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BGP Based Services
Introduction

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Objective

- Short Technical session (Flood & Learn)
  - No Fee
  - No Registration (Let's see if we will not overload meeting;))
- Networking topics with focus on Service Provider(SP) and SP Data Center technologies
- Next Topic and When?
  - We will see based on your interest ☺

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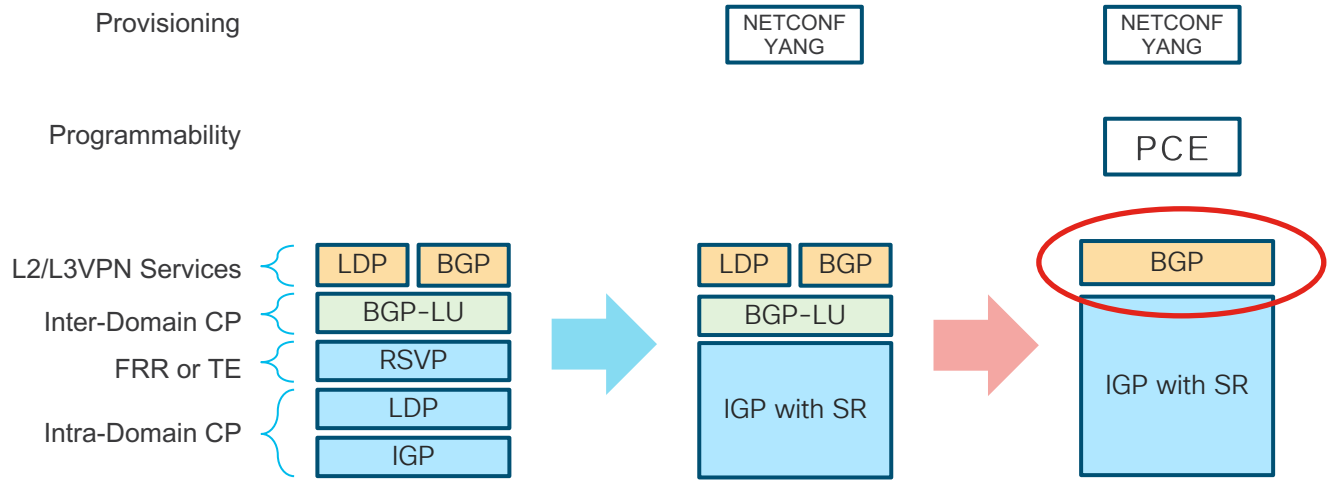
BGP Based Services

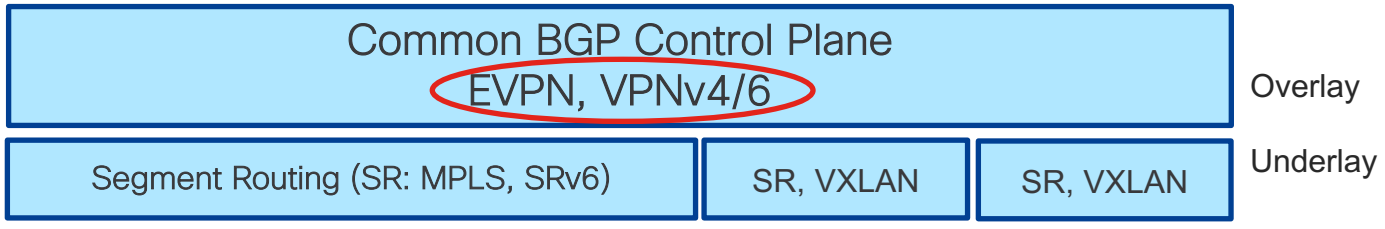
Introduction

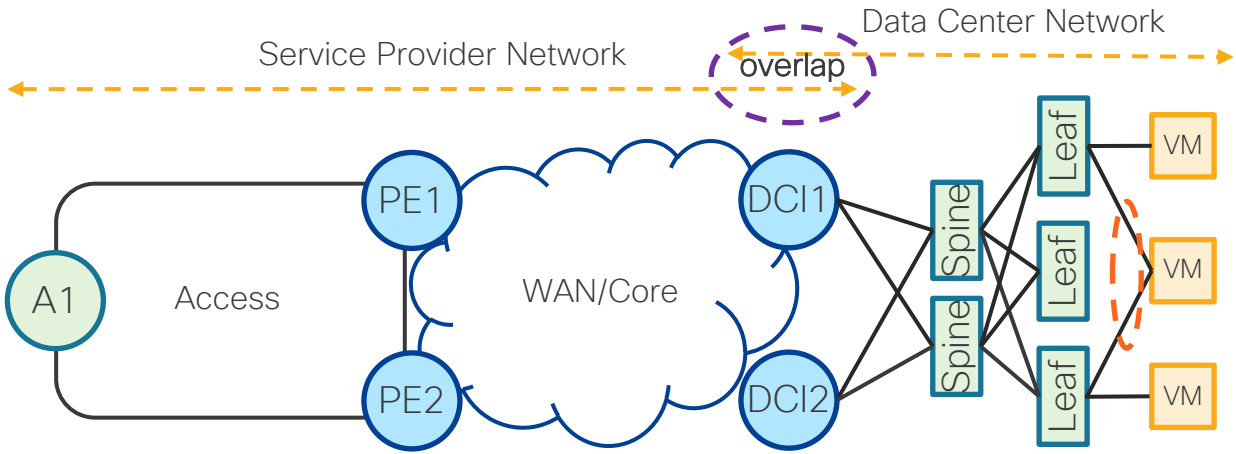
Service Provider Network – Simplification Journey



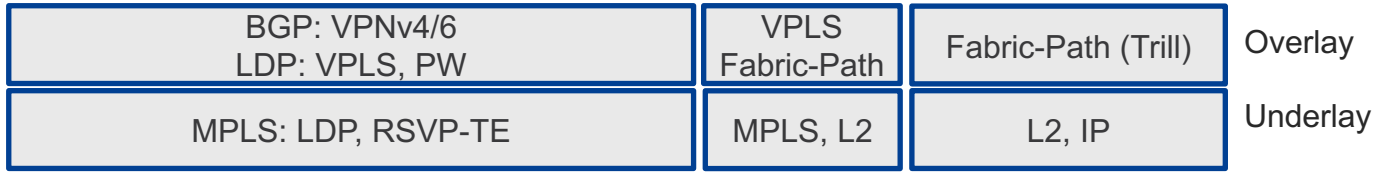
From Mac Bridging to Mac Routing

Evolution:





Existing Solution:



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EVPN Advantages:

Integrated Services

- Integrated Layer 2 and Layer 3 VPN services
- L3VPN-like principles and operational experience for scalability and control

Network Efficiency

- All-active Multi-homing & PE load-balancing (ECMP)
- Fast convergence (link, node, MAC moves)
- Control-Place (BGP) learning. PWs are no longer used.
- Optimized Broadcast, Unknown-unicast, Multicast traffic delivery

Service Flexibility

- Choice of MPLS, VxLAN or SRv6 data plane encapsulation
- Support existing and new services types (E-LAN, E-Line, E-TREE)
- Peer PE auto-discovery. Redundancy group auto-sensing

Investment Protection

- Fully support IPv4 and IPv6 in the data plane and control plane
- Open-Standard and Multi-vendor support

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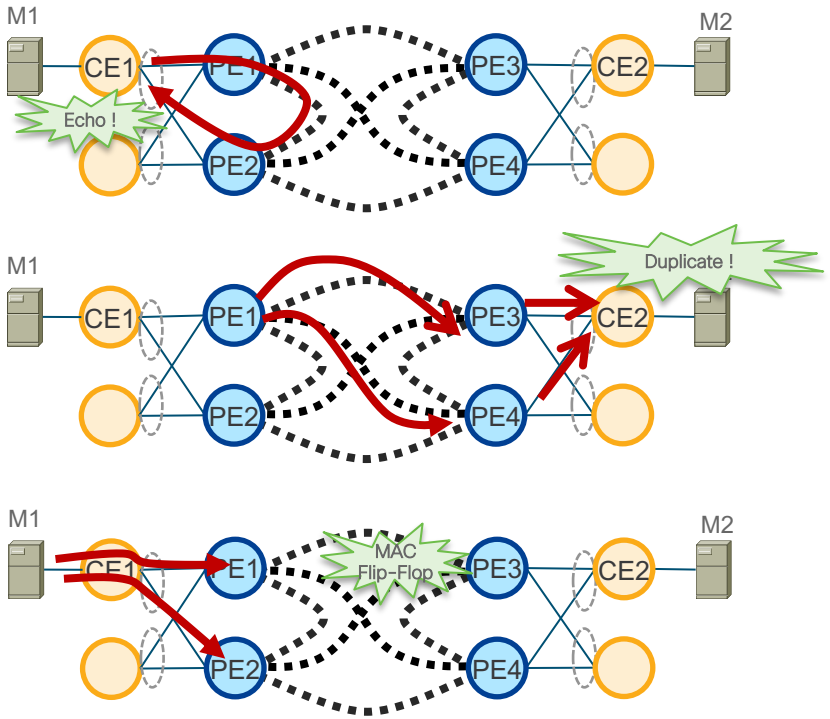
EVPN – Why?
Next-Generation Solutions for L2VPN
Solving VPLS challenges for per-flow Redundancy

- Existing VPLS solutions do not offer an All-Active per-flow redundancy
- Looping of Traffic Flooded from PE
- Duplicate Frames from Floods from the Core
- MAC Flip-Flopping over Pseudowire
  - E.g. Port-Channel Load-Balancing does not produce a consistent hash-value for a frame with the same source MAC (e.g. non MAC based Hash-Schemes)



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EVPN Flavors

- Multi-Homed All-Active Ethernet Access
  - Replacement of: mLACP, STP, T-LDP, BGP-AD, etc.

- Standards-based Multi-chassis / Cluster Control Plane
  - Replacement of: vPC, VSS, nVCluster, etc.
  - Replacement of: HSRP, VRRP, etc.

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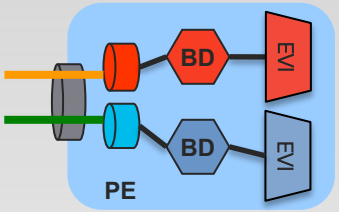
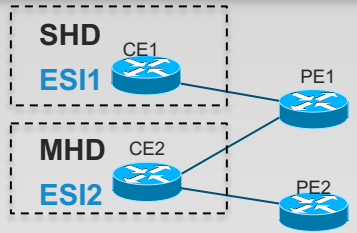
Concepts

EVPN Instance (EVI)



- **EVI identifies a VPN in the network**
- **Encompass one or more bridge-domains, depending on service interface type**
  - Port-based
  - VLAN-based (shown above)
  - VLAN-bundling

Ethernet Segment



- Represents a 'site' connected to one or more PEs
- Uniquely identified by a 10-byte global Ethernet Segment Identifier (ESI)
- **Could be a single device or an entire network**
  - Single-Homed Device (SHD)
  - Multi-Homed Device (MHD)
  - Single-Homed Network (SHN)
  - Multi-Homed Network (MHN)

BGP Routes

Route Types
[1] Ethernet Auto-Discovery (AD) Route
[2] MAC/IP Advertisement Route
[3] Inclusive Multicast Route
[4] Ethernet Segment Route
[5] IP Prefix Advertisement Route

- **New SAFI [70]**
- **Routes serve control plane purposes, including:**
  - MAC address reachability
  - MAC mass withdrawal
  - Split-Horizon label adv.
  - Aliasing
  - Multicast endpoint discovery
  - Redundancy group discovery
  - Designated forwarder election
  - IP address reachability
  - L2/L3 Integration

BGP Route Attributes

Extended Communities
ESI MPLS Label
ES-Import
MAC Mobility
Default Gateway
Encapsulation

- **New BGP extended communities defined**
- **Expand information carried in BGP routes, including:**
  - MAC address moves
  - Redundancy mode
  - MAC / IP bindings of a GW
  - Split-horizon label encoding
  - Data plane Encapsulation

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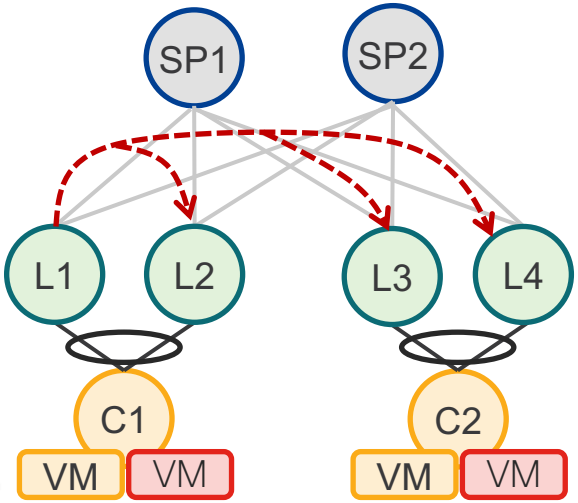
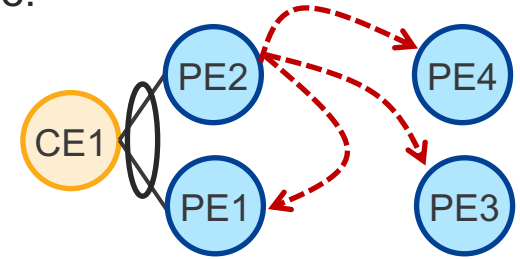
EVPN – Ethernet VPN

- Concepts are same!!! Pick your side!



Pick your side!



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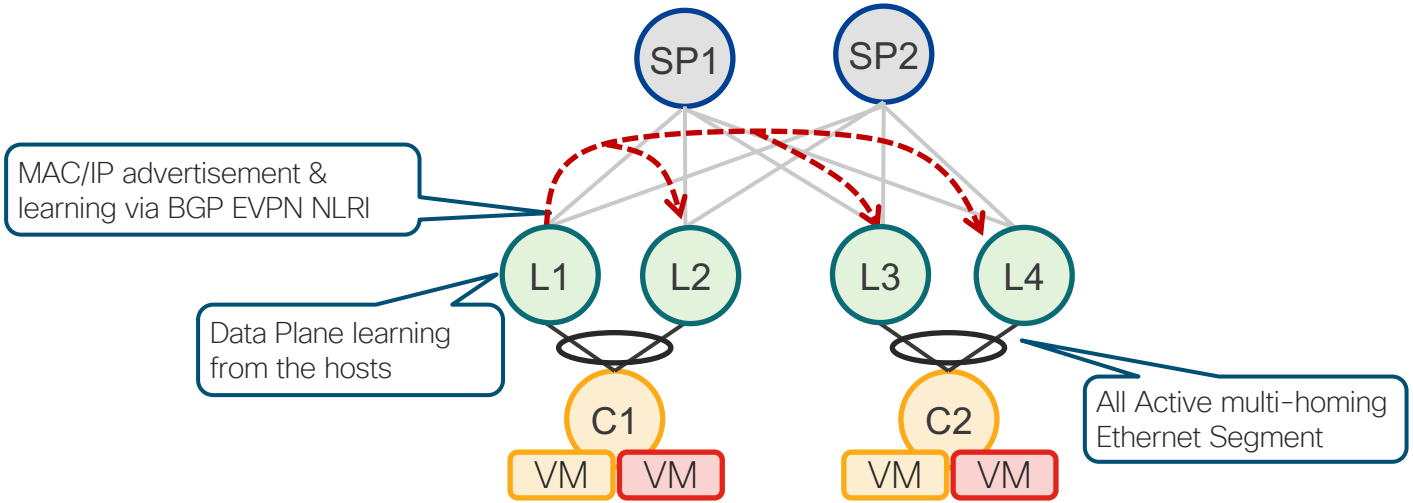
EVPN – Ethernet VPN

- Leafs run Multi-Protocol BGP to advertise & learn MAC/IP addresses over the Network Fabric
- MAC/IP addresses are advertised to rest of Leafs



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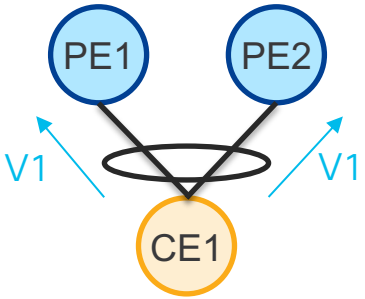
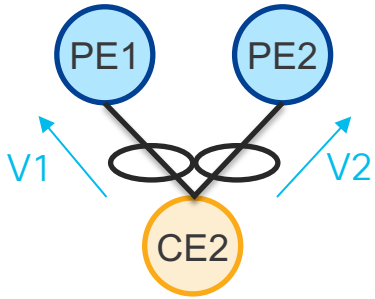
EVPN - load-balancing modes

All-Active (per flow)



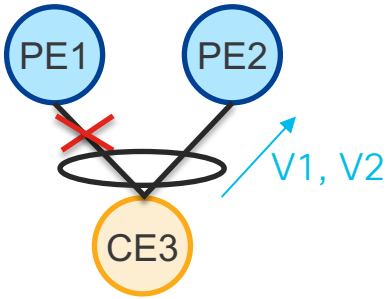
Single LAG at the CE
VLAN goes to both PE
Traffic hashed per flow
Benefits: Bandwidth, Convergence

Single-Active (per VLAN)



Multiple LAGs at the CE
VLAN active on single PE
Traffic hashed per VLAN
Benefits: Billing, Policing

Port-Active (per port)



Single LAGs at the CE
Port active on single PE
Traffic hashed per port
Benefits: Protocol Simplification

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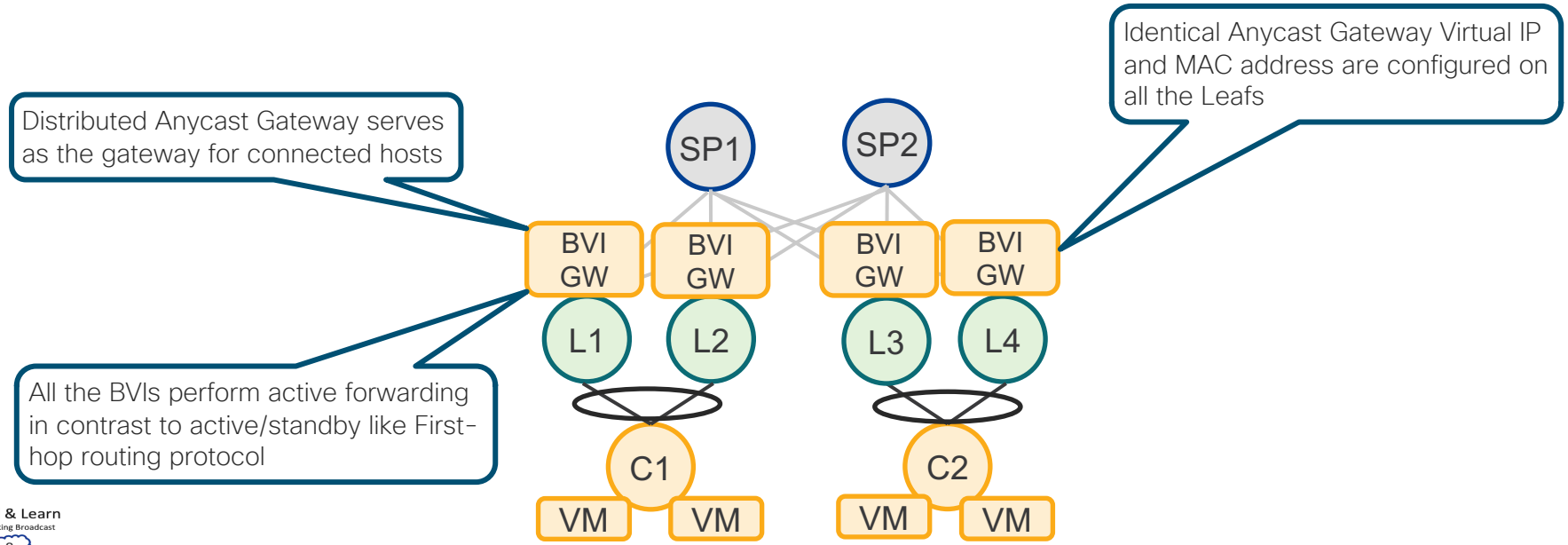
EVPN – Distributed Anycast Gateway

Purpose:

Optimal intra and inter-subnet connectivity with seamless workload mobility



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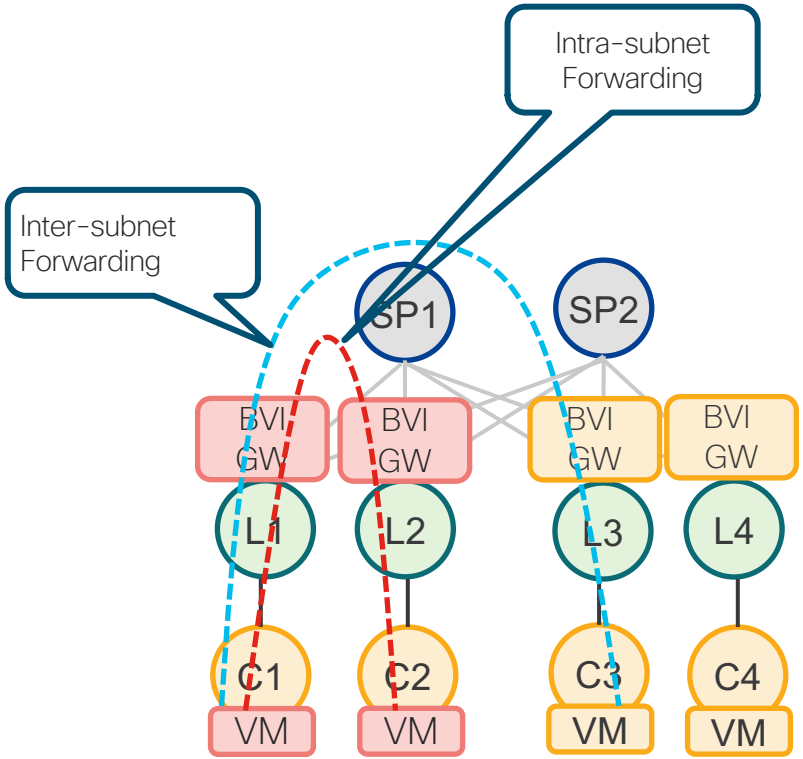
EVPN – IRB in Network Fabric



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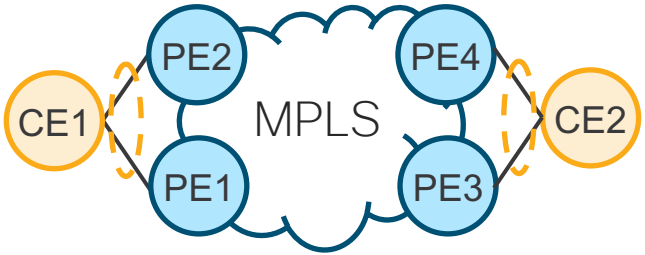
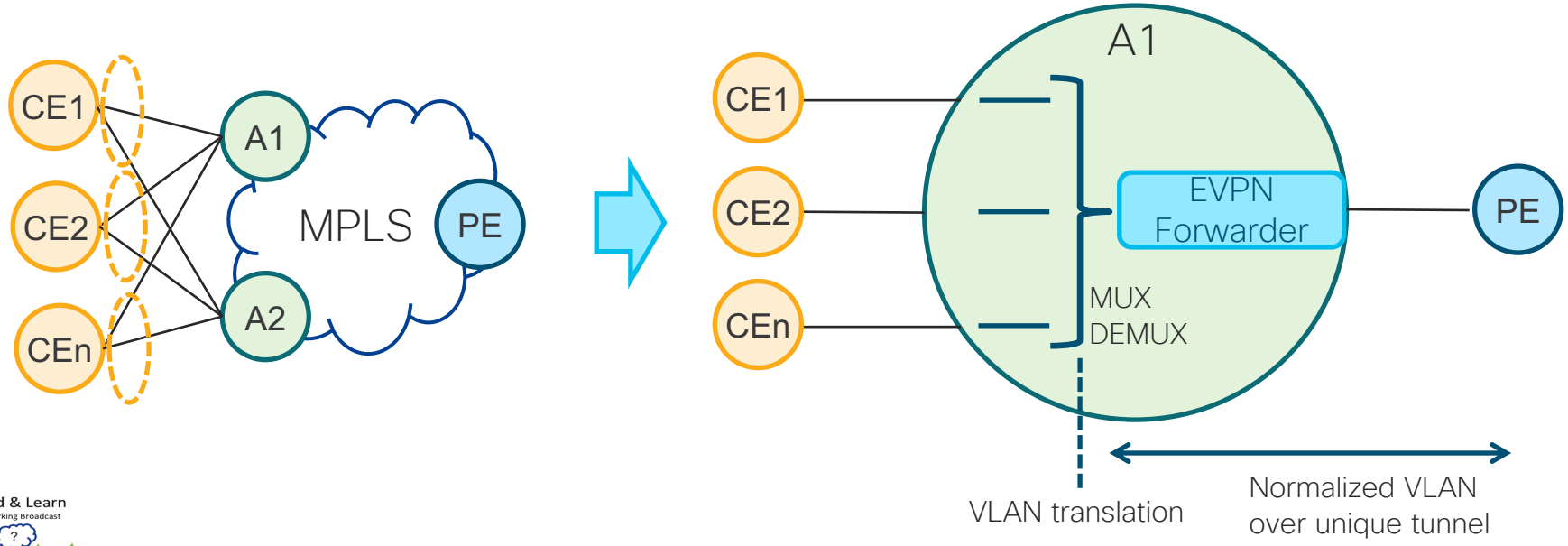
EVPN-VPWS

- Benefits of EVPN applied to point-to-point services
  - No signaling of PWs. Instead signals MP2P LSPs instead (ala L3VPN)
  - All-active CE multi-homing (per-flow LB)
  - Single-active CE multi-homing (per-service LB)
- Relies on a sub-set of EVPN routes to advertise Ethernet Segment and AC reachability
  - PE discovery & signaling via a single protocol – BGP
  - Per-EVI Ethernet Auto-Discovery route



EVPN – Flexible Cross-Connect Service

Challenge:
How to bring multiple access services from different sources using a single EVPN E-LINE tunnel?



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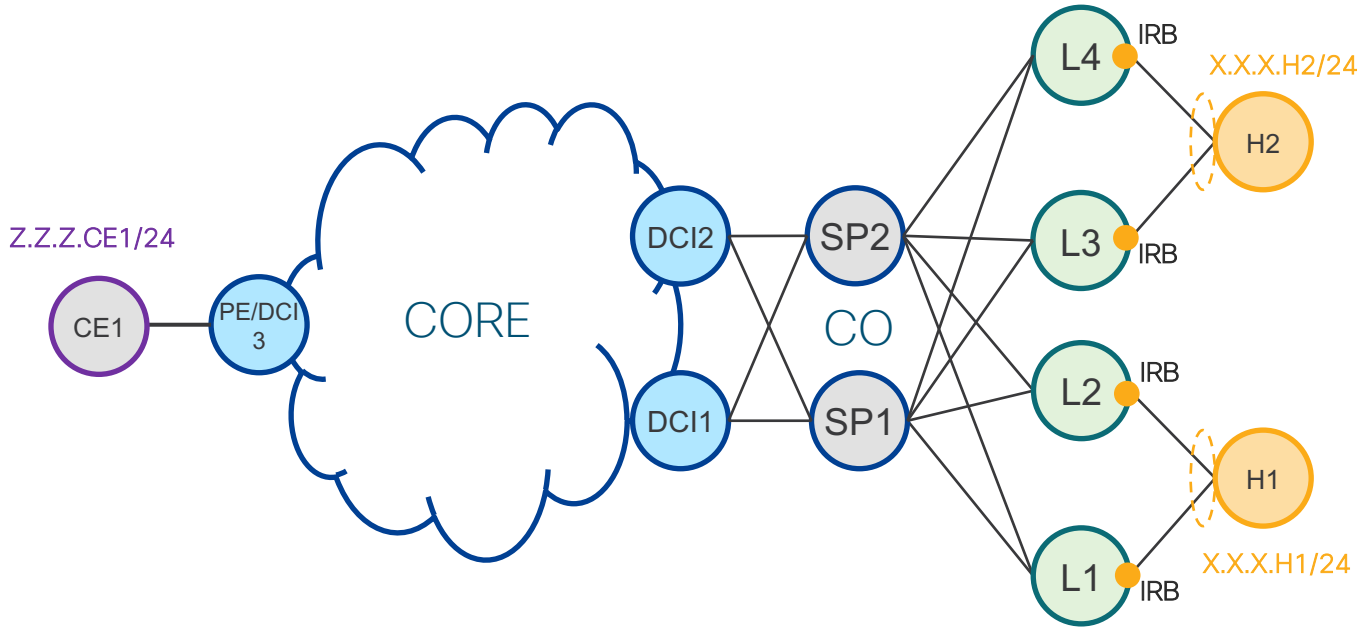
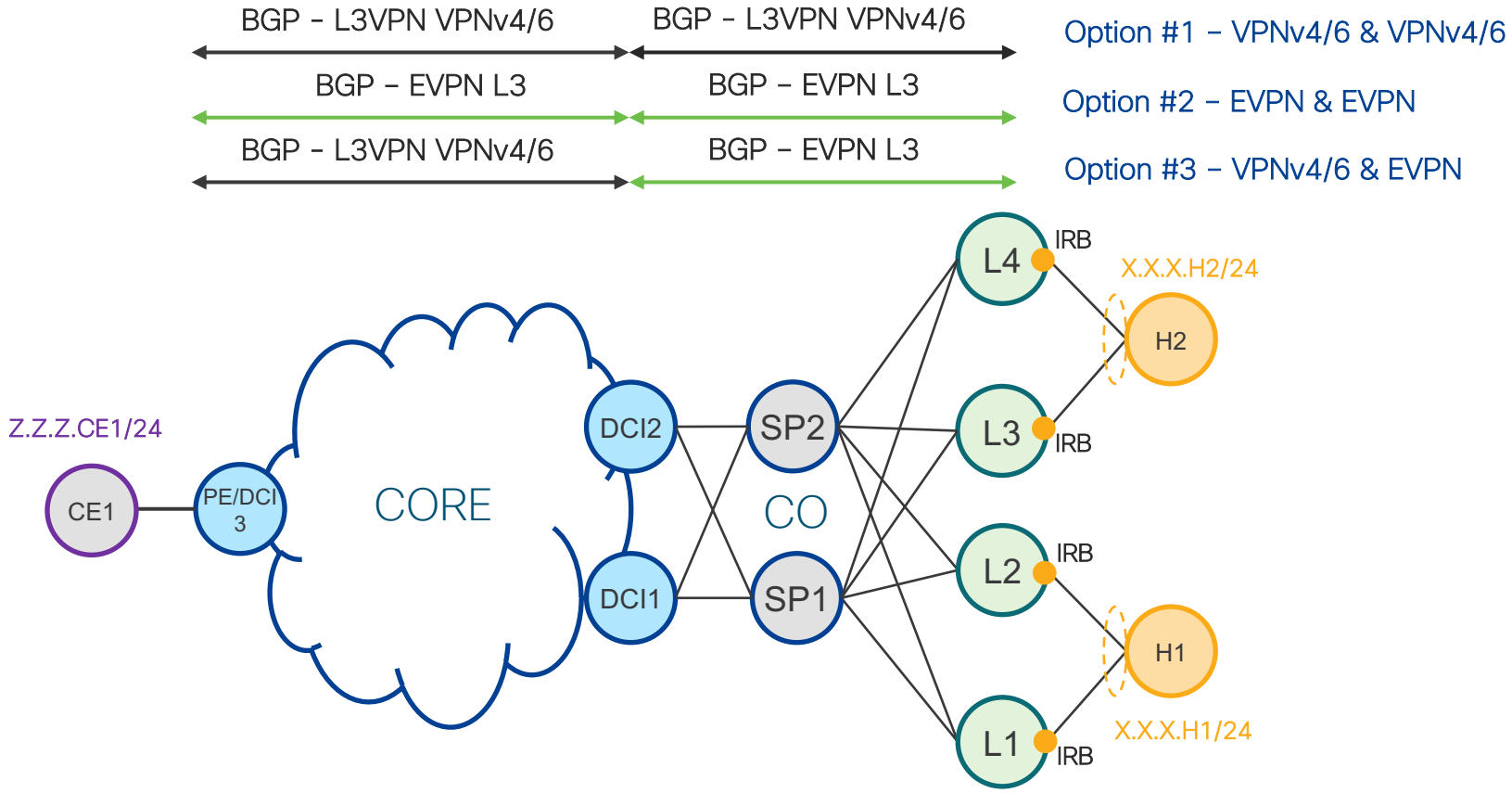
BGP Layer3 Interconnect
Principles

- DCI/BL provides Layer3 Interconnect
- DCI/BL participates in **L3 Routing**, but **not in L2 Bridging**
- **DCI/BL summarization is required/recommended**

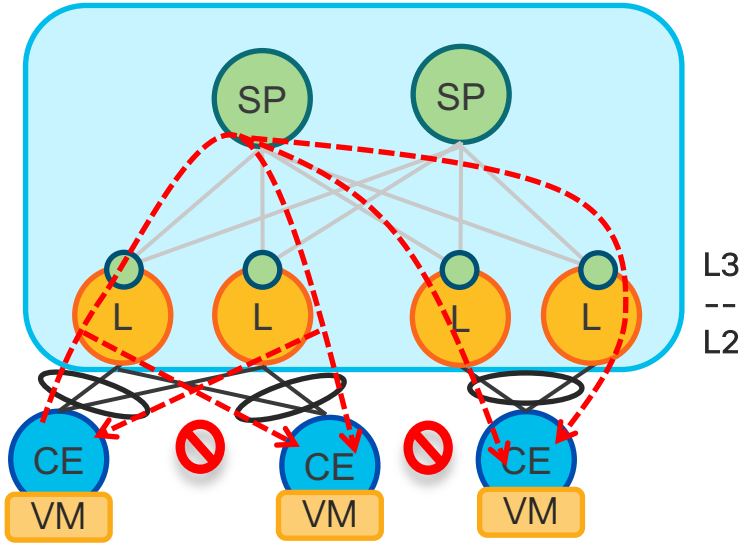


BGP Layer3 Interconnect

Control Plane



EVPN E-TREE



- Based on EVPN-ETREE (RFC8317)
- Extended to support IRB
- Leaf / Root assignment per EVI

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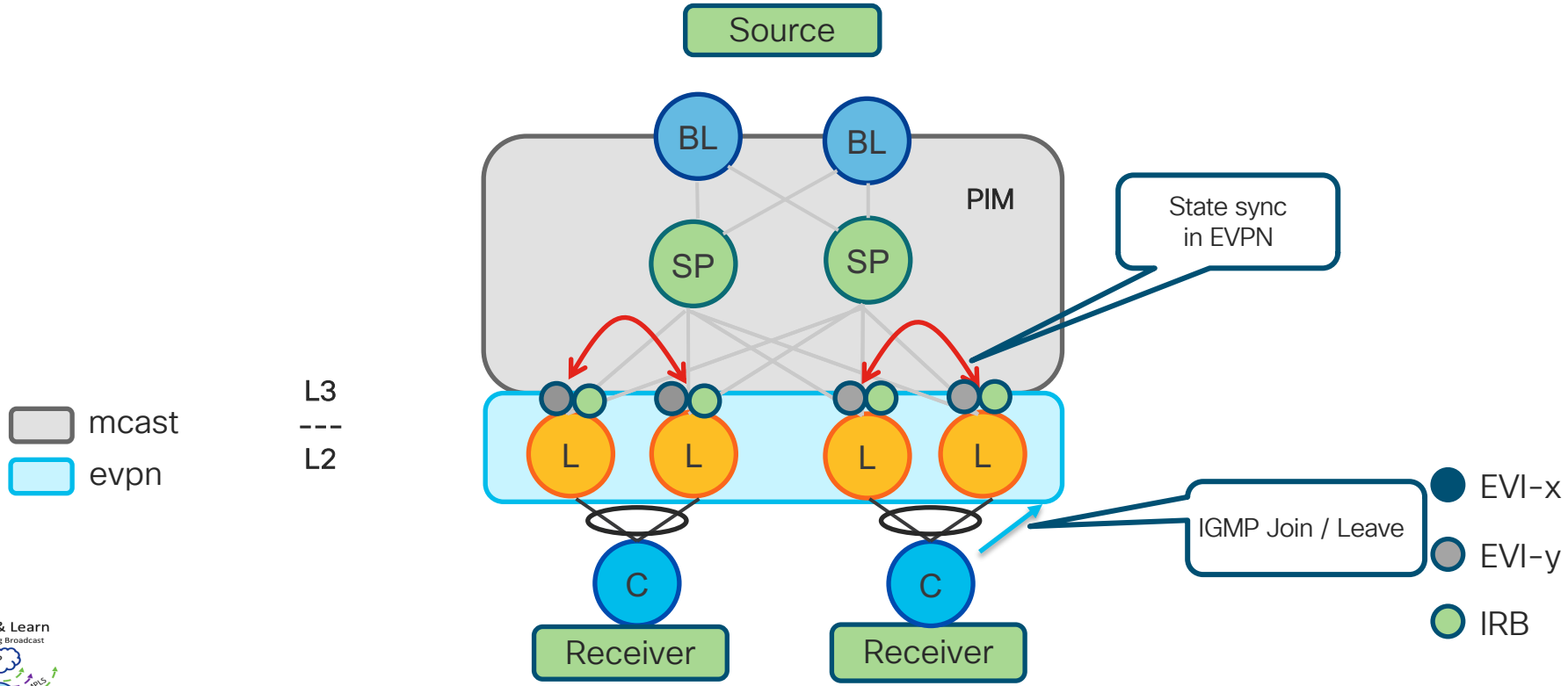
EVPN – Native Multicast in the Network Fabric



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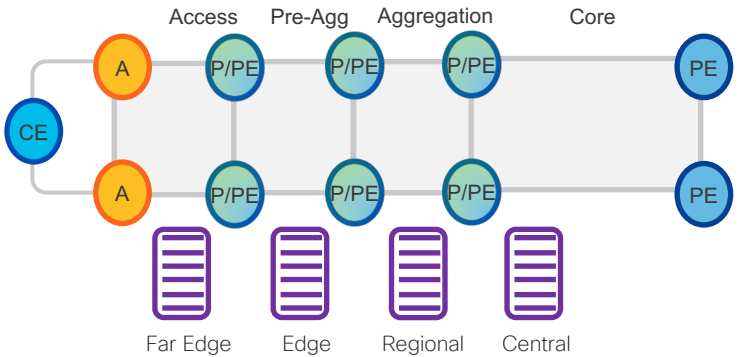
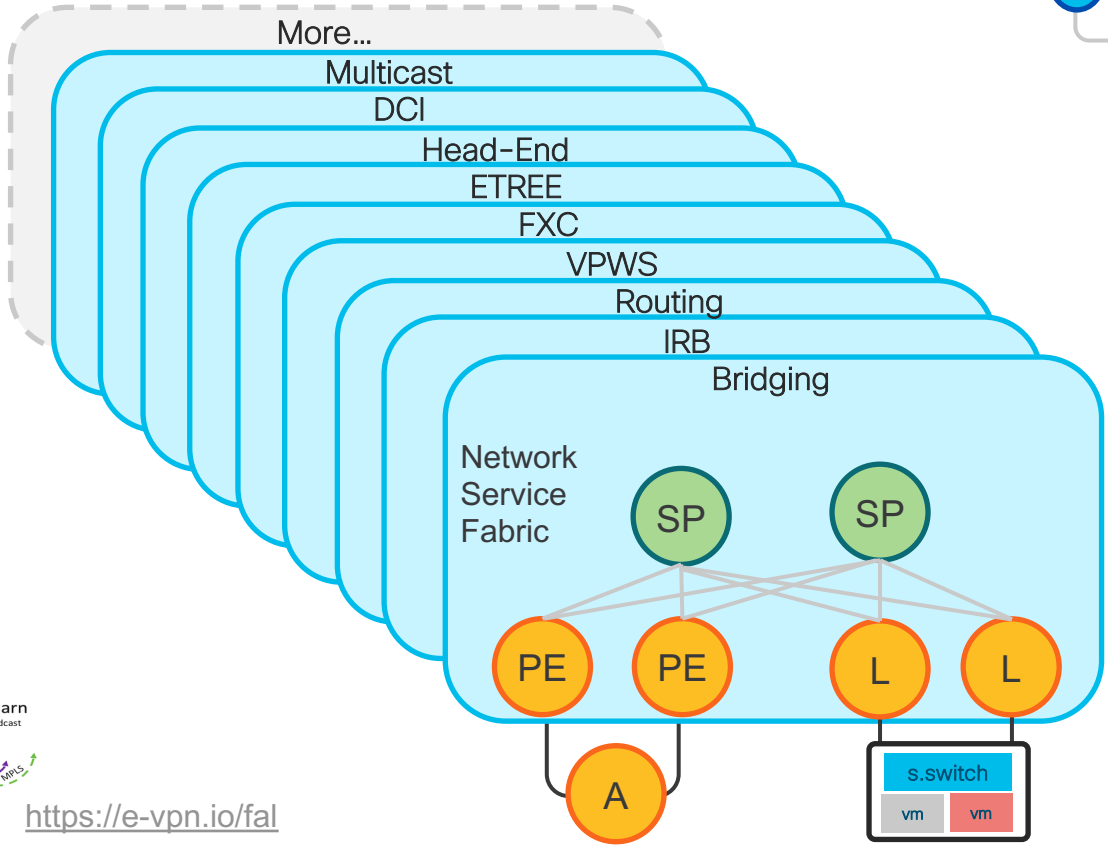
EVPN – Service Unification





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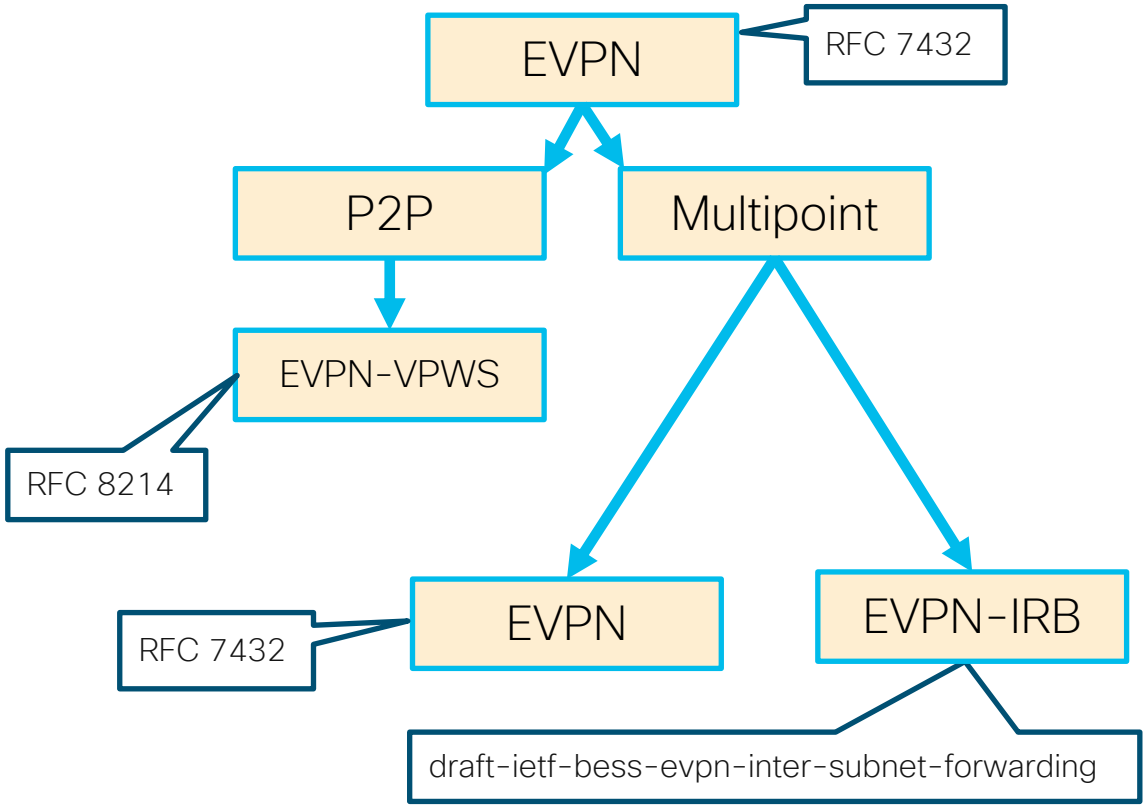
EVPN – RFCs/Drafts



EVPN Interop Highlights

- EVPN VPWS over SR-MPLS (Single-Active / All-Active MH)
- EVPN Integrated Routing and Switching IRB – Symmetric
- EVPN IP Subnet Routing
- EVPN over SR-MPLS (All-active MH with and w/o IRB)
- EVPN-VxLAN to EVPN-MPLS interworking
- EVPN MAC Mobility over SR-MPLS
- EVPN Flexible Cross-Connect (FXC) over SR-MPLS
- EVPN interworking with IPVPN

First time Cisco IOS XR test @ EANTC

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