


# ETHERNET VPN

## *Standardization and Status*

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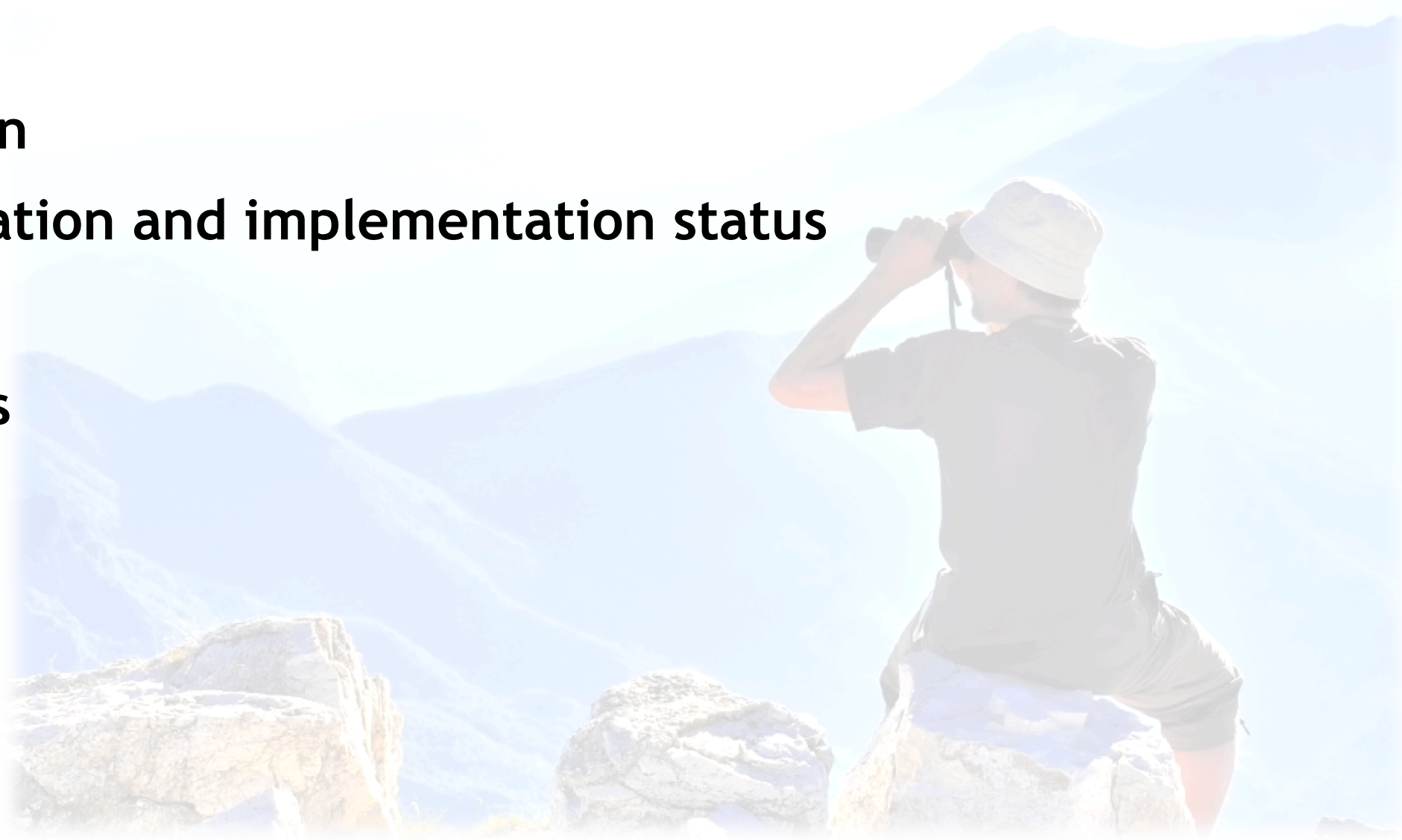
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# AGENDA

1. Introduction
2. Standardization and implementation status
3. Use-cases
4. Conclusions



# EVPN AND THE OPPORTUNITY TO MAKE IT RIGHT

- What we learned about VPNs

- IP-VPN (RFC4364) is successfully deployed without interop issues, easy to provision, supports all-active MH but only IP traffic
- VPLS (RFC4761/4762/6074) has control plane interop issues, provisioning vs efficiency trade-offs, flood-and-learn is not optimum, but works for any Ethernet traffic

- Why another VPN technology

- Cloud and NFV are shifting the way networks must behave
- EVPN is an Ethernet VPN technology (provides L2 and L3) that provides the required flexibility, it is future-proof and inherits over a decade of VPN experience

- Where can we use EVPN

- Cloud and virtualization services
- Integrated Layer-2 and Layer-3 VPN services
- Overlay technologies that simplify topologies and protocols





# WHAT CAN EVPN DO FOR ME?

## OPERATIONAL BENEFITS FOR SERVICE PROVIDERS

### Integrated Services

- Delivering Layer 2 and Layer 3 with a unified control plane
- L3VPN-like operation for scalability and control

### Network Efficiency

- Multi-homing with all-active forwarding and mass withdraw
- BUM reduction/suppression

### Design Flexibility

- MPLS or IP data plane encapsulation choices
- VXLAN encapsulation enables EVPN over a simple IP network

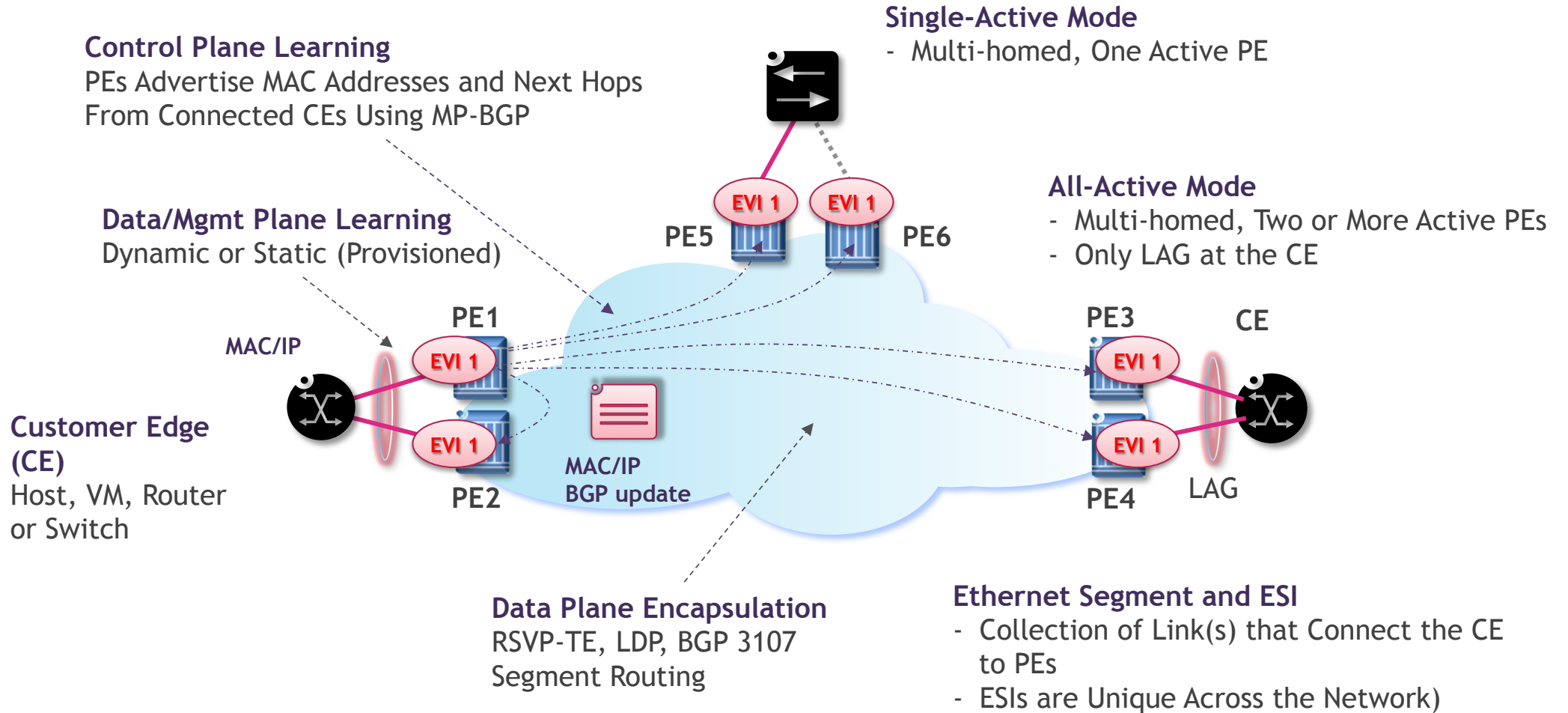
### Greater Control

- EVPN changes the paradigm: FDB signaled in control plane vs. flood-and-learn FDB in data plane
- Proxy-ARP/ND proxy allows PEs to respond to ARP/ND requests

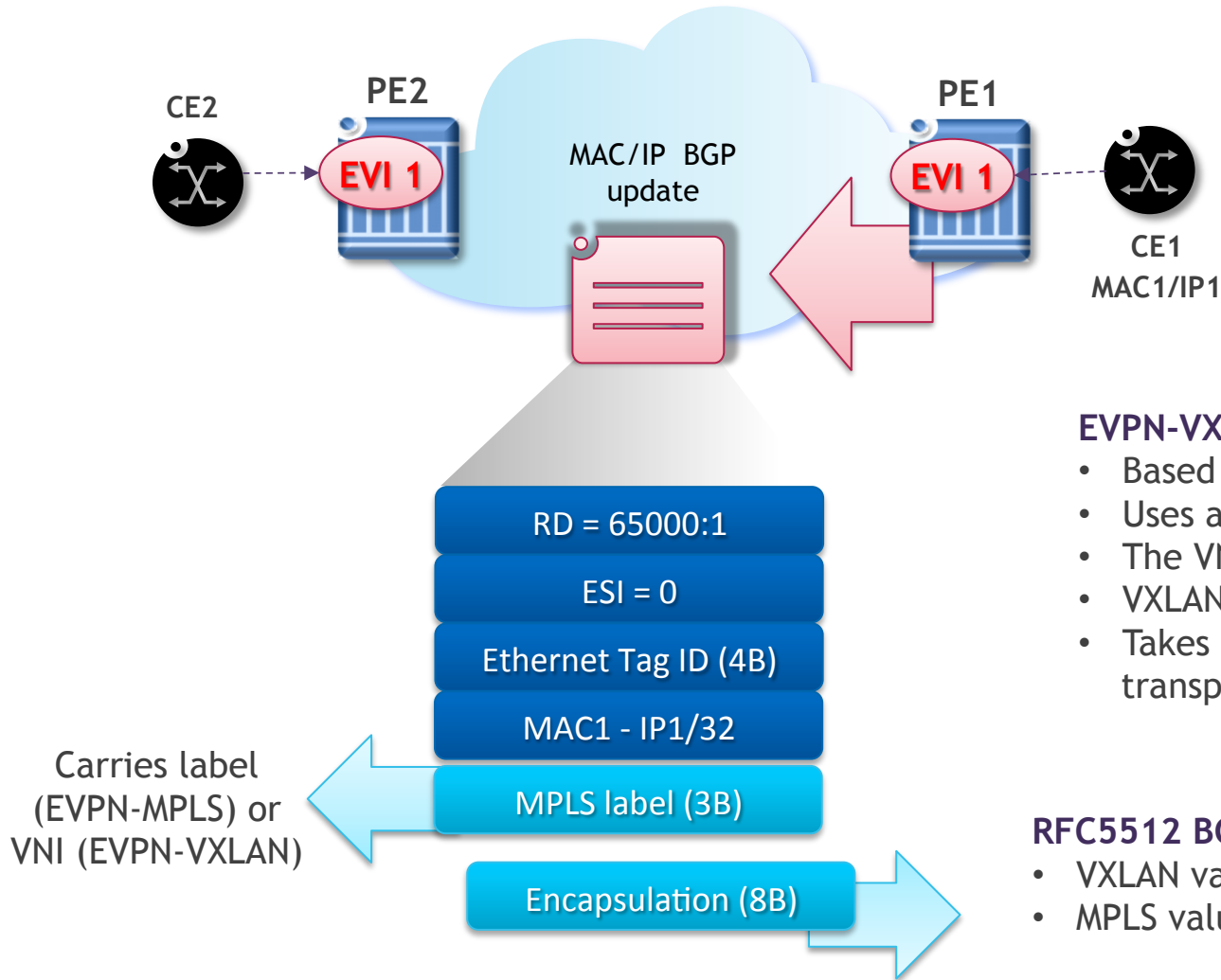


# EVPN main concepts in one shot

## RFC7432



# EVPN ABSTRACTS THE CONTROL PLANE TO SUPPORT CURRENT AND FUTURE DATA PLANE ENCAPSULATIONS



## EVPN-MPLS

- Based on RFC7432
- Uses a 20-bit MPLS service label as MAC-VRF de-multiplexer
- Any MPLS Transport tunnel (RSVP/LDP/BGP/SR)
- Takes advantage of all the underlying MPLS capabilities (FRR, TE, etc.)

## EVPN-VXLAN

- Based on draft-ietf-bess-evpn-overlay
- Uses a 24-bit VNI as MAC-VRF de-multiplexer
- The VNI is encapsulated as part of the VXLAN header
- VXLAN is transported over UDP/IP
- Takes full advantage of the VXLAN simplicity and transparency

## RFC5512 BGP Tunnel Encapsulation

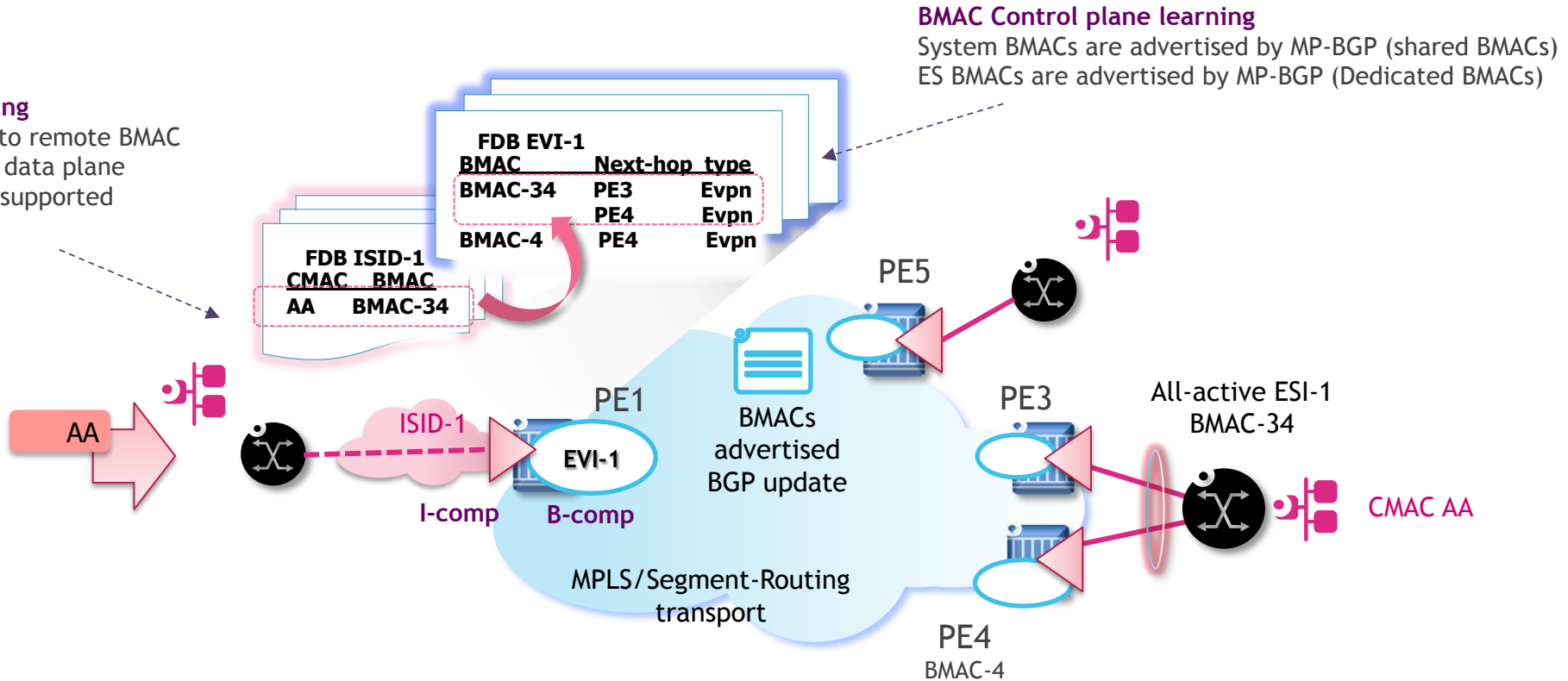
- VXLAN value = 8
- MPLS value = 10

# EVPN and PBB for large L2 Service Provider networks

## PBB-EVPN (RFC7623)

### CMAC Data plane learning

CMAC-local AC or CMAC to remote BMAC mapping is learnt in the data plane  
All-active multi-homing supported



### PBB-EVPN combines 802.1ah and EVPN

- PEs have I-components mapped to B-components (EVIs)
- Reduces the number of MACs in EVPN by aggregating CMACs with BMACs

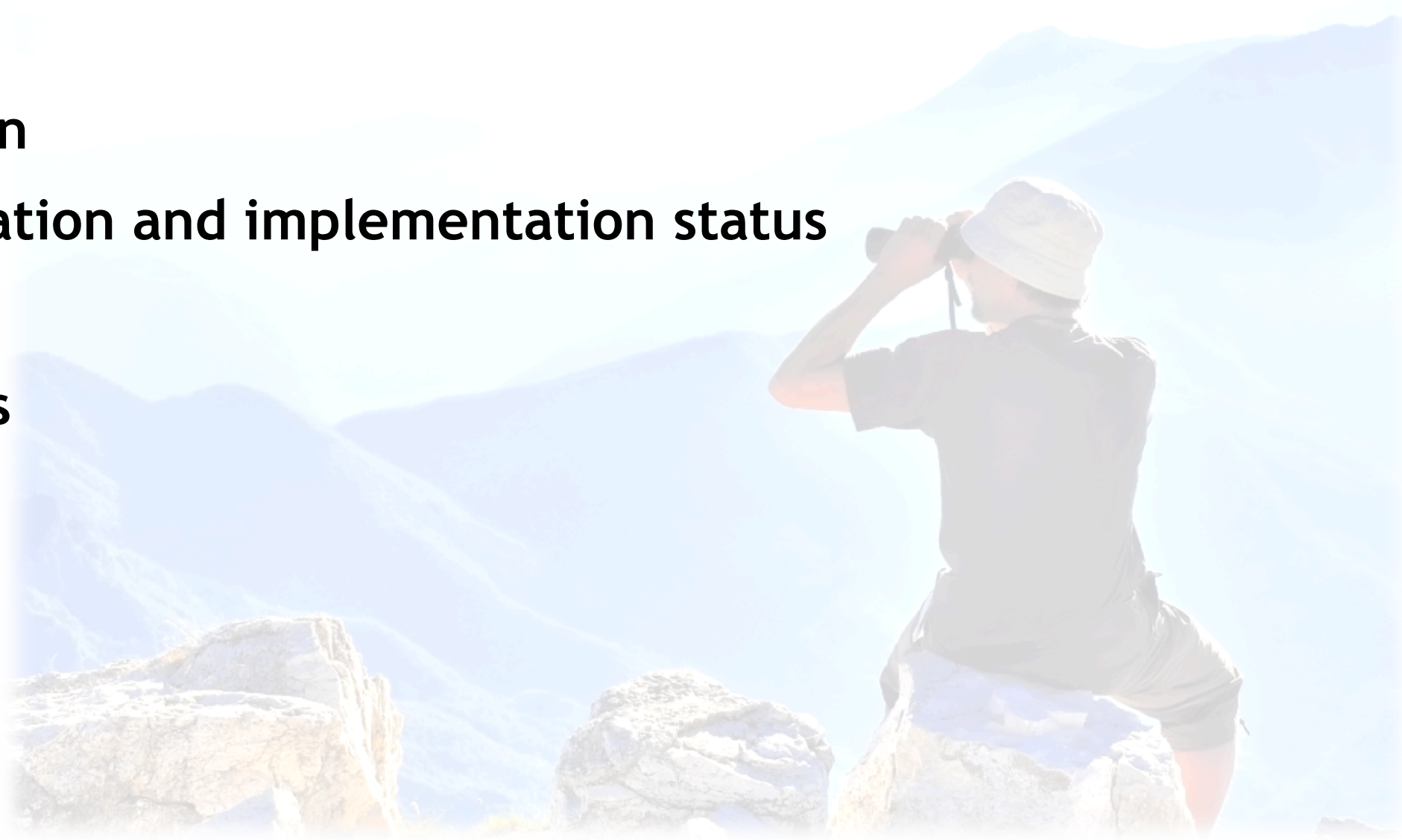
### Used to scale very large layer-2 EVPN networks

- All EVPN Multihoming functions are supported, including single-active and all-active
- Per-ISID flooding trees are supported
- The B-component EVI uses PBB over MPLS data plane



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# WHERE IS EVPN DEFINED IN THE STANDARDS?

## IETF BESS WORKING GROUP

### Layer-2 applications

draft-ietf-bess-evpn-vpws  
(ELINE services)  
draft-ietf-bess-evpn-etree  
(ETREE services)

draft-snr-bess-proxy-arp-nd  
(proxy-arp/nd for BU reduction)  
draft-rabadan-bess-evpn-optimized-ir  
(Optimized Ingress Replication)  
draft-sajassi-bess-evpn-virt-eth-seg  
(Virtual ES)

### Non-MPLS data planes

draft-ietf-bess-evpn-overlay  
(EVPN for overlay tunnels)  
RFC7623  
(EVPN for PBB)

### Layer-3 services

draft-ietf-bess-evpn-inter-subnet-forwarding  
(EVPN for inter-subnet between hosts)  
draft-ietf-bess-evpn-prefix-advertisement  
(ipv4/v6 prefix advertisement in EVPN)

### Integration with VPLS

draft-ietf-bess-dci-evpn-overlay  
(DCI for EVPN-overlay networks)  
draft-ietf-bess-evpn-vpls-seamless-integ  
(Integration with VPLS and PBB-VPLS)

### DCI specific work

draft-ietf-bess-dci-evpn-overlay  
(DCI Gateway for EVPN-overlay networks)  
draft-ietf-bess-evpn-overlay  
(DCI inter-as model B for overlay tunnels)

## EVPN - RFC 7432

PE-CE service  
interfaces

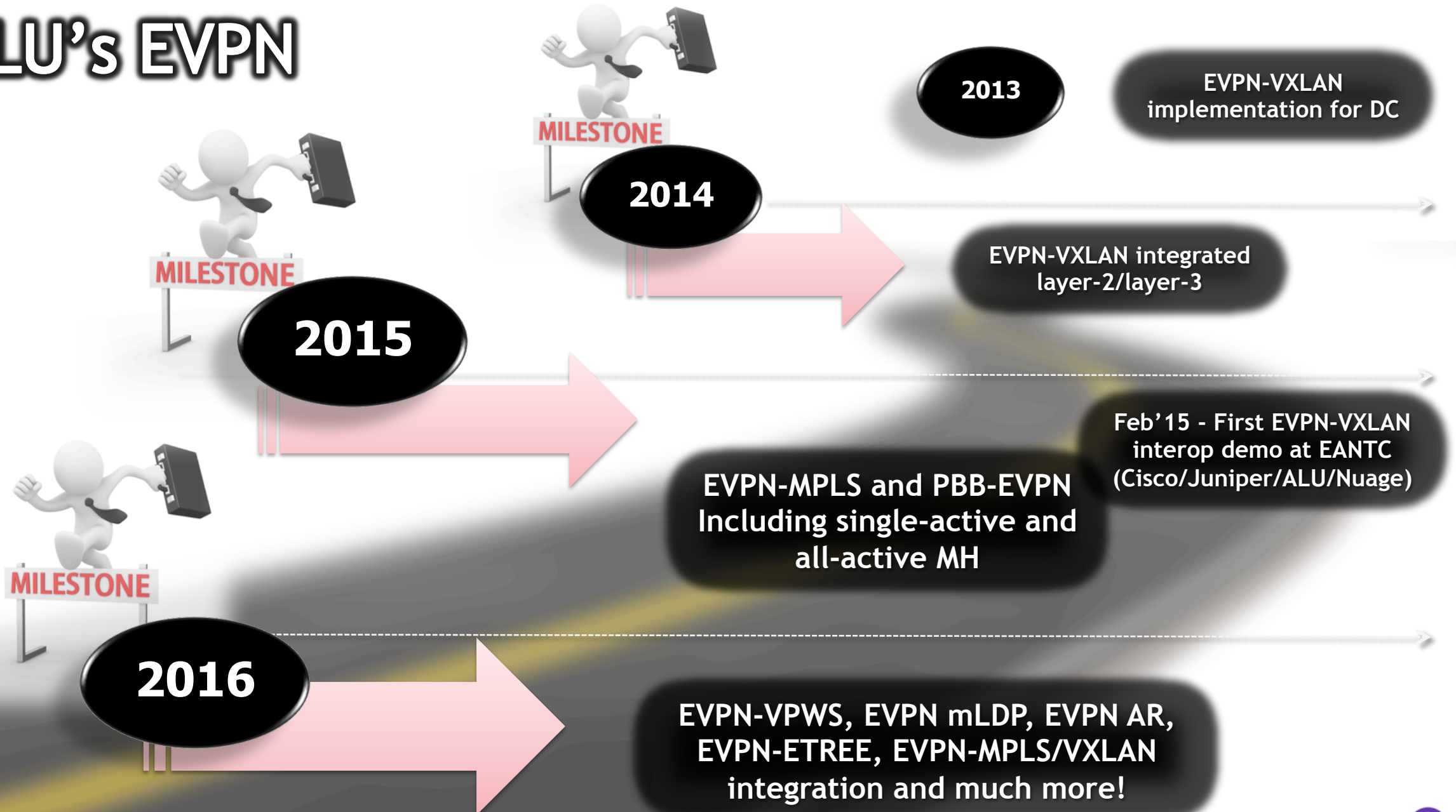
MP-BGP main  
routes  
(ELAN  
services)

Unicast and  
BUM transport  
over MPLS  
tunnels

Multi-homing  
Single and all-  
active

Mobility  
Duplication  
Protection

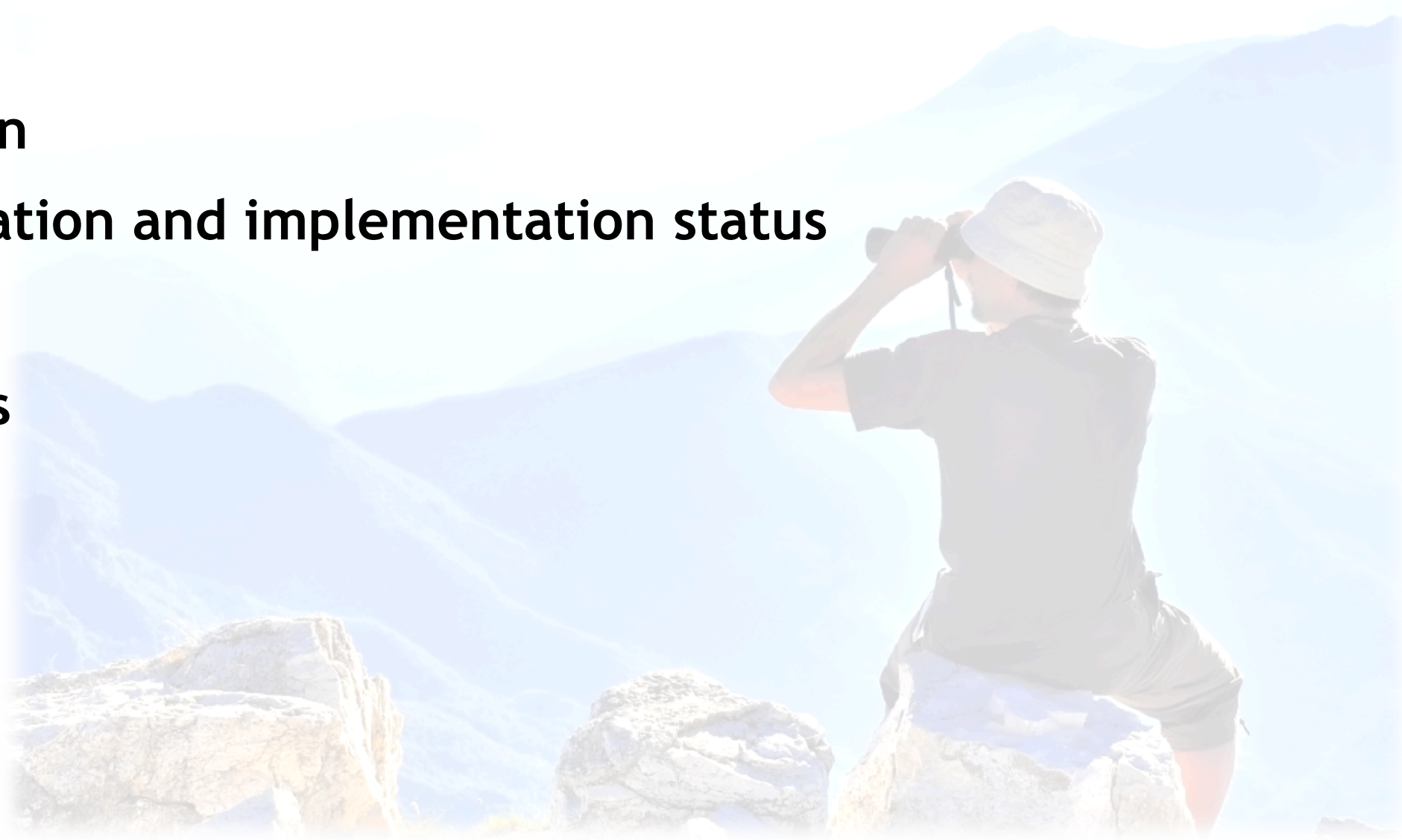
# ALU's EVPN





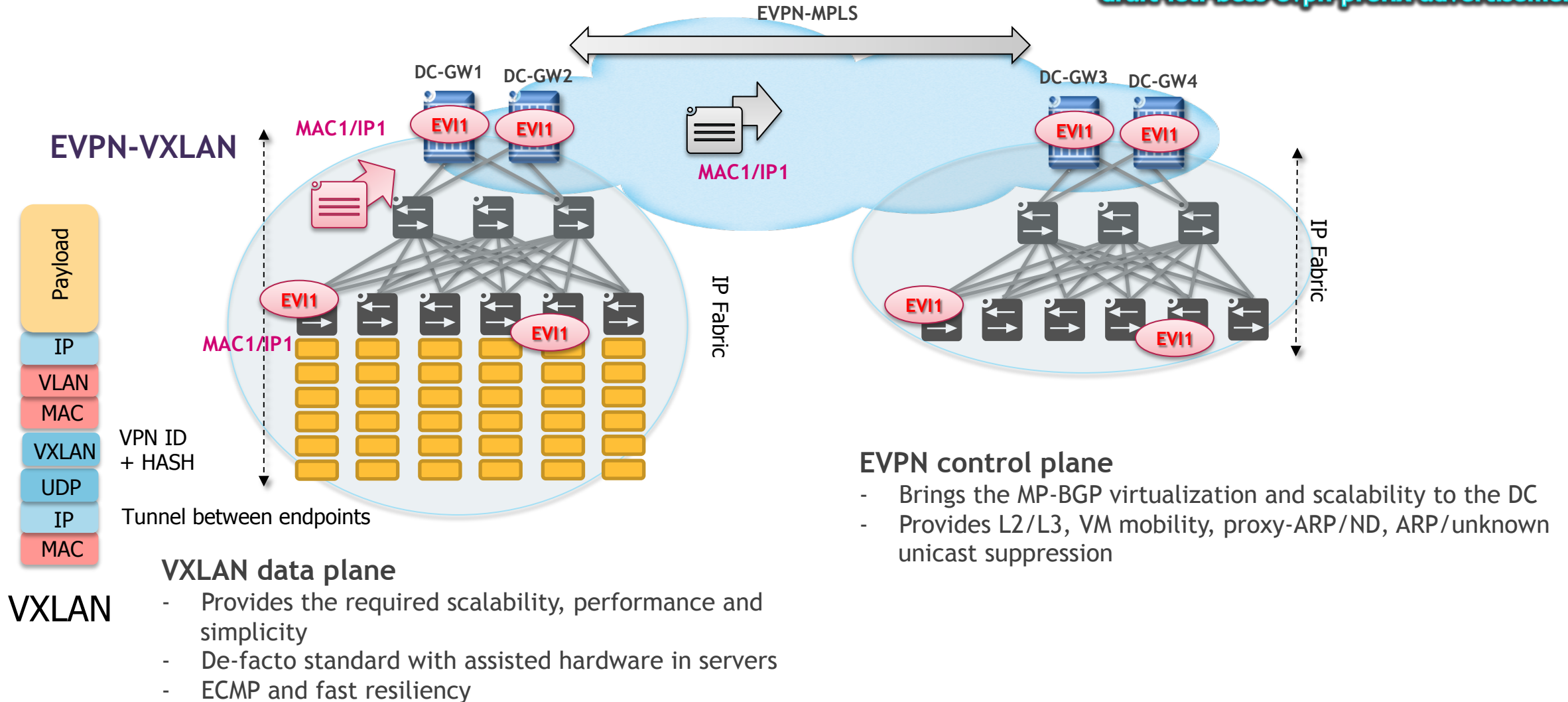
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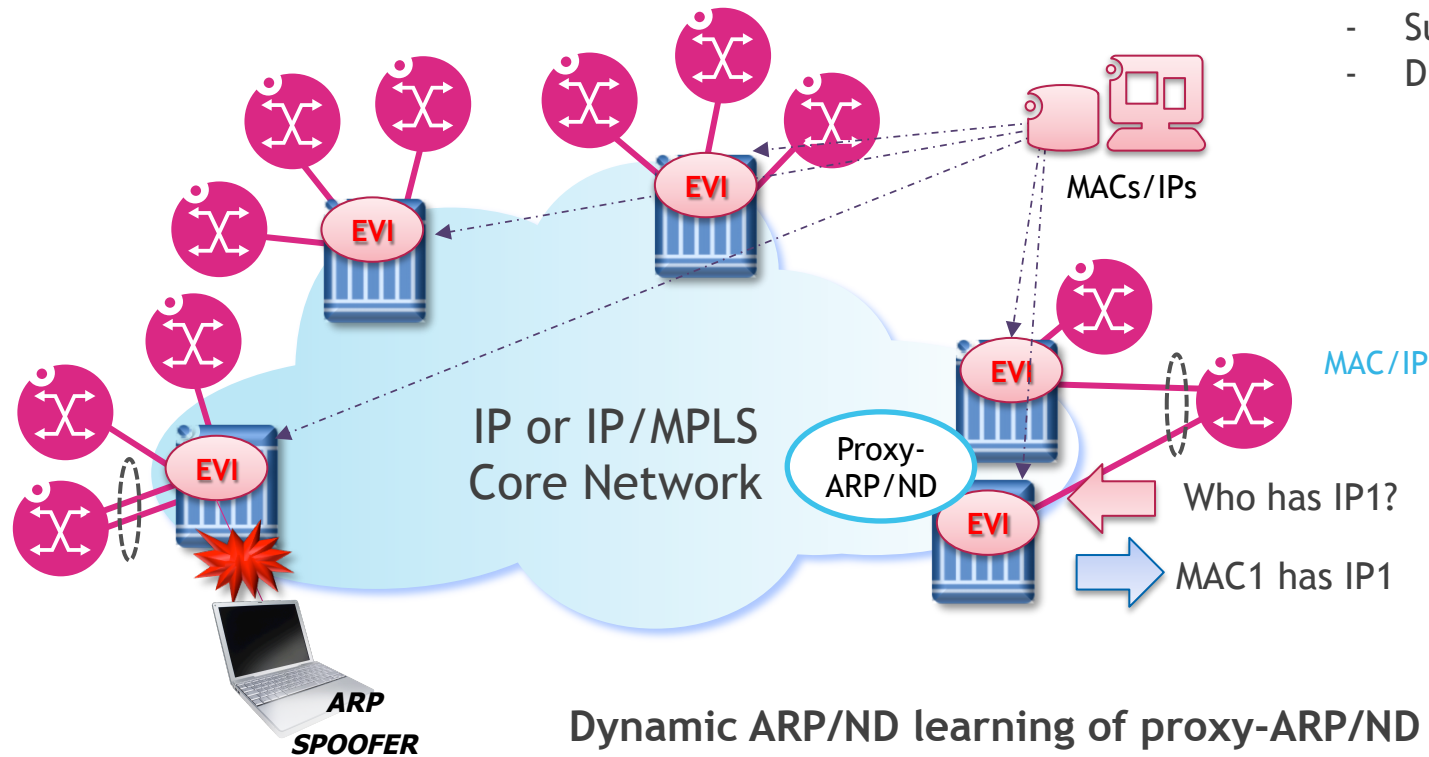
# Data Center and DCI use-case

draft-ietf-bess-evpn-overlay  
 draft-ietf-bess-dci-evpn-overlay  
 draft-rabadan-bess-evpn-optimized-ir  
 draft-ietf-bess-evpn-inter-subnet-forwarding  
 draft-ietf-bess-evpn-prefix-advertisement



# INTERNET EXCHANGE POINTS (IXP) PEERING FABRIC

draft-snr-bess-evpn-proxy-arp-nd



Static MAC/IP provisioning of the router interfaces for maximum security

- Suppresses unknown and ARP/ND flooding
- Drops unknown source MACs

EVPN required features

- L2 interconnection over a VXLAN or MPLS peering fabric
- Proxy-ARP/ND and unknown/ARP/ND suppression
- MAC duplication, MAC protection
- Anti-spoofing operation

Dynamic ARP/ND learning of proxy-ARP/ND entries for easy provisioning, minimum flooding and anti-spoofing monitoring

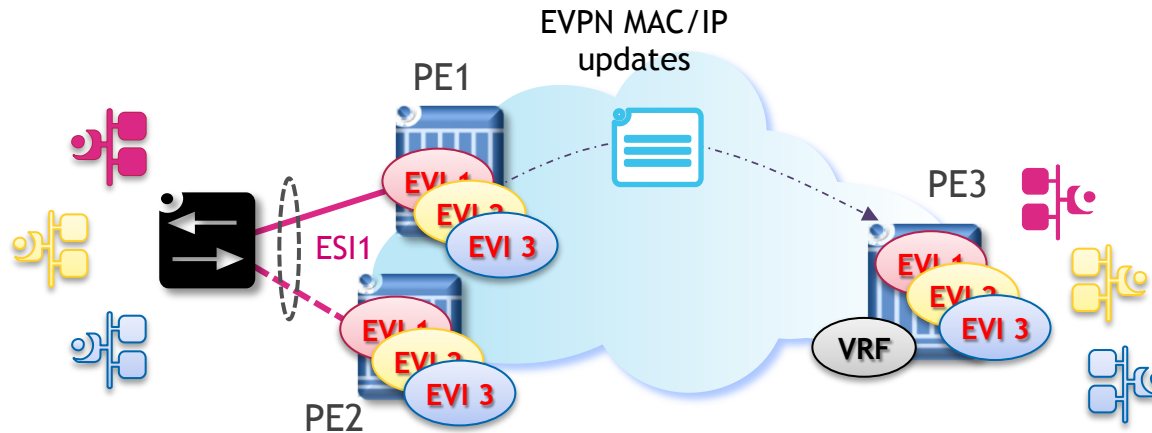
- Dynamic learning of ARP/ND entries is possible
- Anti-spoofing monitors hosts claiming the same IP
  - If a duplicate is detected, an alarm is triggered and MAC/IPs put in hold-down mode
  - An option to inject an anti-spoof mac is possible too



# PROVIDER-PROVISIONED VPNS

## LAYER-2 AND LAYER-3 SERVICES

RFC7432, 7623  
draft-ietf-bess-evpn-etree  
draft-ietf-bess-evpn-vpws  
draft-ietf-bess-evpn-inter-subnet-forwarding  
draft-ietf-bess-evpn-prefix-advertisement  
draft-sajassi-bess-evpn-virt-eth-seg  
draft-ietf-bess-evpn-vpls-seamless-integ



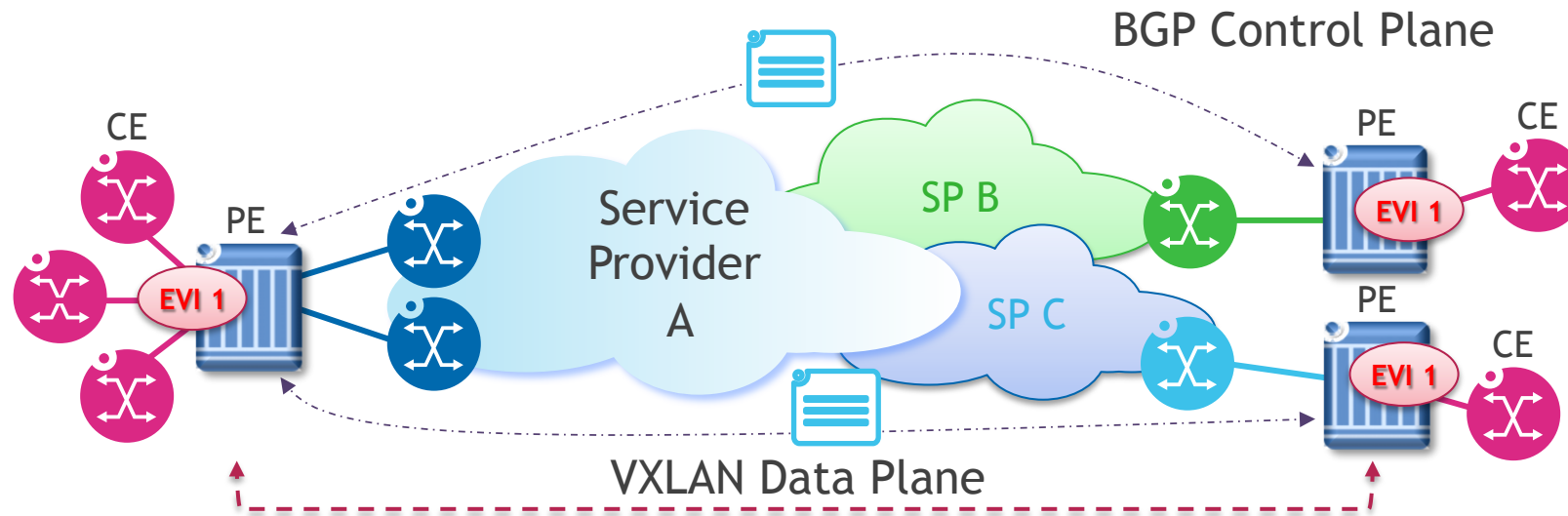
### Required EVPN features

- IP-prefix advertisement and inter-subnet forwarding
- Multi-homing:
  - All-active multihoming for link utilization
  - Single-active multihoming for better determinism
  - Virtual ES for access Ethernet and MPLS networks
- PBB-EVPN for large layer-2 VPNs

### EVPN provides layer-2 and layer-3 services

- Both services are provided through the same logical AC to the customer
- Layer-2 services include: ELAN, ELINE (EVPN-VPWS) and ETREE (EVPN-ETREE)
- One VPN technology for all services, no need for multiple protocols

# ENTERPRISE-PROVISIONED OVERLAY VPNS



**EVPN-VXLAN works over any IP service to provide a flexible Layer-2 and Layer-3 VPN**

- Just requires IP connectivity between the sites, no need to run any MPLS or special configuration by the IP service provider
- Service Provider is transparent to EVPN
- EVPN overlay is transparent to service providers

**VPN routing between endpoints can be controlled with BGP (ipv4) and routing policies to service providers**

**Routing and MAC/IP advertisements within EVPN controlled via iBGP (evpn) between PEs**



**EVPN is the next-generation VPN control plane specified in RFC7432, RFC7623 and other I-Ds.**

**EVPN is data plane agnostic, L2/L3 capable and cloud-optimized, making it the best technology for DCI**

**EVPN is already a reality in many Cloud and Service Provider networks**