

A Universal Protocol Mechanism for Network Function Virtualization and Application-Centric Traffic Steering

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Outline

- Motivation
- SDN and Issues
- Existing Solutions
- Proposed Solution
- Use Cases
- Conclusions



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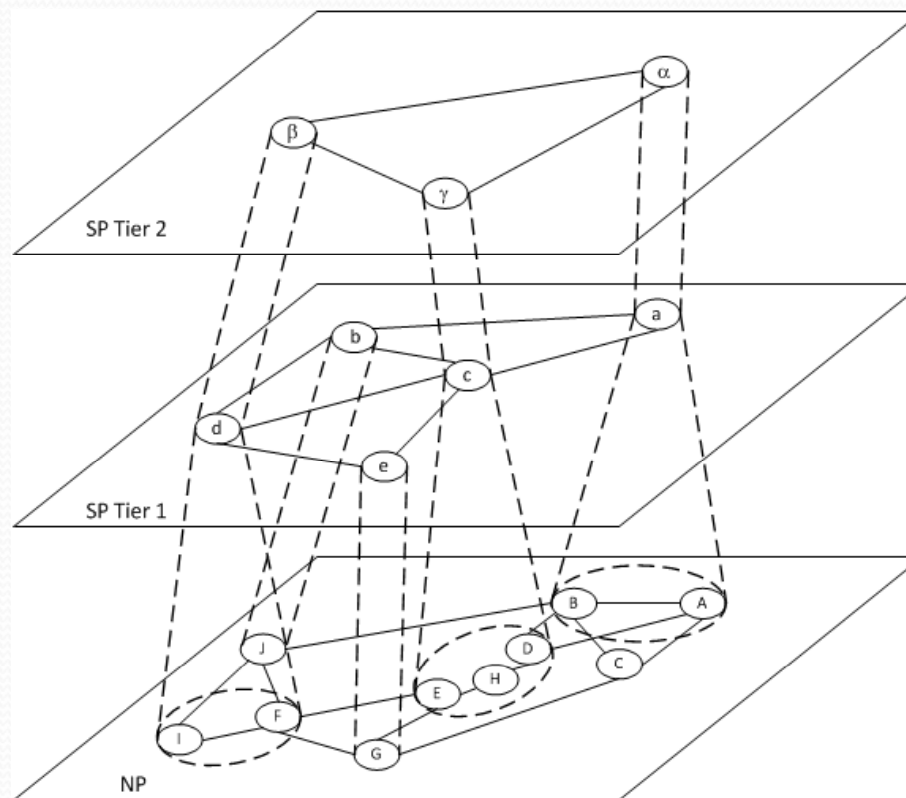


Motivation

- New services and applications are the driver for future Internet
- Network Virtualization
 - A service by network provider
 - Multiple virtual networks share a substrate network
 - **Need a way to identify different virtual networks**
- Network Function Virtualization (NFV)
 - Generalization of Service Chaining
 - Built upon virtual networks
 - A recursive service relationship
 - **Need a way to identify service chains**
- Application-centric Traffic Steering
 - Group-based application (server replication, mobility, etc.)
 - Service providers want to treat user traffic flows differently
 - **Switches need a tag to act on**
- Recursive service
 - A common service structure in all industries
 - **Need identifiers for services at all embedded layers**

Motivation (cont's)

- An example of recursive virtual network





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SDN

- SDN earmarked for future Internet
- More flexibility by separating control and data plane
- OpenFlow adopted for communication between control and data
- Allow forwarding based on arbitrary header fields

SDN: OpenFlow

Switching

Switch Port	MAC src	MAC dst	Eth type	VLAN ID	IP Src	IP Dst	IP Prot	TCP sport	TCP dport	Action
*	*	00:1f:...	*	*	*	*	*	*	*	port6

Routing

Switch Port	MAC src	MAC dst	Eth type	VLAN ID	IP Src	IP Dst	IP Prot	TCP sport	TCP dport	Action
*	*	*	*	*	*	5.6.7.8	*	*	*	port6

Firewall

Switch Port	MAC src	MAC dst	Eth type	VLAN ID	IP Src	IP Dst	IP Prot	TCP sport	TCP dport	Action
*	*	*	*	*	*	*	*	*	22	drop



SDN Issues

- SDN limitation
 - Based on existing header fields
 - No field to identify a group-based application
 - Replication servers in data center
 - User mobility and multiple devices
 - No field to identify a service chain
 - No field to identify a virtual network
 - No way to identify services in recursive service structure



SDN Challenges

- Why not VLAN id
 - Limited to a local area network
 - Hard to support recursive services
- Why not IP address
 - Multiple services may share one interface
 - Multiple services may have overlapped address spaces
- Why not port number
 - Traffic with multiple port numbers may share one service
- Combination of L2-4 headers
 - Fragmented flows and bloated flow table
 - Tunneled traffic difficult to identify



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Existing Solutions

- New header fields need to be defined
- But where?
- VXLAN
 - Tunneling VLAN over IP
 - Limited to extending VLAN service
- OpenADN
 - Use two new labels: one at Layer 3.5 and one at layer 4.5
 - No end-to-end identifier
 - Complex to implement
 - Do not support recursive service structure
- Serval
 - Add a service access layer between Layer 3 and Layer 4
 - Designed for dynamic binding
 - Hard to traverse a middle box
 - Complex to implement
 - Do not support recursive service structure



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Service Forwarding Label (SFL)

- Used to identify a service relationship between a client and a provider at Layer 5
 - Client can be a single user or a group
- ALL SFLs form a service namespace
- SFLs can be stacked to support recursive services
- Administered by network providers
- Unique within the domain of a network provider
- Renewable expiration time
- Added into forwarding entry in Flow Table as a new matching field



(a)



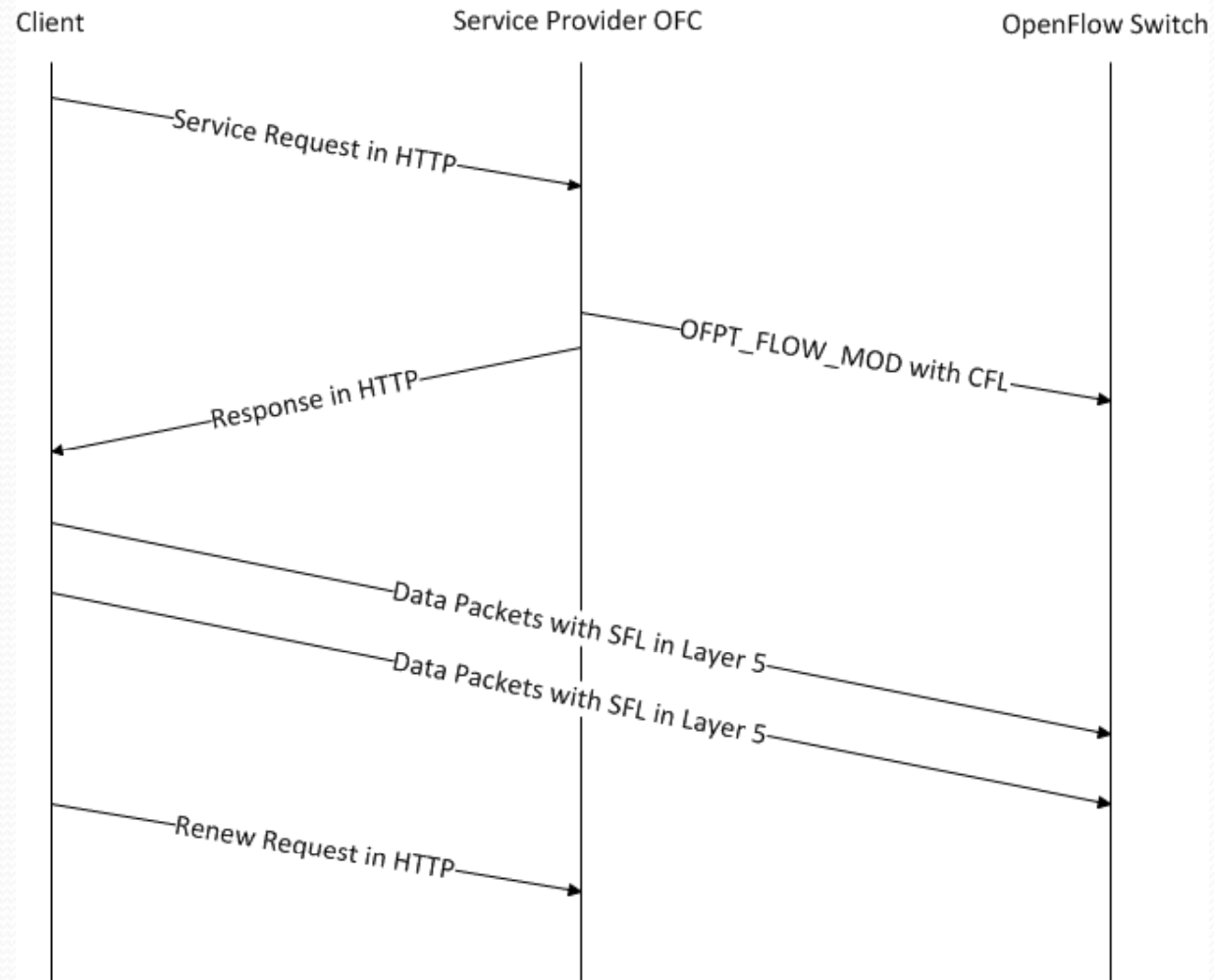
(b)



Design Consideration

- Why Layer 5
 - Virtual Network service is similar to session layer service
 - Establish, manage and terminate Virtual Network between service provider and network provider
 - Easy access from application
 - Allows non-SDN network traversal
 - Allows middle box traversal
- Why fixed length
 - Easy table match (e.g. a 32 bit label can be 0x5434B8E0)
- Why dynamic
 - Services typically have limited time
 - Allows efficient usage of label space

An example for SFL usage



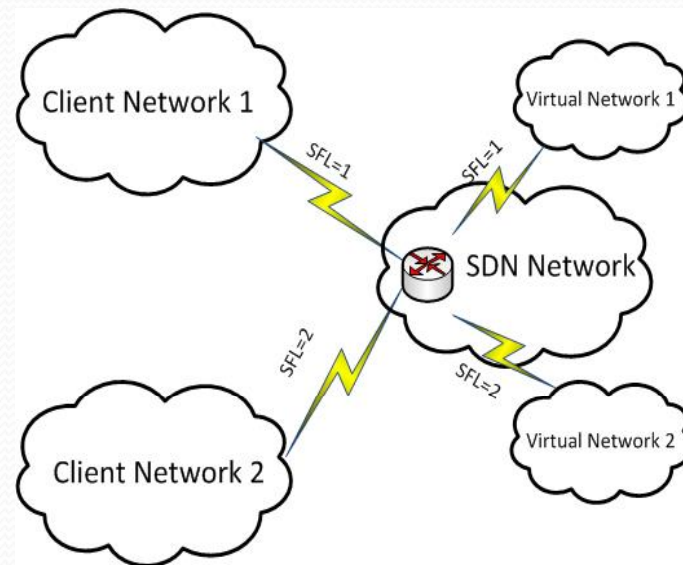
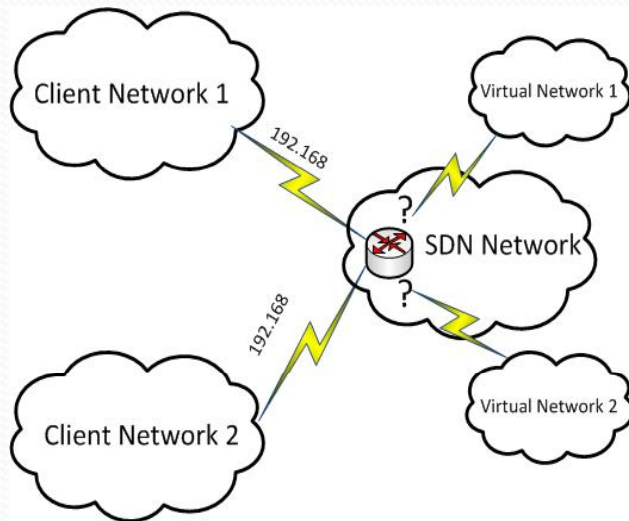


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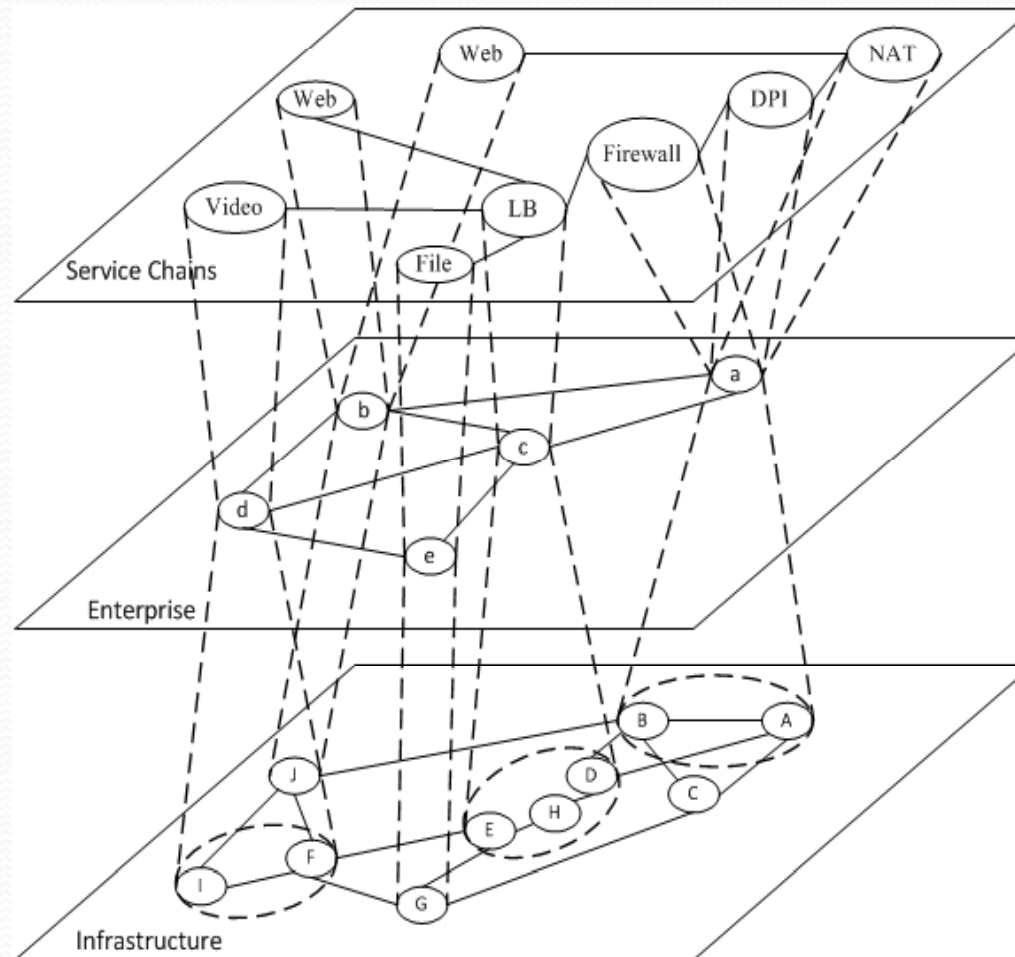
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Virtual Networks

- SFL allows wildcard treatment of traffic from a client network and simplifies forwarding
- Support client mobility and group-based applications
- Support overlapped private address spaces

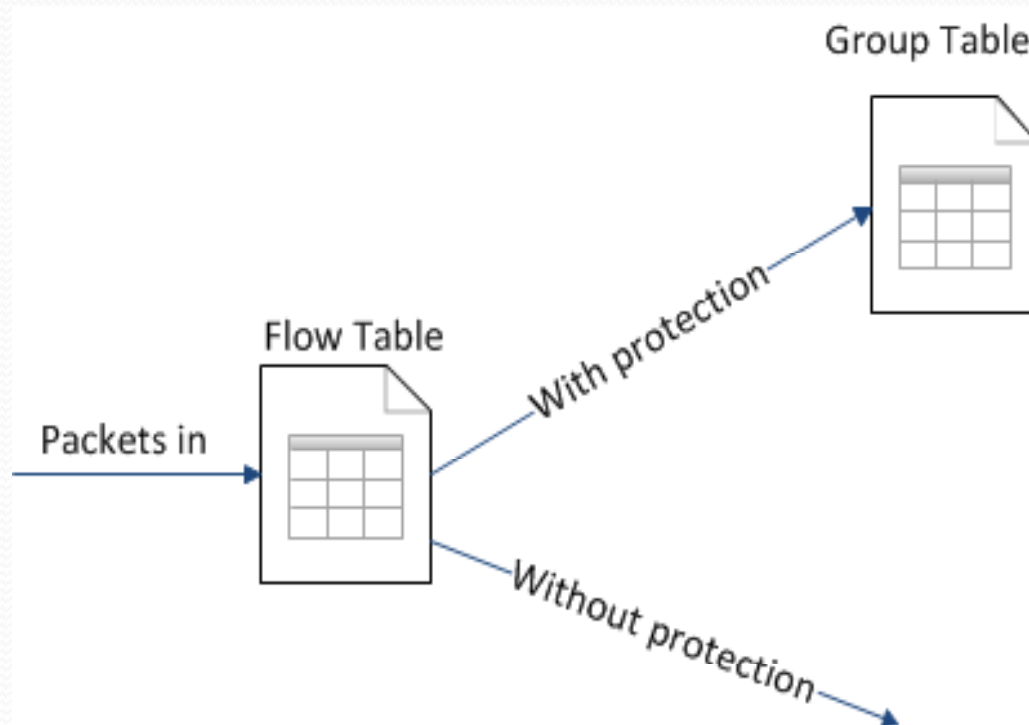


NFV and Service Chaining

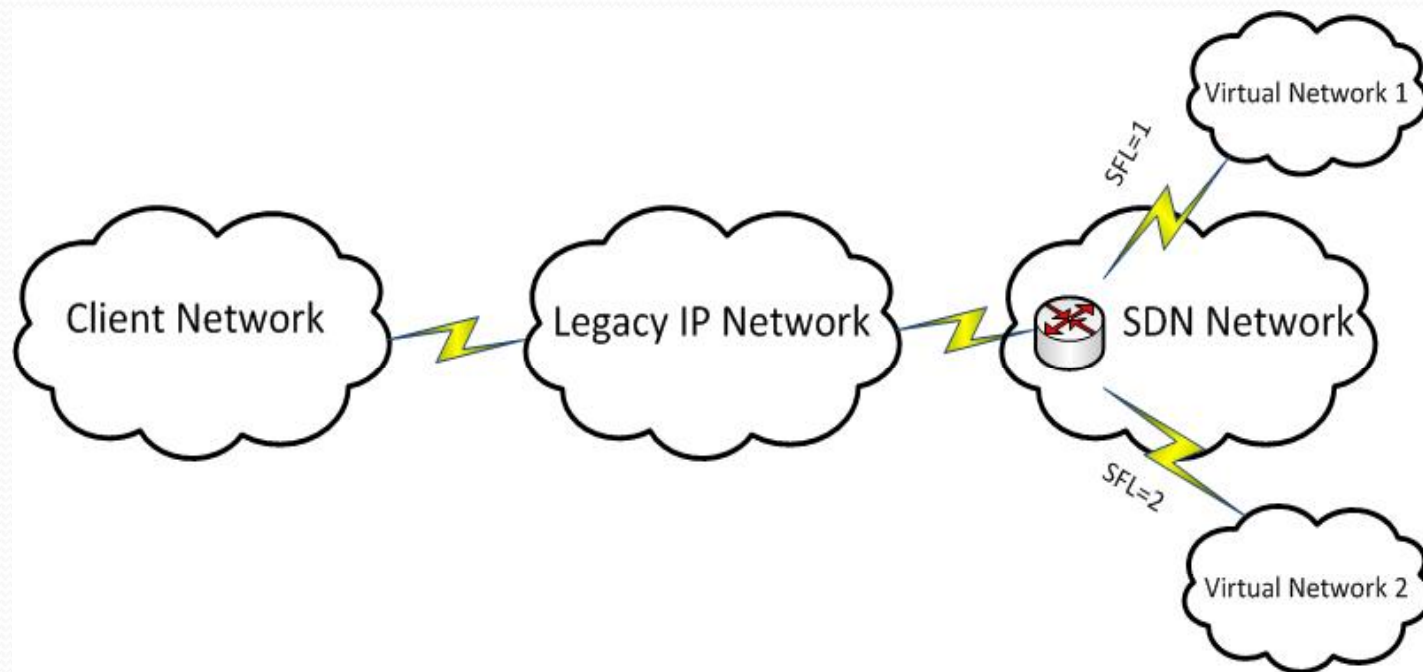


Application-centric Traffic Steering

- SFL used to differentiate client traffic with or w/o protection requirement



Migration





Conclusion

- SFL is a universal service identifier
- Used independently or combined with other header fields
- Can identify a group-based application
- Can traverse middle box
- Easy to implement
 - No change to existing socket interface
 - Fit in OpenFlow naturally



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Thank You