

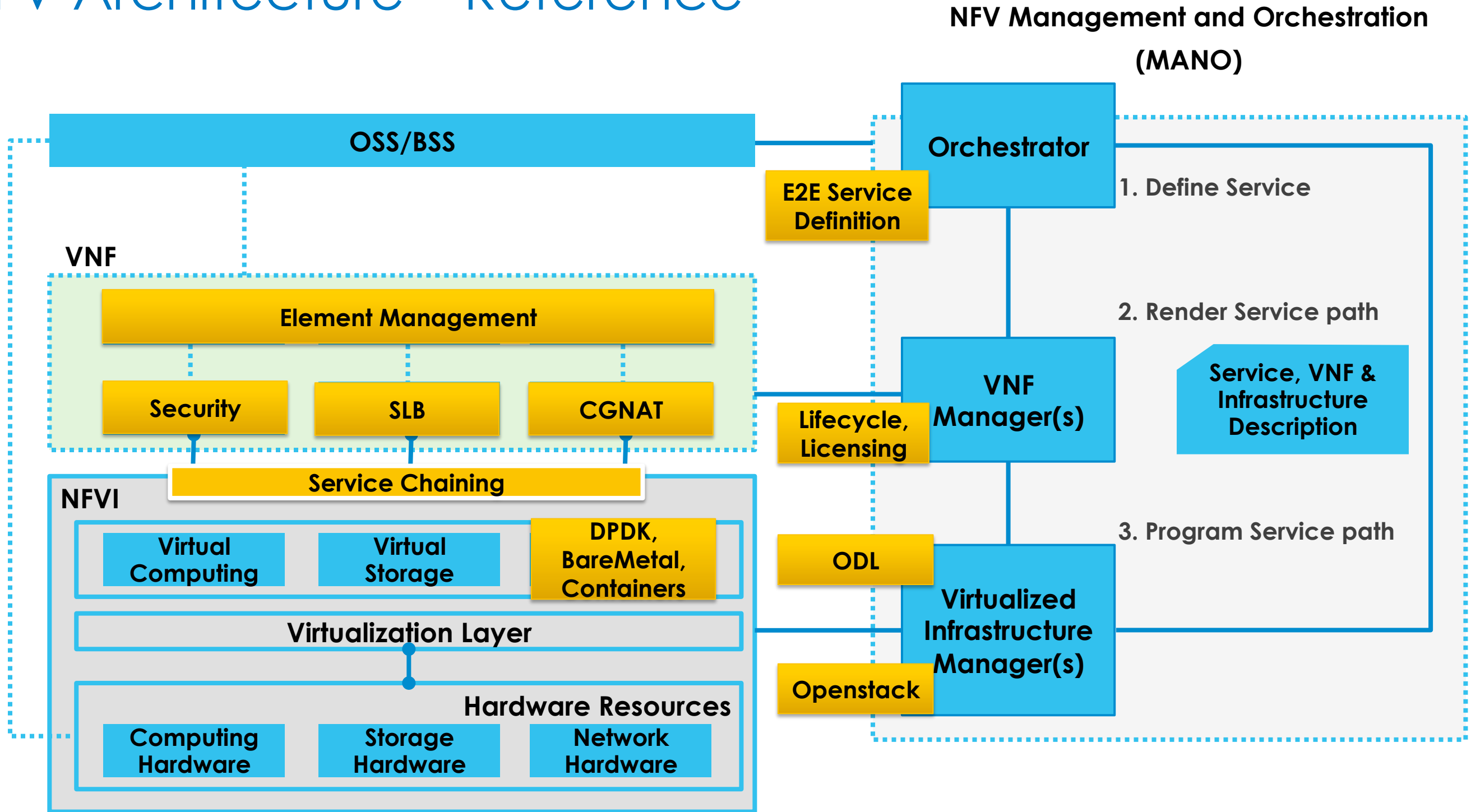
Dynamic Service Chaining for NFV/SDN

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Agenda

- Introduction
 - NFV Reference Architecture
 - NFV Use cases
- Policy Enforcement in NFV/SDN
 - Challenges in NFV environments
 - Policy Enforcement Needs for SDN/NFV environments
- Dynamic Service Chaining Architecture
 - Service chaining standards (SFC, Metadata)
 - Design considerations
- Dynamic Service Chaining Benefits

NFV Architecture – Reference

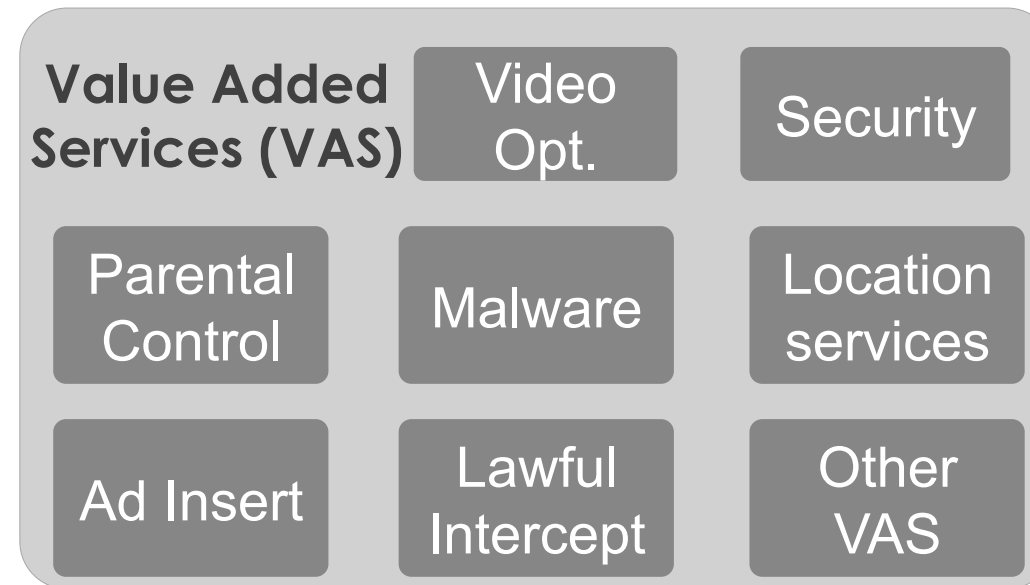
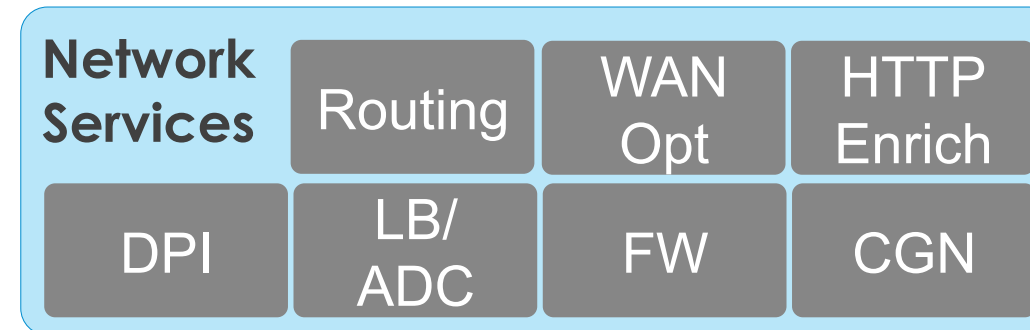


Service Provider: NFV Use cases

User Equipment	Transport Network	Access/Edge
Mobile	3GPP	P-GW
CPE	CATV	CMTS
CPE	FTTH	OLT
CPE	xDSL	BNG

Use cases:

- Mobile: vEPC, vTDF/vPCEF, vIMS, vSecurity
- Fixed: vCPE, vBRAS, vSecurity
- Cable: vCPE, vPE, vSecurity

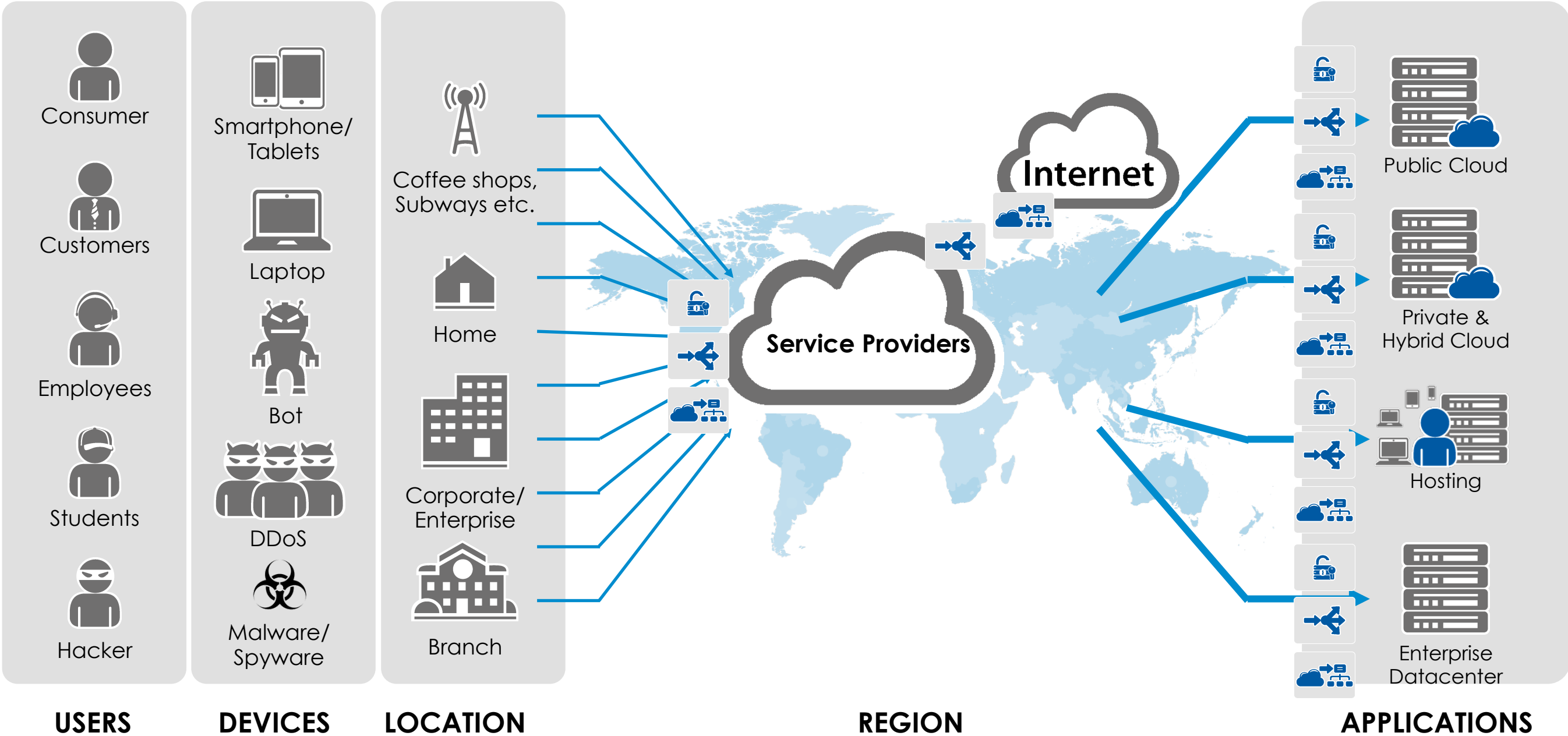


NFV Target
Choice of Form Factors

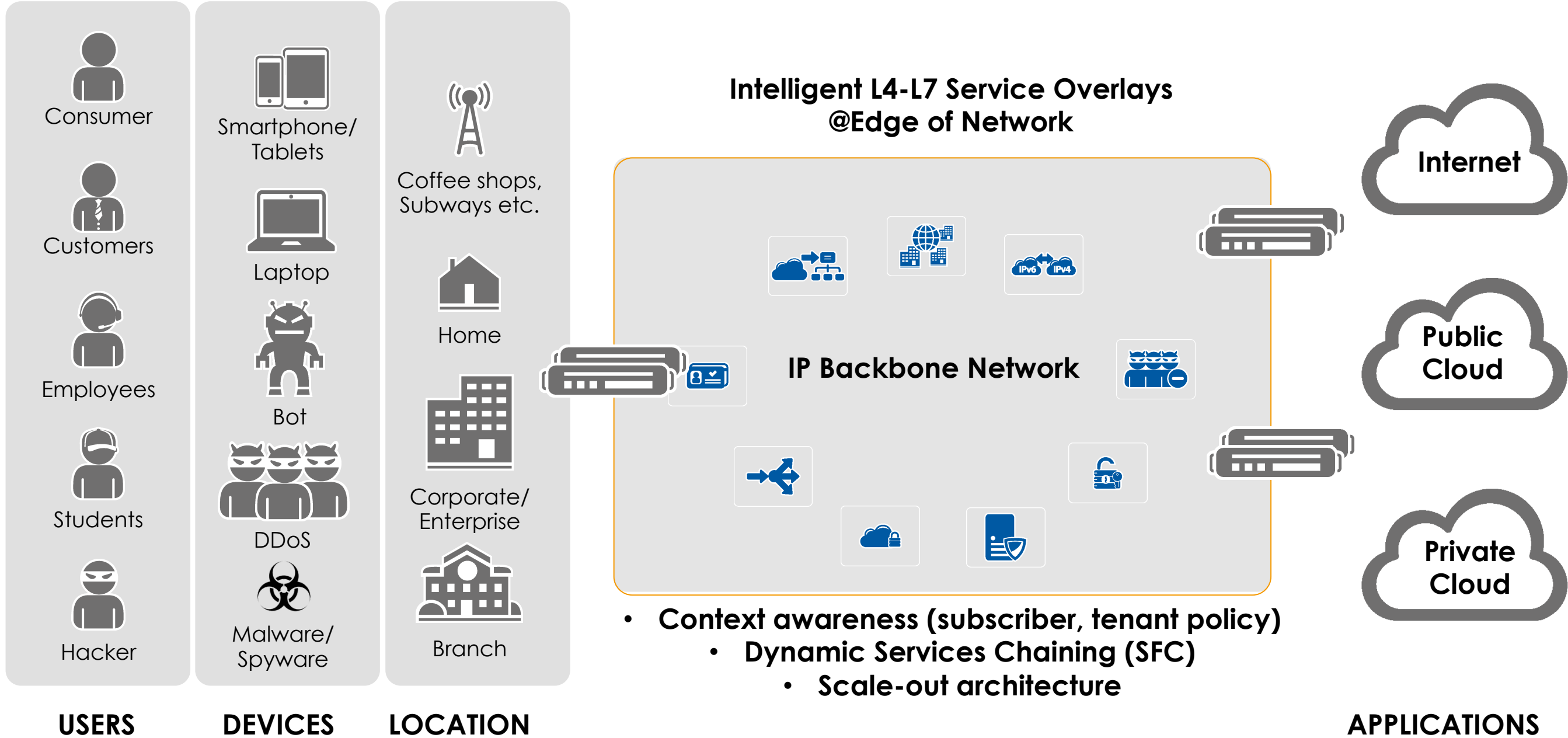
Policy Enforcement in SDN/NFV

Needs & Challenges

The Challenge: Policy Enforcement @ Scale



Solution: Automated Policy Enforcement



NFV Policy Enforcement Needs: Dynamic Service Chaining

Today: Static



Manual & Complex

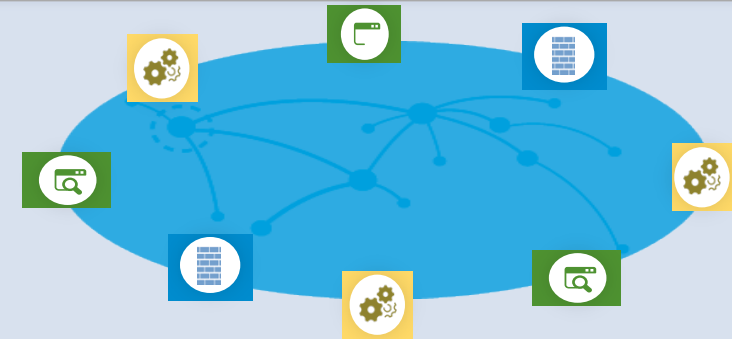
Characteristics:

- Physical Appliances
- Manual Provisioning
- Static Hop by Hop Services
- Basic L2-L3 based Policy classification

Disadvantages:

- Restrictive: Topology dependent
- Sub-optimal: Not context sharing
- Expensive: Overprovisioned resources

Need: Dynamic



Automated & Simple

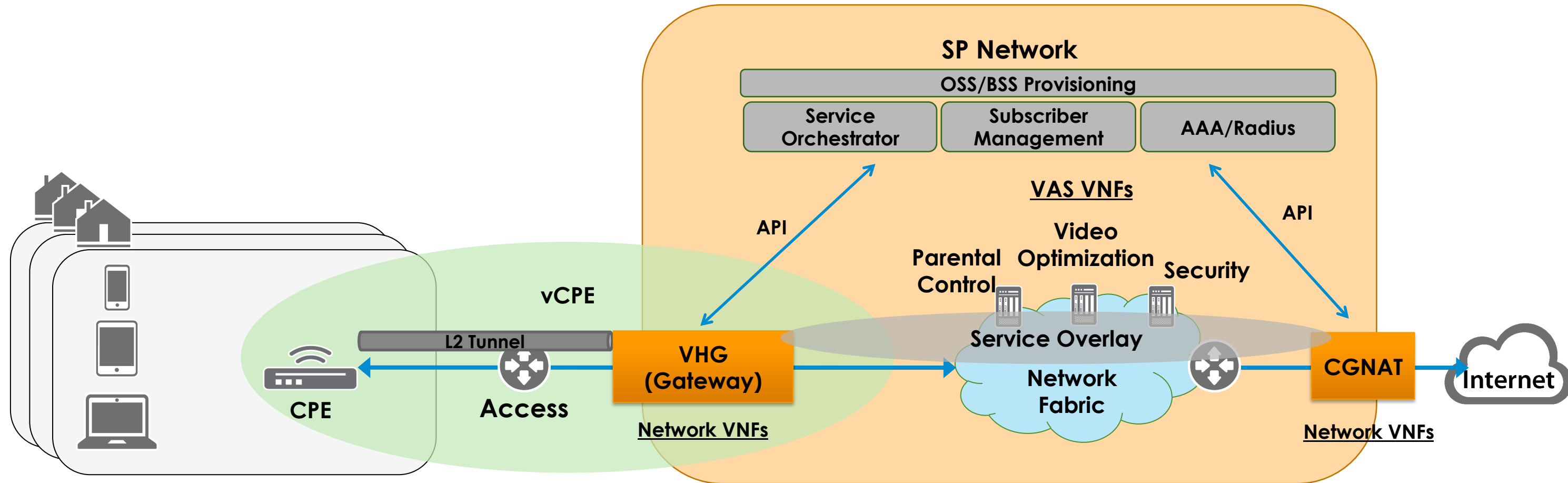
Characteristics:

- Virtual, Physical or Hybrid
- Automated Provisioning
- Intelligent Policy L2-L7 classification

Advantages:

- Flexible: Topology independent
- Optimal: Context awareness
- Cost-effective: On-demand resources

vCPE Example: End to End Solution Requirements



Tunnels:

- Overlays
- L2 for visibility
- Leverage existing Infrastructure

VHG

- Programmability
- Subscriber Awareness
- Policy Enforcement
- Overlays, Tunnels
- Service Chaining
- Scalability

Network Fabric:

- Programmability
- High-speed L2/L3 Interconnect
- Self Healing
- Underlay/Overlay

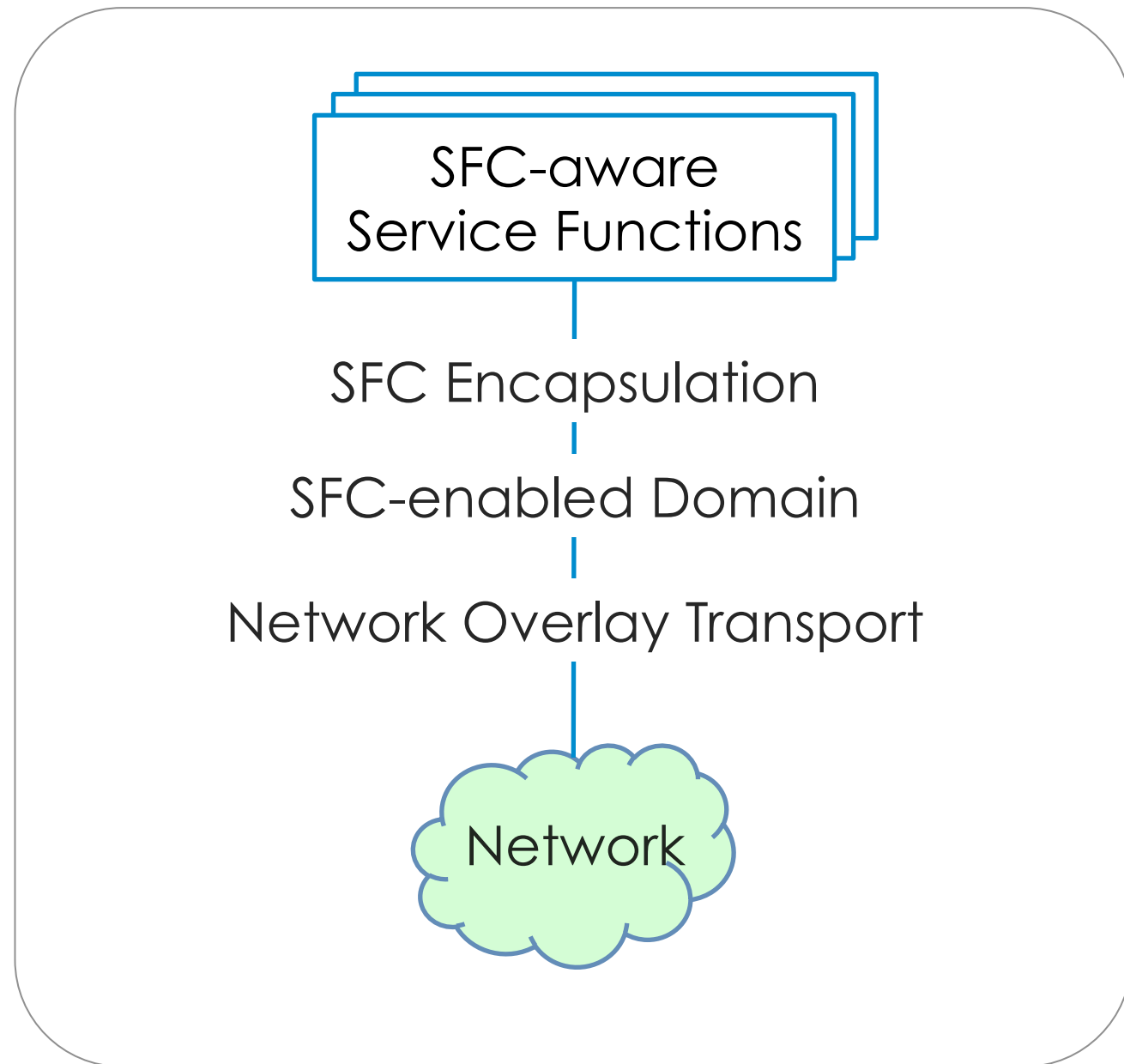
CGN

- Programmability
- High performance
- Integrated Security
- Scalability

Dynamic Service Chaining

Architecture

Standards: Service Function Chaining (SFC)



SFC: Services Overlay Model

- Decouples Service Function from Topology
- Overlays/Underlays for Transport

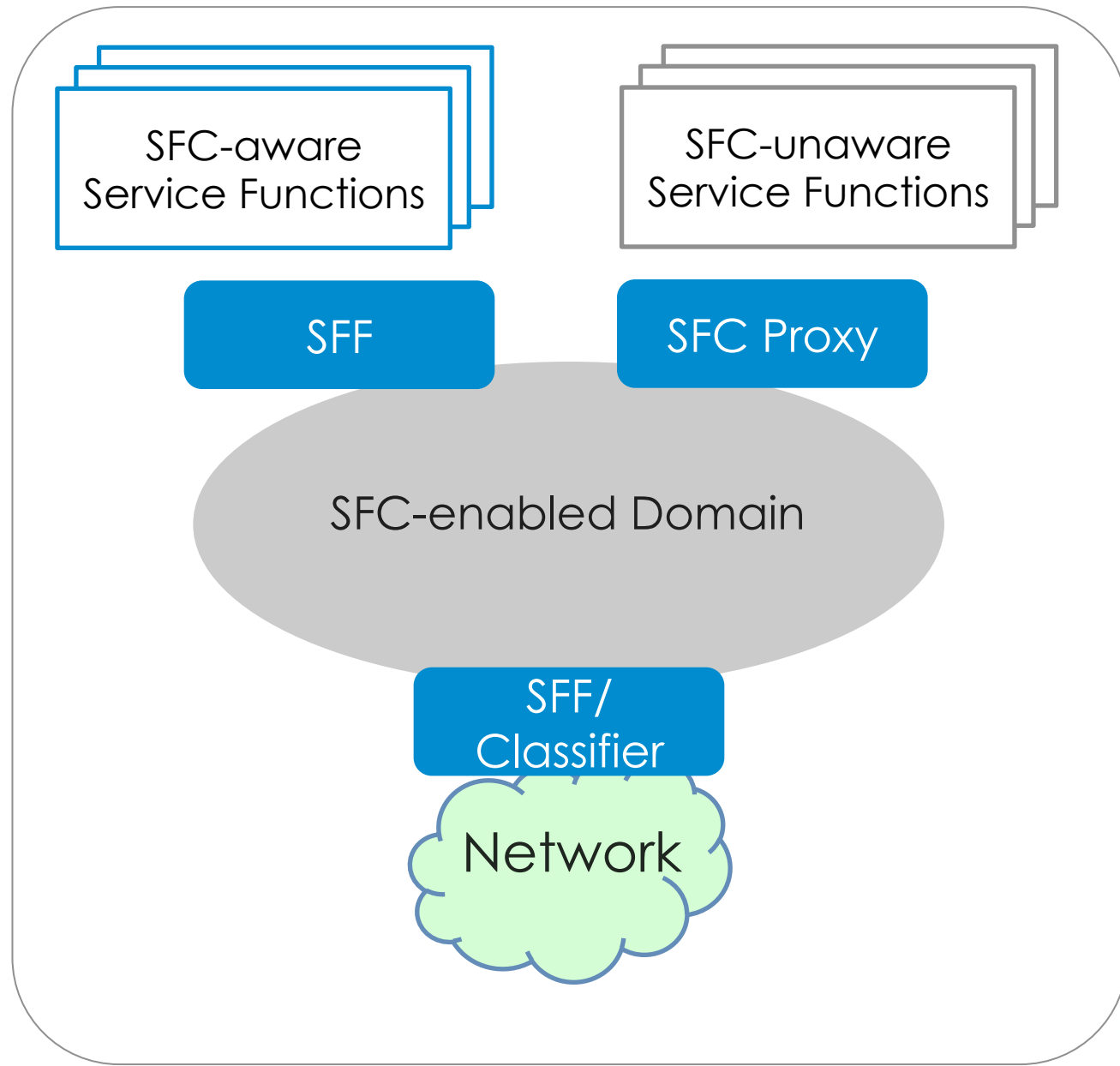
SFC: Orchestration

- Service chain definition
- Service chain instantiation

SFC: Policy

- Policy based Service Chaining
- Transferring Metadata for Context

Standards: SFC Components



SFC Components

Service Function (SF):

- A function responsible for specific treatment of received packets.

Classifier:

- Locally instantiated policy
- Service profile matching of traffic flows for forwarding actions.

Service Function Forwarder (SFF):

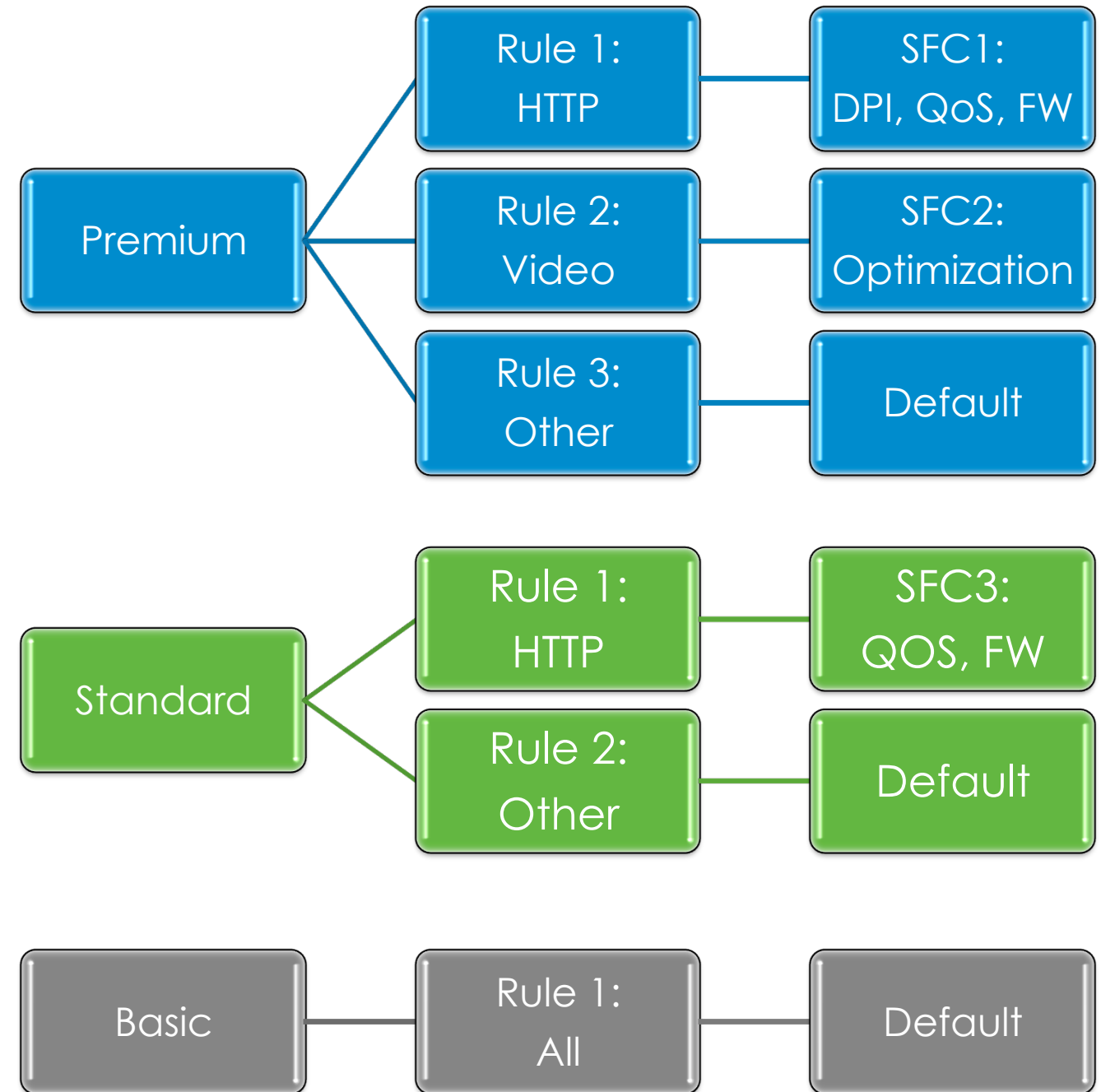
- Forward to one or more connected service functions (SFs).

SFC Proxy:

- Removes and inserts SFC encapsulation on behalf of a SFC-unaware service function.

Policy Model

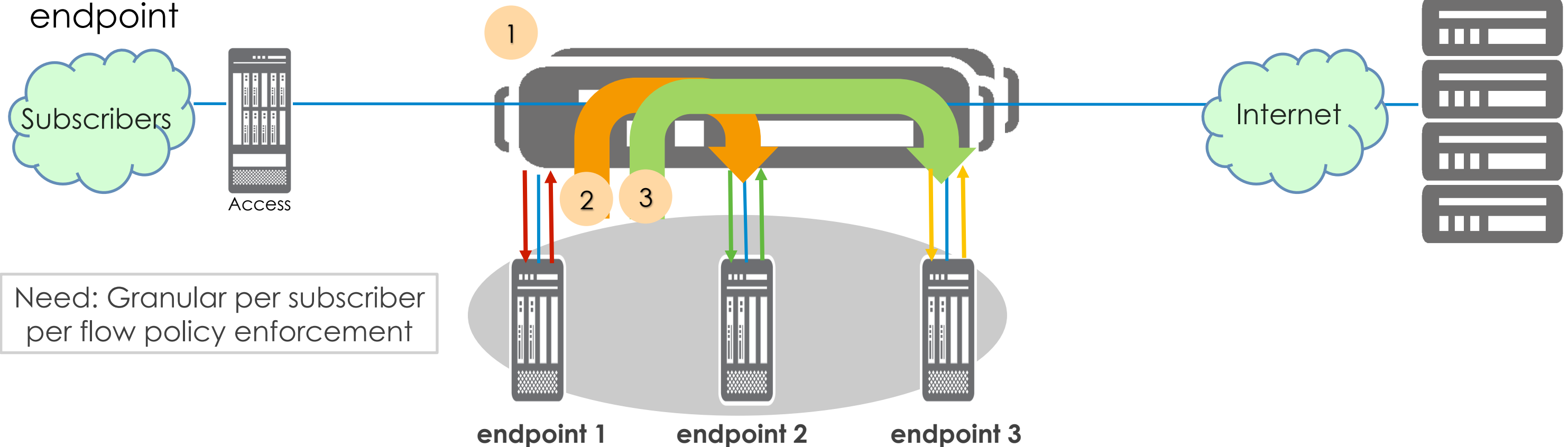
- Policy is a set of policy rules
- Rule consists of a condition-action pair
 - Detects a flow belonging to the Subscriber
 - Identify set of value added services per policy
 - Provide policy control for the flow
 - Report statistics and charging parameters



SFC (Classification, SFF) – Policy Enforcement

- Traffic coming from the endpoint is processed by the classification engine based on conditions
- The next policy action is identified based on policy decision
- Traffic is diverted to the next chain endpoint

1. Rule 1: if condition_1, forward to endpoint 1
2. Rule 2: if condition_2, forward to endpoint 2
3. Rule 3: If condition_3, forward to endpoint 3



SFC/SFF: Transferring Metadata

- Examples of metadata
 - Subscriber-ID
 - Application-ID
 - Service-Profile-ID
 - Service-Chain-ID
- Certain types of information are expensive to extract
- The objective is avoiding repeated execution of expensive operation

What to transfer: Subscriber Identity or Policy Decision?

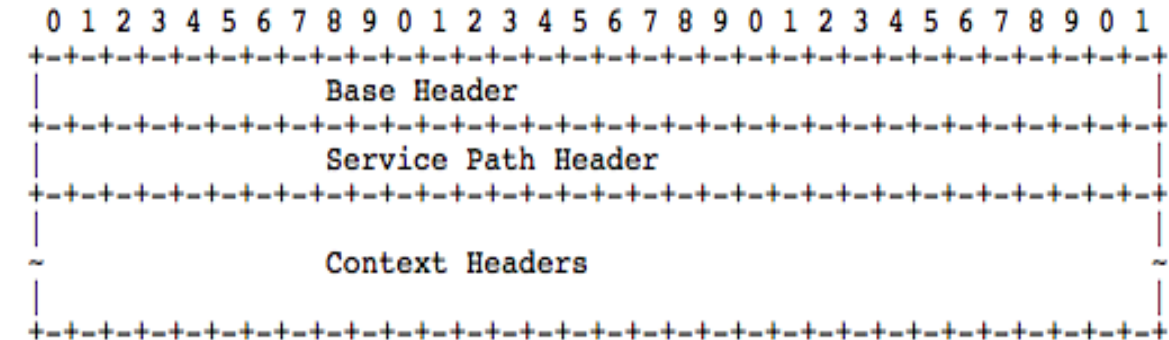
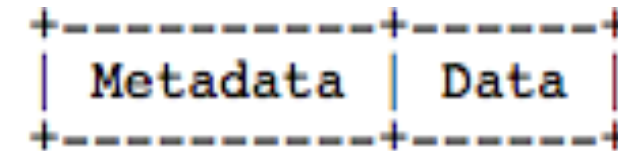
Transferring Metadata – Where the standard is going?

In-band transferring

Labeling
(IPv4, IPv6, TCP options extensions)

Network Service Header (NSH)

Application
(HTTP Header Extensions)



HTTP Request

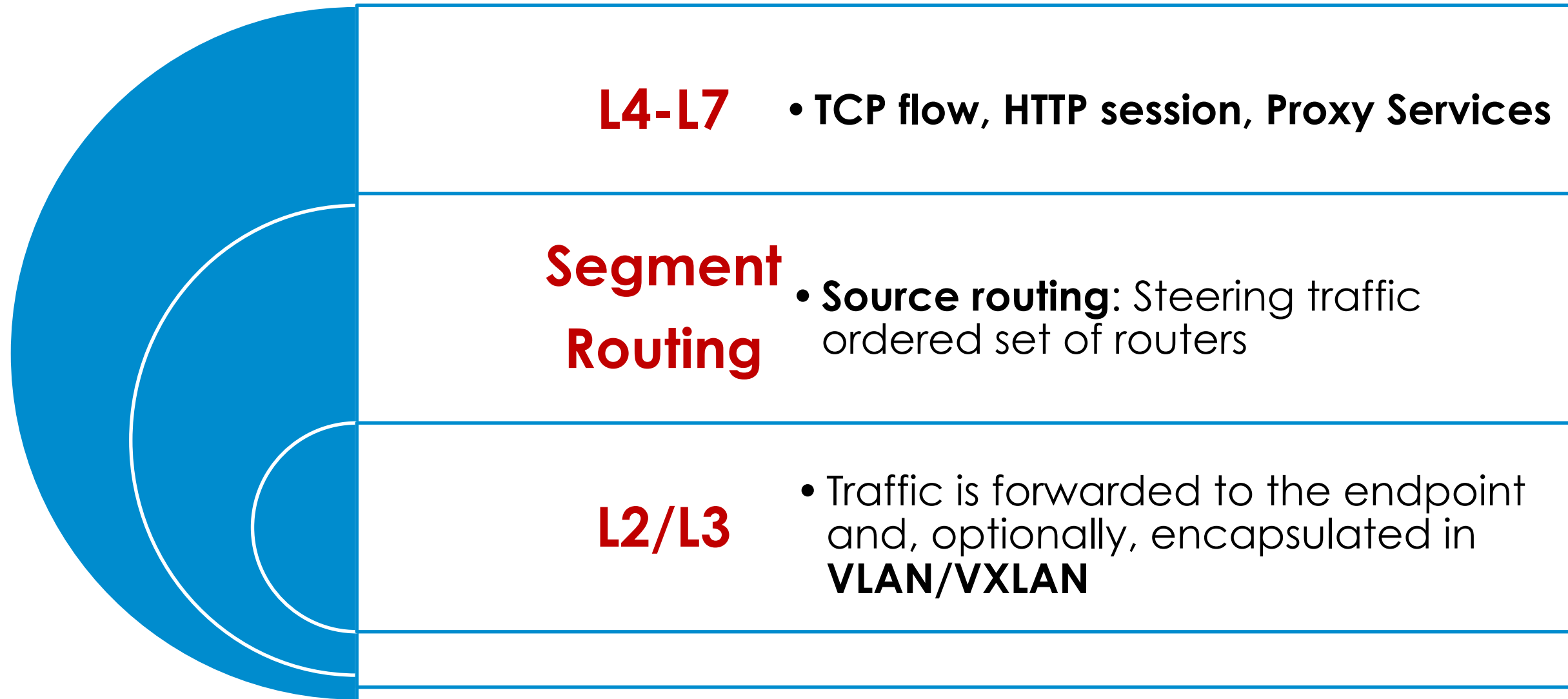
```
+-----+  
GET / HTTP/1.1  
Host: www.google.com  
Connection: keep-alive  
Cache-Control: max-age=0  
Accept: text/html,application/xhtml+xml  
User-Agent: Mozilla/5.0 (Windows NT 6.1)  
Accept-Encoding: gzip,deflate  
Accept-Language: en-US,en;q=0.8  
Metadata-Subscriber-ID: 12345  
Metadata-Application-ID: 67890  
+-----+
```

Source:

<https://tools.ietf.org/html/draft-rijnsman-sfc-metadata-considerations-00>

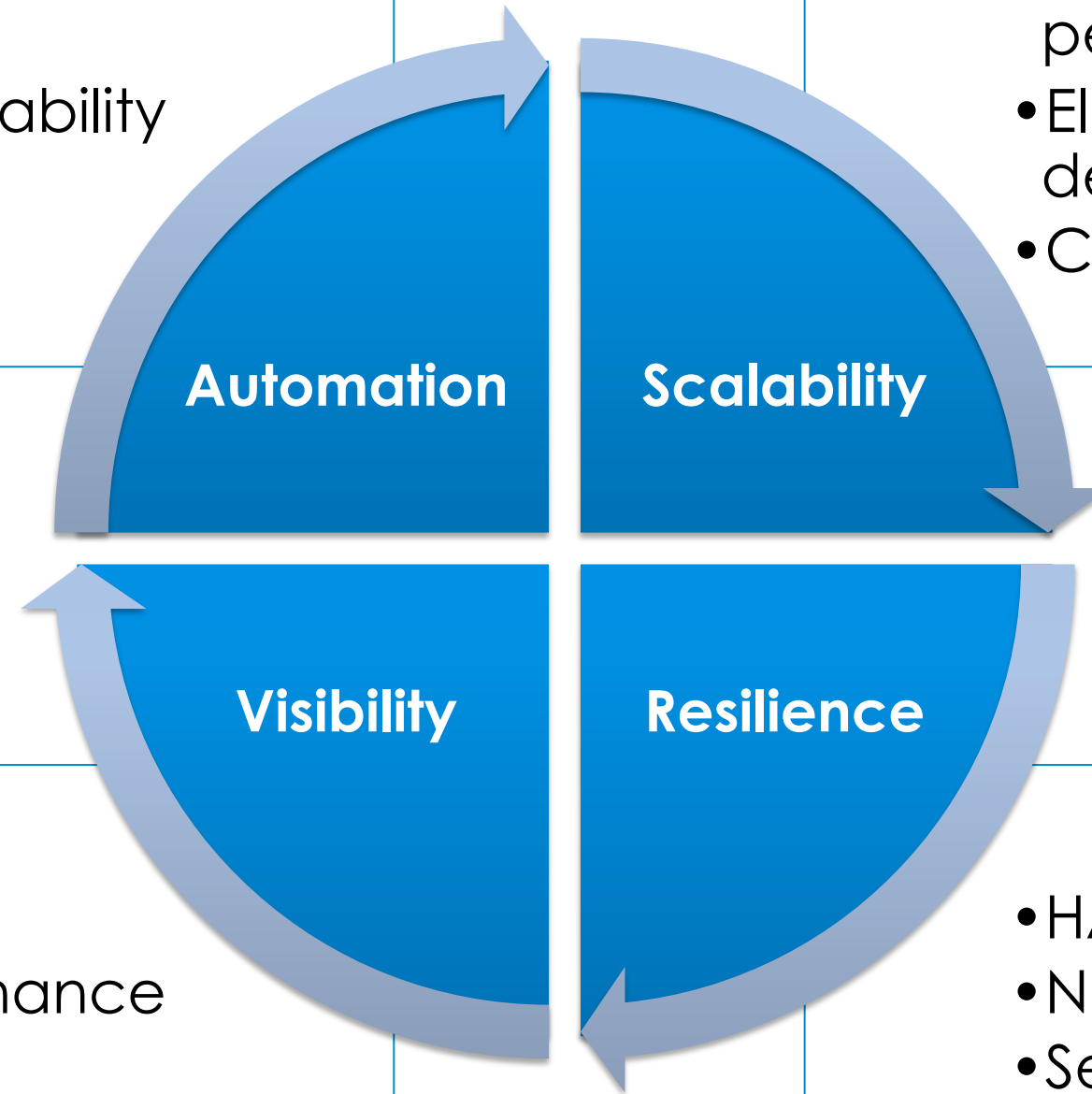
<https://tools.ietf.org/html/draft-quinn-sfc-nsh-07>

SFC: Service Path / Forwarding



Dynamic Service Chaining: Design Considerations

- Service consolidation and convergence
- Service Programmability
- Granular policy enforcement

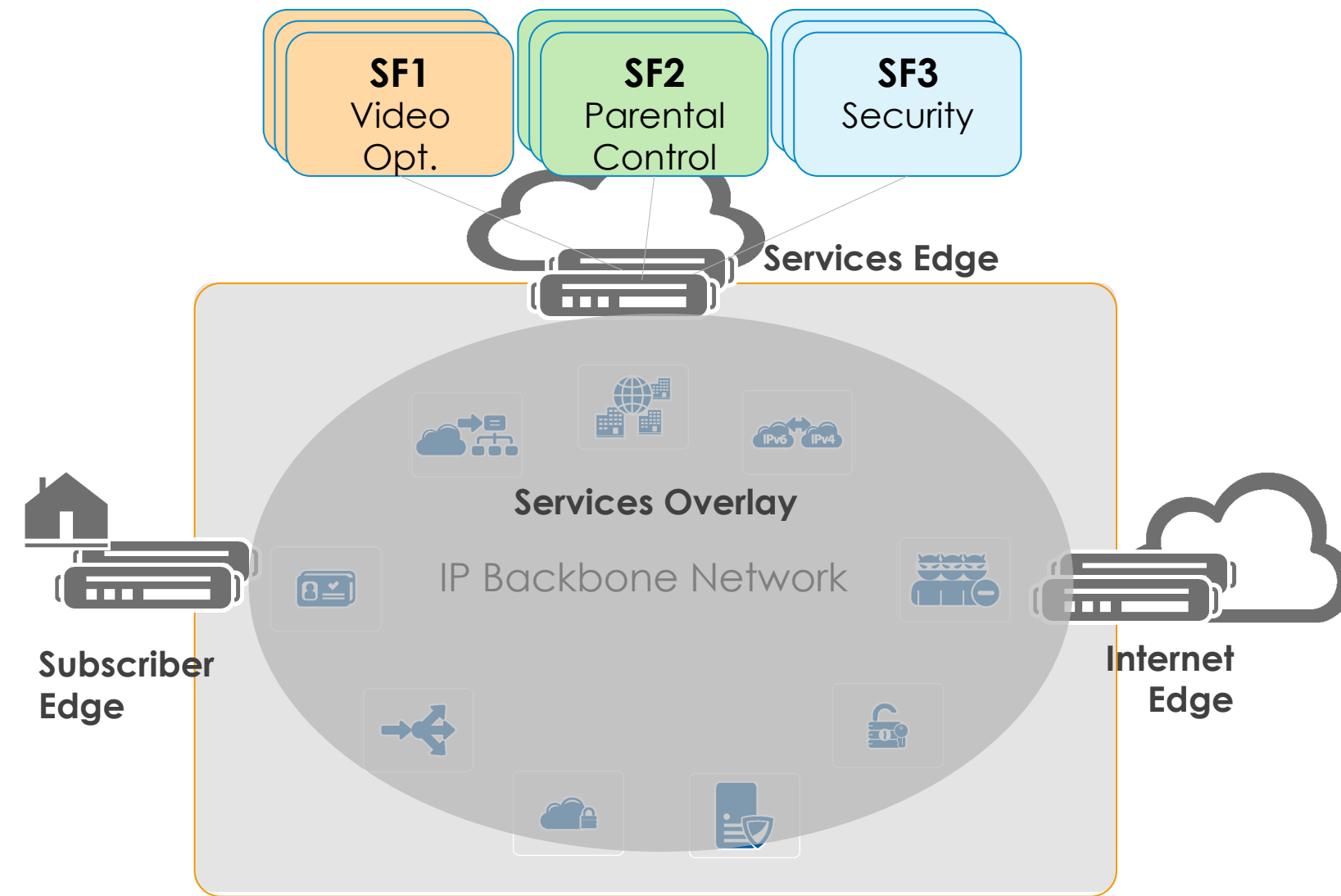


- Carrier class performance
- Elastic Scale – on demand services
- Capacity Planning

- Adv. Analytics
- Predictive Maintenance
- Reporting

- HA, Fault Tolerance
- Non-disruptive failover
- Security, Integrated DDoS protection

Dynamic Service Chaining = Intelligent Edge + Service Overlays



- **Subscriber Edge Gateway**
 - Network Inline: Classifier, SFF
 - Services: DHCP, Radius, etc.
 - Policy: ACL, QoS, SFC etc.
- **Service Edge Gateway**
 - Service Inline: SFF, re-classify, Proxy
 - Services: SLB, Security, etc.
 - Policy: ACL, SFC etc.
- **Internet Edge Gateway**
 - Internet Inline: SFF, Classifier
 - Services: CGN, FW etc.
 - Policy: ACL

Dynamic Service Chaining Benefits



Agility

- Personalized services to subscribers
- Reduce TTM new services
- On-demand service delivery
- Increase ARPU



Automation

- Simplified end to end service orchestration
- Automated configuration and provisioning
- Consistent policy enforcement: SLA, Compliance



Reduced TCO

- Operational Simplicity
- Efficient resource utilization
- Dynamic capacity scale up/down
- Pay-as-you-go usage model

THANK YOU

Policy Enforcement Challenges in NFV/SDN

Network VNFs & VAS VNFs are not fixed and cause operational challenges.

L4-L7 service change Context

- Lost Visibility,
- Header changes
- Flow terminated
- Flows created

Example:

- CGNAT, ADC, WANOpt.

Traffic Management

- Unpredictable traffic flows
- Not predefined
- Address overlap

Example:

- Firewalls, Security, DHCP

Service Management

- Service Resiliency
- Service Placement
- Monitoring, SLA

Example:

- DDoS Protection, CGNAT

Scalability

- In line network functions
- High performance
- Scale out

Example:

- CGNAT, Load balancing