Asterfusion Campus Network Solution with Cloud Tech

AGENDA

01 Underlay Network

02 Overlay L2 VPN

03 Zero-perception WiFi Roaming

04 Broadcast-Free Network

05 Security

06 OpenWiFi Controller

07 Case study

Asterfusion Campus Network Portfolio

Smart Gateways

4 x 10G SFP+, 4 x 2.5G PoE++, 8 x 1G PoE+
1 x DPU (8core ARM, 16G DDR5), 1 x AI chip, 4T SSD

ET2500

2 x 10G SFP+, 16 x 1G PoE++
2 x DPUs (4core ARM, 8G DDR4)

CX102S-16GT-M-D2-SWP

Spine Switches

48 x 25G SFP+, 8 x 100G QSFP28 /40G QSFP+

CX308P-48Y-M-H

48(24) x 10G SFP+, 6 x 100G QSFP28 /40G QSFP+

CX206P-48(24)S-M-H

24 x 25Gb SFP28 SFP+, 2 x 100Gb QSFP28 /40Gb QSFP+

CX202P-24Y-M-H

Leaf Switches

8 x 1G/2.5G RJ45 **PoE++**, 2 x 10G SFP28

CX102S-8MT-(SWP)

24 x 1G RJ45 PoE+, 4 x 10G/25G SFP28

CX204Y-24GT-M-S(WP2|4)

48 x 1G RJ45 PoE+, 4 x 10G/25G SFP28

CX204Y-48GT-M-S(WP4)

48 x 1G/2.5G RJ45 **PoE++**, 6 x 10G/25G SFP28

CX206Y-48MT-M-H(WP4|8)

Wireless APs

Wi-Fi 6E 8.2Gbps, 1 x 1G RJ45, 1 x 2.5G PoE+

AP6050

Wi-Fi 6 3.0Gbps, 1 x 1G RJ45, 1 x 2.5G PoE+

AP6030

Wi-Fi 6 3.0Gbps, outdoor, 1 console, 1 x 1G PoE+

AP6031

Wi-Fi 6 1.8Gbps, Wall Mount, 4 x 1G RJ45, 1 x 1G PoE

AP6020W

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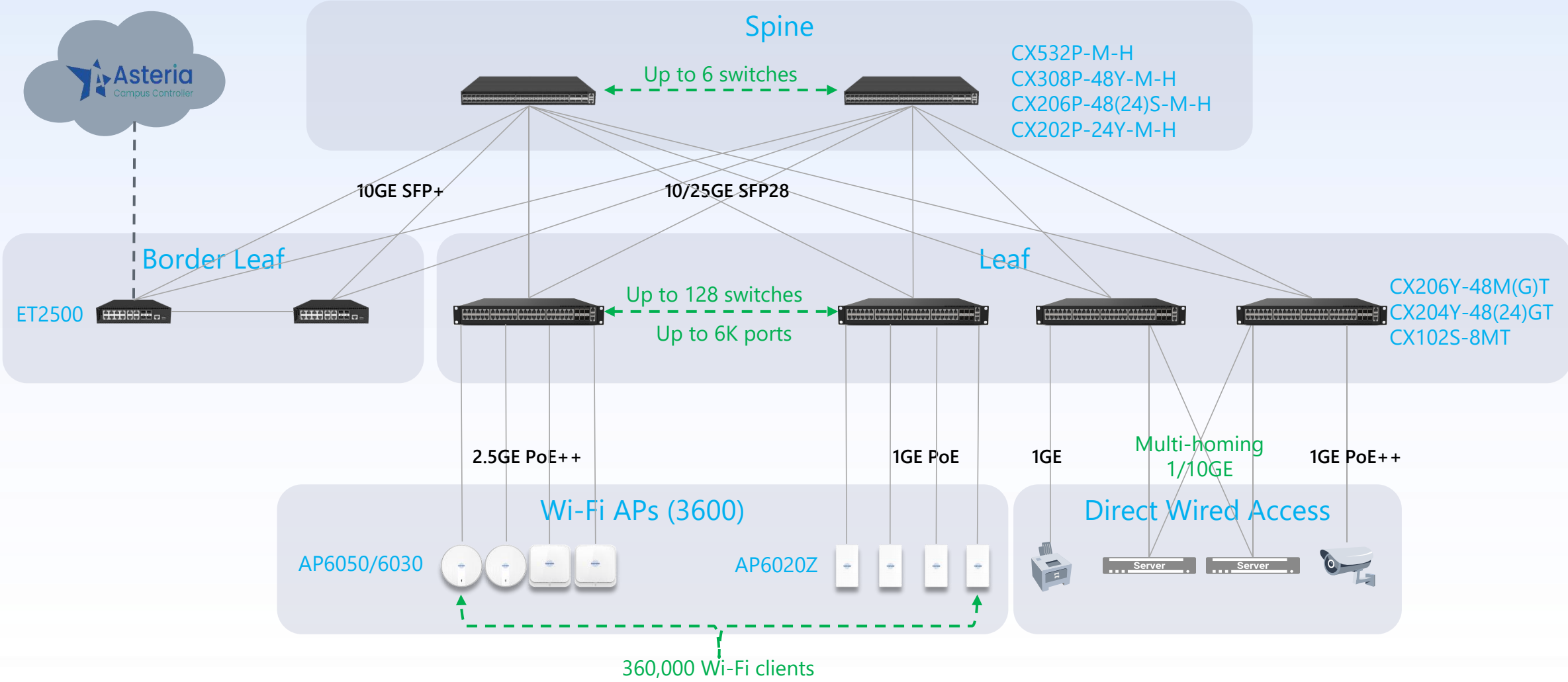
Spine Leaf Topology



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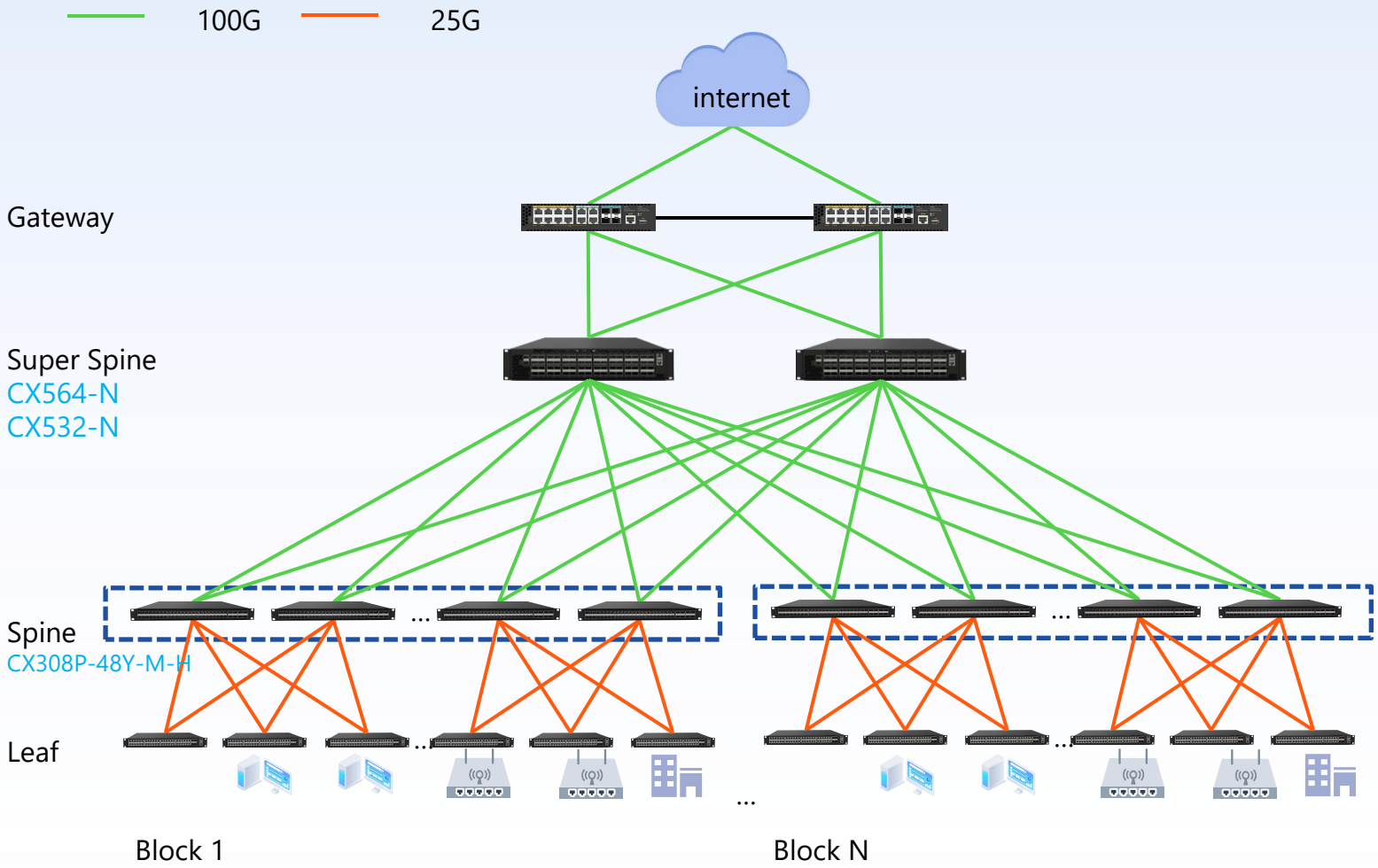
Multi-POD for Larger Scale-out Campus Networking



- Super Spine to scale to larger campus network with 180K access ports/APs

Super Spine	CX532-N	CX564-N
POD #	15	30
Ports #/PoD	6K	6K
Spine#	30	60
Leaf#	1920	3840
1G Ports #	90K	180K

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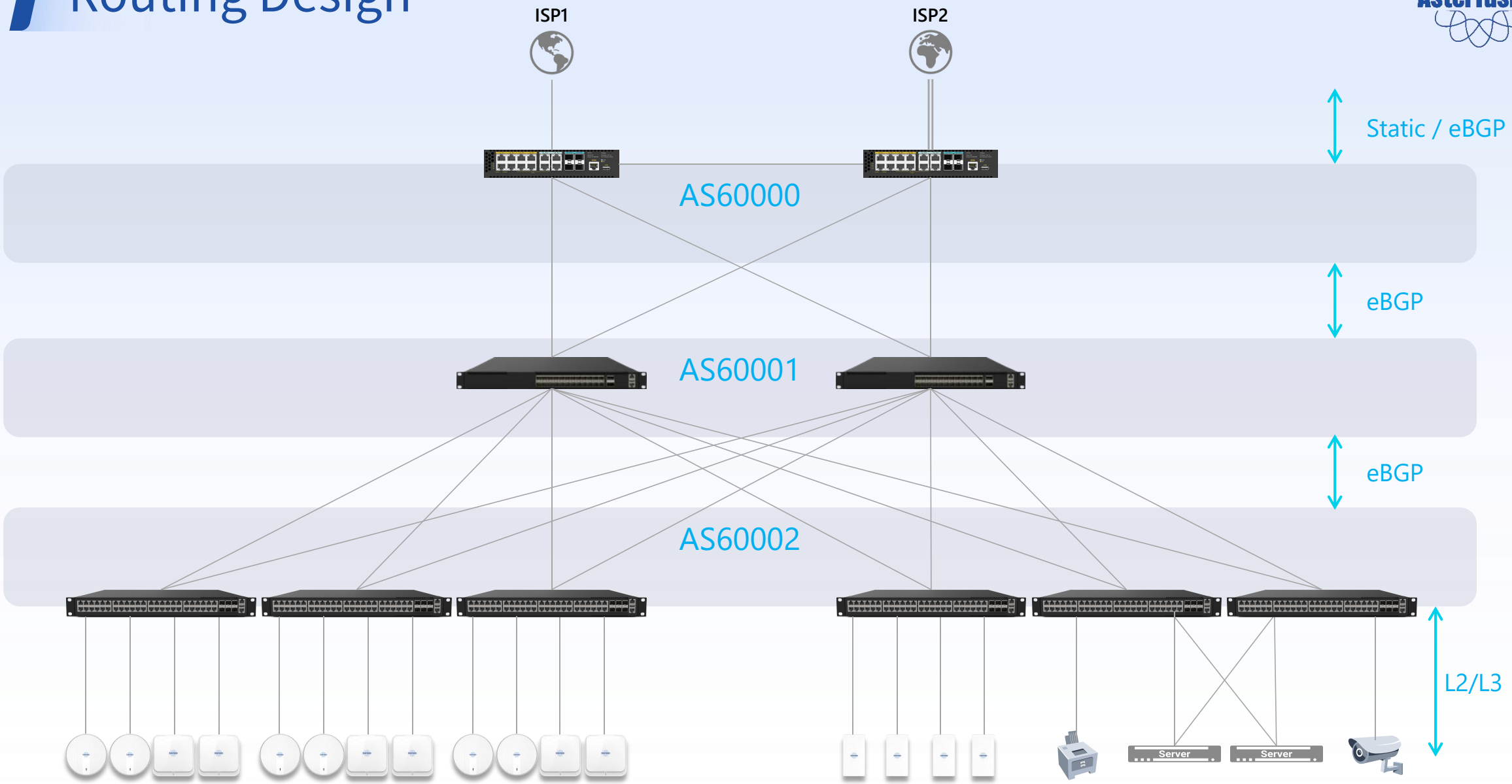
Routing Design



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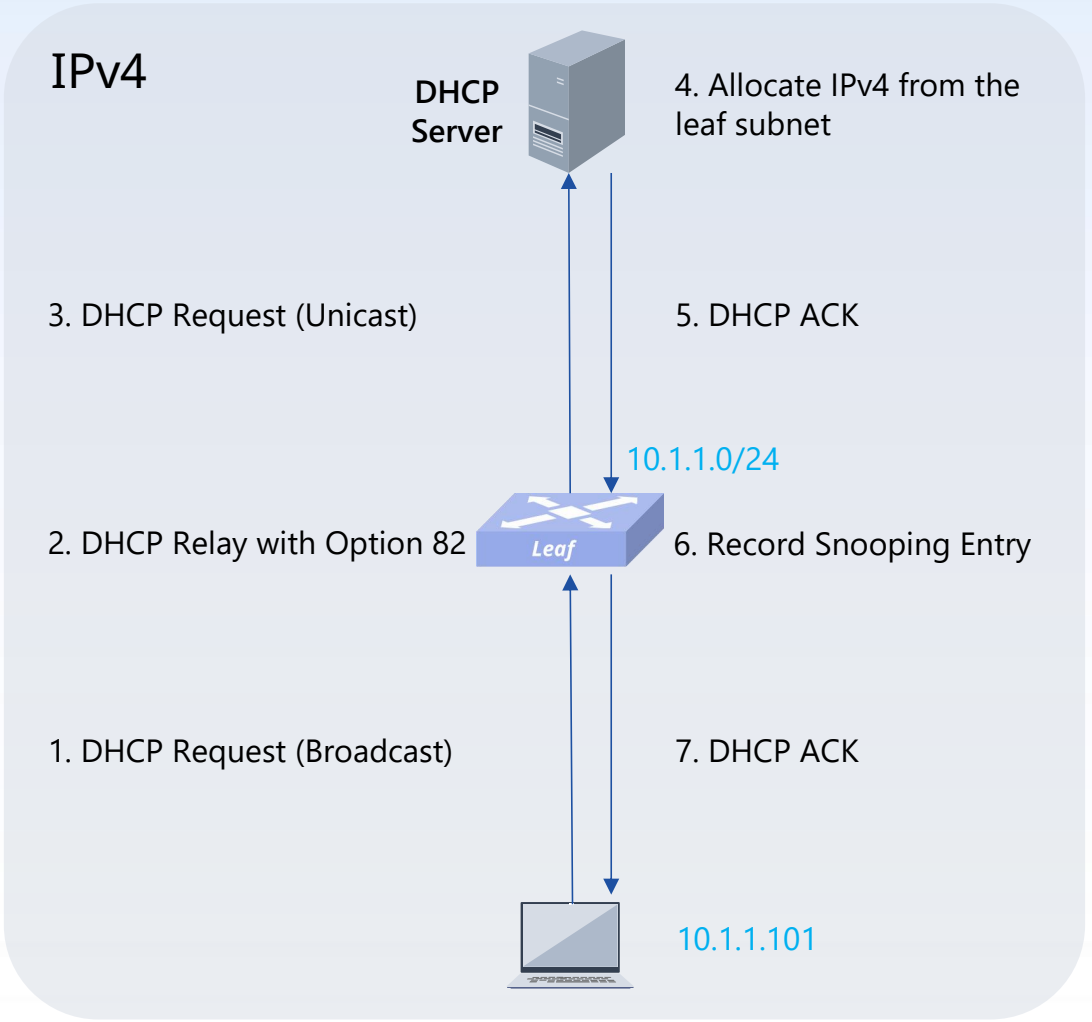
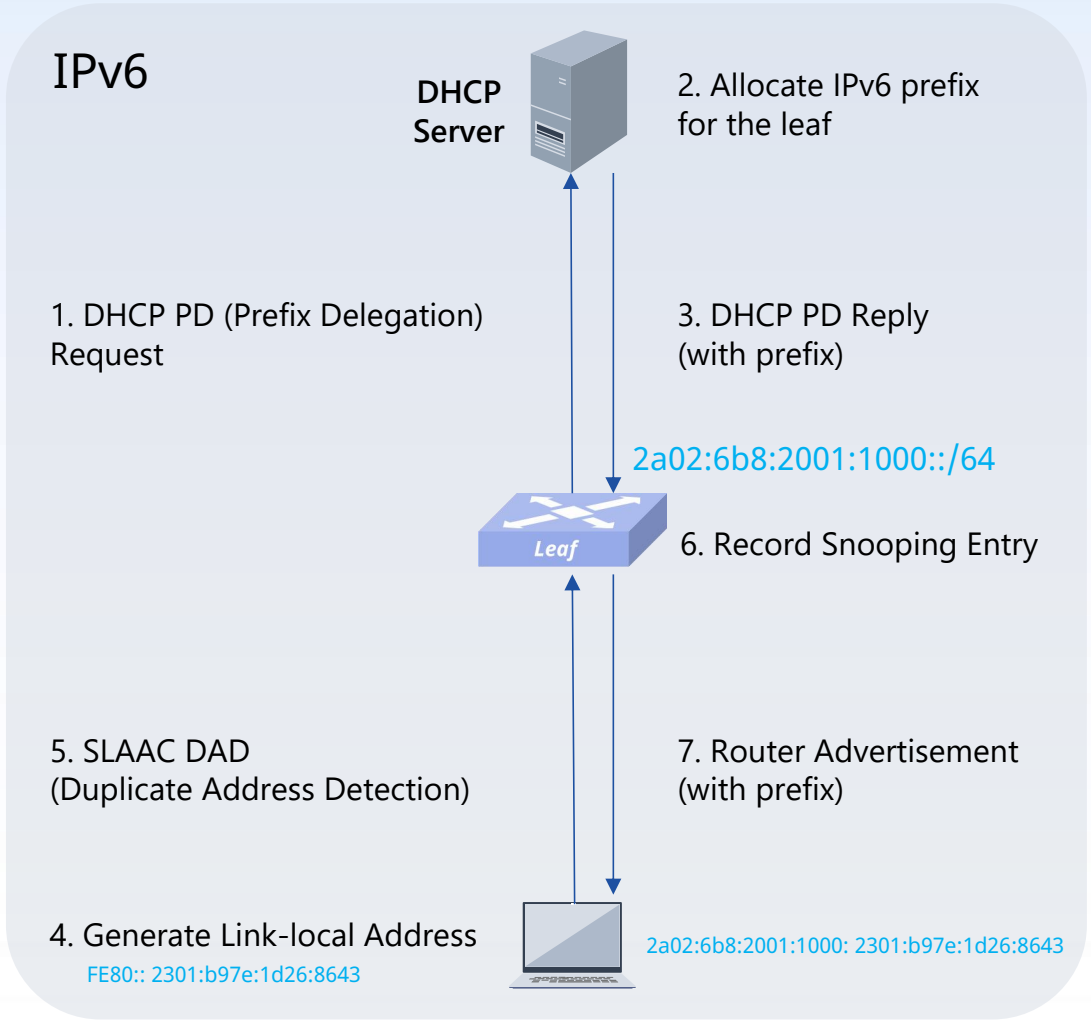
IP Address Assign

Assign a unique subnet to each leaf switch for route aggregation.





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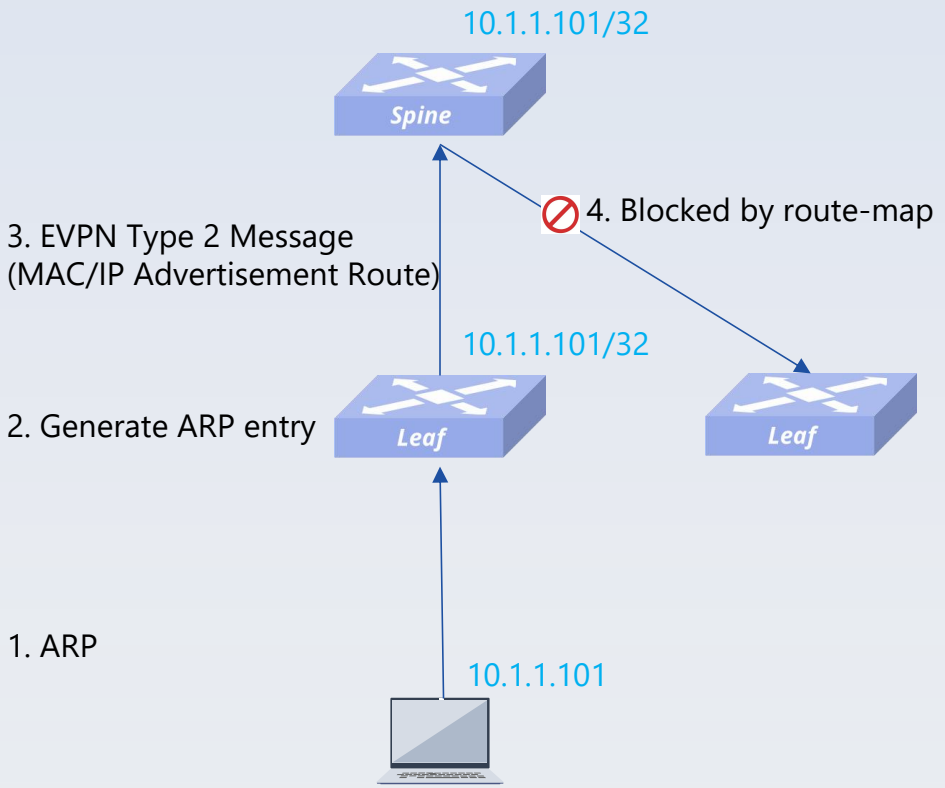
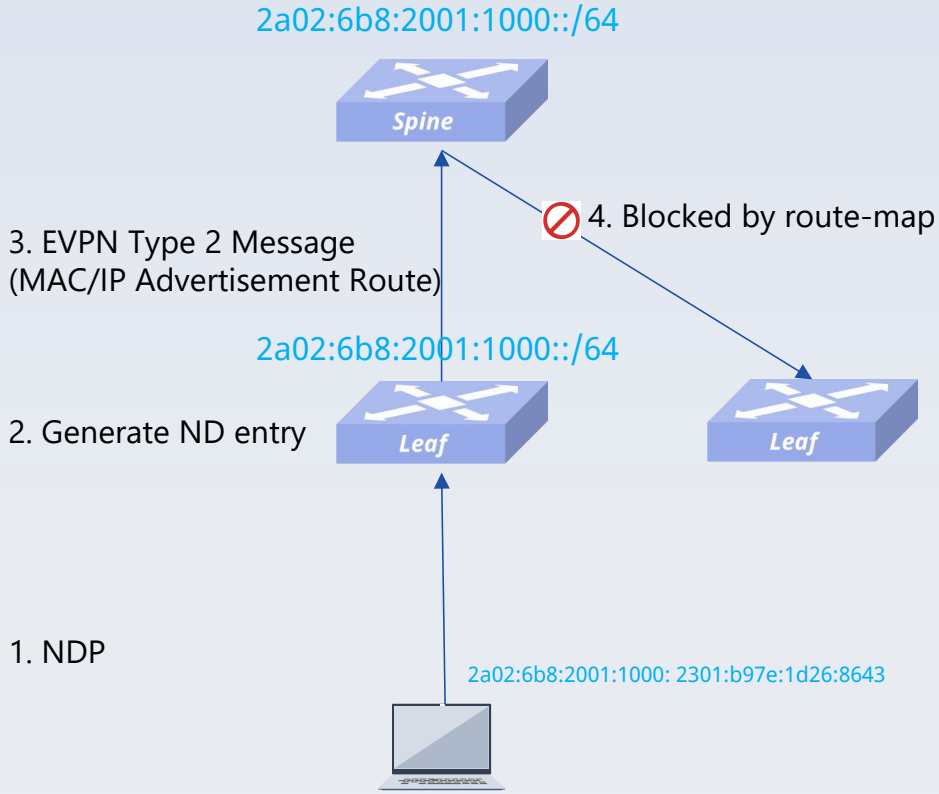
ARP-to-Host

IPv4



IPv6



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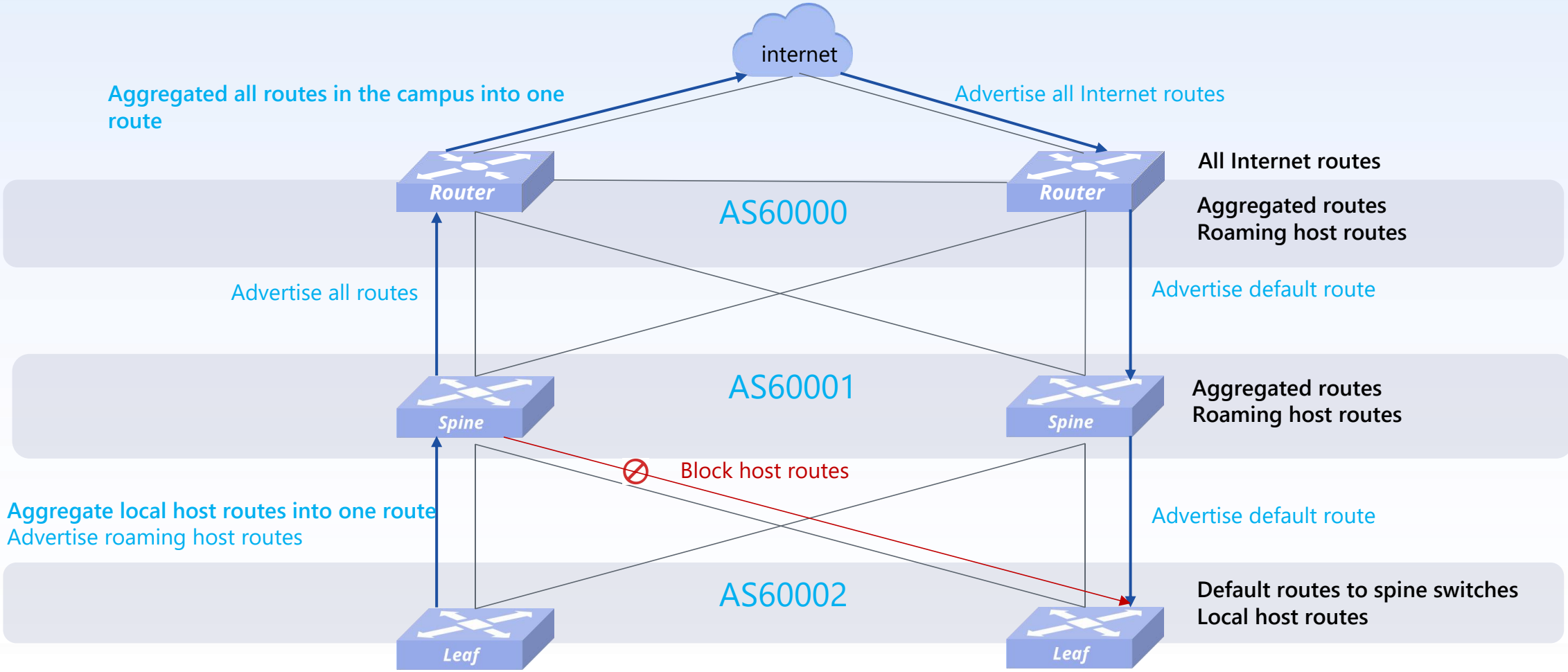
Route Aggregation

Significantly save routing table size of both leaf and spine switches



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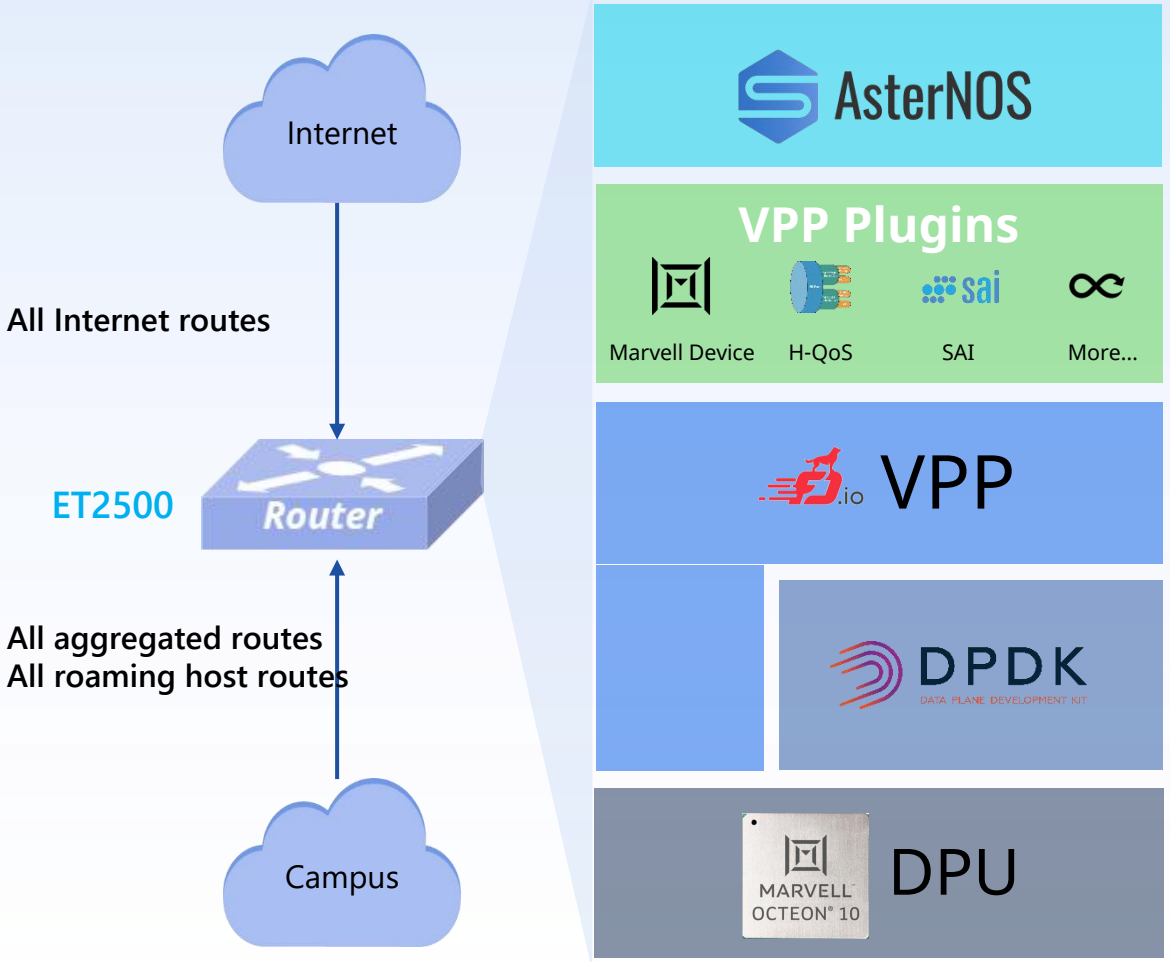
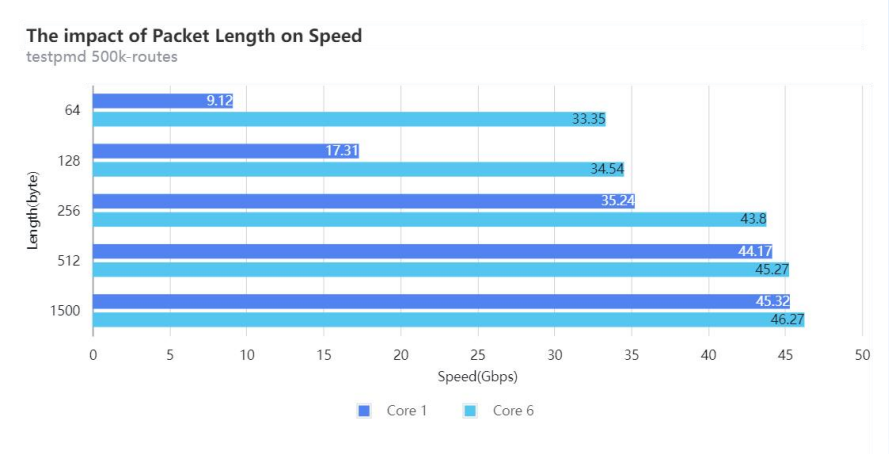
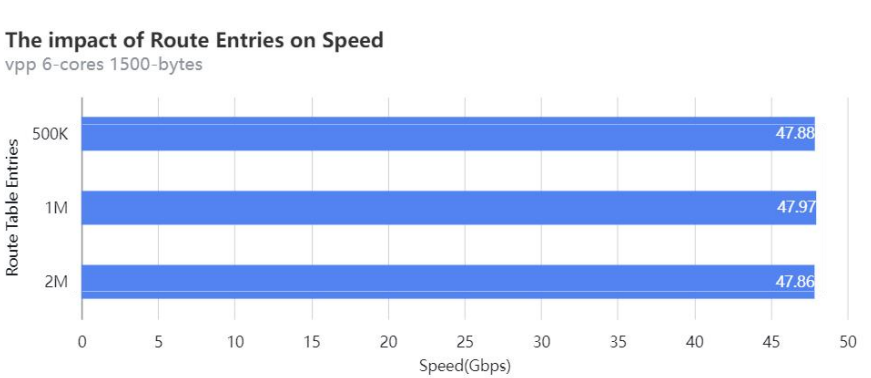
High Performance Border Router



High performance across various packet sizes



Consistent performance across various routing table sizes



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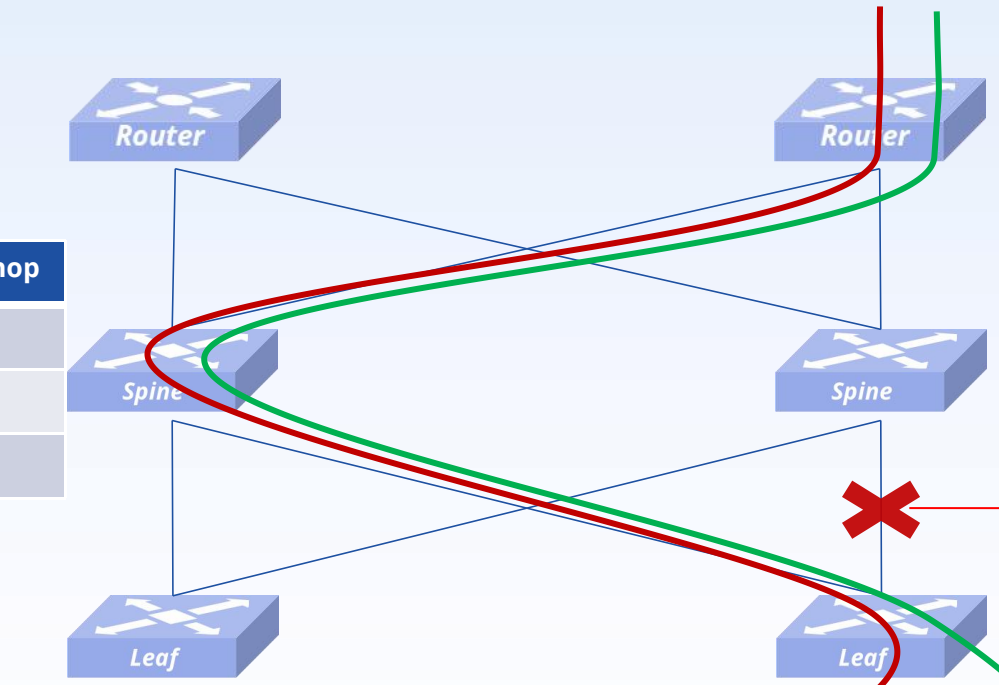
Link Fault Detection and Re-routing based on BFD

Prefix	Next hop
2a02:6b8:2001:1000::/64	Leaf1
2a02:6b8:2001:1001::/64	Leaf2
2a02:6b8:2001:1000:f4de:6eff:fe56:10bd/128	Leaf2

Longest Prefix Match



Prefix	Next hop
2a02:6b8:2001:1000::/64	Spine1 Spine2
2a02:6b8:2001:1001::/64	Spine1 ~~Spine2~~
2a02:6b8:2001:1000:f4de:6eff:fe56:10bd/128	Spine1 ~~Spine2~~

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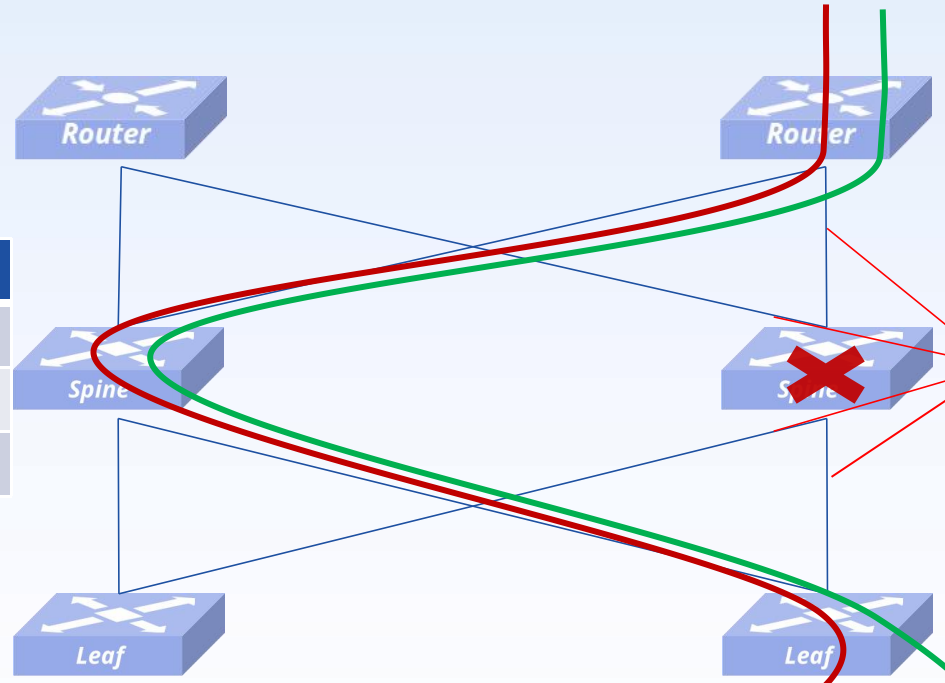
Node Fault Detection and Re-routing based on BFD

Prefix	Next hop
2a02:6b8:2001:1000::/64	Leaf1
2a02:6b8:2001:1001::/64	Leaf2
2a02:6b8:2001:1000:f4de:6eff:fe56:10bd/128	Leaf2

Longest Prefix Match



Prefix	Next hop
2a02:6b8:2001:1000::/64	Spine1 ~~Spine2~~
2a02:6b8:2001:1001::/64	Spine1 ~~Spine2~~
2a02:6b8:2001:1000:f4de:6eff:fe56:10bd/128	Spine1 ~~Spine2~~

Fault Detection in 50ms via BFD

Local PC1:
2a02:6b8:2001:1000:
2301:b97e:1d26:8643

Local PC2:
2a02:6b8:2001:1001:
4e82:a9ff:fe60:469f

Roaming PC3:
2a02:6b8:2001:1000:
f4de:6eff:fe56:10bd

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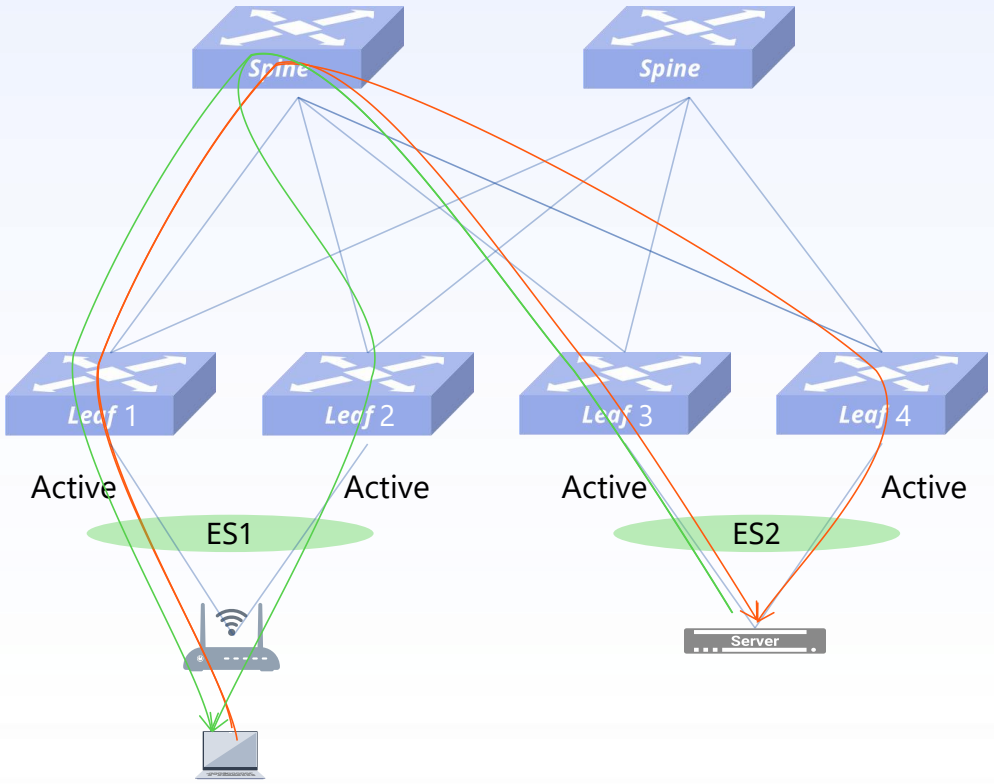
EVPN Multihoming of servers and APs

- Support Multihoming of servers and APs in **active-active** mode.
- Multihoming of servers.
  - Import server's static IP to all leaf switches in the group.
  - Or allocate fixed IP from DHCP server, generate host route in the process of DCHP relay.
- Multihoming of APs
  - The first leaf switch received ARP will MAC-trigger a host route with ESI and advertise it to spines and other leaf switches in the group.
  - Subsequent leaf switches receiving ARP will not generate a host route because it already exists with the same ESI.
- When a client **roams** to a new ES, the host route will migrate there with updated ESI.

Prefix	Next hop
Server host route	Leaf3 Leaf4
AP host route	Leaf1 Leaf2
Client host route	Leaf1 Leaf2



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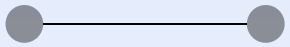
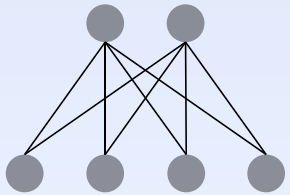
Overlay Networks

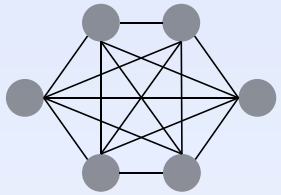
Overlay L2 VPN
VPWS



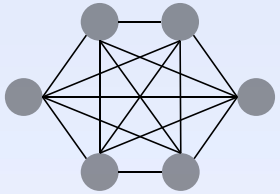
Overlay L2 VPN
E-Tree

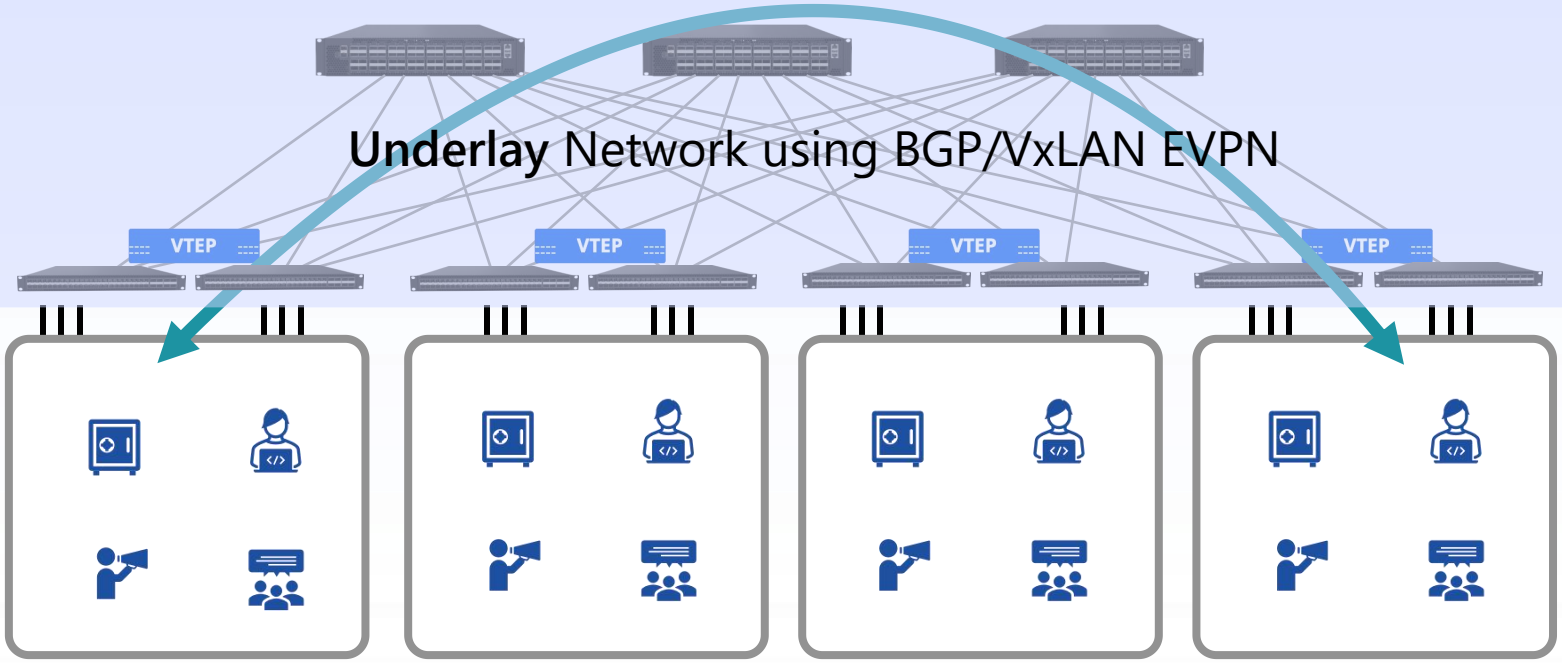


Overlay L2 VPN
E-LAN



Overlay L3 VPN
Full-mesh





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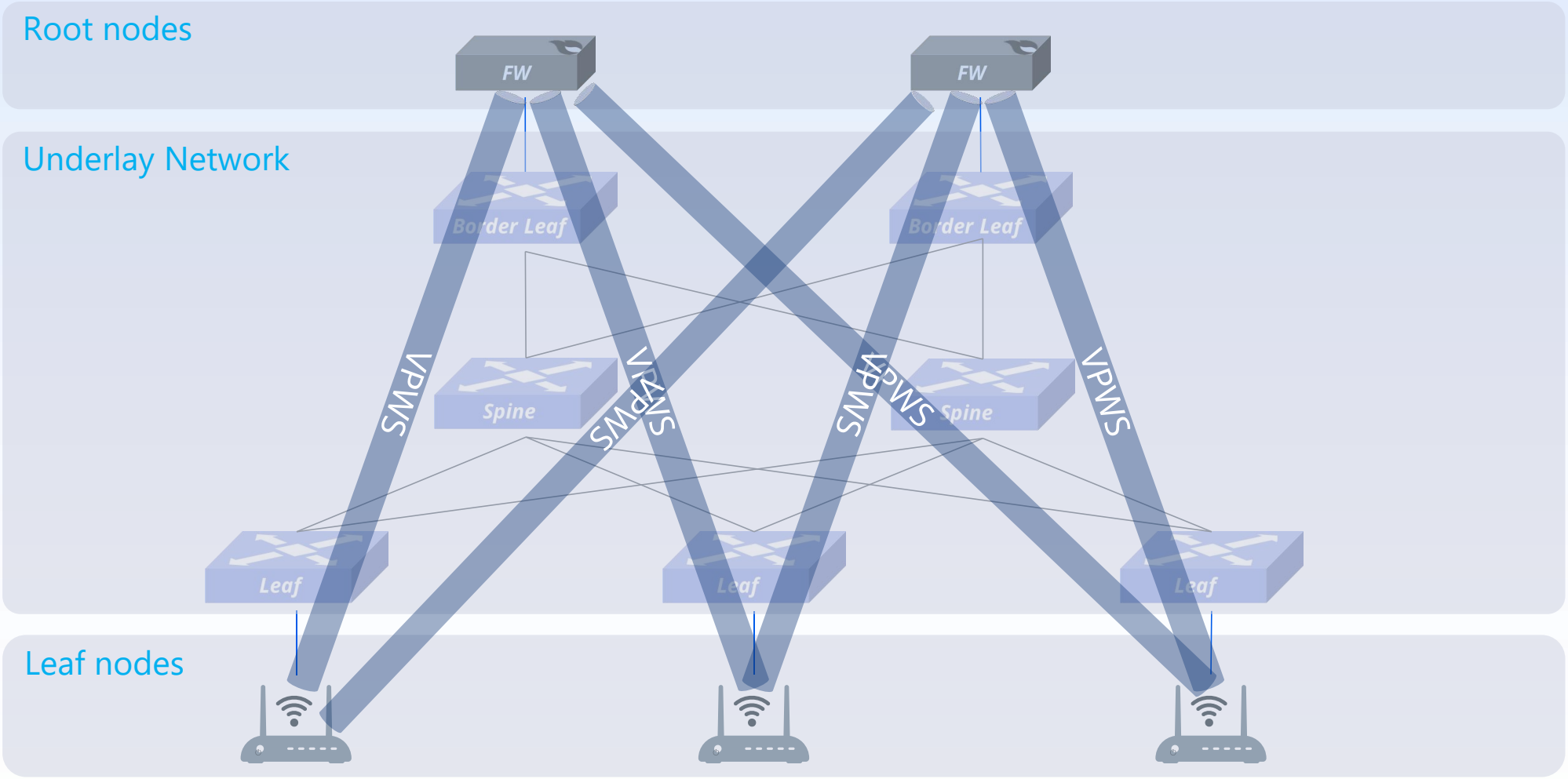
VPWS Overlay Network



- L2 traffic is forwarded from interface to interface without looking up MAC table.

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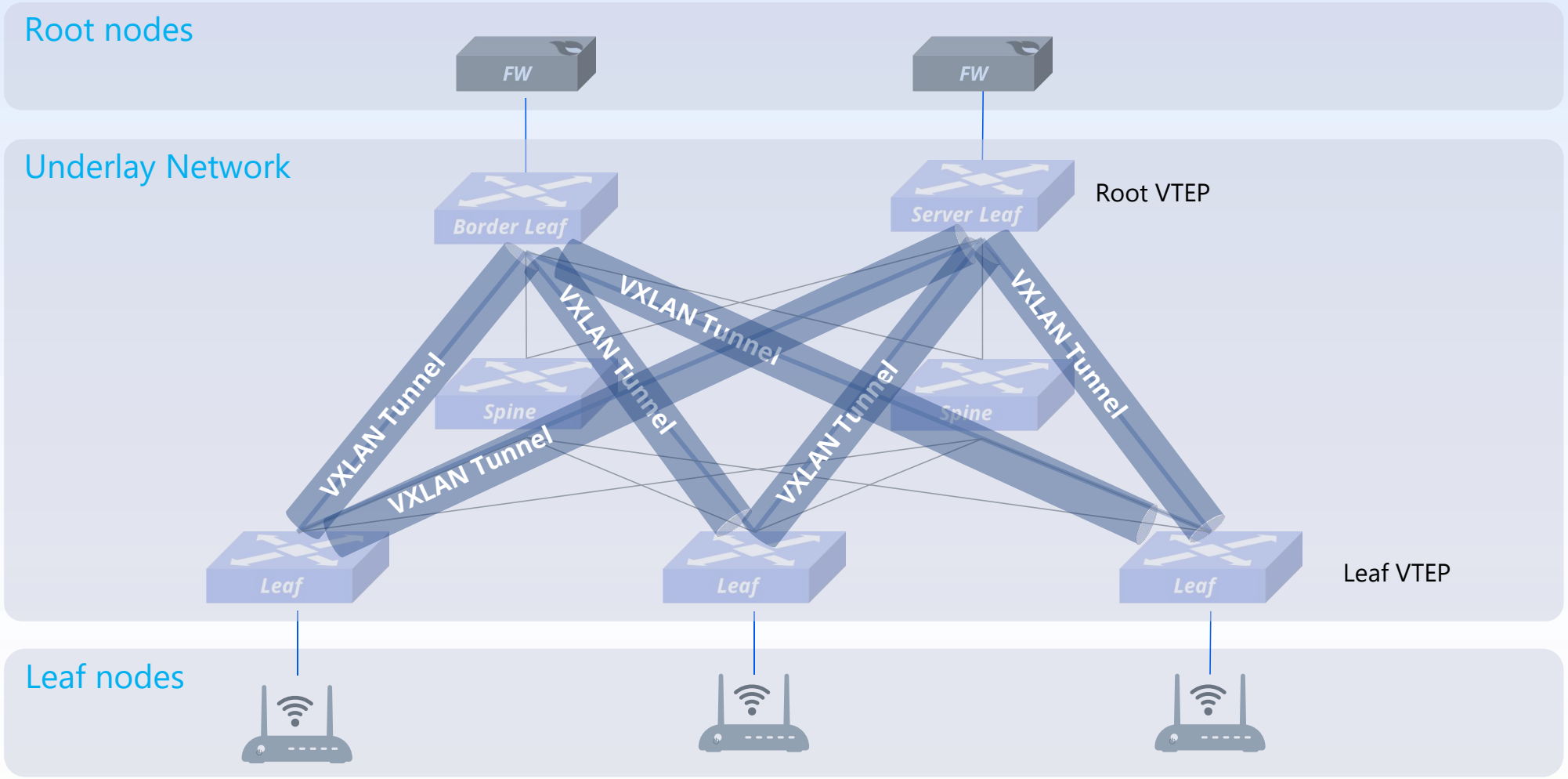
E-Tree Overlay Network



- A leaf node can send or receive traffic only from a root node.
- A root node can send traffic to another root or any of the leaf nodes.
- Root VTEP will block traffic between leaf nodes

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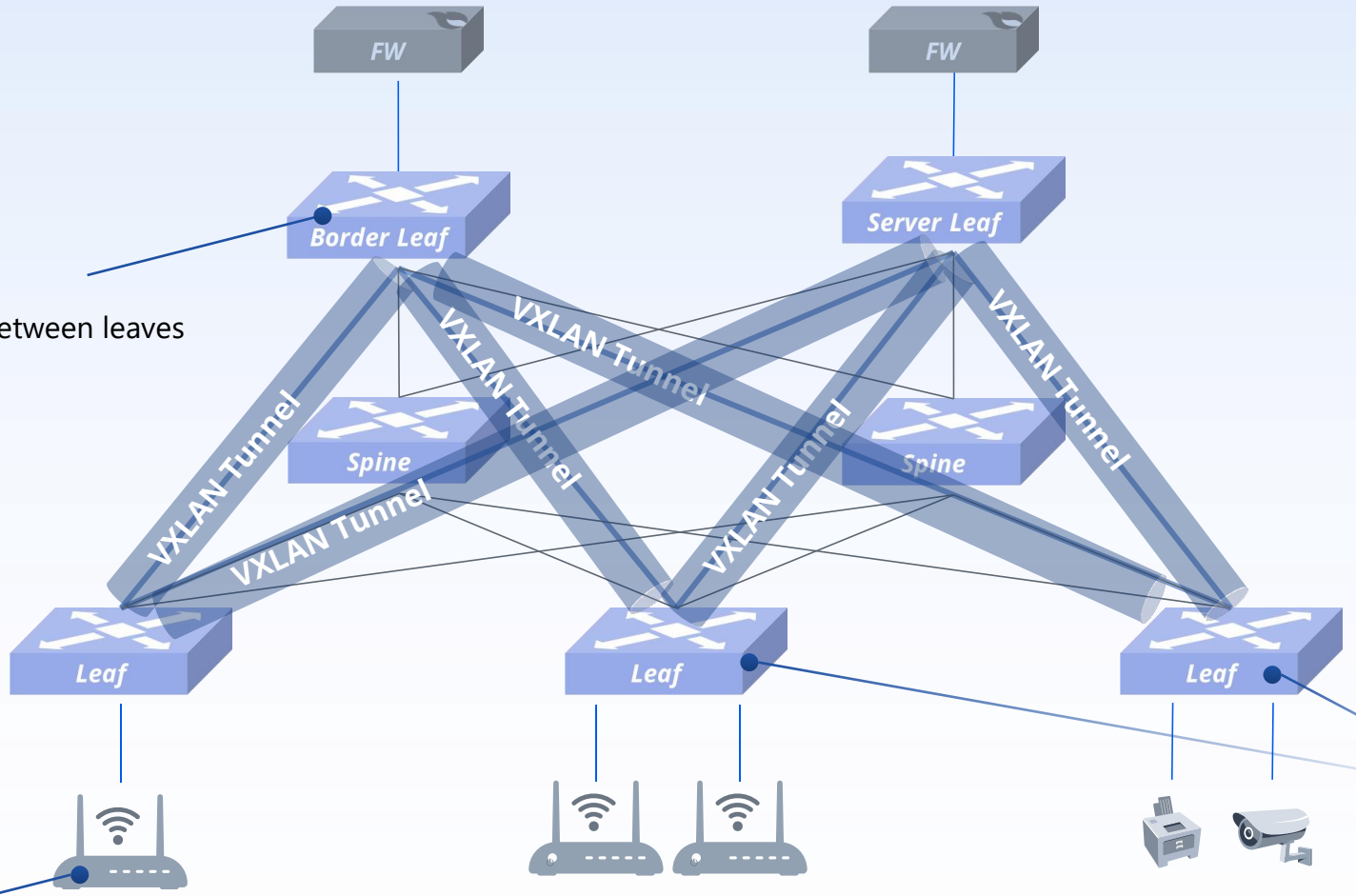
Isolate clients in L2 VPN



Leaf Isolation

Block traffic between leaves

Port Isolation

Block traffic between ports

AP Strict Forwarding

Block traffic between Wi-Fi clients

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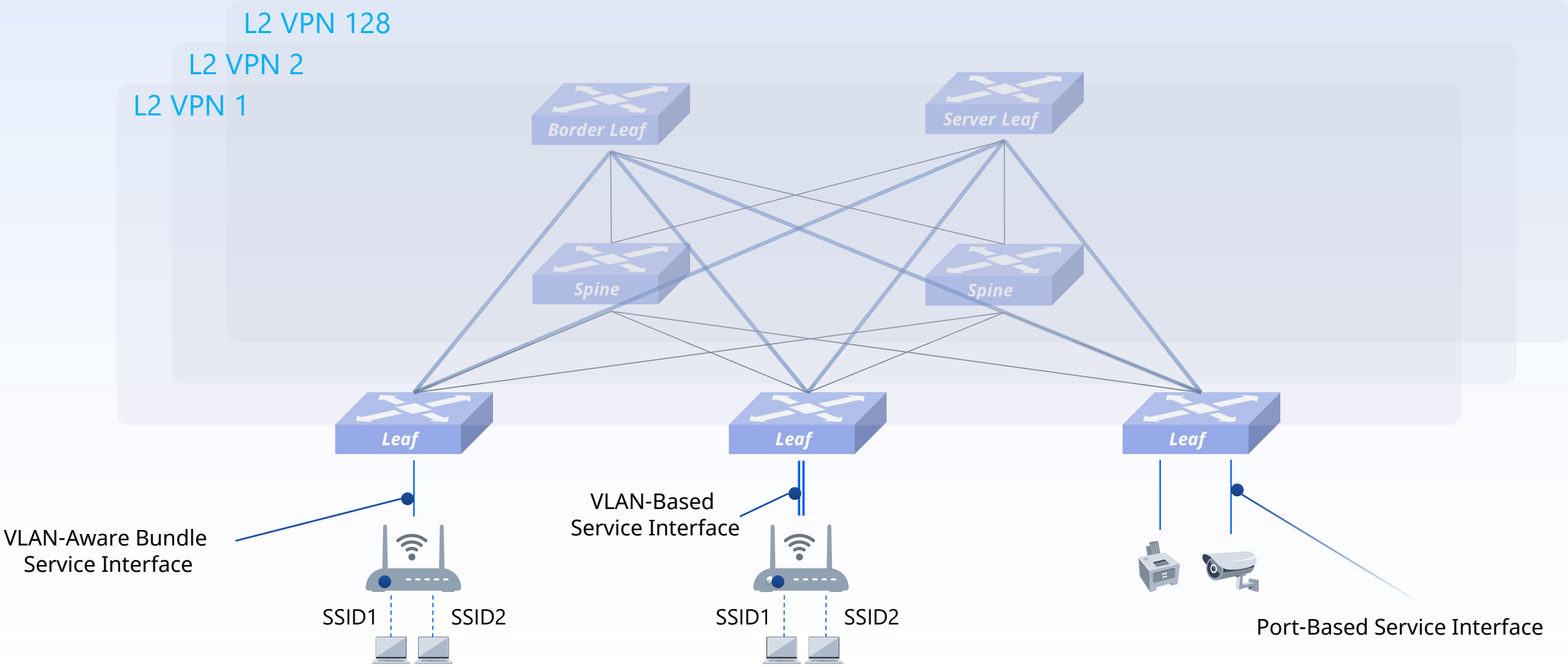
L2 VPN Service Interfaces



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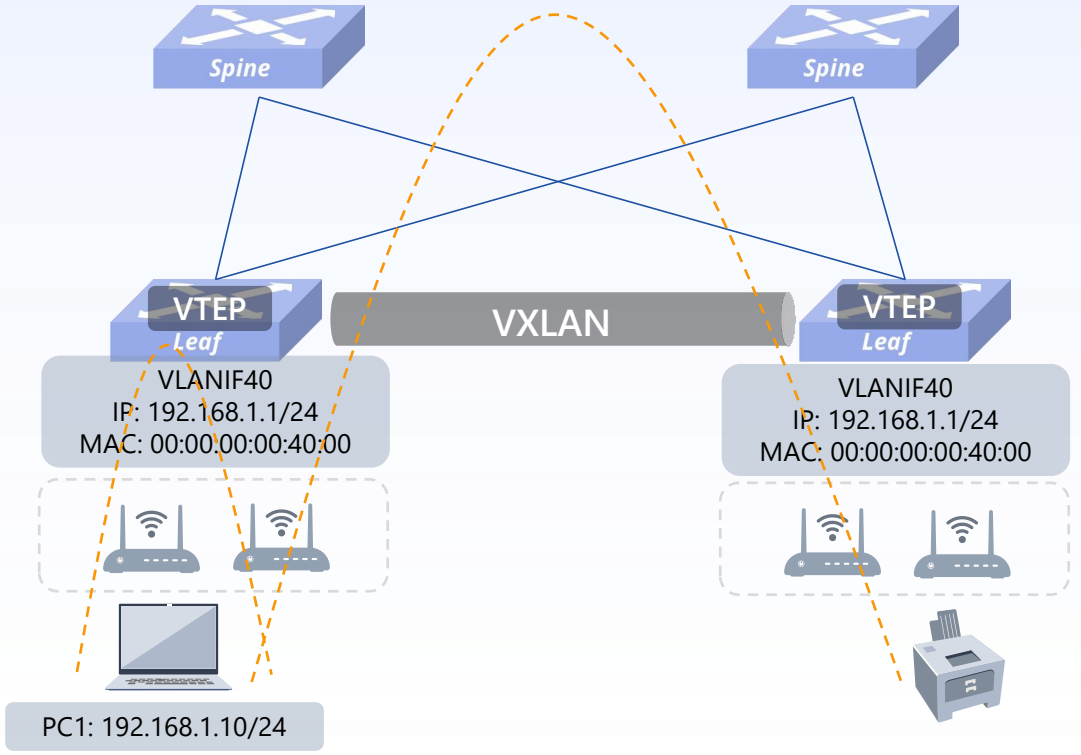
L2 EVPN for multicast discovery

- In traditional LAN environments, multicast protocols like MDNS, SSDP, and LLMNR are widely used for device discovery, allowing clients to find printers, projectors, and other devices within the same L2 network.
- Leaf switches actively identify these types of packets, then encapsulate the with VXLAN headers and forward them over VXLAN tunnels to other Leaf switches.

SMAC	DMAC
Leaf	Spine
SIP	**DIP**
LeafA	LeafB
VXLAN	
SIP	**DIP**
PC1	224.0.0.251
UDP	

SMAC	DMAC
PC1	01:00:5e:00:00:fb
SIP	**DIP**
PC1	224.0.0.251
UDP	



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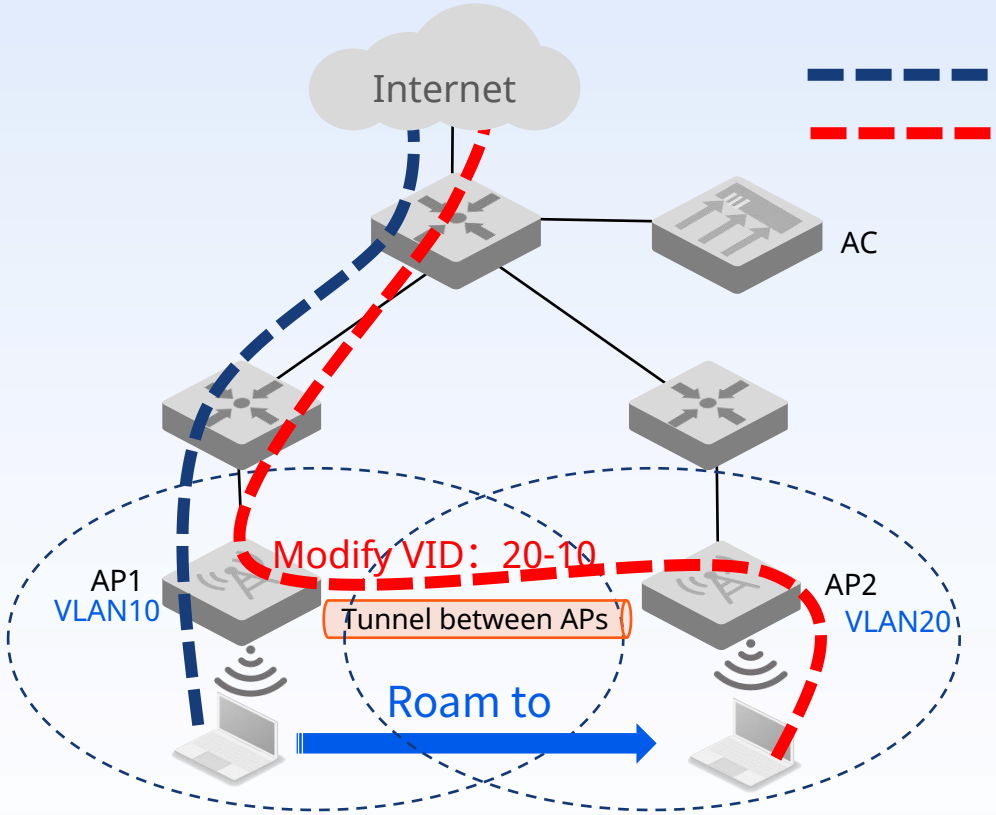
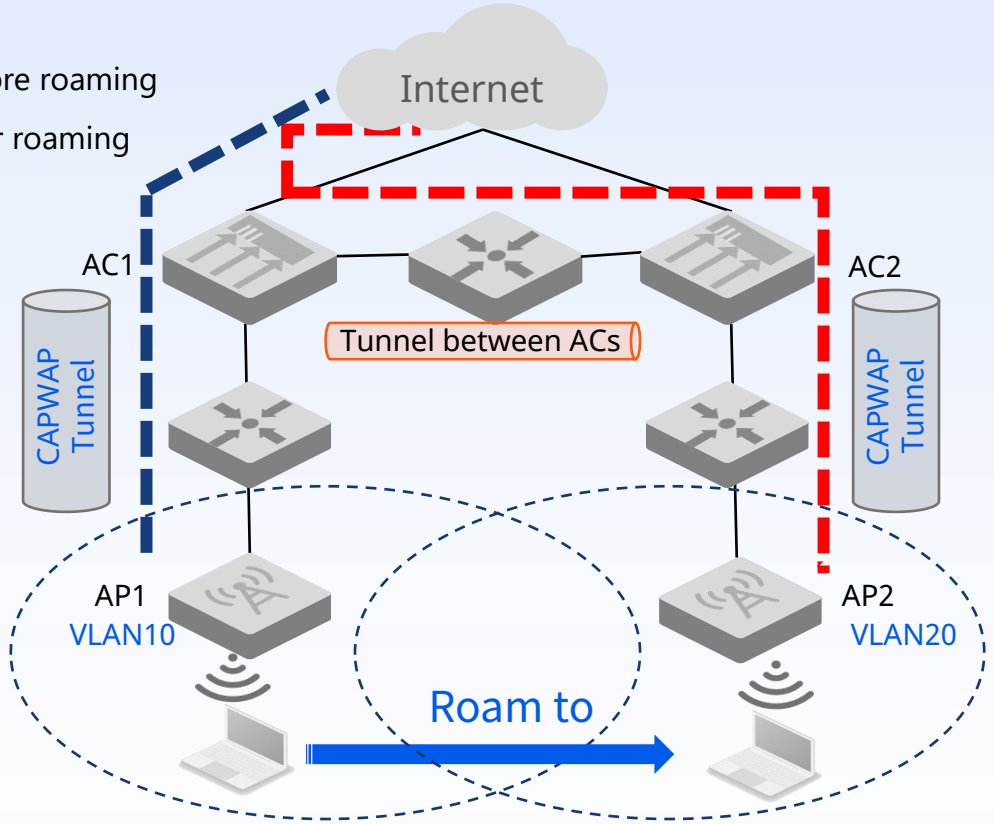
Inefficient traditional L3 roaming





L3 roaming within an AC

1. Build a tunnel between APs
2. Route roamed traffic via the tunnel to original AP
3. The original AP modify VLAN ID before forwarding it

L3 roaming between ACs

1. Build roaming group and tunnel between ACs
2. After roaming, traffic will be sent to AC2 first, then sent to AC1 via the tunnel
3. AC1 relays the traffic

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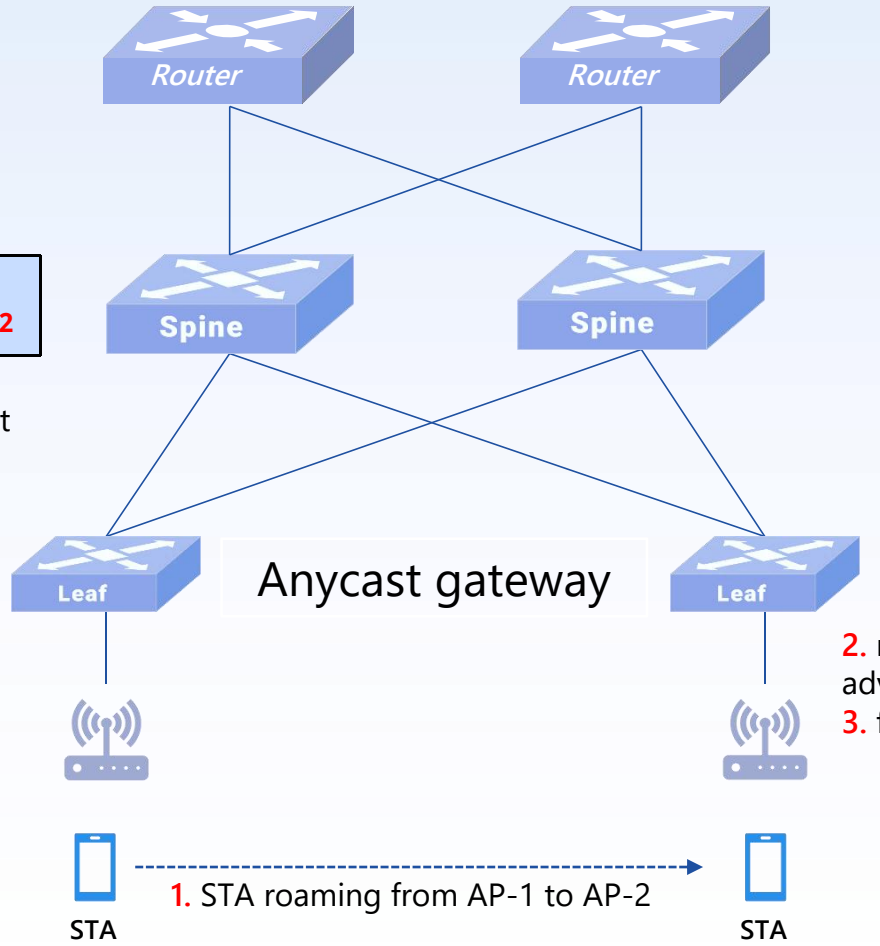
Asterfusion Anycast Gateway WiFi Roaming



Spine-1 RIB:	Default STA	Router 1&2 ~~Leaf-1~~**&Leaf-2**

4. Spine received host route and add it
6. Delete BGP route of STA to Leaf-1

Leaf-1 RIB:	Default ~~STA~~	Spine 1&2 ~~Local~~

5. Leaf-1 received notification from fast-migration, delete local host route of STA and revoke BGP host route

- AP simply forwards all traffic to its uplink leaf switch but do no local switching
- Anycast gateway on each leaf switch so that roaming clients always keep the same IP address to eliminate reconnecting when hand over from one switch to another
- BGP-EVPN between leaf and spine, leaf distributes local ARP hosts to all spines so that spines understand how to route roaming traffic.
- Home leaf switch authenticating clients and storing info, then sync the info to the remote leaf switch when clients hand over to the new one.

2. mac-trigger: Learn ARP, ARP-TO-HOST, BGP host route advertise
3. fast-migration: notify to revoke the original route

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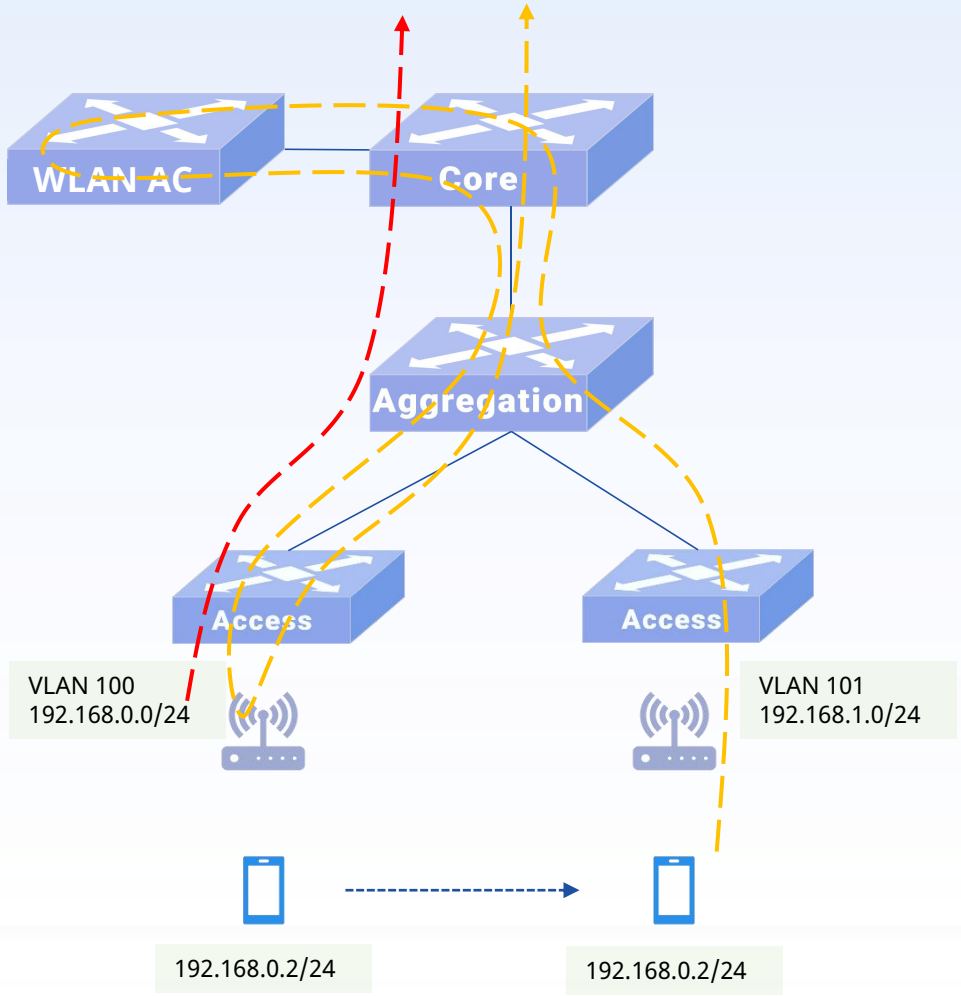
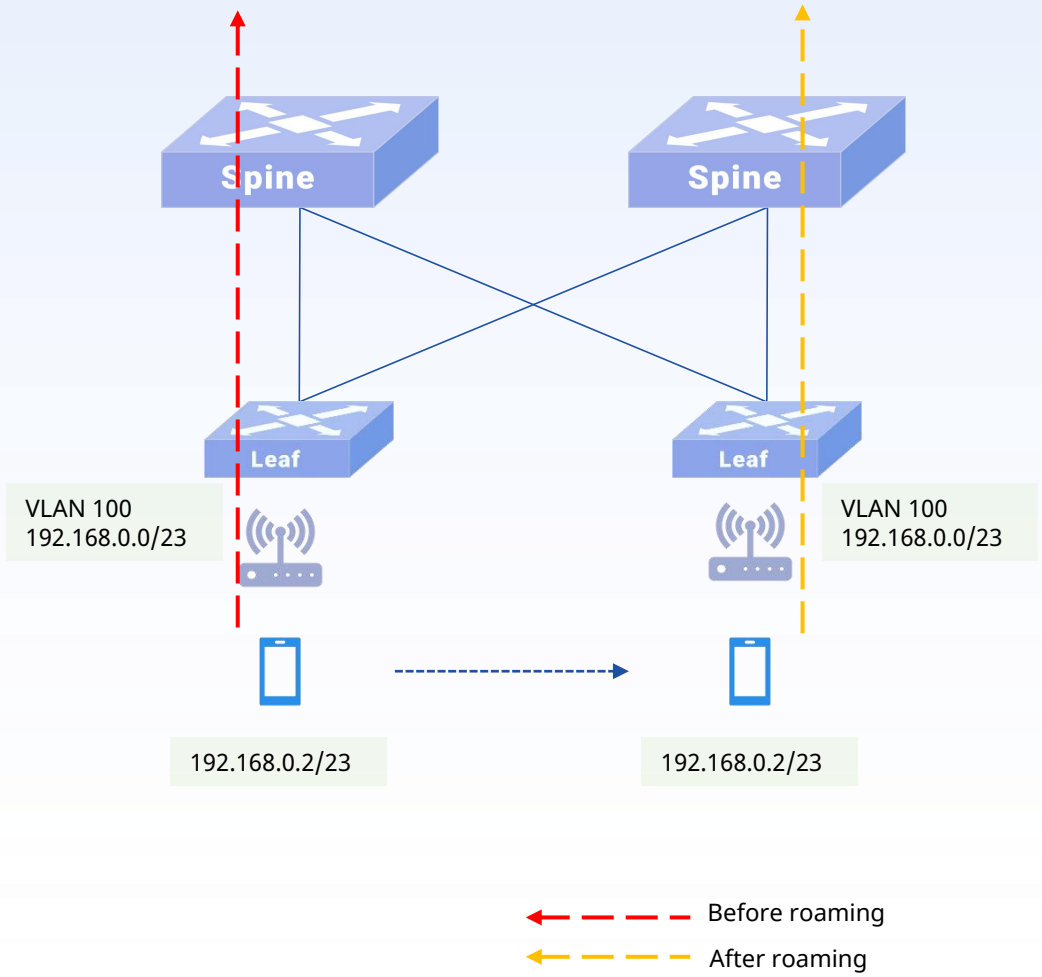
Comparison

Traditional Wireless Roaming:
Dividing subnets results in L3 roaming



Anycast Gateway Roaming:
All L2 roaming in a big subnet



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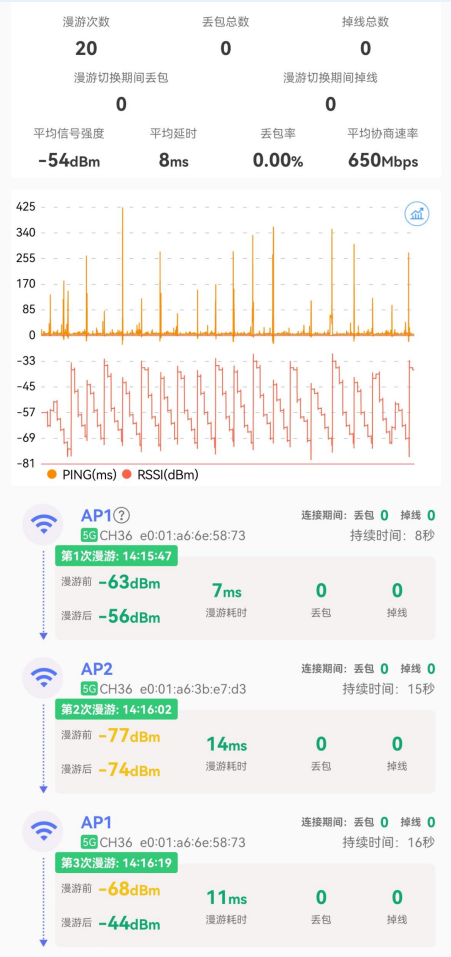
Test result

- Asterfusion's unique algorithm achieves zero-perception roaming and low latency, with an average roaming handover time of 10ms



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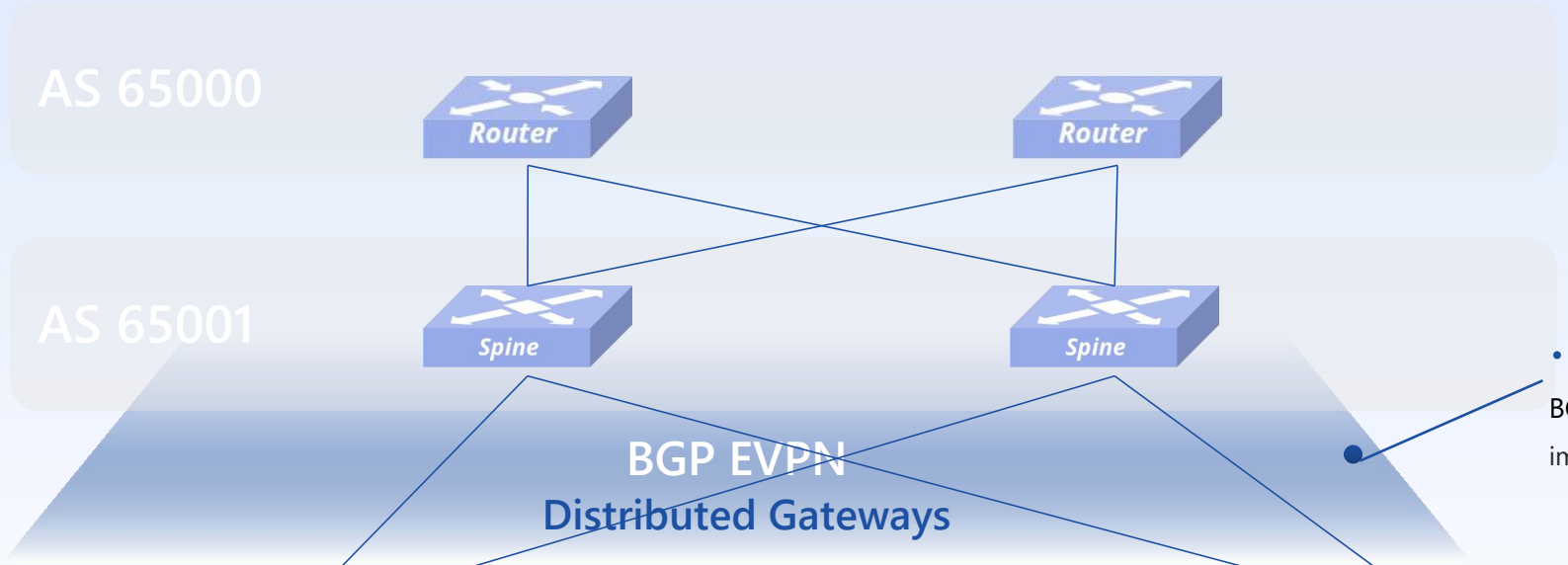
Full Layer 3 Network avoid Broadcast and Loop



- **EVPN Routing**

BGP-EVPN as the control plane implement loop free routing

- **Broadcast Drop**

The broadcast drop function is enabled in VLAN, so broadcast messages such as ARP are not broadcast in the VLAN.

- **ARP Suppression**

Leaf switch as ARP proxy responds to ARP requests, reducing broadcast traffic within the network

- **AP Strict Forwarding**

The AP will not forward traffic directly between clients.
All traffic will be sent to the Leaf switch, which will lookup the routing table and forwarding it.

- **Broadcast to Unicast**

Convert a broadcast packet from the upstream link into multiple unicast packets helps reduce air interface resource consumption

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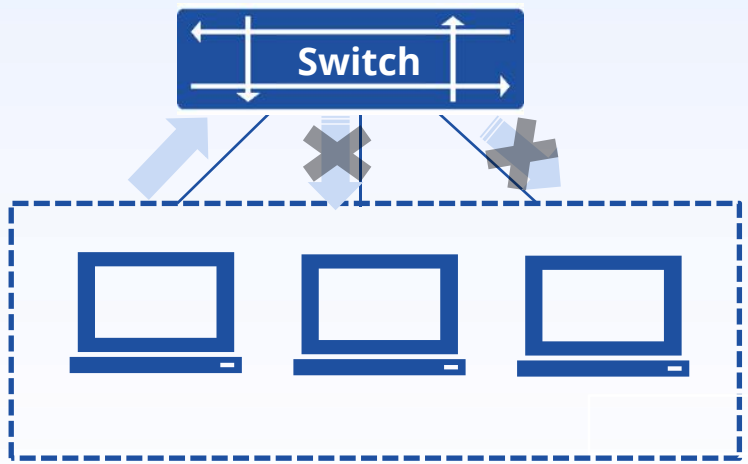
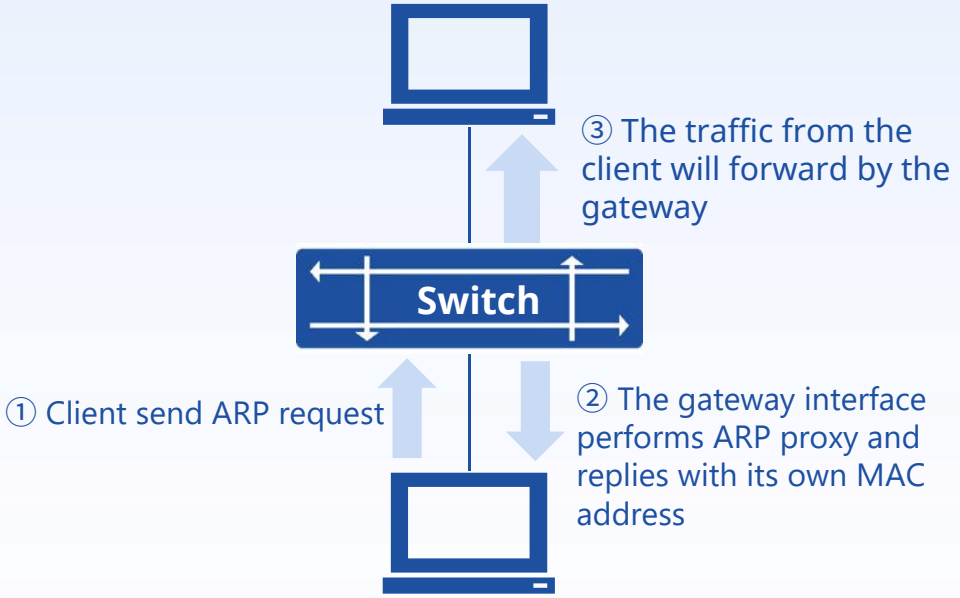
Implementation of Full Layer 3 Broadcast-Free Network

Broadcast Drop



Broadcast packets sent by clients, except for protocol packets such as ARP, will be sent to the switch CPU for processing, while other broadcast packets will be discarded. Isolate Layer 2 broadcast attacks between clients.

ARP Suppression



The Leaf switch turns on the ARP proxy function and uses its own MAC address to quickly proxy the client's request. The client's access is forwarded by the gateway, further suppressing the propagation of broadcasts in the network.

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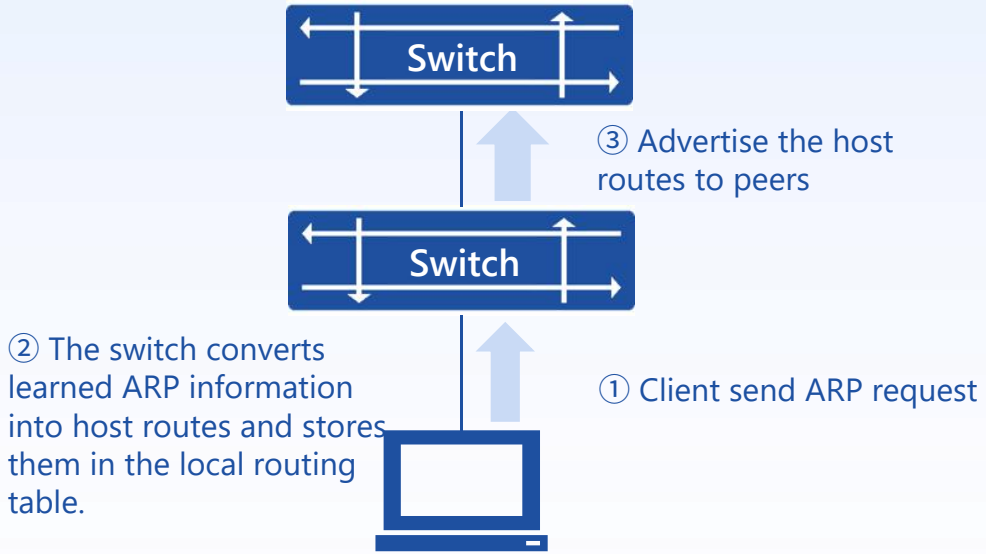
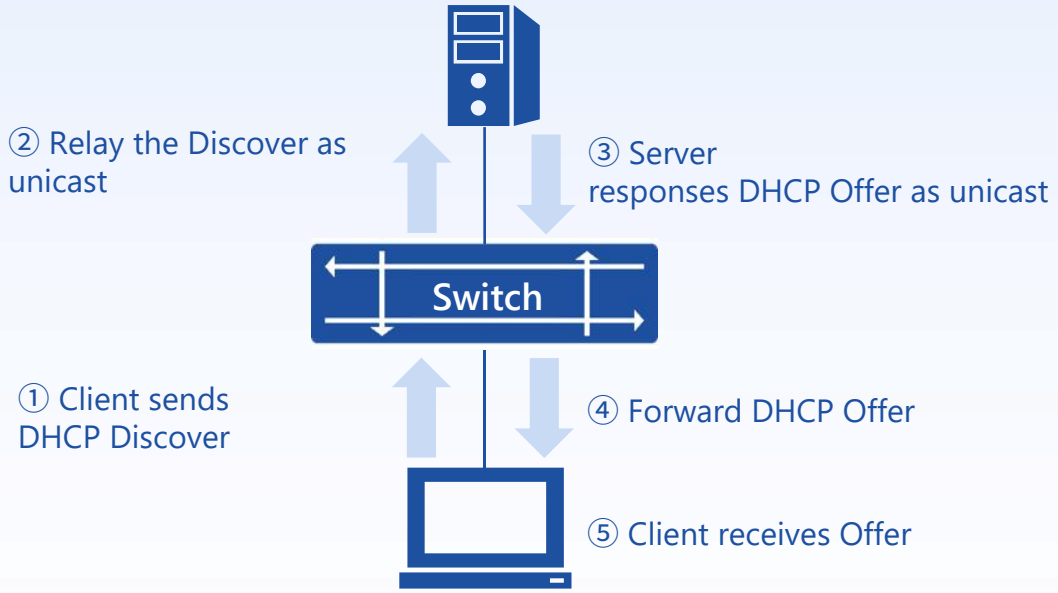
Implementation of Full Layer 3 Broadcast-Free Network

ARP-TO-HOST



With the ARP-to-Host feature, the switch converts ARP/NDP entries into precise host routes for routing, eliminating excessive broadcast flooding and improving forwarding efficiency.

DHCP Relay



With DHCP relay, the switch forwards all DHCP interactions from clients as unicast.

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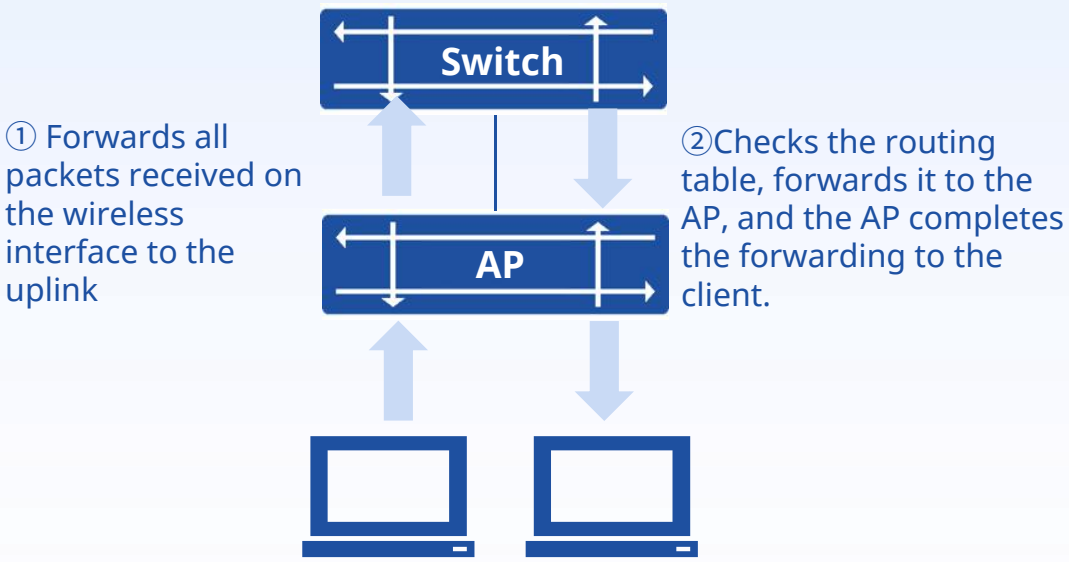
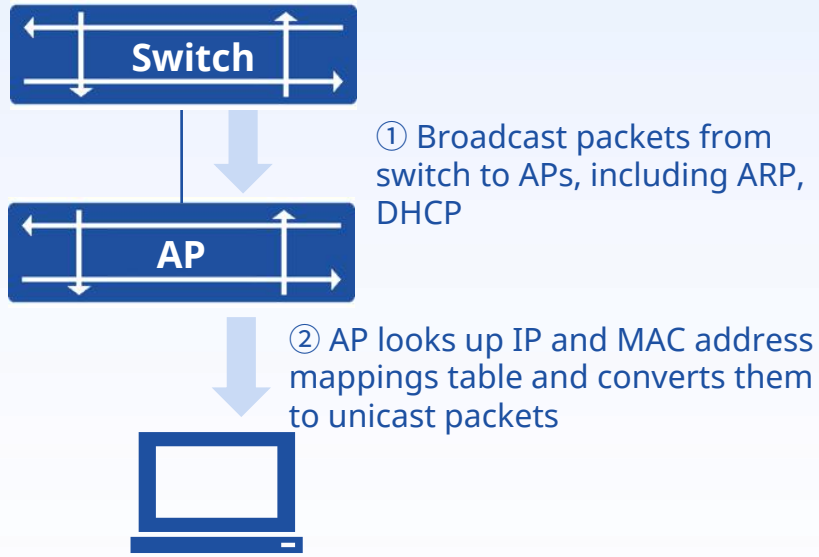
Implementation of Full Layer 3 Broadcast-Free Network

Strict Forwarding



With strict forwarding enabled on the AP, all packets received on the wireless interface, except multicast packets, are forwarded to the uplink, preventing wireless clients from directly learning each other's real MAC addresses on the AP.

Broadcast to Unicast



The AP converts broadcast packets received from the uplink into unicast packets by matching local IP and MAC address mappings table, reducing the use of air interface resources by minimizing broadcast traffic.

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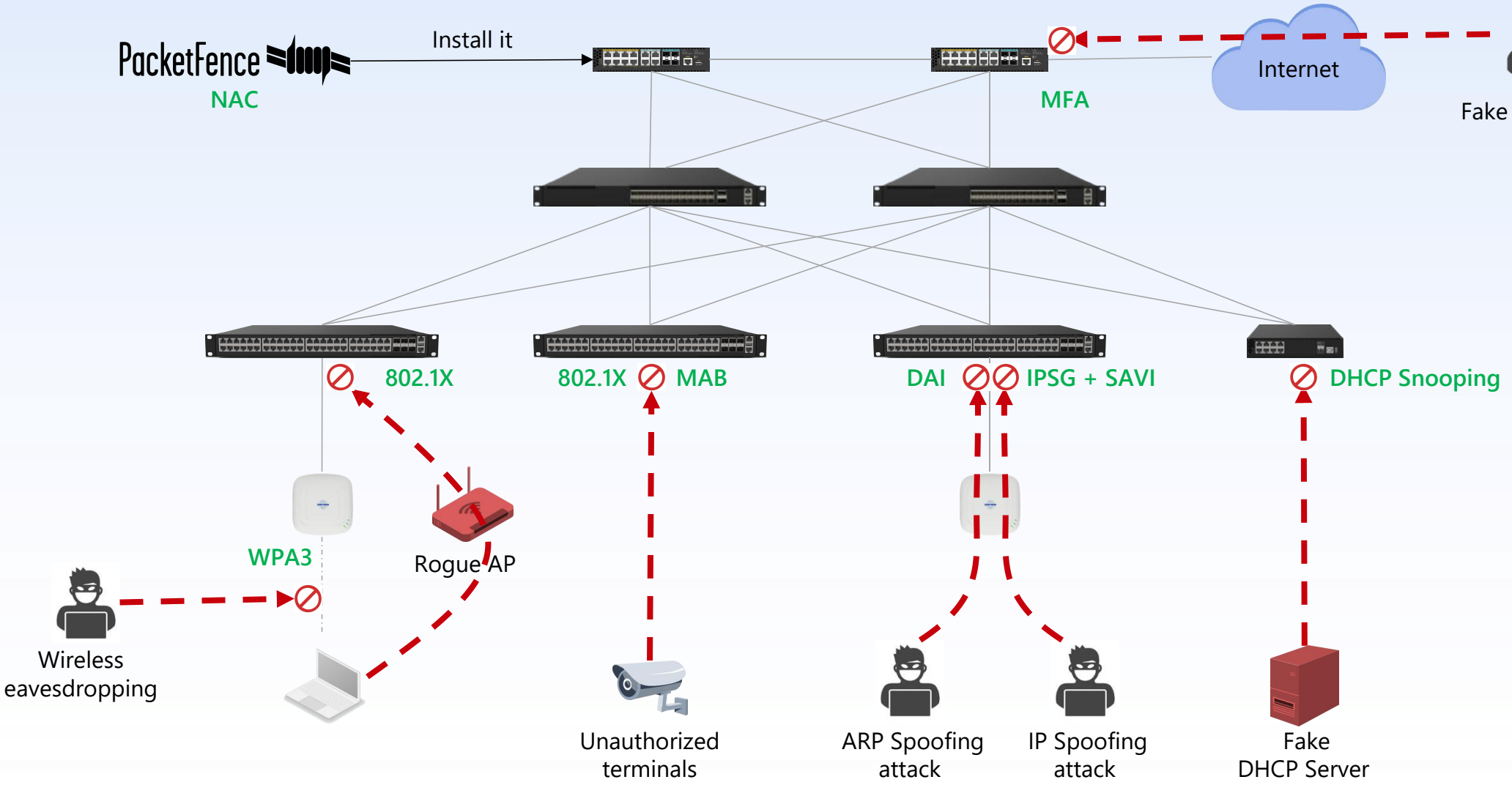
Comprehensive Access Security Mechanisms



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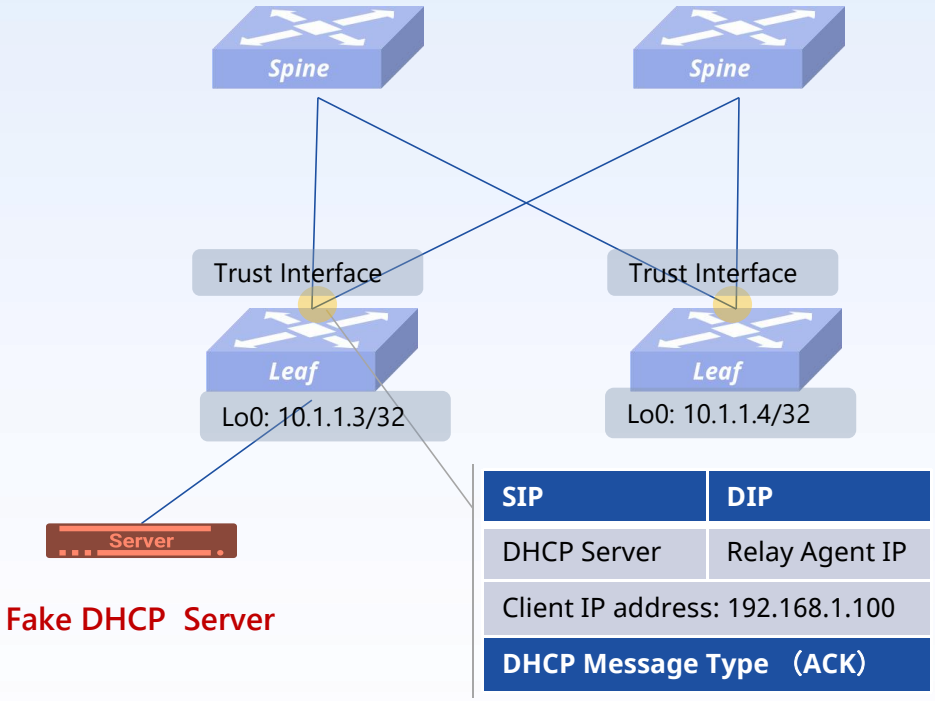
DHCP Snooping



MAC	IP	Lease time	Switch ID	Type
e2:5b:3b:c6:a5:c3	192.168.1.100	7200	10.1.1.3	local
e2:5b:3b:c6:b1:02	192.168.1.101	7200	10.1.1.4	remote

The generation of DHCP Snooping Table

The DHCP server sends the DHCP ACK packet to the Leaf switch via unicast. Upon receiving the DHCP ACK packet from a trusted interface (DHCP Snooping), the Leaf extracts key information (including the PC's MAC address, assigned IP address, and lease time) and generates a Snooping entry.

The purpose of DHCP Snooping

1. When fake DHCP servers are present in the network, DHCP clients may obtain incorrect IP addresses, leading to communication issues.
2. DHCP Snooping Trust only accepts DHCP Offer and DHCP ACK packets from trusted ports, discarding DHCP packets from untrusted ports.
3. The DHCP Snooping table records the IP and MAC address mappings of DHCP clients. By matching packets with the DHCP Snooping table, unauthorized terminal attacks can be prevented. Additionally, ARP request packets can be generated based on client information in the Snooping table to probe silent terminals.

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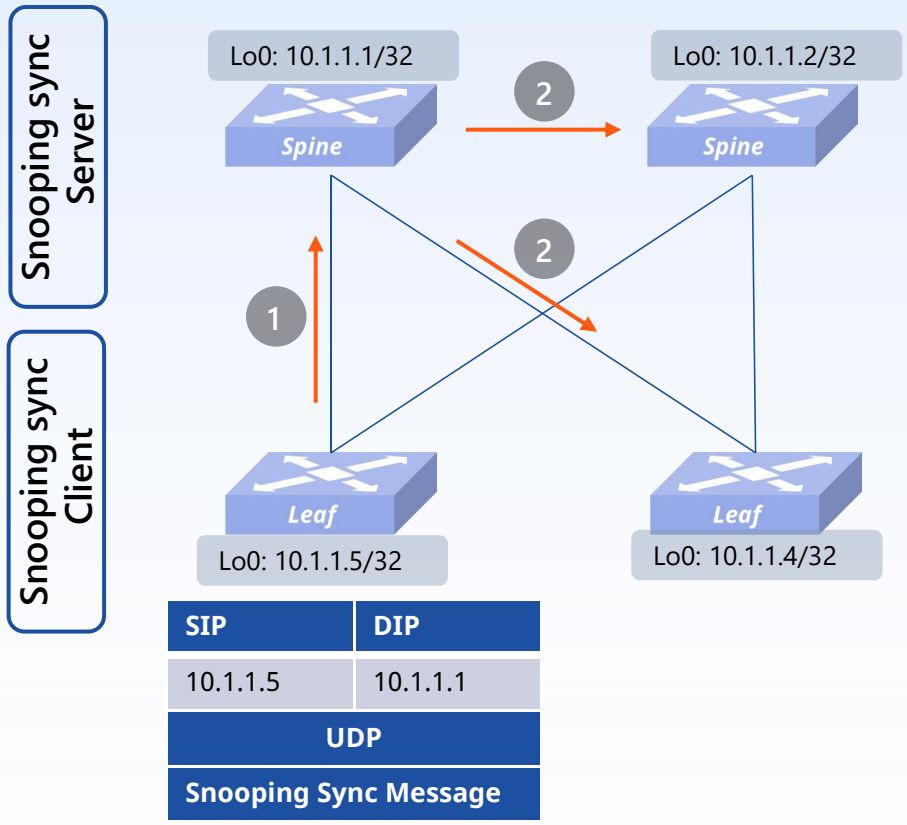
Synchronize Snooping Table across Network



1. The Leaf switch randomly selects a Spine switch to send the Snooping table synchronization message.
2. Upon receiving the Snooping synchronization message and learning the entries, the Spine switch will synchronize these entries with other Leaves and Spines.
3. Finally, DHCP Snooping entries are synchronized across all switches in the network, allowing packet matching and verification as wireless terminals roam within the network, preventing unauthorized terminal attacks.

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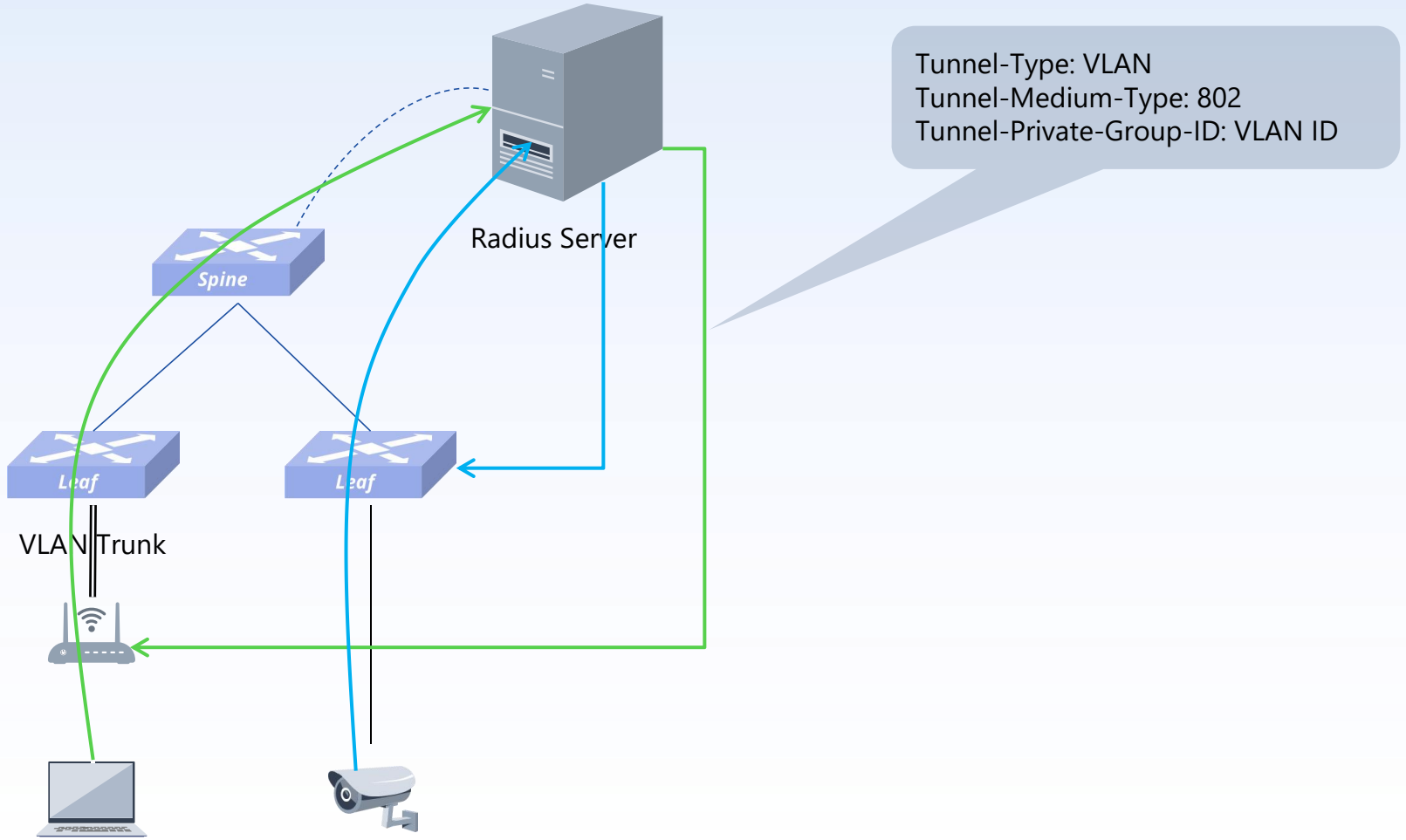
Dynamic VLAN via Authentication

- Allocate dynamic VLAN to Wired clients and configure the leaf switch
- Allocate dynamic VLAN to Wi-Fi clients and configure the AP or the leaf switch



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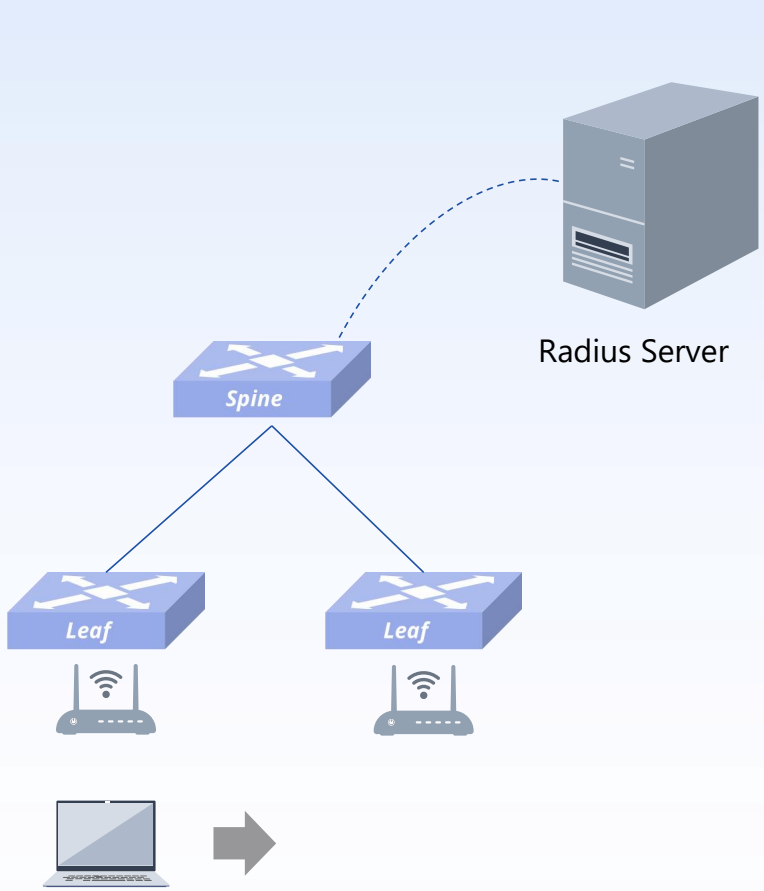
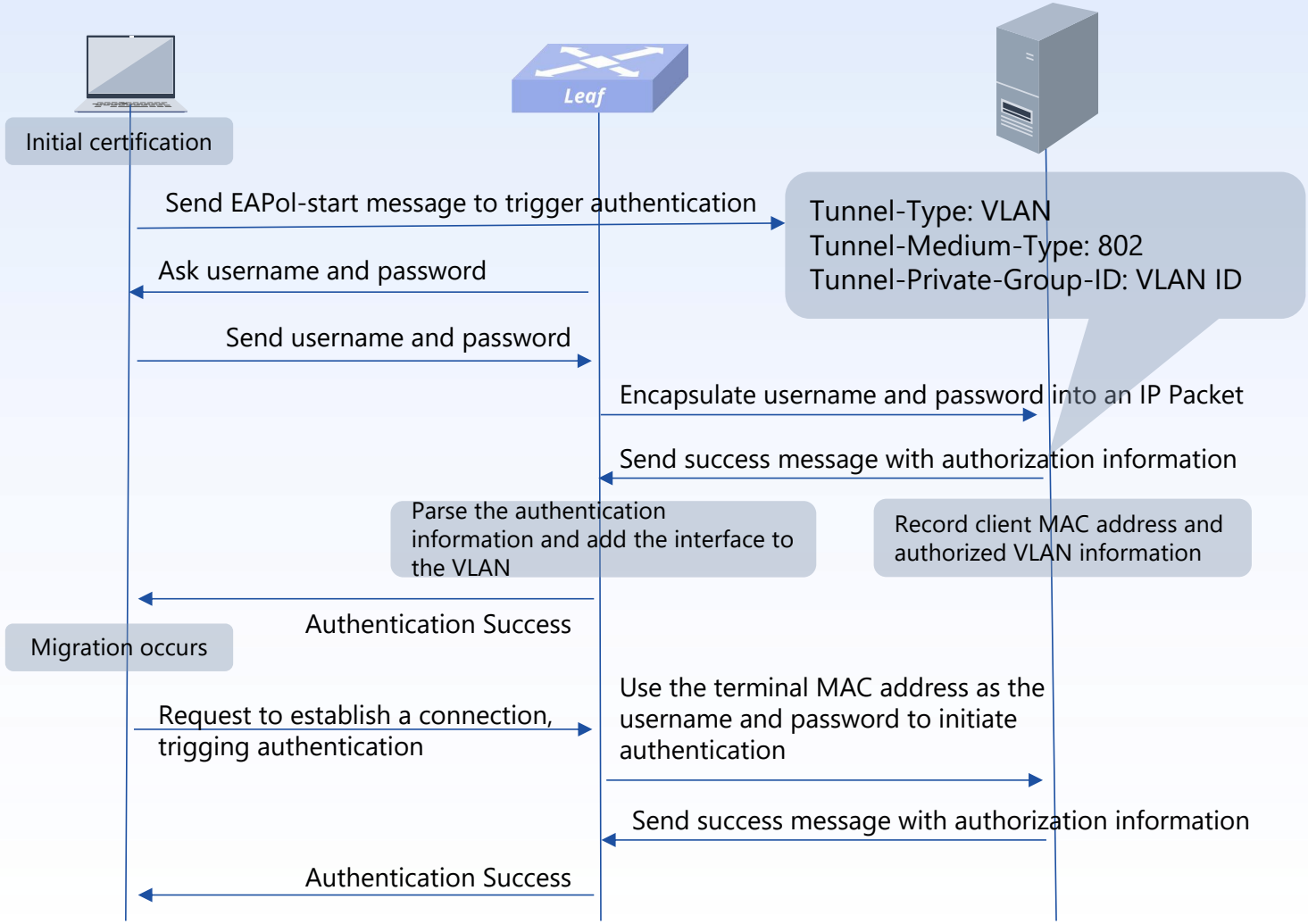
Authentication Persistence during Roaming





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AGENDA

01 Underlay Network

02 Overlay L2 VPN

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06 OpenWiFi Controller

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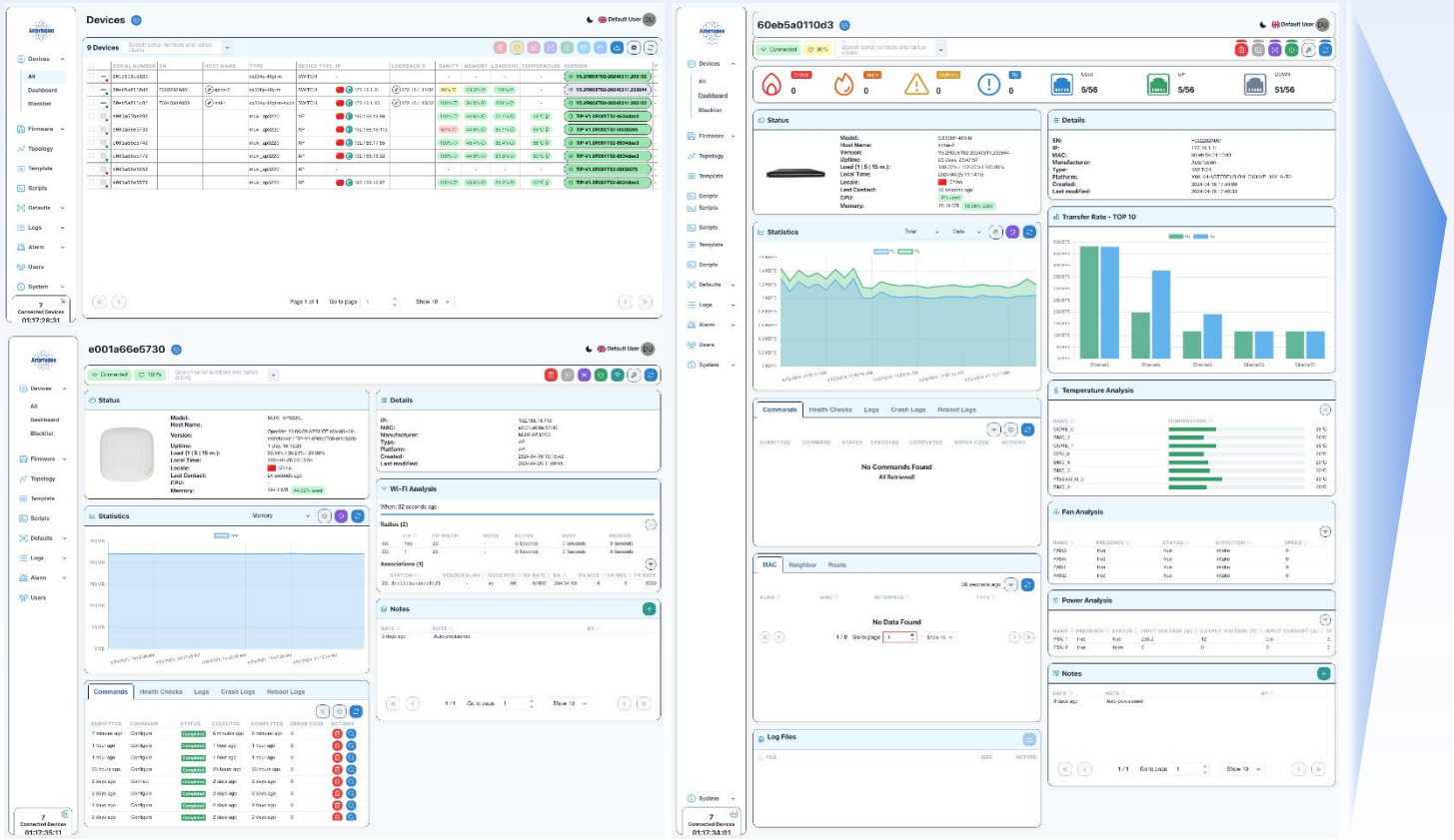
Asteria Campus Controller



- Unified management of wired and wireless networks
- Auto deployment and configuration using ZTP
- Automatically topology showing
- Real-time network status monitoring
- Automated operation using pre-defined scripts
- Comply with OpenWiFi standard
- ZERO license cost for on-prem deployment

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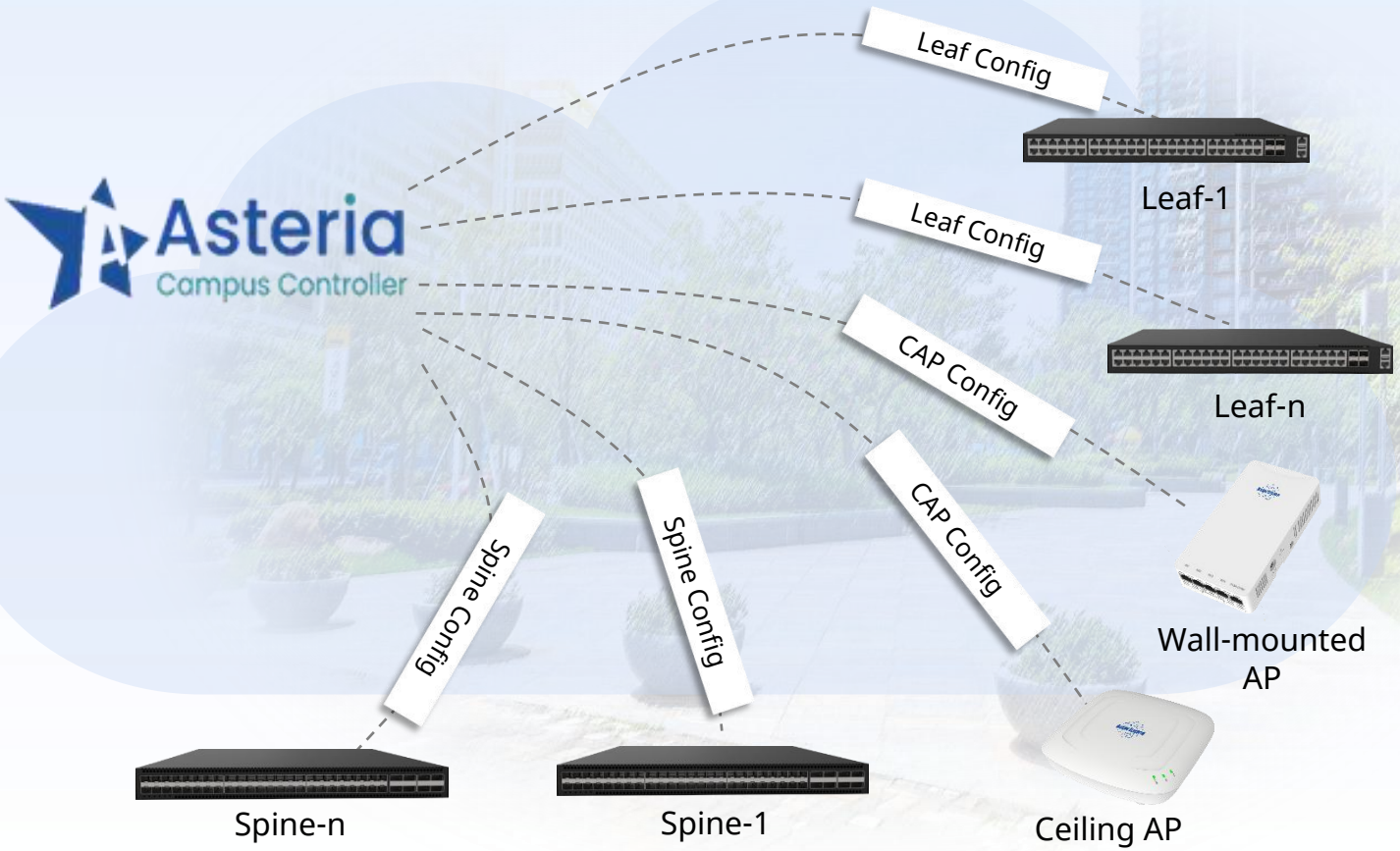
Config All Campus Network Devices



- **Brief steps**

1. Design network topology
2. Connect the devices to the controller
3. Automatically deploy the configuration to the devices by ZTP

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OpenWiFi Compatible

Asteria
Campus Controller

Asterfusion OpenWiFi & OpenLAN compatible Switches

Configure and monitor by
open sourced OpenWiFi compatible
ucentral client

Work together


AP6050 Wi-Fi6E Ceiling


AP6030 Wi-Fi6 Ceiling


AP6020W Wi-Fi6 Wall Mount


AP6031 Wi-Fi6 Outdoor

Asterfusion OpenWiFi compatible APs

Asterfusion OpenWiFi+ OS

ACCTON

Edge-corE NETWORKS

CIG

3rd Party APs with OpenWrt

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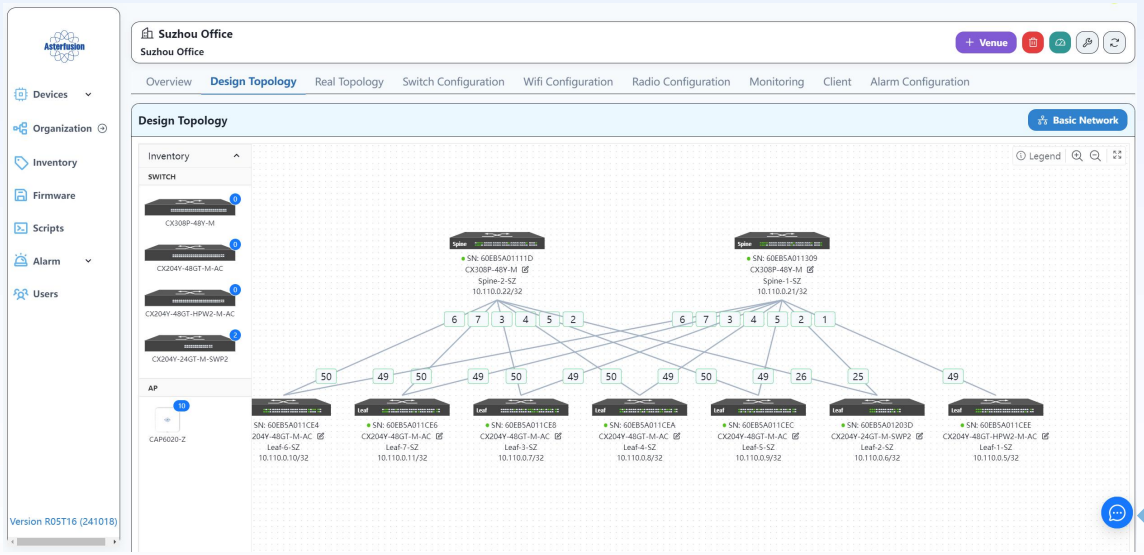
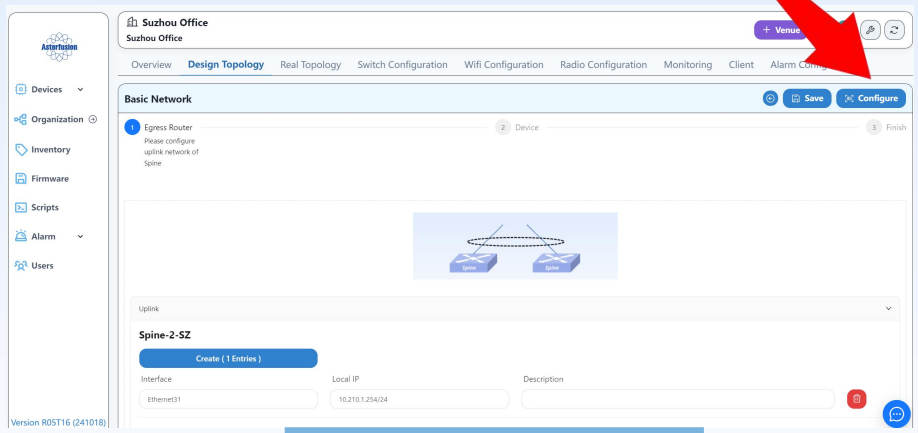
One-Click Network Configuration after Topology Design

Design Topology

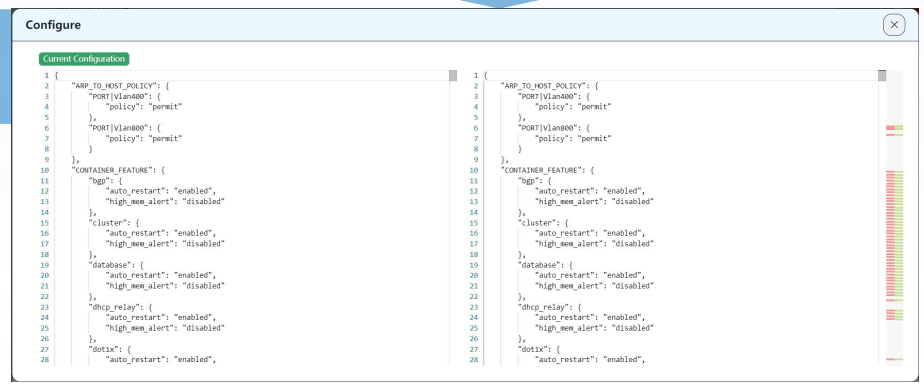


Automatically Deploy via ZTP

Click it



Automatically generate configuration of all devices



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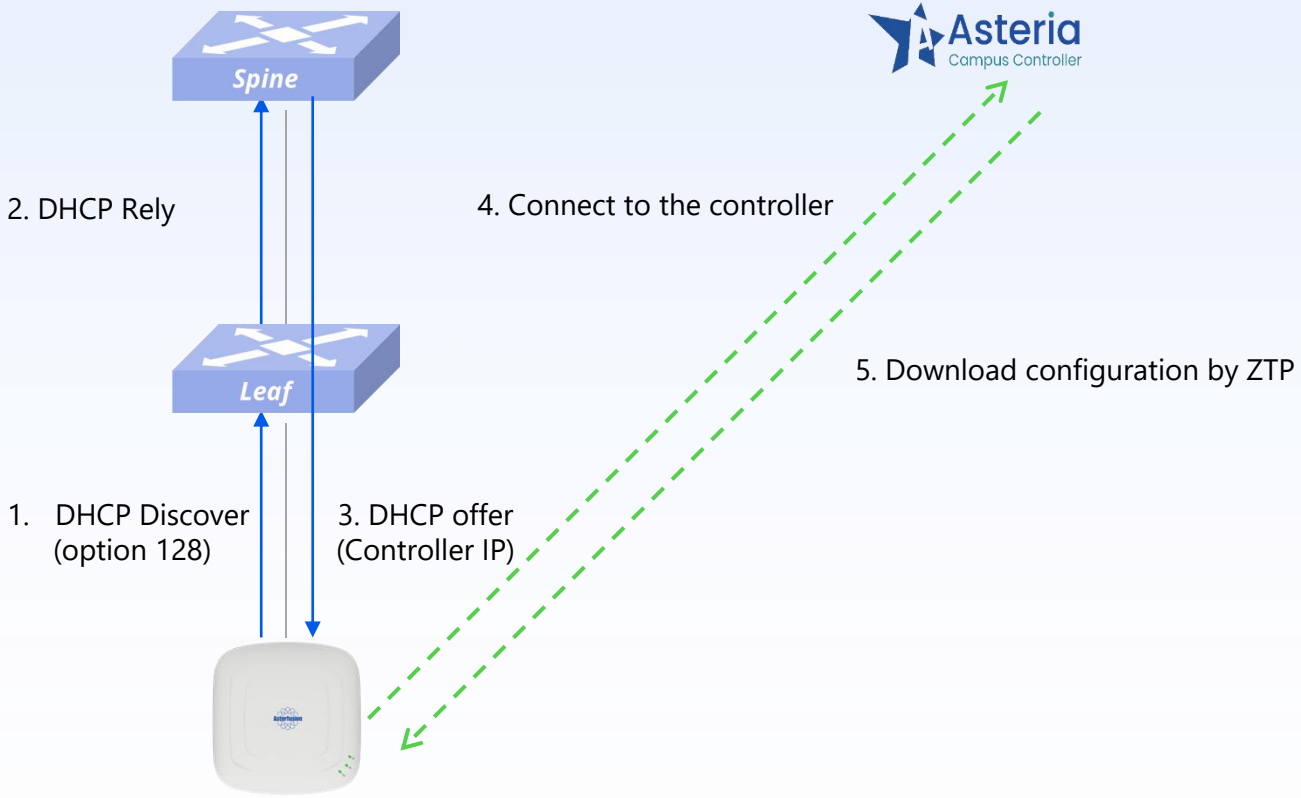
Automated Configuration Process via DHCP and ZTP



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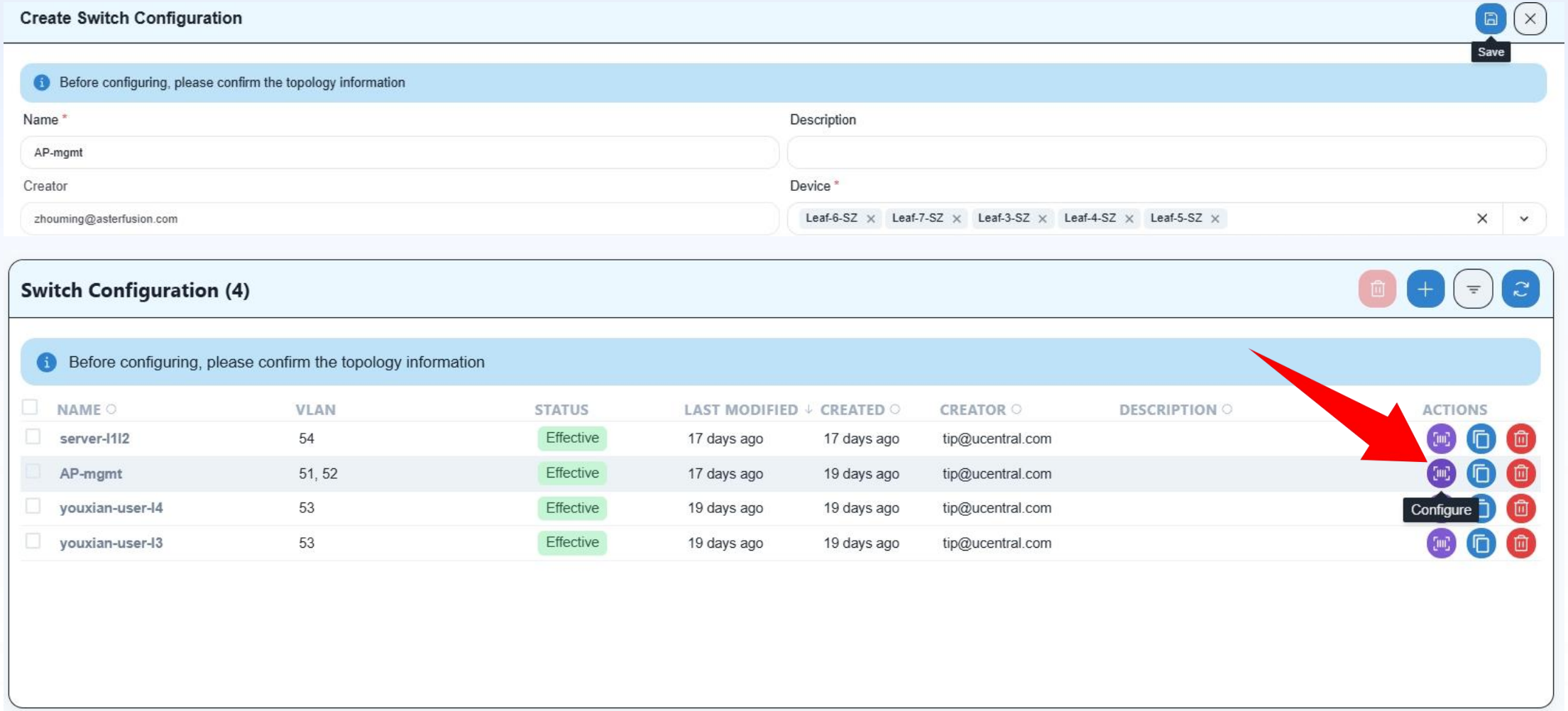
One-Click Function Activation for Entire Network

- Easily activate VLAN, DHCP Relay, ACL, DAI, IPSG, 802.1x and more functions on multiple devices



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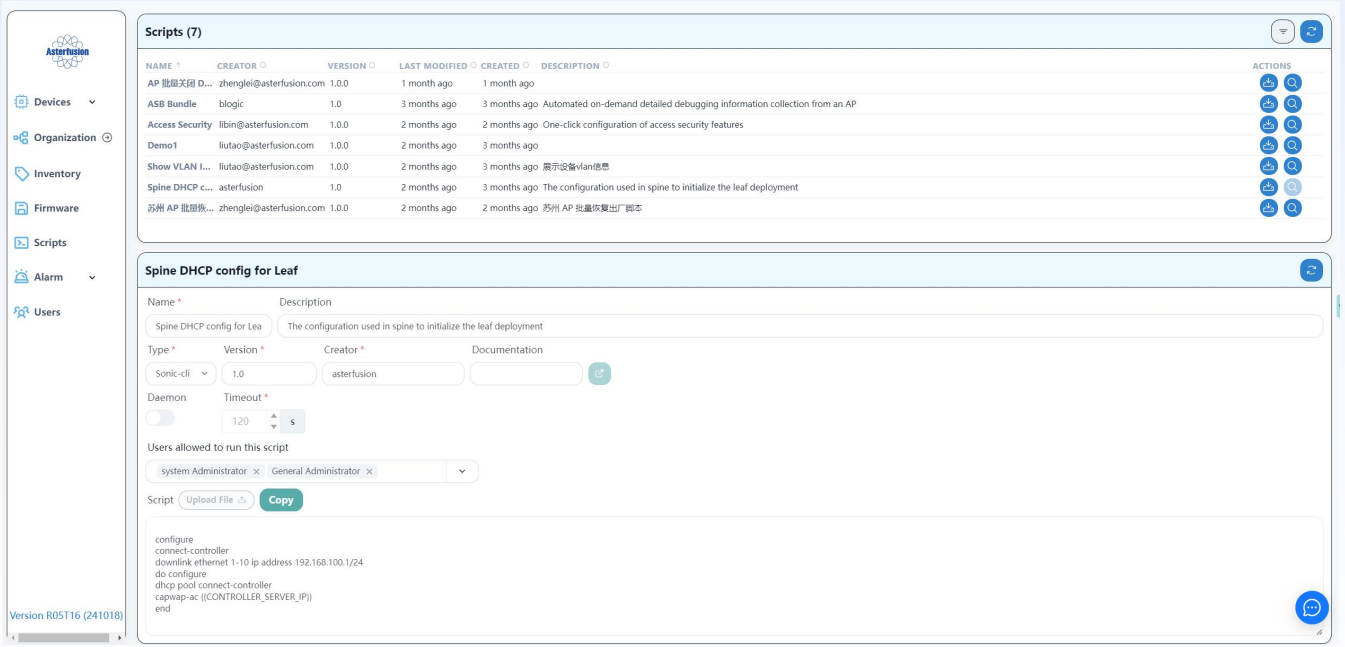
Self-Defined Scripts

- Users can create scripts using Shell, Bundle, or SONiC-CLI languages
- For example, if you need to configure DHCP on all spine switches to initialize leaf deployments, you can create a single, tailored script and deploy it across multiple devices as needed.
- Significantly reduces operational and maintenance (O&M) costs by automating tasks.



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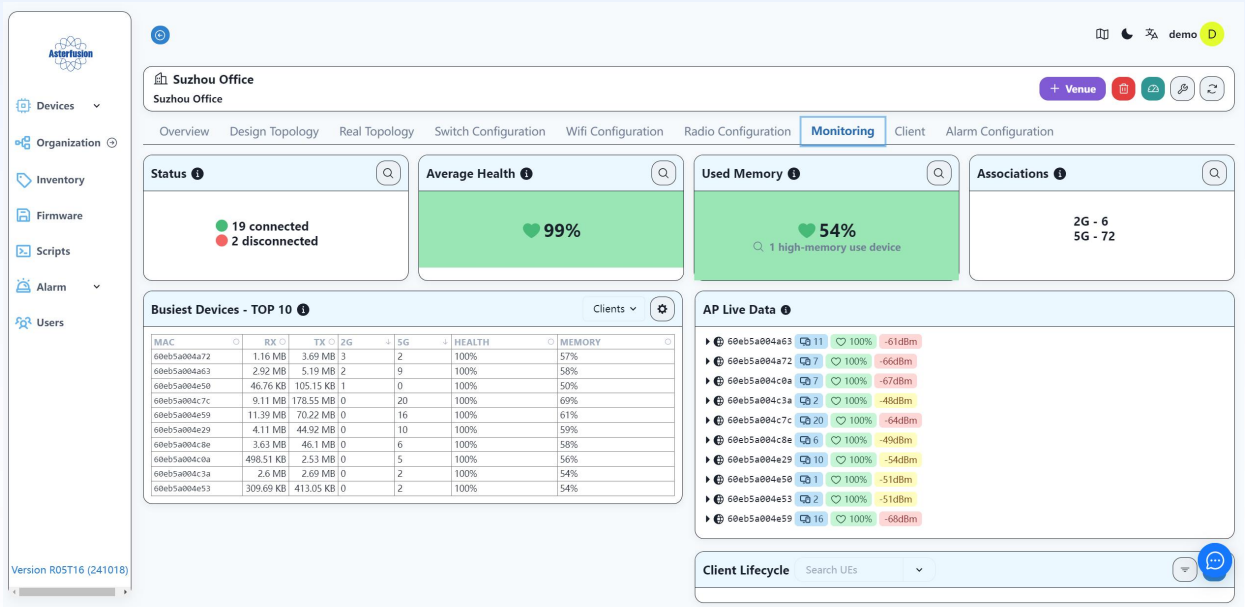
Real-time & Multi-dimensional Network Status Monitoring

- **Resource Utilization**: Identifying risks of memory or CPU exhaustion
- **Traffic Load**: Pinpointing potential bottlenecks through in-depth traffic analysis
- **Hardware Status**: Ensuring components operate within safe temperature ranges and that power supplies and fans function correctly
- **Signal Status**: Real-time visibility into the status of Wi-Fi signal



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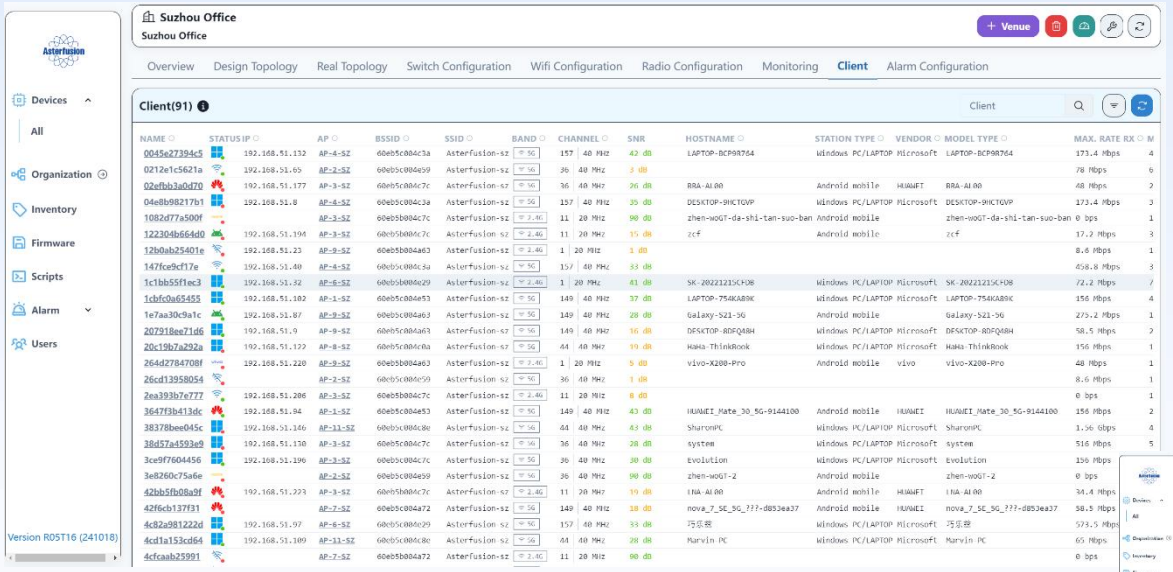
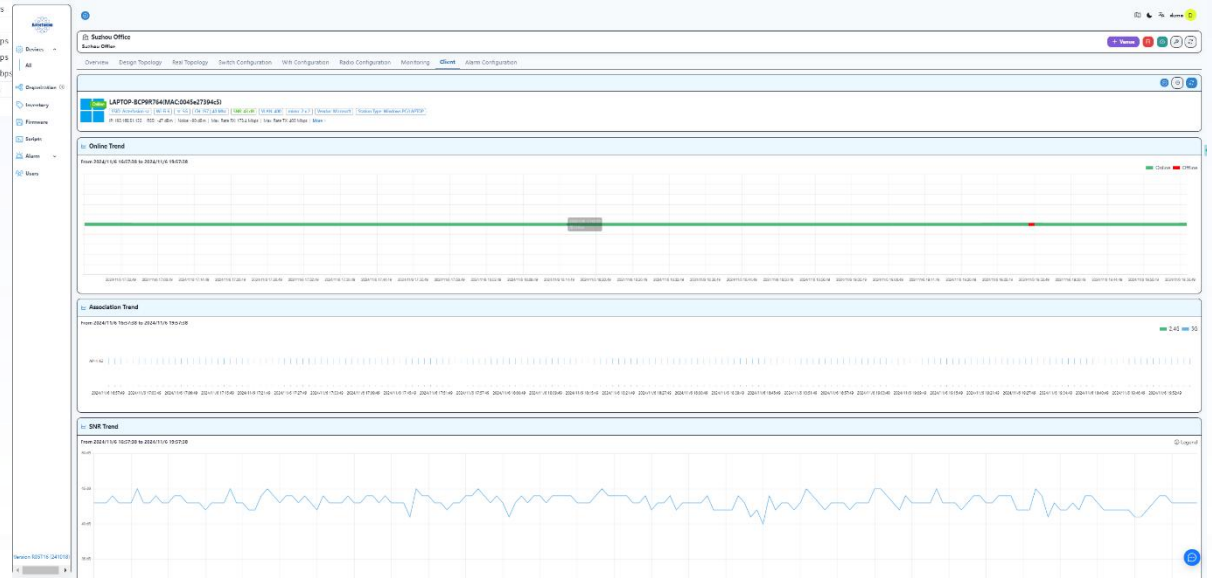
Monitor Client Status



Report basic information of clients

Show vendor, hostname, IP and MAC

View onlie status, including SNR, channel, negotiated rate, etc.



Connection status traceback

Records online status, signal quality, traffic, location of connected AP and other information within 3 hours, making it easier for operator to view the current wireless user's Internet access status and accelerate the rapid location of network faults.

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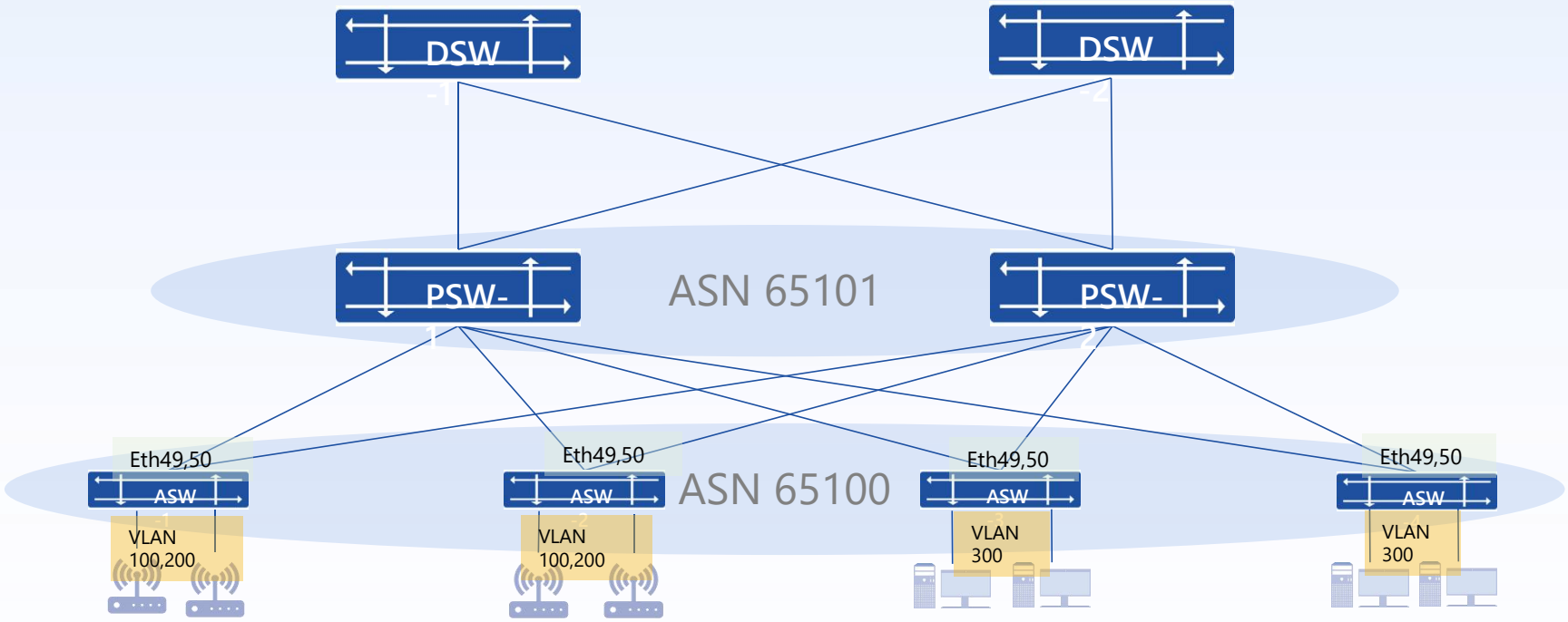
The campus network of one of biggest CSP in China

- 30,000+ employees
- 984,500 square meters
- 7 smart buildings



- ASW（Access Switch） - PSW（Point of Service Switch） - DSW（Distribution Switch）

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Thanks for Listening

https://cloudswit.ch