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123 - Enterprise Campus Wired Design Fundamentals Back to Basics

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BRKENS-1501





Who am I?

I'm a Principal Engineer of Technical Marketing (Principal TME) for Cisco Enterprise 'Network Experience' (NX) Product Management team. I've been with Cisco since 1999.

I mainly focus on Enterprise Switching & Routing technology areas, with a special emphasis on 'next generation' Hardware & Software products and solutions.

As a Principal TME, I'm currently working on the next generation of Catalyst Switching, Wireless & Routing products, and solutions like Software-Defined Access (SDA) & Cisco DNA.

Shawn Wargo Principal TME

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Session Abstract

The goal is to return to the *basic principles* (vs. deep-dive) of **Enterprise Campus "Wired" Design** (what & why?)

This session is *focused primarily* on Cisco Catalyst products:

- The basic characteristics of 1/2/3 & 4-tier Campus network layers (Access, Distro, Core & Edge)
- When to collapse network layers, or to add another layer (based on scale & throughput requirements)
- The basic forwarding & convergence characteristics of L2 & L3 (and Equal Cost Multi-Path [ECMP])
 - vs. Cluster-based design with StackWise (Stacking) and StackWise Virtual (SVL)
 - vs. Fabric-based design with Ethernet VPN (EVPN) or Software Defined-Access (SDA)
- Briefly review some Campus Wireless & Security characteristics (influences Campus Wired design)

What this session is NOT

This session is NOT intended as a Deep-Dive or CVD!

The goal is to understand basic reasons & rationale for each Campus design ©

Please also attend or review <u>BRKCRS-1500</u>

- Introduction to Campus Wired LAN Deployment Using Cisco Validated Designs BRKCRS-1500
 - www.ciscolive.com/c/dam/r/ciscolive/us/docs/2020/pdf/DGTL-BRKCRS-1500.pdf

Other Related Sessions:

- SD-Access Campus Wired and Wireless Network Deployment Using Cisco Validated Designs DGTL-BRKCRS-1501
- Enterprise Campus Design: Multilayer Architectures and Design Principles BRKCRS-2031
- Building for the Campus of the Future BRKENS-2599

www.cisco.com/c/en/us/td/docs/solutions/CVD/Campus/cisco-campus-lan-wlan-design-guide.html

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What is a Campus Network? 1-2-3 or 4⁺ Tier Design ECMP ^{vs.} StackWise MPLS ^{vs.} EVPN ^{vs.} SD-Access

5 Wireless & Security Notes

6 Summary & References



Agenda

Campus Baseline

Campus Networks

What is "Campus"?
Place in Network (PIN)
Multi-Layer Model
Chassis Types
Campus Cabling
PIN Features



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What is a "Campus"?

TIP

The basic Merriam-Webster definition of a Campus is:

A group of one or more buildings, and surrounding grounds, where people and their belongings work together.

Common examples are Hospitals & Research Centers, Schools & Universities and Corporations & Offices.

Using this - it's clear a Campus Network is focused on:

- People (Users, Vendors, etc.)
- People's devices (PCs, Phones, Printers, etc.)
- Similar geographic area (LAN, WLAN or MAN, etc.)
- Access to other domains (WAN, ISP, DC & Cloud, etc.)

This includes many different network technology areas (Wired, Wireless, Security, QoS, Management, etc.) with a common focus on providing users & devices "access".





Campus is focused on User Access

Campus = Geography Buildings are spread out. Multiple floors per building





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www.cisco.com/c/en/us/solutions/cisco-on-cisco/enterprise-networks.html

Campus Networks

Building MDF/IDF & Wiring Closets



MDF = Main Distribution Framework (Core) IDF = Intermediate Distribution Framework (Distro/Access)



www.cisco.com/c/en/us/solutions/design-zone/networking-design-guides/campus-wired-wireless.html



Campus ≠ Data-Center One or few large buildings nearby. Usually a single floor. Security accumant are protected UPS Internutually-redunders 1.08 magevise UPS a provide the Data Contex with energy in tes of failure of contex www.cisco.com/c/en/us/solutions/cisco-on-cisco/enterprise-networks.html

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Campus Networks - Real Life





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Campus PINs & Topology



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Campus Multi-Layer Model



Always 3 "Logical" Layers

- Each layer serves a specific set of functions
- Each layer has a specific set of requirements

If you collapse layers your multi-layer device needs to support all "logical" functions

Modular vs. Fixed Platforms







CONs

 More Complex • BW limit by Chassis

Lower MTBF

Higher COGs

Slow(er) Dev & Test





- Higher MTBF
- Lower COGs

- Lower Port Density
- Less Power/Cooling
- Single Processor

Modular

PROs

- More Flexible

- More Power/Cooling
- Redundant Processors
- Longer Life-Cycle
- Higher Port Density

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Copper vs. Fiber Media

Shielded (STP)

Cat5 🧹 Cat6 🖌 Cat7 🧹

Category 5, 6 & 7

RJ45 (Access to Endpoints)

Distance

100m

1G - 100m

10G - 50m

100m

100m

Data Rate

1000 Mbps

1 Gbps

10 Gbps

10 Gbps

10 Gbps

NBASE-T

Shielding

UTP or STP

UTP or STP

UTP or STP

Shielded only

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Cat5E

Frequency

100-350 MHz

250-550 MHz

500-550 MHz

600 MHz

Unshielded (UTP)

A 0 0 4

Cat6A

(Offset Wires)

Category

5E

6

6A

7



www.cisco.com/c/en/us/products/interfaces-modules/transceiver-modules/



www.cisco.com/c/en/us/products/collateral/switches/catalyst-9000/nb-06-cat9000-panduit-cables-wp-cte-en.html

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Campus Networks L2/L3 Unicast Technologies



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Campus Networks L2/L3 Multicast Technologies



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Cisco Catalyst 9000 Switching Portfolio



One Family from Access to Core - Common Hardware & Software



Campus Baseline

Core & Edge

Campus Core (Baseline)
Campus Core Interconnect
Campus Core + WAN Edge

Campus PIN & Topology





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Campus Core (Baseline)

The **Core PIN** (Tier 3) focuses on connecting multiple Distribution layers to an Interconnect (if applicable) and/or other network domains

- Other names: <u>MDF</u>, <u>BDF</u>
- Common in Medium & Large Campus

Main goal is a simple, high-bandwidth, L3 transport between other network layers

Tends to be L3 routed (north & south)

- North: BGP or IGP (ABR), PIM + MSDP
- South: OSPF, IS-IS or EIGRP, PIM

Tends to use minimal L3 Features

- Limited ACLs (e.g. inter-area route-maps, remote access)
- Limited QoS (e.g. many-to-one WRED, aggregate policers)
- Limited NetFlow (e.g. inter-area, aggregate flows)

Tends to require high L3 forwarding scale



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Campus Core Interconnect

The Interconnect PIN (Tier 4) is an extension of the Core, used to connect multiple Core layers (areas) and/or other network domains.

- Other names: <u>Backbone</u>, <u>Super Core</u>, <u>MAN</u>, <u>DCI</u>
- Common in Large & Very-Large Campus
- Main goal is to distribute the bandwidth and density requirements of multiple Core layers
 - Similar attributes & requirements as Core PIN
- Tends to be L3 routed (north & south)
 - North: BGP or IGP (ABR/ASBR), PIM + MSDP
 - South: OSPF, IS-IS or EIGRP, PIM
- Tends to use minimal L3 Features
 - , Limited ACLs (e.g. inter-area route-maps, remote access)
 - Limited QoS (e.g. many-to-one WRED, aggregate policers)
 - Limited NetFlow (e.g. inter-area, aggregate flows)
- Tends to require higher L3 scale





Campus Core + (SP/WAN) Edge

The **Core-Edge PIN** (Tier 4) focuses on connecting multiple Campus areas to SP/WAN (remote domains) and/or to the Internet.

- Other names: Edge Device, Internet Edge
- Common in Medium to Very-Large Campus

Main purpose is to collapse Core & Edge layers

Tends to be L3 routed (north & south)

- North: MP-BGP + Inter-AS, NAT/PAT, PIM + MSDP
- South: BGP or IGP (ABR/ASBR), PIM + MSDP

Tends to use Virtualization & Tunnels

- VRF-Lite, MPLS/VPLS, SR, MVPN
- GRE/MGRE, IPSec, DMVPN
- QinQ, L2oMGRE, OTV, EVPN

Tends to use multiple L3/VRF Features

- Edge Security ACLs (e.g. RACL, CBAC, ZBFW)
- Hierarchical QoS (e.g. Class-based Queuing, Shaping)
- Policy Based Routing (e.g. WAAS & WCCP)
- WAN NetFlow (e.g. L3/VRF FNF, WAN ETA)

Tends to require highest L3/VRF + Feature scale





Campus Baseline Distribution

- Campus Distribution (Baseline)
- **Collapsed Core**
- Campus Distro + Ext. Access

Campus PIN & Topology





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Campus Distribution (Baseline)

The **Distribution PIN (Tier 2)** focuses on connecting multiple Access layers and the Core layer.

- Other names: <u>Collapsed Core</u>, <u>Aggregation</u>, <u>IDF</u>
- Common in Small to Large Campus

Main purpose is to "distribute" connectivity (fan-out) from the Core/WAN to the Access

- Reduces need for high port-density in Core layer
- Also applicable to <u>L3 Routed Access</u>

Tends to be both L3 routed (north) and L2 switched (south)

- North: SVI, HSRP/VRRP, ARP/ND, IGP, PIM
- South: VLAN, 802.1Q, STP, MAC, IGMP

Tends to use multiple L2 & L3 Features

- Access Security (e.g. IPDT/SISF, VACLs, PACLs, etc)
- Access QoS (e.g. NBAR, Classification & Marking)
- Access NetFlow (e.g. AVC, FNF, EPA & ETA)

Tends to require med-high L2/L3 + Feature scale





Campus Collapsed Core

The **Collapsed Core** (Tier 2) focuses on connecting multiple Access layers and the WAN/Edge layer.

- Other names : Distribution, BDF
- Common in Small Campus or Medium Branch

Main purpose is to collapse Core & Distribution layers

- Mostly for small(er) sites, with low(er) port density
- Similar attributes & requirements as Core + Distribution
- Also applicable to <u>L3 Routed Access</u>

Tends to be both L3 routed (north) and L2 switched (south)

- North: SVI, HSRP/VRRP, ARP/ND, IGP, PIM
- South: VLAN, 802.1Q, STP, MAC, IGMP

Tends to use multiple L2 & L3 Features

- Access Security (e.g. IPDT/SISF, VACLs, PACLs, etc)
- Access QoS (e.g. NBAR, Classification & Marking)
- Access NetFlow (e.g. AVC, FNF, EPA & ETA)

Tends to require high L2/L3 + Feature scale





Campus Distro + Ext. Access

The **Distribution + Ext. Access PIN** (Tier 2+) focuses on connecting multiple Access layers, including an Extended Access (IOT/FTTX) layer, to the Core layer.

- Other names: <u>Distribution</u>, <u>BDF</u>
- Common in Very-Large Campus or Large Branch

Main purpose is to "distribute" connectivity (fan-out) from the Core/WAN to the Access + Ext. Access

• Reduces need for high port-density in Core layer

Tends to be both L3 routed (north) and L2 switched (south)

- North: VRF, SVI, HSRP/VRRP, ARP/ND, IGP, PIM
- South: VLAN, 802.1Q, STP, MAC, IGMP

Tends to use multiple L2 & L3 Features

- Access Security (e.g. IPDT/SISF, VACLs, PACLs, etc)
- Access QoS (e.g. NBAR, Classification & Marking)
- Access NetFlow (e.g. AVC, FNF, EPA & ETA)

Tends to require highest L2/L3 + Feature scale



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Campus Baseline



- Campus Access (Baseline)
- Routed Access
- Extended Access (for IOT & FTTX)

Campus PIN & Topology





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Campus Access (Baseline)

The Access PIN (Tier 1) focuses on connecting Users & Devices, and an Extended Access (if applicable) to the Distribution layer

- Other names: <u>IDF</u>, <u>Wiring Closet</u>
- Common in all Campus & Branch networks

Main purpose is to connect users to network

Tends to be L2 switched (north & south)

- North: VLAN, 802.1Q, STP, MAC, IGMP Snooping
- South: AAA, STP, Portfast, Storm-Control

Tends to use multiple L2 Features & Services

- Access Security (e.g. 802.1x, VACLs, PACLs, etc)
- Access QoS (e.g. L2 CoS, Classification & Marking)
- Access NetFlow (e.g. AVC, FNF, EPA & ETA)

Tends to require low-med L2 + Feature scale



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Extended Access (IOT / FTTX)

The **Extended Access PIN** (Tier 1) is an extension of the Access, to connect multiple Access layers (areas) to the Distribution layer

- Other names: High-End Access, IOT, FTTX
- Common in Very-Large Campus or Large Branch

Main goal is to extend the size and scale of the Access layer and connect more hosts

Tends to be L2 switched (north & south)

- North: VLAN, 802.1Q, STP/REP, MAC, IGMP Snooping
- South: AAA, STP/REP, Portfast, Storm-Control

Tends to use multiple L2 Features & Services

- Access Security (e.g. 802.1x, VACLs, PACLs, etc)
- ACCESS QOS (e.g. L2 CoS, Classification & Marking)
- Access NetFlow (e.g. AVC, FNF, EPA & ETA)

Tends to require med-high L2 + Feature scale



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Campus Baseline

Campus Architecture

Equal Cost Multi-Path
 Virtual Switches (StackWise)



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Campus Architectures

Control-Plane & Data-Plane Redundancy

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ECMP (L2/L3 Paths)

Complex Topology

*

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• More Nodes, Less Cables

*

⋇

- More Neighbors (+ Tuning)
- Protocol Load-Balancing (ECMP)
- Node-level Redundancy

L1 : Single Connections L2: STP, MST, REP + ECMP (Port Cost) L3: FHRP, IGP, BGP + ECMP(Port Cost) More Neighbors = Requires Protocol Tuning

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EtherChannel (L2/L3 LAG)



- Complex Topology
- Same Nodes, More Cables ⁽²⁻⁸⁾
- Same Neighbors (+ Tuning)
- EtherChannel Load-Balancing
- Node & Link-level Redundancy

L1 : Multiple Connections L2: STP, MST, REP + ECMP (Portchannel Cost) L3: FHRP, IGP, BGP + ECMP (Portchannel Cost) More Neighbors = Requires Protocol Tuning

StackWise (L2/L3 MEC)



- Simple Topology
- Same Cables, Less Nodes
- Less Neighbors (No Tuning)
- Multi-chassis EtherChannel (MEC)
- Layer-level Redundancy

L1 : Multiple Connections L2: L2 MEC (No STP or REP) L3: IGP, BGP + L3 MEC (No FHRP) Fewer Neighbors = No Protocol Tuning

3

Campus + EtherChannel

Using **EtherChannel** focuses on combining multiple physical links into a single logical link

- Other names: Portchannel, Link-Aggregation (LAG)
- Common in Medium & Large Campus

Main goal is to increase bandwidth, and provide link-level redundancy between network layers

- Mostly for large(r) sites, with high(er) port density
- Similar attributes & requirements as existing PIN(s)

Can be used for both L2 & L3 links (north & south)

- North: BGP or IGP, PIM
- South: STP or REP, IGMP/MLD

Tends to require special L2/L3 Features

- Portchannel ACLs (e.g. L2/L3 RACL)
- Portchannel QoS (e.g. L2/L3 aggregate policers)
- Portchannel NetFlow (e.g. L2/L3 FNF)

Tends to require high L2/L3 forwarding scale



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StackWise Virtual Core/Distro

The **StackWise Virtual (SVL)** Core PIN focuses on combining Core and/or Distribution into a single virtual switch to connect to outside areas.

- Typically, the same layer as Distribution or Core (Tier 2-3)
- The same 'physical' topology as a multi-layer network

Main goal is to simplify Distribution or Core layer

Same L2 & L3 protocols as Distribution or Core

- North: SVI, ARP/ND, IGP/BGP, PIM
- South: VLAN, 802.1Q, MAC, IGMP (No STP)

Leverages Stateful Switchover (SSO)

- Active/Standby Control-Plane (synchronized)
- Works with NSF/NSR for L3 protocols

Leverages Multi-chassis EtherChannel (MEC)

- Active/Active Data-Plane (both switches forwarding)
- L2 & L3 Portchannel (neighbor sees single neighbor)

Same L2 & L3 features as Distribution or Core

Tends to require med-high L2, L3 & Feature scale

DC ISP WAN ----Core OSPF, IS-IS or L3 MEC Distribution ----L2 L2 MEC Access

StackWise Access

The **StackWise** Access PIN focuses on combining multiple Access switches into a single virtual switch to increase access-layer port density.

- Typically, the same layer as Access (Tier 1)
- The same 'physical' topology as a multi-layer network

Main goal is to expand port density of Access layer

Same L2 protocols as Access

- North: VLAN, 802.1Q, STP, MAC, IGMP Snooping
- South: AAA, STP, Portfast, Storm-Control

Leverages Stateful Switchover (SSO)

- Active/Standby Control-Plane (synchronized)
- Works with NSF/NSR for L3 protocols

Leverages Multi-chassis EtherChannel (MEC)

- Active/Active Data-Plane (both switches forwarding)
- L2 Portchannel (neighbor sees single neighbor)

Same L2 L3 features as Access

Tends to require med-high L2 + Feature scale







Campus Solutions

MPLS/VPLS (L2/L3VPN)
BGP-EVPN (L2/L3VNI)
SD-Access (L2/L3VNI + SGT)







Campus Solutions & Designs

Providing additional services (beyond basic PINs)



MPLS (L2/L3VPN)



- L3 Underlay + L2/L3 VPN Overlay
- Virtual Private Networks
- L3 VRF-based Segmentation
- WAN/Edge + VPN Services

MPLS/VPLS, LDP, SR, MP-BGP, PIC MVPN, LSM, Extranet, MSR SSO, NSF/NSR, ECMP, GIR VPN-FNF, Uniform/Pipe QoS, PBR, IPACL

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- L3 Underlay + L2/L3 VNI Overlay
- Virtual Network Instances
- L2/L3 VNI-based Segments
- Common WAN/LAN Services

MP-BGP/EVPN, VXLAN, VRF-Lite L2 TRM, L3 TRM, L2 BUM SSO, NSF/NSR, ECMP, GIR Fabric-FNF, Uniform QoS, IPACL/OGACL

3 SDA (L2/L3VNI + SGT)

- L3 Underlay + L2/L3 VNI Overlay
- VNIs + Scalable Group Tagging
- L2/L3 VNI + SGT Segments
- LAN Services + Group-Based Policy

LISP, VXLAN, MP-BGP, VRF-Lite LISP HER, Native, L2 BUM SSO, NSF/NSR, ECMP, GIR Fabric-FNF, App QoS, SGACL

EVPN Border & Spine

The **EVPN Border & Spine PIN** focuses on connecting an **EVPN Fabric** and/or **other network domains**.

• Typically, the same layer as Core or Edge (Tier 3-4)

Main goal is to connect EVPN to other networks

Uses a L3 Underlay + L3 Hand-off

- North (outside): L3 MP-BGP + Inter-AS, PIM + MSDP
- South (inside): L3 IGP, PIM + MSDP

Uses a Virtualized L2/L3 Overlay

- Control-Plane: BGP-EVPN (RR), TRM
- Data-Plane: VXLAN
- Policy-Plane: L2/L3 VNID

Tends to use Overlay-aware Features

- IP/OG ACLs (e.g. destined Outside)
- Uniform QoS (e.g. copy Inner, queue Outer)
- Inter-VRF Routing (e.g. VRF-Lite, Leaking)
- Fabric NetFlow (e.g. VRF/VNID in FNF)

Tends to require multiple encapsulation(s)

Tends to require high L2/L3 + Feature scale



EVPN Leaf

The **EVPN Leaf PIN** focuses on connecting Wired endpoints to an **EVPN Fabric domain**.

• Typically, the same layer as Access or Extended (Tier 1)

Main goal is to connect Endpoints to EVPN network

Uses a L3 Underlay + L2 Hand-off

- North (inside): L3 IGP, PIM + MSDP
- South (outside): L2 VLAN (L3 SVI), STP, IGMP

Uses a Virtualized L2/L3 Overlay

- Control-Plane: BGP-EVPN, TRM
- Data-Plane: VXLAN
- Policy-Plane: L2/L3 VNI

Tends to use Overlay-aware Features

- IP/OG ACLs (e.g. destined outside)
- Uniform QoS (e.g. copy inner, queue outer)
- Inter-VRF Routing (e.g. VRF Leaking)
- Fabric NetFlow (e.g. FNF + VNID)

Tends to require multiple encapsulation(s)

Tends to require med-high L2/L3 + Feature scale

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SD-Access Border & CP

The **SDA Border / CP PIN** focuses on connecting an **SDA Fabric** and/or **other network domains**.

• Typically, the same layer as Core or Core/Edge (Tier 3-4)

Main goal is to connect SDA to traditional networks

Uses a L3 Underlay + L3 Hand-off

- North (outside): L3 MP-BGP + Inter-AS, PIM + MSDP
- South (inside): L3 IGP, PIM + MSDP

Uses a Virtualized L2/L3 Overlay

- Control-Plane: LISP (XTR, MS/MR), PIM
- Data-Plane: VXLAN-GPO
- Policy-Plane: L2/L3 VNI + SGT

Tends to use Overlay-aware Features

- Security Group ACLs (e.g. destined outside)
- Uniform Pipe QoS (e.g. copy inner, queue outer)
- Inter-VRF Routing (e.g. VN Extranet, or VRF-Lite)
- Fabric NetFlow (e.g. VRF/VNID + SGT FNF, NaaS/ETA)

Tends to require multiple encapsulation(s)

Tends to require higher L3 & Feature scale



SD-Access Edge

The **SDA Edge PIN** focuses on connecting Wired/Wireless endpoints to an **SDA Fabric domain**.

• Typically, the same layer as Access or Extended (Tier 1)

Main goal is to connect Endpoints to SDA network

Uses a L3 Underlay + L2 Hand-off

- North (inside): L3 IGP, PIM + MSDP
- South (outside): L2 VLAN (L3 SVI), STP, IGMP

Uses a Virtualized L2/L3 Overlay

- Control-Plane: LISP (XTR), PIM
- Data-Plane: VXLAN-GPO
- Policy-Plane: VN + SGT

Tends to use Overlay-aware Features

- Security Group ACLs (e.g. destined outside)
- Uniform Pipe QoS (e.g. copy inner, queue outer)
- Inter-VRF Routing (e.g. VN Extranet)
- Fabric NetFlow (e.g. FNF, NaaS)

Tends to require multiple encapsulation(s)

Tends to require higher L3 & Feature scale

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Campus Baseline

Wireless & Security

Central Wireless Firewalls & ACLs



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Wireless LAN

The **Central Wireless PIN** focuses on connecting Wireless APs centrally to one or multiple WLCs.

- WLC is typically connected to Core, Edge or DC (Tier 3+)
- APs are typically connected to Access (Tier 1)

Main goal is to connect Wireless Endpoints (via APs) to a Wireless LAN (WLAN), centrally in the network

Uses a L2/L3 Underlay + L2 Hand-off

- North (to WLC): L2 VLAN + 802.1Q, L3 SVI, IGP
- South (to AP): L2 VLAN + 802.1Q, STP, IGMP

Uses a Tunneled L2 Overlay

- Control-Plane: CAPWAP, DTLS, LWAPP
- Data-Plane: CAPWAP, DTLS

Tends to require L2 (WLAN) Features

- L2 ACLs (e.g. VACL, MAC ACL)
- L2 QoS (e.g. VLAN QoS)
- L2 NetFlow (e.g. FNF, AVC, EPA & ETA)

Tends to require higher L2 + Feature scale



Central Wireless



Firewalls & ACLs

The **Firewall (DMZ) PIN** focuses on controlling access into or out of different network areas.

- Typically connected to Core, Edge or DC (Tier 3+)
- Complex designs may use Distro or Access (Tier 1-2)

Main goal is to prevent unauthorized access to different network domains (segments).

- Evolved from "Edge" Access-Control Lists (ACLs)
- Can be either L2, L3 or VRF-aware
- Tends to focus on L4-L7 flows (with or w/o DPI)

Uses a L2 or L3/VRF + ACLs

- North (outside): L2 802.1Q, L3 (SVI, Sub-Ints), IGP, BGP
- South (inside): L2 802.1Q, L3 (SVI, Sub-Ints), IGP, BGP

Tends to use L2 & L3/VRF + DPI & ACL Features

- L4/App ACLs (e.g. VACL, MAC ACL)
- L4/App QoS (e.g. VLAN QoS)
- L4/App NetFlow (e.g. FNF, AVC, EPA & ETA)

Tends to require med-high L2/L3 + Feature scale

Firewalls (DMZ)



Campus Baseline

Know the Campus PINs
Other References
Keep Learning!!! ^(C)



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Campus PINs & Topology





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Keep Learning! Cisco Validated Design (CVD)

cisco.com/go/cvd cs.co/en-cvds







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References – Multi-Layer Campus



Туре	Sub-Type	References
General	Multi-Layer	www.cisco.com/c/en/us/td/docs/solutions/CVD/Campus/cisco-campus-lan-wlan-design-guide.html www.cisco.com/c/en/us/td/docs/solutions/Enterprise/Campus/HA_campus_DG/hacampusdg.html www.ccexpert.us/network-design-2/designing-a-campus-network-design-topology.html networkdirection.net/articles/network-theory/hierarchicalnetworkmodel www.geeksforgeeks.org/types-of-area-networks-lan-man-and-wan/
Core	Edge	www.cisco.com/c/en/us/td/docs/solutions/Enterprise/Security/IE_DG.html www.ccexpert.us/network-design/enterprise-edge-modules.html what-when-how.com/ipv6-for-enterprise-networks/enterprise-edge-network-design-ipv6/
	Interconnect	www.geeksforgeeks.org/difference-between-lan-and-man www.ti.com/solution/intra-dc-interconnect-metro en.wikipedia.org/wiki/Backbone_network
	Baseline	www.cisco.com/c/en/us/td/docs/solutions/CVD/Campus/cisco-campus-lan-wlan-design-guide.html#Corelayer www.cisco.com/c/en/us/td/docs/solutions/Enterprise/Campus/HA_campus_DG/hacampusdg.html#wp1107724 www.ccexpert.us/network-design/campus-core-design-considerations.html en.wikipedia.org/wiki/Hierarchical_internetworking_model#Core_layer
Distribution	Collapsed Core	www.cisco.com/c/en/us/td/docs/solutions/CVD/Campus/cisco-campus-lan-wlan-design-guide.html#Twotierdesign www.econfigs.com/ccna-1-5-compare-and-contrast-collapsed-core-and-three-tier-architectures interestingtraffic.nl/2018/06/08/collapsed_core_design oreilly.com/library/view/ccna-data-center/9780133860429/ch01lev3sec4.html
	Baseline	www.cisco.com/c/en/us/td/docs/solutions/CVD/Campus/cisco-campus-lan-wlan-design-guide.html#Distributionlayer www.ccexpert.us/network-design/building-distribution-layer-design-considerations.html en.wikipedia.org/wiki/Hierarchical_internetworking_model#Distribution_layer
Access	Baseline	www.cisco.com/c/en/us/td/docs/solutions/CVD/Campus/cisco-campus-lan-wlan-design-guide.html#Accesslayer www.cisco.com/c/en/us/td/docs/solutions/Enterprise/Campus/HA_campus_DG/hacampusdg.html#wp1107746 www.ccexpert.us/network-design/building-access-layer-design-considerations.html en.wikipedia.org/wiki/Hierarchical_internetworking_model#Access_layer
	Routed Access	www.cisco.com/c/en/us/td/docs/solutions/CVD/Campus/cisco-campus-lan-wlan-design-guide.html#Layer3routedaccesscampusdesign www.cisco.com/c/en/us/td/docs/solutions/Enterprise/Campus/HA_campus_DG/hacampusdg.html#wp1108952
	Extended/IOT	www.cisco.com/c/en/us/td/docs/solutions/Verticals/CCI/CCI/DG/cci-dg/cci-dg.html#99480 www.geeksforgeeks.org/5-layer-architecture-of-internet-of-things/

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References – ECMP & StackWise^(Virtual)



Туре	Sub-Type	References
General	Redundancy	www.cisco.com/c/en/us/solutions/hybrid-work/what-is-high-availability.html#~infrastructure-elements www.ccexpert.us/network-design/designing-link-redundancy.html www.geeksforgeeks.org/redundant-link-problems-in-computer-network/
Core	ECMP	www.cisco.com/c/en/us/support/docs/ip/border-gateway-protocol-bgp/5212-46.html www.ccexpert.us/routing-protocols/equalcost-load-balancing.html en.wikipedia.org/wiki/Equal-cost multi-path routing
	EtherChannel	www.cisco.com/c/en/us/td/docs/solutions/CVD/Campus/cisco-campus-lan-wlan-design-guide.html#EtherChannel en.wikipedia.org/wiki/Link_aggregation#Network_backbone en.wikipedia.org/wiki/Multi-chassis_link_aggregation_group
	SVL	www.ciscolive.com/c/dam/r/ciscolive/emea/docs/2020/pdf/BRKCRS-2650.pdf www.cisco.com/c/en/us/products/collateral/switches/catalyst-9000/nb-06-cat-9k-stack-wp-cte-en.html www.cisco.com/c/en/us/td/docs/solutions/CVD/Campus/cisco-campus-lan-wlan-design-guide.html#StackWiseVirtualTechnology
Distribution	ECMP	www.cisco.com/c/en/us/support/docs/ip/border-gateway-protocol-bgp/5212-46.html www.ccexpert.us/routing-protocols/equalcost-load-balancing.html en.wikipedia.org/wiki/Equal-cost_multi-path_routing
	EtherChannel	www.cisco.com/c/en/us/td/docs/solutions/CVD/Campus/cisco-campus-lan-wlan-design-guide.html#EtherChannel en.wikipedia.org/wiki/Link_aggregation_ en.wikipedia.org/wiki/Multi-chassis_link_aggregation_group
	SVL	www.ciscolive.com/c/dam/r/ciscolive/emea/docs/2020/pdf/BRKCRS-2650.pdf www.cisco.com/c/en/us/products/collateral/switches/catalyst-9000/nb-06-cat-9k-stack-wp-cte-en.html www.cisco.com/c/en/us/td/docs/solutions/CVD/Campus/cisco-campus-lan-wlan-design-guide.html#StackWiseVirtualTechnology
Access	ECMP	www.cisco.com/c/en/us/support/docs/lan-switching/spanning-tree-protocol/10555-15.html en.wikipedia.org/wiki/Spanning Tree Protocol#Path to the root bridge en.wikipedia.org/wiki/Flex_links
	EtherChannel	www.cisco.com/c/en/us/td/docs/solutions/CVD/Campus/cisco-campus-lan-wlan-design-guide.html#EtherChannel en.wikipedia.org/wiki/EtherChannel
	Stacking	www.ciscolive.com/c/dam/r/ciscolive/emea/docs/2020/pdf/BRKCRS-2650.pdf www.cisco.com/c/en/us/products/collateral/switches/catalyst-9300-series-switches/white-paper-c11-741468.html www.cisco.com/c/en/us/products/collateral/switches/catalyst-9200-series-switches/nb-06-stackwise-architecture-cte-en.html www.cisco.com/c/en/us/td/docs/solutions/CVD/Campus/cisco-campus-lan-wlan-design-guide.html#SwitchStacksandCiscoStackWiseTechnology

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References – SD-Access, EVPN & MPLS



Туре	Sub-Type	References
General	SDN/IBN	www.cisco.com/c/en/us/solutions/intent-based-networking.html www.networkworld.com/article/3281447/a-new-era-of-campus-network-design.html www.geeksforgeeks.org/difference-between-software-defined-network-and-traditional-network/
Core	SDA	www.ciscolive.com/c/dam/r/ciscolive/us/docs/2020/pdf/DGTL-BRKCRS-2810.pdf#page=27 www.cisco.com/c/en/us/td/docs/solutions/CVD/Campus/cisco-sda-design-guide.html#BorderNode www.cisco.com/c/en/us/td/docs/solutions/CVD/Campus/cisco-sda-design-guide.html#ControlPlaneNode
	EVPN	www.ciscolive.com/c/dam/r/ciscolive/us/docs/2021/pdf/BRKENS-2003.pdf#page=12 www.cisco.com/c/en/us/td/docs/switches/lan/catalyst9500/software/release/17- 7/configuration_guide/vxlan/b_177_bgp_evpn_vxlan_9500_cg/bgp_evpn_vxlan_overview.html#id_126799 www.cisco.com/c/en/us/td/docs/solutions/CVD/Campus/cisco-campus-lan-wlan-design-guide.html#AlternativevirtualizationdesignforcampusBGPEVPNVXLAN
	MPLS	www.ciscolive.com/c/dam/r/ciscolive/us/docs/2020/pdf/DGTL-BRKMPL-1100.pdf#page=48 www.ciscolive.com/c/dam/r/ciscolive/us/docs/2020/pdf/DGTL-BRKMPL-2112.pdf#page=42 www.geeksforgeeks.org/multi-protocol-label-switching-mpls/
Distribution	SDA	www.ciscolive.com/c/dam/r/ciscolive/us/docs/2020/pdf/DGTL-BRKCRS-2810.pdf#page=19 www.cisco.com/c/en/us/td/docs/solutions/CVD/Campus/cisco-sda-design-guide.html#IntermediateNode
	EVPN	www.ciscolive.com/c/dam/r/ciscolive/us/docs/2021/pdf/BRKENS-2003.pdf#page=12 www.cisco.com/c/en/us/td/docs/switches/lan/catalyst9500/software/release/17- 7/configuration_guide/vxlan/b_177_bgp_evpn_vxlan_9500_cg/bgp_evpn_vxlan_overview.html#id_126799
	MPLS	www.ciscolive.com/c/dam/r/ciscolive/us/docs/2020/pdf/DGTL-BRKMPL-1100.pdf#page=48 www.ciscolive.com/c/dam/r/ciscolive/us/docs/2020/pdf/DGTL-BRKMPL-2112.pdf#page=42 www.geeksforgeeks.org/multi-protocol-label-switching-mpls/
Access	SDA	www.ciscolive.com/c/dam/r/ciscolive/us/docs/2020/pdf/DGTL-BRKCRS-2810.pdf#page=24 www.cisco.com/c/en/us/td/docs/solutions/CVD/Campus/cisco-sda-design-guide.html#EdgeNode www.cisco.com/c/dam/en/us/solutions/collateral/internet-of-things/nb-09-intent-based-iot-wp-cte-en.pdf www.cisco.com/c/en/us/td/docs/solutions/CVD/Campus/cisco-campus-lan-wlan-design-guide.html#CiscoSoftwareDefinedAccesscampusdesign
	EVPN	www.ciscolive.com/c/dam/r/ciscolive/us/docs/2021/pdf/BRKENS-2003.pdf#page=12 www.cisco.com/c/en/us/td/docs/switches/lan/catalyst9500/software/release/17- 7/configuration_guide/vxlan/b_177_bgp_evpn_vxlan_9500_cg/bgp_evpn_vxlan_overview.html#id_126799
	MPLS	www.ciscolive.com/c/dam/r/ciscolive/us/docs/2020/pdf/DGTL-BRKMPL-1100.pdf#page=48 www.geeksforgeeks.org/multi-protocol-label-switching-mpls/

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