Basics of Switched Networks

SWITCH Module 1

Agenda

- **Cisco Documentation**
- **Network Design**
- **Ethernet**
  - A brief introduction
  - L2 devices
- **Switch Port Analyzer**
- **Neighbor Discovery Protocols**
  - CDP
  - LLDP

Absolute Mandatory Commands Minimum

- To alleviate and ease your work with Cisco boxes in labs:

```
(conf)# line console 0
(conf-line)# logging synchronous
(conf)# line vty 0 15
(conf-line)# logging synchronous
(conf-line)# no login
(conf-line)# privilege exec level 15
(conf)# no ip domain-lookup
(conf)# ip host NAME IP
(conf)# terminal monitor
```

Course Recommendation

```
DLS1(config)# line vty 0 15
DLS1(config-line)# no login
DLS1(config-line)# privilege level 15
```

```
DLS1# terminal monitor
```

```
DLS1(config)# ip host als2 10.1.1.104
DLS1# als2
Trying als2 (10.1.1.104)... Open
ALS2#
ALS2# conf t

! Ctrl+Shift+6 and then x which simulates Ctrl^x

DLS1# show sessions
Conn Host                    Address                Byte   Idle Conn
Name
   1 DLS2                    10.1.1.102              671      0 DLS2
   2 ALS1                    10.1.1.103                0      0 ALS1
*  3 ALS2                    10.1.1.104                0      0 ALS2
DLS1# 3
[Resuming connection 3 to als2 ... ]

ALS2#
```

Cisco Web Documentation

Cisco Web Documentation ①

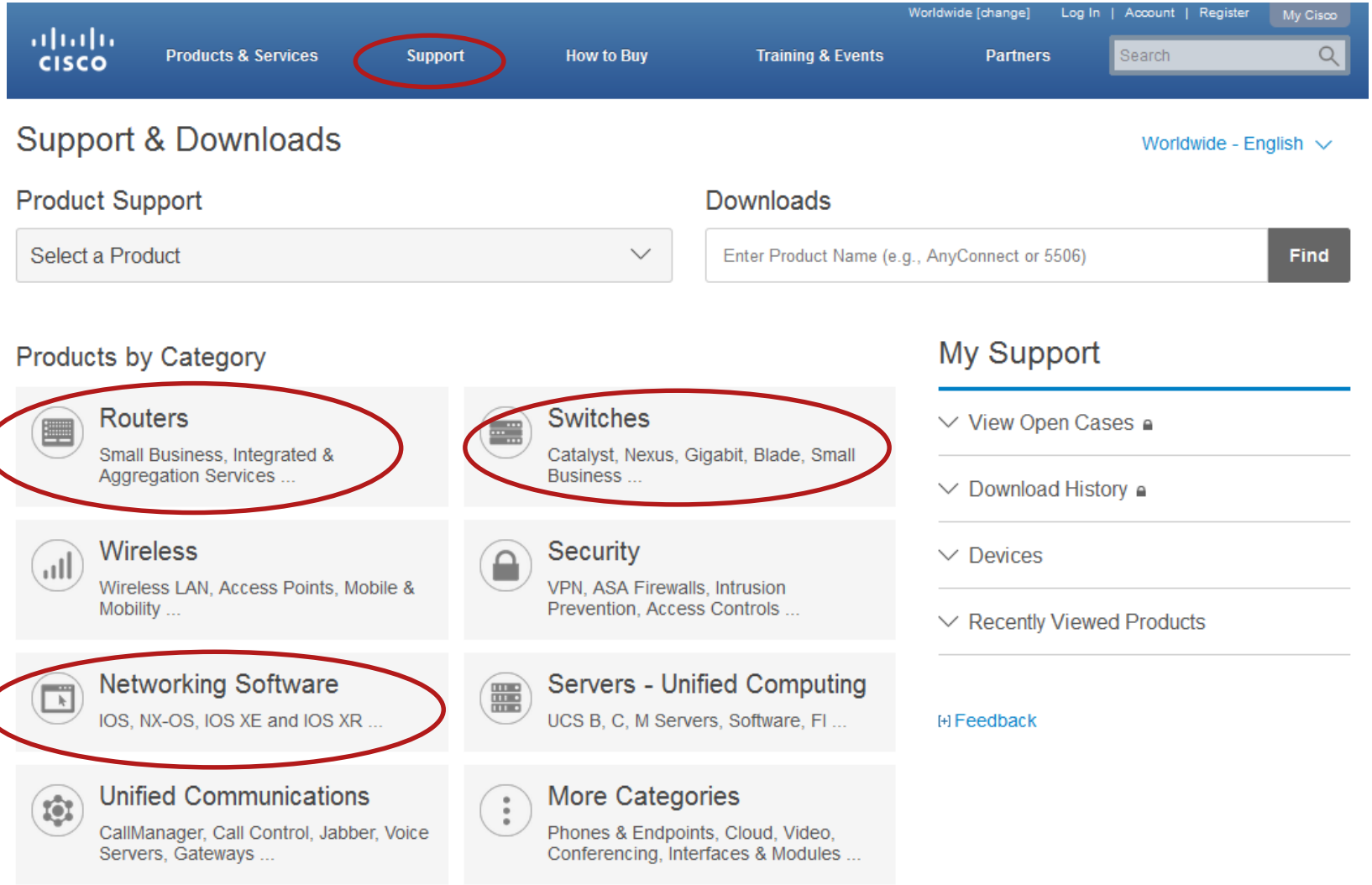
- *No web curriculums at all!!!*
- cisco.com is your best friend
- Orientation on web pages are crucial for all IT networkers
  - *…and they are trying to sabotage it all the time* ☺
  - Huge knowledgebase

Cisco Web Documentation ②

- Products documentation available
  - by HW platforms
  - by IOS versions
- Experience learn us that IOS commands…
  - for routers are best to find directly in relevant IOS documentation
  - for switches are best to find directly in relevant switch product documentation

- *Hence it is usually good to know exact IOS and HW version*

http://cisco.com/go/support



IOS Documentation

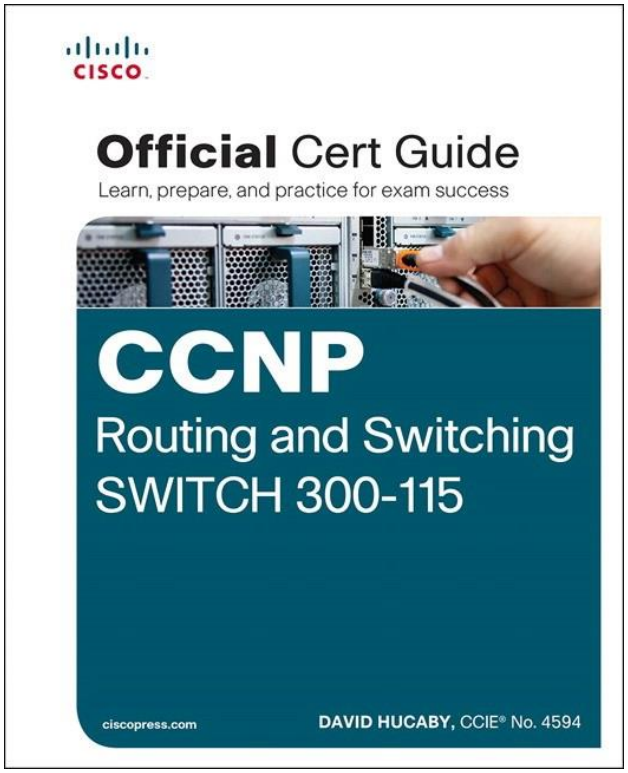
- Most important/interesting are following parts:
  - Configuration Guides consists of thorough description of technologies or protocols and ways how to configure them
  - Command References consists of commands descriptions, syntax and semantics
  - Master Index is alphabet index of commands with references to Command Reference
  - Error and System Messages consists of lists of IOS messages and theirs explanations
- Alternatively it's possible to use Command Lookup Tool to find Command Reference to appropriate command
  - CCO account needed!

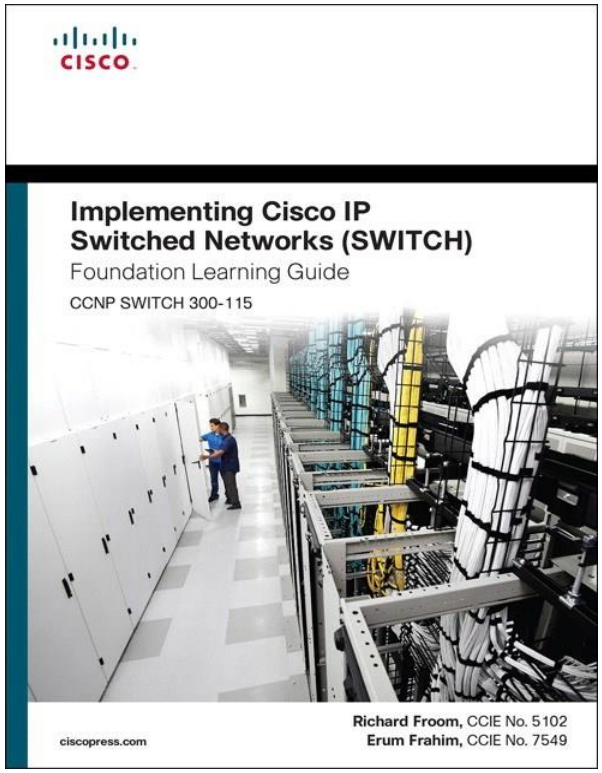
Supporting Documentation

- Case-studies, principle descriptions, configuration examples, technologies reviews
- Many of them have **Document ID** *NUMBER*
- How to search for them
  - „Configuring ...“
  - „Understanding ...“
  - „Troubleshooting ...“
  - „How to ...“
  - Support → Cisco IOS and NX-OS Software → Technology
- Cross-referencing between documents hence it’s necessary to make bookmarks

Self-study Literature

- CCNP R&S: SWITCH 300-115 official certification guide
- CCNP R&S: SWITCH 300-115 Foundation Learning Guide



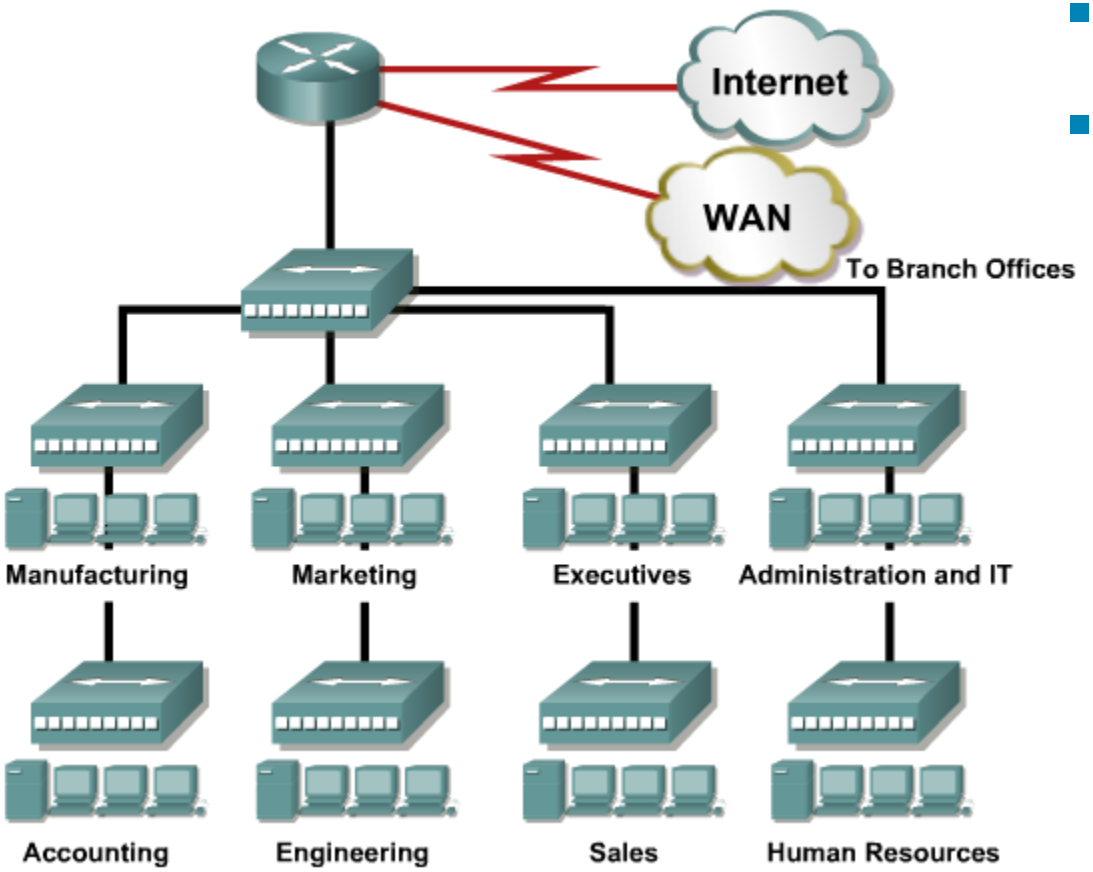


Network Design:
Models and Frameworks

Multilayer Switching?

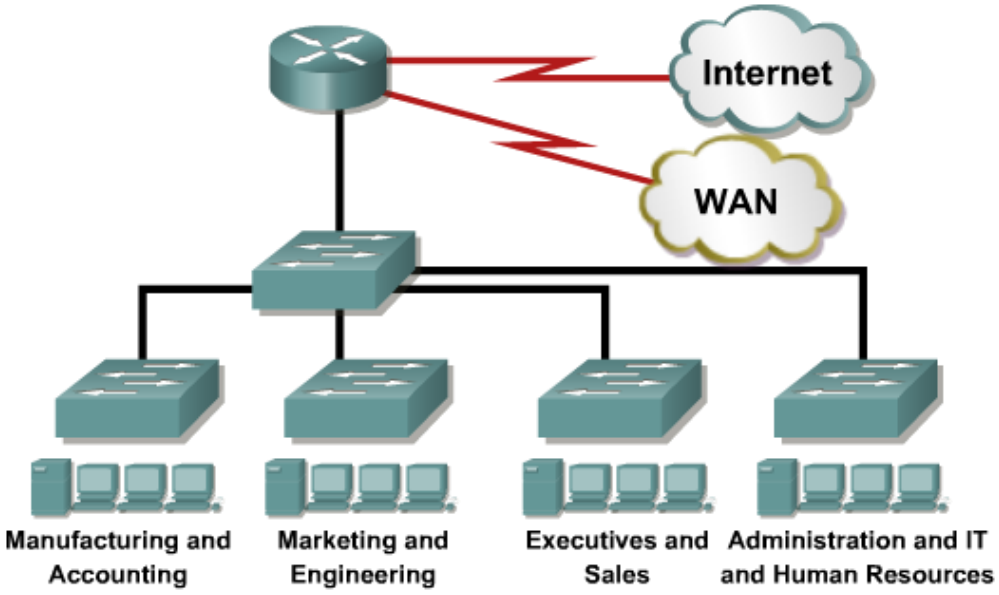
- **Multilayer Switching** is term referring to datagram switching on different layers of ISO/OSI model:
  - Layer 1 switching: Signal transmission and amplification
  - Layer 2 switching: Frame transmission (according to L2 header)
  - Layer 3 switching: Packet transmission (according to L3 header)
  - Layer 4 switching: Segment transmission (according to L4 header)
  - Layer 7 switching: Aplication data transmission (according to content)
- *What is difference between L3 switching and routing?*
  - Today it is usually the same process:
    - Routing is usually done by SW – CPU processed
    - Switching is accelerated by HW – ASIC processed
- **Multilayer switches**
  - Switches with datagram switching support on multiple layers at the same time
  - TCAM for fast lookup of RIB

Network without Hierarchy ①



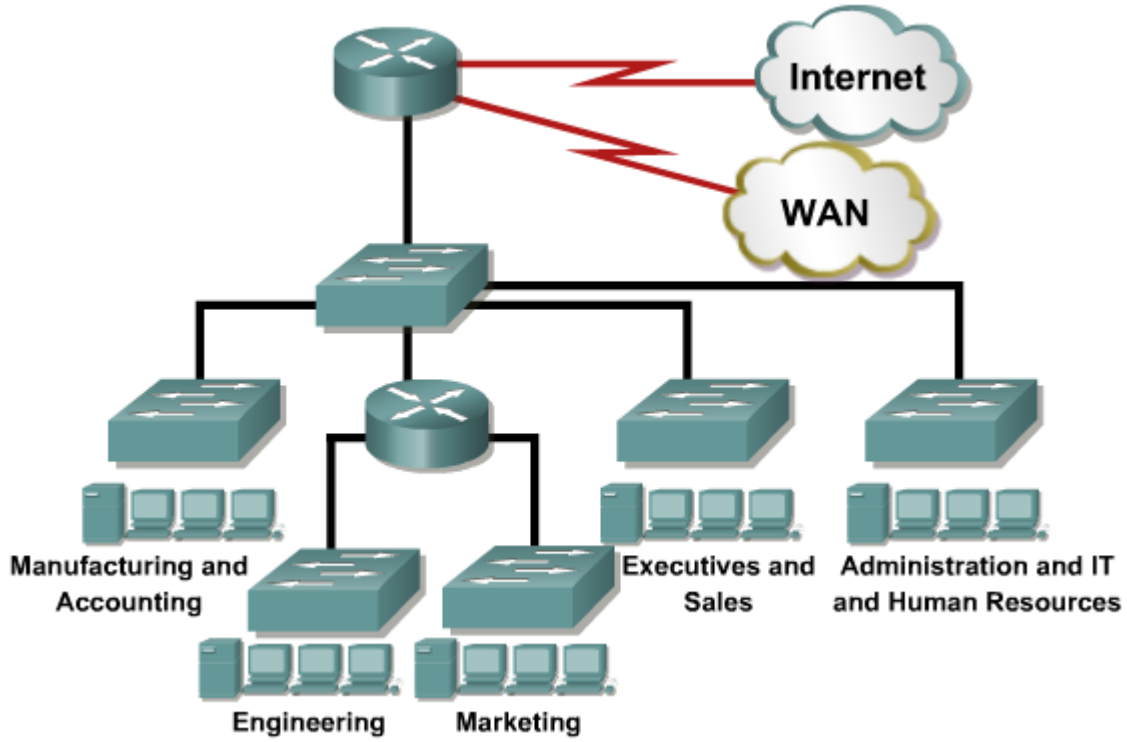
- *Notice HUBs*
- Disadvantages:
  - Large collision domains
  - Large broadcast domains
  - No working groups separations
  - Nearly none security
  - Very hard to troubleshoot

Network without Hierarchy ②



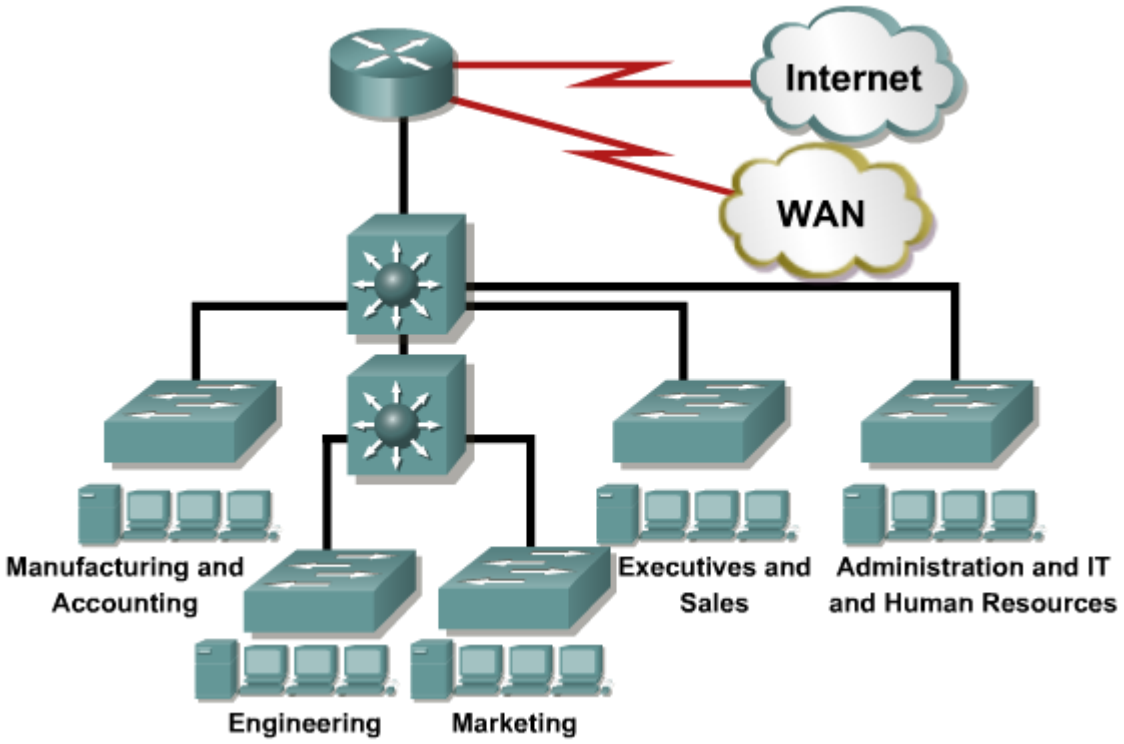
- *What if we replace hubs with switches – what is corrected and what is still missing?*
  - Bandwidth is not shared anymore
  - Large broadcast domains stays
  - Working groups are still not separated
  - No central point for sharing network resources

Introducing Hierarchy to Network



- With help of router
  - Smaller broadcast domains
  - More control over transferred traffic
- *Unfortunately routers are quite expensive*
  - Price for port is high
  - Number of ports on usual router is limited

Introducing Multilayer Switching



- Multilayer switches replace routers as integrated devices
- Combine features of
  - Layer 2 switching
  - Layer 3 routing
  - Layer 4 balancing
- Low latency
- High switching throughput

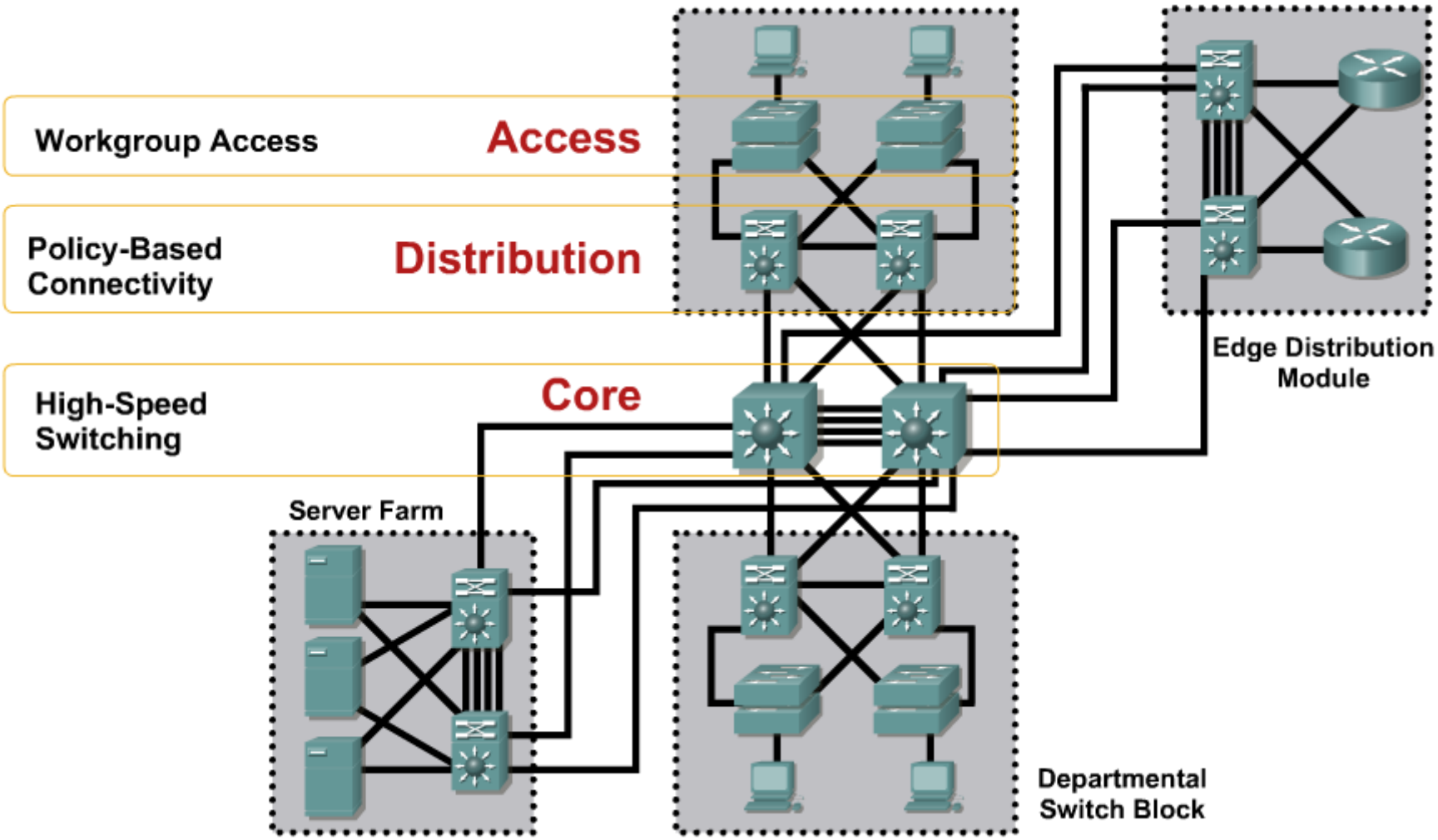
Features of Good Design

- Ad-hoc approach and design *leads you to hell and further!!!*
- Hierarchically designed network:
  - Has well-known borders of collision, broadcast and error domains
  - Has positive impact on operation
  - Scalable assignment of addresses together with their summarization
  - Transparent network flows
  - Divides L2 and L3 functionality

3Layered Network Design ①

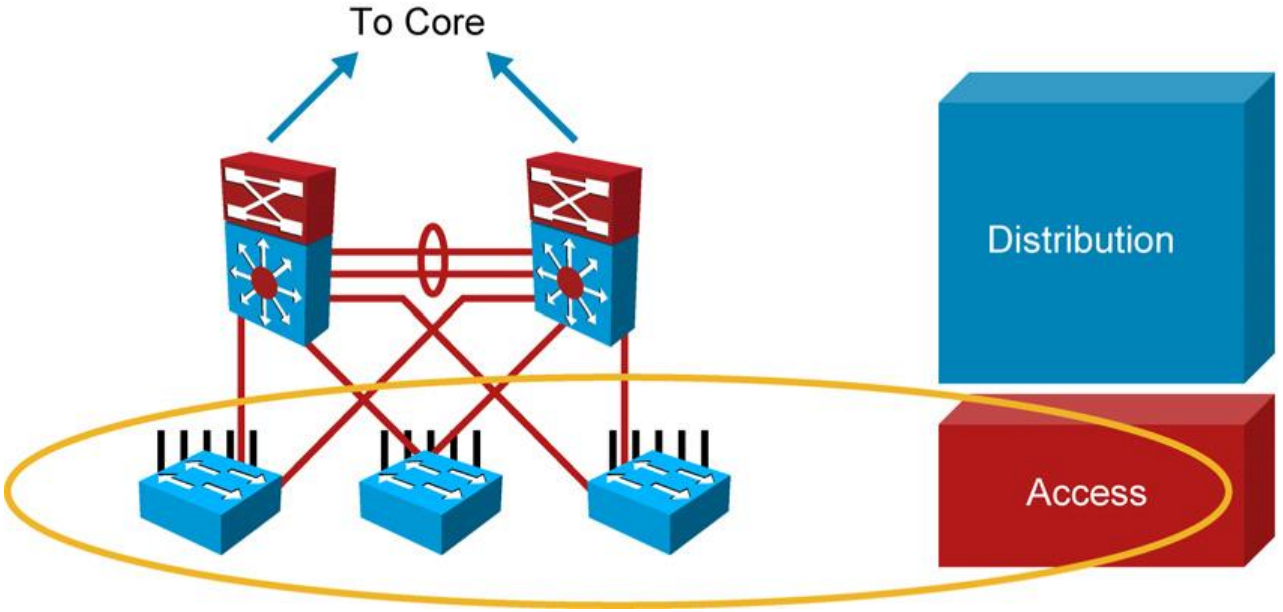
- *Bigger network means more attached devices*
- It’s favorable to divide them according to theirs network function thereby organize them into layers
  - End-to-end connectivity
  - Policy-based routing
  - Fast backbone switching
- System of those three layers (**access**, **distribution**, **core**) is old, traditional but still working

3Layered Network Design ②



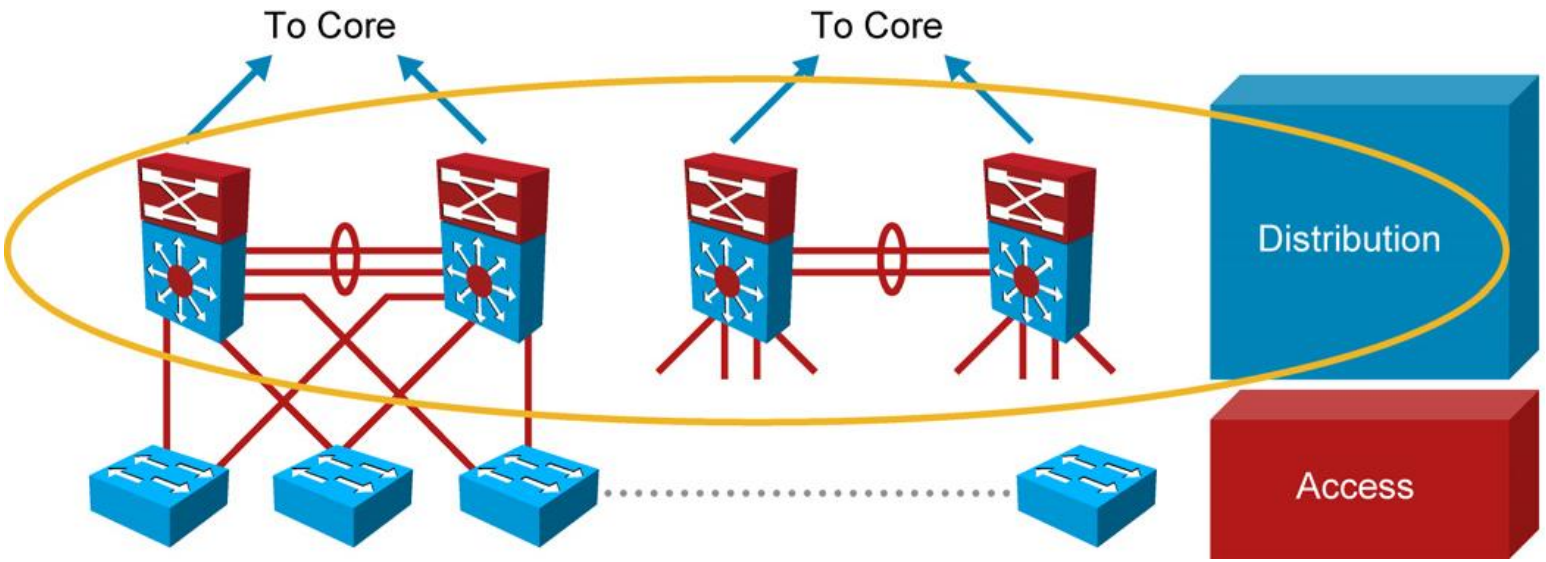
Access Layer

- Provides access and aggregation for users in a feature-rich environment
- Provides high availability through software attributes and redundancy
- Supports convergence for voice, wireless, and data
- Provides security services to help control network access
- Offers QoS services including traffic classification and queuing
- Supports IP multicast traffic for efficient network use



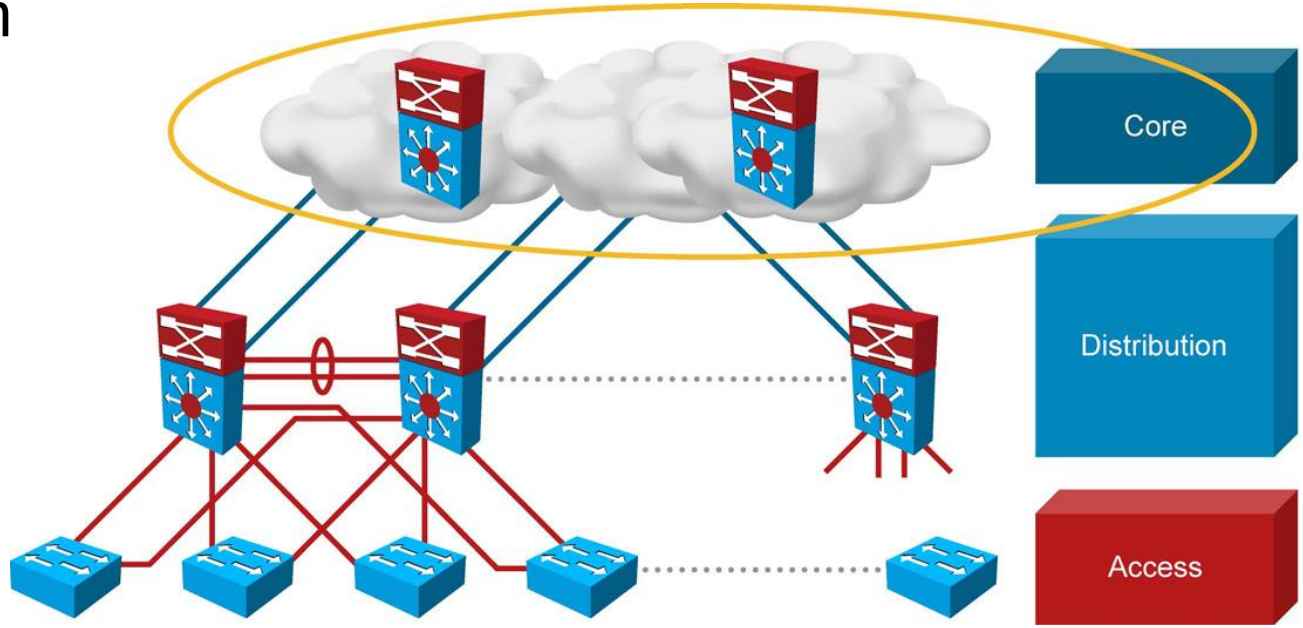
Distribution Layer

- Aggregates access nodes and uplinks
- Provides redundant connections and devices for high availability
- Offers routing services such as summarization, redistribution, and default gateways
- Implements policies including filtering, security, and QoS mechanisms
- Segments workgroups and isolates problems



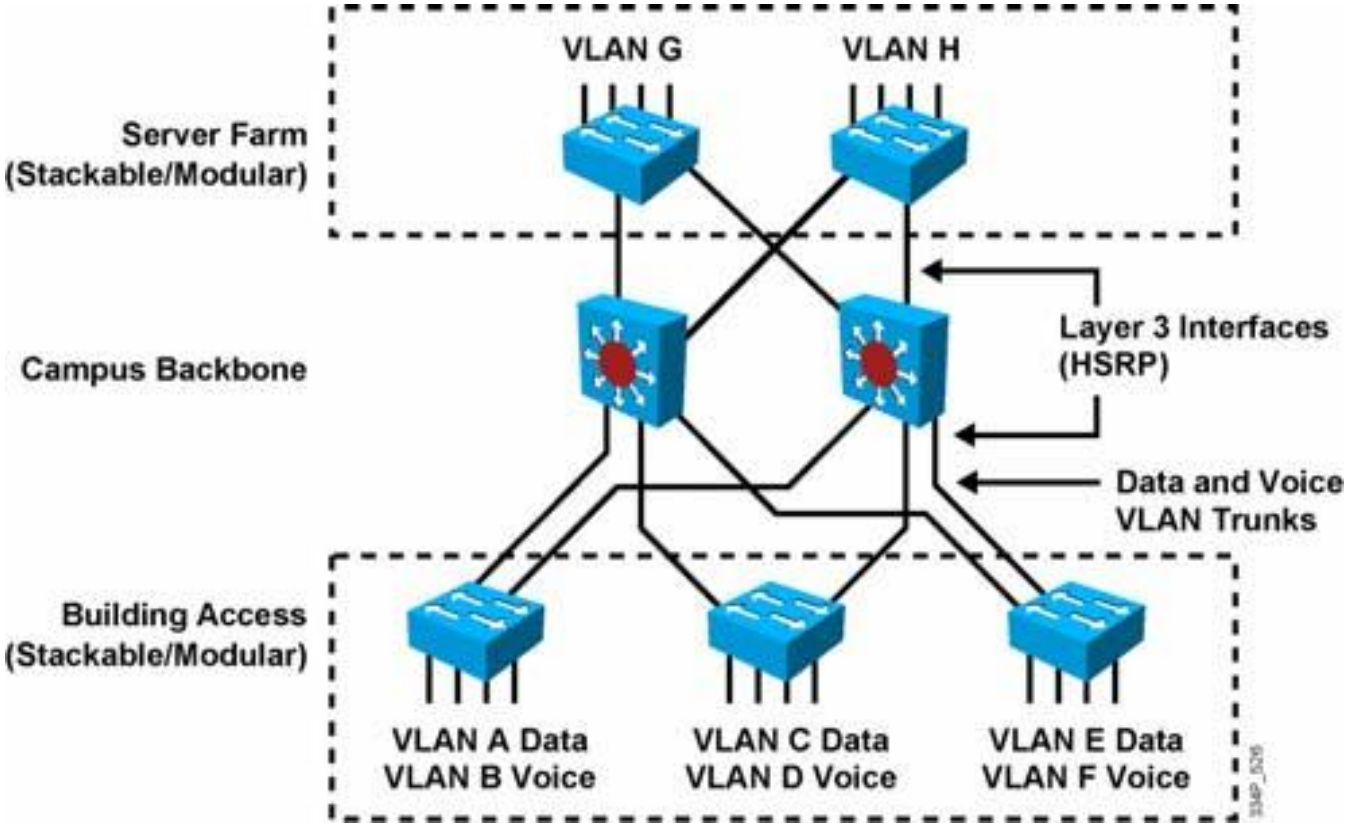
Core Layer (Backbone)

- The core layer is a high-speed backbone and aggregation point for the enterprise.
- It provides reliability through redundancy and fast convergence.
- The separate core layer helps in scalability during future growth



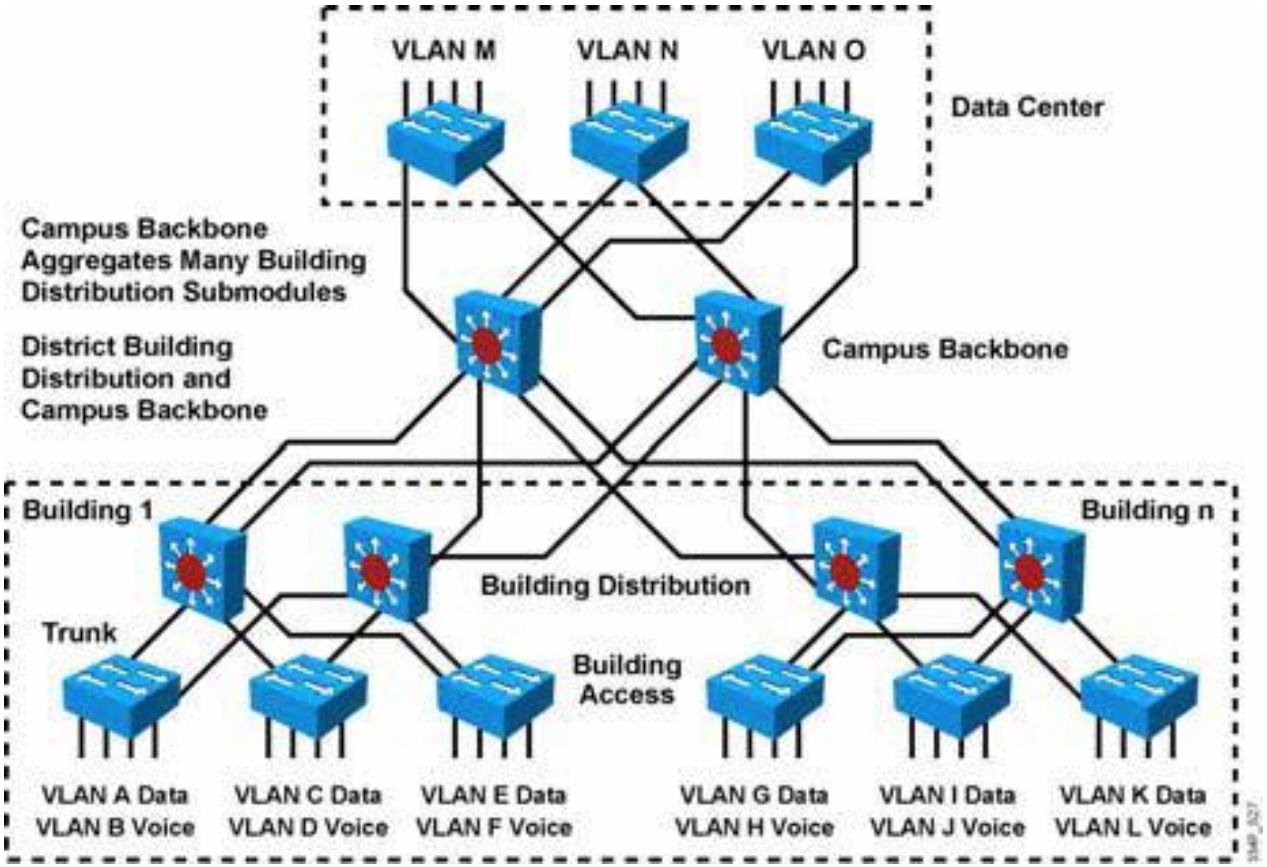
Small Size Network

- Less than 200 end stations
- **Collapsed core** (core and distribution form one layer



Medium Size Network

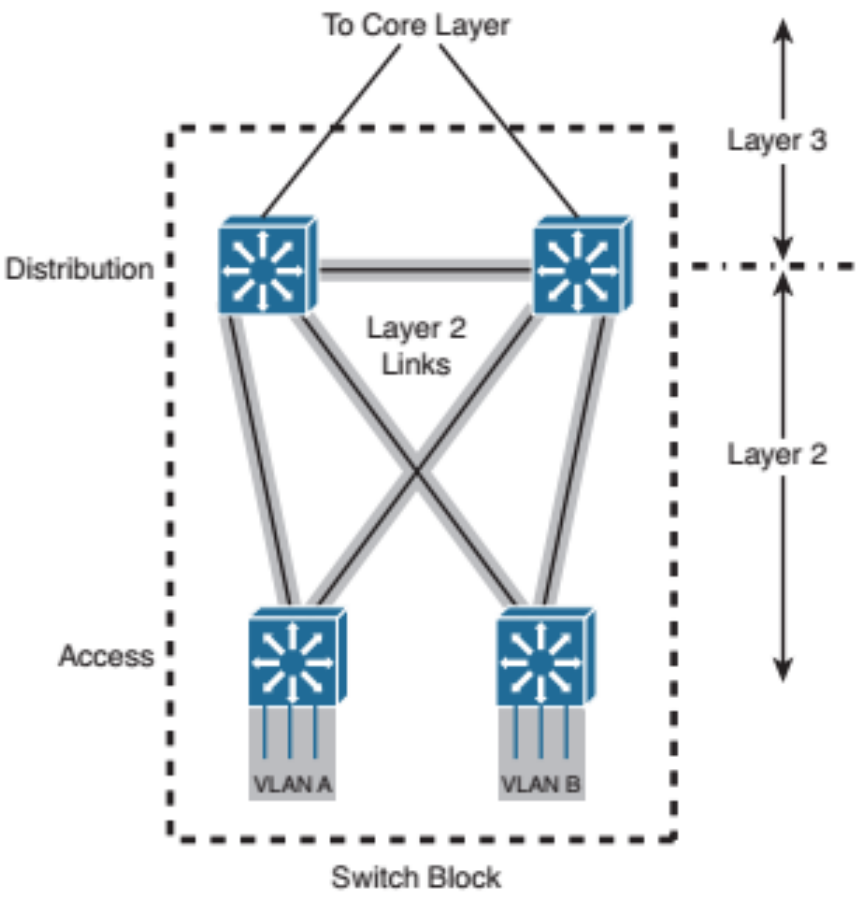
- Cca 200 up to 1000 end stations
- Redundancy of switches on distribution layer

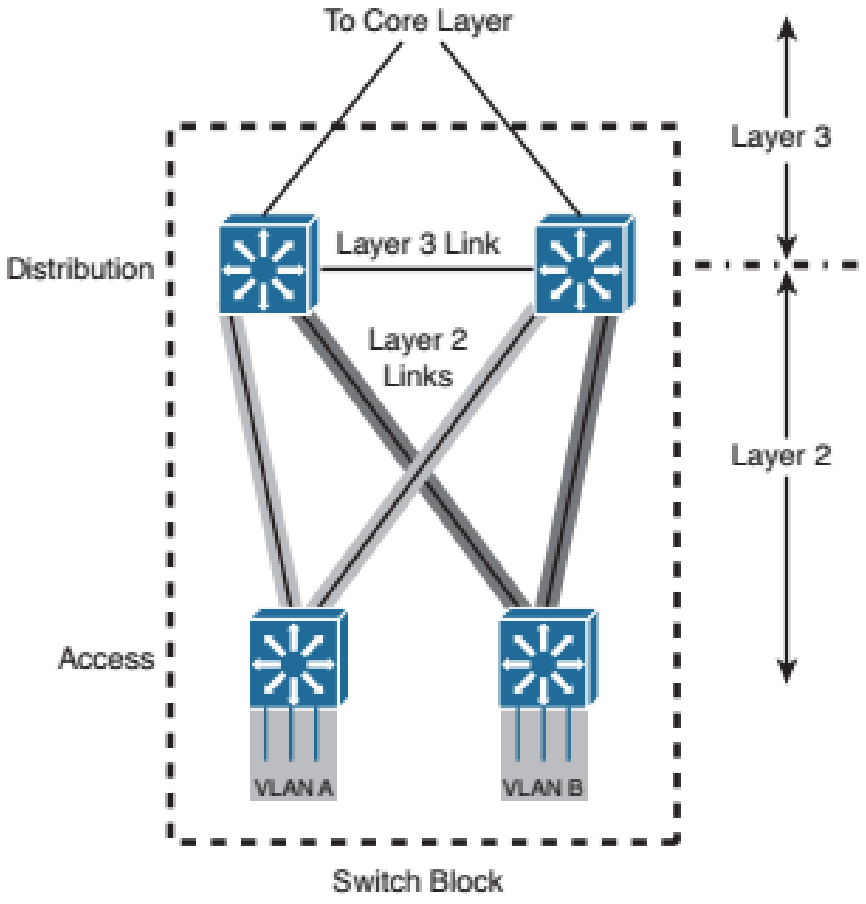


Large Size Networks

- Strictly following hierarchical design and boundaries between layers
- Backbone and on distribution layer is usually place for Catalyst 6800 switches or high-end routers like ASR
- In datacenters specialized switches Nexus 5000/7000

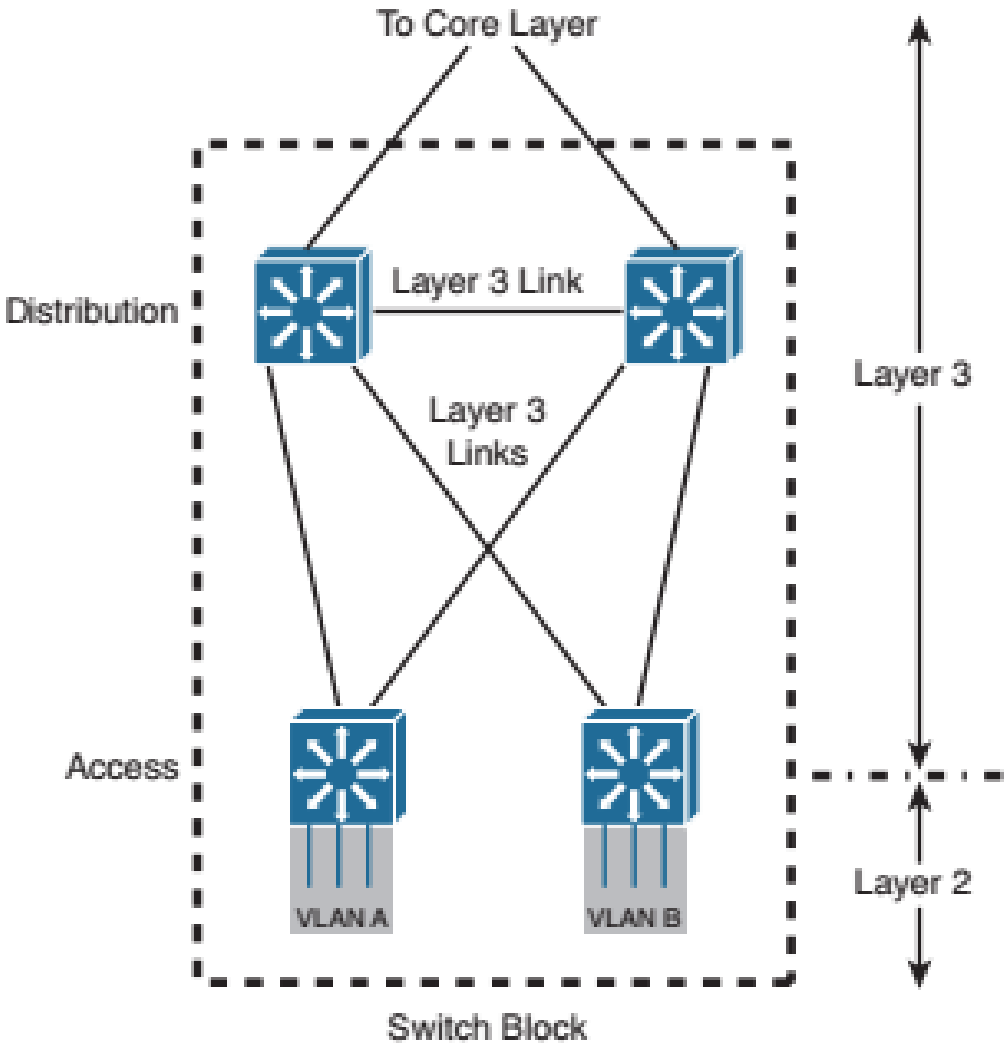
Redundancy in the network design





L3 access

- Fast convergence of routing protocols and updates
- Routing can load balance packets across the redundant uplinks
- Access switches must support routing functions



Best practices for hierarchical design

- Design each layer with pairs of switches.
- Connect each switch to the next higher layer with two links for redundancy
- Connect each pair of distribution switches with a link
- Do not connect the access layer switches to each other (unless logical stack).
- Do not extend VLANs beyond distribution switches. The distribution layer should always be the boundary of VLANs, subnets, and broadcasts.
- VLAN traffic should not traverse the network core.

Enterprise Campus
L2 Devices

Switch Properties ①

- **Form factor (size)**
  - Number of rack units (R or RU)
  - 1 RU = 1,75” = 44,45 mm

1 rack unit (1U)

- **Configuration**
  - Fixed
  - Modular
    - Supervisors and link cards
    - ASICs
    - Power supply

- **Stackable**
  - Stacking of routers which from outside behave as one switch

Switch Properties ②

- **Port density**
  - Number of available ports on device
- **Forwarding rate (overall bandwidth)**
  - Efficiency of device datagram switching in bps resp. pps
- **Link aggregation**
  - Option to combine multiple ports to one logical interconnection
- **Power over Ethernet (PoE)**
  - To provide power for IP phones, wireless Aps or CATV
  - Increasing cost of devices
- **Multilayer capabilities**
  - L3 routing, load-balancing

Switches for 3Layered Network Design

- Access layer
  - Catalyst 2960X (L2 switch)
  - Catalyst 3650, 3850, 4500 (L3 switch)
  - Wifi Aps
- Distribution layer
  - Catalyst 4500-X, 4500-E, 6800
- Core
  - Catalyst 4500, 6800

Access layer

	Catalyst Model	Max Port Density	Uplinks	Max Backplane	Other Features
	2960-X	384 (Up to 8 48-port switches in a stack)	2 10GE or 4 1 Gigabit Ethernet per switch	80 Gbps	RIP, OSPF available for routed access layer; PoE+
	3650	432 (Up to 9 48-port switches in a stack)	2 Gigabit Ethernet or 4 10GE	160 Gbps	Full-featured routing available, integrated wireless controller, PoE+
	3850	432 (Up to 9 48-port switches in a stack)	4 Gigabit Ethernet, 4 10GE	480 Gbps	Full-featured routing available, integrated wireless controller, PoE+, UPoE

Distribution layer

	Catalyst Model	Max Port Density	Max Backplane	Other Features
	4500-X	80 10GE	1.6 Tbps	Dual-chassis Virtual Switching System (VSS) redundancy
	4500E	96 10GE or 384 Gigabit Ethernet	928 Gbps	Dual supervisors

Core layer

Catalyst Model	Max Port Density	Max Backplane	Other Features
6807-XL	40 40Gbps, 160 Gigabit Ethernet, 480 Gigabit Ethernet	22.8 Tbps	Dual supervisor, dual-chassis VSS redundancy

Ethernet

A Brief Introduction

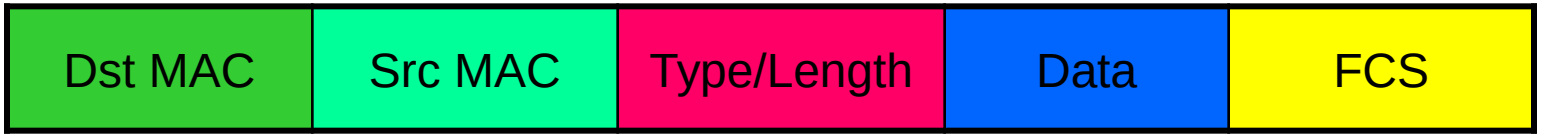
- Ethernet was invented in the first half of 70s in XEROX Inc.
- One of inventors was Robert Metcalf, founder of 3Com
- *It is cheap, undemanding, best-effort technology*
- Currently is wide-spread dominant L2 technology for LANs which targets also SANs, MANs and even WANs
  - Carrier Ethernet
  - Data Center Bridging
  - Synchronous Ethernet
- Speeds from 10 Mbps up to 100 Gbps

Questions FYI and Discussion

- What is collision and broadcast domain?
- Why has frame set minimum and maximum length?
- What is slot time?
- How does CSMA/CD work?
- How does full-duplex work on TP cabling? How is it related with CSMA/CD?
- What is collision? What kind of collision types do exist?
- What types of active network devices are/were usually used in Ethernet?
- Is there any limit for number of devices in cascade?
- How does auto-negotiation operate? What if it does not work?
- What is Auto-MDIX and when does it work properly?
- Is Ethernet synchronous technology?
- How many Ethernet frame types actually do exist?

Ethernet Frame Format ①

- Multiple types of Ethernet frame exists and all of them has same base structure:

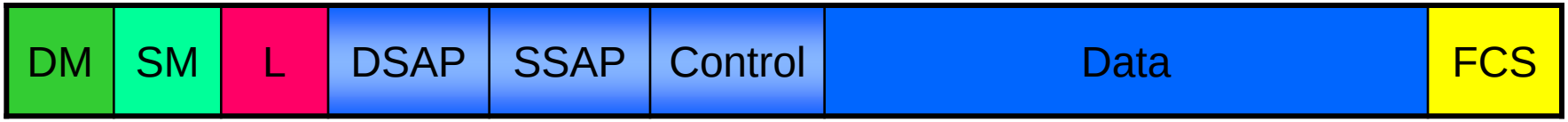


- Currently known variants:
  - Ethernet II (aka DIX)
  - 802.3 (sometimes referred as 802.2 because of LLC header)
  - SNAP (aka 802.3 SNAP)
  - Novell Raw (IPX run over it)

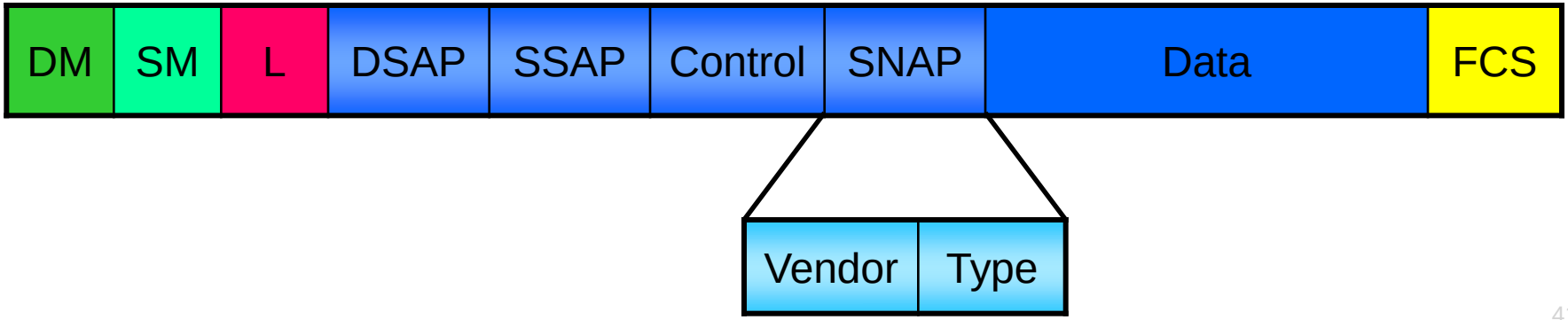
Ethernet Frame Format ②

Ethernet II

Ethernet 802.2 LLC



Ethernet 802.3 SNAP



Configuration Tips&Tricks

Interface Default Configuration

- *How to set interface to default configuration state?*

```
Switch(config)# default interface interface-id
E.g.:
Switch(config)# default interface fa 0/1
```

- *How to accomplish same thing with multiple interfaces?*

```
Switch(config)# default interface range fa 0/1 – 24
```

Resetting Switch

- Catalyst switches do not have NVRAM
  - NVRAM is just emulated in FLASH memory
  - Hence, startup configuration is stored in file **`flash:config.text`**
- Along with startup configuration is also VLAN and VTP configuration (**`vlan.dat`**) stored in FLASH
- Resetting switch means deleting “NVRAM” and also VLAN configuration:

```
Switch# erase startup-config
!or alternatively
Switch# write erase

Switch# delete vlan.dat !not necessary to write flash:vlan.dat
Switch# reload
```

Large Topology Reset

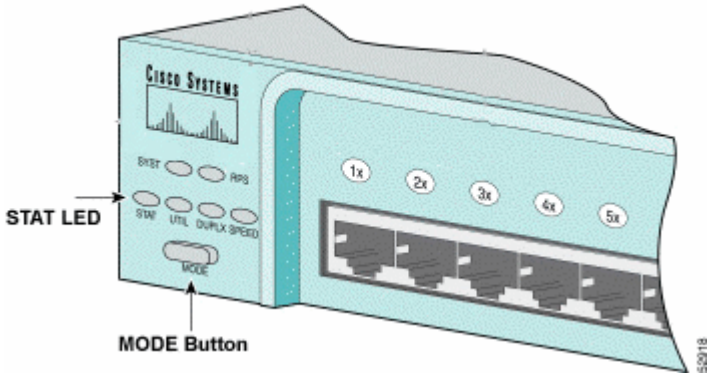
- Systematic approach is needed when resetting lab without breaking the interconnections
  - VTP is capable to renew current VLAN database configuration after reloading switch to blank state
- Recommended procedure:
  1. On all switches issue:

```
Switch(config)# interface range fa0/1 - 24 , gi0/1 - 2
Switch(config-if)# shutdown
```

  2. Only after completing previous step we can start to clear configurations and restart switches

Password Recovery Procedure

1) Unplug switch - Push and hold MODE - Plug switch again
2) Hold MODE button until amber blinking SYST turns to be solid green



3) Enter following commands:

```
switch: flash_init
switch: load_helper !not necessary with newer IOS

switch: delete flash:config.text
!or alternatively
switch: rename flash:config.text flash:config.old

switch: boot
```

IOS Restoration

- Be aware of confusing **`erase startup-config`** resp. **`delete flash:vlan.dat`** with the command **`erase flash:`**
- Catalyst switch could upload IOS only through COM port (XMODEM protocol) – unfortunately not through Ethernet
- After getting to bootloader following must be issued:

```
switch: flash_init
switch: load_helper !not necessary with newer IOSes
switch: set BAUD 115200 !speed up console speed to 115.2 kbps
switch: format flash: !not mandatory
switch: copy xmodem:IOS_name flash:IOS_name
switch: unset BAUD !set console speed back to 9.6 kbps
switch: boot
```

Treacherousness of Port Speed and Duplex ①

- Speed and duplex are configured in following manner:

```
Switch(config-if)# speed { 10 | 100 | 1000 | auto }
Switch(config-if)# duplex { half | full | auto }
```

- IF at least one of those parameters is set to auto THEN port has auto-negotiation ENABLED
  - In port “capabilities” are shown only alternatives according to fixed set parameter
- IF both parameters are set fixed THEN port has auto-negotiation DISABLED only whenever
  - As a consequence switch guess speed (from channel coding) but set half-duplex as a fallback parameter
  - Possible cause of severe troubles because of duplex mismatch!
- *Hence there is strong difference between „auto-negotiation turned off“ and „auto-negotiation advertising only one alternative“!!!*

Treacherousness of Port Speed and Duplex ①

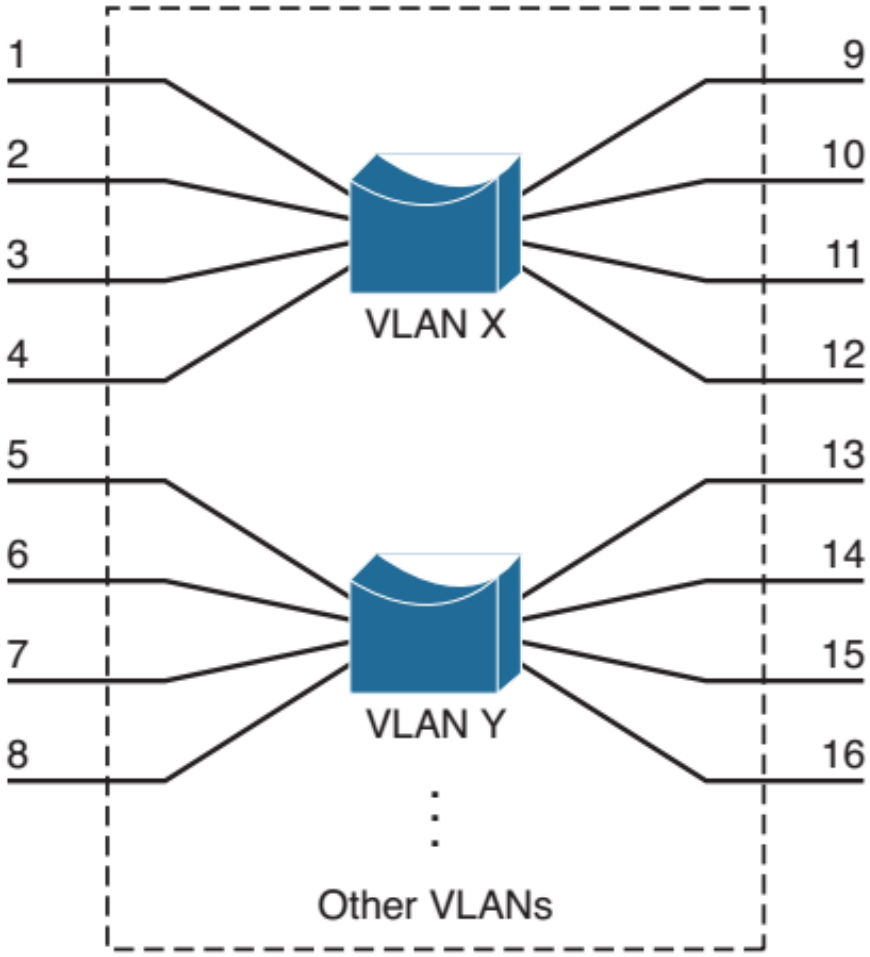
- `IF` auto-negotiation is turned off `THEN` auto-MDIX is not working!
- From praxis: Cat3560v2 turns auto-negotiation off but Cat2960 not
- Hence following principle:
  - `IF` *speed and duplex must be fixedly configured* `THEN` *do it on both ends of link simultaneously*
- *Enforcing speed or duplex is in general not a very good idea!*

Layer 2 switch operation

Basic switch operation

- Ethernet switch operates at L2, making decisions based on the destination MAC addresses found within the frames
- Provides isolation between connected host
  - Host connections can operate in full-duplex mode
  - On each switch port, the collision domain consists of the switch port itself and the devices directly connected to that port
  - Errors in frames are not propagated
  - You can limit broadcast traffic to a volume threshold

L2 switch



Forwarding Table

0000.1111.1111: port 11, vlan X
0000.2222.2222: port 6, vlan Y
0000.3333.3333: port 1, vlan X
0000.4444.4444: port 9, vlan X
0000.5555.5555: port 8, vlan Y
0000.6666.6666: port 14, vlan Y
0000.7777.7777: port 3, vlan X
0000.8888.8888: port 16, vlan Y

Broadcast: VLAN X: all VLAN X ports
Broadcast: VLAN Y: all VLAN Y ports

Content-Addressable Memory (CAM)

- A CAM table is used for Layer 2 switching
- Switch stores the source MAC address, port of arrival, VLAN and timestamp
- By default, CAM table entries are kept for 300 seconds

```
Switch(config)# mac address-table aging-time seconds
```

- MAC addresses are learned dynamically from incoming frames

```
Switch(config)# mac address-table static mac-address
   vlan vlan-id interface type mod/num
```

Ternary Content-Addressable Memory (TCAM)

- a packet can be evaluated against an entire access list within a single table lookup
- Most switches have multiple TCAMs
  - inbound and outbound security and QoS ACLs, forwarding L3 decision
- Feature Manager (FM):
  - Compiles and merges ACLs into entries in the TCAM table
- Switching Database Manager (SDM):
  - the TCAM is partitioned into several areas that support different functions
  - configures or tunes the TCAM partitions

TCAM

```
Switch(config)# show platform tcam utilization
```

```
Switch(config)# show sdm prefer
The current template is "desktop default" template.
   The selected template optimizes the resources in
   the switch to support this level of features for
   8 routed interfaces and 1024 VLANs.
   number of unicast mac addresses: 6K
   number of IPv4 IGMP groups + multicast routes: 1K
   number of IPv4 unicast routes: 8K
   ...
```

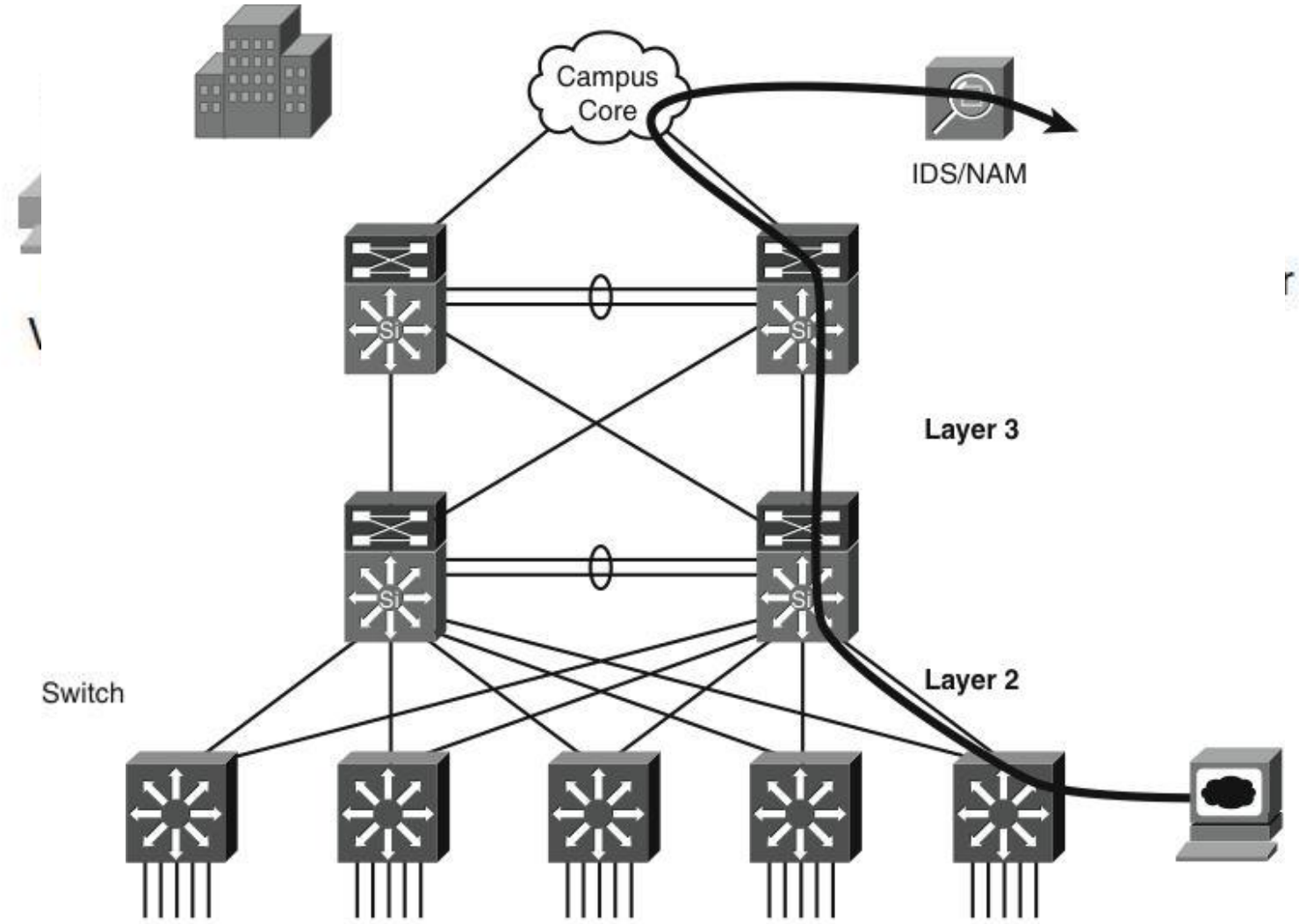
```
Switch(config)# sdm prefer template
```

Traffic Monitoring

Traffic Monitoring

- Many times it is useful to monitor traffic on some ports
- Cisco introduces following monitoring feature
  - **(VLAN) Switched Port Analyzer** a.k.a. **(V)SPAN**
  - **Remote SPAN (RSPAN)**
  - **Enhanced RSPAN (ERSPAN)**
- Basic idea is that monitoring session is configured which consists of
  - Definition on which port (or VLAN) sniffing occurs
  - Definition to which port (or VLAN) is sniffed traffic sent

SPAN Variants



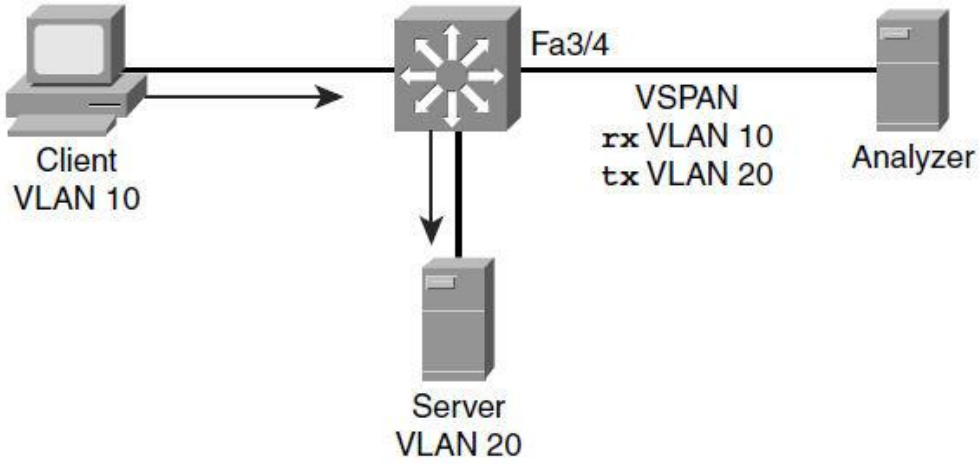
Configuring (V)SPAN

- SPAN is relation in which traffic from local ports or VLANs is replicated on concrete interface

```
Switch(config)# monitor session session-id source {interface
IFACE | vlan vlan-id [,][-] {rx | tx | both}
Switch(config)# monitor session session-id destination interface
IFACE [encapsulation {dot1q | isl}] [ingress vlan vlan-id]
```

- By default destination port is no longer capable of switching – incoming frames are discarded
  - But it is possible to overcome this behavior by appending command **`ingress`**
- By default command **`encapsulation replicate`** bellow is needed whenever we want to monitor L2 protocols (e.g. CDP, DTP, VTP, STP, PAgP, LACP, ...) and keep original VLAN tags
  - Without this command all frames will be marked as „untagged“ and service L2 protocols won’t be captured

Example: VSPAN




```
cat4k(config)# monitor session 1 source vlan 10 rx
cat4k(config)# monitor session 1 source vlan 20 tx
cat4k(config)# monitor session 1 destination interface FastEthernet 3/4
cat4k# show monitor session 1
Session 1
---------
Type                      : Local Session
Source VLANs    :
  RX Only         : 10
  TX Only         : 20
Destination Ports : Fa3/4
  Encapsulation : Native
  Ingress                 : Disabled
```

Configuring RSPAN

- **Remote SPAN** is pair of relation where
  - Traffic is catch on source ports or VLAN(s) and sent to special RSPAN VLAN
  - Traffic inside RSPAN VLAN is then replicated to destination port on target switch
  - RSPAN VLAN could be used only for purpose of RSPAN
- Dedicate one VLAN as RSPAN VLAN:

```
Switch(config-vlan)# remote-span
```

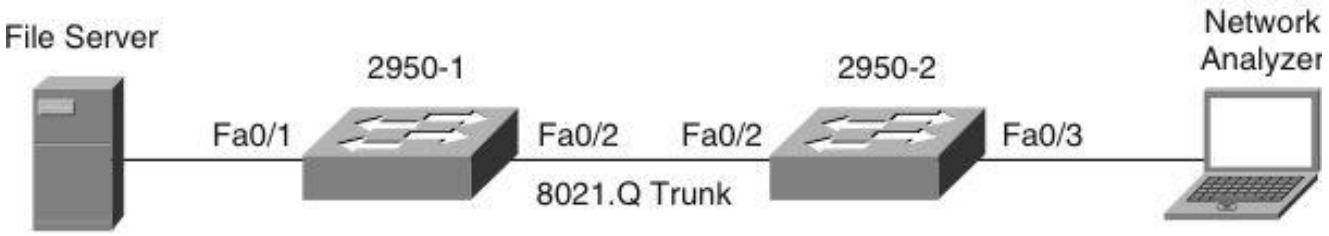
- On the source switch:

```
Switch(config)# monitor session session-id source {interface
IFACE | vlan vlan-id} [,][-] {rx | tx | both}
Switch(config)# monitor session session-id destination remote
vlan vlan-id
```

- On the destination switch:

```
Switch(config)# monitor session session-id source {interface
IFACE | vlan vlan-id [,][-] {rx | tx | both}
Switch(config)# monitor session session-id destination interface
IFACE [encapsulation {dot1q | isl}] [ingress vlan vlan-id]
```

Example: RSPAN



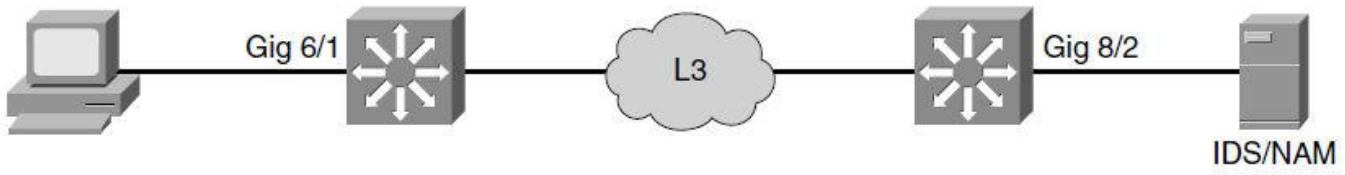

```
2950-1(config)# vlan 100
2950-1(config-vlan)# remote-span
2950-1(config)# monitor session 1 source interface Fa 0/1
2950-1(config)# monitor session 1 destination remote vlan 100
reflector-port Fa0/24
2950-1(config)# interface Fa0/2
2950-1(config-if)# switchport mode trunk

2950-2(config)# monitor session 2 source remote vlan 100
2950-2(config)# monitor session 2 destination interface Fa0/3
2950-2(config)# interface Fa0/2
2950-2(config-if)# switchport mode trunk
```

Enhanced RSPAN

- **Enhanced Remote SPAN (ERSPAN)** is similar to RSPAN, but it supports source ports, source VLANs, and destination ports on different switches, even across the Layer 3 boundary
  - The payload of a Layer 3 ERSPAN packet is a copied Layer 2 Ethernet frame, excluding any ISL or 802.1Q tags
  - ERSPAN adds a 50-byte header to each copied Layer 2 Ethernet frame and replaces the 4-byte cyclic redundancy check (CRC) trailer
  - ERSPAN session carries SPAN traffic in GRE tunnel
  - Only for Catalyst6500
- ERSPAN supports jumbo frames that contain Layer 3 packets of up to 9202 bytes
  - `IF` the length of the copied Layer 2 Ethernet frame is greater than 9170 bytes (9152-byte Layer 3 packet) `THEN` ERSPAN truncates the copied Layer 2 Ethernet frame to 9202-byte

Example: ERSPAN




```
Switch1(config)# monitor session 66 type erspan-source
Switch1(config-mon-erspan-src)# source interface gigabitethernet 6/1
Switch1(config-mon-erspan-src)# destination
Switch1(config-mon-erspan-src-dst)# ip address 10.10.10.10
Switch1(config-mon-erspan-src-dst)# origin ip address 20.20.20.200
Switch1(config-mon-erspan-src-dst)# erspan-id 111

Switch2(config)# monitor session 60 type erspan-destination
Switch2(config-erspan-dst)# destination interface Gi8/2
Switch2(config-erspan-dst)# source
Switch2(config-erspan-dst-src)# ip address 10.10.10.10
Switch2(config-erspan-dst-src)# erspan-id 111
```

Useful Commands

```
show interfaces [IFACE]
show interfaces status
show interfaces description
show interfaces counters [errors]
show interfaces capabilities
test cable-diagnostics tdr
show cable-diagnostics tdr
```

The show interface capabilities Command

```
Router# show interfaces fastethernet 4/1 capabilities

FastEthernet4/1
Model: WS-X6348-RJ-45
Type: 10/100BaseTX
Speed: 10,100,auto
Duplex: half,full
Trunk encap. type: 802.1Q,ISL
Trunk mode: on,off,desirable,nonegotiate
Channel: yes
Broadcast suppression: percentage(0-100)
Flowcontrol: rx-(off,on),tx-(none)
Fast Start: yes
QOS scheduling: rx-(1q4t), tx-(2q2t)
CoS rewrite: yes
ToS rewrite: yes
Inline power: no
SPAN: source/destination
```

The test cable-diagnostics tdr Command

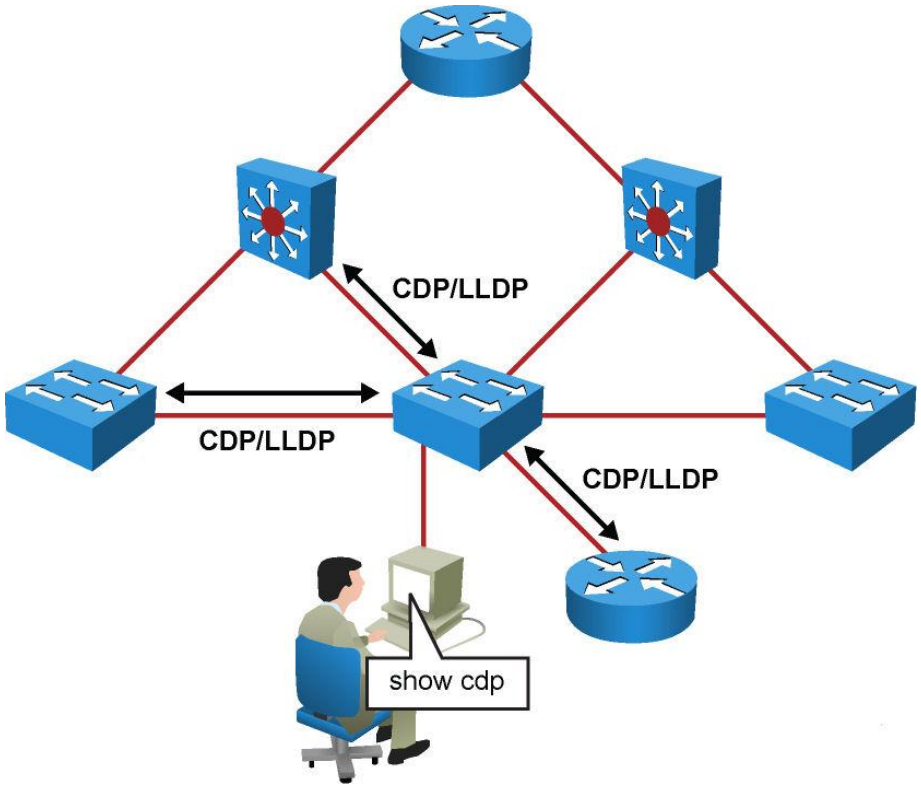
```
Router> test cable-diagnostics tdr interface gi8/1

Router> show cable-diagnostics tdr interface gi8/1
TDR test last run on: February 25 11:18:31
Interface Speed Pair Cable length    DistanceToFault Channel Pair status
--------- ----- ---- ----- --------  --------------- ------- -----------
Gi8/1     1000  1-2  1     +/- 6 m   N/A             Pair B  Terminated
                3-4  1     +/- 6 m   N/A             Pair A  Terminated
                5-6  1     +/- 6 m   N/A             Pair C  Terminated
                7-8  1     +/- 6 m   N/A             Pair D  Terminated
Router>
```

Neighbor Discovery Protocols

Neighbor Discovery Protocols

- **Neighbor Discovery Protocols (NDP)** provide a summary of directly connected switches, routers and other Cisco devices
- CDP is Cisco proprietary
- LLDP is vendor-neutral IEEE 802.1ab standard



Cisco Discovery Protocol

- **Cisco Discovery Protocol (CDP)** is multicast hello-based protocol periodically advertising device's attributes
- Uses TTL value in seconds to indicate freshness of information
- Cached CDP information are available to network management
- CDP is enabled by default with 60 s gap between consecutive messages
- Configuration:

```
Switch(config)# cdp timer seconds
Switch(config)# [no] cdp run
Switch(config-if)# [no] cdp enable
```

Displaying CDP Intel

```
switch# show cdp neighbor
Capability Codes: R - Router, T - Trans Bridge, B - Source Route Bridge
                  S - Switch, H - Host, I - IGMP, r - Repeater, P - Phone,
                  D - Remote, C - CVTA, M - Two-port Mac Relay
Device ID       Local Intrfce   Holdtme    Capability   Platform    Port ID
c2960-8         Fas 0/8         168        S I          WS-C2960-   Fas 0/8
```

```
4506# show cdp neighbor detail
-----------------------
Device ID: TBA03501074(SwitchA-6500)
Entry address(es):
IP address: 10.18.2.137
Platform: WS-C6506, Capabilities: Trans-Bridge Switch IGMP
Interface: FastEthernet3/21, Port ID (outgoing port): 3/36
Holdtime : 170 sec
Version :
WS-C6506 Software, Version McpSW: 7.6(1) NmpSW: 7.6(1)
Copyright © 1995-2003 by Cisco Systems
advertisement version: 2
VTP Management Domain: ‘0’
Native VLAN: 1
Duplex: full

<output omitted>
```

Link Layer Discovery Protocol

- **Link Layer Discovery Protocol (LLDP)** is open-standard clone of CDP
- Supported by HP, Juniper and other vendors as unified solution
- LLDP allows more features to be announced
- LLDP is disabled by default on Cisco boxes
- Configuration

```
Switch(config)# lldp timer seconds
Switch(config)# [no] lldp run
Switch(config-if)# [no] lldp enable
```

Displaying LLDP Intel

```
switch(config)# lldp run
switch(config)# end
switch# show lldp neighbor
Capability codes:
        (R) Router, (B) Bridge, (T) Telephone, (C) DOCSIS Cable Device
        (W) WLAN Access Point, (P) Repeater, (S) Station, (O) Other
Device ID       Local Intf      Hold-time       Capability      Port ID
c2960-8         Fa0/8           120             B               Fa0/8
Total entries displayed: 1
```

Slides adapted by Vladimír Veselý and Matěj Grégr partially from official course materials but the most of the credit goes to CCIE#23527 Ing. Peter Palúch, Ph.D.

The last update: 2016-09-28