

The background features a vibrant, multi-colored abstract design. On the left, there are horizontal, wavy bands of color in shades of red, orange, yellow, and green. On the right, a bright white light source emits a series of sharp, triangular rays in various shades of blue and cyan, creating a sunburst effect that spreads across the right half of the image.

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The bridge to possible

Fabric Based Networking

What's the fuss and what are the choices?

Ashley Burton
Technical Solutions Architect
CCIE 3225
BRKENS-2700

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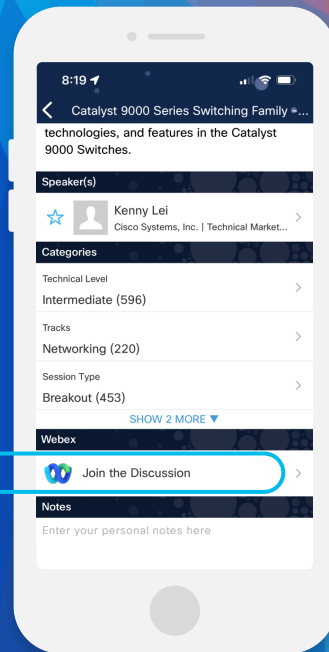
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How

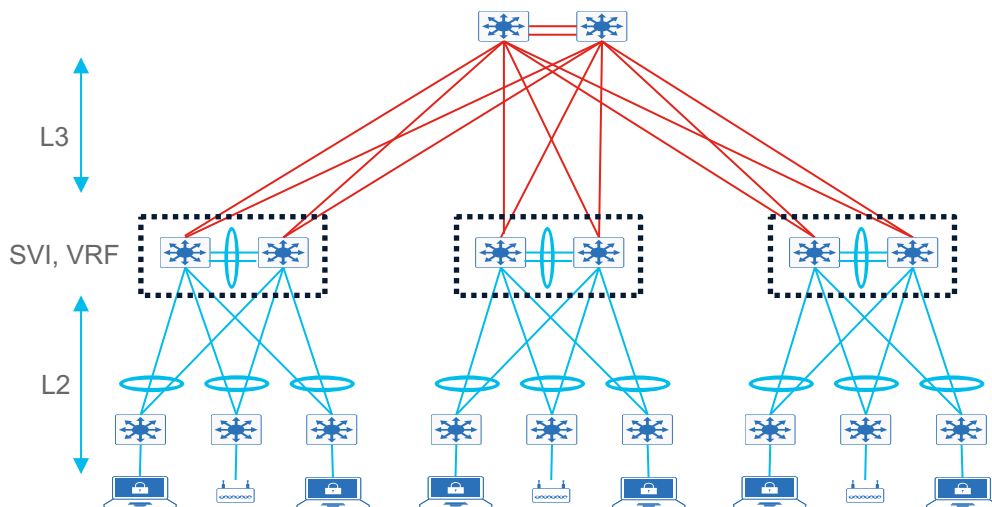
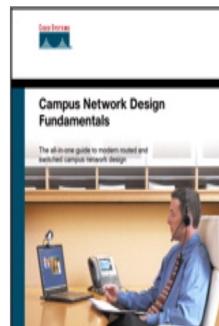
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Webex spaces will be moderated by the speaker until December 22, 2023.



<https://ciscolive.ciscoevents.com/ciscolivebot/#BRKENS-2700>

The traditional enterprise network



Campus Network Design Fundamentals

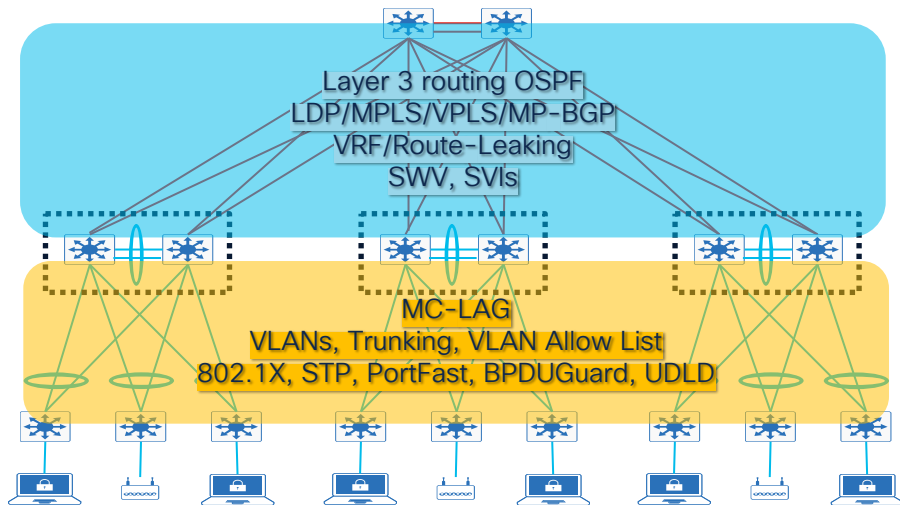
By [Diane Teare](#), [Catherine Paguet](#)

Published Dec 8, 2005 by [Cisco Press](#). Part of the [Fundamentals](#) series.

- Well known pattern, built for the last 20+ years
- Not much changed since
- Facilitates north-south connectivity
- Manual configuration and complexity

The traditional enterprise network

REALITY



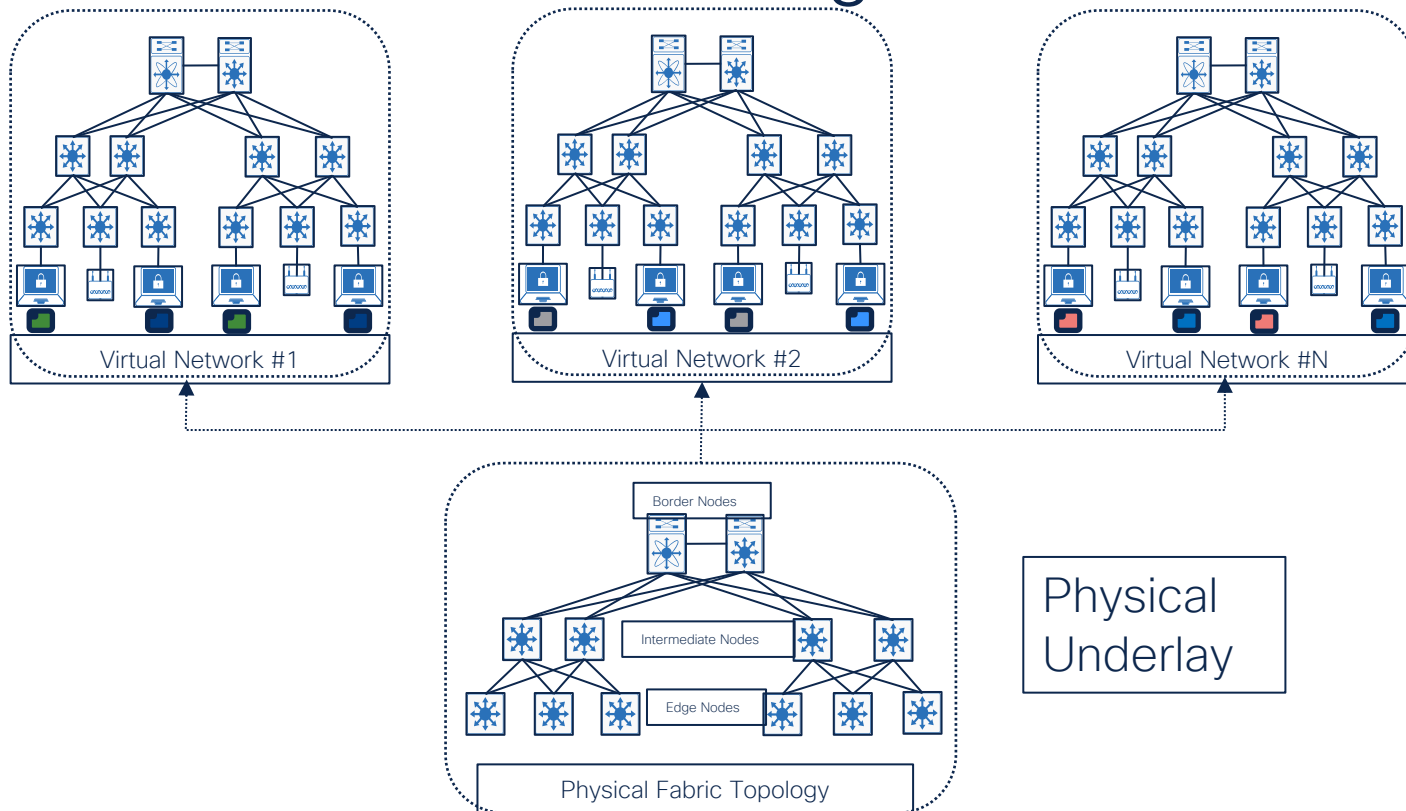
- Hard to automate – each device is unique
- Be-spoke “best guess config”
- Lots of protocols running on the same boxes
- Network security is an after thought
- Wireless is after thought

Agenda

- What is a network fabric?
- What are the drivers behind the adoption of fabric architectures?
- Fabric fundamentals
- What types of fabrics are available?
- BGP EVPN network fabrics
- LISP network fabrics
- Conclusion

What is a Network Fabric?

Fabric based networking



What are the
drivers behind the
adoption of fabric
architectures?

Why should I consider a fabric architecture?

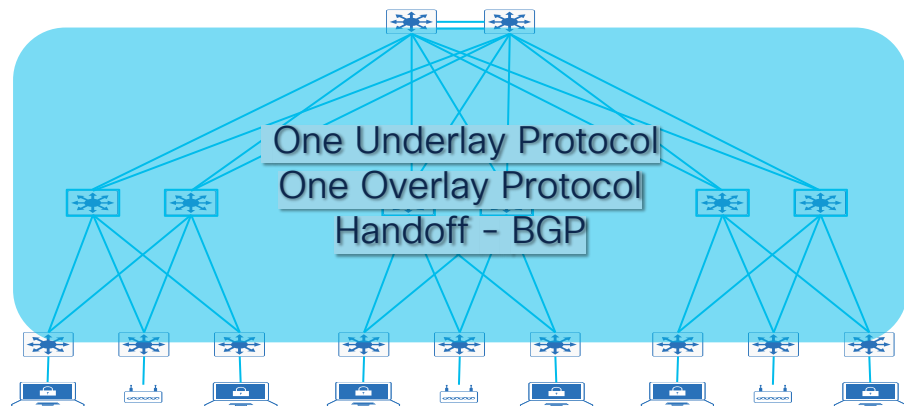


Business Outcomes

- Simplicity = Network Availability
- Segmentation
 - Security/Cyber
 - Isolate users, devices and IoT things
 - Contains blast radius of incident
 - IT/OT convergence
- Wireless Convergence
 - Improved wireless experience

Fabric solves network problems

- Fabric to the access removes Layer 2 protocols from the LAN
- Simple, scalable, reliable and automatable network
- Consistent access layer configurations
- Reliable Layer 2 extension over Layer 3 network
- Routing everywhere
- Convergence of wired and wireless



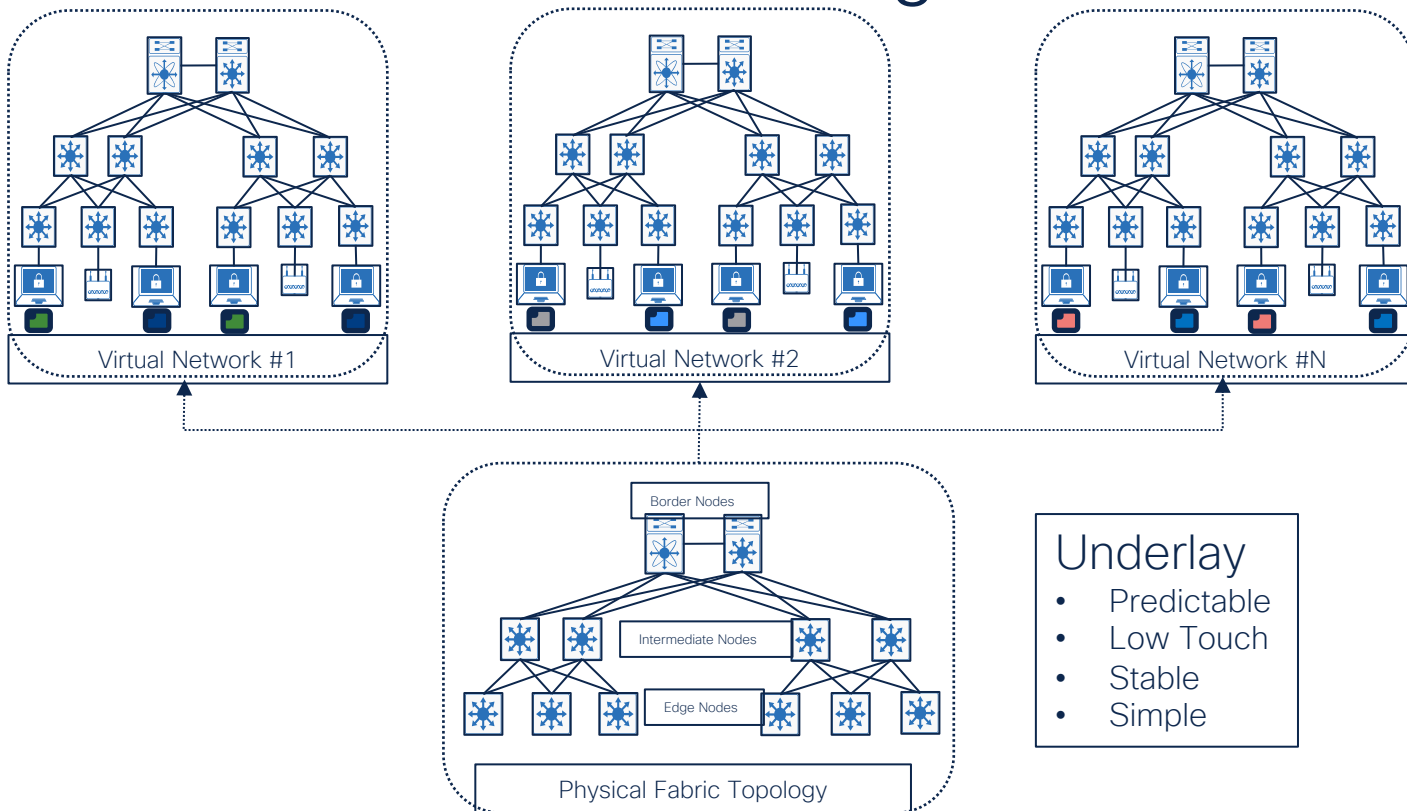
Fabric solves network CAMPUS problems

Three unique campus network requirements:

- Network topology is influenced by geography – cannot always build Leaf and Spine
- Wireless users are Roaming
- Massive amount of unmanaged, "headless" devices on the network – Segmentation

Fabric Fundamentals

Fabric based networking



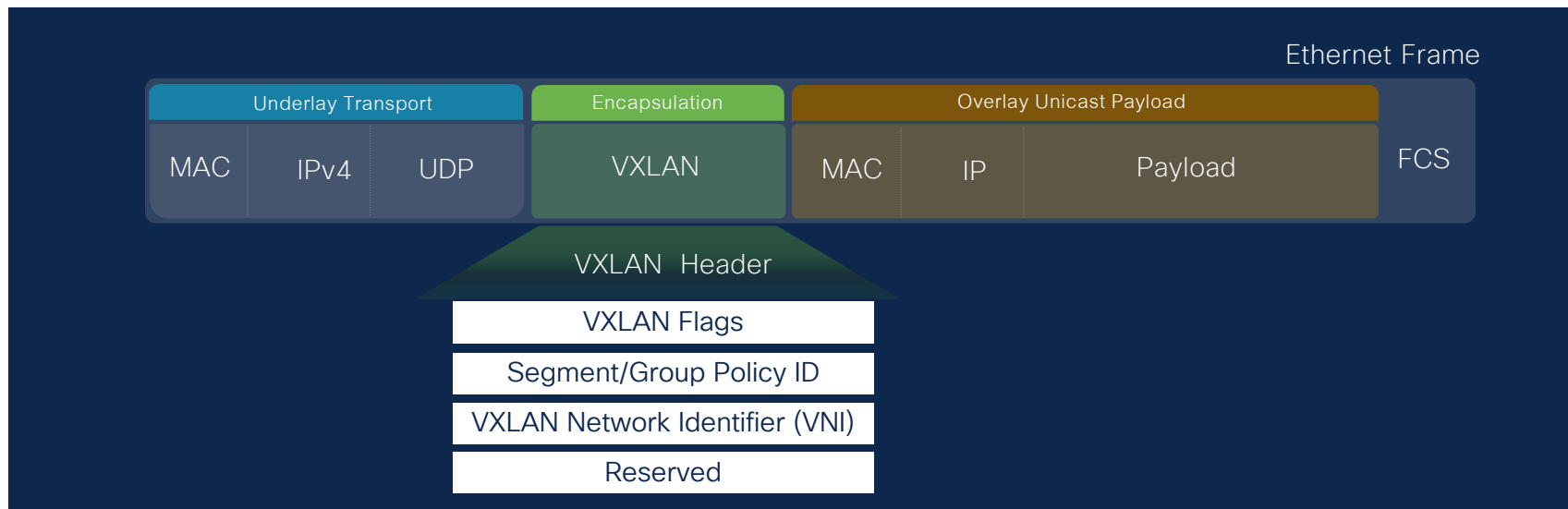
Overlay

- Device Connectivity
- Authentication
- Authorization
- Policy
- Segmentation

Underlay

- Predictable
- Low Touch
- Stable
- Simple

Policy in a fabric

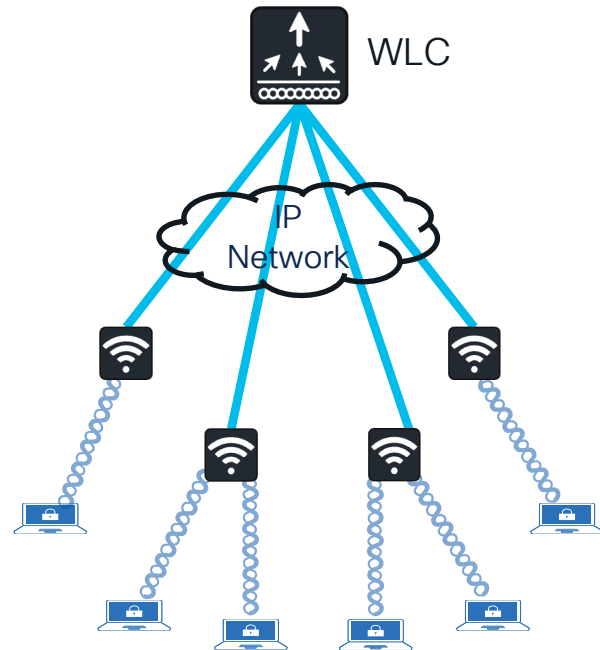


Macro Segmentation = VNID = VRF

Micro Segmentation within a VNID/VRF = SGT/GBP

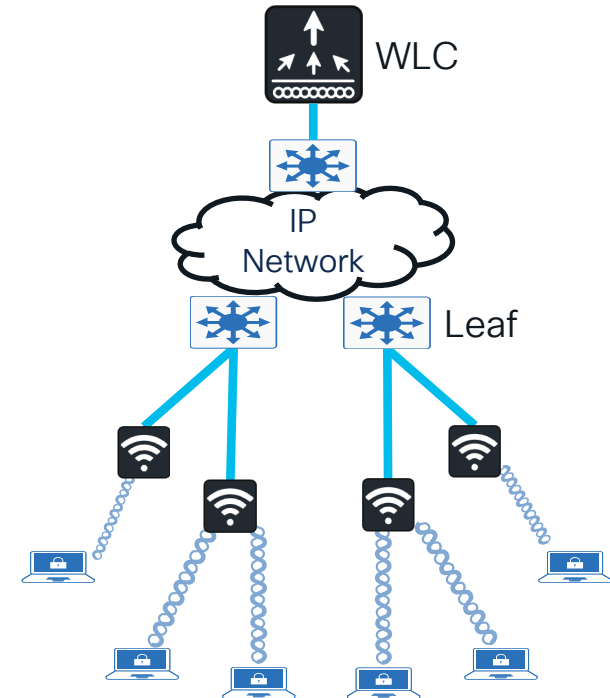
Wireless in a fabric architecture – centralised switching

- Pros:
 - Fast wireless roaming
 - Do not need to worry about subnet management
- Cons:
 - Suboptimal traffic flow
 - Performance bottleneck – especially with wireless-first approach
 - Different sets of policies for wired/wireless users
 - Need WLC hardware capable of pushing 10Gbps +
 - Need switch hardware with large TCAM tables adjacent to the WLC



Wireless in a fabric architecture – distributed switching

- Pros:
 - No performance bottleneck, optimal traffic flow
 - Consistent policy for wired/wireless users
- Cons:
 - Relies on wired control plane
 - Must understand how APs communicate with other and with the switching infrastructure.



What types of
fabrics are
available ?

Fabric technology options

BGP EVPN

One Fabric Architecture (Campus & DC)

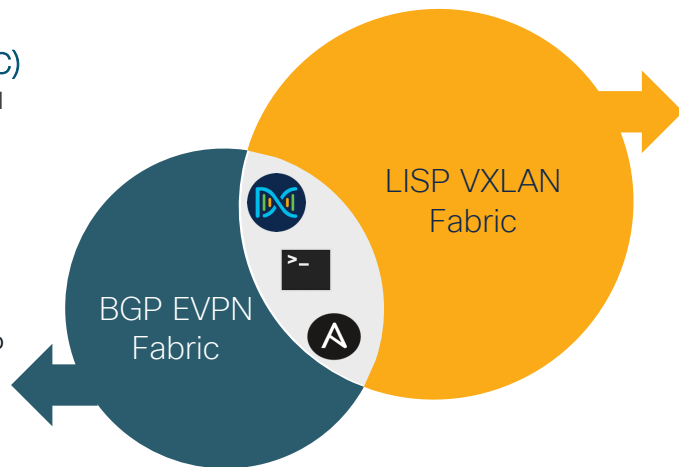
Operational ease with a single familiar protocol

Multi-vendor interoperability

Vendor-agnostic solution with unique Cisco differentiators

Segmentation

Zero-Trust Architecture with Micro and Macro Segmentation with customizable Overlay Network Types and Topologies.



LISP

Network Simplification

Lightweight, extensible, massive scale with rapid convergence. Single overlay for wired/wireless

Mobility First Requirement

Fabric Integrated Wireless, L2 Mobility, Enhanced wireless performance

Segmentation

Zero-Trust Architecture with Unified Wired + Wireless Policy

IETF – Open standards

EVPN

Datatracker	Groups	Documents	Meetings	Other	User
RFC 8489 (was draft-ietf-nvo3-evpn-applicability)					
Applicability of Ethernet Virtual Private Network (EVPN) to Network Virtualization over Layer 3 (NVO3) Networks					
RFC 9251 (was draft-ietf-bess-evpn-lgmp-mld-proxy)		30 pages	2022-06	Proposed Standard RFC	
Internet Group Management Protocol (IGMP) and Multicast Listener Discovery (MLD) Proxies for Ethernet VPN (EVPN)					
RFC 9161 (was draft-ietf-bess-evpn-proxy-arp-nd)		22 pages	2022-01	Proposed Standard RFC	
Operational Aspects of Proxy ARP/ND in Ethernet Virtual Private Networks					
RFC 9135 (was draft-ietf-bess-evpn-inter-subnet-forwarding)		30 pages	2021-10	Proposed Standard RFC	
Integrated Routing and Bridging in Ethernet VPN (EVPN)					
RFC 9136 (was draft-ietf-bess-evpn-prefix-advertisement)		31 pages	2021-10	Proposed Standard RFC	
IP Prefix Advertisement in Ethernet VPN (EVPN)					
RFC 9047 (was draft-ietf-bess-evpn-na-flags)		10 pages	2021-06	Proposed Standard RFC	
Propagation of ARP/ND Flags in an Ethernet Virtual Private Network (EVPN)					
RFC 9062 (was draft-ietf-bess-evpn-oam-req-frmwk)		16 pages	2021-06	Informational RFC	
Framework and Requirements for Ethernet VPN (EVPN) Operations, Administration, and Maintenance (OAM)					
RFC 9014 (was draft-ietf-bess-dci-evpn-overlap)		24 pages	2021-05	Proposed Standard RFC	
Interconnect Solution for Ethernet VPN (EVPN) Overlay Networks					
RFC 8560 (was draft-ietf-bess-evpn-vpls-seamless-integ)		16 pages	2019-05	Proposed Standard RFC	
Seamless Integration of Ethernet VPN (EVPN) with Virtual Private LAN Service (VPLS) and Their Provider Backbone Bridge (PBB) Equivalents					
RFC 8584 (was draft-ietf-bess-evpn-df-election-framework)		32 pages	2019-04	Proposed Standard RFC	
Framework for Ethernet VPN Designated Forwarder Election Extensibility					
RFC 8388 (was draft-ietf-bess-evpn-usage)		31 pages	2018-05	Informational RFC	
Usage and Applicability of BGP MPLS-Based Ethernet VPN					
RFC 8365 (was draft-ietf-bess-evpn-overlay)		33 pages	2018-03	Proposed Standard RFC	
A Network Virtualization Overlay Solution Using Ethernet VPN (EVPN)					
RFC 8317 (was draft-ietf-bess-evpn-etree)		23 pages	2018-01	Proposed Standard RFC	
Ethernet-Tree (E-Tree) Support in Ethernet VPN (EVPN) and Provider Backbone Bridging EVPN (PBB-EVPN)					
RFC 8234 (was draft-ietf-bess-evpn-geo)		17 pages	2017-08	Proposed Standard RFC	
Virtual Private Wire Service Support in Ethernet VPN					
RFC 7734 (was draft-ietf-bess-spbm-evpn)		11 pages	2016-01	Proposed Standard RFC	
Support for Shortest Path Bridging MAC Mode over Ethernet VPN (EVPN)					
RFC 7623 (was draft-ietf-l2vpn-pbb-evpn)		23 pages	2015-09	Proposed Standard RFC	
Provider Backbone Bridging Combined with Ethernet VPN (PBB-EVPN)					
RFC 7452 (was draft-ietf-l2vpn-evpn)		56 pages	2015-02	Proposed Standard RFC	
BGP MP L5-Based Ethernet VPN					
RFC 7209 (was draft-ietf-l2vpn-evpn-req)		15 pages	2014-05	Informational RFC	
Requirements for Ethernet VPN (EVPN)					

LISP

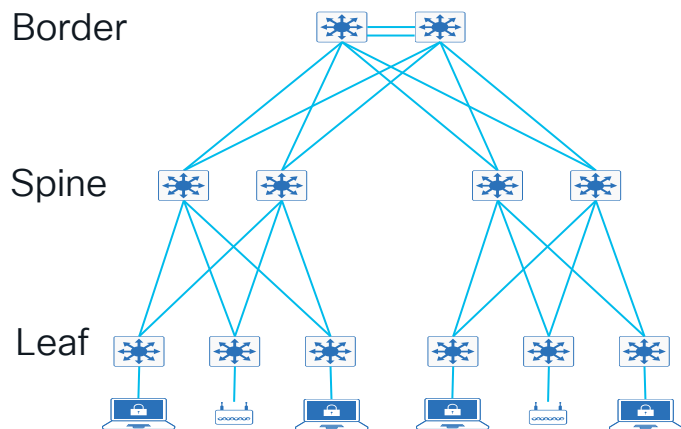
Datatracker	Groups	Documents	Meetings	Other	User
RFCS (30 hits)					
RFC 8432 (was draft-ietf-lisp-subnbl)		18 pages	2023-08	Proposed Standard RFC	
Publish/Subscribe Functionality for the Locator/ID Separation Protocol (LISP)					
RFC 8299 (was draft-ietf-lisp-introduction)		24 pages	2022-10	Informational RFC	
An Architectural Introduction to the Locator/ID Separation Protocol (LISP)					
RFC 8300 (was draft-ietf-lisp-rfc8300a)		33 pages	2022-10	Proposed Standard RFC	
The Locator/ID Separation Protocol (LISP)					
RFC 8301 (was draft-ietf-lisp-rfc8301a)		42 pages	2022-10	Proposed Standard RFC	
Locator/ID Separation Protocol (LISP) Control Plane					
RFC 8302 (was draft-ietf-lisp-6834bis)		15 pages	2022-10	Proposed Standard RFC	
Locator/ID Separation Protocol (LISP) Map-Versioning					
RFC 8303 (was draft-ietf-lisp-map)		22 pages	2022-10	Proposed Standard RFC	
Locator/ID Separation Protocol Security (LISP-SEC)					
RFC 8304 (was draft-ietf-lisp-rfc8304a)		5 pages	2022-10	Proposed Standard RFC	
Locator/ID Separation Protocol (LISP): Shared Extension Message and IANA Registry for Packet Type Allocations					
RFC 8305 (was draft-ietf-lisp-gpe)		14 pages	2022-10	Proposed Standard RFC	
Locator/ID Separation Protocol (LISP) Generic Protocol Extension					
RFC 8306 (was draft-ietf-lisp-vendor-leaf)		5 pages	2022-10	Experimental RFC	
Vendor-Specific LISP Canonical Address Format (LCAF)					
RFC 8378 (was draft-ietf-lisp-signal-free-multicast)		21 pages	2018-05	Experimental RFC	
Signal-Free Locator/ID Separation Protocol (LISP) Multicast					
RFC 8111 (was draft-ietf-lisp-ddt)		44 pages	2017-05	Experimental RFC	
Locator/ID Separation Protocol Delegated Database Tree (LISP-DDT)					
RFC 8112 (was draft-farmanco-lisp-rig)		11 pages	2017-05	Informational RFC	
Locator/ID Separation Protocol Delegated Database Tree (LISP-DDT) Referral Internet Groper (RIG)					
RFC 8113 (was draft-ietf-lisp-type-iana)		6 pages	2017-03	Experimental RFC	
Locator/ID Separation Protocol (LISP): Shared Extension Message & IANA Registry for Packet Type Allocations					
RFC 8060 (was draft-ietf-lisp-leaf)		34 pages	2017-02	Experimental RFC	
LISP Canonical Address Format (LCAF)					
RFC 8061 (was draft-ietf-lisp-crypto)		18 pages	2017-02	Experimental RFC	
Locator/ID Separation Protocol (LISP) Data-Plane Confidentiality					
RFC 8059 (was draft-ietf-pm-join-attributes-for-lisp)		9 pages	2017-01	Experimental RFC	
PM Join Attributes for Locator/ID Separation Protocol (LISP) Environments					
RFC 7964 (was draft-ietf-lisp-aid-block)		12 pages	2016-09	Experimental RFC	
Locator/ID Separation Protocol (LISP) Endpoint Identifier (EID) Block					
RFC 7955 (was draft-ietf-lisp-aid-block-mgmt)		10 pages	2016-09	Informational RFC	
Management Guidelines for the Locator/ID Separation Protocol (LISP) Endpoint Identifier (EID) Block					
RFC 7434 (was draft-ietf-lisp-mgmt)		18 pages	2016-04	Informational RFC	
Locator/ID Separation Protocol (LISP) Impact					

- Interoperability
- Vendor lock-in – consider the automation and management tool

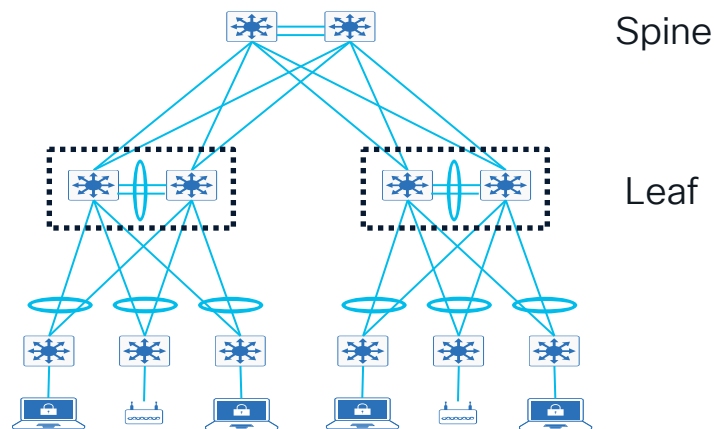
BGP EVPN network fabrics

BGP EVPN design considerations

Routed Access

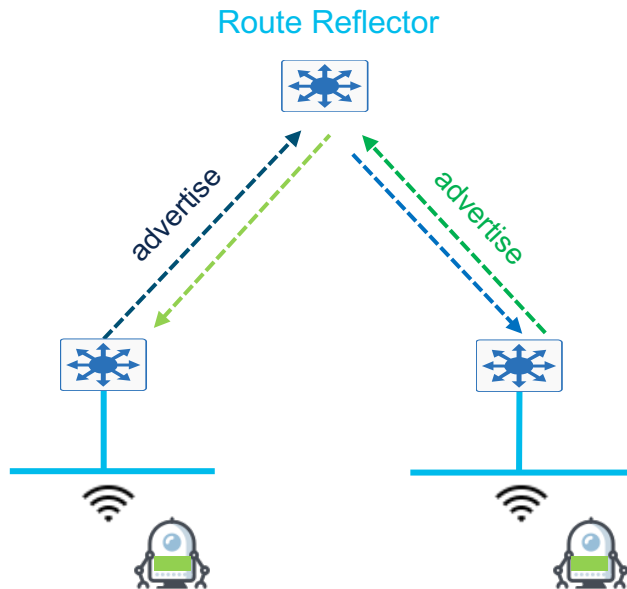


L2 Access with MLAG



BGP EVPN design considerations

Host registration



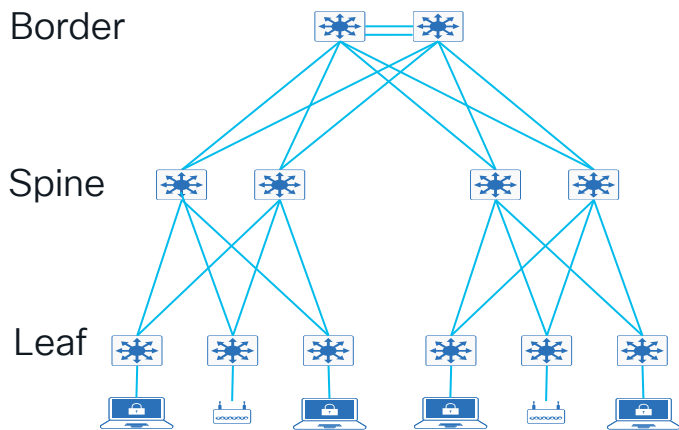
- Host Registration

- Leaf (BGP Speaker) advertises to route reflector – if /32 or new subnet
- Route reflector advertises to all edges
- This multiplies with additional route reflectors.
- i.e. in a design with 2 route reflectors each leaf switch will receive 2 updates when a host registers and 2 updates when a host leaves the fabric

BGP EVPN design considerations

IP Mobility

Routed Access

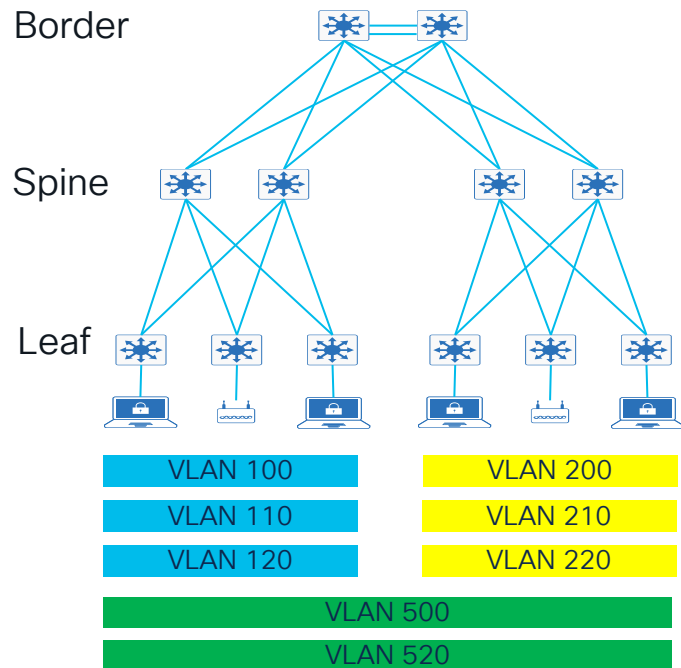


- Access Layer TCAM resources
 - Every access switch has a complete and consistent routing table
 - Fabric size is limited by TCAM resources in access switch (lowest common denominator)
 - Total number of host routes = maximum number of endpoints
- Note : Endpoint address
 - 1 x TCAM slot per IPv4 device (1 address per device)
 - ~4 x TCAM slots per IPv6 device (~4 addresses per device)

BGP EVPN design considerations

Zones

Routed Access



- Contain subnets to distribution blocks
 - Eliminates TCAM scale concern
- Restrict the number of stretched layer 2 VLANs

Mobility in the access

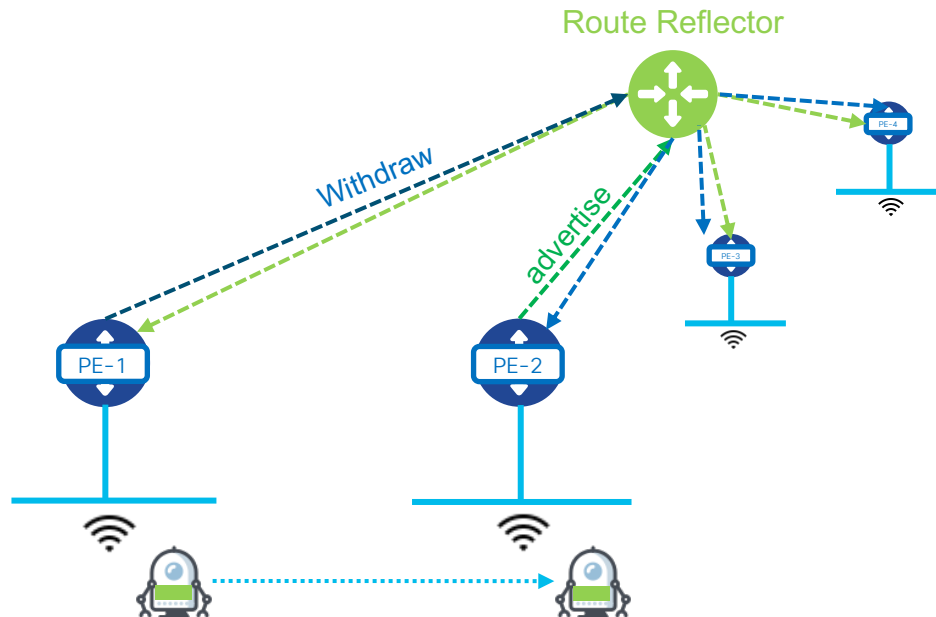
BGP Control Plane – Pervasive move signaling and processing

- Dense signaling:

- All PEs are notified of the move twice
- Local events triggers a global network-wide event

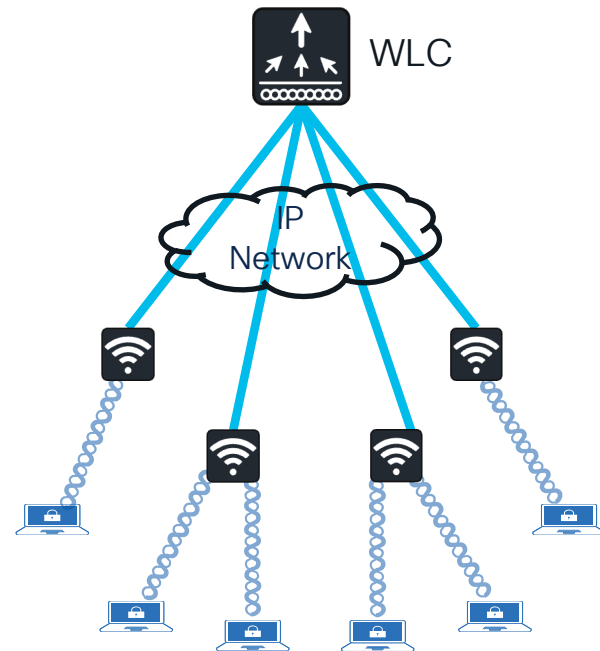
- Processing:

- Path computation at RR and PEs
- Replication of the routing updates to all nodes



BGP EVPN Wireless design considerations

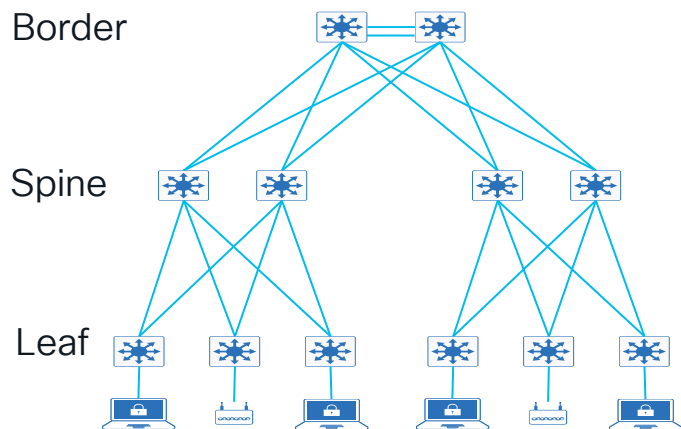
- Number of wireless clients
- The size/scope of the wireless roam – can the fabric be broken into multiple roam zones?
- The number of roams per second/minute within the zone
- Number of leaf switches in the zone/campus



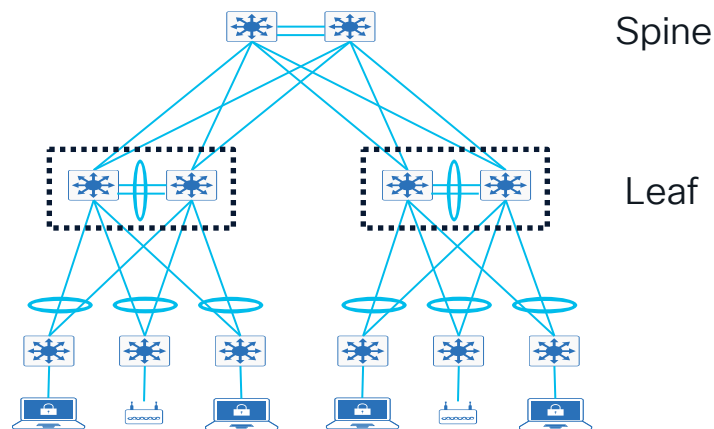
LISP Network Fabrics

LISP design considerations

Routed Access



L2 Access with MLAG



LISP operations

LISP :: Mapping Resolution “Level of Indirection”

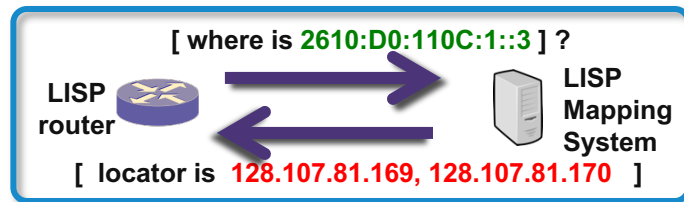
LISP “Level of Indirection” is analogous to a DNS lookup

- DNS resolves IP addresses for URL Answering the “WHO IS” question



DNS
Name-to-IP
URL Resolution

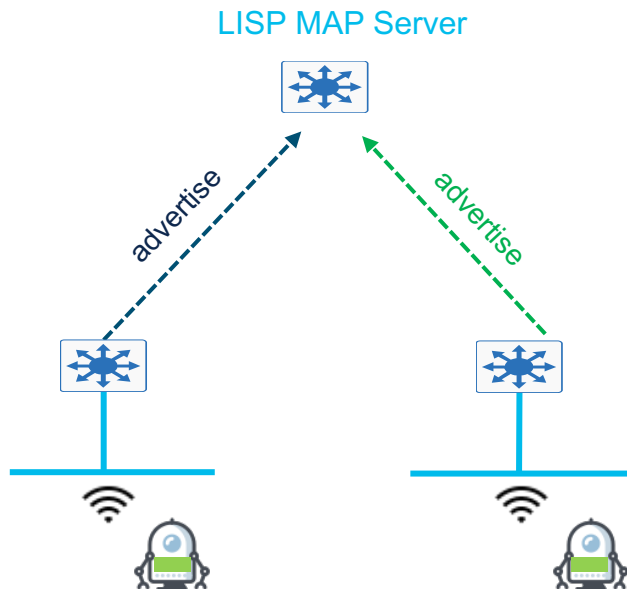
- LISP resolves locators for queried identities Answering the “WHERE IS” question



LISP
Identity-to-locator
Mapping Resolution

LISP design considerations

Host registration

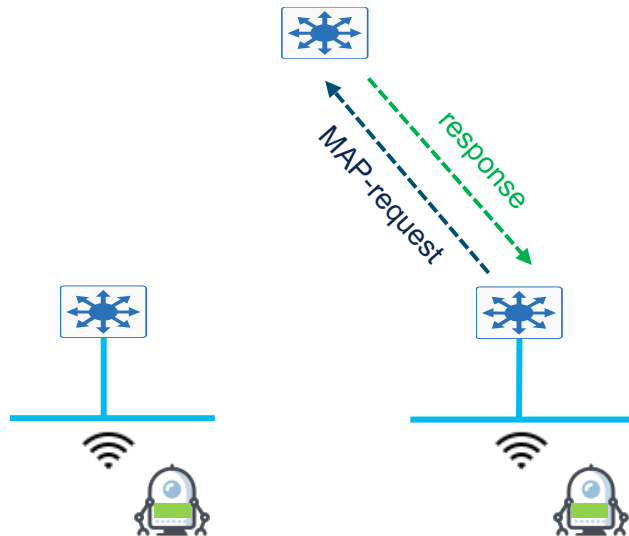


- Host Registration
 - Leaf registers to MAP Server
 - Endpoint ID – EID
 - Routing Locator – RLOC

LISP design considerations

Host resolution

LISP MAP Server

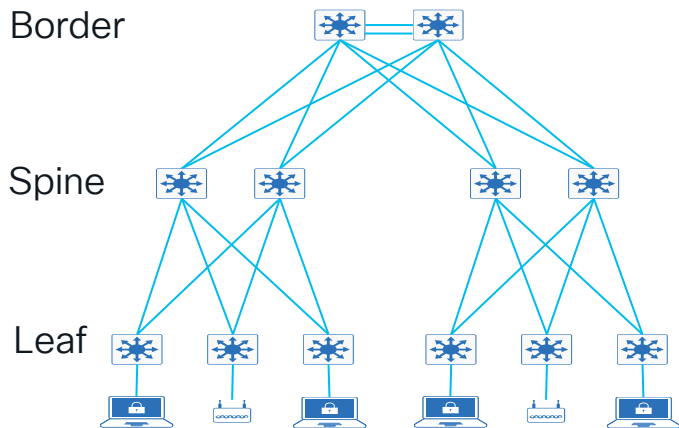


- Host resolution

- Leaf issues a MAP request to the MAP Server
- MAP Server responds to leaf
- Response is cached on leaf

LISP design considerations

TCAM resources

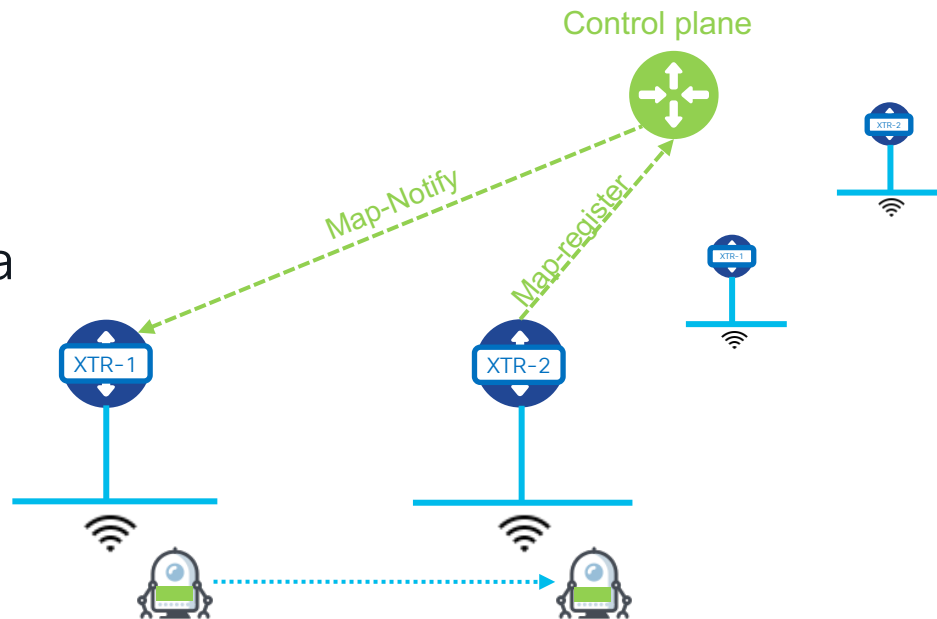


- Leaf switch TCAM
 - Efficient and scalable
 - Doesn't limit the scale of the fabric
- Border Nodes
 - Need to know all routes of all hosts and therefore TCAM resources and number of routes limits the size of the entire fabric.
- Note : Endpoint address
 - 1 x TCAM slot per IPv4 device (1 address per device)
 - ~4 x TCAM slots per IPv6 device (~4 addresses per device)

Mobility in the access

LISP Control Plane - Scoped move signaling

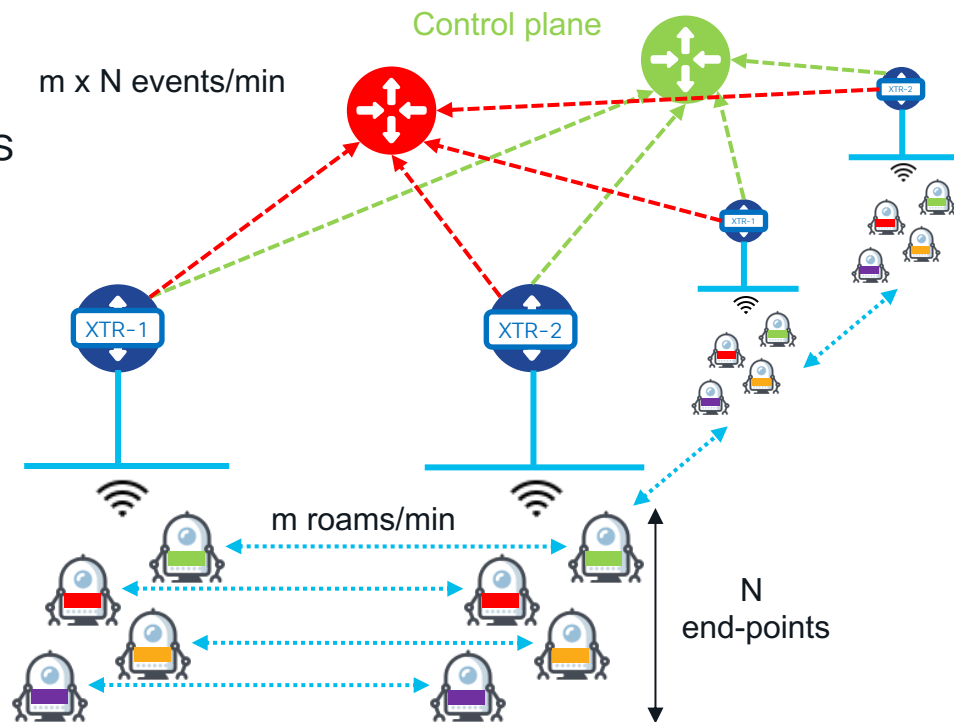
- Sparse signaling: Only the xTRs involved in the move
- Light processing: Only mapping updates, no path calculation
- The rate of events at the xTRs is a fraction of the total rate of events
- $\text{Rate@xTR} = (m \times N) / \text{number of xTRs}$



Mobility in the access

LISP Control Plane – Horizontal Scale of the Control Plane

- Prefixes can be scoped to different control plane nodes
- Horizontally scale by adding nodes
- Scoped signaling enabled fast convergence
- Increased network performance



Conclusion

Flexible deployment options

Fabric with LISP or with BGP EVPN

Catalyst
Center



Do It Yourself with
CLI



DIY using
Ansible/Terraform



Catalyst Center Architecture Flexibility

SD-Access with LISP or SD-Access with BGP EVPN

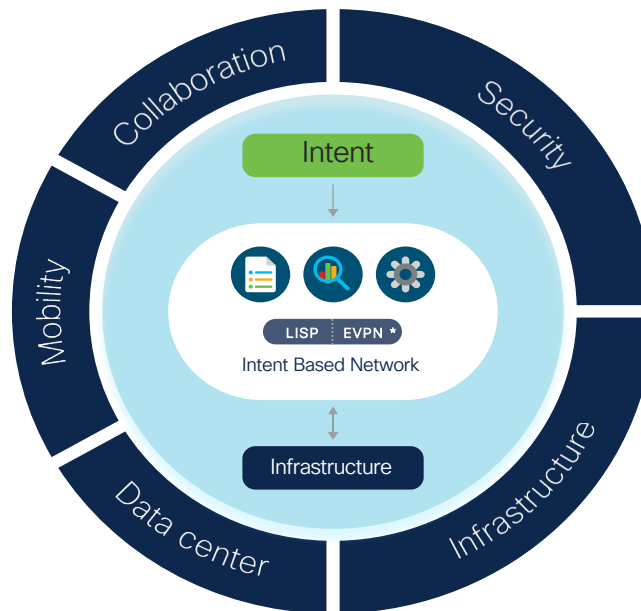
LISP VxLAN

Simple: Standards-based, Campus optimized Control Plane

Efficient: Lightweight, unparalleled scale & high performance due to rapid convergence time

Extensible: Highly extensible to drive innovation (Pub Sub, Multi-site, Extranet)

Robust: Integrated wireless w/ L2 mobility support campus wide



BGP EVPN VxLAN

Unified Fabric: Extend Fabric across Campus and Data Center

Use-case Driven: Customizable Overlay Network Types and Topologies. Use case driven topologies

Industry Standard: Multi-vendor deployment

Proven & Scalable: Leveraging BGP Control-Plane

One Infrastructure | Single Data plane | Consistent Zero-Trust Experience

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The bridge to possible

Thank you

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