



# Cloud Enablement Architecture and NfV Services

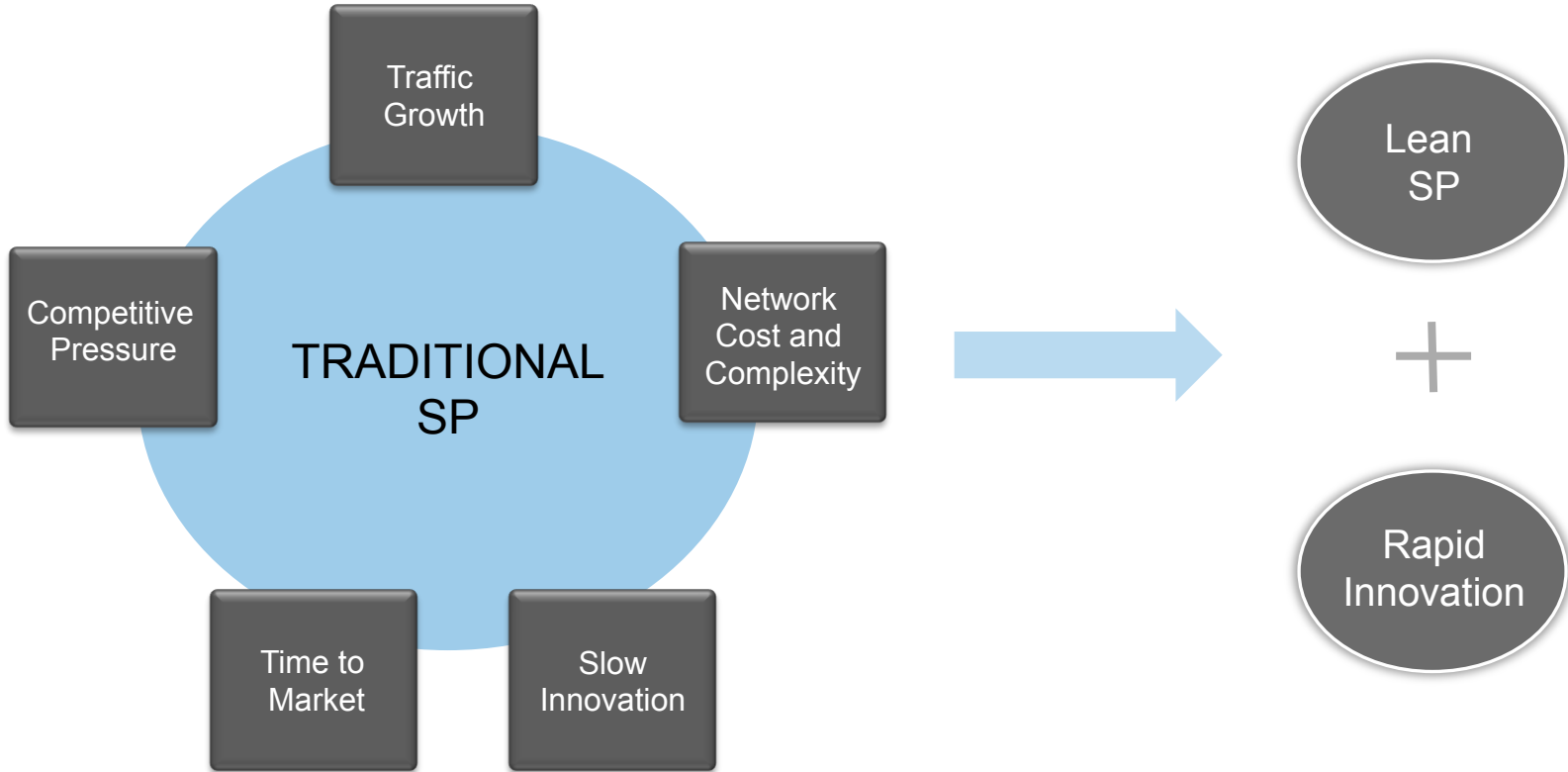
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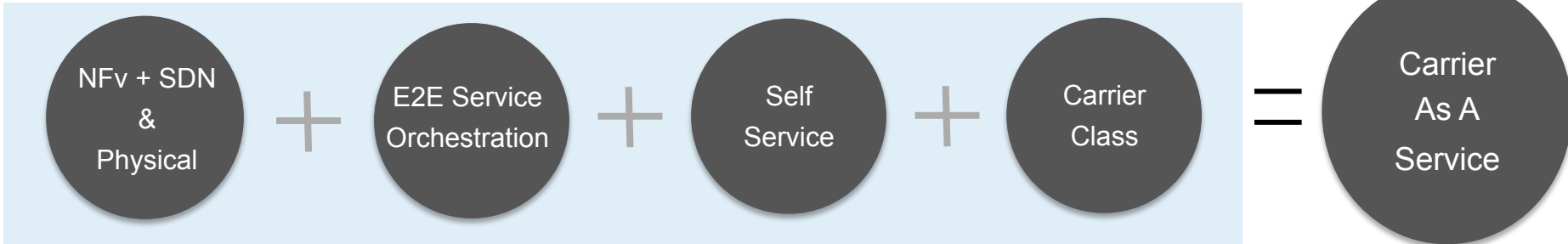
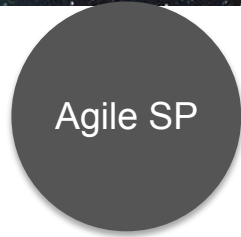
# Agenda

- Key SP Challenges
- Demystifying NfV
- NfV and Standardization
- Applicability of NfV
- NfV Use cases
- Case Study - Virtualizing Service Provider Wi-Fi Core
- Summary

# Key SP challenges and Path Forward



# Transformation To Carrier As A Service



NfV E2E Solution



# Demystifying NfV

# Network Functions Virtualisation

## Enablers, benefits and applications

NfV = Transition of network infrastructure services to run on virtualised compute platforms  
Using cloud technology to provide network functionality

- Enablers

Hypervisor and cloud computing technology

Improving x86 h/w performance

Optimised packet processing and coding techniques

Network industry standardising on Ethernet

SDN based orchestration

- Value Proposition

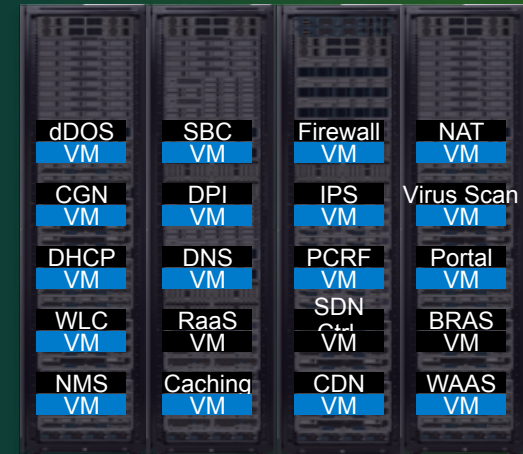
Shorter innovation cycle

Improved service agility

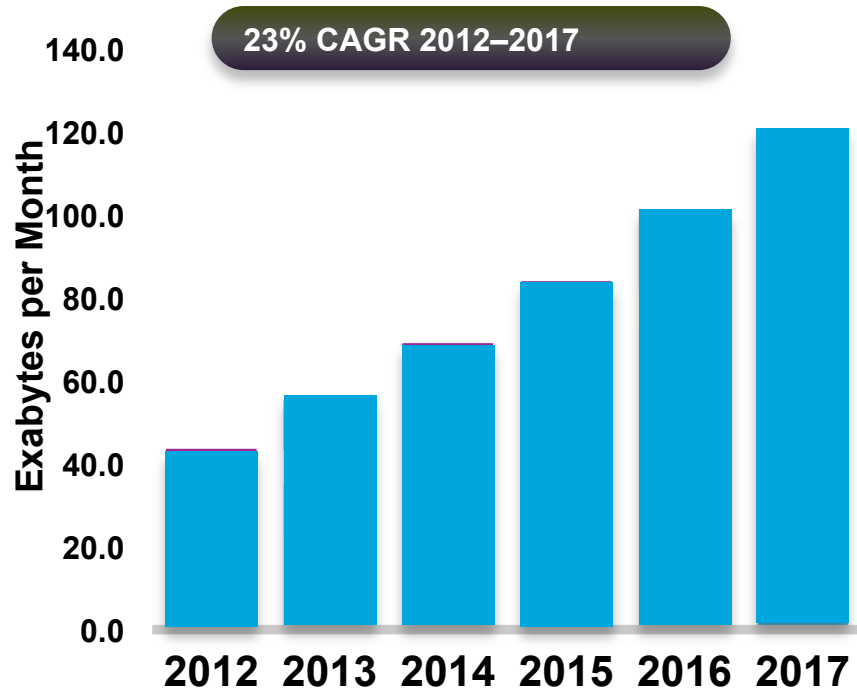
Reduction in CAPEX and OPEX

- Applications

Potentially all network functions



# The Backdrop : Ever increasing Traffic Levels



Source: Cisco VNI Global IP Traffic Forecast, 2012–2017



■ Long-Haul (Also Traverses Metro)



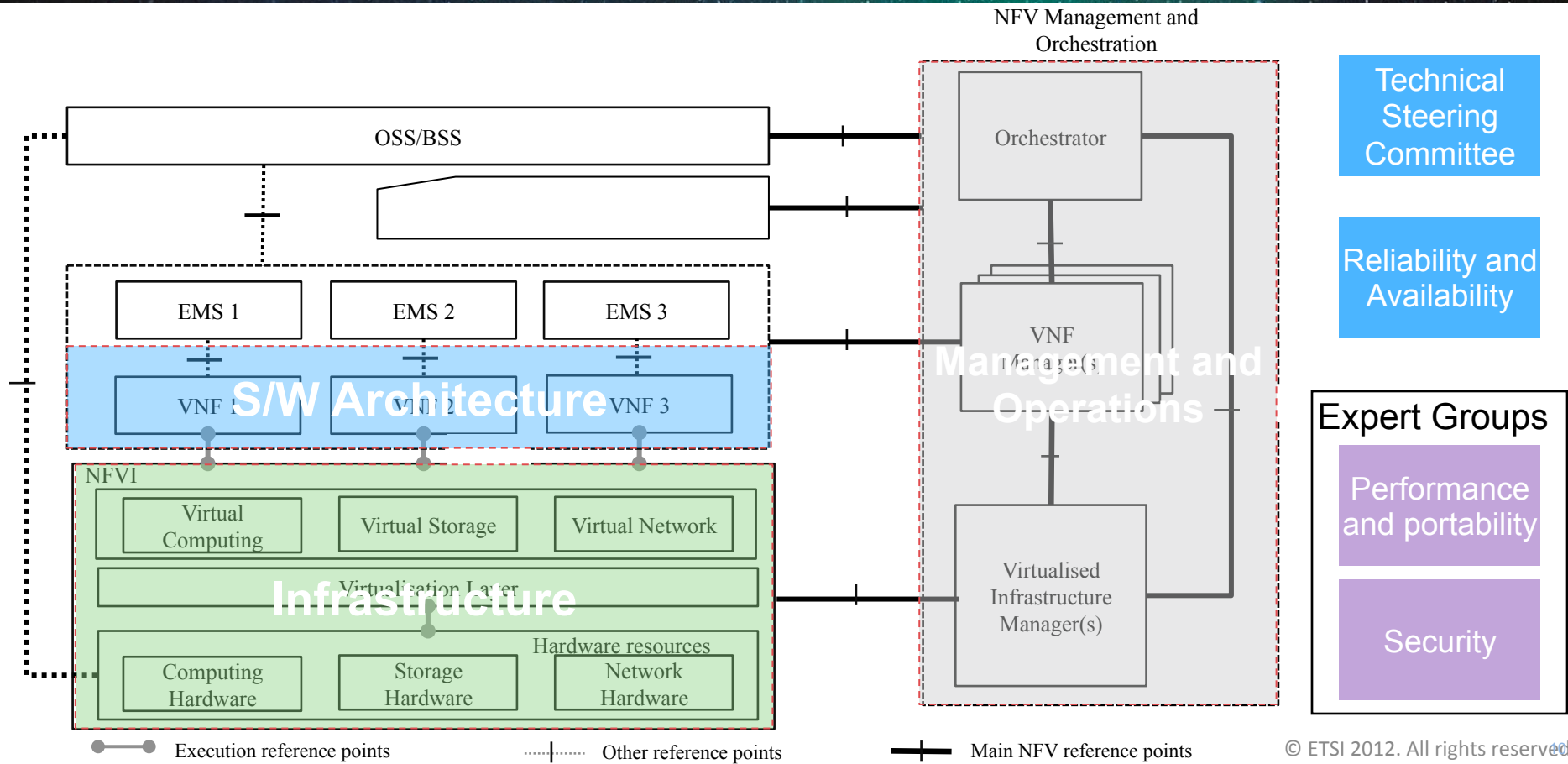
## NfV and Standardization



# Network Functions Virtualization history

- Brought to prominence in October 2012  
13 operators published a white paper, **coining the term** Network Functions Virtualization (NFV)  
Announced and the highlight of the “SDN and OpenFlow world Congress in Darmstadt
- Formal process based on an ETSI Industry Standard Group (ISG)  
Created January 2013  
Anticipated lifetime 2 years
- Role of NFV part 1  
Use cases, architecture and terminology, highlighting of functional gaps  
Output is informational
- Role of NFV part 2  
Format, terms of reference etc. under discussion  
Continue when NFV part 1 completes  
Likely to be more normative in nature than NFV part 1

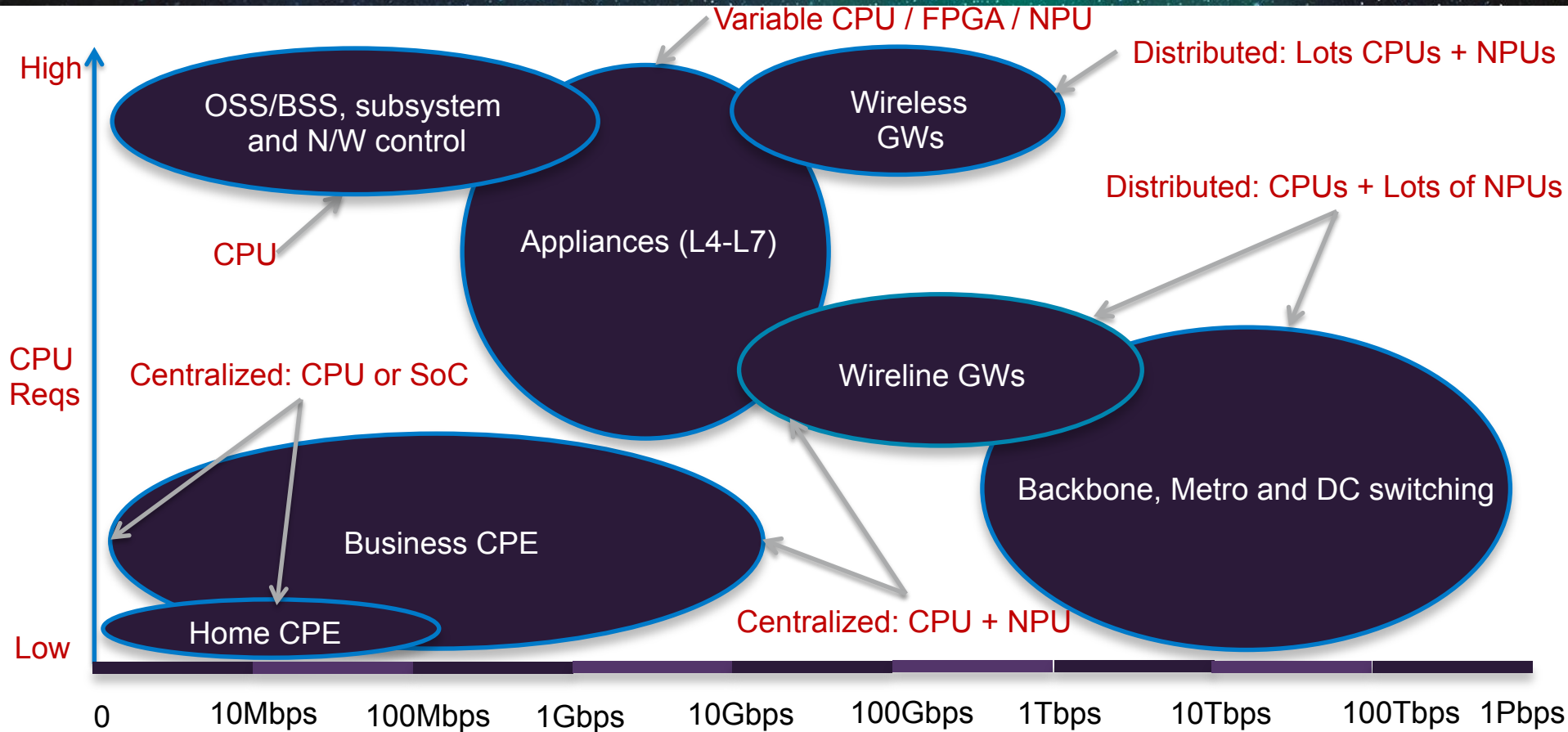
# ETSI NFV Organization





## Applicability of NfV

# Network solutions: Design approaches



# Virtual Network Functions (VNF) – evaluation criteria

- Physical Design Requirements

interface count, interface size, system design requirements, specialist N/W functions

- Performance Requirements

L1-L3 packet performance, CPU processing, fabric capacity

- Network Architecture

Will virtualization fit the network architecture principles of the network

- Elasticity of the service

- Economics

Onboarding, CapEX and OpEx

# Virtualized standard server based solutions – assessment

## Strengths

- High CPU processing functions
- Not extreme packet processing
- Low physical interface counts (<20)
- Low-medium interface speeds
- Ethernet interfaces (copper 10/1000/10Gbps)
- Standard hardware server builds
- Elastic services where h/w can be redeployed

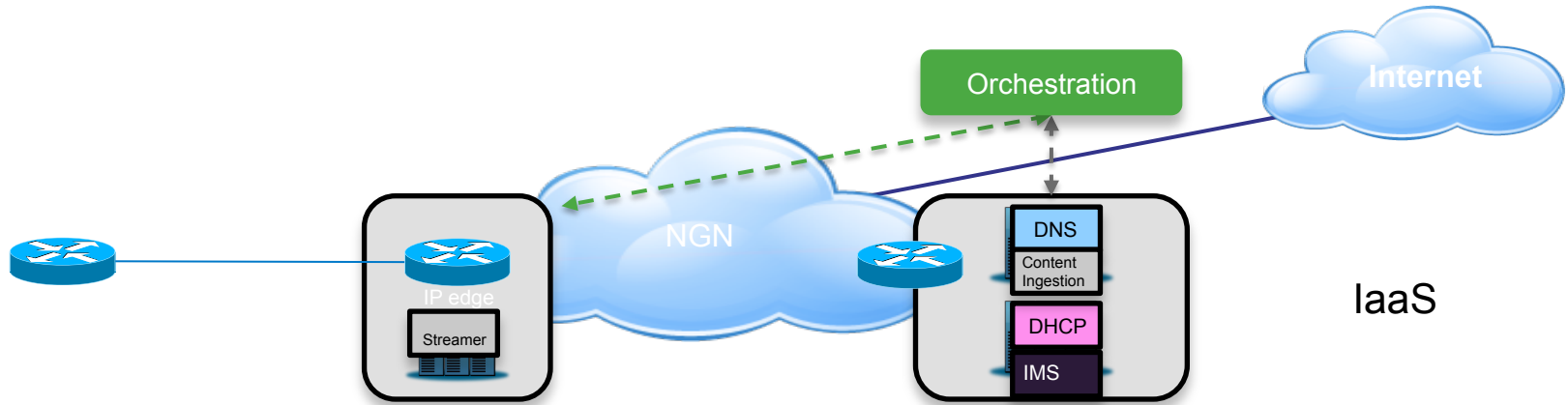
## Weaknesses

- Very high packet processing
- Specialized SP design and h/w functionality
- High physical interface counts (>20s)
- High interface speeds (>40G)
- Diverse interfaces types
- Unpredictable performance metrics



## NfV Use Cases

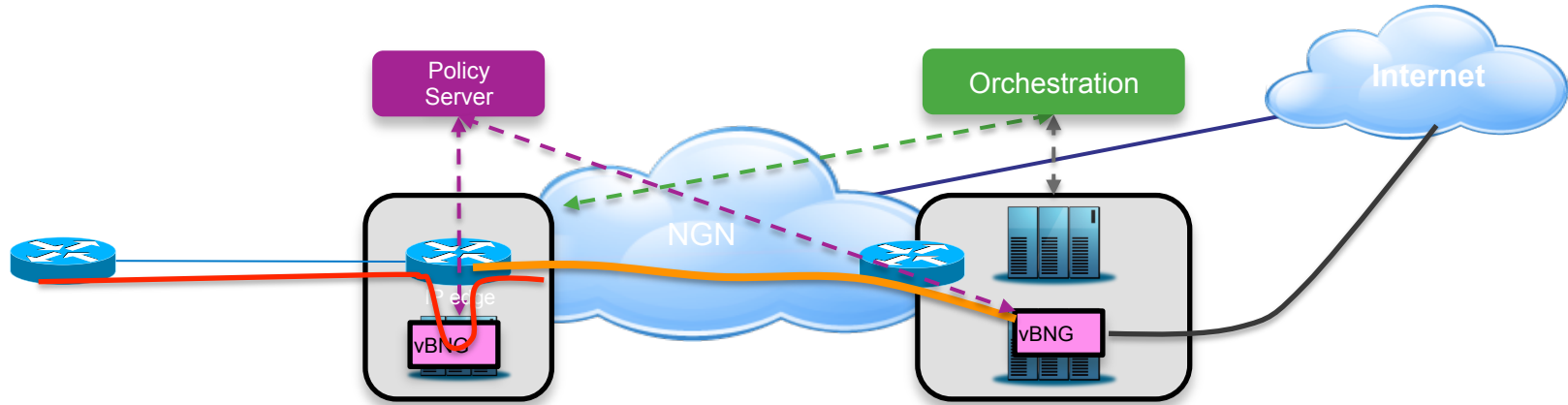
# Nfv use case: Virtualized SP / 3<sup>rd</sup> party applications



- Many examples  
OSS/BSS, voice and video solutions, N/W control, video/collaboration solutions, wireless/Wi-Fi, security
- NFV transition well underway
- There are several existing products in this space  
See earlier slide for details
- New solutions coming think and fast

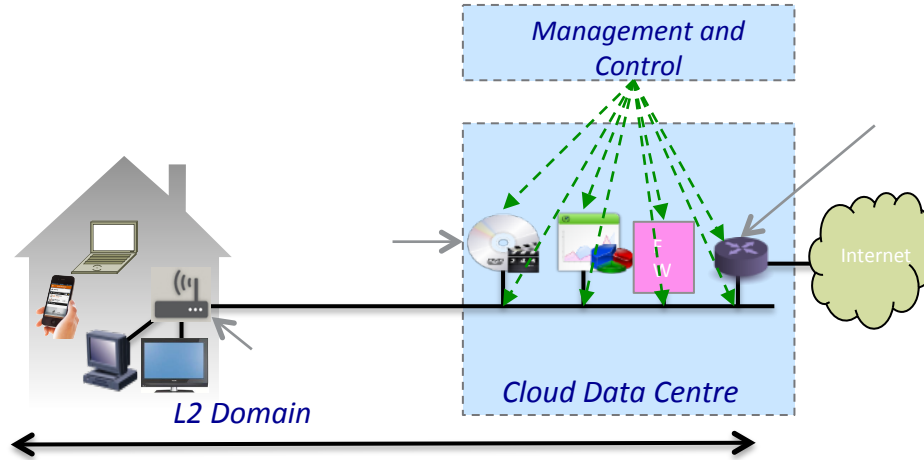


# NfV use case: Virtualized Edge Gateway



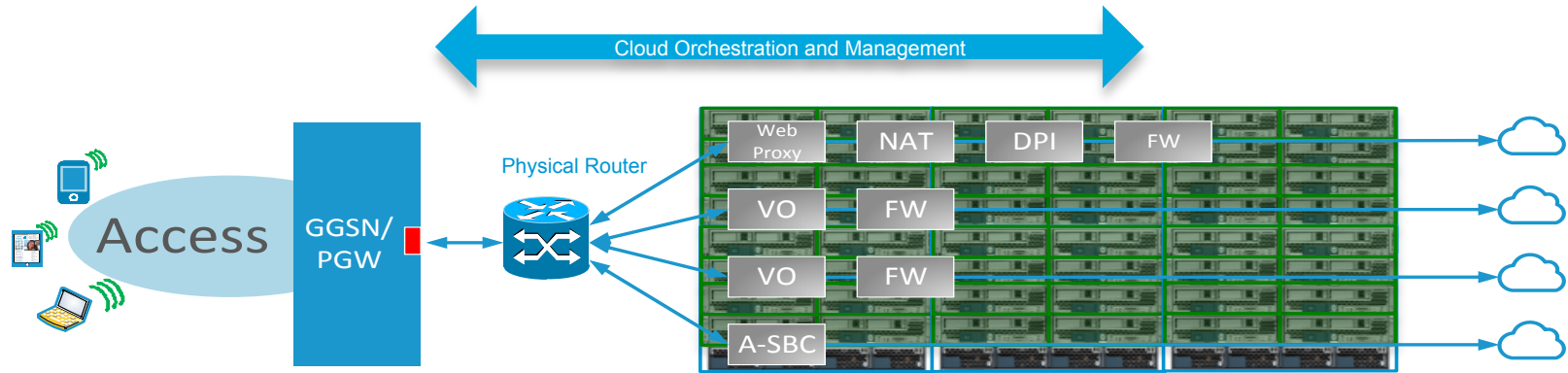
- Vendors have complementing existing h/w gateway solutions with virtualized g/w solutions
- vPE, vBNG/BRAS based on Cloud Service Router
- Virtual mobile gateways (MME, S/PGW)
- CableLabs have kicked off work on vCMTS
- Virtualized gateways may require architectural changes  
Virtual racking and stacking

# NfV use case : Virtual residential gateway



- Quantum Virtual Broadband Node  
L2 domain between home and data center  
Virtualized CPE and home services in the cloud

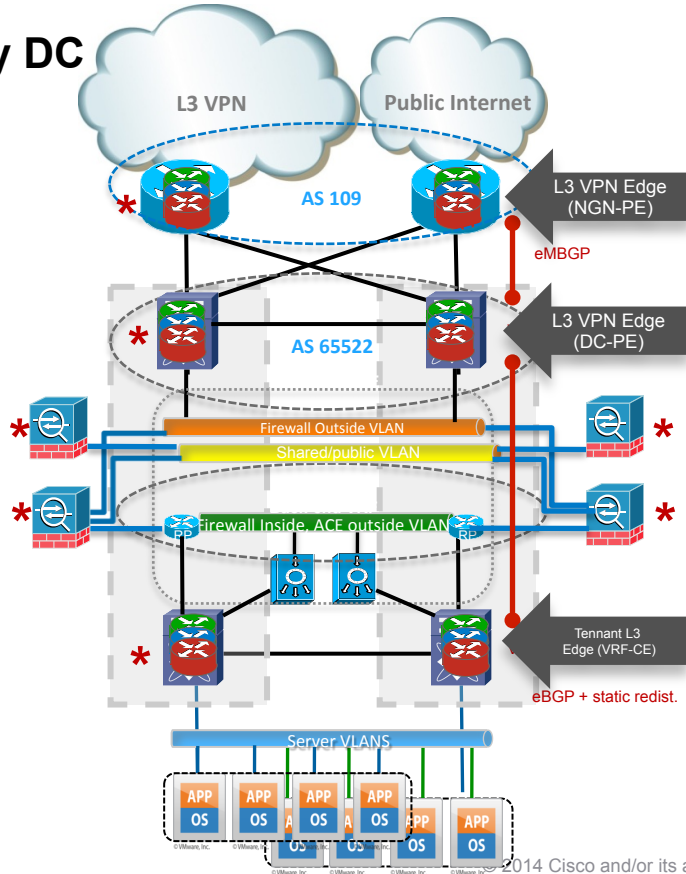
# NfV use case: Virtual Service Infrastructure



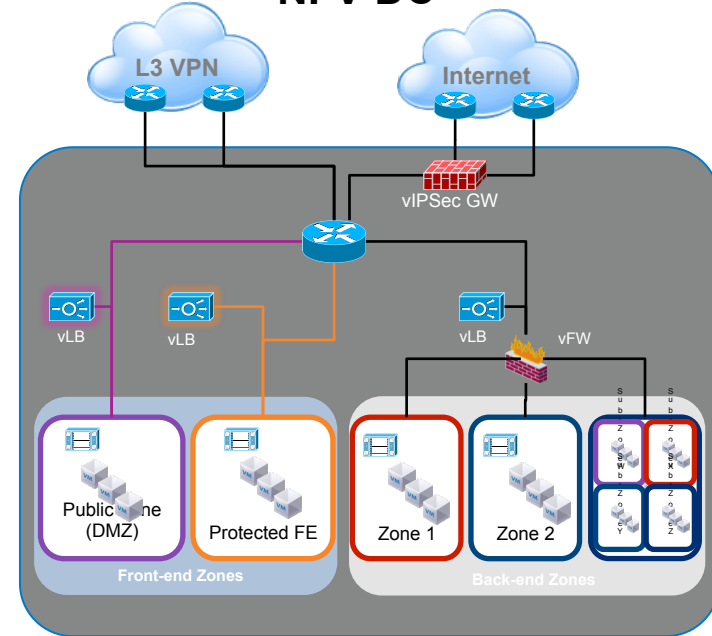
- Simple reconfiguration of service chains via SDN and virtualization tools
  - Improved scaling
  - Elastic services

# Data Center Evolution

## Legacy DC



## NFV DC

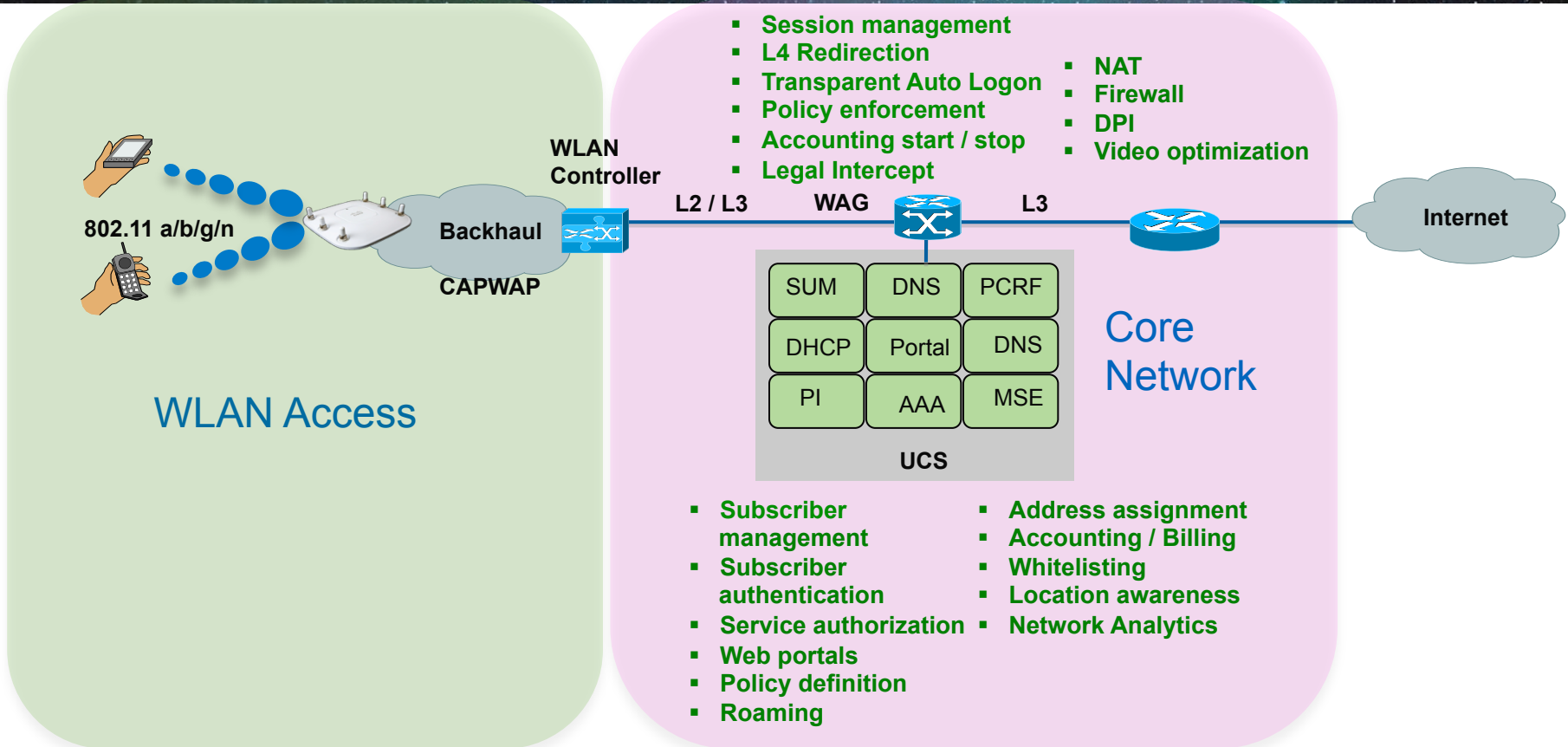


**Virtualized Compute and DC overlay**  
 Agility (Create/Delete), Scale, Flexible Topologies, BYOD, Elasticity,  
 Utility Based Pricing

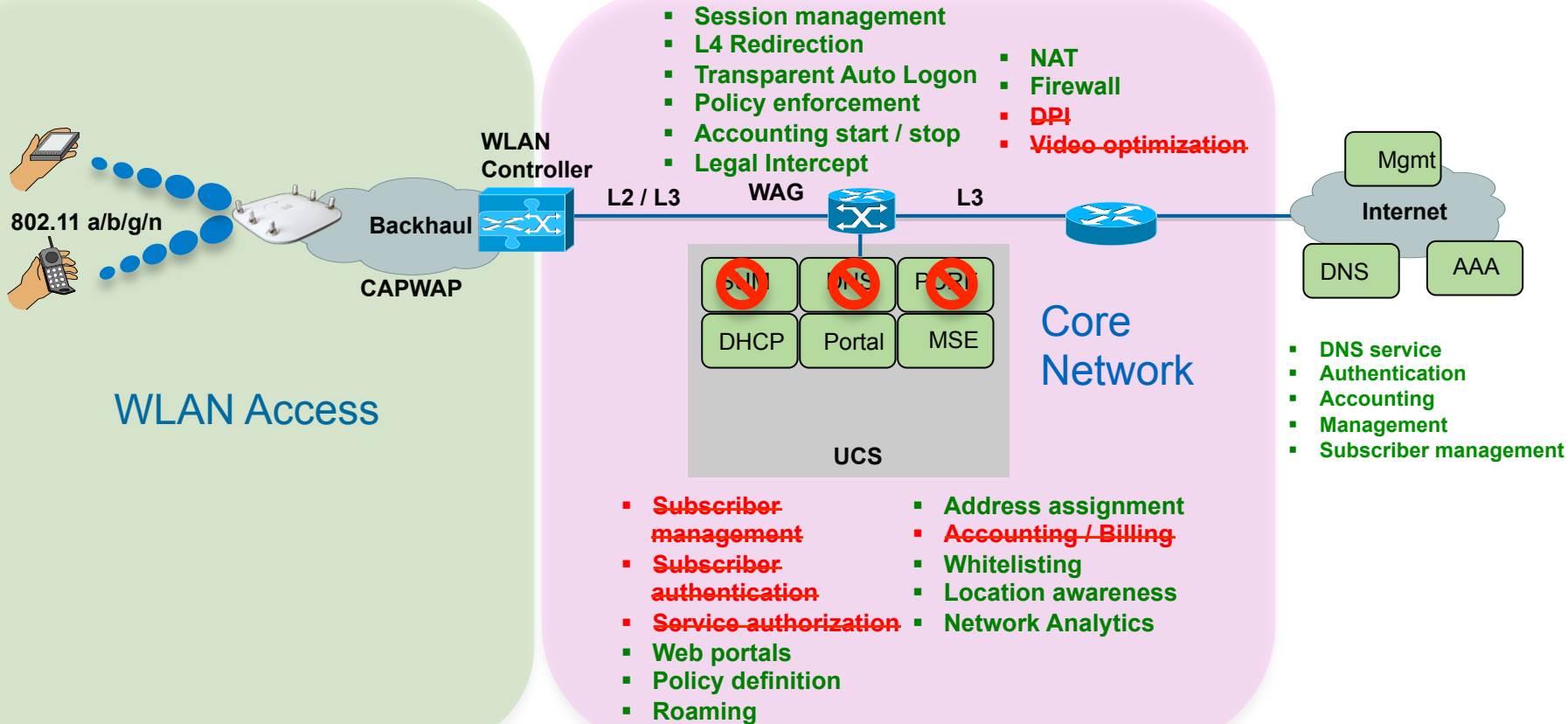


## Case Study: Virtualizing Service Provider Wi-Fi Core

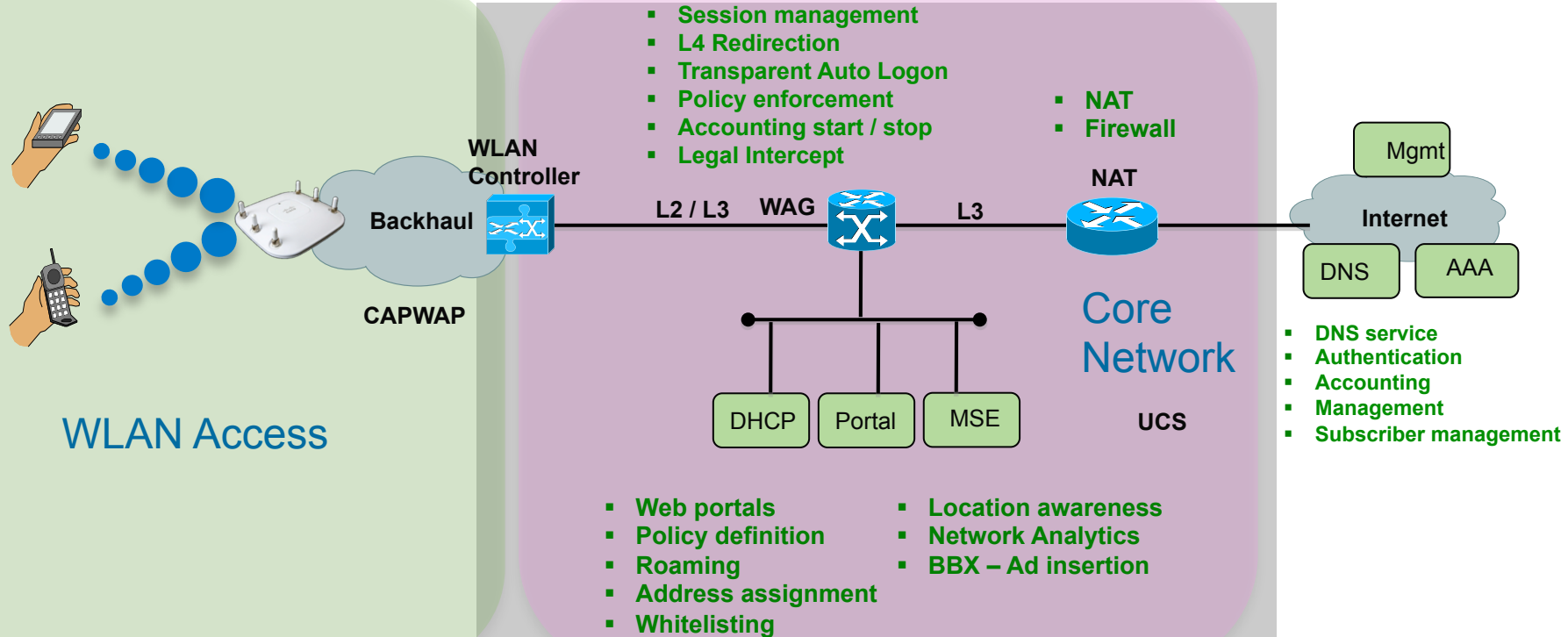
# Wi-Fi E2E Solution Architecture



# What to virtualize?

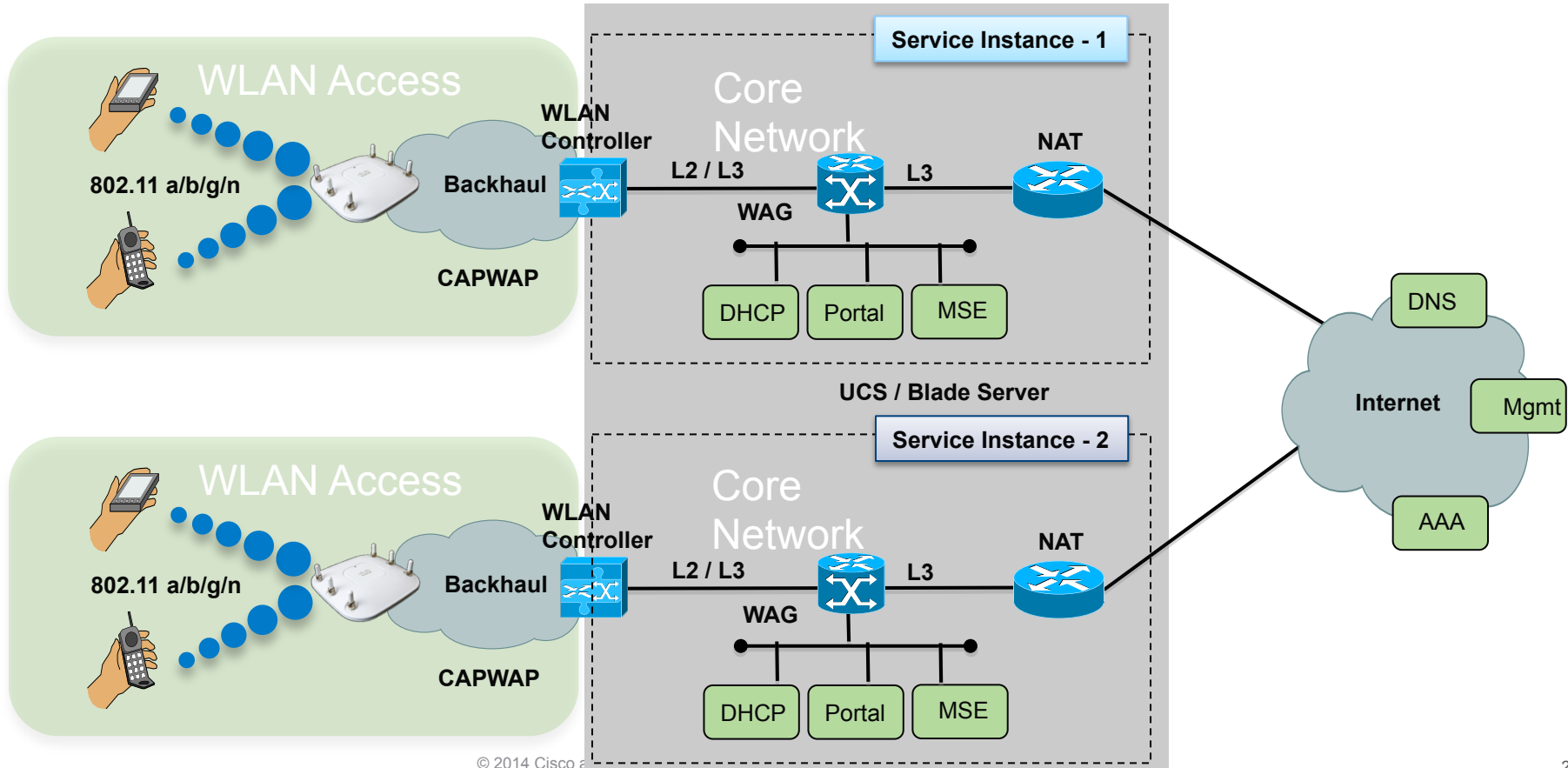


# Virtualized Wi-Fi instance





# Virtualized Wi-Fi Service Instances

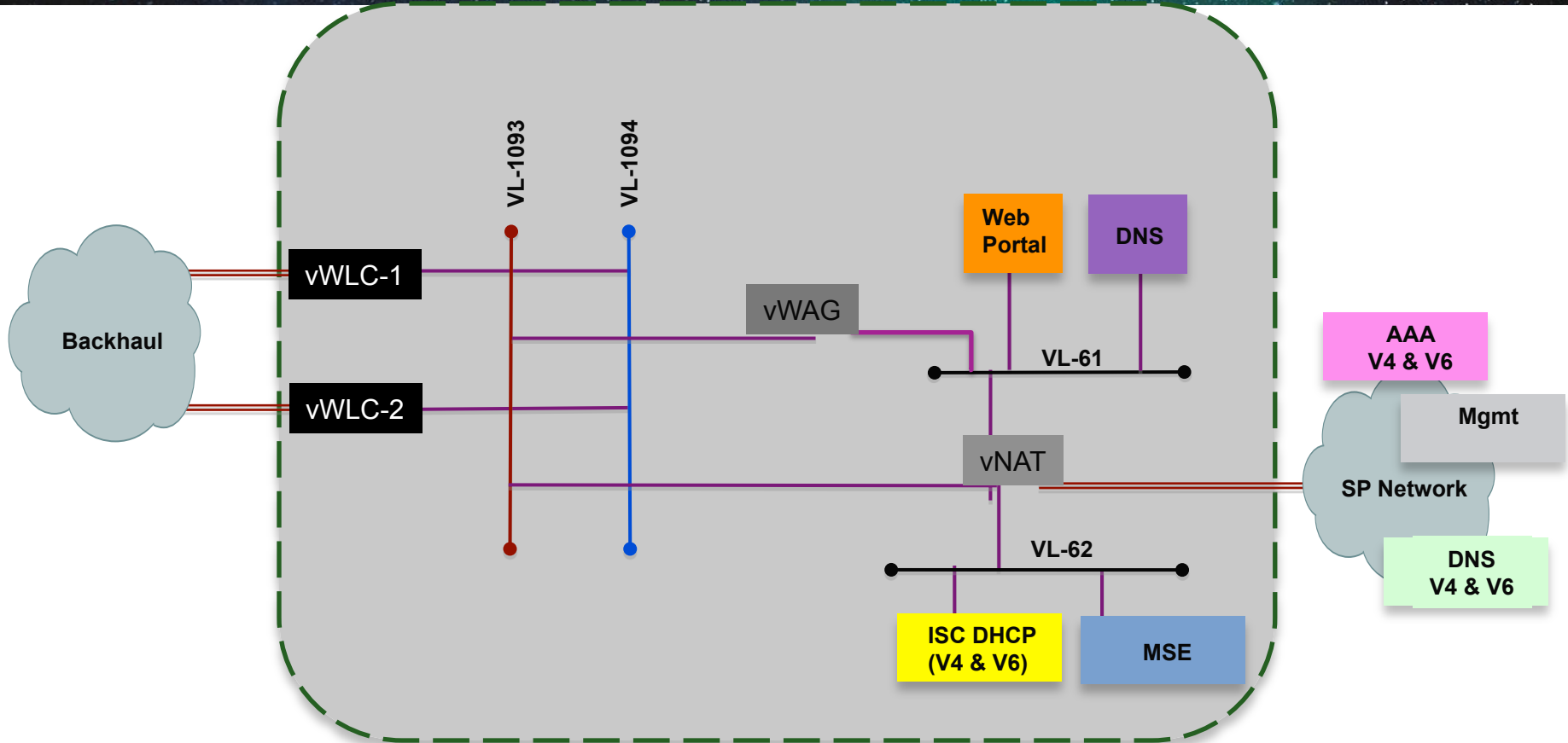


# Differences between service instances

- IP addresses for all components on the SP management network
- Public IP addresses for virtual WLC's
- NAT pool for each service instance
- VLAN's must be unique per service instance within a cluster

Everything else remains the same across ALL service instances

# Virtual Wi-Fi (inside of a service instance)



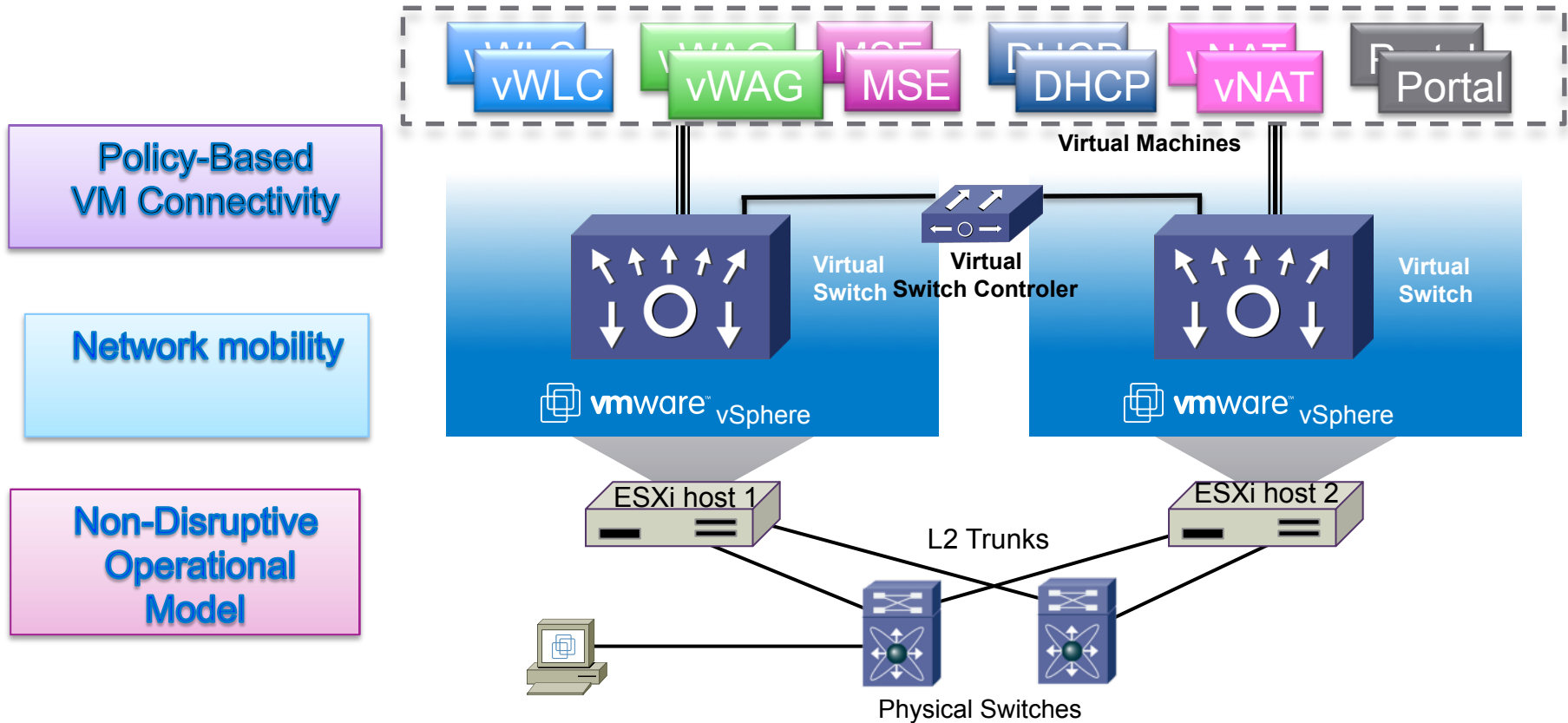
# Summary

- The backdrop to NfV and all network evolution is increasing amount of network traffic
- Both vendors & SP's are experimenting with NfV
- Caution: NfV doesn't mean EoL of your production hardware
- NfV: some functions are obvious / large spectrum are dependent on SP and their architecture
- A hybrid network environment consisting of blend of custom NFs and Virtualized NFs (VNFs)

Thank you.



# Layer 2 Connectivity with Virtual Switch

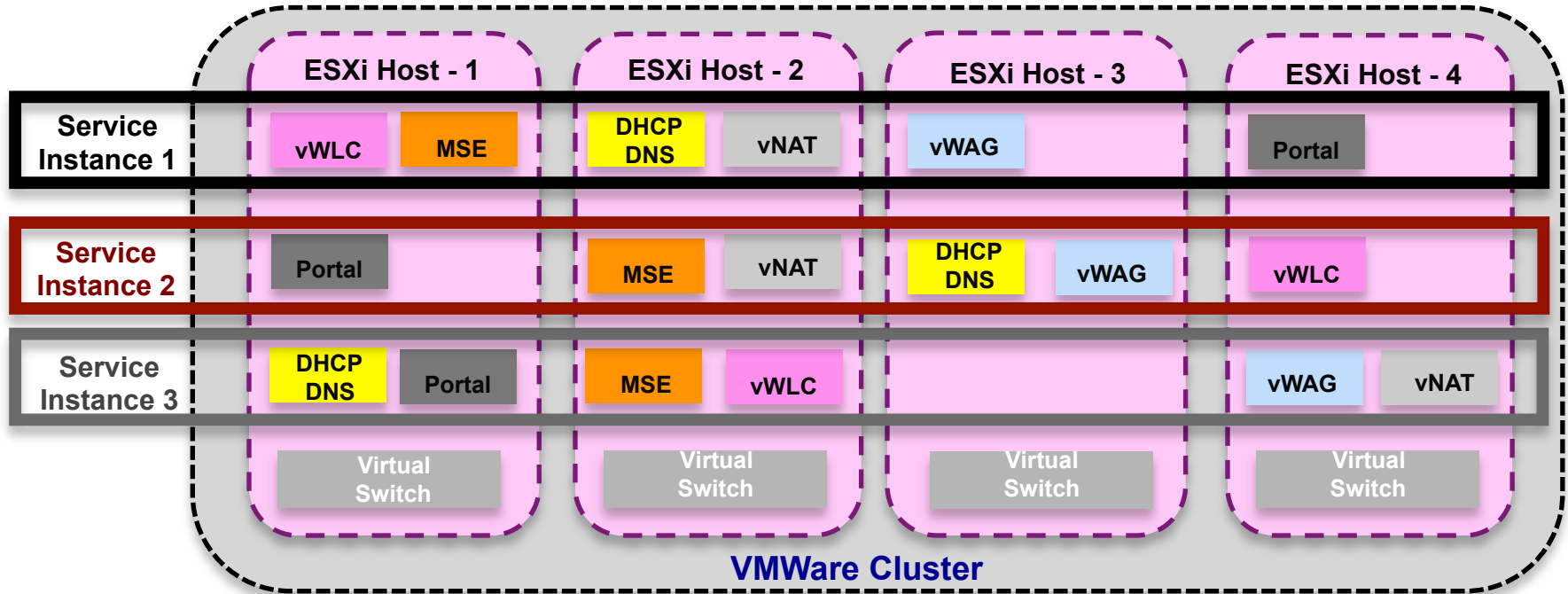


Policy-Based VM Connectivity

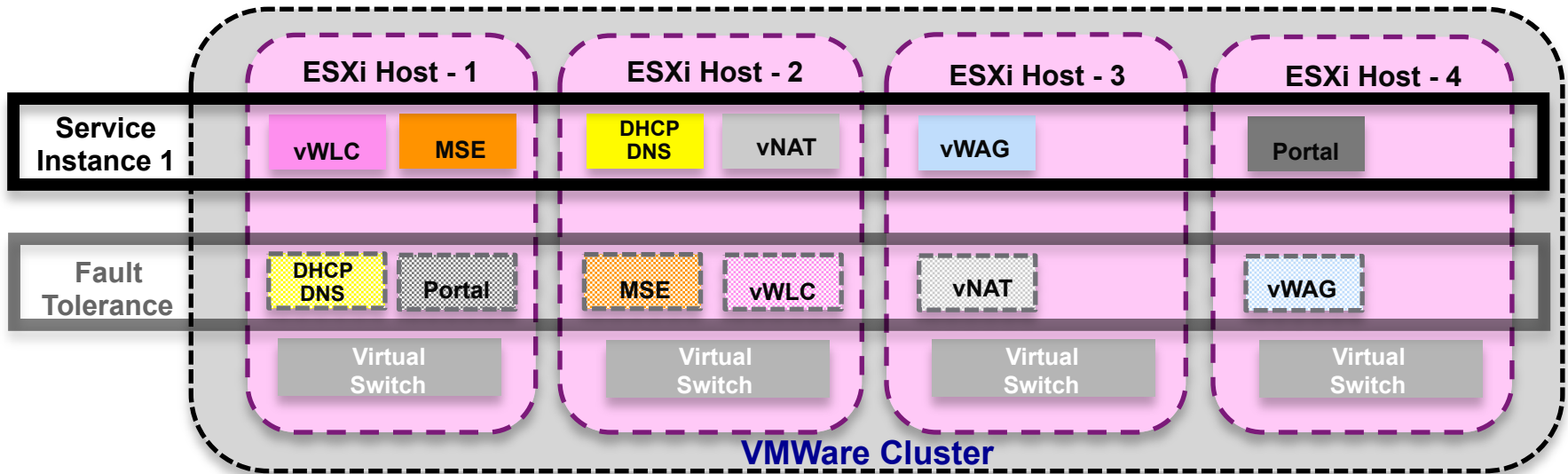
Network mobility

Non-Disruptive Operational Model

# Service Instances across a cluster



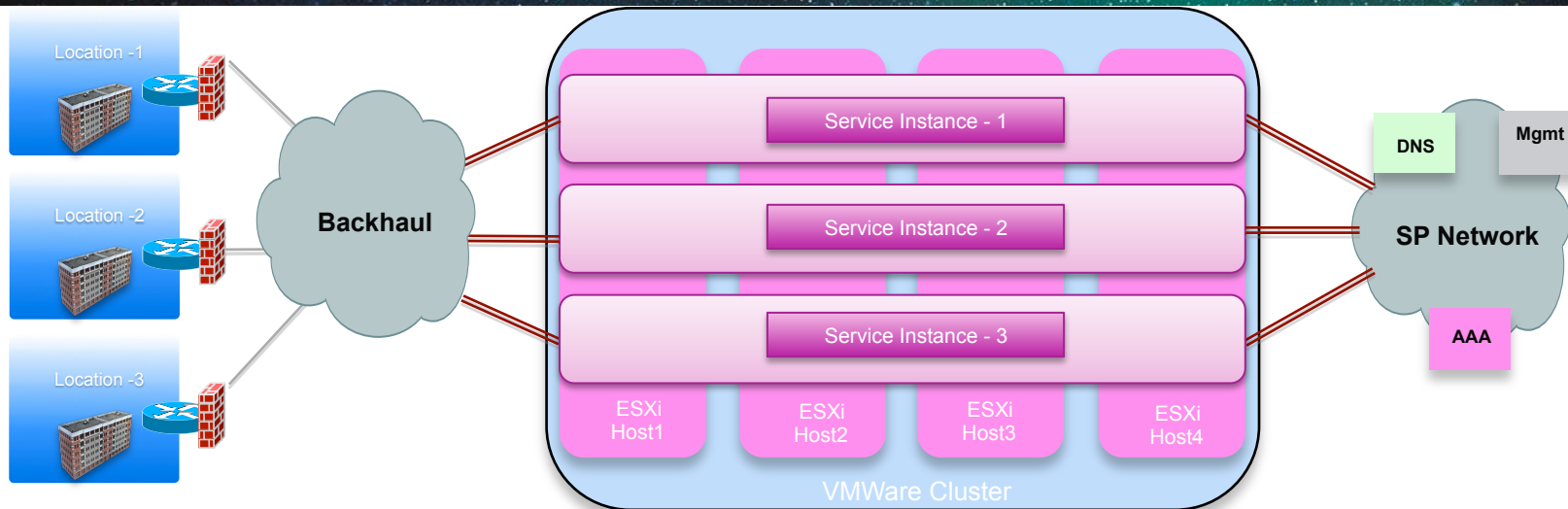
# Fault tolerance for service instances



- Only VM's with a single vCPU can be made fault tolerant
- Virtual hard disk should be set up as Thick eager zeroed
- Only 4 Fault Tolerant VM's per ESXi host



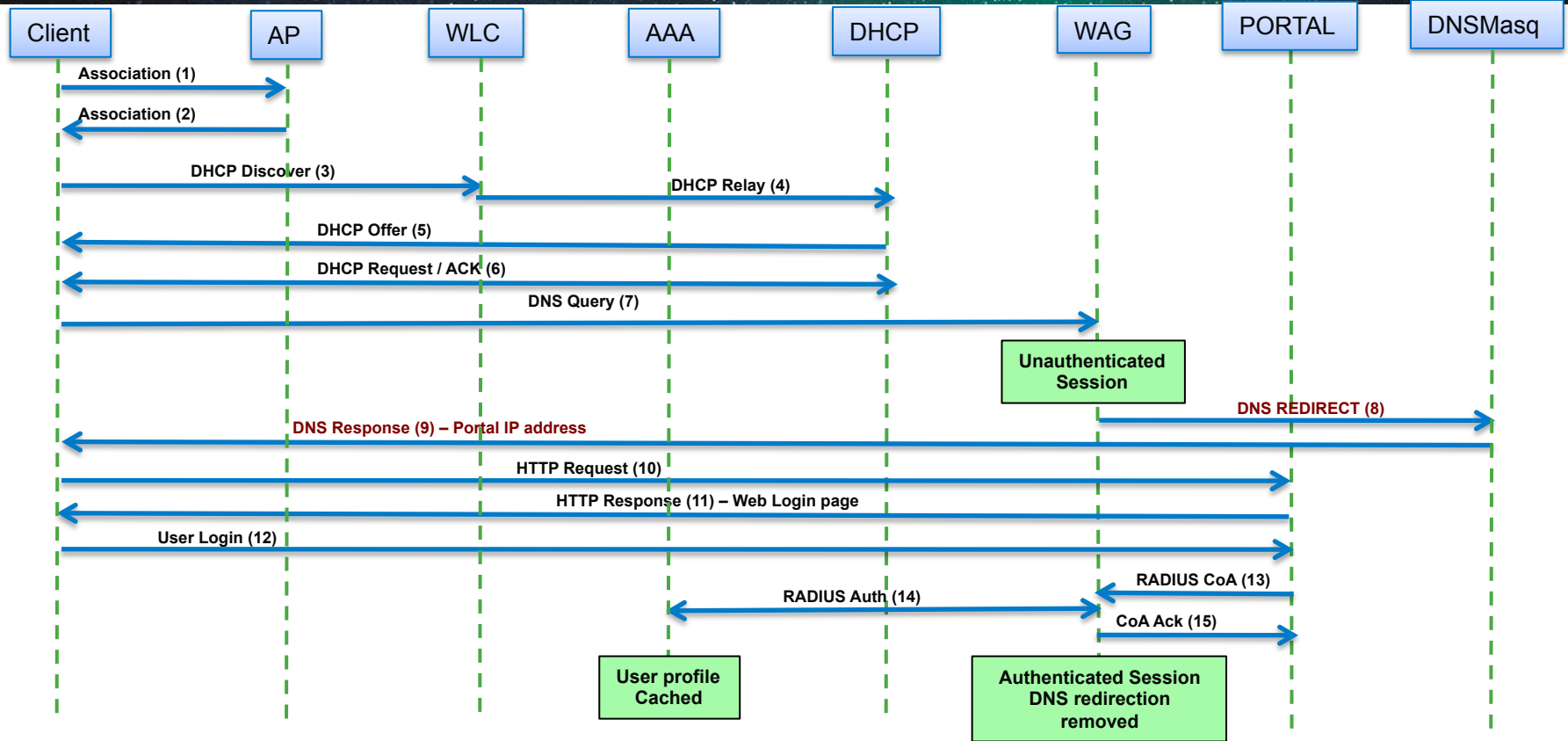
# Wi-Fi service instances



- Consistent subscriber experience
- Centralized asset management
- Customized portal experience
- Shared IP address space
- Separate administration domain
- Custom billing / reporting

- Centralized asset management
- Fault isolation / troubleshooting
- Rapid “cookie cutter” deployment
- Opportunity to customize
- Self service management portals
- License based solution

# Web-Authentication with DNS redirect



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# References

- ETSI - <http://www.etsi.org/technologies-clusters/technologies/nfv/nfv-poc>
- SDN Central - <http://www.sdncentral.com/whats-network-functions-virtualization-nfv/>
- Cisco Live - <http://www.ciscolive.com/>

# Content Contributors

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Thank you.

