Cisco Expo 2009

Ethernet Virtual Circuit Framework for Carrier Ethernet Services

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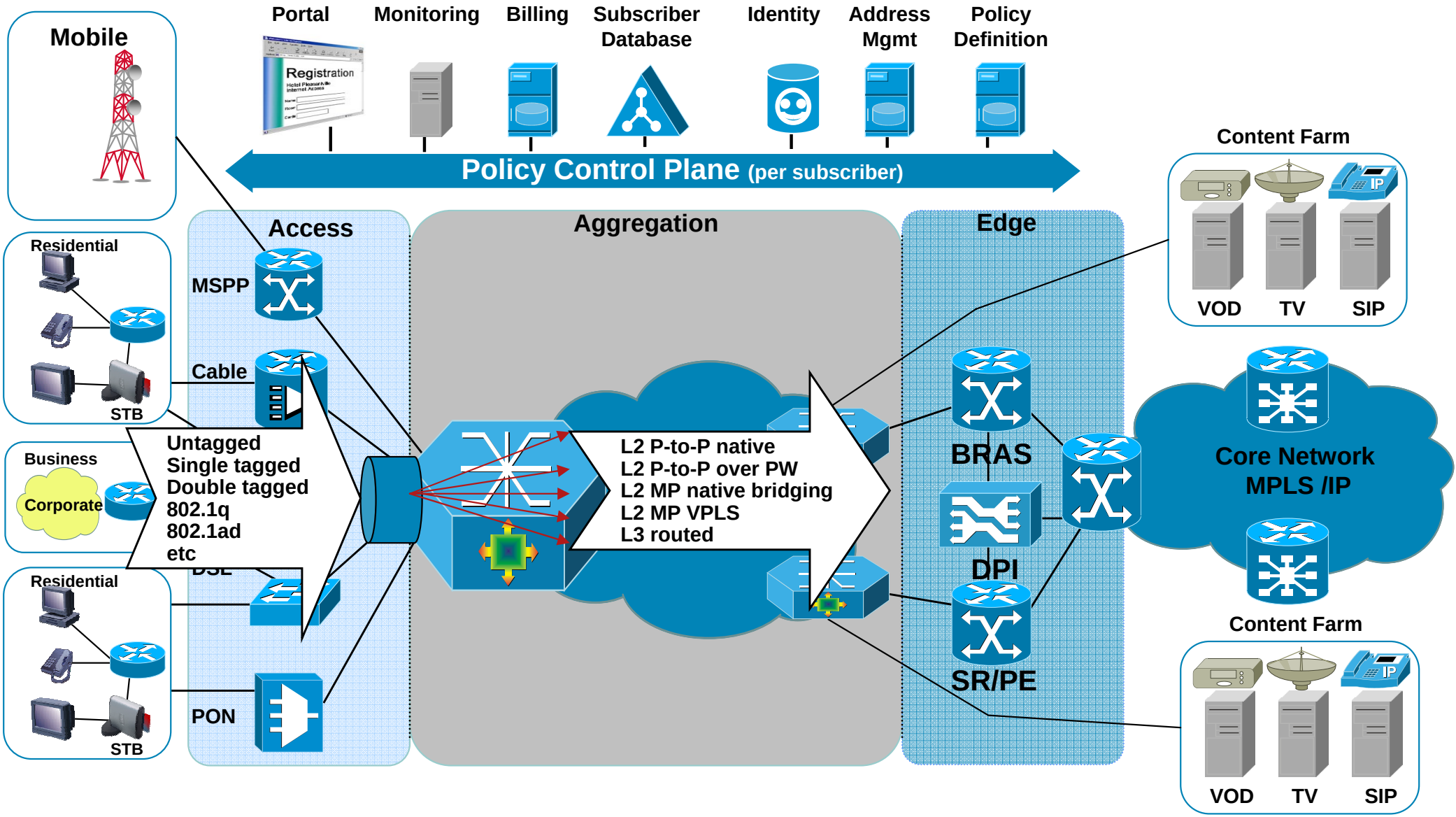
Agenda

- Introduction
- EVC Fundamentals
- EVC Operation and Packet Flow
- EVC Configuration
- Examples of Deployment Scenarios
- Conclusions

Flexible Ethernet Edge



What Is Cisco EVC Framework?

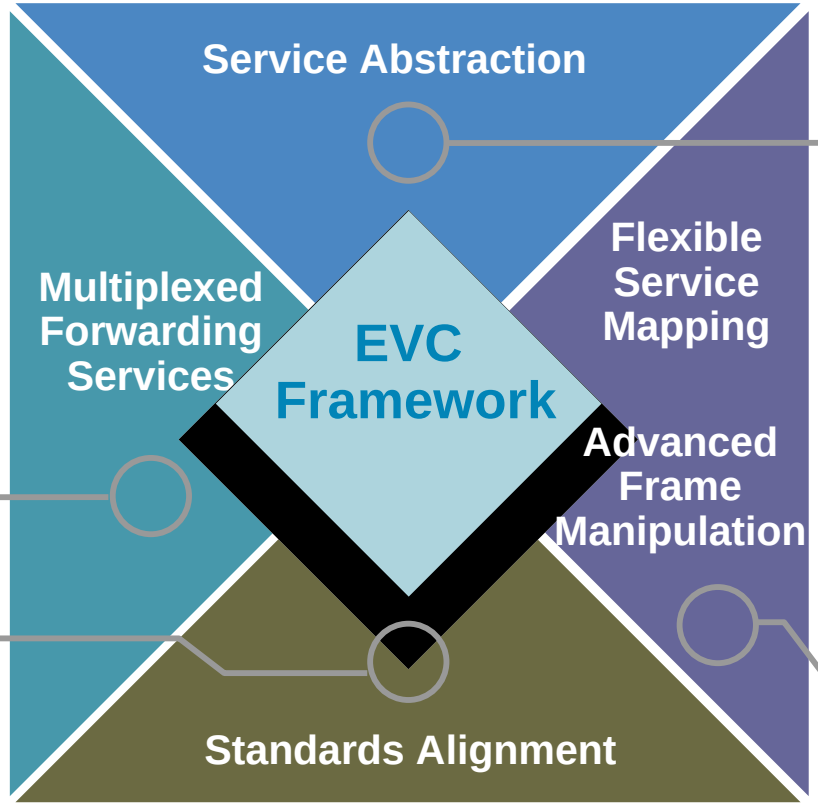
- Cisco Ethernet Virtual Circuit (EVC) is the next-generation cross-platform Carrier Ethernet Software Infrastructure
- Addresses Flexible Ethernet Edge requirements
- Supports service convergence over Ethernet
- Complies with MEF, IEEE, IETF standards

Cisco EVC – Functional Highlights

Ethernet Service Instances
- Model Ethernet Service Layer
- Transport agnostic

Support mix of Layer 2 and Layer 3 services on same physical port

Concurrent support of different flavors of Layer 2 services: Pt-to-Pt and Mpt



Flexible definition of service delimiters based on Ethernet header fields

Selective EVC Mapping

Advanced VLAN tag manipulation

Alignment with emerging standards:
- MEF 6, 10.1, 11
- IEEE 802.1ad
- IEEE 802.1ah

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Cisco EVC Building Blocks

- Ethernet Service Instance (S-I)

  Transport-agnostic abstraction of an Ethernet service on an interface

- Ethernet Virtual Circuit (EVC)

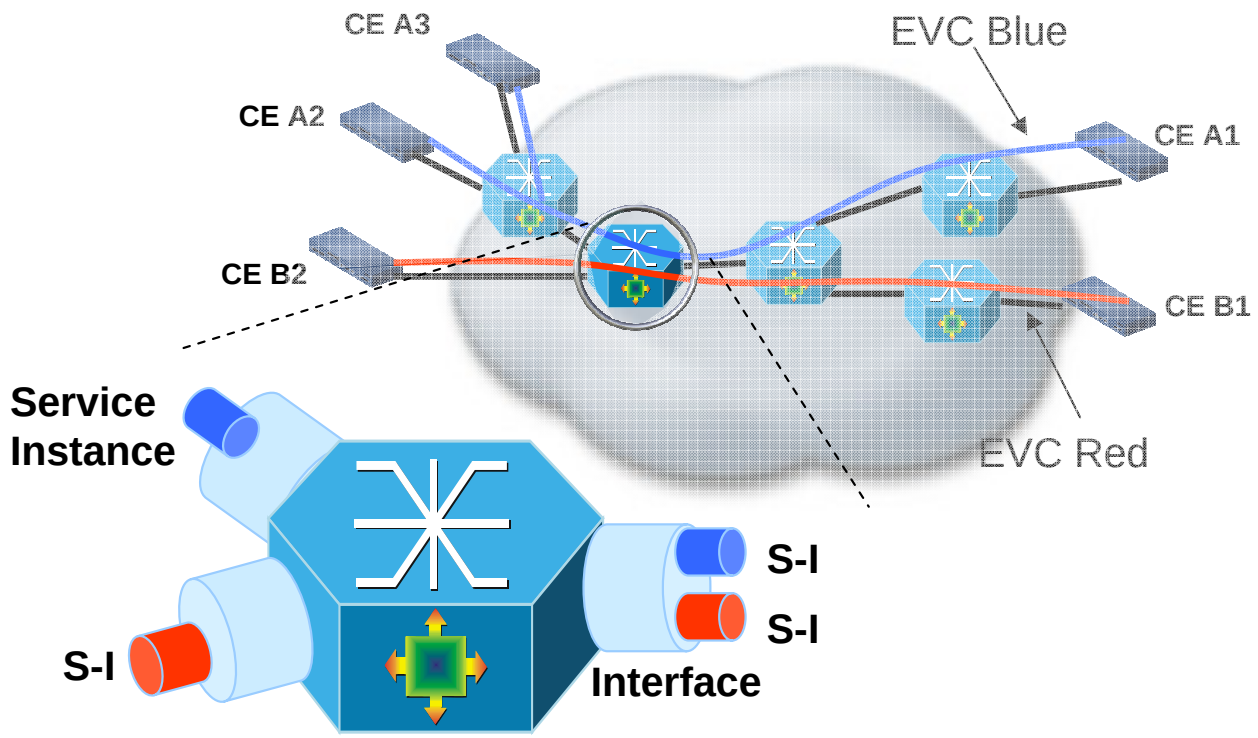
  Device local object (container) for network-wide service parameters

  Not to be confused with MEF EVC

- Bridge Domain (BD)

  Ethernet Broadcast Domain local to a device

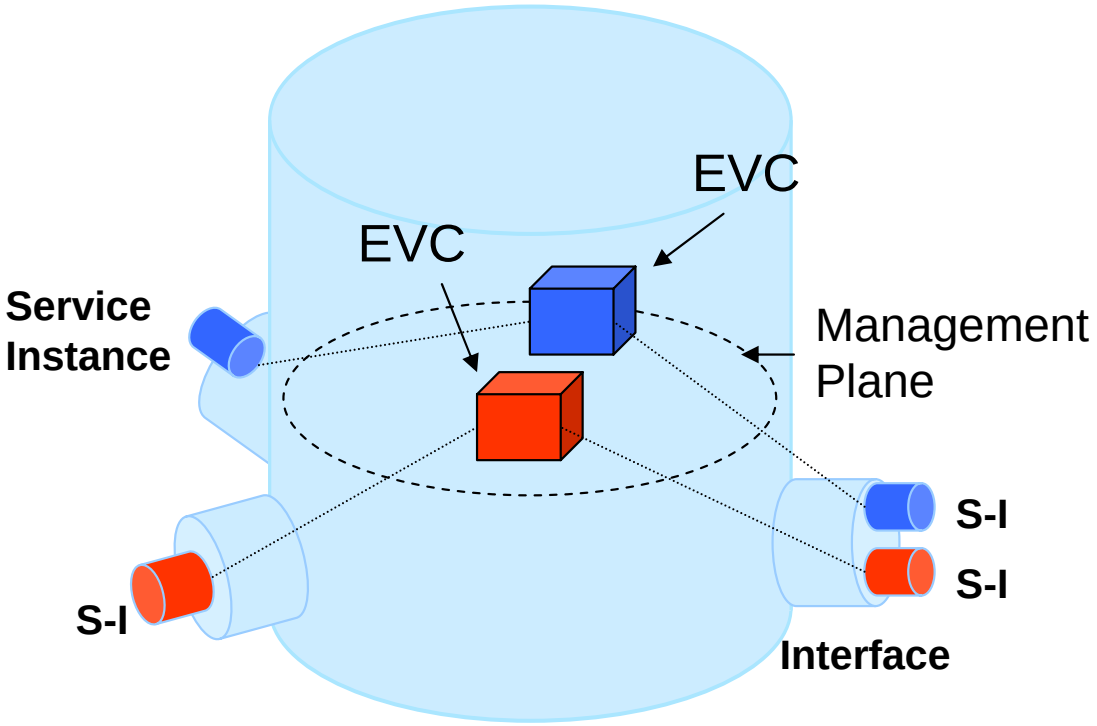
Ethernet Service Instance



Ethernet Service Instance → Ethernet Flow Point (EFP)

- Instance of a MEF EVC on a port
- Classify frames belonging to a particular Ethernet Service
- Apply features selectively to service frames
- Define forwarding actions and behavior

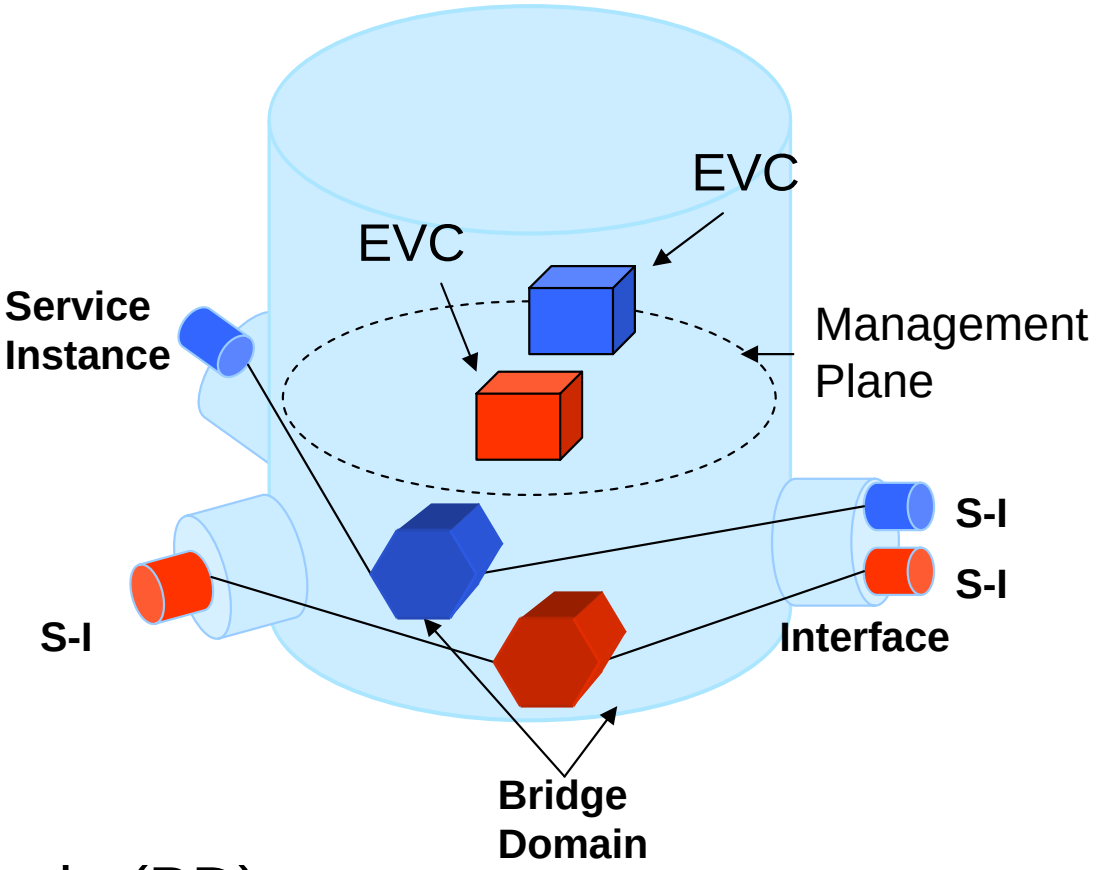
Ethernet Virtual Circuit



Ethernet Virtual Circuit (EVC)

- Global representation of MEF EVC on the device
- Management Plane container
- Hosts global EVC attributes
- One-to-many mapping from EVC to Service Instance

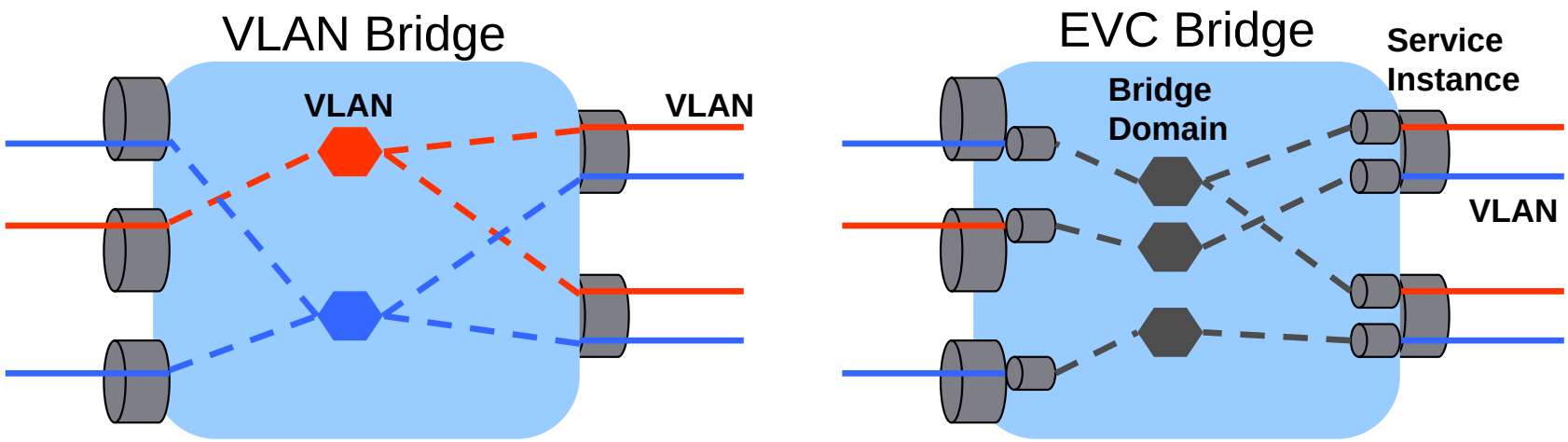
Bridge Domain



Bridge Domain (BD)

- Broadcast Domain internal to the device
- Allows decoupling broadcast domain from VLAN (per por VLAN significance)
- One-to-many mapping from BD to Service Instances

EVC Bridge vs. VLAN Bridge



- VLAN bridge has 1:1 mapping between VLAN and internal Broadcast Domain
  - VLAN has global per-device significance
- EVC bridge decouples VLAN from Broadcast Domain
  - VLAN treated as encapsulation on a wire
  - VLAN on a wire mapped to internal Bridge Domain via Service Instances
  - Net result: per-port VLAN significance

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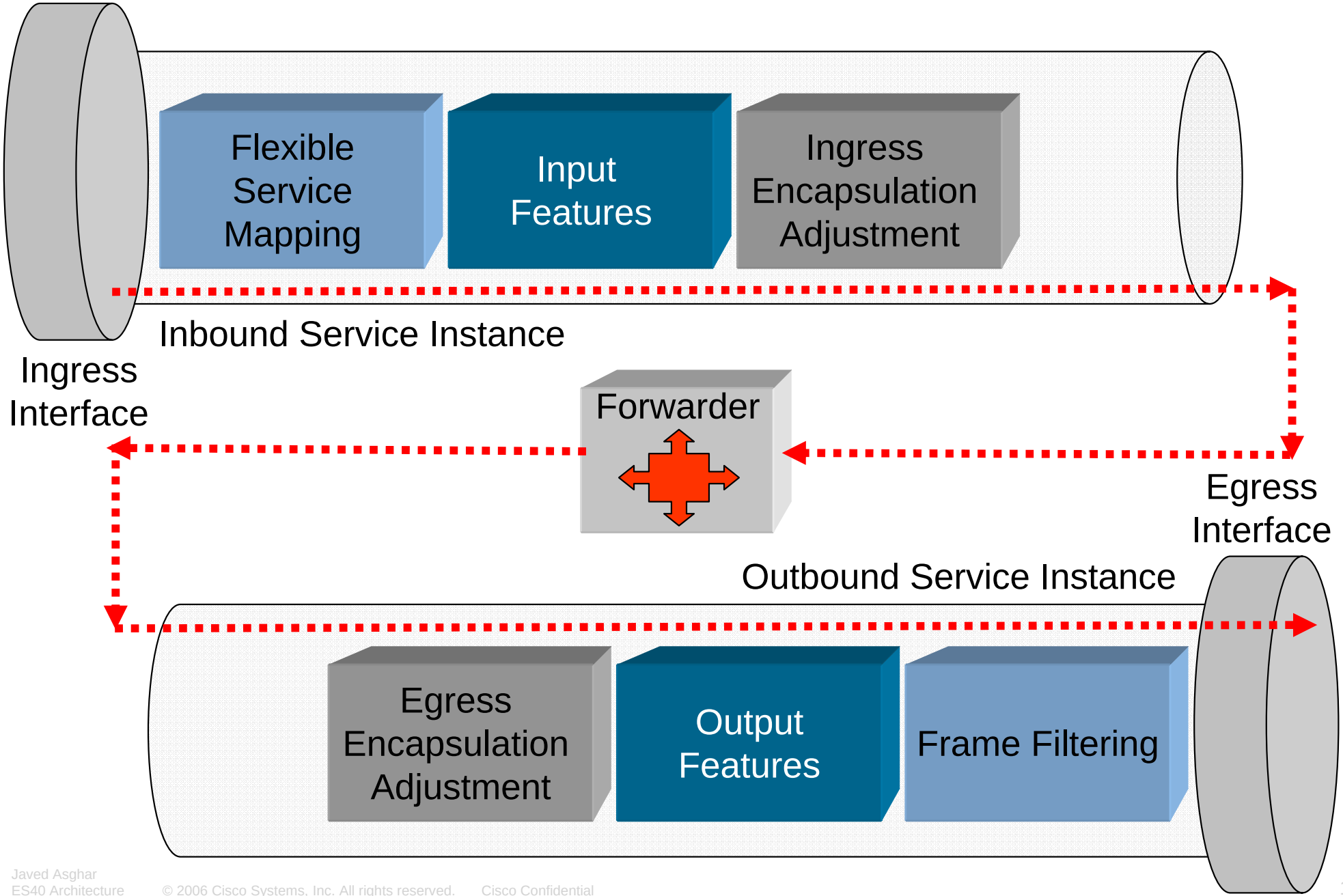
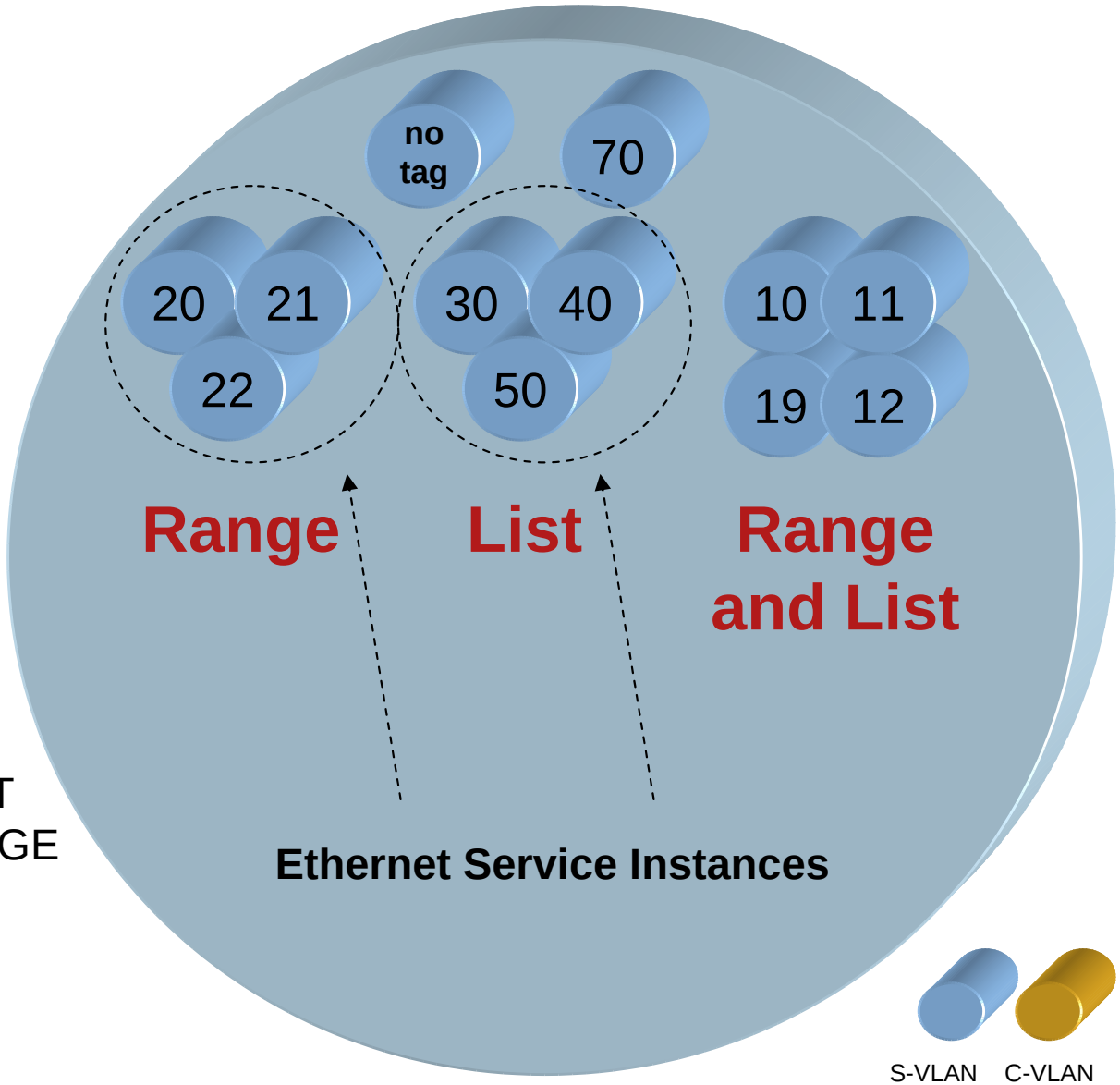
Packet Flow Pipeline



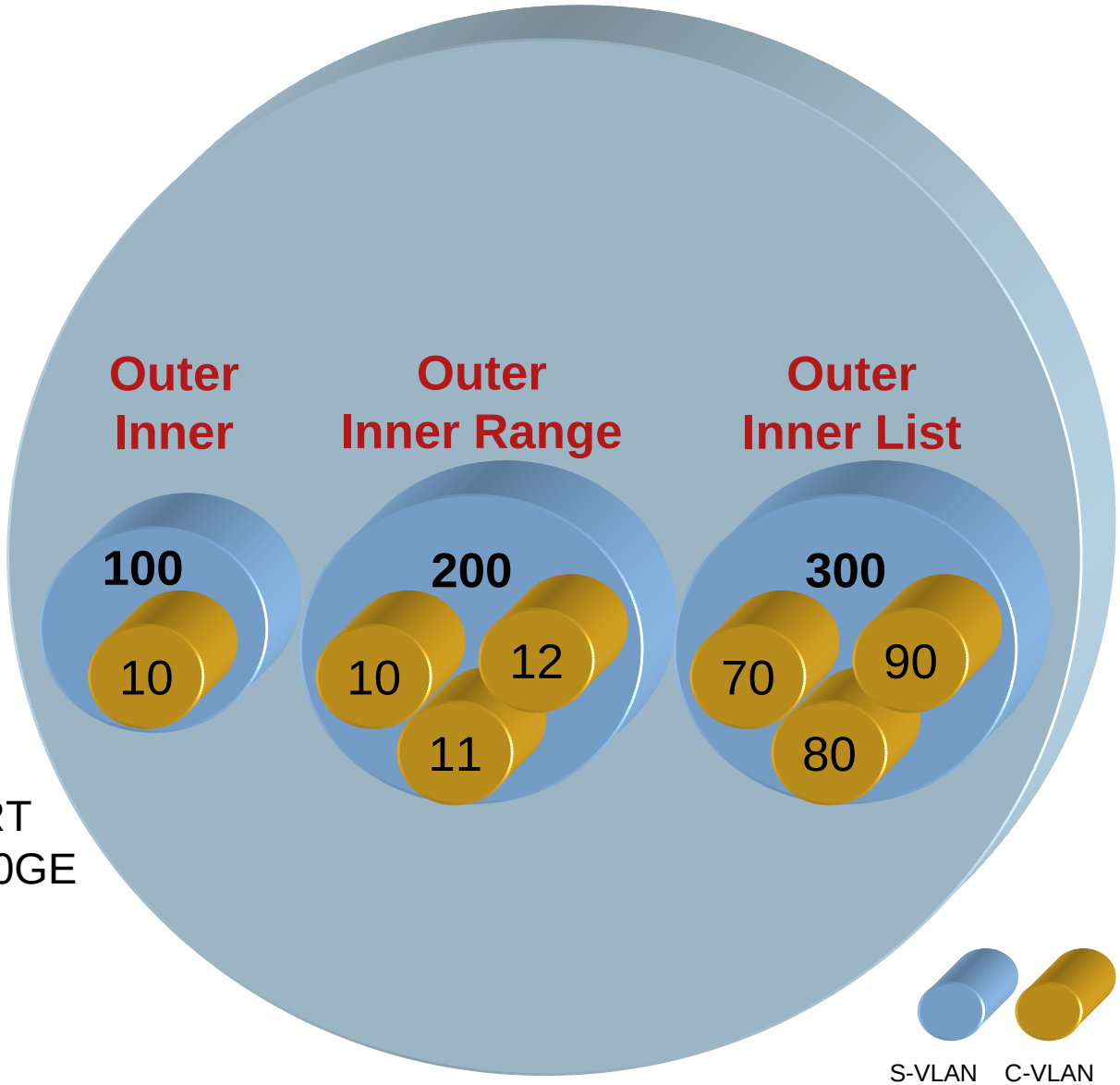
Flexible Service Mapping – Single VLAN

- Untagged traffic
- Single VLAN ID value
- Single VLAN ID Range (contiguous)
- Single VLAN ID List
- Single VLAN ID Range and List



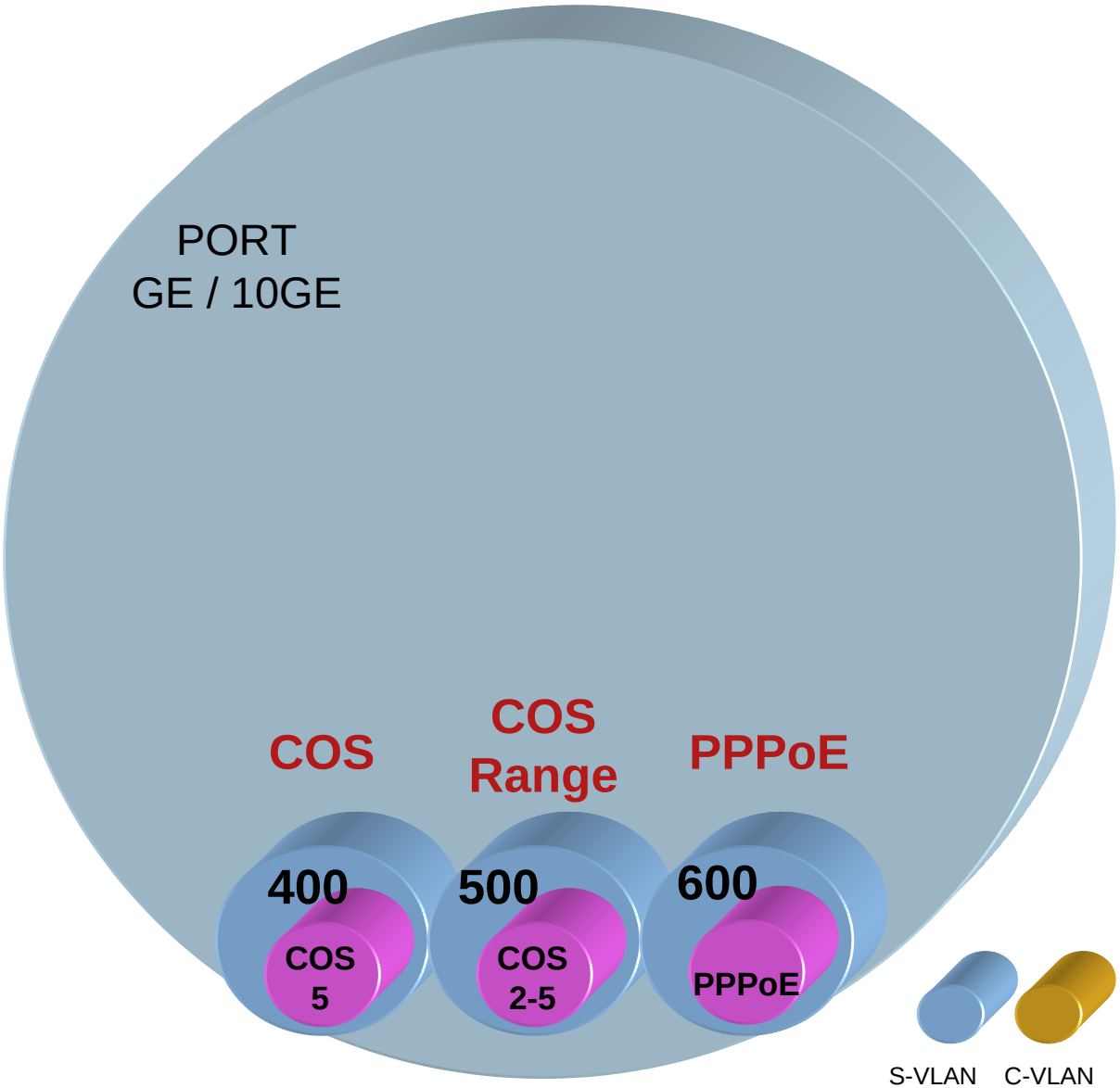
Flexible Service Mapping – Double Tag

- Outer VLAN, Inner VLAN
- Outer VLAN and Range of Inner VLANs (contiguous)
- Outer VLAN and List of Inner VLANs
- Outer VLAN and Range and List of Inner VLANs



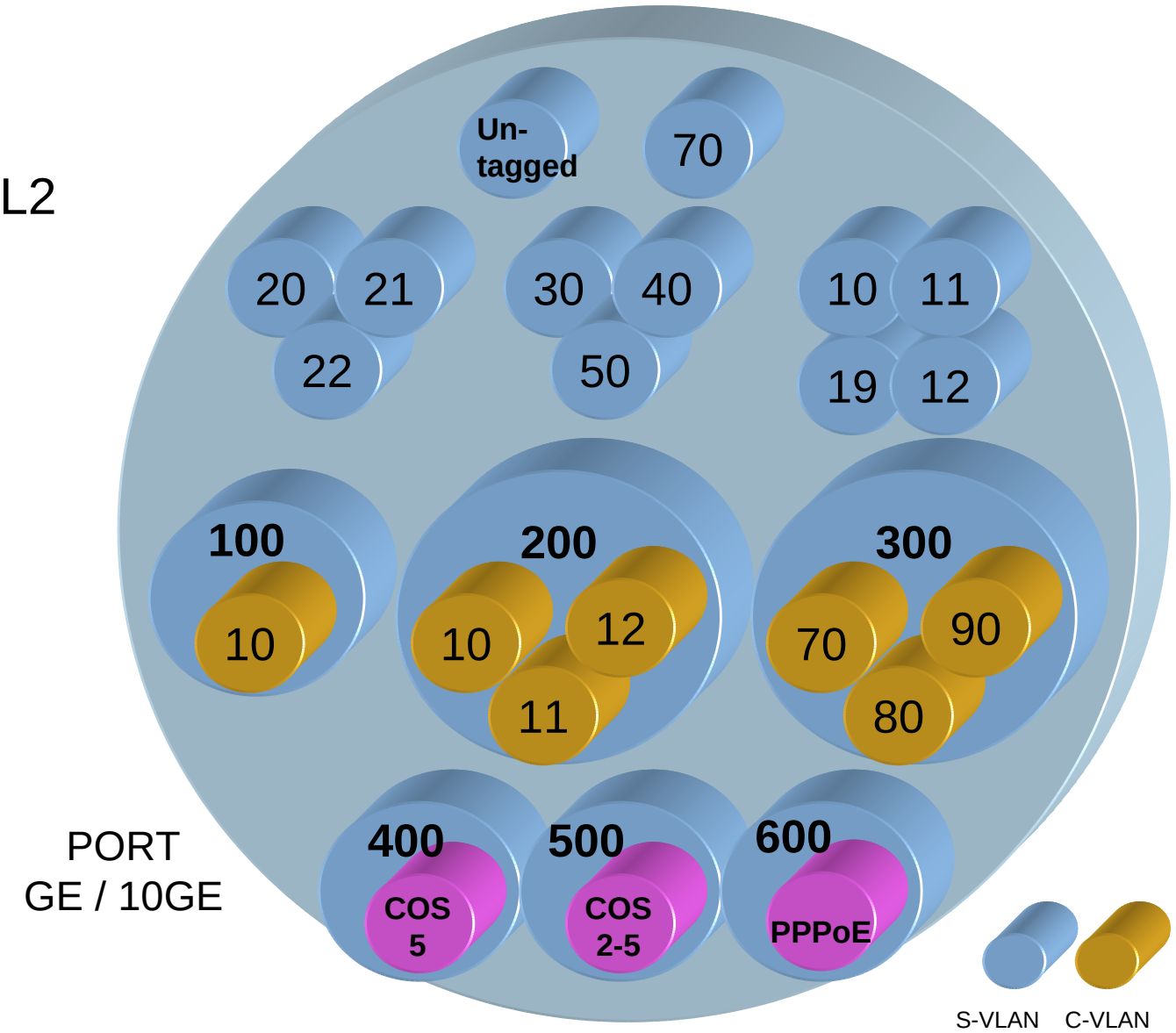
Flexible Service Mapping – Header Matching

- Single VLAN, single 802.1p (COS) value
- Single VLAN, COS List/Range
- Outer VLAN, outer COS and Inner VLAN
- Outer VLAN, Inner VLAN and inner COS
- Single VLAN, Ethertype value (PPPoE)
- Outer VLAN, Inner VLAN and Ethertype value (PPPoE)



Flexible Service Mapping

- Service Instance construct classifies L2 flows on Ethernet interfaces
- Single Tagged
- Double Tagged
- Header/Payload

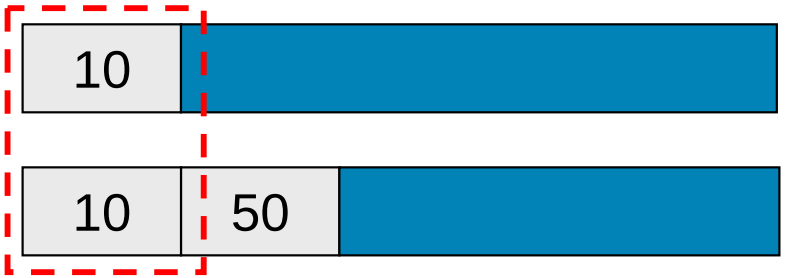


Industry's Most Comprehensive Matching Capabilities

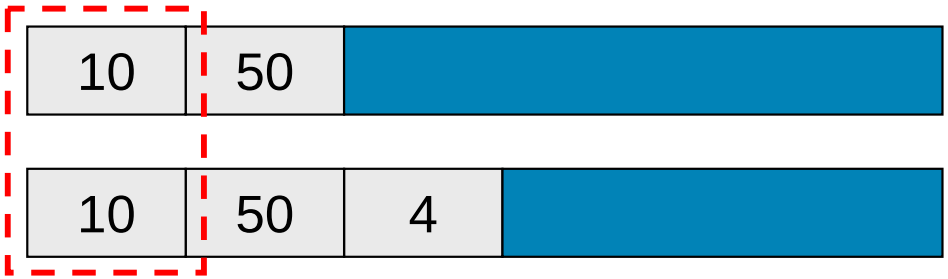
Loose Match Classification Rule

Cisco EVC follows a ‘Loose Match’ classification model: unspecified fields are treated as **wildcard**

- ‘encap dot1q 10’ matches any frame with outer tag equal to 10:



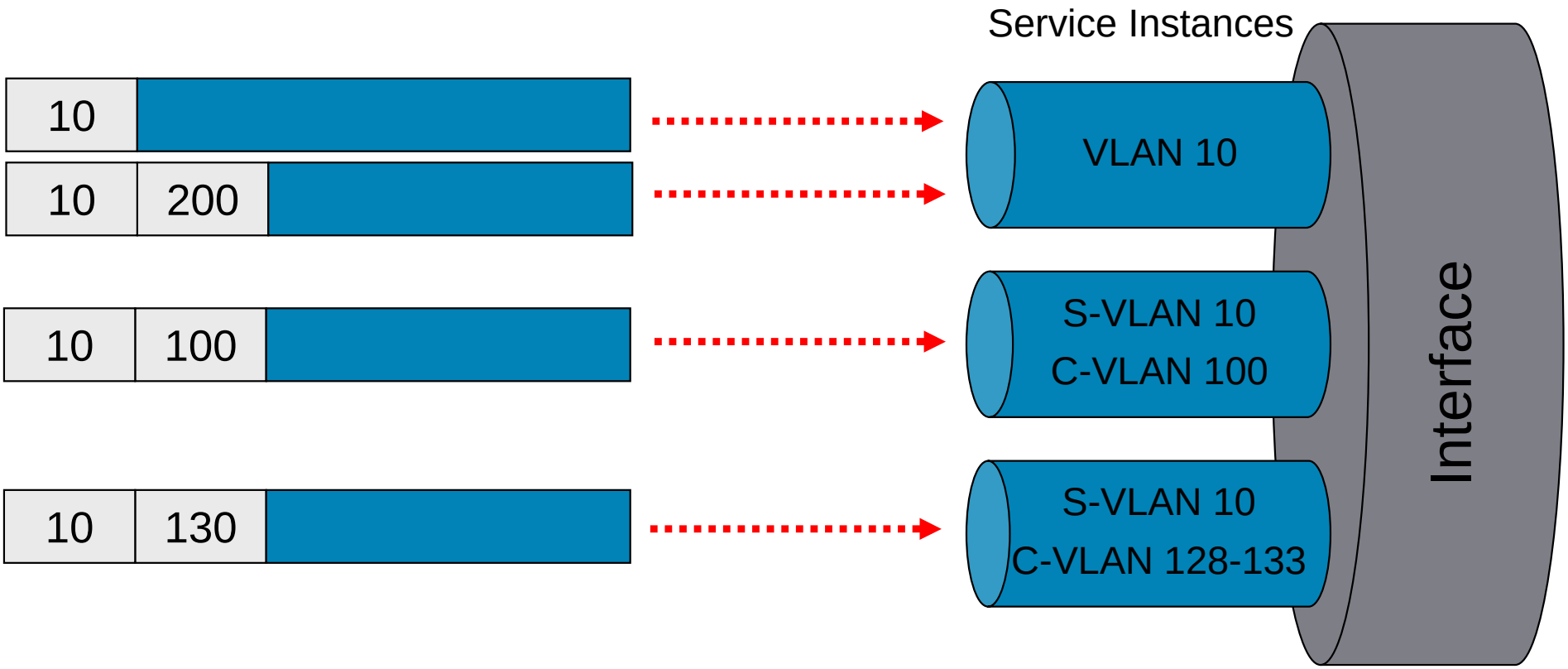
- ‘encap dot1q 10 sec 50’ matches any frame with outer-most tag as 10 and second tag as 50



Longest Match Classification Rule

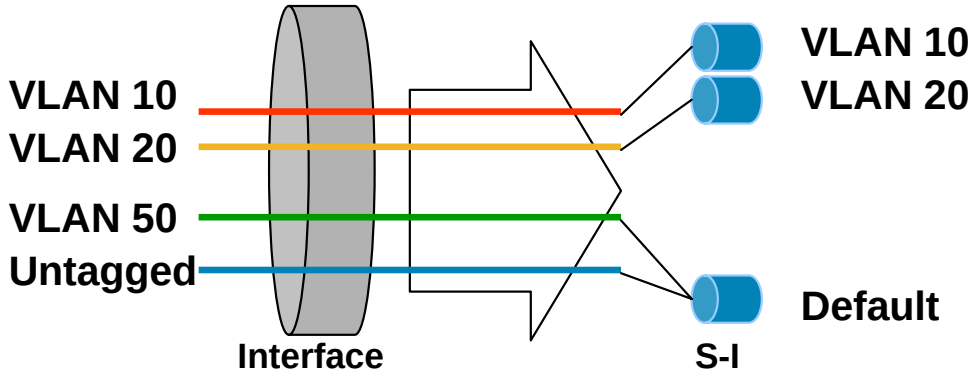
Cisco EVC follows the ‘Longest Match’ classification model:

- Frames are mapped to Service Instance with **longest matching set** of classification fields

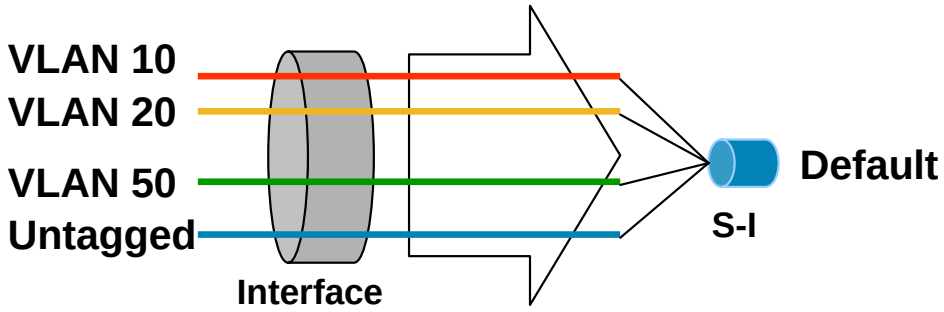


Service Instance with ‘Default’ Encapsulation

- Service Instance with ‘Default’ encapsulation matches all frames otherwise unmatched by any other S-I on the same port



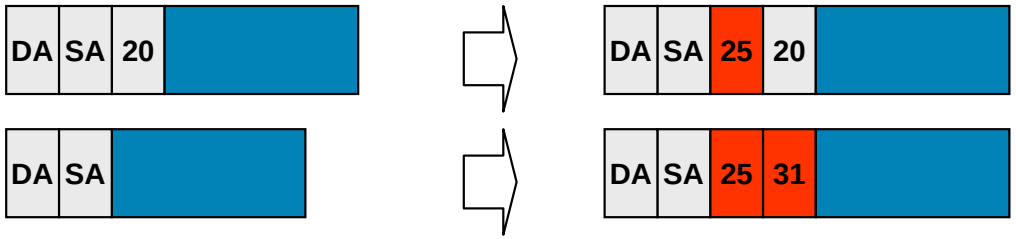
- If default Service Instance is the only one configured on a port, it matches all traffic on the port (tagged and untagged)



Advanced Frame Manipulation

PUSH Operations

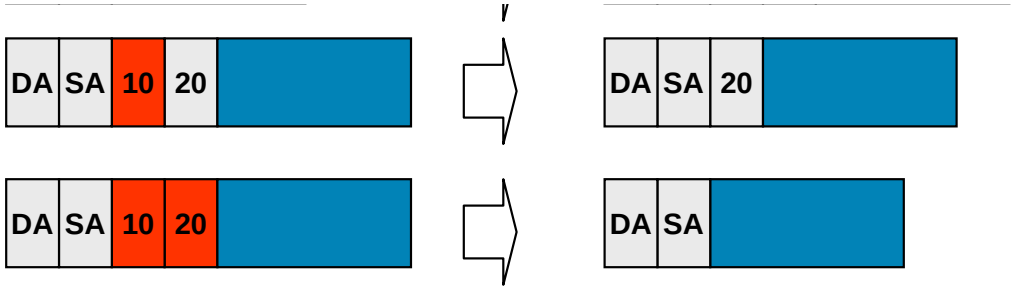
- Add one VLAN tag
- Add two VLAN tags



Advanced Frame Manipulation

POP Operations

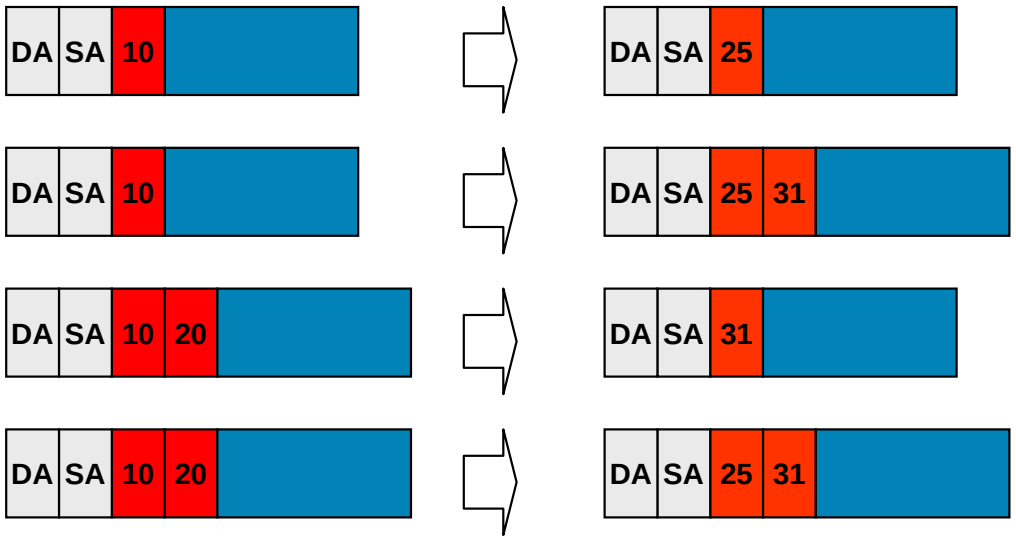
- Remove one VLAN tag
- Remove two VLAN tags



Advanced Frame Manipulation

Translation Operations

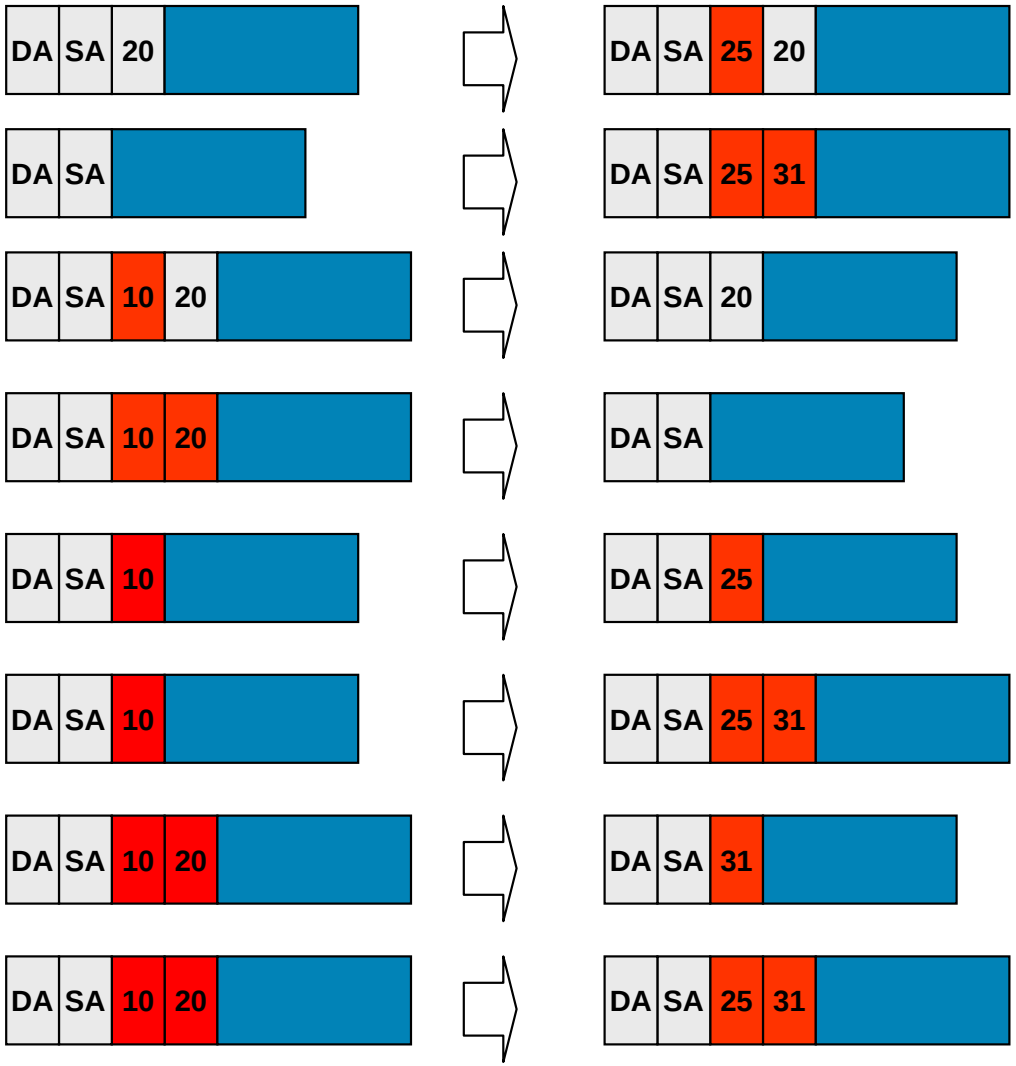
- 1:1 VLAN Translation
- 1:2 VLAN Translation
- 2:1 VLAN Translation
- 2:2 VLAN Translation



Advanced Frame Manipulation

VLAN Tag Manipulation

- PUSH operations
- POP operations
- TRANSLATION operations

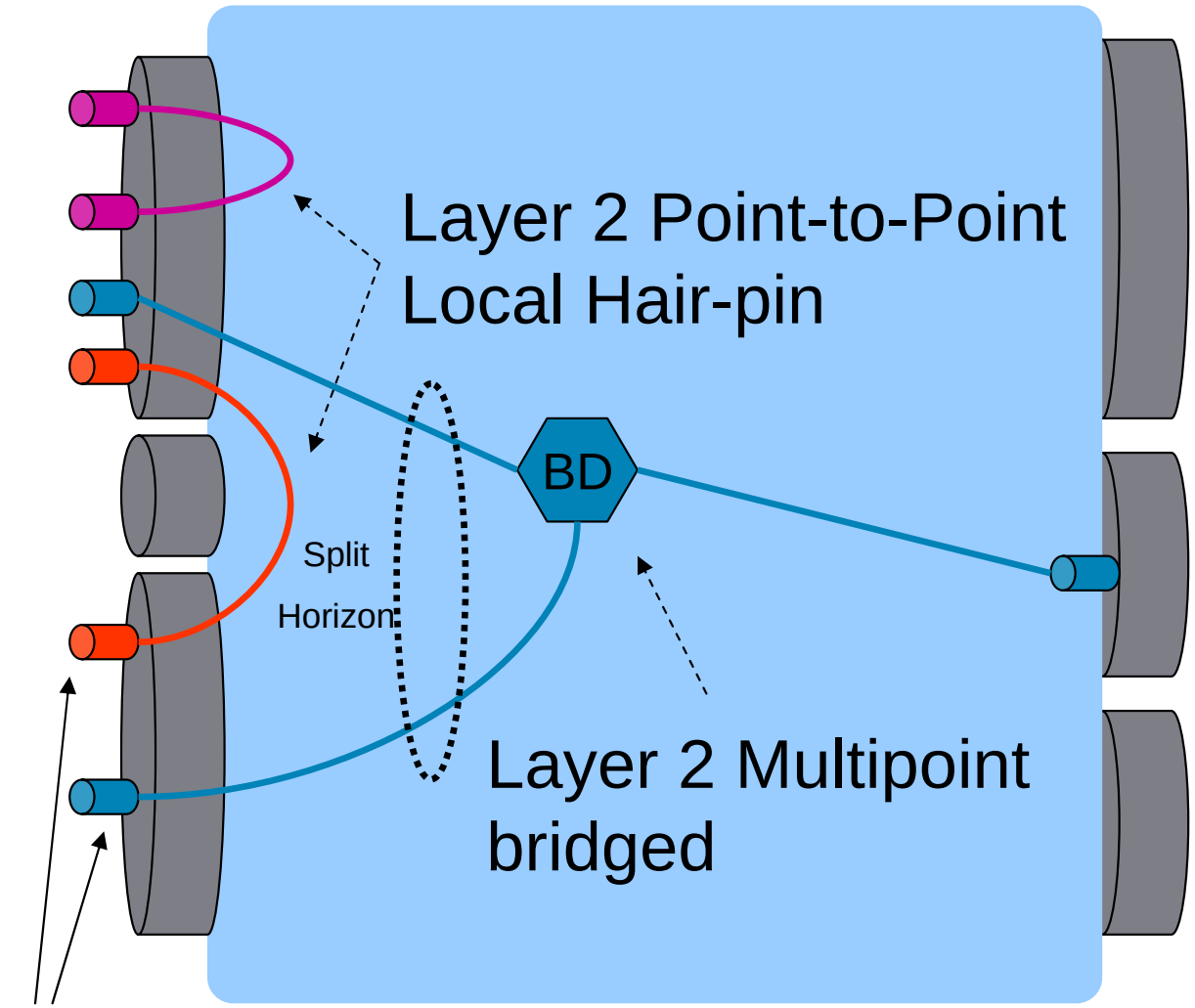


Multiplexed Forwarding Services

- Cisco EVC supports flexible access VLAN to forwarding service mapping
  - 1-to-1 access VLAN to a service
  - Same port, multiple access VLANs to a service
  - Multiple ports, multiple access VLANs to a service
- Forwarding services include:
  - L2 point-to-point local connect
  - L2 point-to-point xconnect
  - L2 multipoint bridging
  - L2 multipoint VPLS
  - L2 point-to-multipoint bridging
  - L3 termination

Local P2P and MP Forwarding Services

- Layer 2 P2P local services
  - No MAC learning
  - Two Service Instances on same interface (hair-pin)
  - Two SIs on different interfaces
- Layer 2 MP bridged services
  - MAC based forwarding and learning
  - Local VLAN significance
  - Bridge Domain (BD)—different access VLANs in the same broadcast domain
  - Split-horizon—prevent communication between service instances



BD = Bridge Domain
PW = Pseudowire

VFI = Virtual Fwd Instance
SVI = Switch Virtual Instance

MPLS-Based P2P and MP Forwarding Services

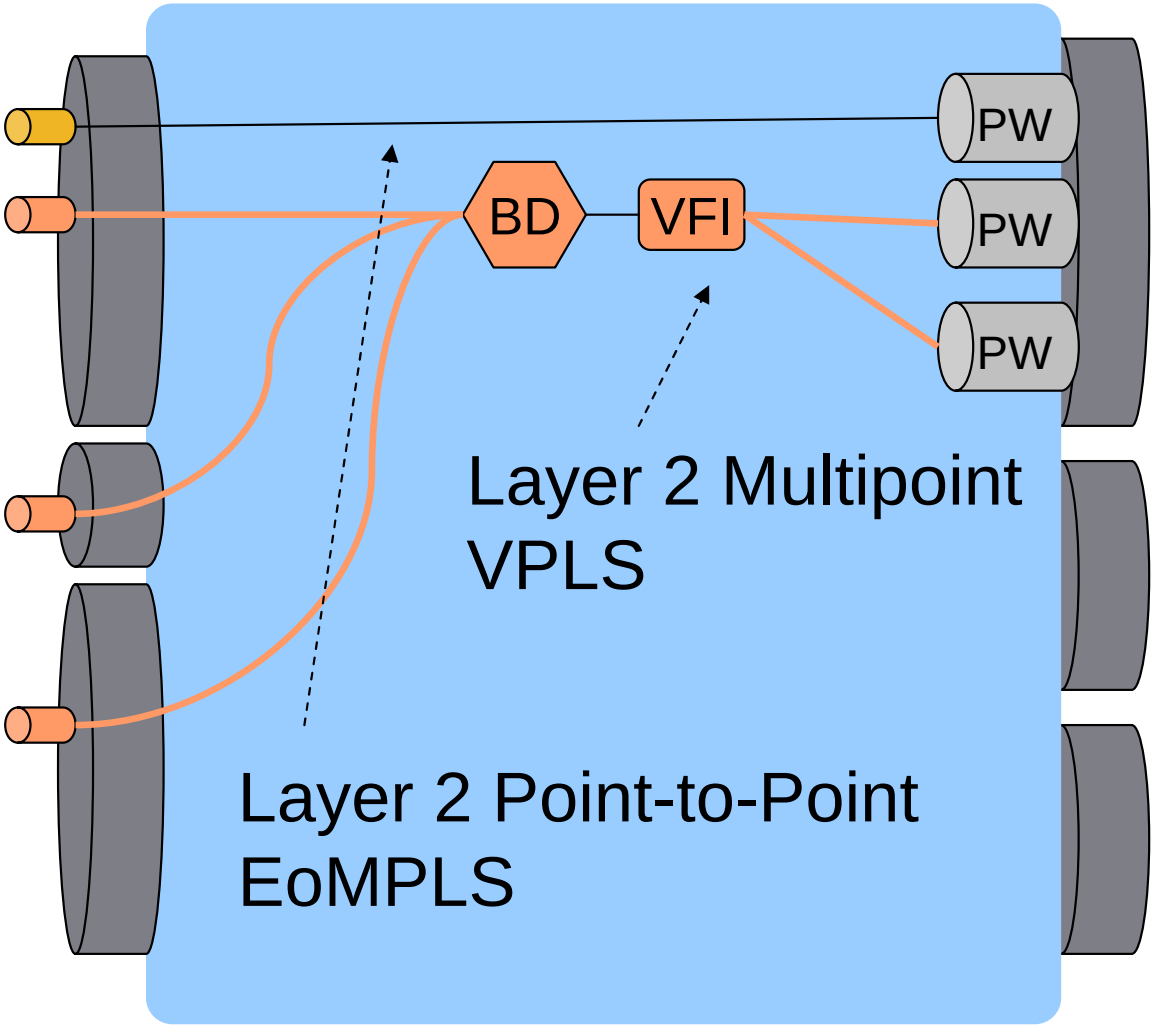
- Layer 2 P2P services using Ethernet over MPLS

  Service Instance to EoMPLS PW

- Layer 2 MP services using VPLS

  Extends ethernet multipoint bridging over a full mesh of PWs

  Split horizon support over attachment circuits (configurable) and PWs

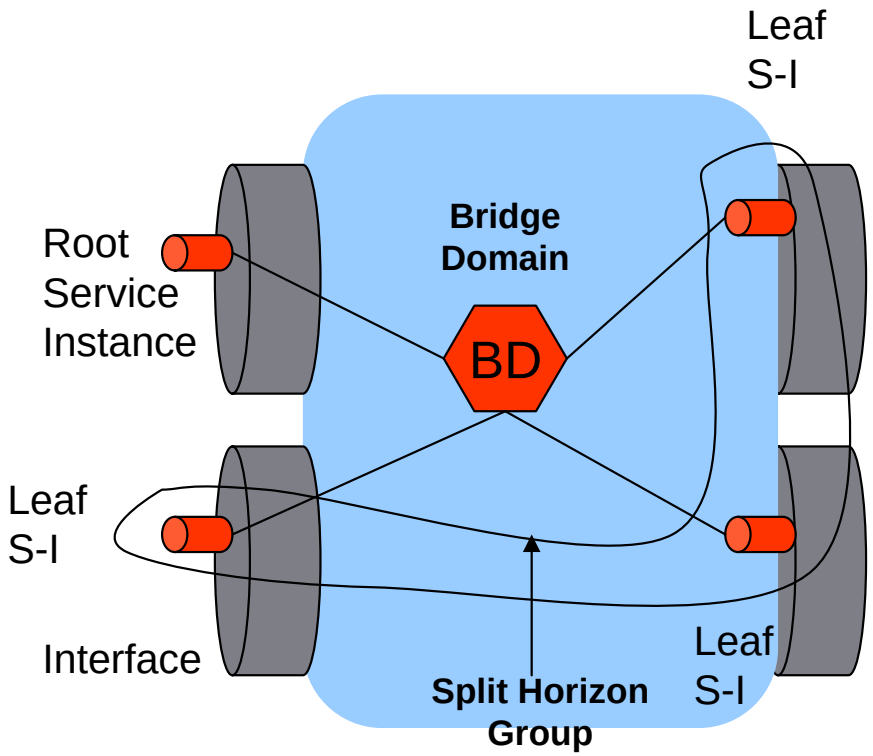


BD = Bridge Domain
PW = Pseudowire
VFI = Virtual Fwd Instance
SVI = Switch Virtual Instance

Rooted-Multipoint Forwarding Services

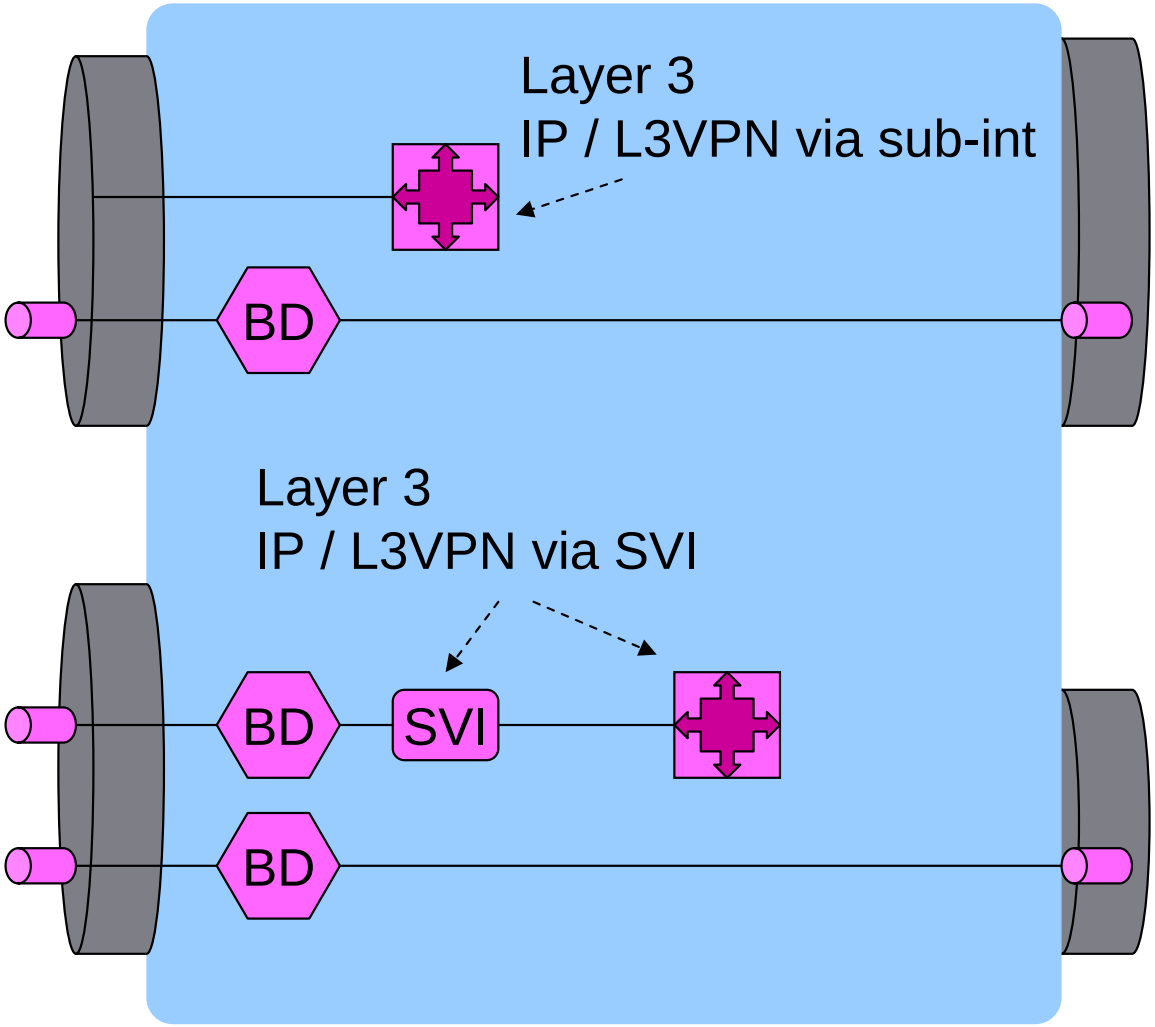
- Bridge-domain with Split Horizon Group can be used to implement rooted-multipoint forwarding service:
  - Place all Leaf Service Instances in Split Horizon Group
  - Keep Root Service Instance outside the Split Horizon Group

- Net effect
  - Bidirectional connectivity between Root and all Leaf Service Instances
  - Leaf Service Instance cannot communicate to each other



Layer 3 Forwarding Services

- Co-existence with Routed sub-interfaces
- Layer 3 termination through SVI interface (interface vlan)
- Layer 3 termination through Routed sub-interfaces

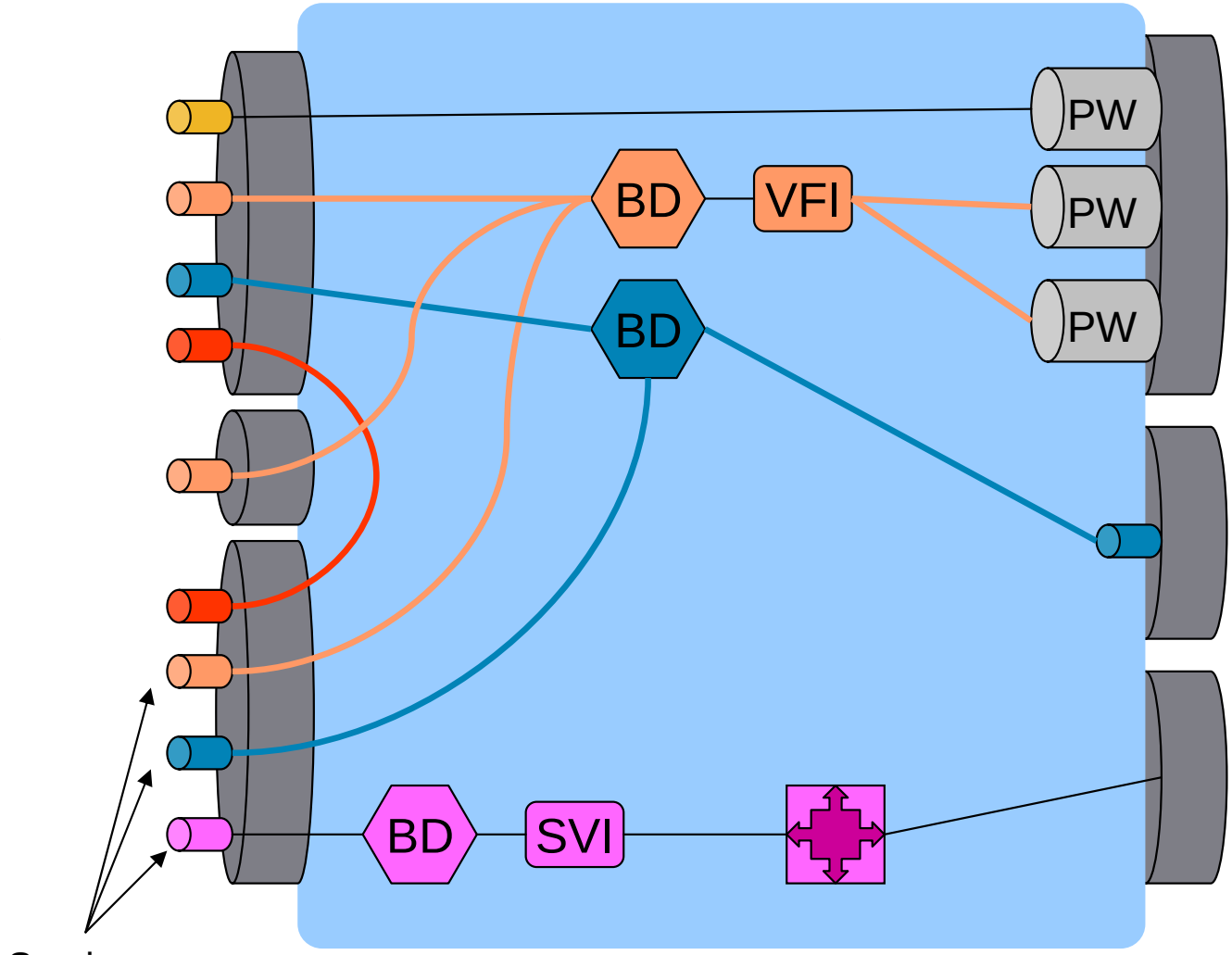


BD = Bridge Domain
PW = Pseudowire

VFI = Virtual Fwd Instance
SVI = Switch Virtual Instance

Putting It All Together

- Multiplexed Service Interface
- Mix of L2 and L3 services on same port
- Different types of L2 services
  - Point-to-Point
  - Multipoint



BD = Bridge Domain
PW = Pseudowire

VFI = Virtual Fwd Instance
SVI = Switch Virtual Instance

Service-Instance/Bridge Domain Features

- Security
  - MAC limit on EVC Bridge Domain
  - MAC security on Service Instance
  - MAC ACL on Service Instance
  - Storm Control on Service Instance
  - IP Source Guard on Service Instance
  - DHCP snooping with Option-82 on Service Instance
  - Dynamic ARP Inspection (DAI)

- OAM
  - IEEE 802.1ag (CFM) on Service Instance with Bridge Domain
  - IP SLA for Metro Ethernet (using CFM on Service Instance with BD)

Service-Instance/Bridge Domain Features

- Resiliency
  - MST on EVC Bridge Domain
  - EVC “manual” Etherchannel
  - EVC “LACP” Etherchannel
  - EVC and FlexLink (backup interface) integration
- Miscellaneous
  - IGMP Snooping
  - UDLD on Service Instance
  - Custom Ether-type on Service Instance
- Instrumentation
  - EVC MIB
  - IF-MIB extensions to support Service Instance

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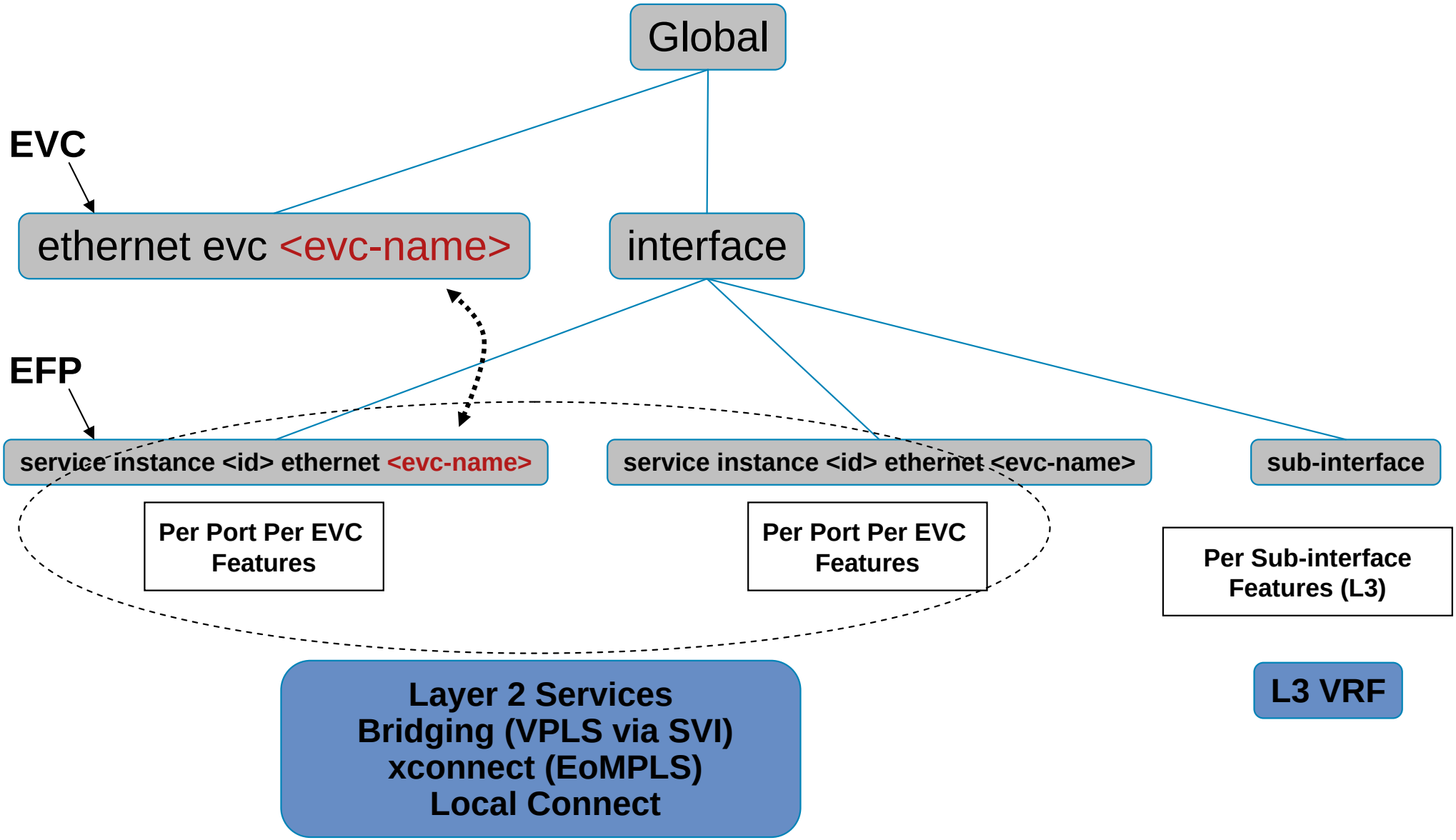
Cisco EVC Configuration Anatomy



Configuring Service Instance

interface <type><slot/port>

service instance <id> ethernet <evc-name>

<match criteria commands>

<rewrite commands>

<forwarding commands>

<feature commands>

- id is per-port
- evc-name global per device

VLAN, VLAN range/list, double-tags, CoS, Ethertype

VLAN tag pop/push/translate

Layer 2 Point-to-Point or Multipoint Bridging

- QoS, ACL, etc.

Configuring Flexible Frame Matching

- Single-Tagged Frame

  encapsulation dot1q {any | “<vlan-id>[,<vlan-id>[-<vlain-id>]]”}

  VLAN tag can be single, multiple or range or any (1-4094)

- Double-Tagged Frame

  encapsulation dot1q <vlan-id> second-dot1q {any | “<vlan-id>[,<vlan-id>[-<vlain-id>]]”}

  First vlan tag must be unique, second vlan tag can be any, unique, range or multiple

- Untagged Frame

  encapsulation untagged

  Match un-tagged frames, for example control traffic

- Default

  encapsulation default

  Match all frames tagged or untagged that are not matched by other more specific service instances

Configuring VLAN Manipulations

NPE1(config-if-srv)# rewrite ingress tag pop ?

1 Pop the outermost tag ← remove 1 tag

2 Pop two outermost tags ← remove 2 tag

NPE1(config-if-srv)# rewrite ingress tag push dot1q 10 ← add one tag

NPE1(config-if-srv)# rewrite ingress tag push dot1q 10 second-dot1q 20 ← add two tags

NPE1(config-if-srv)# rewrite ingress tag translate ?

1-to-1 Translate 1-to-1

1-to-2 Translate 1-to-2

2-to-1 Translate 2-to-1

2-to-2 Translate 2-to-2

Configuring P2P Forwarding Services

Point-to-point local connect

connect <name> <interface-type/slot/port> <SI-id> <ethernet-type/slot/port> <SI-id>

```
interface GigabitEthernet4/1/0
 service instance 3 ethernet
  encapsulation dot1q 51
  rewrite ingress tag translate 1-to-2 dot1q 52 second-dot1q 52 symmetric

interface GigabitEthernet4/1/1
 service instance 3 ethernet
  encapsulation dot1q 52 second-dot1q 52

connect eline-3 GigabitEthernet4/1/0 3 GigabitEthernet4/1/1 3
```

Point-to-point xconnect

xconnect <peer-add> <VC-ID> encapsulation mpls

```
interface GigabitEthernet4/1/1
  service instance 11 ethernet
  encapsulation dot1q 101 second-dot1q 60-70
  xconnect 10.0.0.3 101 encapsulation mpls
```

Configuring Multipoint Forwarding Services

Multipoint Native Ethernet Bridging and VPLS

bridge-domain <global-vlan-id> [split-horizon]

Split-horizon to disable L2 communication between two Service Instances

Local Bridging

```
interface GigabitEthernet4/1/0
 service instance 101 ethernet
  encapsulation dot1q 101-1000
  bridge-domain 100

interface GigabitEthernet4/1/1
 service instance 101 ethernet
  encapsulation dot1q 101-1000
  bridge-domain 100
```

VPLS

```
interface GigabitEthernet4/1/0
 service instance 2 ethernet
  encapsulation dot1q 60
  bridge-domain 20 split-horizon

interface GigabitEthernet4/1/1
 service instance 2 ethernet
  encapsulation dot1q 61
  bridge-domain 20 split-horizon

interface Vlan20
 xconnect vfi vpls-20
```

Configuring P2MP Forwarding Service

Multipoint Native Ethernet Bridging and VPLS

bridge-domain <global-vlan-id> [split-horizon]

Disables communication between leaf Service Instances in Split Horizon Group

Local Bridging

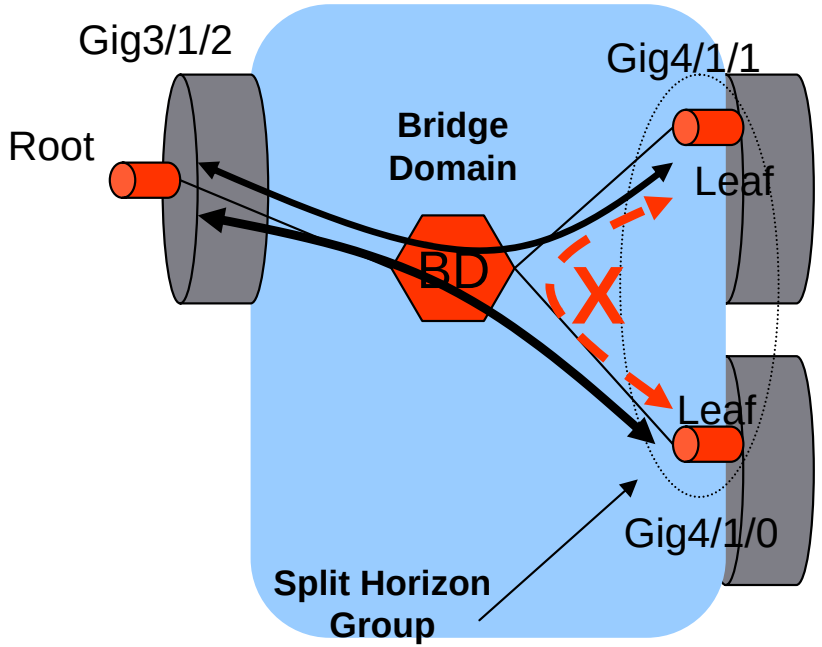
```
interface GigabitEthernet4/1/0
 service instance 101 ethernet
  encapsulation dot1q 101-1000
  bridge-domain 100 split-horizon

interface GigabitEthernet4/1/1
 service instance 101 ethernet
  encapsulation dot1q 101-1000
  bridge-domain 100 split-horizon
```

Leaf/ Leaves

```
interface GigabitEthernet3/1/2
 service instance 101 ethernet
  encapsulation dot1q 101-1000
  bridge-domain 100
```

Root



Configuring L3 Forwarding Service

Single tag termination

Option 1

```
interface GigabitEthernet4/1/1
 service instance 666 ethernet
  encapsulation dot1q 200
  rewrite ingress tag pop 1 symmetric
  bridge-domain 100

interface Vlan100
 ip address 100.1.100.1 255.255.255.0
```

Option 2

```
interface GigabitEthernet4/1/1.200
encapsulation dot1q 200
ip address 100.1.100.1 255.255.255.0
```

Double tag termination

Option 1

```
interface GigabitEthernet4/1/1
 service instance 666 ethernet
  encapsulation dot1q 200 second 300
  rewrite ingress tag pop 2 symmetric
  bridge-domain 100

interface Vlan100
 ip address 100.1.100.1 255.255.255.0
```

Option 2

```
interface GigabitEthernet4/1/1.200
encapsulation dot1q 200 second 300
 ip address 100.1.100.1 255.255.255.0
```

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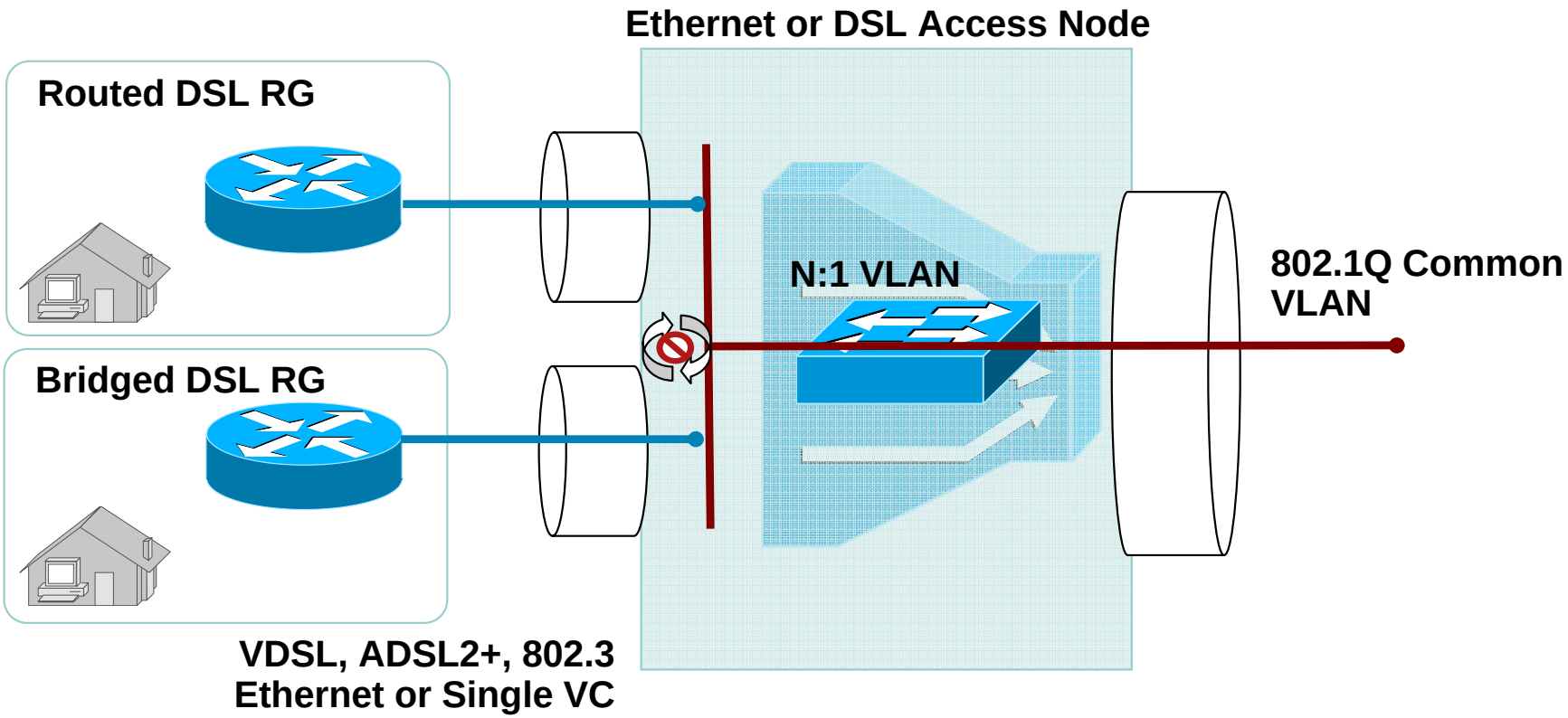
Residential UNI Standards

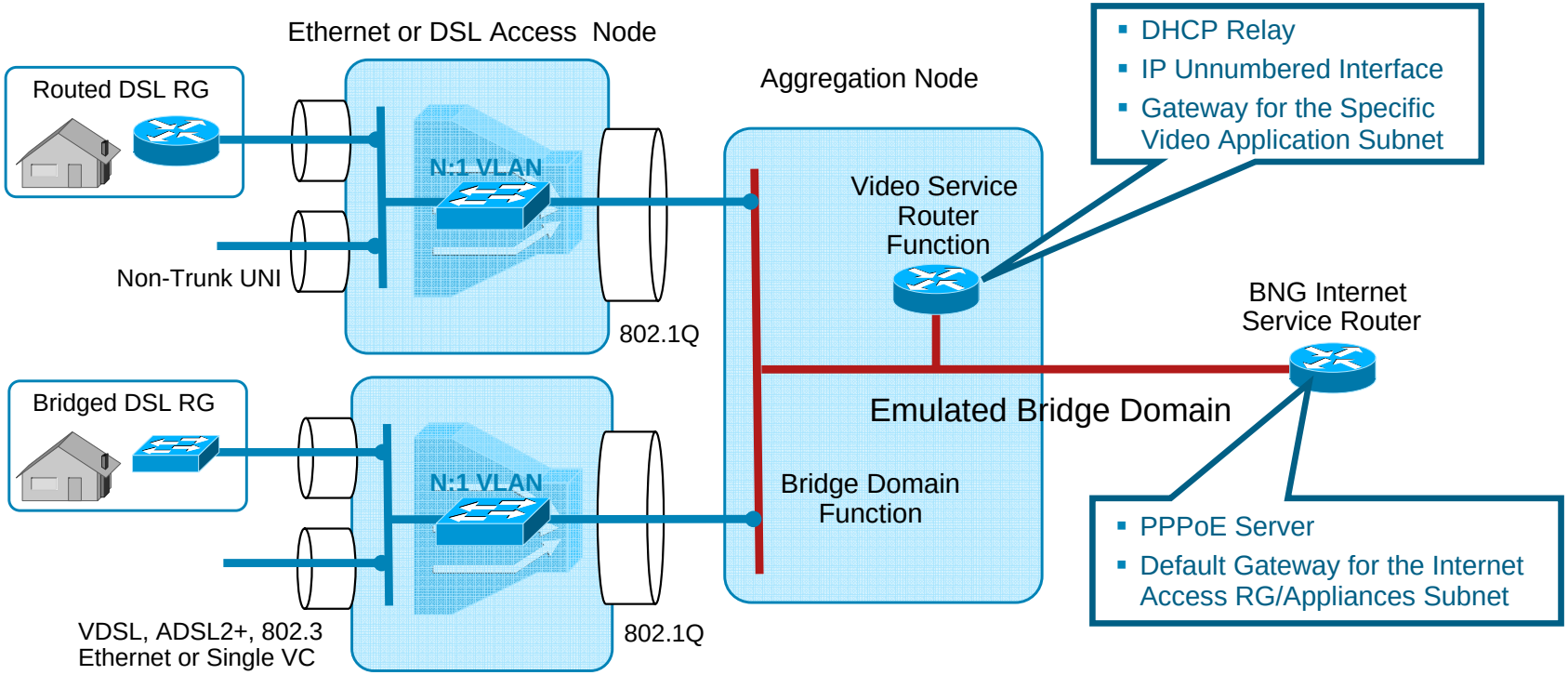
- DSL Forum 101 for residential services
  - UNI exists between the access node and the CPE
  - Trunk UNI means a different VLAN or VC per service
  - Non-Trunk UNI means no VLANs to CPE
  - 1:1 means one VLAN per customer
  - N:1 means multiple customers share a VLAN
- Prevalent Residential service options
  - Non-Trunk UNI, N:1 VLAN
  - Trunk (Multi-VC) UNI, N:1 Service VLAN
  - Trunk (Multi-VC) UNI, 1:1 Internet Access (HSI) VLAN

Non-Trunk UNI, N:1 VLAN



- Residential DSL, Ethernet UNI
  - ADSL2+ Single ATM VC
  - Ethernet 802.3 interface with priority tagged frames
- Access Node UNI Aggregation
  - Common 802.1Q VLAN
  - IGMP snooping
  - PPPoE and DHCP Tags
  - Bridge domain split

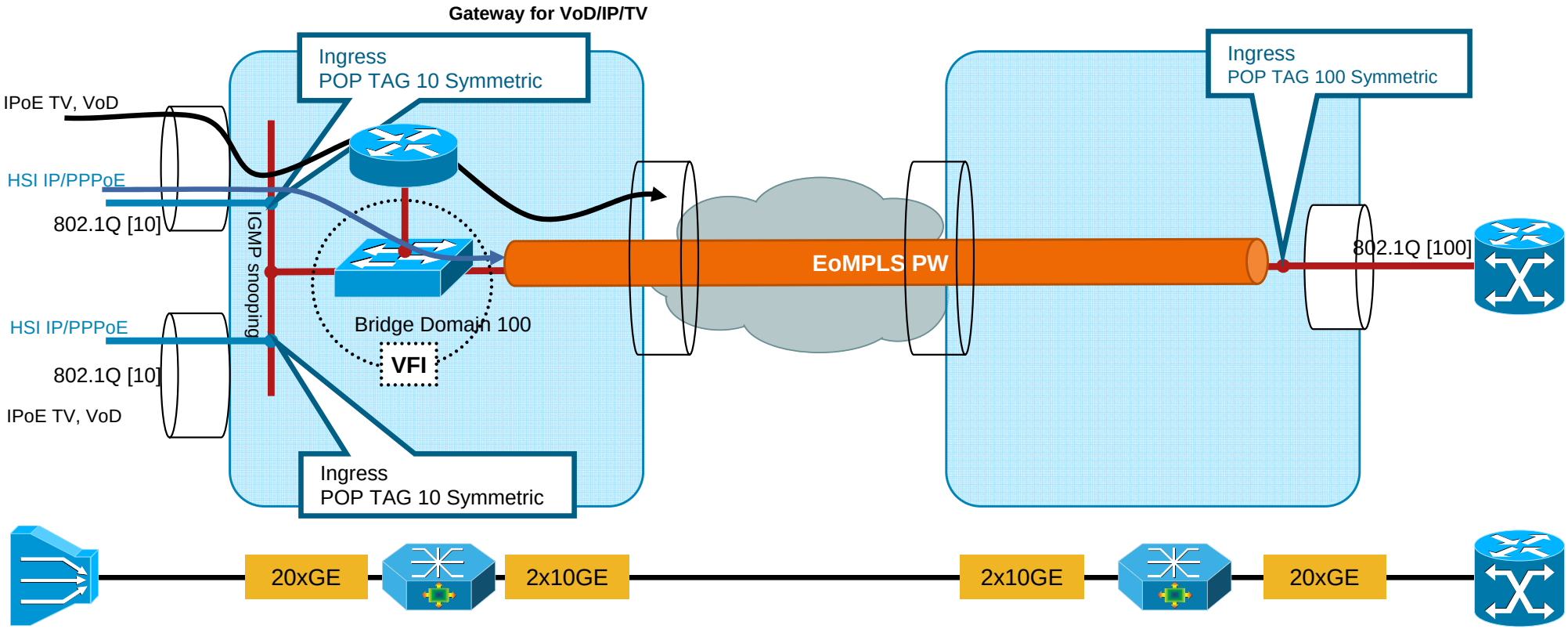
Residential Service Connectivity



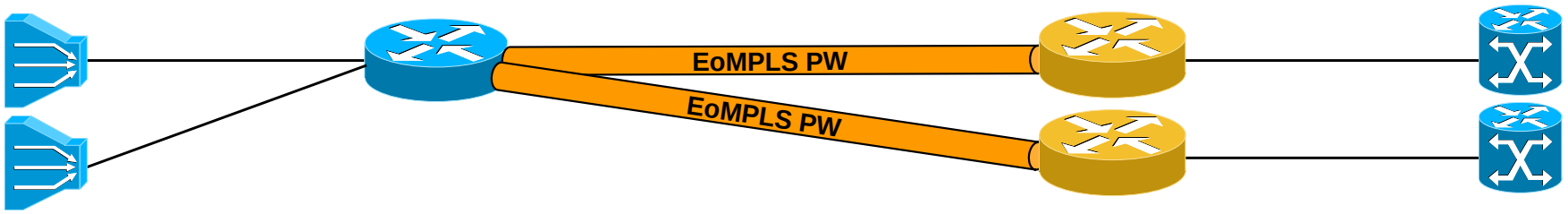
- Common bridge domain with Split horizon forwarding and Subscriber Line Identity through PPPoE Tag Line ID or DHCP Option 82
- Default Route pointing to BNG, specific router pointing to Video Service Router (through RG GUI, TR-69, DHCP Option 121)

Residential Service Aggregation Model

- Port-significant VLAN ids removed on ingress
- Routing AND bridging in a common N:1 VLAN
- VLAN id added on egress towards BNG



Aggregation/Distribution Node Configuration



Aggregation

```
vlan 300
!
interface Loopback0
 ip address 10.30.30.172 255.255.255.255
!
interface Loopback1
 ip address 130.172.1.1 255.255.255.255
!
interface GigabitEthernet4/0/4
 service instance 1 ethernet
  encapsulation dot1q 10
  rewrite ingress tag pop 1 symmetric
  bridge-domain 100 split-horizon
 !
interface GigabitEthernet4/0/5
 service instance 1 ethernet
  encapsulation dot1q 10
  rewrite ingress tag pop 1 symmetric
  bridge-domain 100 split-horizon

interface Vlan100
 ip dhcp relay information trusted
 ip unnumbered Loopback1
 ip helper-address 10.20.61.3
 ip pim sparse-mode
 xconnect 10.30.30.16 300 pw-class F1601
  backup peer 10.30.30.17 300 pw-class F1701
```

Distribution #1

```
interface Loopback0
 ip address 10.30.30.16 255.255.255.255

interface GigabitEthernet3/0/1
 service instance 100 ethernet
  encapsulation dot1q 100
  rewrite ingress tag pop 1 symmetric
  xconnect 10.30.30.172 300 pw-class F1702
```

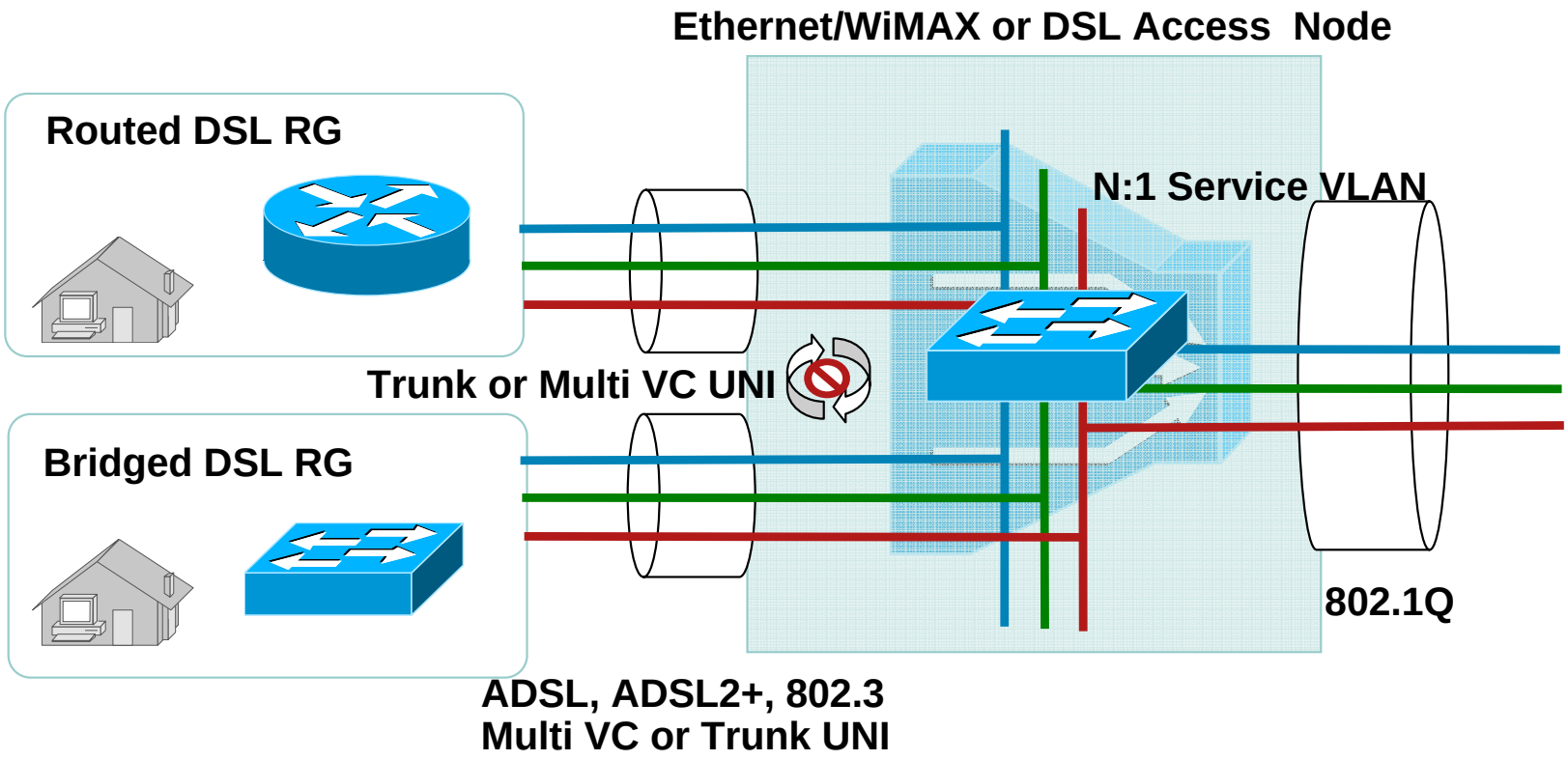
Distribution #2

```
interface Loopback0
 ip address 10.30.30.17 255.255.255.255

interface GigabitEthernet3/0/1
 service instance 100 ethernet
  encapsulation dot1q 100
  rewrite ingress tag pop 1 symmetric
  xconnect 10.30.30.173 300 pw-class F1703
```

Active/Backup Example by Using EoMPLS with a Backup PW

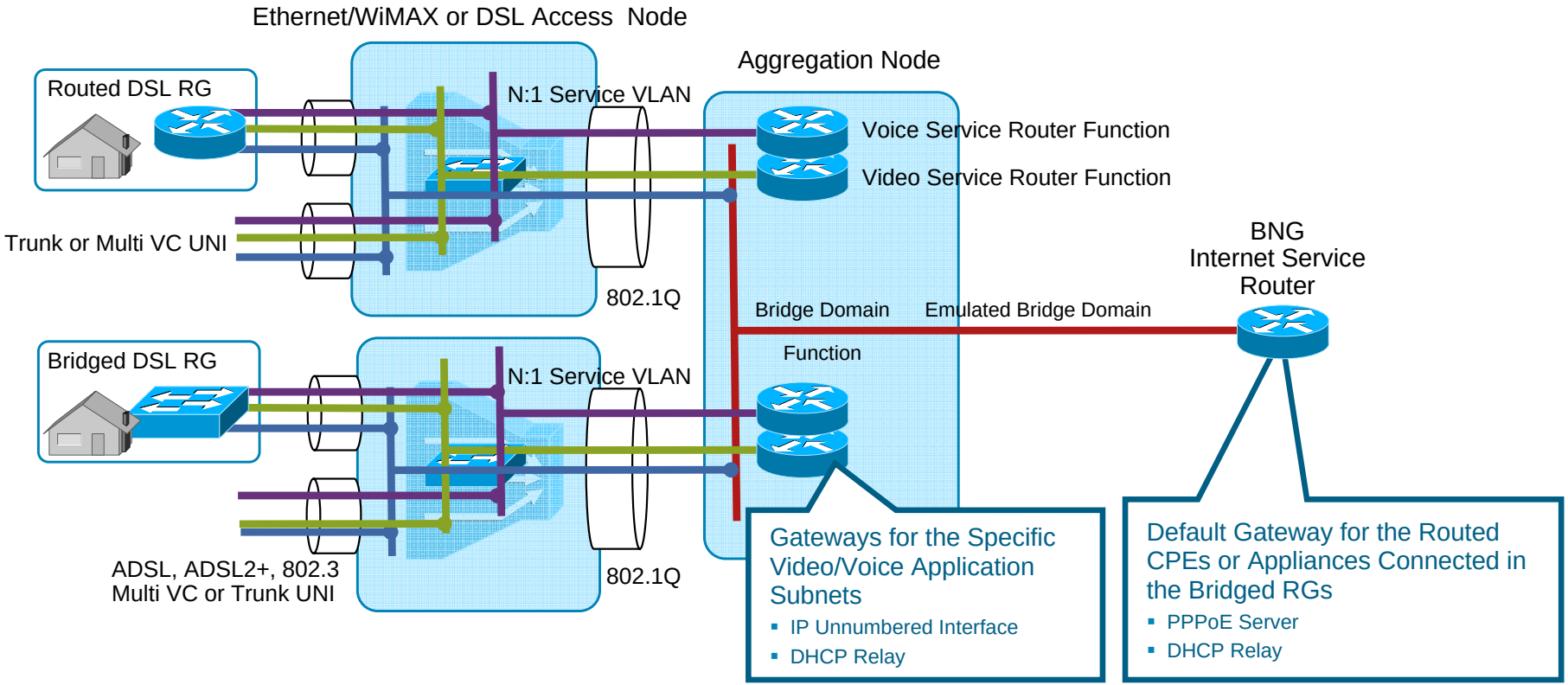
Trunk (Multi-VC) UNI, N:1 Service VLAN



- Residential DSL, Ethernet UNI:
  - ADSL(2+) Multiple VC interface
  - Ethernet IEEE Ethernet 802.1Q and 802.1p
- Access Node UNI Aggregation:
  - Service 802.1Q VLAN
  - IGMP snooping
  - PPPoE and DHCP Tags
  - Bridge domain split horizon

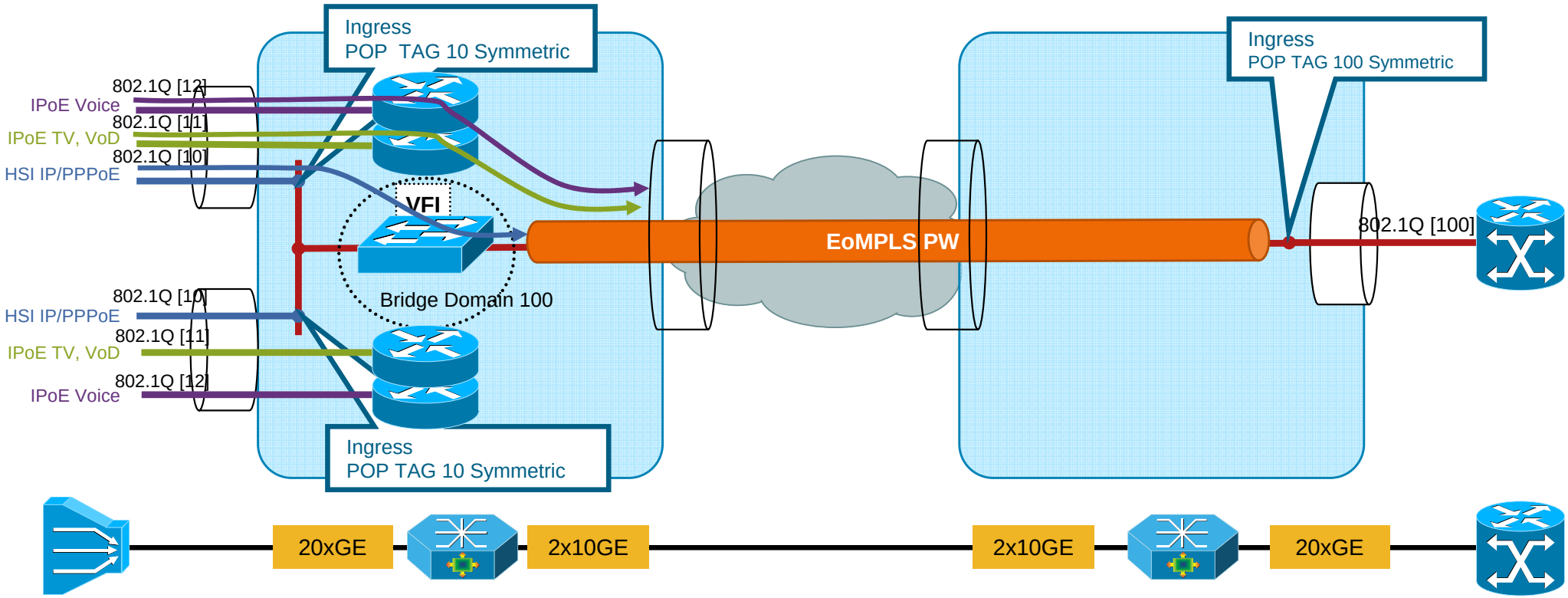
Residential Service Connectivity

- Split Horizon Forwarding, locally significant VLAN ids combined into a per service ‘Bridge Domains’ (N:1)
- Video routed (unnumbered) in Aggregation, other transported to Distribution

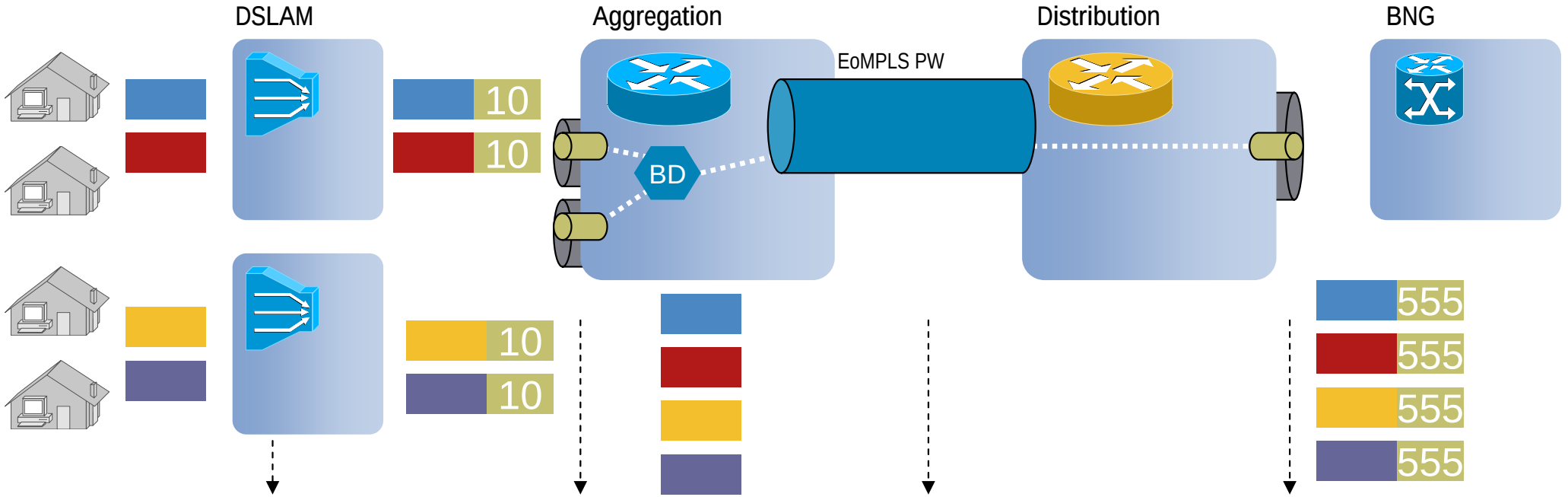


Residential Service Aggregation Model

- Port-significant VLAN ids removed on ingress
- Some VLANs routed, other bridged
- Common Bridge Domain allows to use single MPLS PW per Aggregation Node
- VLAN id added on egress towards BNG



Pseudowire per Aggregation Node Scenario



DSLAM assigns a single VLAN for Data service (e.g. 10). This VLAN is shared for all subscribers (N:1)

DATA Service Instance

Ingress direction:
- Match traffic from DSLAM based on single VID (e.g. 10)
- POP the service VLAN
- Send traffic to DATA bridge domain (BD)

Egress direction:
- PUSH service VLAN (e.g. 10) on traffic received from DATA BD

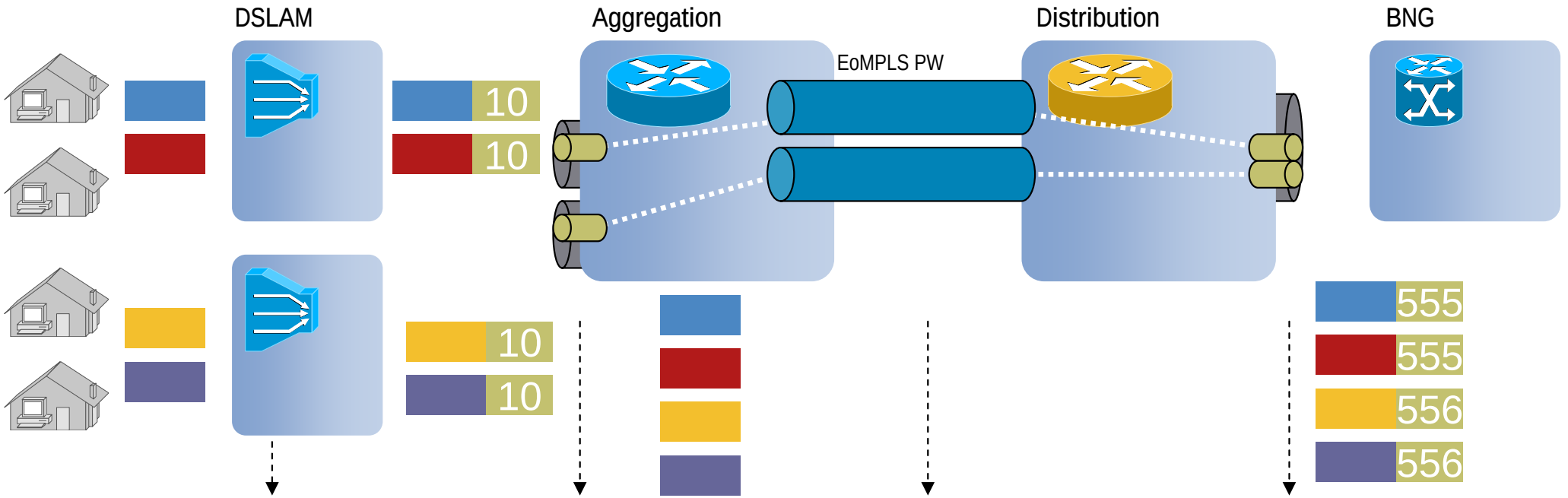
Single EoMPLS PW carries traffic from all DSLAMs in a given AGG node

DATA Service Instance

Egress direction:
- PUSH VLAN representing AGG node (e.g. 555) on traffic received from PW

Ingress direction:
- Match traffic from BNG based on AGG VID (e.g. 555)
- POP AGG VLAN
- Send traffic to PW

Pseudowire per DSLAM Scenario



DSLAM assigns a single VLAN for Data service (e.g. 10). This VLAN is shared for all subscribers (N:1)

DATA Service Instance

Ingress direction:
- Match traffic from DSLAM based on single VID (e.g. 10)
- POP the service VLAN
- Send traffic to PW

Egress direction:
- PUSH service VLAN (e.g. 10) on traffic received from PW

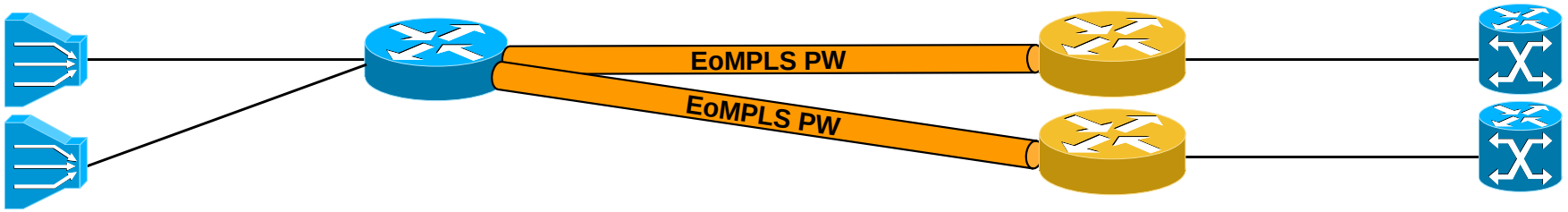
Single EoMPLS PW carries traffic from all subscribers in a given DSLAM

DATA Service Instance

Egress direction:
- PUSH VLAN representing DSLAM (e.g. 555, 556) on traffic received from PW

Ingress direction:
- Match traffic from BNG based on DSLAM VID (e.g. 555, 556)
- POP DSLAM VLAN
- Send traffic to PW

Aggregation Node EVC/SVI Configuration



Aggregation EVC

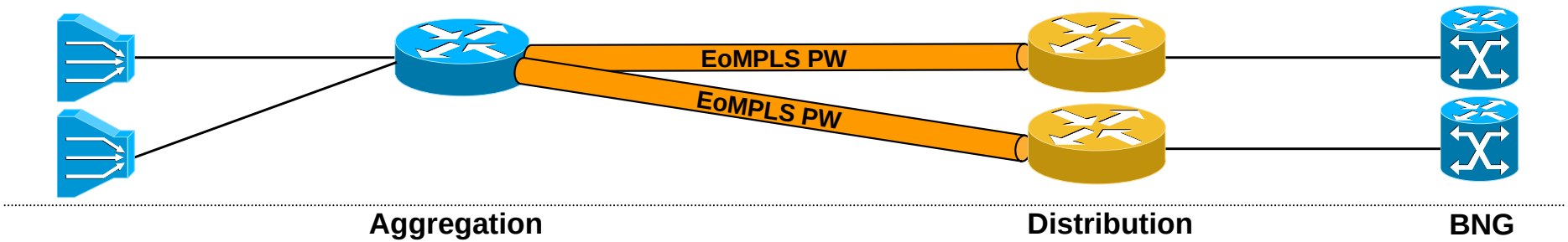
```
interface GigabitEthernet4/0/4
service instance 1 ethernet
  encapsulation dot1q 10
  rewrite ingress tag pop 1 symmetric
  bridge-domain 310 split-horizon
 !
 service instance 2 ethernet
  encapsulation dot1q 11
  rewrite ingress tag pop 1 symmetric
  bridge-domain 311 split-horizon
!
interface GigabitEthernet4/0/5
service instance 1 ethernet
  encapsulation dot1q 10
  rewrite ingress tag pop 1 symmetric
  bridge-domain 310 split-horizon
 !
 service instance 2 ethernet
  encapsulation dot1q 11
  rewrite ingress tag pop 1 symmetric
  bridge-domain 312 split-horizon
```

Aggregation SVI

```
vlan 310
vlan 311
vlan 312
!
interface Loopback1
 ip address 130.173.1.1 255.255.255.255
!
interface Vlan310
 no ip address
 xconnect vfi v310
!
interface Vlan311
 ip dhcp relay information trusted
 ip unnumbered Loopback1
 ip helper-address 10.20.61.3
 ip pim sparse-mode
!
interface Vlan312
 ip dhcp relay information trusted
 ip unnumbered Loopback1
 ip helper-address 10.20.61.3
 ip pim sparse-mode
```

- One common bridge domain for HSI (VLAN 310)
- Per DSLAM SVI for video (VLAN 311 and VLAN 312)
- Active/Active example using VPLS

Distribution Node/VPLS Configuration



Aggregation

```
Vlan 310
!
pseudowire-class F1701
 encapsulation mpls
 preferred-path interface Tunnel1
!
pseudowire-class F1601
 encapsulation mpls
 preferred-path interface Tunnel3
!
l2 vfi v310 manual
 vpn id 310
neighbor 10.30.30.16 pw-class F1601 no-split-horizon
neighbor 10.30.30.17 pw-class F1701 no-split-horizon
!
interface Loopback0
 ip address 10.30.30.172 255.255.255.255
!
interface Vlan310
xconnect vfi v310
```

Distribution #1

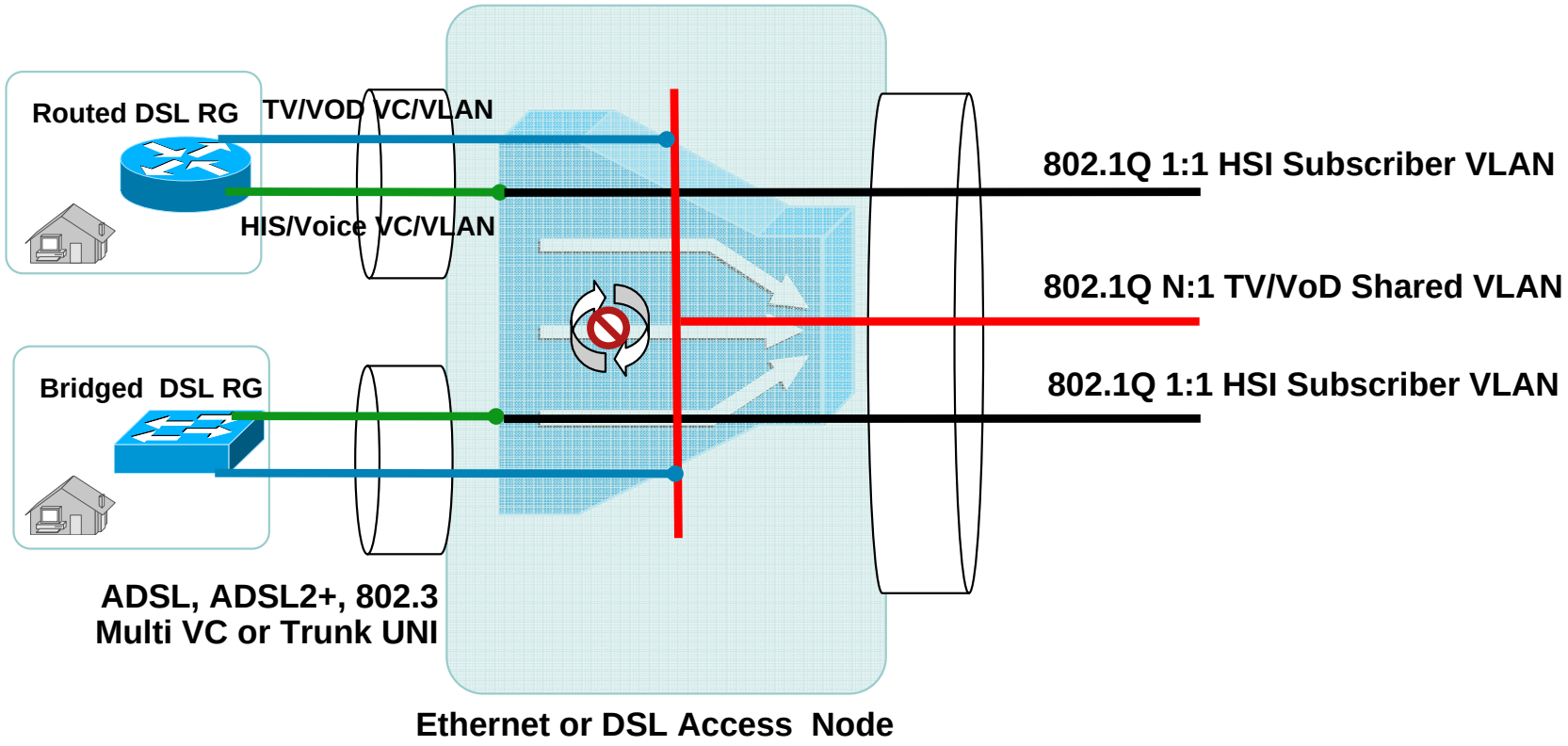
```
interface Loopback0
 ip address 10.30.30.16 255.255.255.255
!
interface GigabitEthernet3/0/3
 service instance 310 ethernet
  encapsulation dot1q 555
  rewrite ingress tag pop 1 symmetric
  xconnect 10.30.30.173 310 pw-class F1703
```

Distribution #2

```
interface Loopback0
 ip address 10.30.30.17 255.255.255.255
!
interface GigabitEthernet3/0/3
 service instance 310 ethernet
  encapsulation dot1q 555
  rewrite ingress tag pop 1 symmetric
  xconnect 10.30.30.173 310 pw-class F1703
```

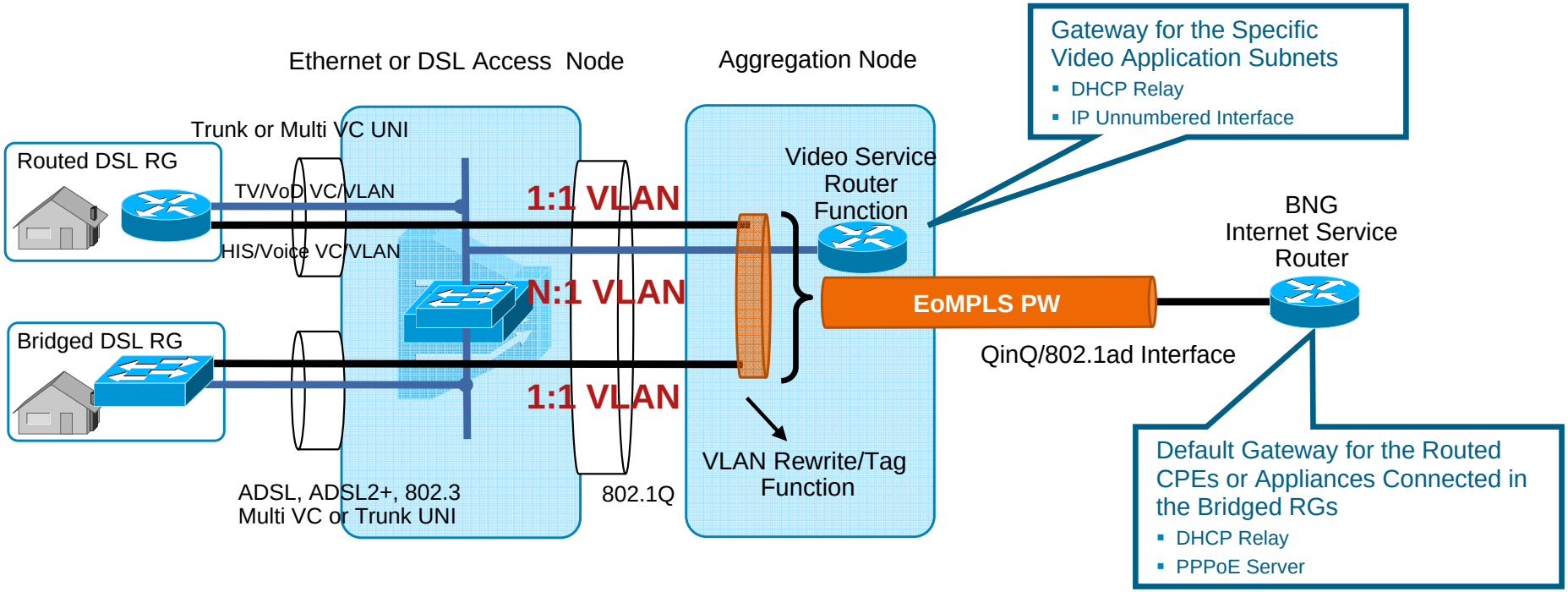
* These configurations reflect only the VPLS CLI required for HSI transport toward the redundant BNGs on the Aggregation Node; for complete Aggregation Node configuration, please refer to the previous slide

Trunk (Multi-VC) UNI, 1:1 HSI VLAN



- Residential DSL, Ethernet UNI:
  - ADSL(2+) Multi ATM VCs
  - Ethernet interface with IEEE Ethernet 802.1Q and 802.1p
- DSL Access Node UNI Aggregation:
  - 1:1 802.1Q subscriber VLAN for HSI/Voice
  - N:1 802.1Q shared VLAN for TV and VoD service

Residential Service Connectivity



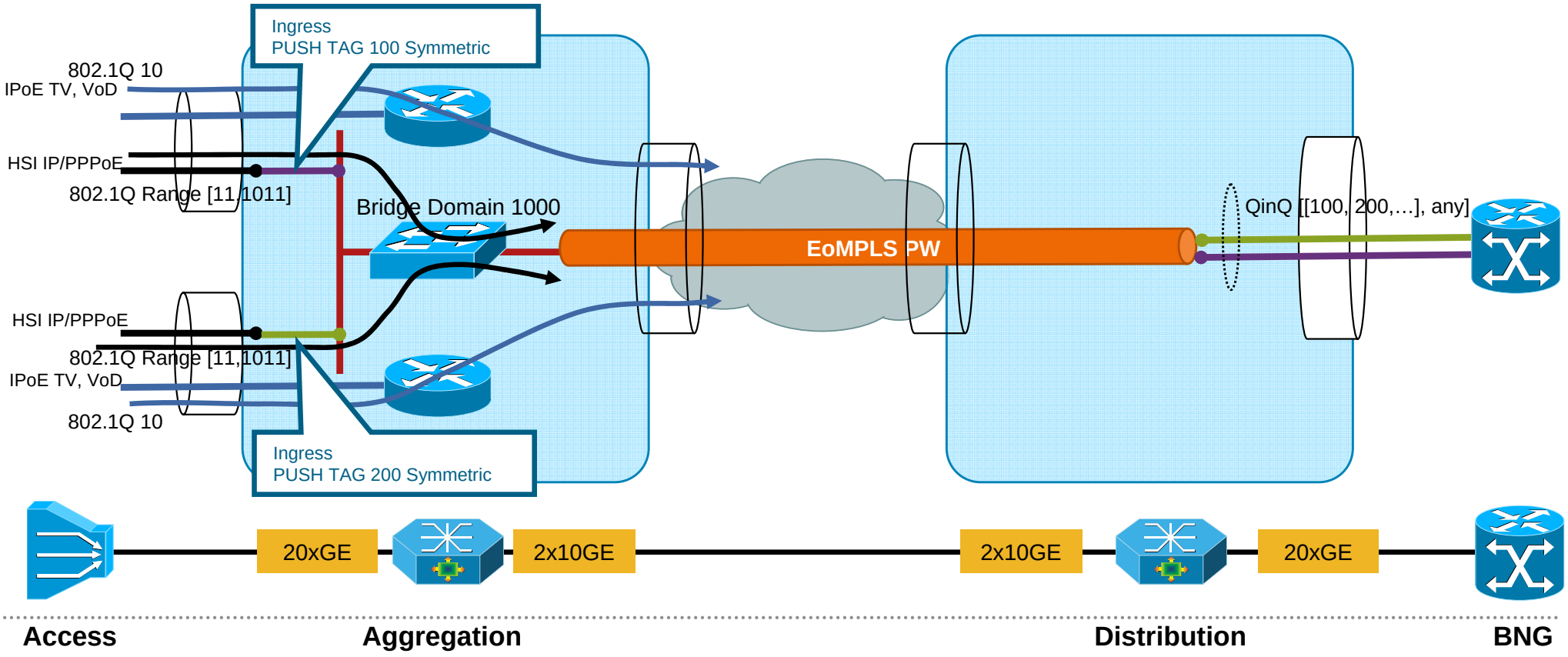
- This models allows to migrate from a single/dual-play 1:1 scenario to a triple play one **with** video optimisation
- Different Bridge Domains:

  N:1 VLAN for TV/VoD with Split Horizon forwarding in Access and Aggregation

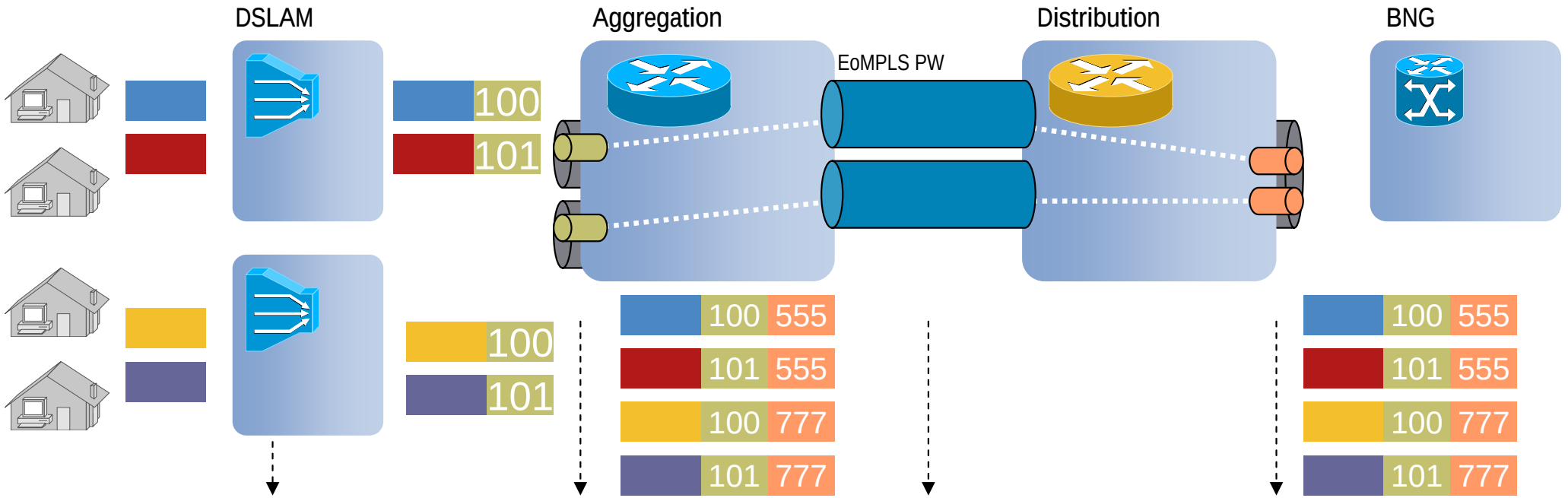
  1:1 VLAN for Internet Access/Voice

Residential Service Aggregation Model

- Internet Access 1:1 VLANs are selectively double-tagged, added to a Bridge Domain, and tunnelled across a single PW
- TV/VoD N:1 VLAN routed in Aggregation



Pseudowire per DSLAM Scenario



DSLAM assigns a dedicated VLAN (1:1) for Data service per subscriber (e.g. range 100-499 for 400 subscribers)

DATA Service Instance

Ingress direction:
- Match traffic from DSLAM based on VID range (e.g. 100-499)
- PUSH vlan representing DSLAM (e.g. 555, 777)
- Send traffic to PW

Egress direction:
- POP DSLAM vlan (e.g. 555) on traffic received from PW

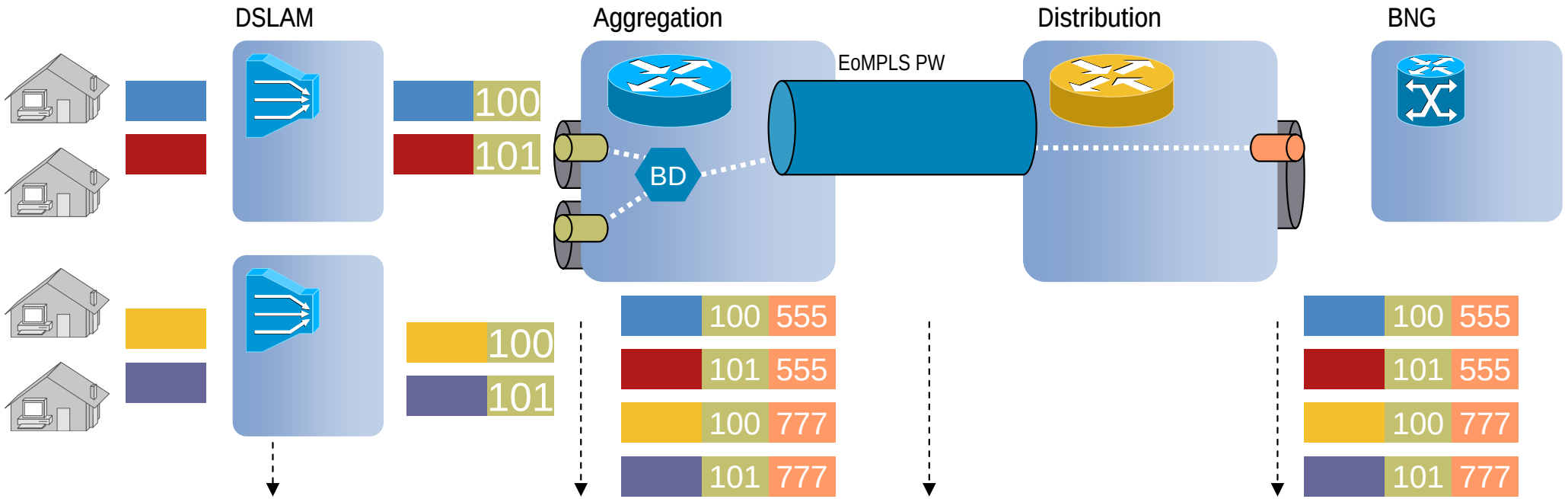
Single EoMPLS PW carries traffic from all subscribers in a given DSLAM

DATA Service Instance

Egress direction:
- Forward traffic received from PW

Ingress direction:
- Match traffic from BNG based on DSLAM VID (e.g. 555, 777)
- Send traffic to PW

Pseudowire per Aggregation Node Scenario



DSLAM assigns a dedicated VLAN (1:1) for Data service per subscriber (e.g. range 100-499 for 400 subscribers)

DATA Service Instance

Ingress direction:
- Match traffic from DSLAM based on VID range (e.g. 100-499)
- PUSH vlan representing DSLAM (e.g. 555, 777)
- Send traffic to DATA BD

Egress direction:
- POP DSLAM vlan (e.g. 555) on traffic received from PW

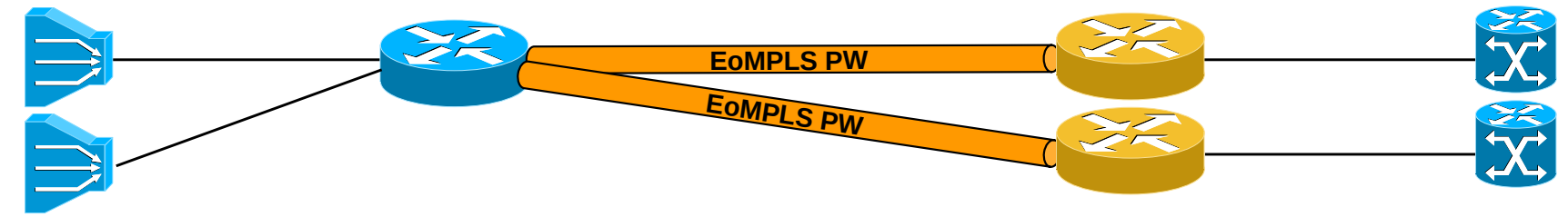
Single EoMPLS PW carries traffic from all DSLAMs in a given AGG node

DATA Service Instance

Egress direction:
- Forward traffic received from PW

Ingress direction:
- Match traffic from BNG based on DSLAM VID list (e.g. 555,777)
- Send traffic to PW

Aggregation Node EVC/SVI Configuration



Aggregation EVC

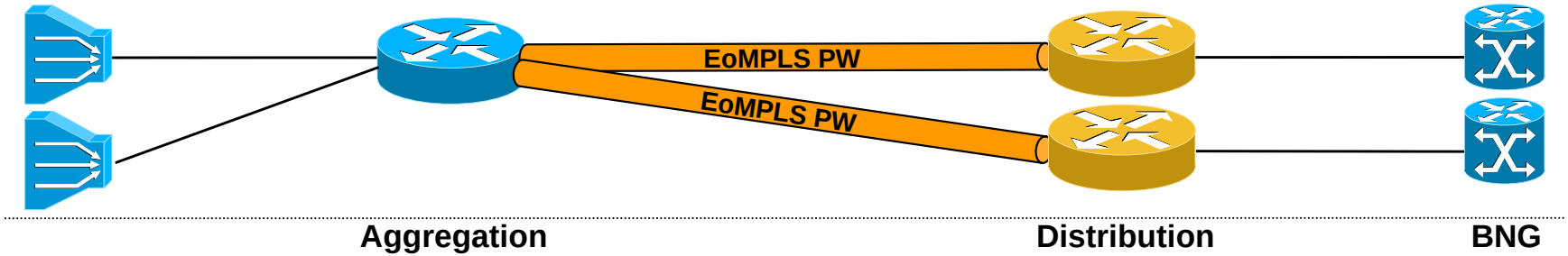
```
interface GigabitEthernet4/0/4
 service instance 1 ethernet
  encapsulation dot1q 11-1011
  rewrite ingress tag push dot1q 555 symmetric
  bridge-domain 310 split-horizon
 !
 service instance 2 ethernet
  encapsulation dot1q 10
  rewrite ingress tag pop 1 symmetric
  bridge-domain 311 split-horizon
!
interface GigabitEthernet4/0/5
 service instance 1 ethernet
  encapsulation dot1q 11-1011
  rewrite ingress tag push dot1q 777 symmetric
  bridge-domain 310 split-horizon
 !
 service instance 2 ethernet
  encapsulation dot1q 10
  rewrite ingress tag pop 1 symmetric
  bridge-domain 312 split-horizon
```

Aggregation SVI

```
vlan 310
vlan 311
vlan 312
!
interface Loopback1
 ip address 130.173.1.1 255.255.255.255
!
interface Vlan310
 no ip address
 xconnect vfi v310
!
interface Vlan311
 ip dhcp relay information trusted
 ip unnumbered Loopback1
 ip helper-address 10.20.61.3
 ip pim sparse-mode
!
interface Vlan312
 ip dhcp relay information trusted
 ip unnumbered Loopback1
 ip helper-address 10.20.61.3
 ip pim sparse-mode
```

- One common bridge domain for HSI (VLAN 310)
- Per DSLAM SVI for video (VLAN 311 and VLAN 312)
- Active/Active example using VPLS

Distribution Node/VPLS Configuration



Aggregation

```
Vlan 310
!
pseudowire-class F1701
 encapsulation mpls
 preferred-path interface Tunnel1
!
pseudowire-class F1601
 encapsulation mpls
 preferred-path interface Tunnel3
!
l2 vfi v310 manual
 vpn id 310
neighbor 10.30.30.16 pw-class F1601 no-split-horizon
neighbor 10.30.30.17 pw-class F1701 no-split-horizon
!
interface Loopback0
 ip address 10.30.30.172 255.255.255.255
!
interface Vlan310
xconnect vfi v310
```

Distribution #1

```
interface Loopback0
 ip address 10.30.30.16 255.255.255.255
!
interface GigabitEthernet3/0/3
 service instance 310 ethernet
  encapsulation dot1q 555,777
  xconnect 10.30.30.173 310 pw-class F1703
```

Distribution #2

```
interface Loopback0
 ip address 10.30.30.17 255.255.255.255
!
interface GigabitEthernet3/0/3
 service instance 310 ethernet
  encapsulation dot1q 555, 777
  xconnect 10.30.30.173 310 pw-class F1703
```

* These configurations reflect only the VPLS CLI required for HSI transport toward the redundant BNGs on the Aggregation Node; for complete Aggregation Node configuration, please refer to the previous slide

Agenda

- Introduction
- EVC Fundamentals
- EVC Operation and Packet Flow
- EVC Configuration
- Examples of Deployment Scenarios
- Conclusions

Cisco EVC Framework – Platform Support

Scalable Edge Services

Cisco 7600

SIP-400, ES-20 and

NEW ES+ linecards

Cisco ASR 9000

Bandwidth Per Slot

Cisco EVC Framework – Key Take Aways

- Next-generation cross-platform Carrier Ethernet Software Infrastructure
- Addresses Flexible Ethernet Edge requirements
- Flexible Service Mapping
- Advanced Frame Manipulation
- Service Multiplexing
- Features – Security, OAM, QoS, etc.