

VTP

| Server | Client | Transparent |
|-------------------------------|-------------------------------|-------------------------------|
| create/modifies/deletes VLANs | synchronizes VTP information | create/modifies/deletes VLANs |
| synchronizes VTP information | originates VTP advertisements | stores VLAN info in NVRAM |
| originates VTP advertisements | forwards VTP advertisements | forwards VTP advertisements |
| forwards VTP advertisements | | |
| stores VLAN info in NVRAM | | |

Default mode: **Server** Default version: **1** Default domain: **null**

Higher revision number in same domain = update VLAN database to match

To reset revision to 0 = Change VTP domain or VTP mode to transparent

cAse-Sensitive Domain, Password and VTP version must match

Banner

| | |
|--------------|-------------------------------|
| Banner motd | Message of the day (temp) |
| Banner login | Message at login (permanent) |
| Banner exec | Message at enable (permanent) |

Serial interfaces

| |
|----------------------------|
| Doesn't use ARP |
| Clock rate on DCE (Female) |
| HDLC default encapsulation |

VLANs

| | |
|-------------------|-----------------------|
| Usable VLAN Range | 1-4094 (12-bit) |
| Default VLANs | 1,1002-1005 (5 total) |
| Normal Range | 1-1005 |
| Extended Range | 1006-4096 |

Port numbers

Routing metric (best path)

| Protocol | Metric |
|----------|---------------------------------|
| RIP | Lowest hop count |
| OSPF | Lowest cost |
| EIGRP | Highest bandwidth, lowest delay |
| BGP | Shortest AS path |

IPv6 dynamic routing

RIPng, EIGRP for IPv6, OSPFv3, MP-BGPv4

Classless routing (includes /mask)

| | |
|-----------|-------------------------|
| Classless | RIPv2, OSPF, EIGRP, BGP |
| Classful | RIPv1, IGRP |

Static route types

| | |
|--------------------|---------------------------|
| Directly connected | Exit-interface |
| Recursive | Nexthop-IP |
| Fully specified | Exit-interface+nexthop IP |
| Floating static | Higher AD >1 |

Max age defaults

| | |
|---------------------|-----|
| MAC table | 300 |
| Errdisable recovery | 300 |

Timers

OSPF DR/BDR election

- 1) Highest priority (0-255, 1 = default)
 - 2) Highest router-id (x.x.x.x)
- BDR will be second highest

Change require new election and **clear ip ospf process**

OSPF default cost (100 Mbps)

| Reference BW | Speed | Cost | Cost |
|--------------|--------------|------|-------|
| 100 Mbps | 10 Mbps | 10 | 10000 |
| 100 000 Mbps | 100 Mbps | 1 | 1000 |
| | 1000 Mbps | 1 | 100 |
| | 10 000 Mbps | 1 | 10 |
| | 100 000 Mbps | 1 | 1 |

Auto-cost reference-bandwidth <> (same on all OSPF routers)

OSPF multicast

| | |
|------------------------------|-----------|
| OSPF Routers HELLO | 224.0.0.5 |
| OSPF Designated Routers LSAs | 224.0.0.6 |

OSPF states

| |
|----------|
| Down |
| Init |
| 2-Way |
| Exstart |
| Exchange |
| Loading |
| Full |

SDN architecture

| TCP | UDP | TCP & UDP |
|------------------|-------------------------|-----------|
| FTP data (20) | DHCP server (67) | DNS (53) |
| FTP control (21) | DHCP client (68) | |
| SSH (22) | TFTP (69) | |
| Telnet (23) | SNMP agent (161) | |
| SMTP (25) | SNMP manager Trap (162) | |
| HTTP (80) | Syslog (514) | |
| HTTPS (443) | CAPWAP control (5246) | |
| | CAPWAP data (5247) | |
| Chef (10002) | | |
| Puppet (8140) | | |
| Ansible (22) | | |
| Salt (4505) | | |
| TACACS+ (49) | RADIUS (1812+1813) | |

| Protocol | HELLO / Holdtime |
|------------------------|------------------|
| CDP (L2) | 60 / 180 |
| LLDP (L2) | 30 / 120 |
| OSPF (L3) | 10 / 40 (x4) |
| EIGRP (L3) | 5 / 15 |
| STP forward delay (L2) | 15 |
| HSRP (L3) | 3 / 10 |

| IPv4 Protocol field | |
|---------------------|----------|
| Value | Protocol |
| 1 | ICMP |
| 6 | TCP |
| 17 | UDP |
| 88 | EIGRP |
| 89 | OSPF |

| | |
|-----------------------------|--------------------------------------|
| Application layer | App --> Controller (NBI) |
| Control layer | SDN controller receives instructions |
| Infrastructure layer | Controller --> devices (SBI) |



By **Emil1502**
cheatography.com/emil1502/

Published 5th February, 2025.
 Last updated 13th August, 2022.
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API

| | |
|----------------|---|
| Northbound API | REST API (<i>format</i> JSON, XML, OSGi) |
|----------------|---|

| | |
|----------------|--|
| Southbound API | NETCONF, RESTCONF, OpenFlow, OpFlex, onePK |
|----------------|--|

Automation = script to one device

Orchestration = scripts to many devices

Southbound SBI

| | |
|-------|-----------------------|
| OnePK | Cisco proprietary API |
|-------|-----------------------|

| | |
|----------|-------------------------------------|
| OpenFlow | uses an imperative SDN model |
|----------|-------------------------------------|

| | |
|--------|-------------------------------------|
| OpFlex | uses a declarative SDN model |
|--------|-------------------------------------|

| | |
|---------|------------------|
| NETCONF | uses XML and RPC |
|---------|------------------|

OSPF timers

| OSPF type | Hello | Hold |
|----------------------------------|-------|------|
| Broadcast | 10 | 40 |
| Nonbroadcast | 30 | 120 |
| Point-to-point | 10 | 40 |
| Point-to-multipoint broadcast | 30 | 120 |
| Point-to-multipoint nonbroadcast | 30 | 120 |

OSPF network type default

| Network | Default | DR/BDR election | Manual neighbor |
|----------------------------------|-------------------|-----------------|-----------------|
| Broadcast | Ethernet, FDDI | Yes | No* |
| Nonbroadcast | Frame Relay, X.25 | Yes | Yes |
| Point-to-point | PPP, HDLC | No | No* |
| Point-to-multipoint | | No | No* |
| Point-to-multipoint nonbroadcast | | No | Yes |

*Uses multicast to form neighbor adjacency

Routing algorithm

| | |
|------------|----------|
| OSPF/IS-IS | Dijkstra |
|------------|----------|

| | |
|-------|-----------------------------------|
| EIGRP | Diffusing Update ALgorithm (DUAL) |
|-------|-----------------------------------|

| | |
|-----|--------------|
| RIP | Bellman-Ford |
|-----|--------------|

Wireless QoS

| | |
|----------|--------------------------|
| Platinum | Voice (highest priority) |
|----------|--------------------------|

| | |
|------|-------|
| Gold | Video |
|------|-------|

| | |
|--------|-----------------------|
| Silver | Best effort (default) |
|--------|-----------------------|

| | |
|--------|------------------------------|
| Bronze | Background (lowest priority) |
|--------|------------------------------|

Dynamic routing

| | |
|-----------|-------------|
| Linkstate | OSPF, IS-IS |
|-----------|-------------|

| | |
|-----------------|------------|
| Distance vector | EIGRP, RIP |
|-----------------|------------|

| | |
|-------------|-----|
| Path vector | BGP |
|-------------|-----|

Multicast groups

| Protocol | IPv4 | IPv6 |
|--------------------------|-------------|------------|
| All nodes/host broadcast | 224.0.0.1 | |
| HSRPv1 | 224.0.0.2 | FF02::5/16 |
| OSPF HELLO (ALL) | 224.0.0.5 | FF02::5 |
| OSPF LSA (DR->DROTHER) | 224.0.0.6 | FF02::6 |
| EIGRP | 224.0.0.10 | FF02::A |
| VRRP | 224.0.0.18 | ff02::12 |
| GLBP | 224.0.0.102 | |
| HSRPv2 | 224.0.0.102 | |

Port status codes

| Hardware status | Line Protocol status | Typical reason |
|-----------------|----------------------|----------------|
|-----------------|----------------------|----------------|

Port status codes (cont)

| | | |
|---------------|------|--|
| admini str- | down | Has shutdown command configured |
| actively down | | |

| | | |
|------|------|---|
| down | down | Has no shutdown configured, but an error on the physical layer e.g. no cable connected or the other end is shut down |
|------|------|---|

| | | |
|----|------|--|
| up | down | Data link (L2) error e.g. wrong encapsulation HDLC-->PPP or Ethernet |
|----|------|--|

| | | |
|----|----|----------------------|
| up | up | All is well and good |
|----|----|----------------------|

Syslog severity

| Severity level 0-7 | Name |
|--------------------|---------------|
| 0 | Emergency |
| 1 | Alert |
| 2 | Critical |
| 3 | Error |
| 4 | Warning |
| 5 | Notification |
| 6 | Informational |
| 7 | Debugging |

Every Awesome Cisco Engineer Will Need Ise Daily

By default, syslog servers receive **informational messages (level 6)**.

FHRP virtual MAC

| Protocol | MAC |
|----------|----------------|
| HSRPv1 | 0000.0c07.acxx |
| HSRPv2 | 0000.0c9f.fxxx |
| VRRP | 0000.5E00.01xx |
| GLBP | 007.B400.xxyy |



Multicast MAC addresses

| Protocol | MAC |
|----------|----------------|
| CDP | 0100.0CCC.CCCC |
| LLDP | 0180.C200.000E |

IPv6 address types

| Group | IPv6 address group |
|--------------------|--------------------|
| Global Unicast | 2000::/3 |
| Link-local | fe80::/10 |
| Unique-Local | fc00::/7 |
| Unique-Local (new) | fd00::/8 |
| Multicast | ff00::/8 |
| Default route | ::/0 |
| Loopback | ::1 |

IPv6 multicast groups (FF00::/8)

| | |
|-----------|--------------------|
| FF01::/16 | node-local |
| FF02::/16 | link-local |
| FF05::/16 | site-local |
| FF08::/16 | organization-local |
| FF0E::/16 | global |

ACL range

| | |
|-------------------|---------|
| Standard numbered | 1-99 |
| Standard named | 1-99 |
| Extended numbered | 100-199 |
| Extended named | 100-199 |

Standard ACL as close to **destination** as possible

Extended ACL as close to **source** as possible

SNMP

| Class | Message | Sent by |
|--------------|---------|---------|
| Read | Get | NMS |
| | GetNext | |
| | GetBulk | |
| Write | Set | NMS |
| Notification | Trap | Agent |
| | Inform | |
| Response | Reponse | Agent |

HTTP status code

| Class | Response status code |
|--------------------------|--|
| 1xx informational | 102 Processing |
| 2xx successful | 200 OK 201 Created |
| 3xx redirection | 301 Moved Permanently |
| 4xx client error | 400 Bad Request 401 Unauthorized 403 Forbidden 404 Not Found 408 Request Timeout |
| 5xx server error | 500 Internal Server Error |

CRUD REST API (HTTP)

| Purpose | CRUD operation | HTTP Verb |
|---------------------|----------------|------------|
| Create new variable | Create | POST |
| Retrieve variable | Read | GET |
| Change variable | Update | PUT, PATCH |
| Delete variable | Delete | DELETE |

REST API encoding

Serialized format

JSON
XML
YAML

Power policing

| | |
|---|---|
| power inline police (default) | Disables port and send syslog. Must be re-enabled with shutdown and no shutdown |
| power inline police action err-disable | Same as power inline police |

Power policing (cont)

| | |
|---------------------------------------|---|
| power inline police action log | does NOT shut down but restarts the interface and sends syslog |
|---------------------------------------|---|

EIGRP K-values

| | | |
|----|-----------|---|
| K1 | Bandwidth | Lowest bandwidth of the route |
| K3 | Delay | Cumulative interface delay of the route |

Administrative Distance (Lower is better)

| Source | Default Distance | Table Entry |
|--------------------|------------------|-------------|
| Directly Connected | 0 | C |
| Static | 1 | S |
| eBGP | 20 | B |
| EIGRP | 90 | D |
| OSPF | 110 | O |
| ISIS | 115 | i |
| RIP | 120 | R |
| External EIGRP | 170 | D EX |
| iBGP | 200 | B |
| Unkown | 255 | |

Packet Forwarding Decision

- 1) Longest Prefix Match /
- 2) Gateway of last resort
- 3) Drop

Spanning Tree

| | |
|----------------------------|--------|
| Default STP on Cisco | PVST+ |
| PVST+ and RSTP compatible? | Yes |
| Rapid PVST | 802.1w |
| Legacy STP | 802.1d |

STP port election

Root bridge

1: Lowest bridge ID (superior)

Root port election

1: Lowest root cost

2: Lowest neighbor bridge ID

3: Lowest neighbor port ID

Designated port (per collision domain)

1: Interface on switch with lowest root cost

2: Interface on switch with lowest bridge ID

STP cost

| Speed | Cost |
|----------|------|
| 10 Mbps | 100 |
| 100 Mbps | 19 |
| 1 Gbps | 4 |
| 10 Gbps | 2 |

Port states

| Legacy STP (802.1D) | Rapid STP (802.1W) |
|---------------------|--------------------|
| Disabled | Discarding |
| Blocking | |
| Listening | |
| Learning | Learning |
| Forwarding | Forwarding |

Port Roles

| Legacy STP (802.1D) | Rapid STP (802.1w) |
|---------------------|---------------------------|
| Root | Root |
| Designated | Designated |
| Blocking | Alternate |
| | Backup (shared link, hub) |

WLC Interfaces (Logical)

| | |
|----------------------|--|
| Management interface | MGMT traffic, CAPWAP tunnels are formed to/from this interface |
|----------------------|--|

WLC Interfaces (Logical) (cont)

Redundancy MGMT interface Two WLCs connected as 'active' and 'standby' interface

Virtual interface Communicate with wireless clients e.g. relay DHCP requests

Service port interface Out-of-band MGMT bound to service port

Dynamic interface Used to map WLAN to a VLAN bound to port

Autonomous AP

Locally switched

Trunk/tagged between Distribution System (DS) and AP

Configured via Telnet, SSH or HTTP (GUI)

No central monitoring or management

Lightweight AP

Centrally controlled by WLC

Split-MAC architecture

Control and Provisioning of Wireless Access Points protocol (CAPWAP)

CAPWAP tunnel UDP 5246 (control) 5247 (data)

AP connect to access port

Local mode traffic can not be locally switched (default mode)

FlexConnect can be locally switched when CAPWAP is down

Modes: Local, flexConnect, monitor, sniffer, rogue detector, bridge, SE-Connect

Default console settings

9600 bits/second

8-bit ASCII

No parity bits

No flow control

1 stop bit

WLC controller

Max. 512 dynamic interfaces (WLANS)

Telnet timeout 5 min (Default)

Wireless security

| Version | Authentication | Encryption+MIC |
|---------|--------------------|-----------------|
| WPA | PSK | TKIP (RC4) |
| WPA-2 | PSK | AES 128 CCMP |
| WPA-3 | SAE (replaces PSK) | AES 256 GCMP |

SAE - Simultaneous Authentication of Equals

PMF - Protected Management Frame: Protects 802.11 mgmt frames

Forward Secrecy prevents decryption after transmitted

EAP authentication

| Method | Process |
|------------------|--|
| LEAP (Cisco) | Mutual authentication (least secure) |
| EAP-FAST (Cisco) | Uses a client PAC key |
| PEAP | 1-way server side certificate |
| EAP-TLS | 2-way server and client certificate (best) |

Port violation modes

| Mode | Disable interface | Increment counter | Syslog |
|----------|-------------------|-------------------|--------|
| Protect | No | No | No |
| Restrict | No | Yes | Yes |
| Shutdown | Yes | Yes | Yes |

Protect+Restrict discard traffic from unauthorized MACs (filter)

Enable SSH

- 1) Configure hostname (*other than Router or Switch*)
- 2) Configure domain name
- 3) Generate RSA keys
- 4) Transport input SSH on vty lines

Security methods

- 1) Something you know (Password, Pin)
- 2) Something you have (Card, Phone MFA)
- 3) Something you are (Biometric)

Site-to-site VPN (4 steps)

- 1) Combines session/encryption key with data and **encrypt both the data and the key**
- 2) The sending device **encapsulates** the encrypted data and session key and **adds a VPN header and a new IP header**
- 3) Sending device **sends the completed packet** to the destination device (other end of tunnel)
- 4) The destination or receiving device **decrypt the packet** with the sessions key

PCP CoS values (3-bit) voice

- | | |
|---|---|
| 0 | Best effort (default all traffic) |
| 3 | Critical application (IP phones mark call signaling traffic with 3) |
| 5 | Voice (IP phones mark voice traffic with 5) |

One-way delay: 150 ms or less

Jitter: 30 ms or less

Loss: 1% or less

Voice is **AF46** expedited forwarding EF

Configuration Register

- | | |
|---------------|---|
| 0x2102 | Factory default, load IOS from flash to NVRAM |
| 0x2100 | Load ROM monitor mode |
| 0x2142 | Load IOS from Flash without startup-config |

