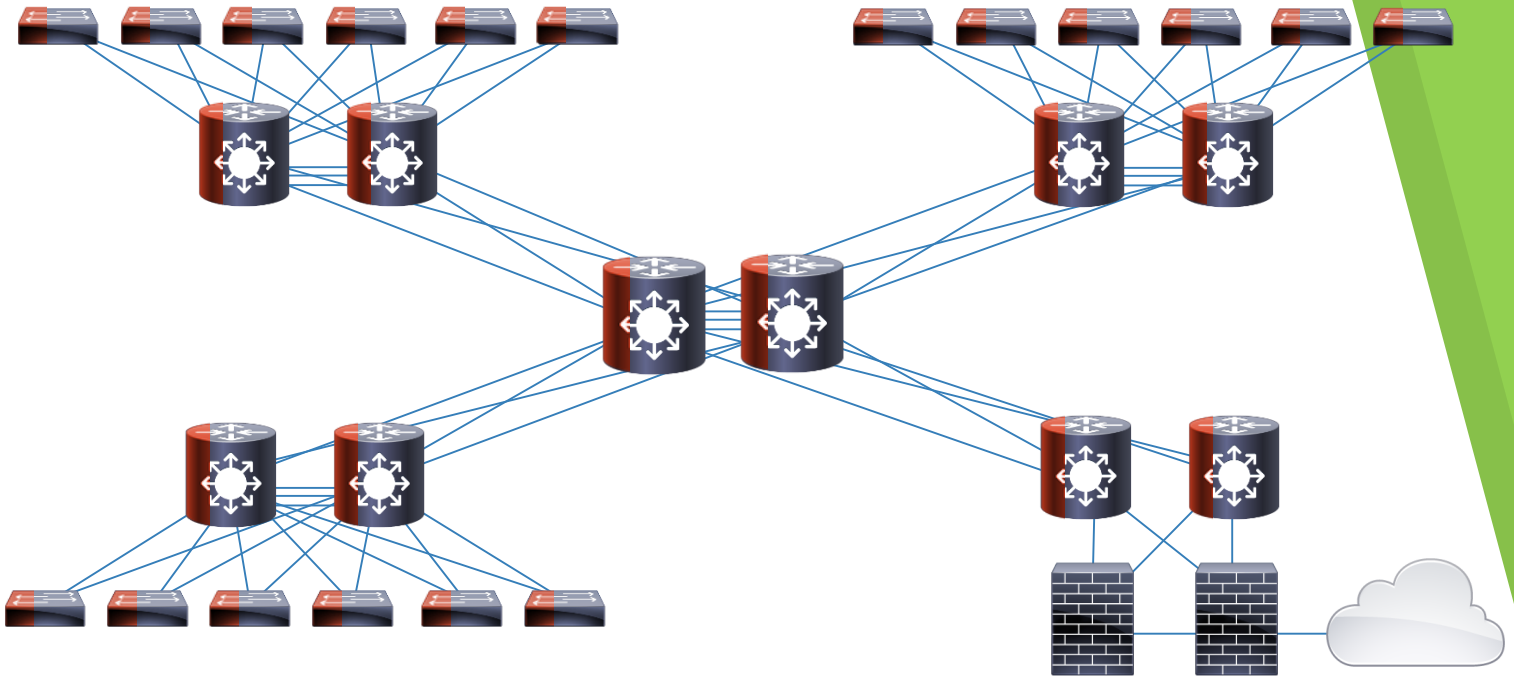


Programmable Forwarding: OpenFlow

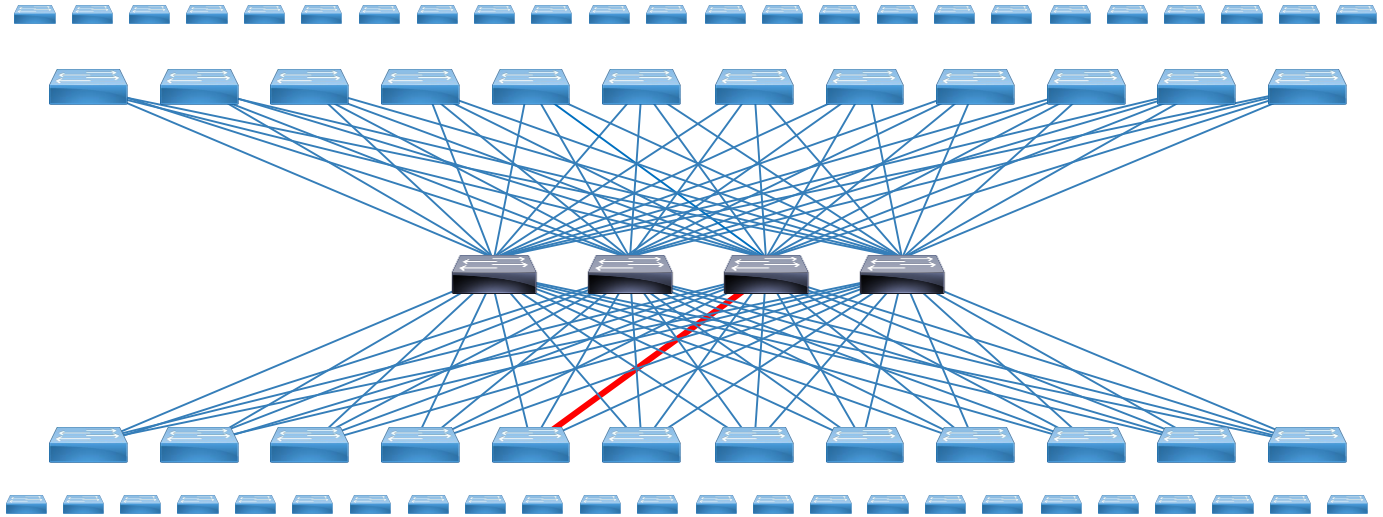


- Forward
  - Port
  - Flood
  - Normal
  - Controller
- Drop
- Set

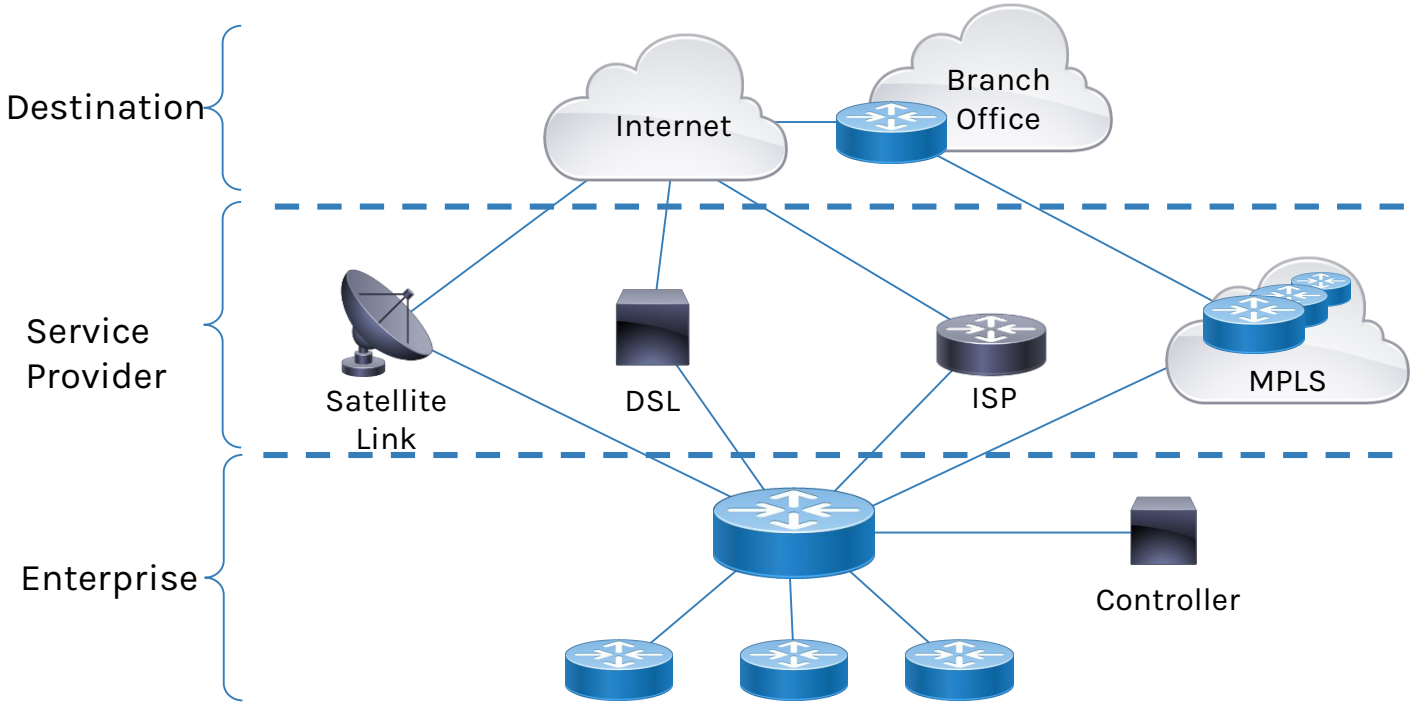
Experiment in Production



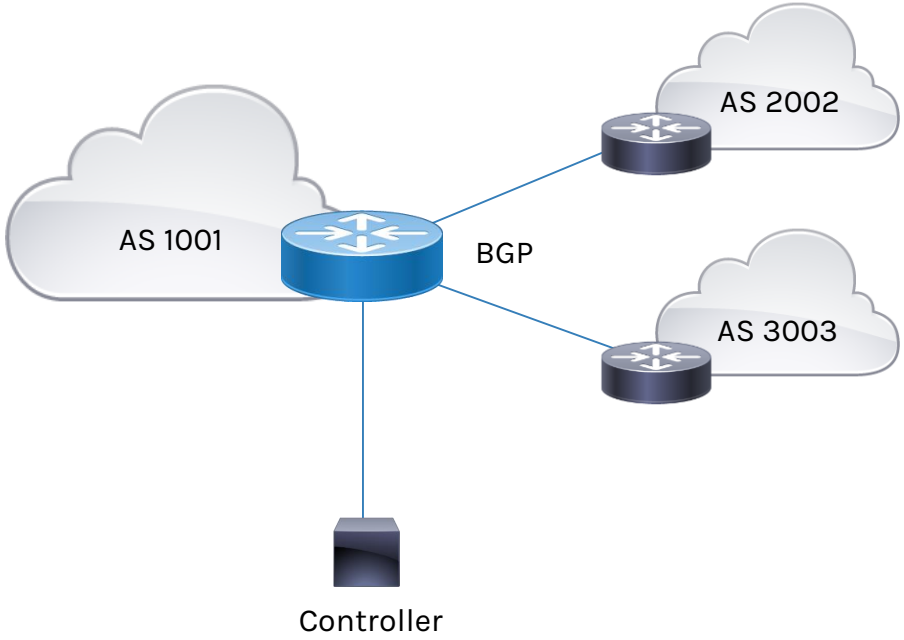
Large Scale Provisioning



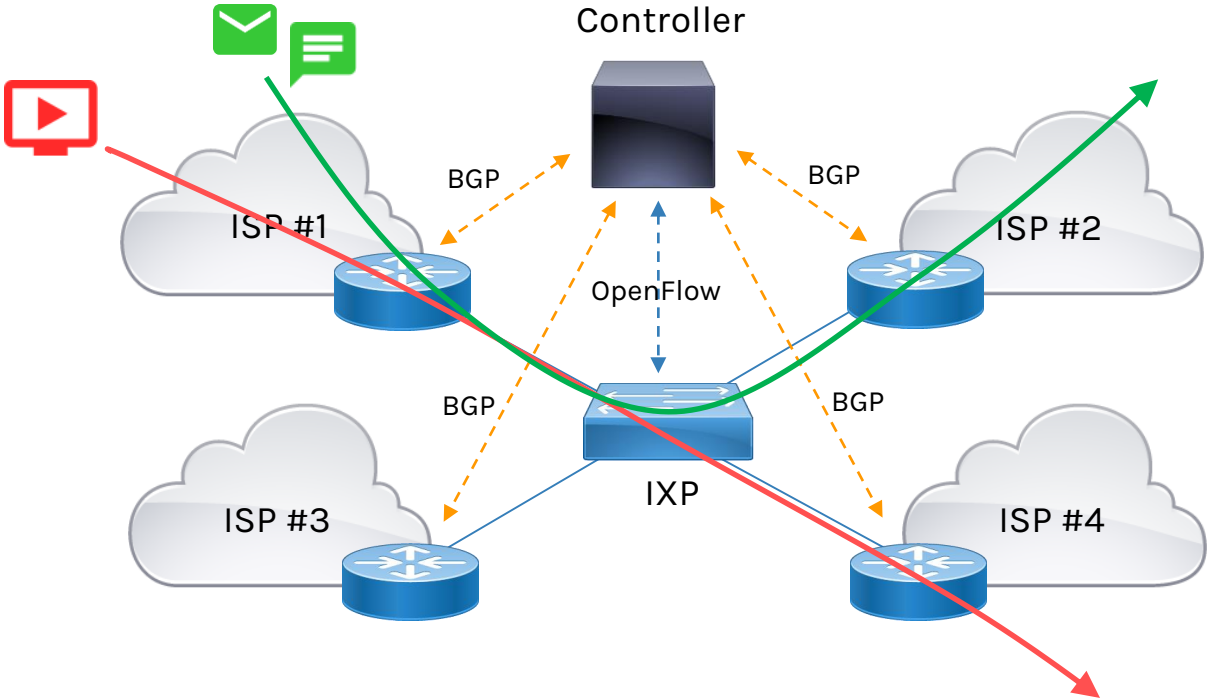
Traffic Steering



Traffic Steering

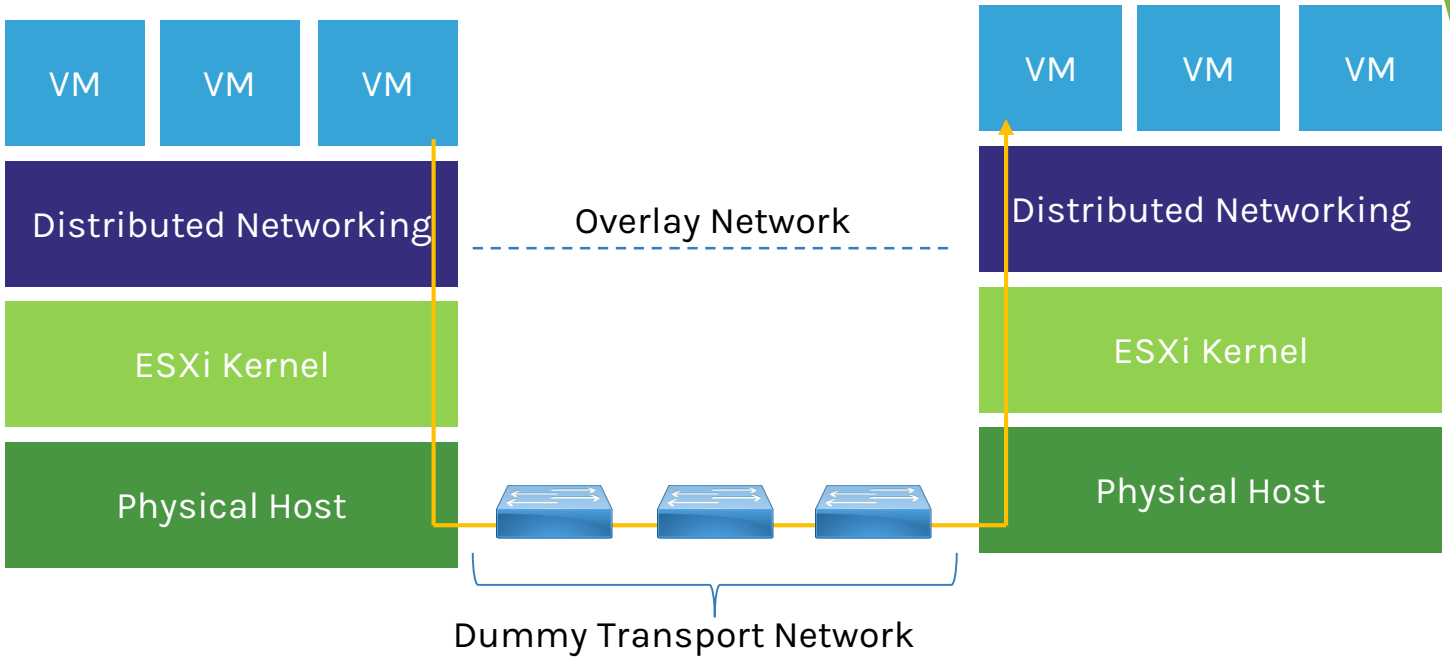


IXP Enhancements

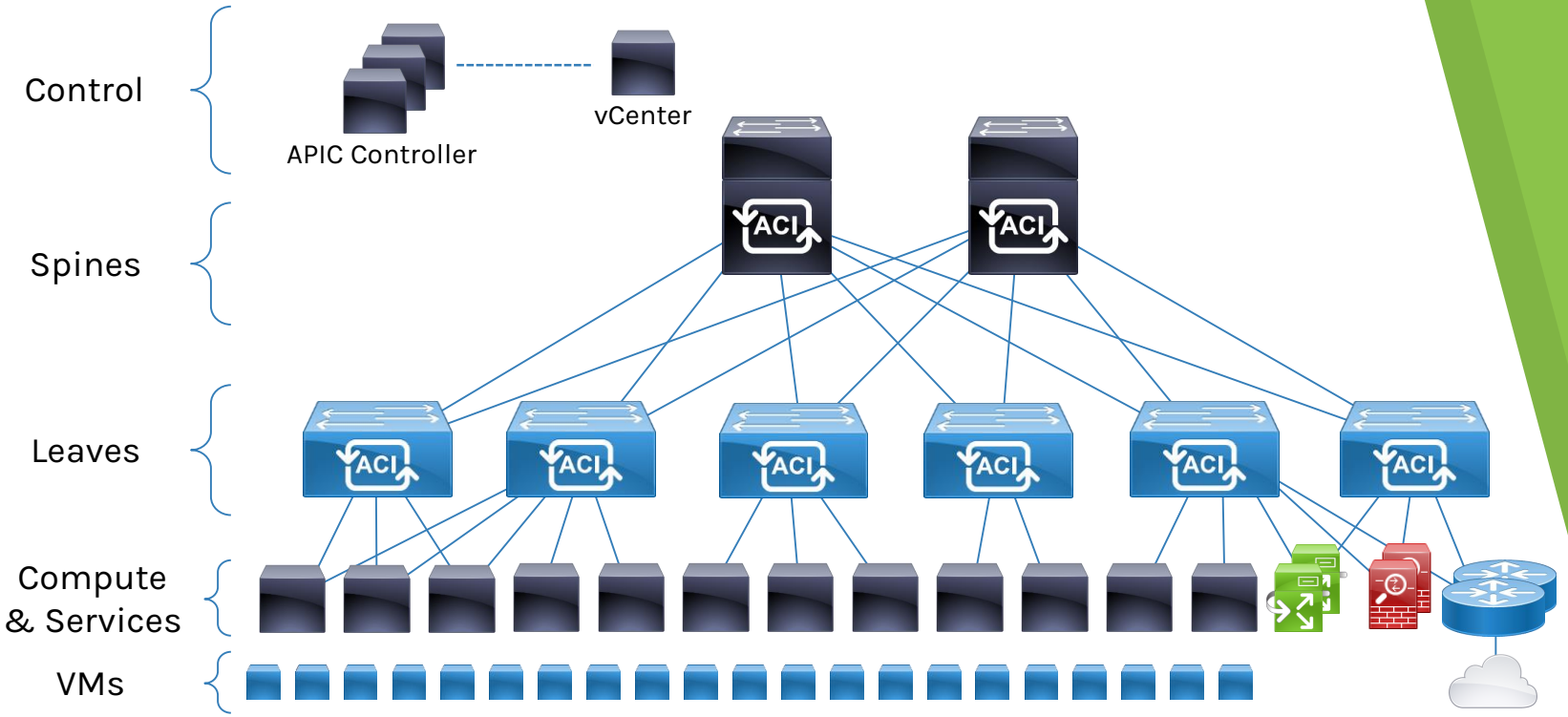


WAN Optimisation

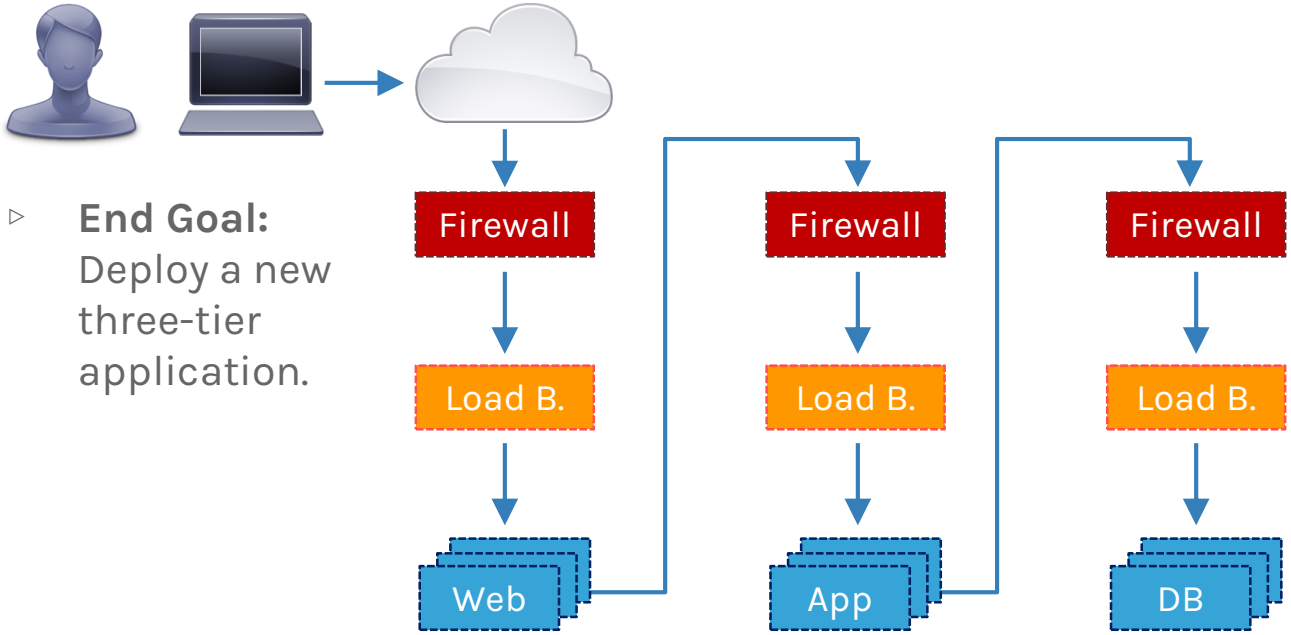
VMWare NSX


VM
VM
VM
Distributed Networking
ESXi Kernel
Physical Host
Overlay Network
VM
VM
VM
Distributed Networking
ESXi Kernel
Physical Host
Dummy Transport Network

Cisco ACI

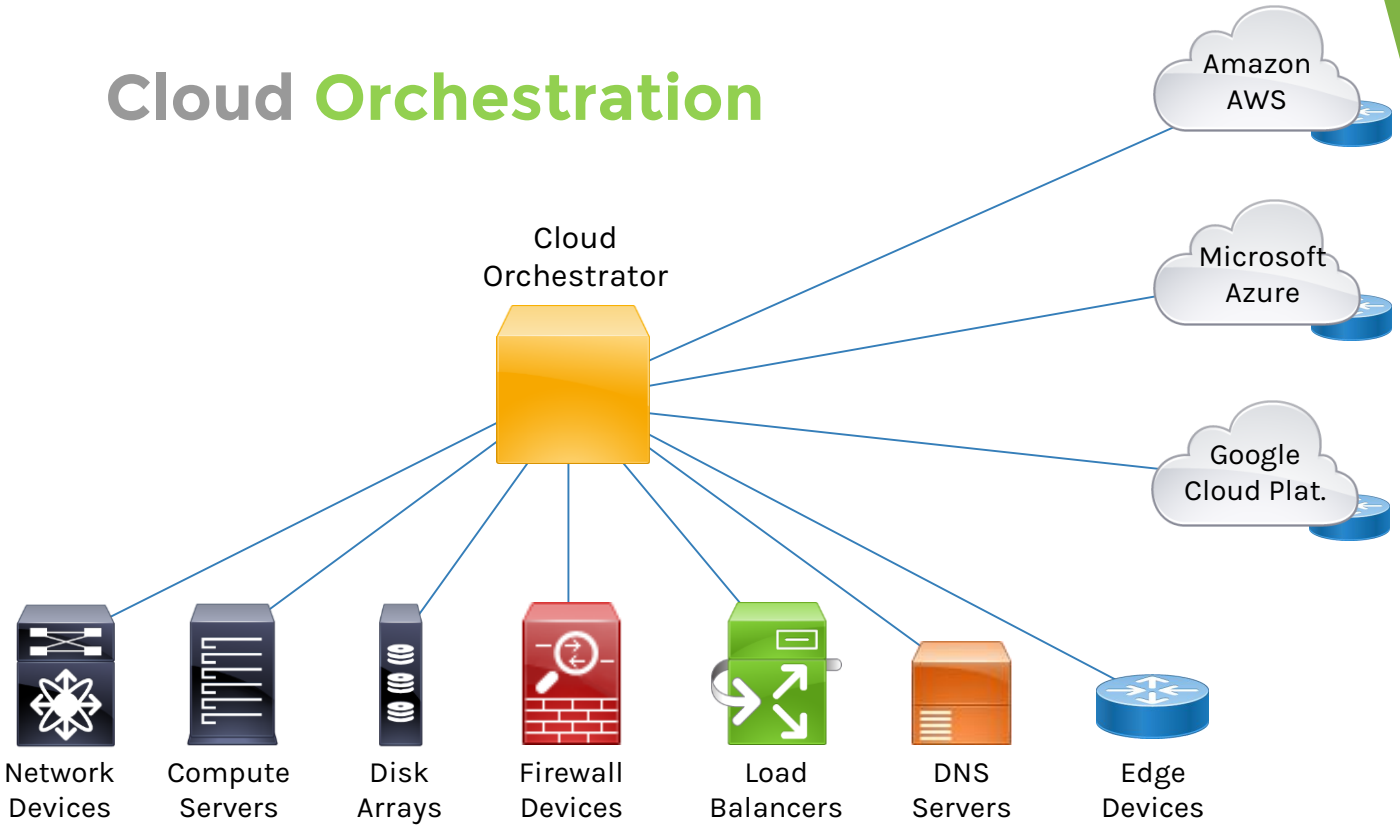

Control
Spines
Leaves
Compute & Services
VMs
APIC Controller
vCenter
ACI

Cloud Orchestration

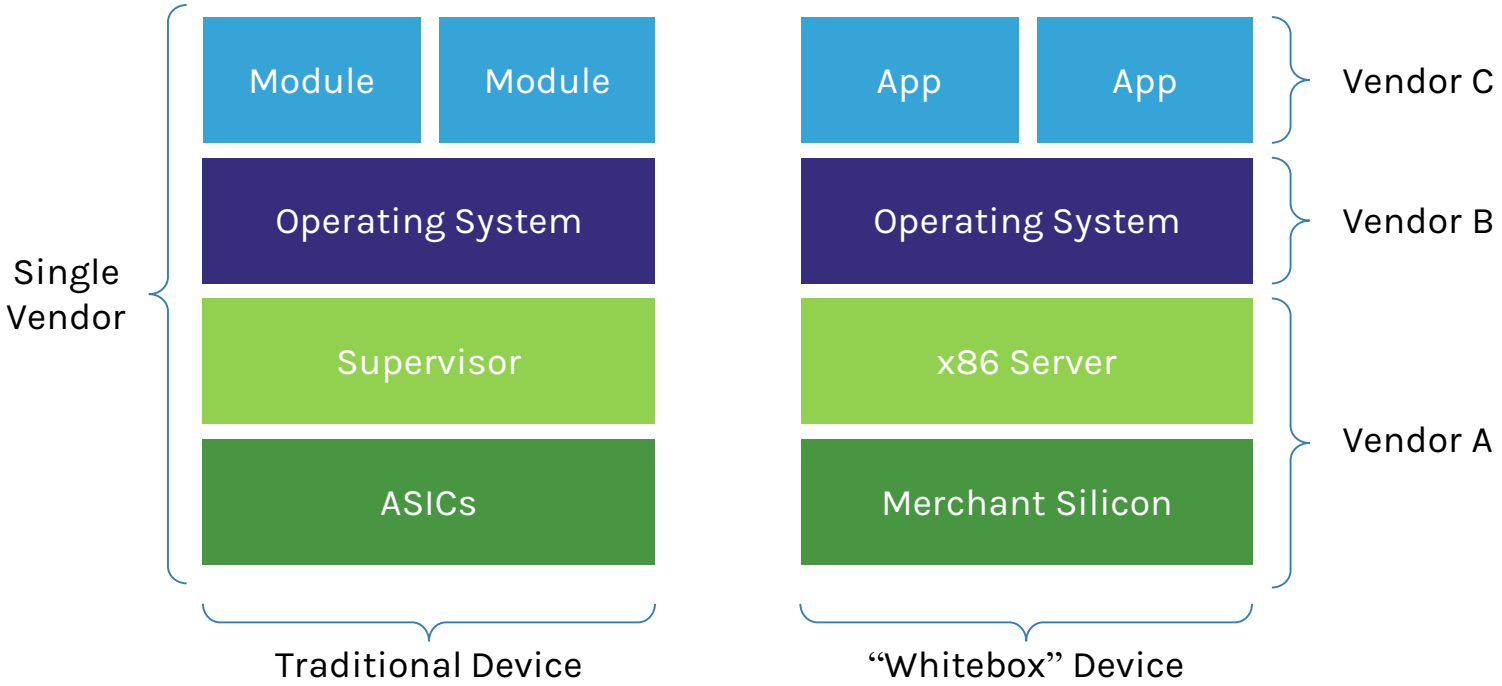


- **End Goal:** Deploy a new three-tier application.

Cloud Orchestration



Whitebox Networking



Other Tendencies

- Flow Visualization
- Self-Configuring Networks
- Self-Optimizing Networks
- Network abstractions closer to the application
- Convergence to Ethernet end-to-end.
- Network Engineering teams bringing in SW Developers.
- Industry creating the standards, not the IETF.

Questions?

Thanks!

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