The bridge to possible

Migrating Classical Enterprise Campus Networks to VXLAN EVPN Based Networks

Nazim Khan, Customer Success Specialist

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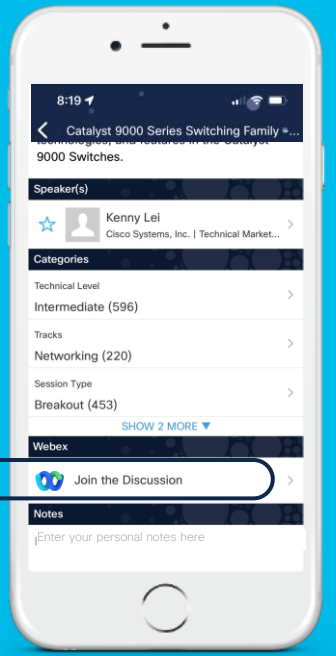
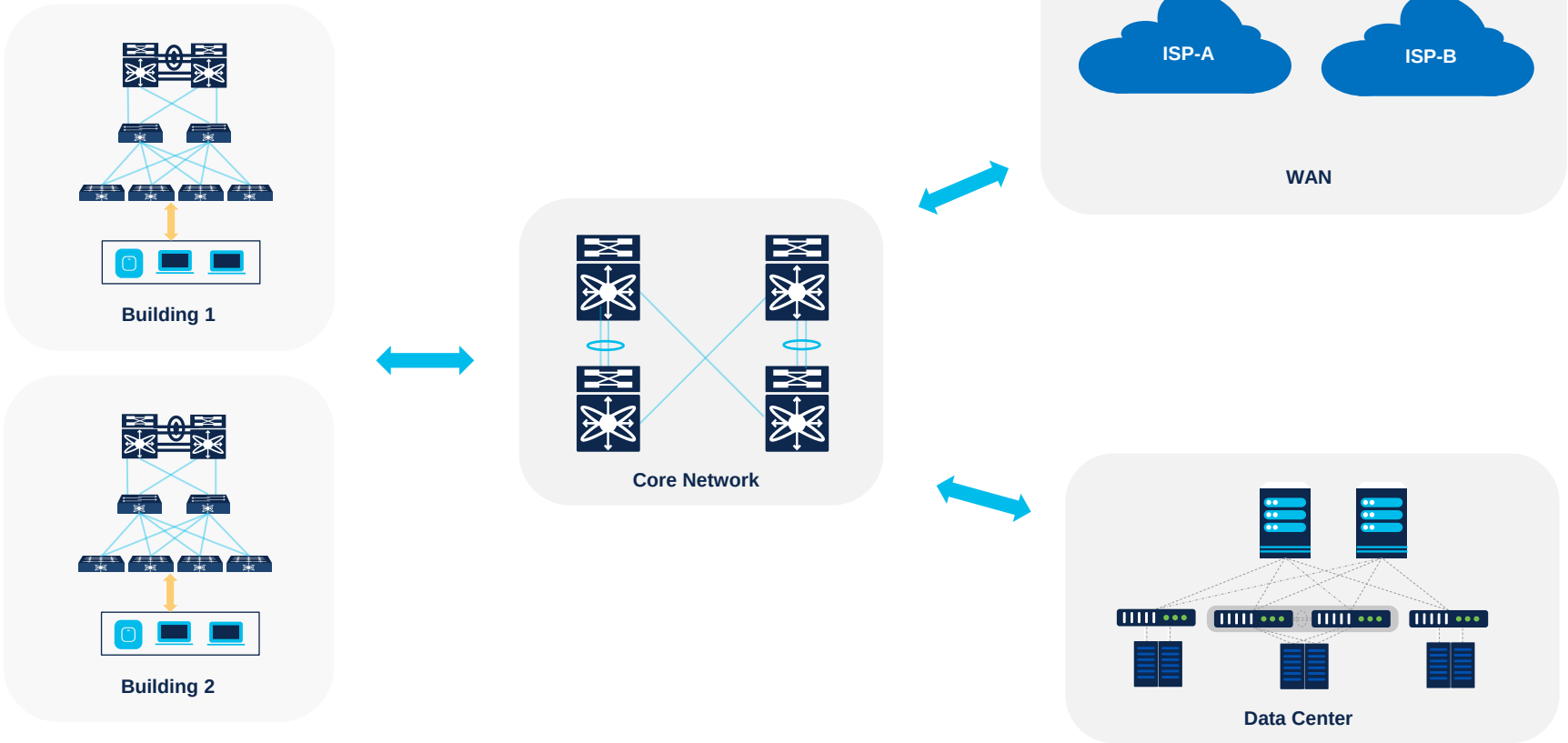


Agenda

- Introduction
- VXLAN EVPN Architecture overview
- Migration Strategies
- Planning & Pre-requisites
- Migration Considerations
- Migration Walkthrough
- Post-Migration
- Automation Tools
- Key Take Away

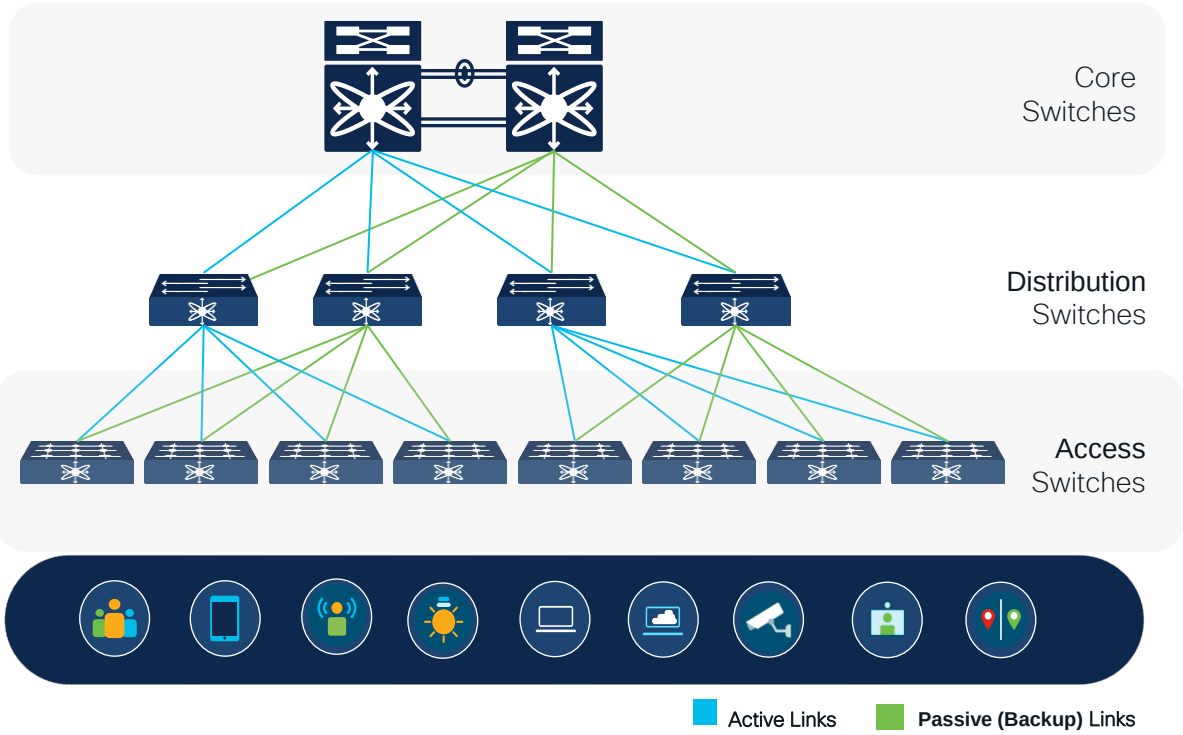
Typical Campus Network



Traditional 3-Tier Networks

Challenges

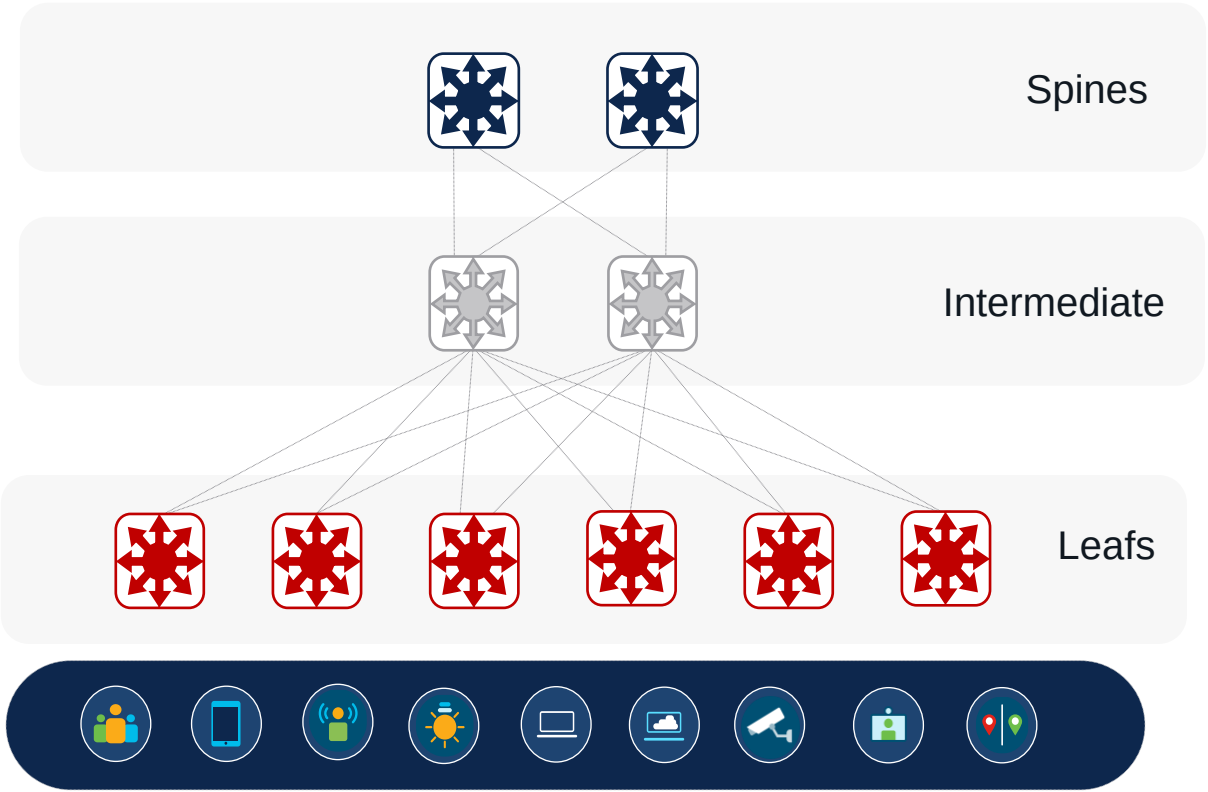
- Broadcast Domain – Spanning-Tree
- Flood & Learn Mechanism
- Mobility- Roaming
- VLAN Scale
- Load Balancing
- Resiliency
- Scalability



VXLAN EVPN Architecture

Benefits

- Any Subnet, Anywhere
- Layer-3 ECMP links end-to-end
- No Flooding with BGP Control Plane
- Extensible Scale & Resiliency
- Distributed Gateway on all Edge nodes (Leaf)
- Segmentation



What is … ?

VXLAN

- Standards based Encapsulation
  - RFC 7348
  - Uses UDP-Encapsulation
- Transport Independent
  - Layer-3 Transport (Underlay)
- Flexible Namespace
  - 24-bit field (VNID) provides ~16M unique identifier
  - Allows Segmentations

EVPN

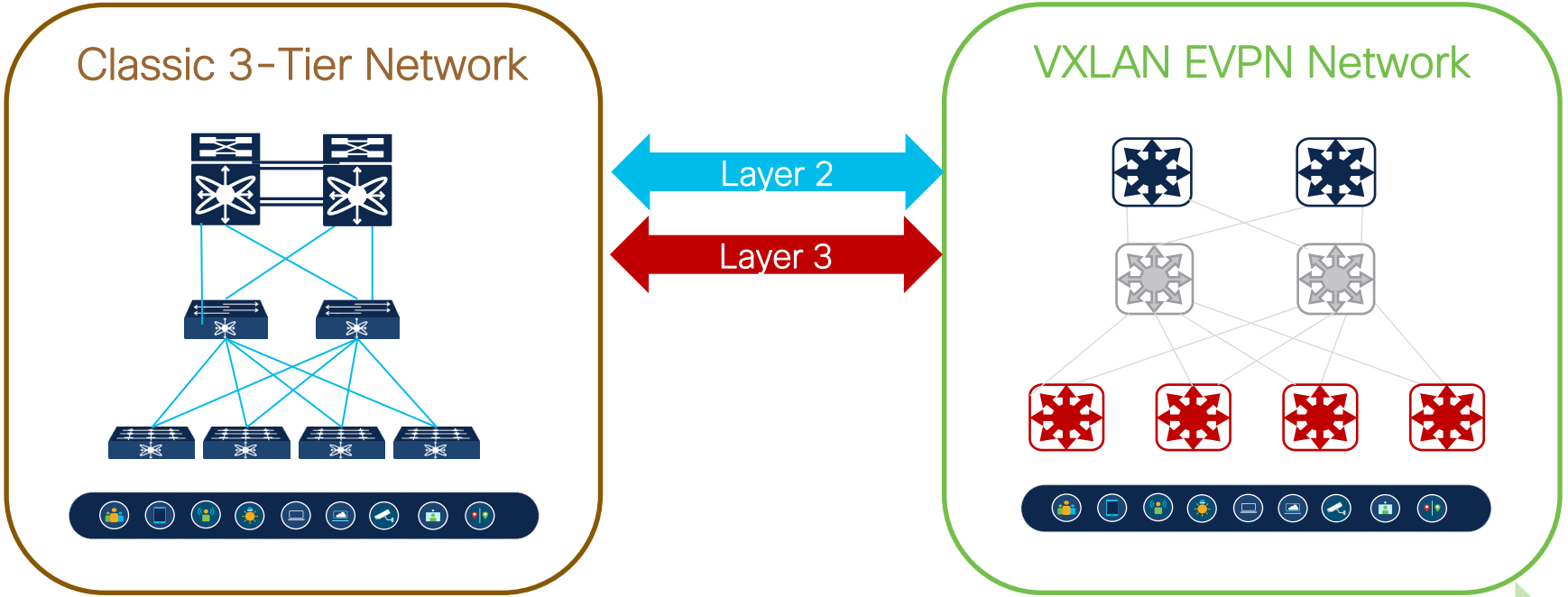
- Standards based Control-Plane
  - RFC 8365 (and RFC 7432)
  - Uses Multiprotocol BGP
- Uses Various Data-Planes
  - VXLAN (EVPN-Overlay), MPLS, Provider Backbone (PBB)
- Many Use-Cases Covered
  - Bridging, MAC Mobility, First-Hop & Prefix Routing, Multi-Tenancy (VPN)

Why BGP EVPN for Enterprise Campus ?

- Industry-standard
- One Fabric Architecture
- Proven & Scalable
- Hierarchical Fabric Domain
- Flexible Overlay

Migration Strategies

Migration Strategy -1 : Build and Move

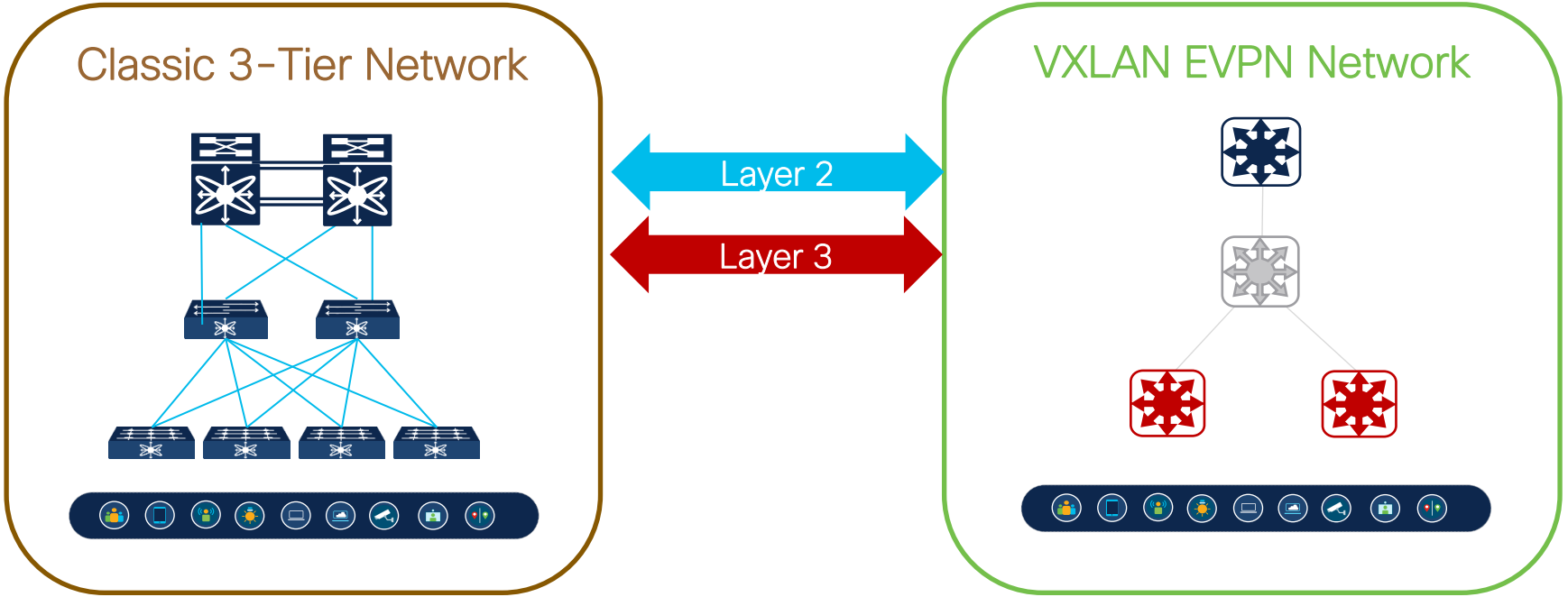


Deployment
Design & deploy new VXLAN BGP EVPN fabric

Integration
Connect VXLAN BGP EVPN to classical 3-tier network

Migration
Migrate end-points to use new VXLAN BGP EVPN fabric

Migration Strategy -2 : Phased Migration

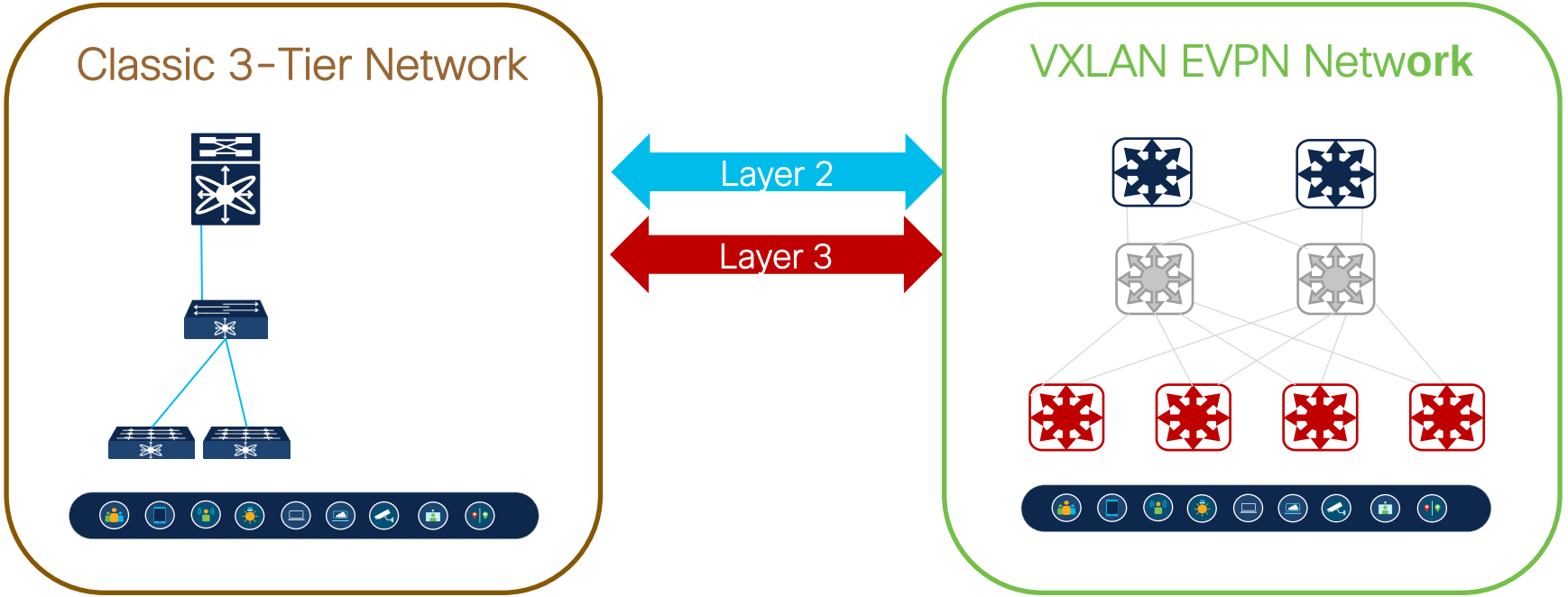


EVPN Island Deployment
Design & deploy new minimalistic VXLAN BGP EVPN fabric

Integration
Connect VXLAN BGP EVPN to classical 3-tier network

Phased Migration -1
Migrate few end-points to use new VXLAN BGP EVPN fabric

Migration Strategy -2 : Phased Migration



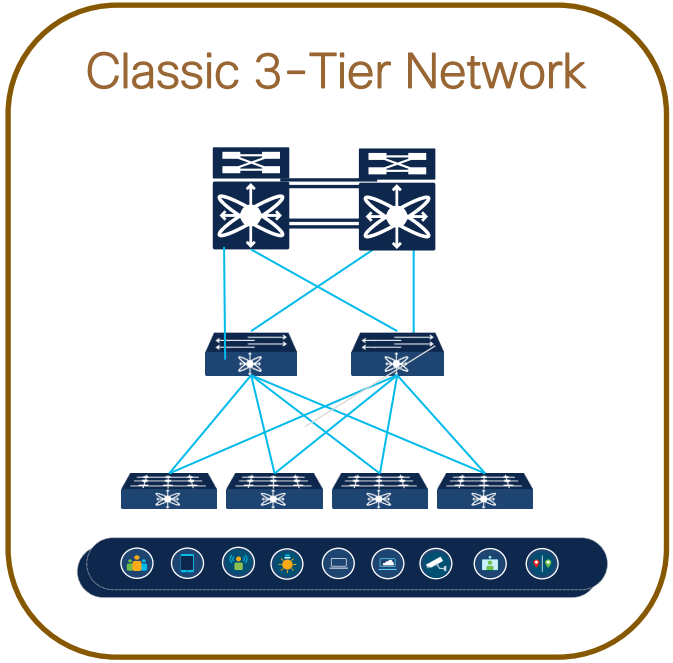
EVPN Island Deployment
Design & deploy new minimalistic VXLAN BGP EVPN fabric

Integration
Connect VXLAN BGP EVPN to classical 3-tier network

Phased Migration -1
Migrate few end-points to use new VXLAN BGP EVPN fabric

Phased Migration -2
Migrate switches and scale the EVPN fabric

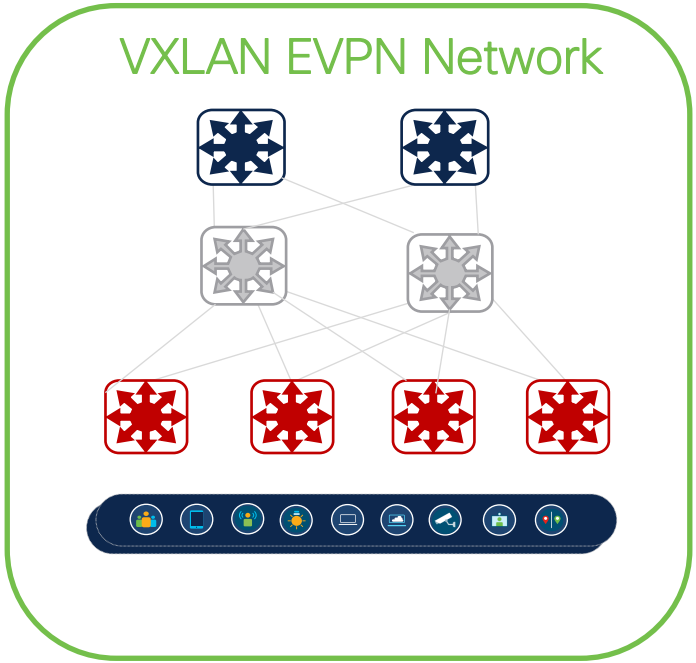
Migration Strategy -3 : Flag Day



Backup Existing Network
Backup configuration, device states of existing classic 3-tier network

Prepare
Gracefully shutdown the classic 3-tier network and associated services

Migration Strategy -3 : Flag Day



Backup Existing Network
Backup configuration, device states of existing classic 3-tier network

Prepare
Gracefully shutdown the classic 3-tier network and associated services

Bring Up
Upgrade Software, reconnect devices as per VXLAN EVPN Architecture

Migration Strategies Comparison

Build & Move

- Seamless Migration
- Additional Hardware and resources required
- Opportunity to test & familiarize VXLAN EVPN
- Low Change Management Risks
- Moderate change window

Phased Migration

- Seamless Migration in phases
- Minimal additional hardware and resources required
- Opportunity to test & familiarize VXLAN EVPN
- Lowest Change Management Risks
- Long change window

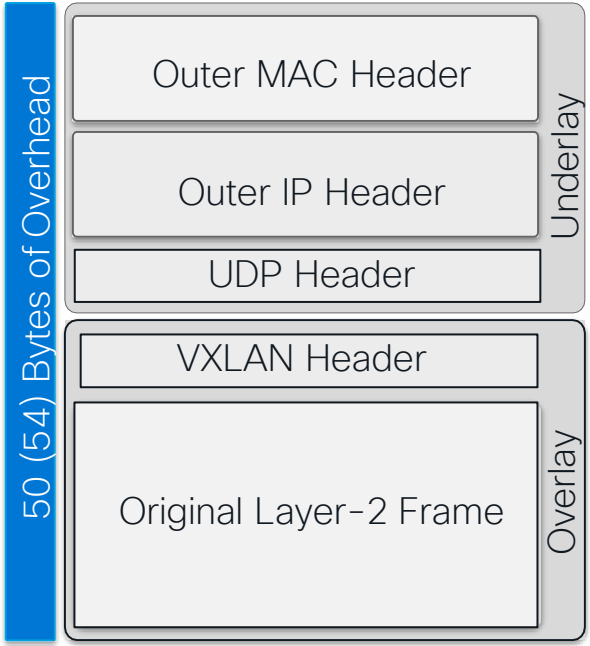
Flag Day

- Migration with downtime
- No Additional hardware and resources required*
- No opportunity to test & Familiarize VXLAN EVPN
- High Change Management Risks
- Minimal change window

* If existing devices can support VXLAN / EVPN and other required features

Planning & Pre-requisites

MTU and VXLAN

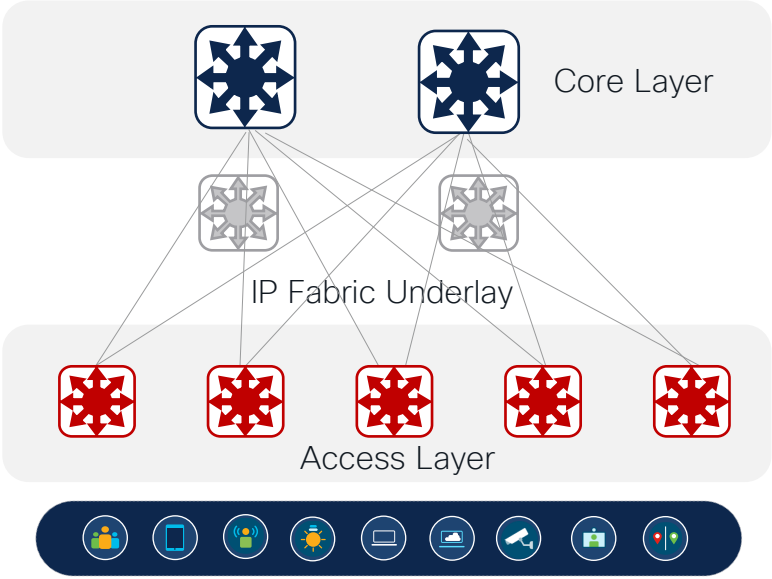


- VXLAN adds 50 Bytes (or 54 Bytes)
- Network switches support MTU up to 9216* bytes
  - Accommodates jumbo MTU plus overlay overhead (50/54bytes)
- Avoid Fragmentation
  - Adjust the Transport Network with appropriate MTU

*Cisco Catalyst 9k switches only support 9198 Byte for Layer-3 Traffic

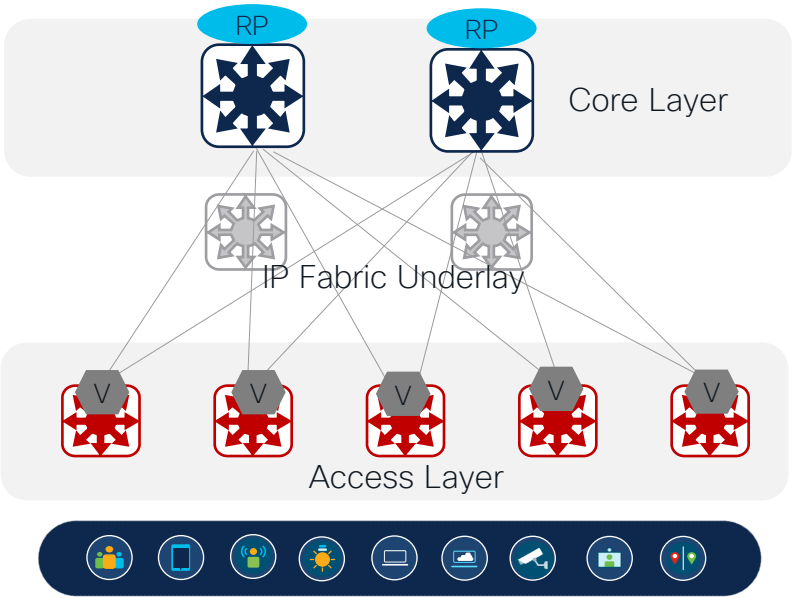
Interface Principles

- Routed Ports and Interfaces
  - Layer-3 Interfaces between Access and Core (no switchport) Or SVI
  - For each Point-to-Point (P2P) connection, minimum /31 required (IPv4)
  - Alternatively, use IP Unnumbered /32
- Loopback as Source-Interface for VTEP



IP Addressing Principles

- Prepare an IP addressing Plan
- Separate Interface functions through IP addressing (aggregates)
  - Unicast Routing – Routing Protocol Peering (p2p)
  - Unicast Routing – Routing Identifier (RID)
  - VTEP (NVE) Loopback
  - Multicast Routing Loopback (RP)



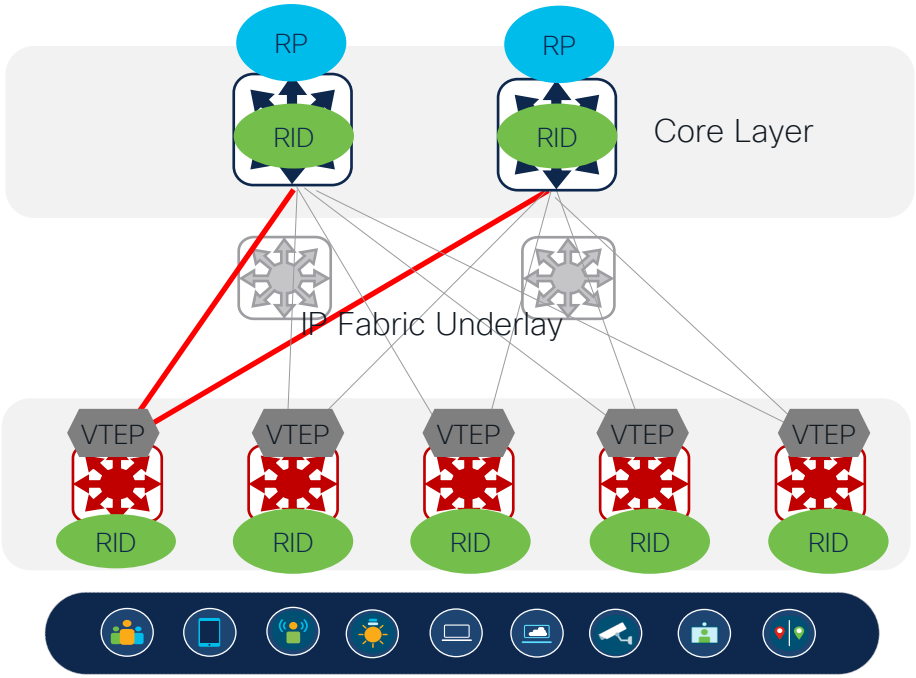
IP Addressing Principles

P2p Agg : 10.1.1.0/24
10.1.1.0/30
10.1.1.4/30
10.1.1.8/30

RID Agg : 10.10.10.0/24
10.10.10.1/32
10.10.10.2/32
10.10.10.3/32

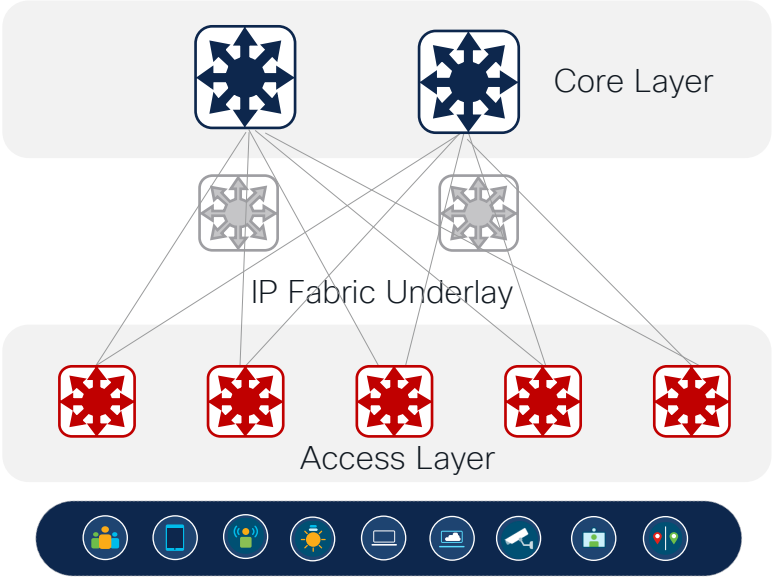
VTEP Agg : 10.200.200.0/24
10.200.200.1/32
10.200.200.2/32
10.200.200.3/32

RP Agg : 10.254.254.0/24
10.254.254.1/32



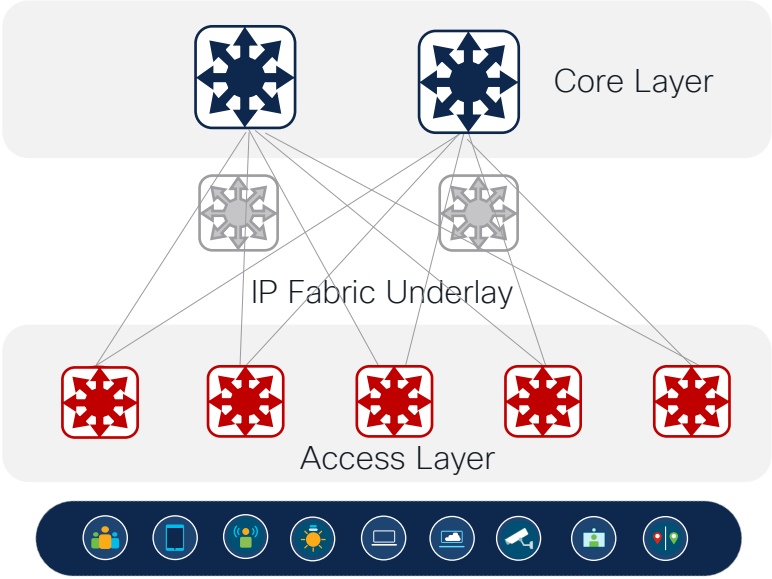
Unicast Routing – OSPF

- OSPF – watch your Network type!
  - Network Type Point-2-Point (P2P)
  - Preferred (only LSA type-1)
  - No DR/BDR election
- Suits well for routed interfaces/ports
- Full SPF calculation on Link Change



Unicast Routing - IS-IS

- IS-IS – what was this CLNS?
- Independent of IP (CLNS)
- Well suited for routed interfaces/ports
- No SPF calculation on Link change
- Fast Re-convergence
- Not everyone is familiar with it

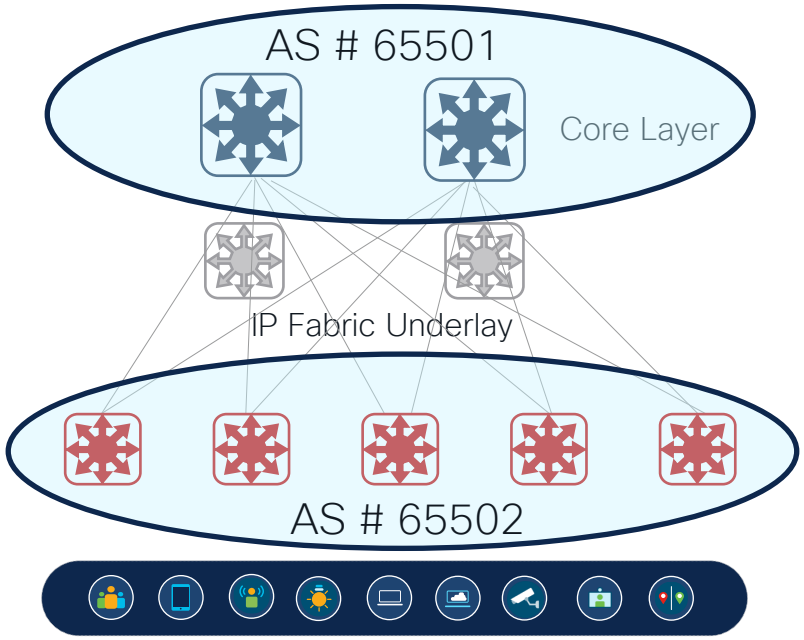


Unicast Routing – eBGP

- eBGP Underlay Routing – Service Provider style
  - Two Different Models
    - Two-AS
    - Multi-AS
- BGP is a Distance Vector Protocol
  - AS* are used to calculate the Path (AS_Path)

Unicast Routing - eBGP

- eBGP – TWO-AS, yes it works!
- eBGP peering for Underlay
  - Spine is not a Route-Reflector (eBGP)
  - Retain Route-targets
  - Disable BGP AS-Path check
- Underlay is Reachability !
  - Advertise all loopbacks
- Special Overlay Control-Plane treatment
  - Next-Hop needs to be unchanged
  - Disable BGP AS-path check



Unicast Routing - eBGP

- eBGP – Multi-AS, rebuild the Internet
- eBGP peering for Underlay
  - Spine is not a Route-Reflector(eBGP)
  - Retain Route-Targets
  - Next-Hop needs to be unchanged
- Underlay is Reachability !
  - Advertise all loopbacks
- Special Overlay Control-Plane treatment
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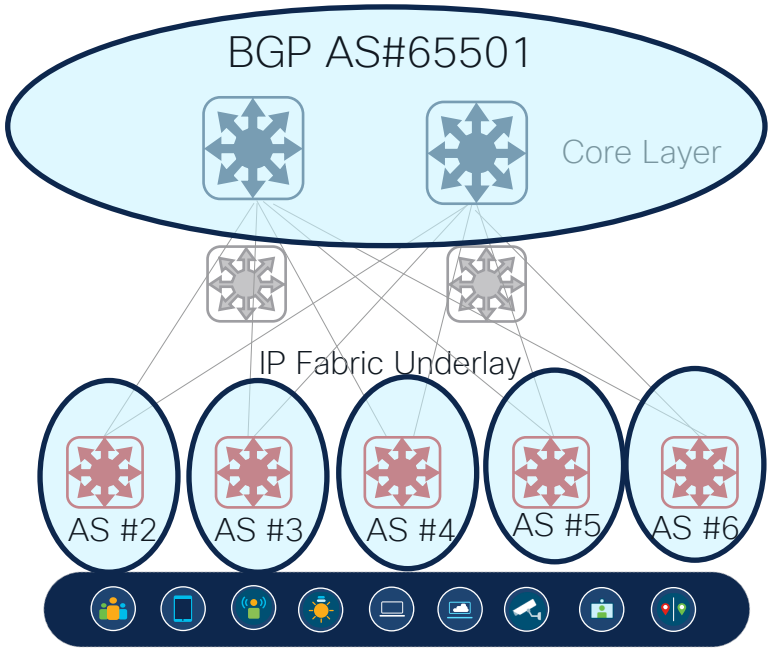
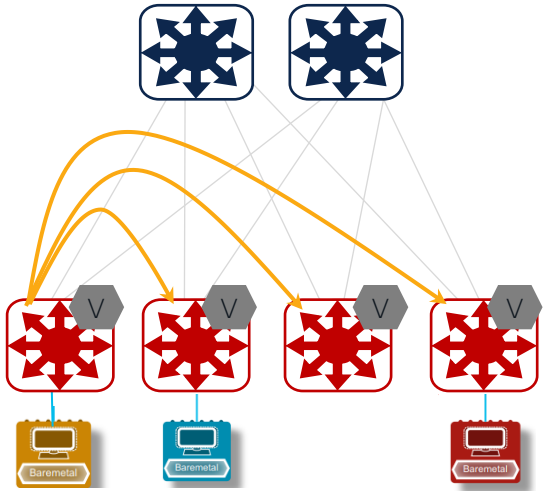
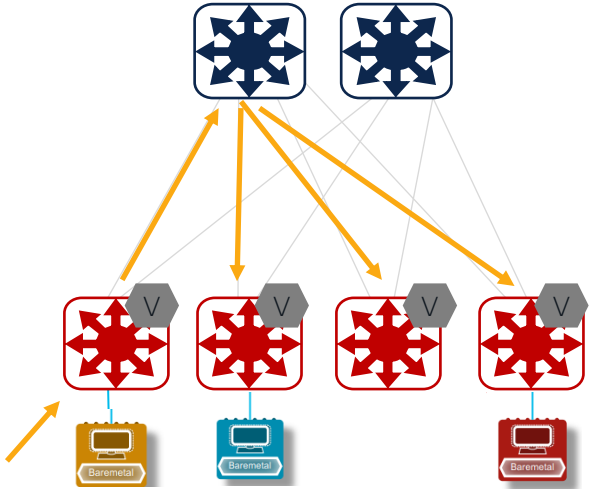


Overlay Broadcast, Unknown Unicast, Multicast (BUM) Forwarding

INGRESS-REPLICATION



MULTICAST-REPLICATION



Two mechanics to handle Broadcast, Unknown Unicast and Link-Local Multicast (BUM):

- Ingress-Replication – Convert each BUM packet to multiple Unicast packets and transmit to each remote VTEP
- Multicast-Replication – Convert each BUM packet to single Multicast packets and transmit in Underlay network

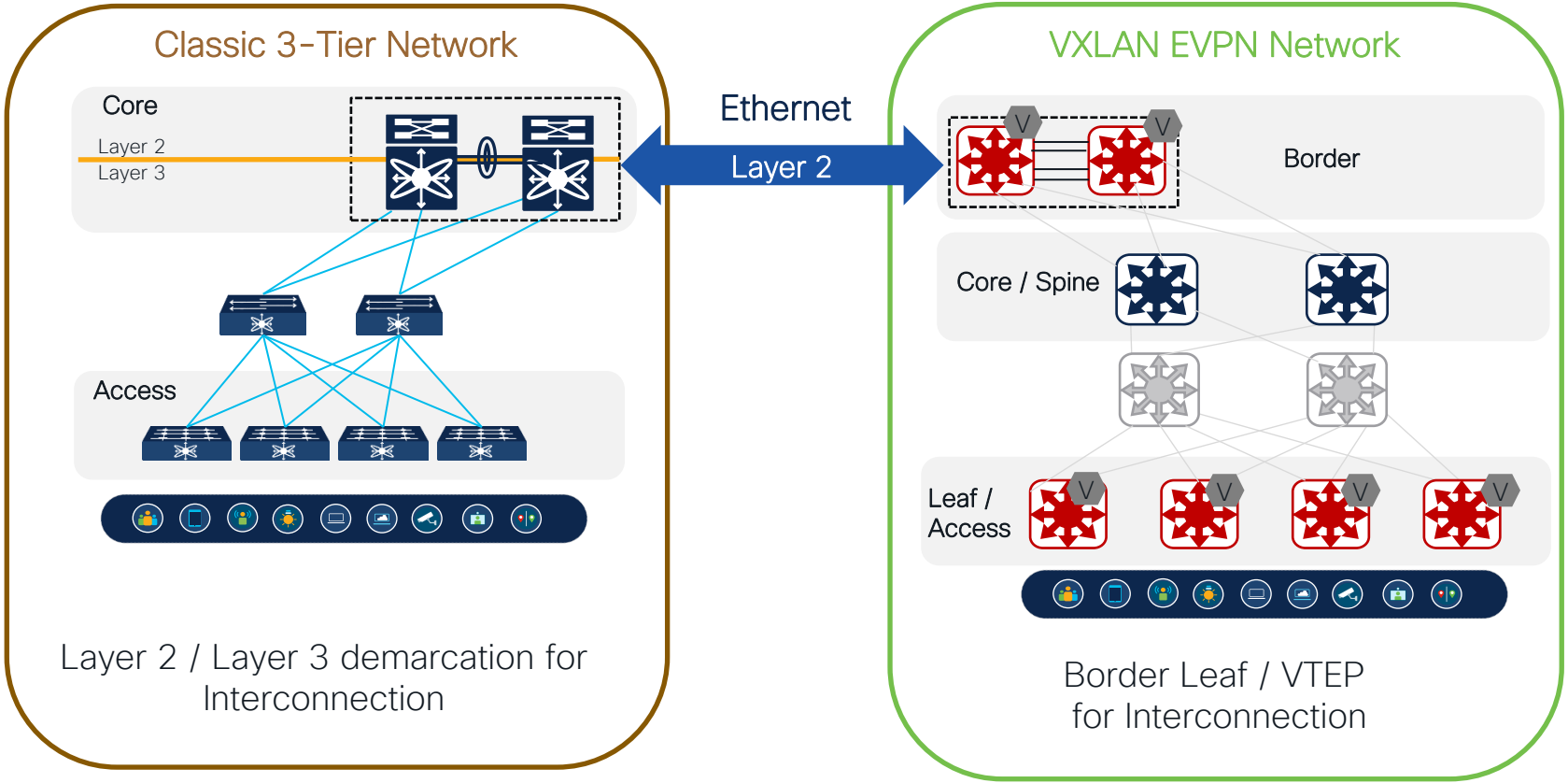
Multicast Enabled Underlay for BUM

- Only PIM ASM is supported on Catalyst 9k
- Multi-Destination Traffic (Broadcast, Unknown Unicast, etc.) needs to be replicated to ALL VTEPs serving a given VNI
- Each VTEP is Multicast Source & Receiver
- For a given VNI, all VTEPs act as a Sender and a Receiver
- Aggregation Switches make good Rendezvous-Point (RP) Locations in Topologies
- Reserve a range of Multicast Groups (Destination Groups/DGroups) to service the Overlay and optimize for diverse VNIs

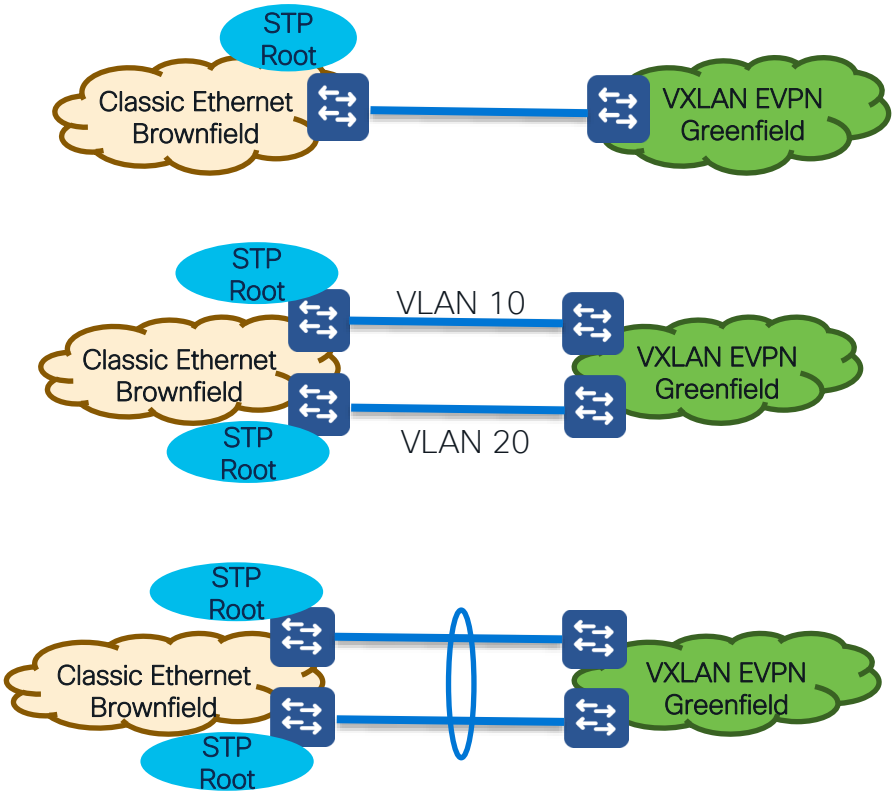
Migration Considerations

Layer 2 Interconnect

Layer 2 Interconnection



Spanning-Tree Considerations

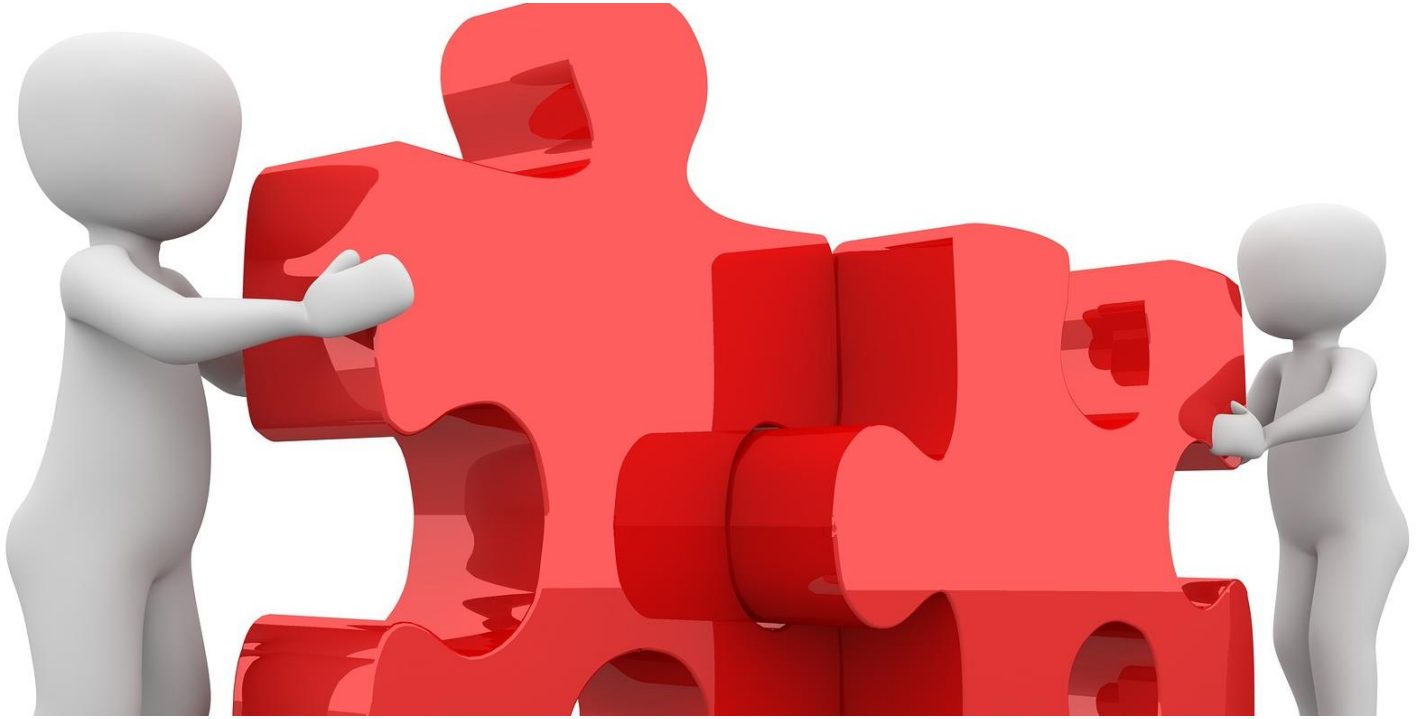


VLAN Mapping

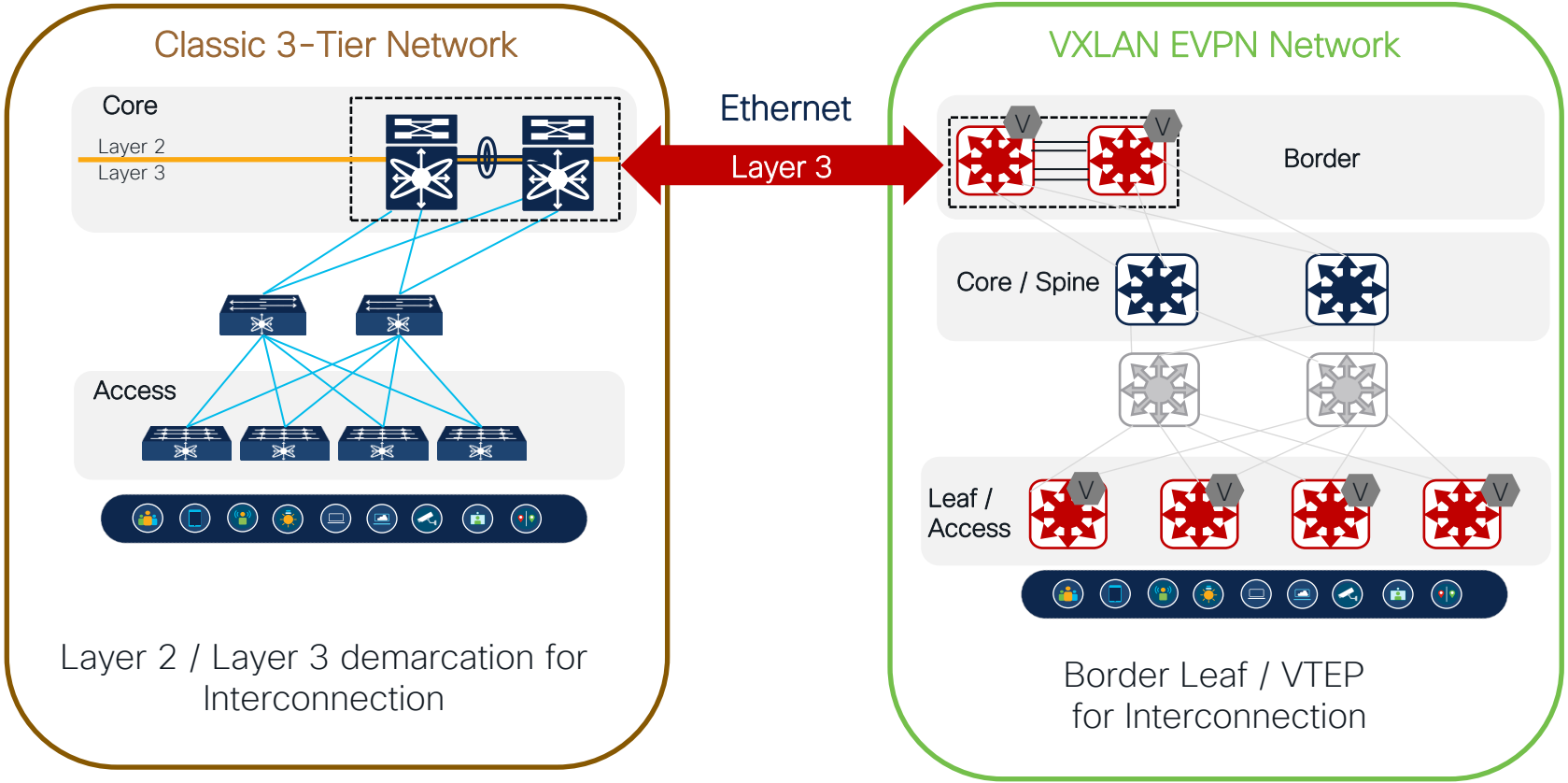
1:1 VLAN Mapping

Mapping between different VLANs

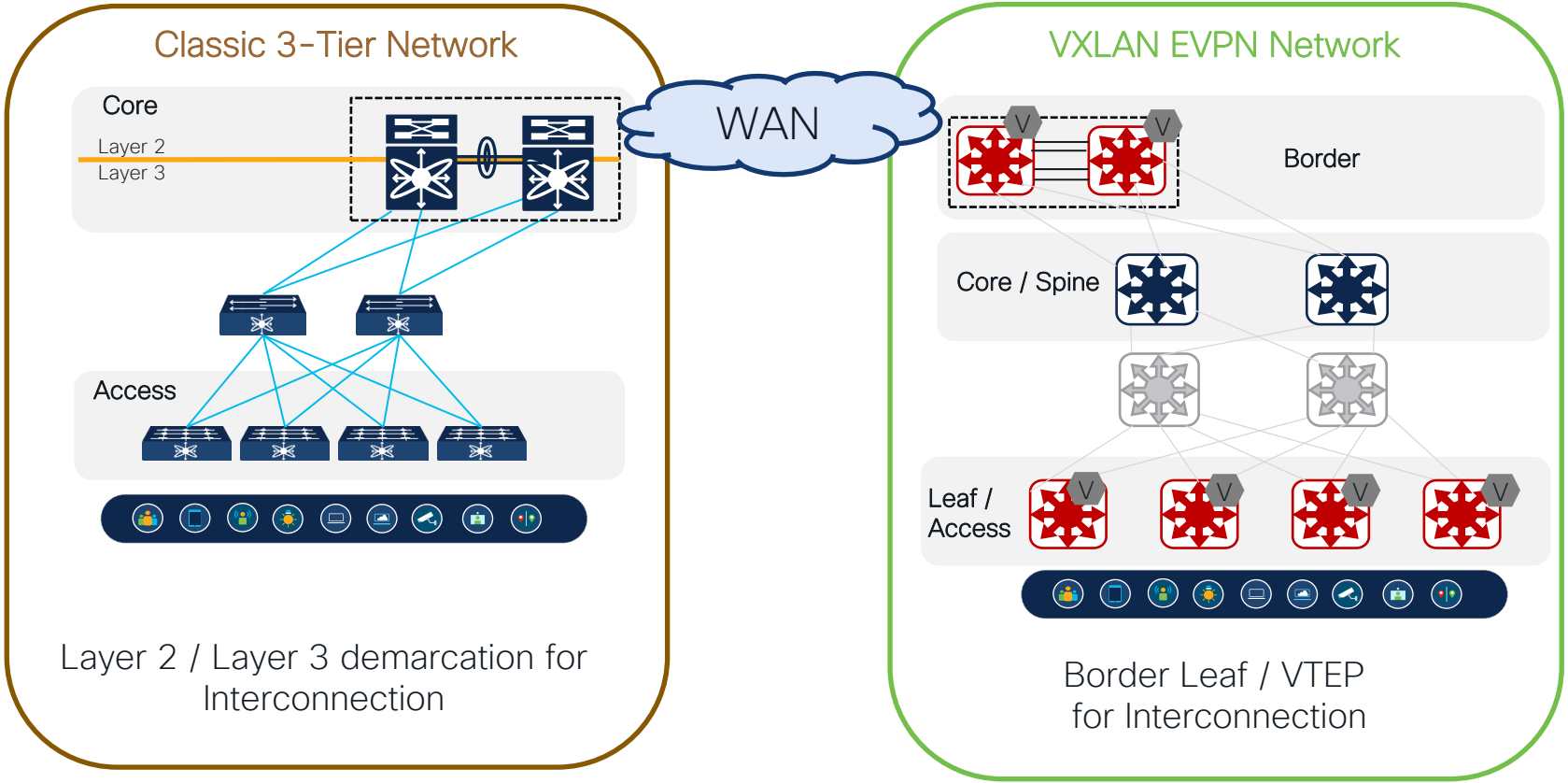
Layer 3 Interconnect



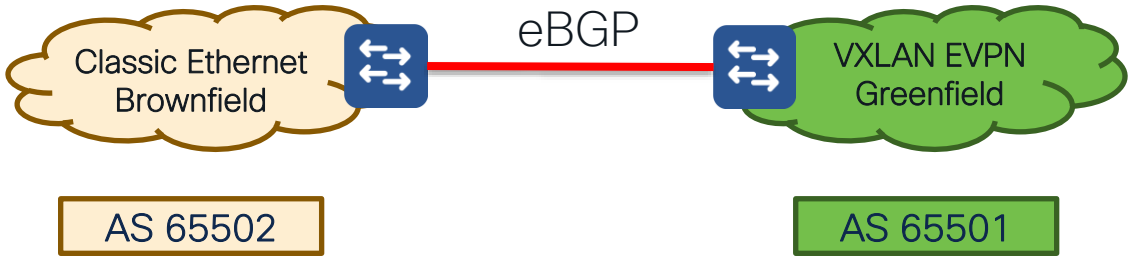
Layer 3 Interconnection : Direct



Layer 3 Interconnection : WAN

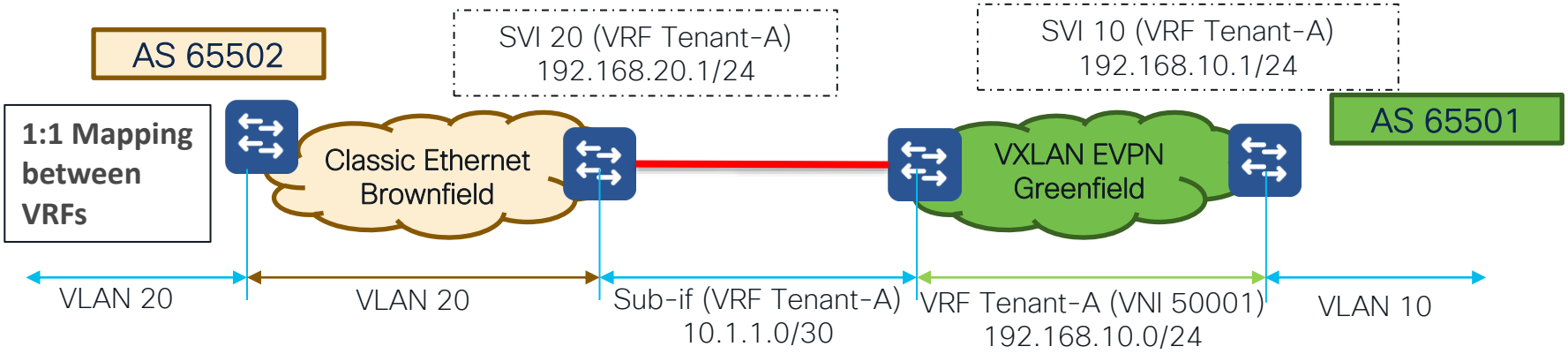


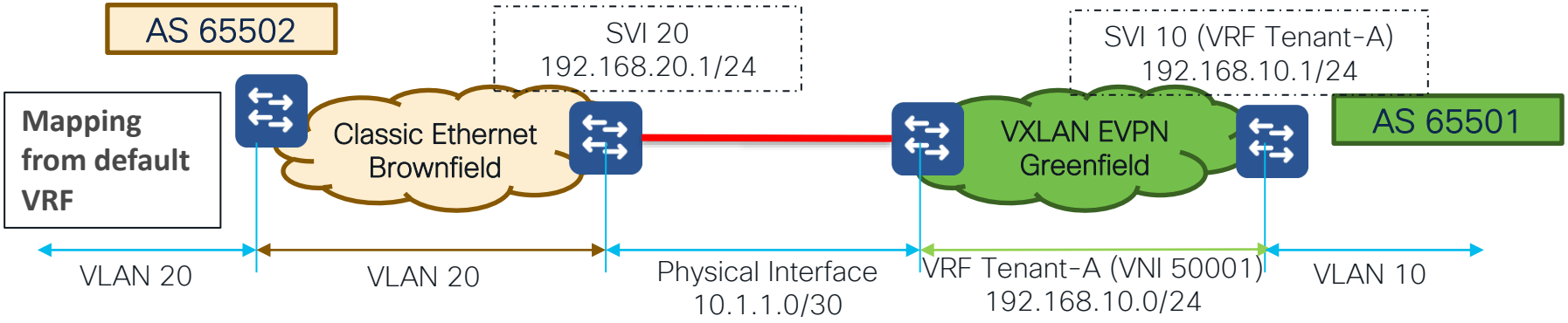
Layer-3 Interconnection : Routing Protcol

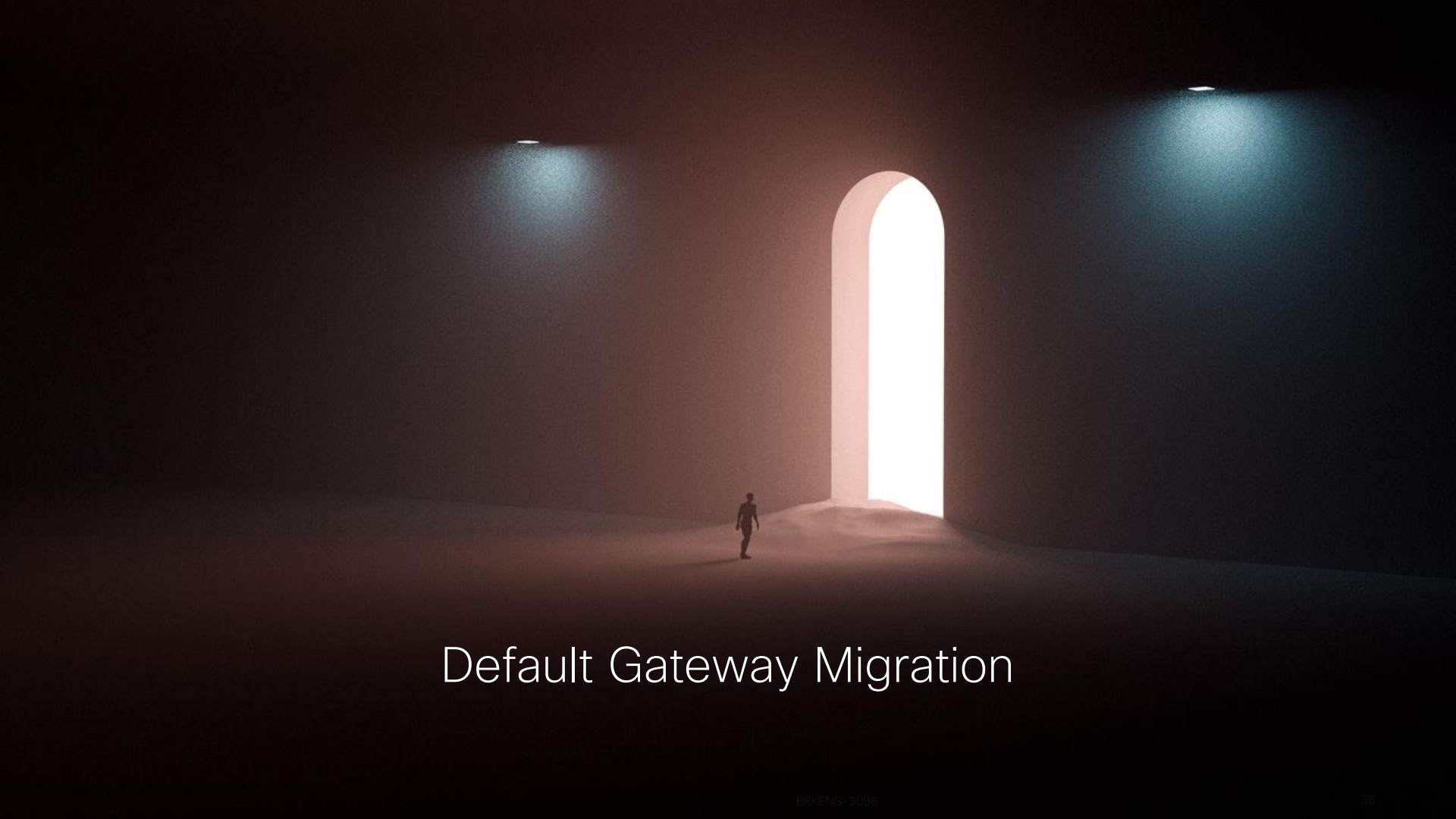


- **Routing Protocol considerations**
  - ✓ Greenfield network with VXLAN BGP EVPN
  - ✓ Routing domain separation
  - ✓ Extensive routing policy capability
  - ✓ VRF awareness
- **BGP meets these requirements & capabilities**

VRF Mapping

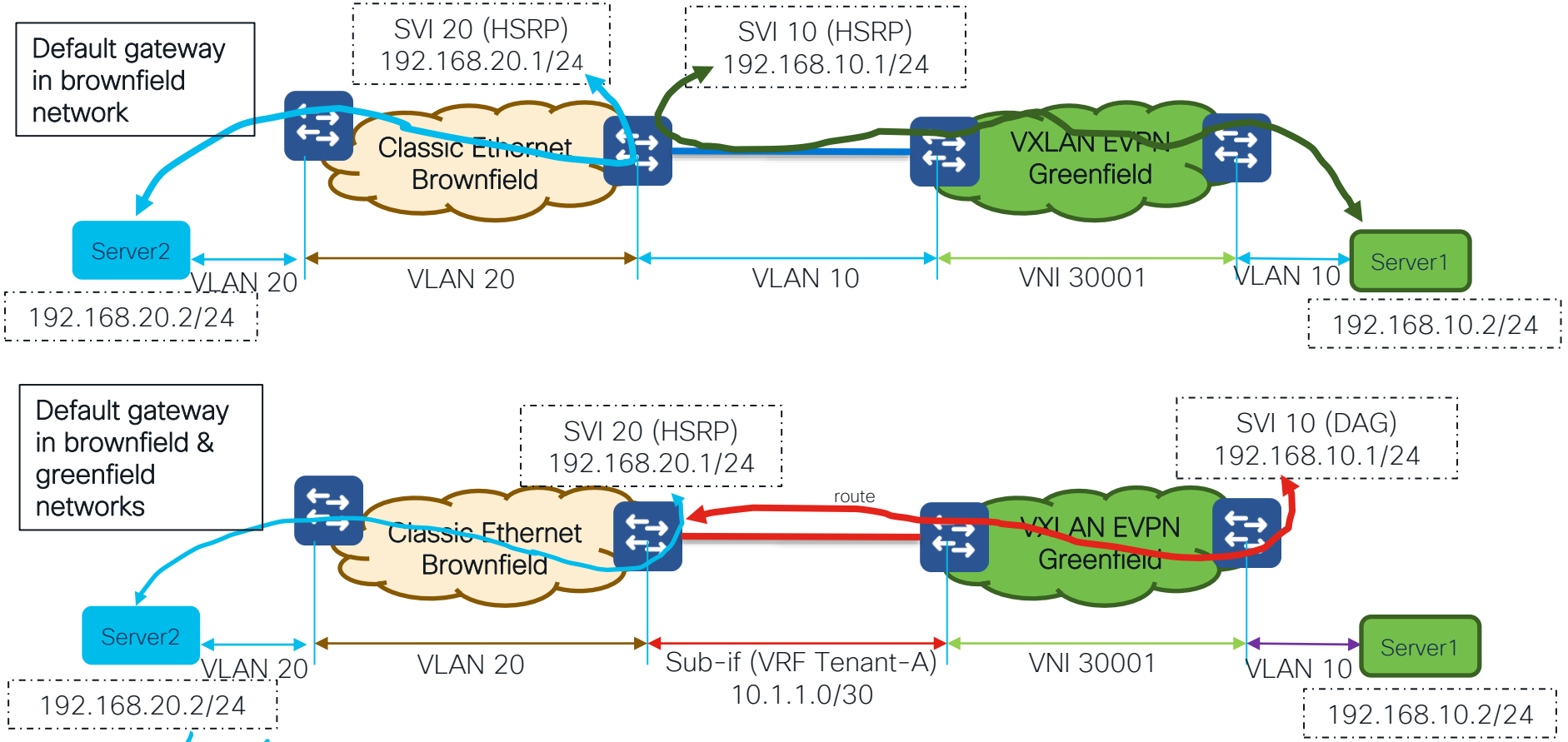






Default Gateway Migration

Default Gateway Migration Considerations



Migration Walkthrough

Migration Walkthrough

Build & Move

- Build EVPN Fabric
- Layer 3 Interconnect
- Layer 2 Interconnect
- Default GW Migration
- Workload Migration
- Decommission

Phased Migration

- Build EVPN Fabric prototype
- Acclimate to VXLAN EVPN
- Layer 3 & 2 Interconnect
- Plan & Migrate in phases
- Scale EVPN fabric
- Default GW Migration
- Complete Migration
- Decommission

Flag Day

- Plan a shutdown window
- Backup Existing Network
- Rewire or add connections
- Gracefully shutdown
- Upgrade to support software
- Bring up EVPN fabric
- Integrate & Test

Pre-Migration Checklist

- ✓ Validate Design & Hardware
- ✓ Validate Supported Software
- ✓ Validate required Licensing
- ✓ Verify Supported Scale
- ✓ Layer 2 & Layer 3 Interconnect Point
- ✓ Select VLAN Mapping strategy
- ✓ Select Routing Protocol
- ✓ Select VRF mapping strategy
- ✓ Default gateway migration strategy
- ✓ Method of Procedure (MOP)

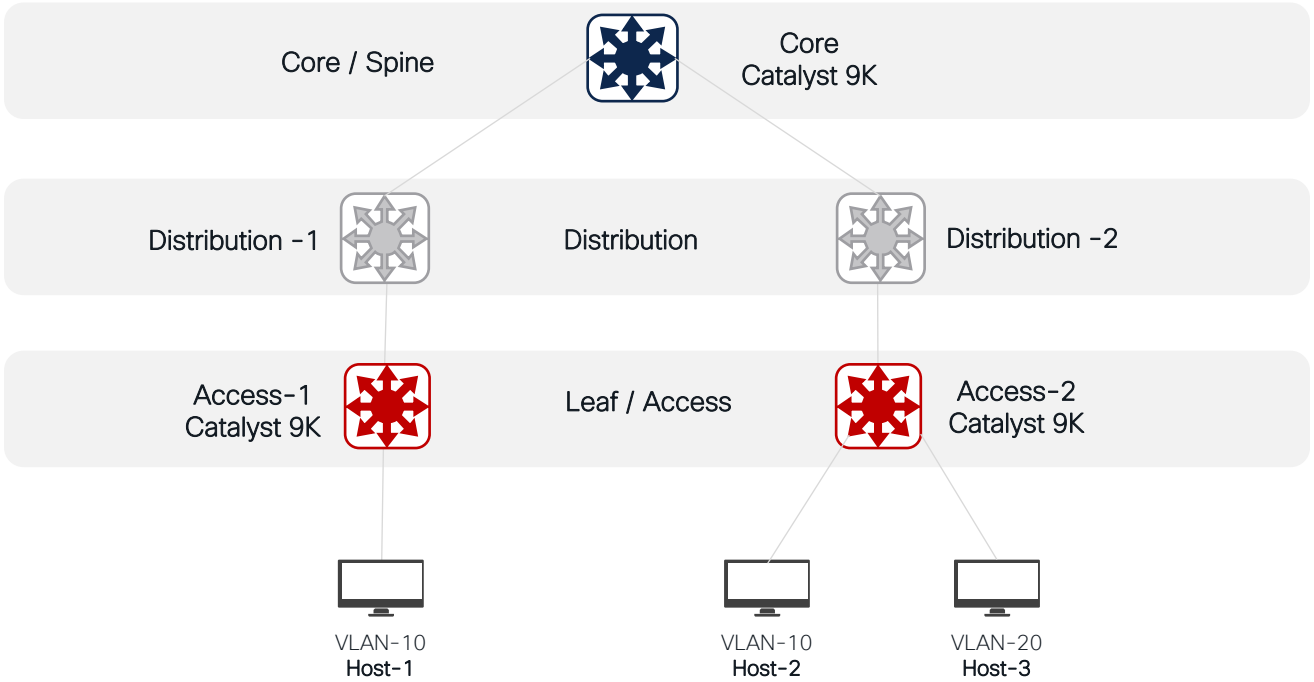
Migration Step-by-Step

Building EVPN Fabric

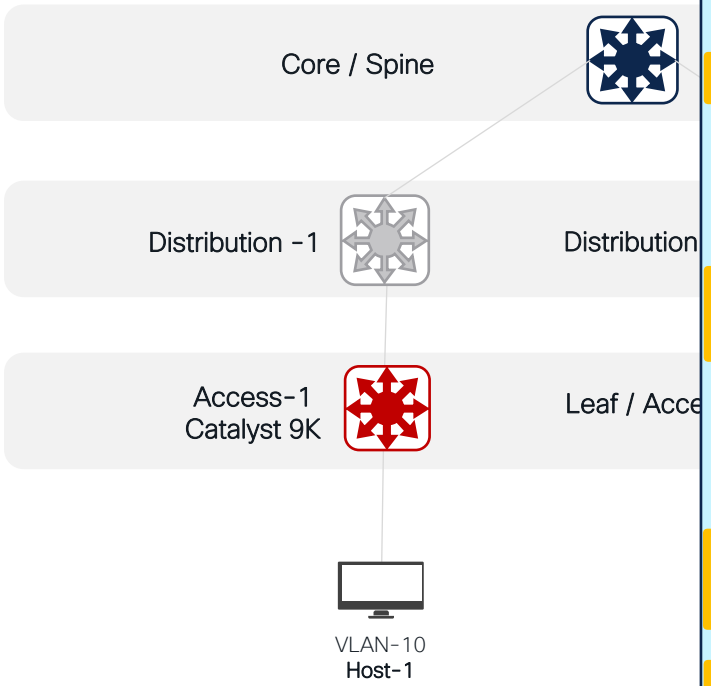
VXLAN EVPN – Configuration Constructs

1. Underlay Configuration
2. Underlay Configuration for BUM – Ingress replication / Multicast
3. EVPN Control Plane Configuration
4. EVPN – Multitenancy Configuration
5. Overlay Configuration- Vxlan Data Plane
6. Distributed Anycast Gateway Configuration

Underlay Configuration – OSPF

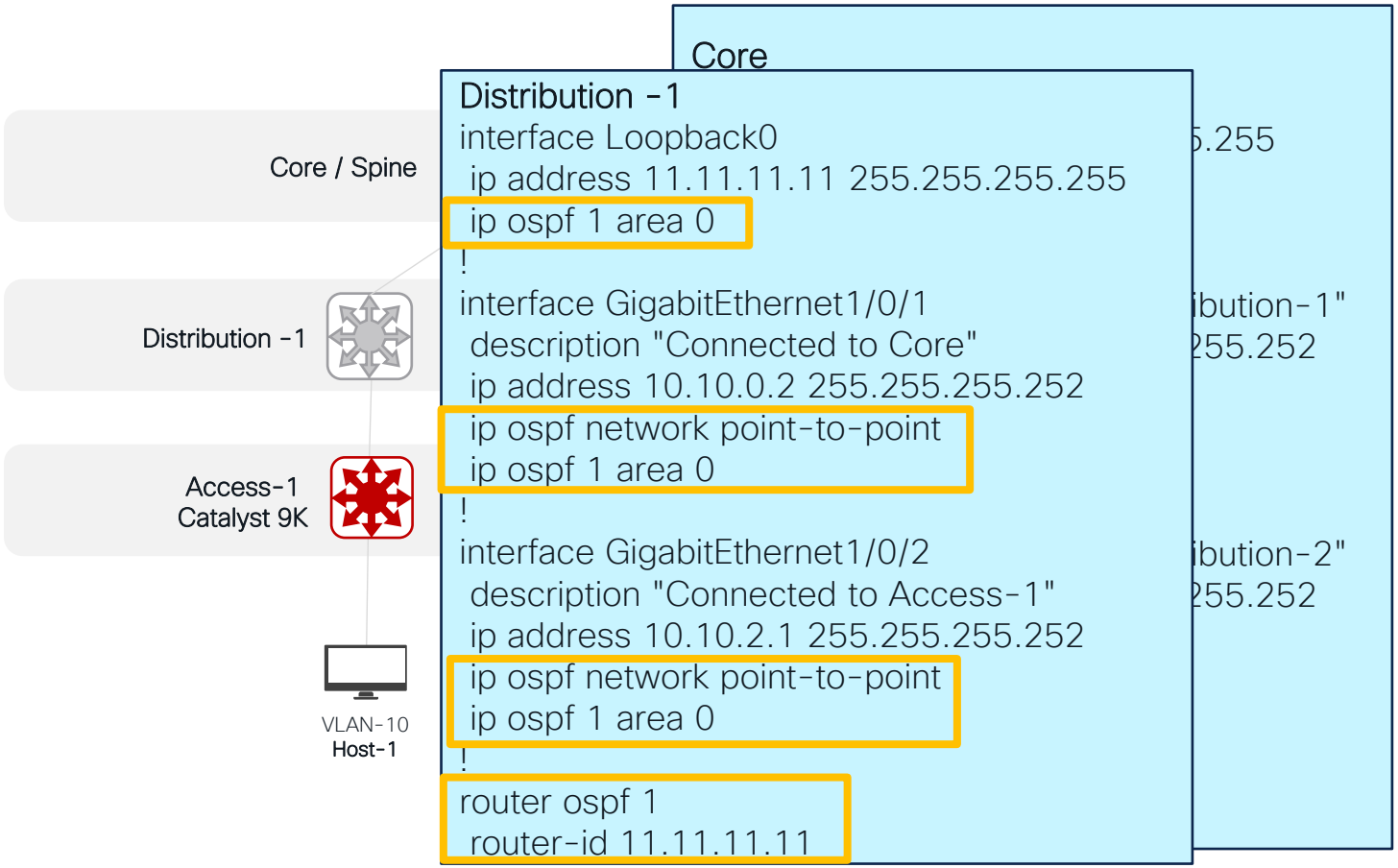


Underlay Configuration – OSPF

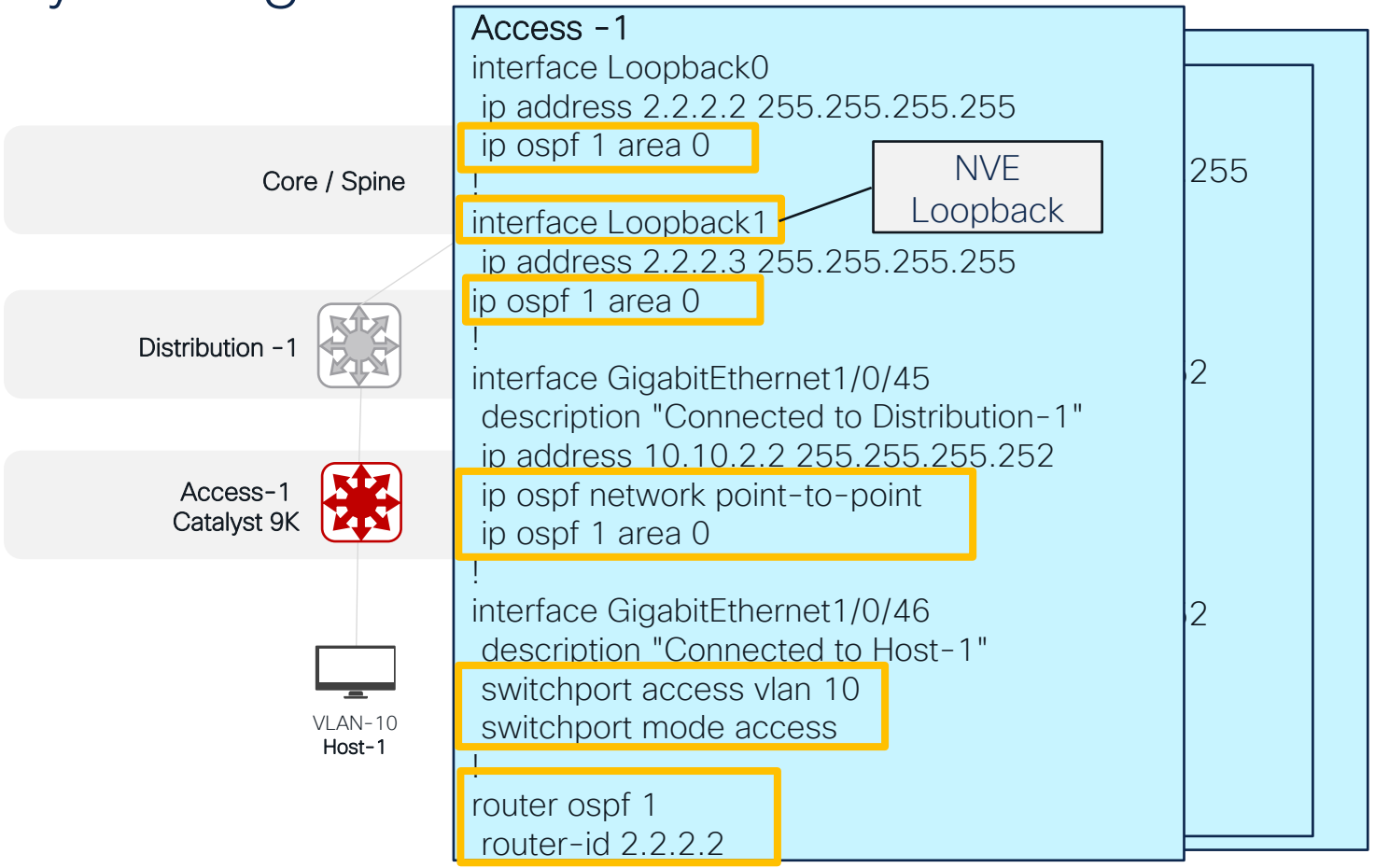



```
Core
interface Loopback0
 ip address 1.1.1.1 255.255.255.255
 ip ospf 1 area 0
!
interface TwentyFiveGigE1/0/3
 description "Connected to Distribution-1"
 ip address 10.10.0.1 255.255.255.252
 ip ospf network point-to-point
 ip ospf 1 area 0
!
interface TwentyFiveGigE1/0/4
 description "Connected to Distribution-2"
 ip address 10.10.1.1 255.255.255.252
 ip ospf network point-to-point
 ip ospf 1 area 0
!
router ospf 1
 router-id 1.1.1.1
```

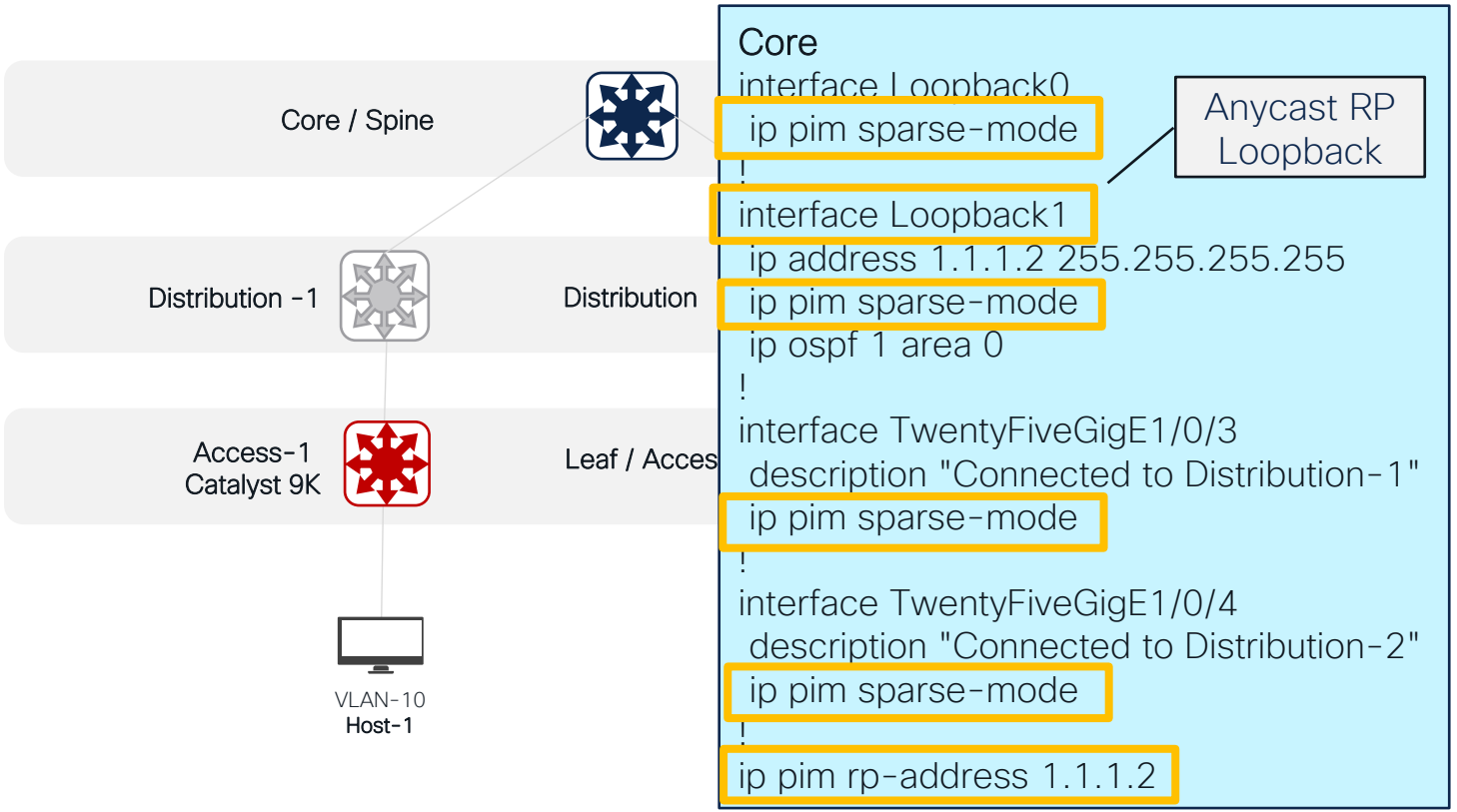
Underlay Configuration – OSPF



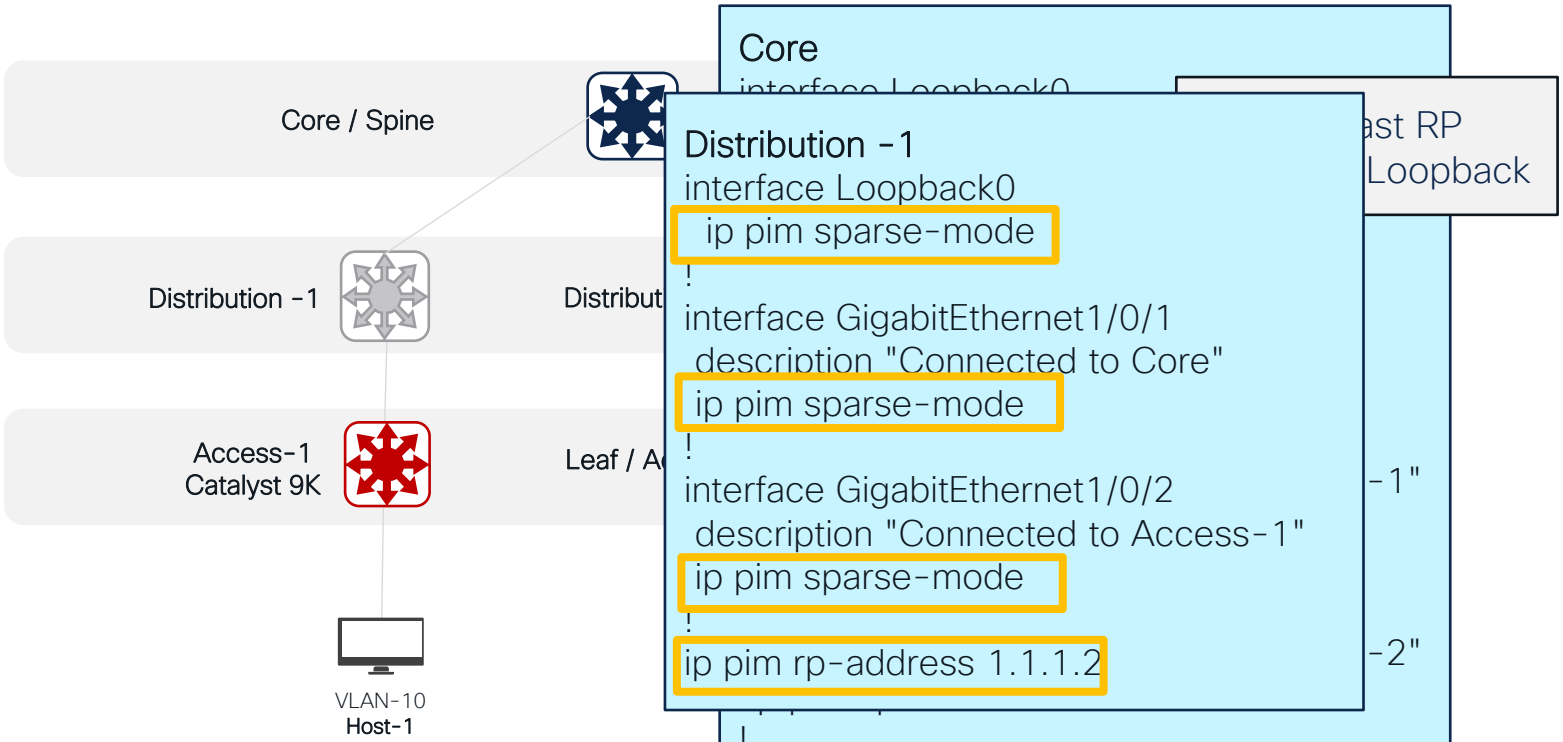
Underlay Configuration – OSPF



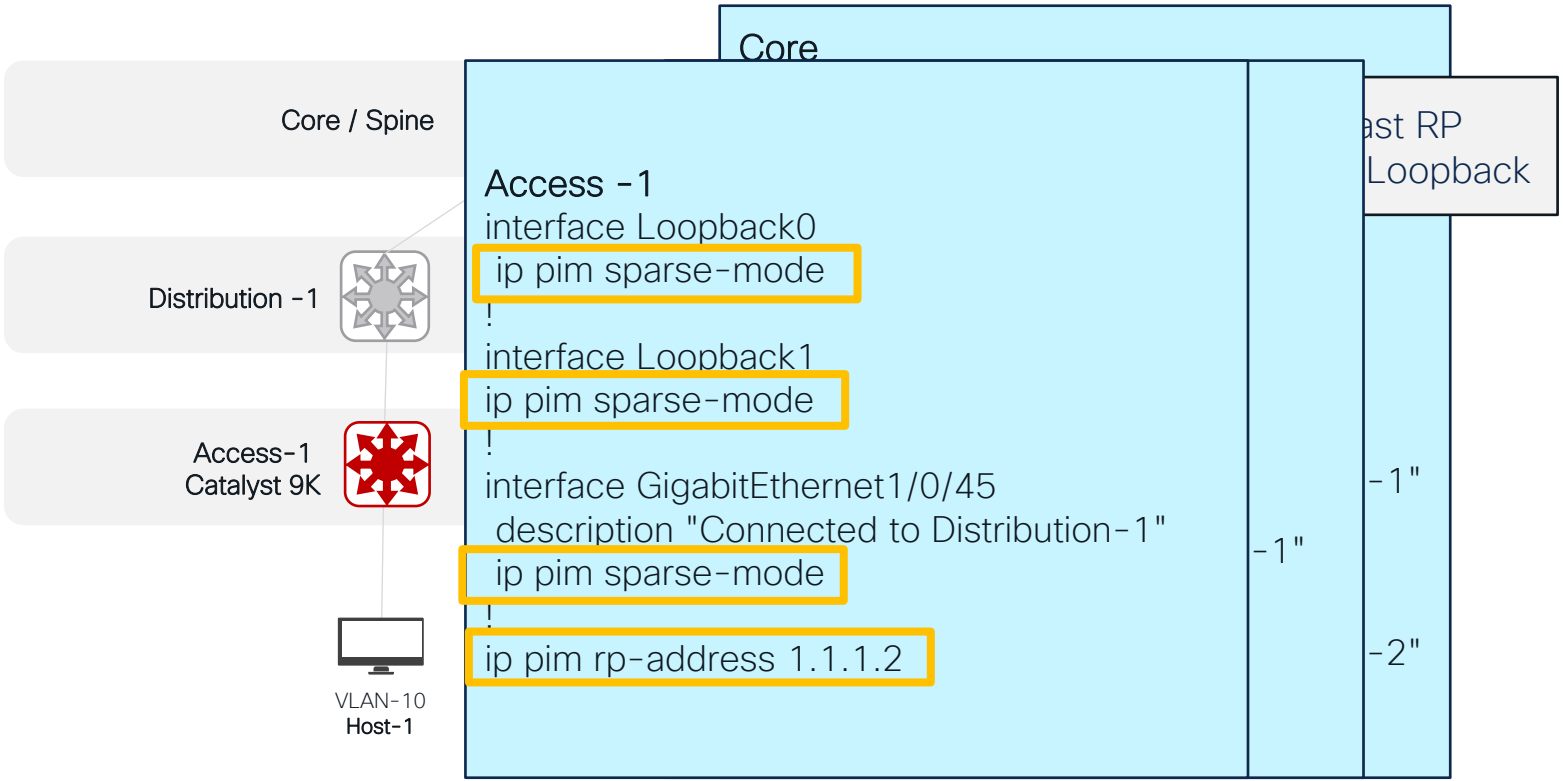
Underlay Configuration for BUM – PIM ASM



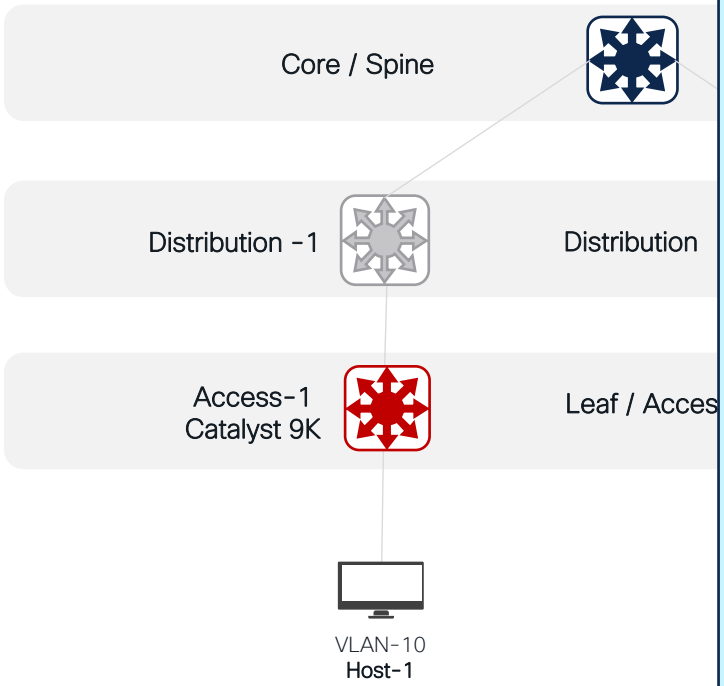
Underlay Configuration for BUM – PIM ASM



Underlay Configuration for BUM – PIM ASM

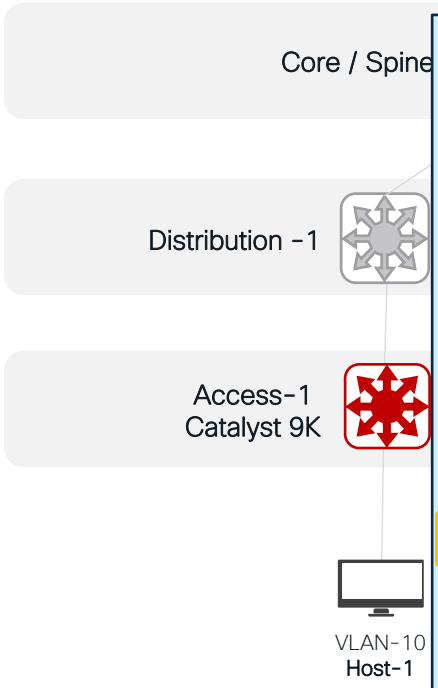


Overlay Configuration – BGP EVPN Control Plane




```
Core
router bgp 64000
 neighbor 2.2.2.2 remote-as 64500
 neighbor 2.2.2.2 update-source Loopback0
 neighbor 3.3.3.3 remote-as 64500
 neighbor 3.3.3.3 update-source Loopback0
 !
 address-family ipv4
  redistribute connected
  neighbor 2.2.2.2 activate
  neighbor 3.3.3.3 activate
  maximum-paths 2
 !
 address-family l2vpn evpn
  neighbor 2.2.2.2 activate
  neighbor 2.2.2.2 send-community both
  neighbor 2.2.2.2 route-reflector-client
  neighbor 3.3.3.3 activate
  neighbor 3.3.3.3 send-community both
  neighbor 3.3.3.3 route-reflector-client
  maximum-paths 2
```

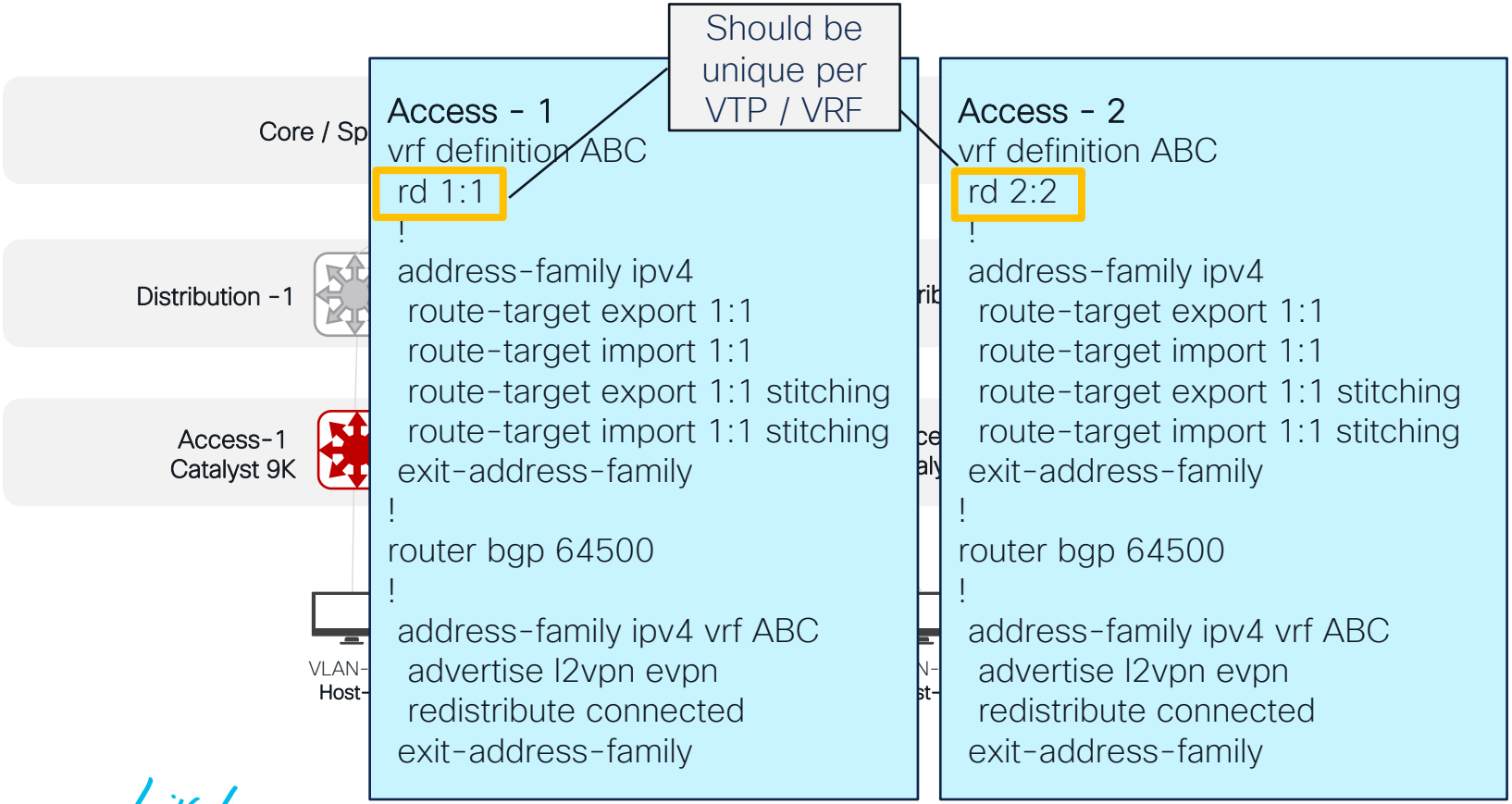
Overlay Configuration – BGP EVPN Control Plane



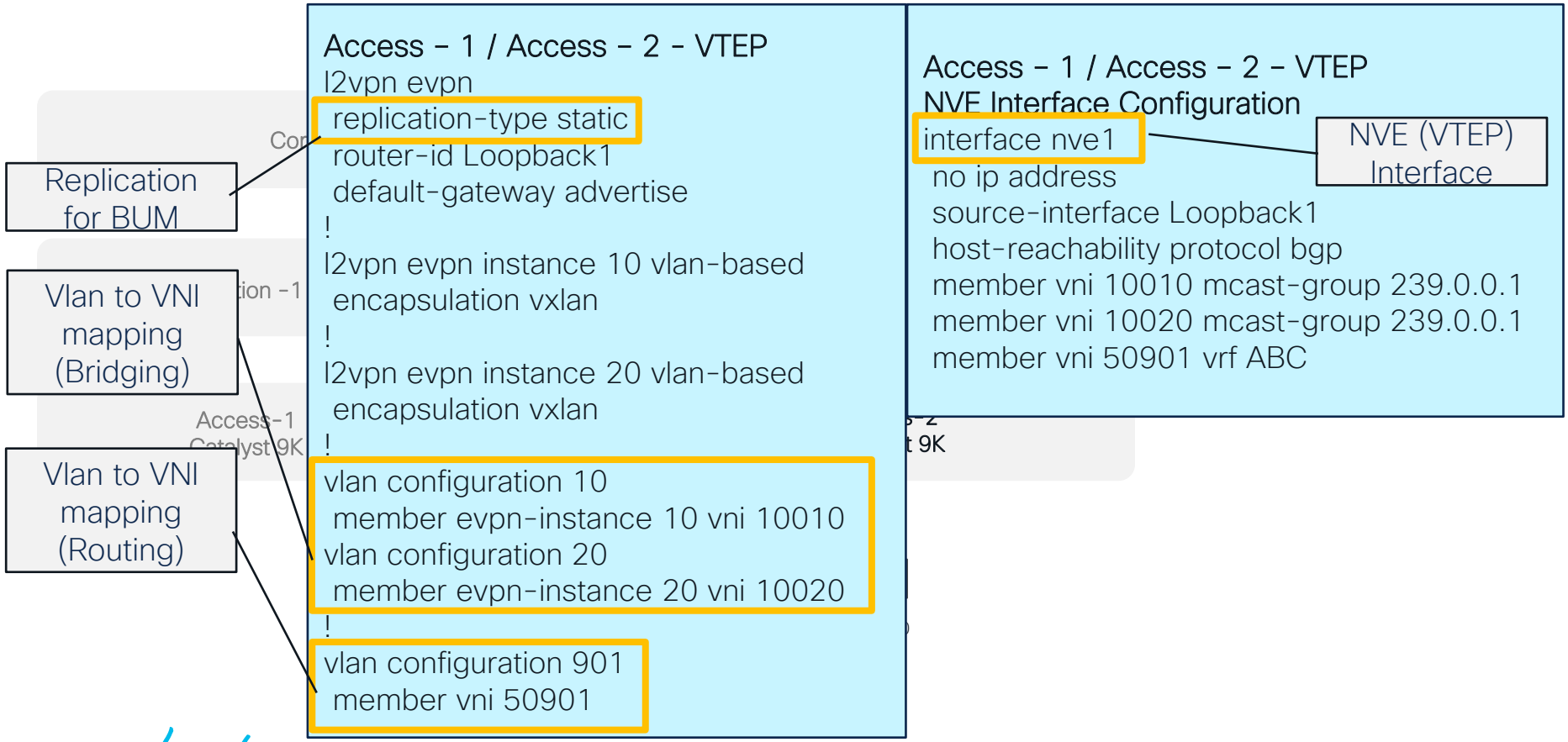

```
Core
router bgp 64000
 neighbor 2.2.2.2 remote-as 64500
                                    oopback0
                                    0
                                    oopback0
                                    y both
                                    client
                                    y both
 neighbor 3.3.3.3 route-reflector-client
 maximum-paths 2
```

```
Access - 1
router bgp 64500
 neighbor 1.1.1.1 remote-as 64000
 neighbor 1.1.1.1 ebgp-multihop 255
 neighbor 1.1.1.1 update-source Loopback0
 !
 address-family ipv4
  redistribute connected
  neighbor 1.1.1.1 activate
 exit-address-family
 !
 address-family l2vpn evpn
  neighbor 1.1.1.1 activate
  neighbor 1.1.1.1 send-community both
 exit-address-family
```

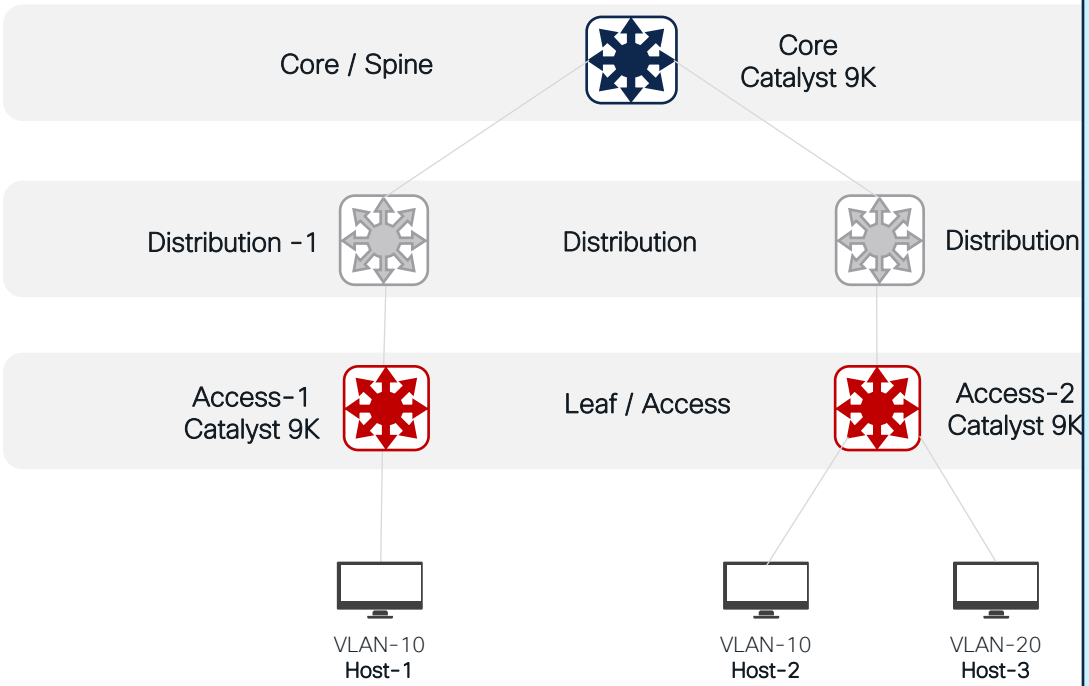
Overlay Configuration – Multitenancy



Overlay Configuration – VXLAN Data Plane



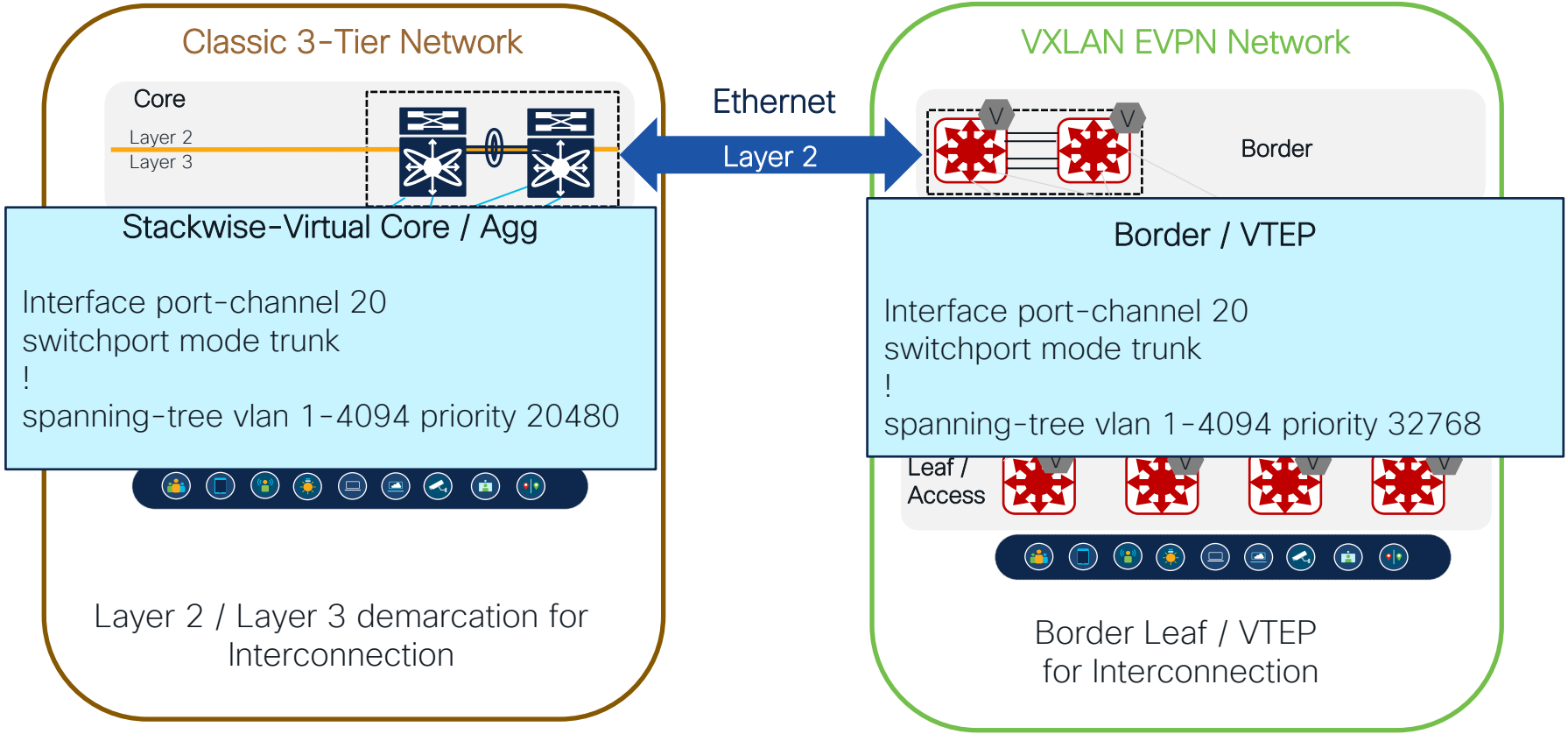
Distributed Anycast Gateway Configuration



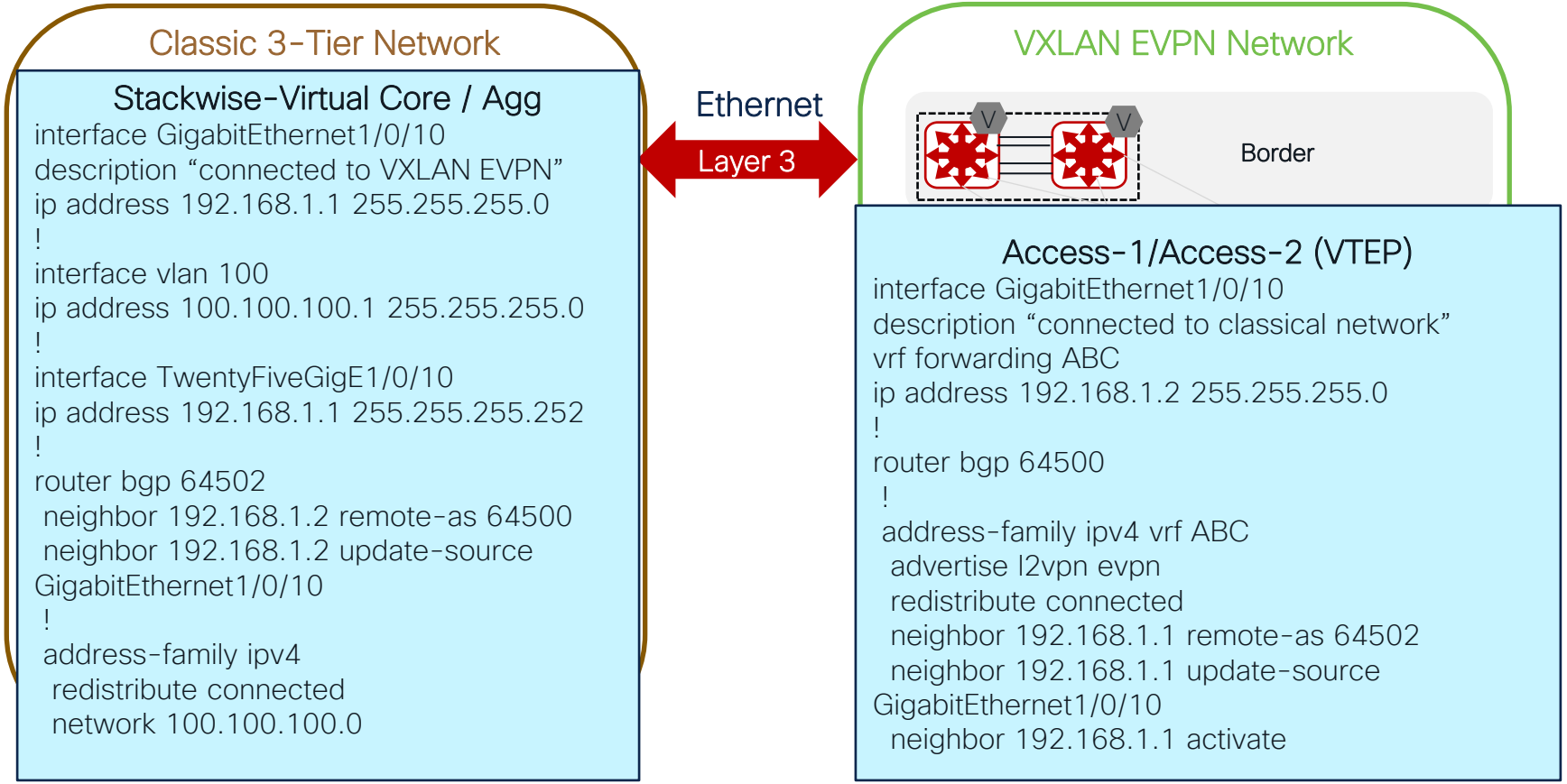
Access – 1 / Access – 2 : VTEP

```
interface Vlan10
 vrf forwarding ABC
 ip address 10.10.10.200 255.255.255.0
!
interface Vlan20
 vrf forwarding ABC
 ip address 10.10.20.200 255.255.255.0
 no autostate
!
interface Vlan901
 vrf forwarding ABC
 ip unnumbered Loopback1
 no autostate
```

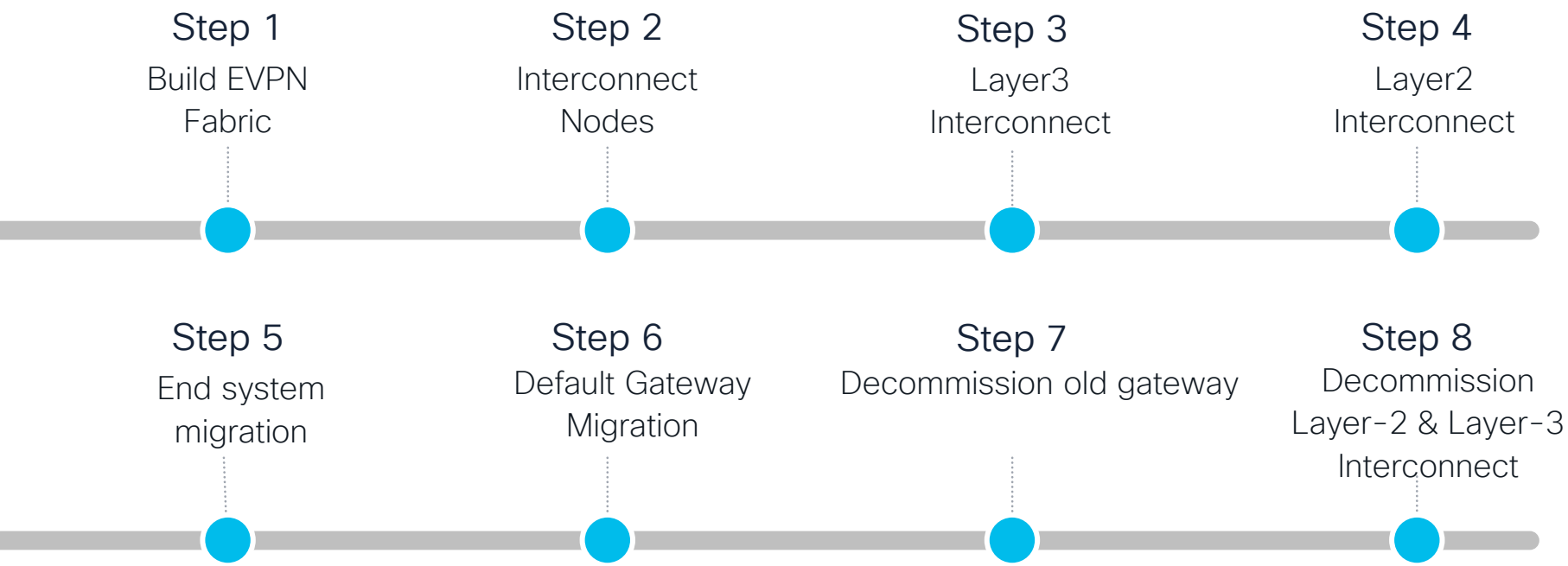
Layer 2 Interconnection



Layer 3 Interconnection : Direct



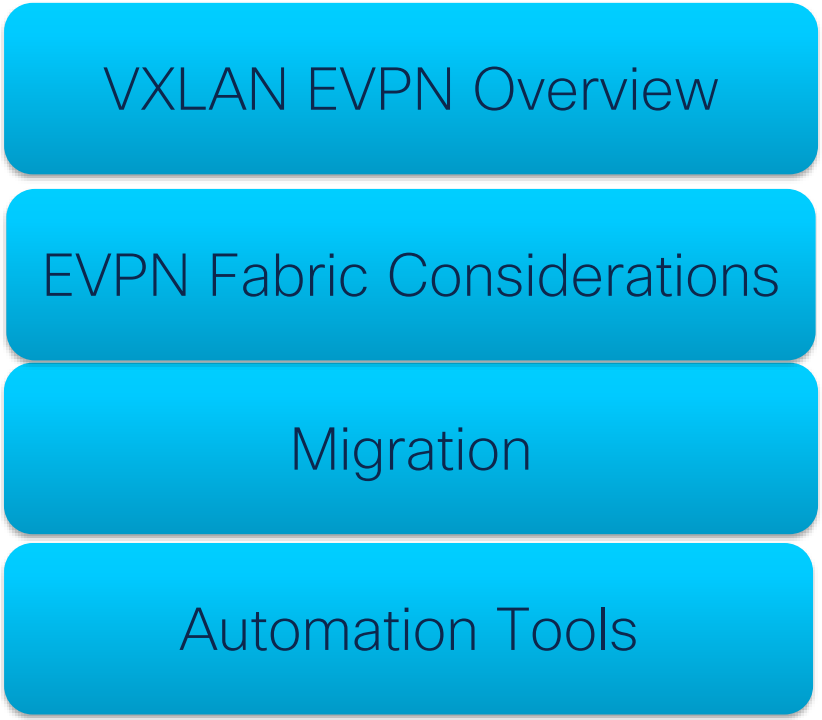
Migration workflow



Automation Tools

- DIY
- Ansible Playbook
- Intent Based Networking

Key Takeaways



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