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!!!*

- Not enough details in course
  - *hence 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 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 SWITCH 642-813 **Official Certification Guide**

- Implementing Cisco IP Switched Networks (SWITCH) **Foundation Learning Guide**:
Foundation learning for SWITCH 642-813 Exam
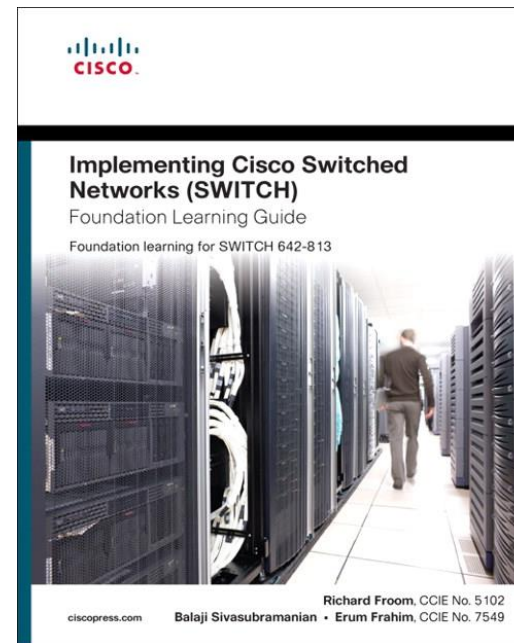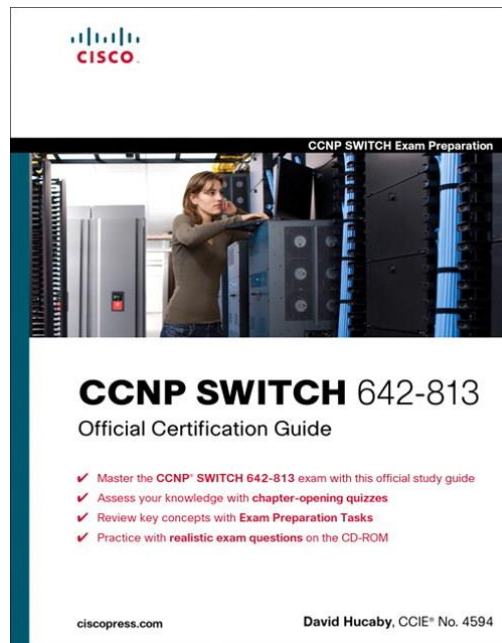
Network Design: Models and Frameworks

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 switching and routing?*
  - 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
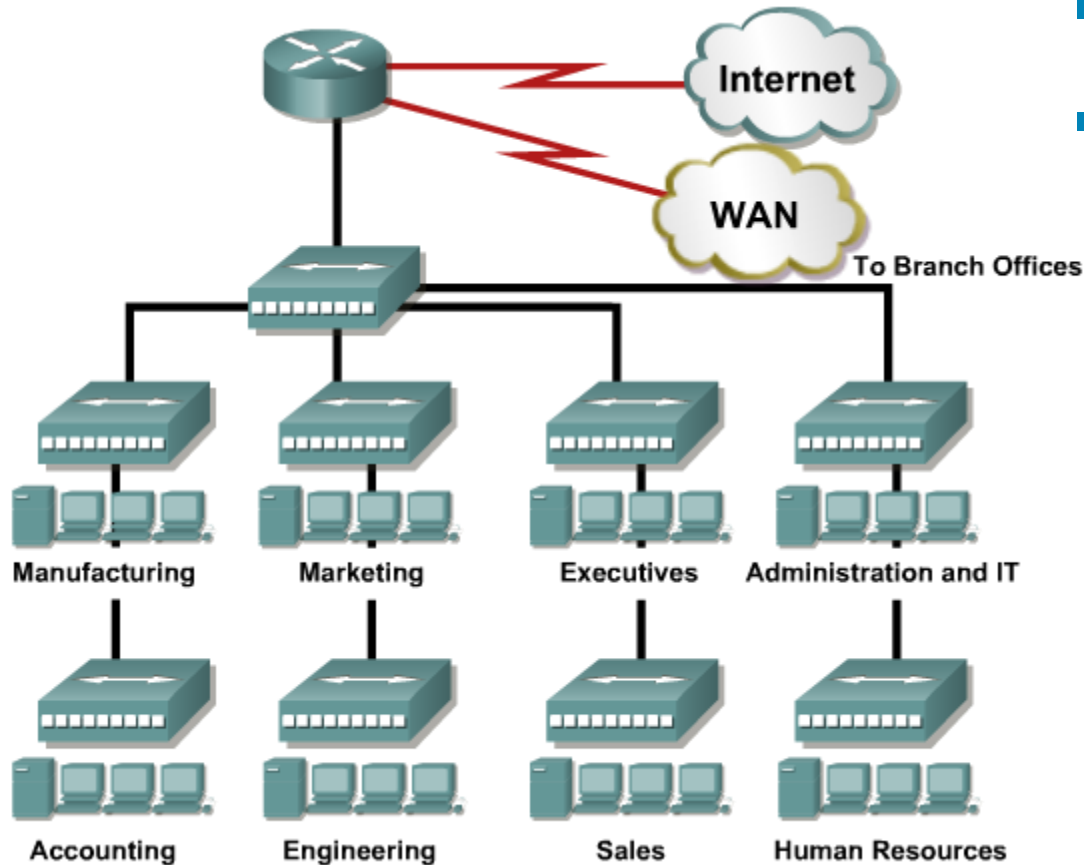
- *Notice HUBs*

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

Network without Hierarchy ②
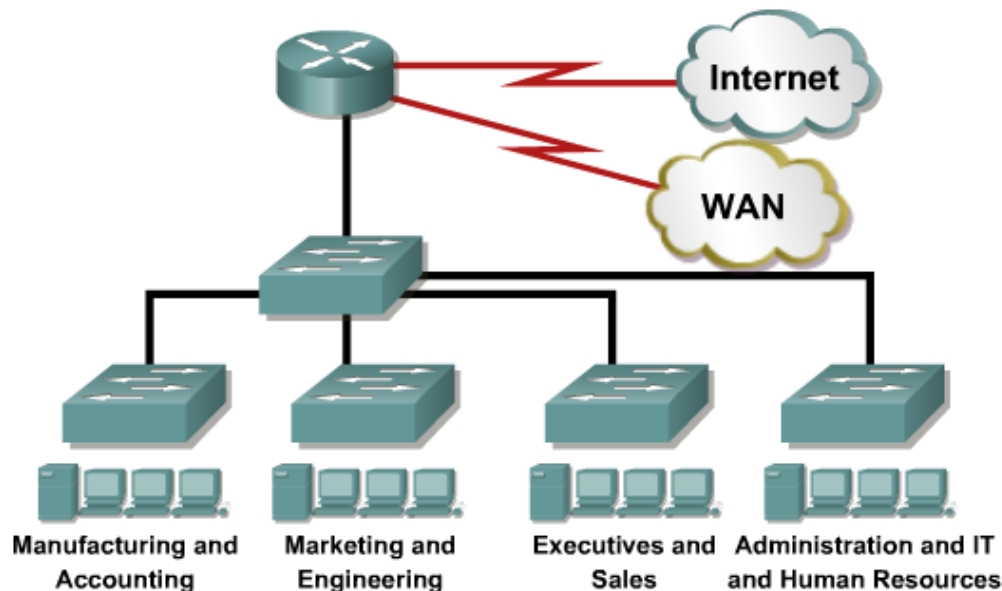
- *What if we replace hubs with switches – what is corrected and what is still missing?*

  - 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

Internet

WAN

Manufacturing and Accounting

Engineering

Marketing

Executives and Sales

Administration and IT and Human Resources
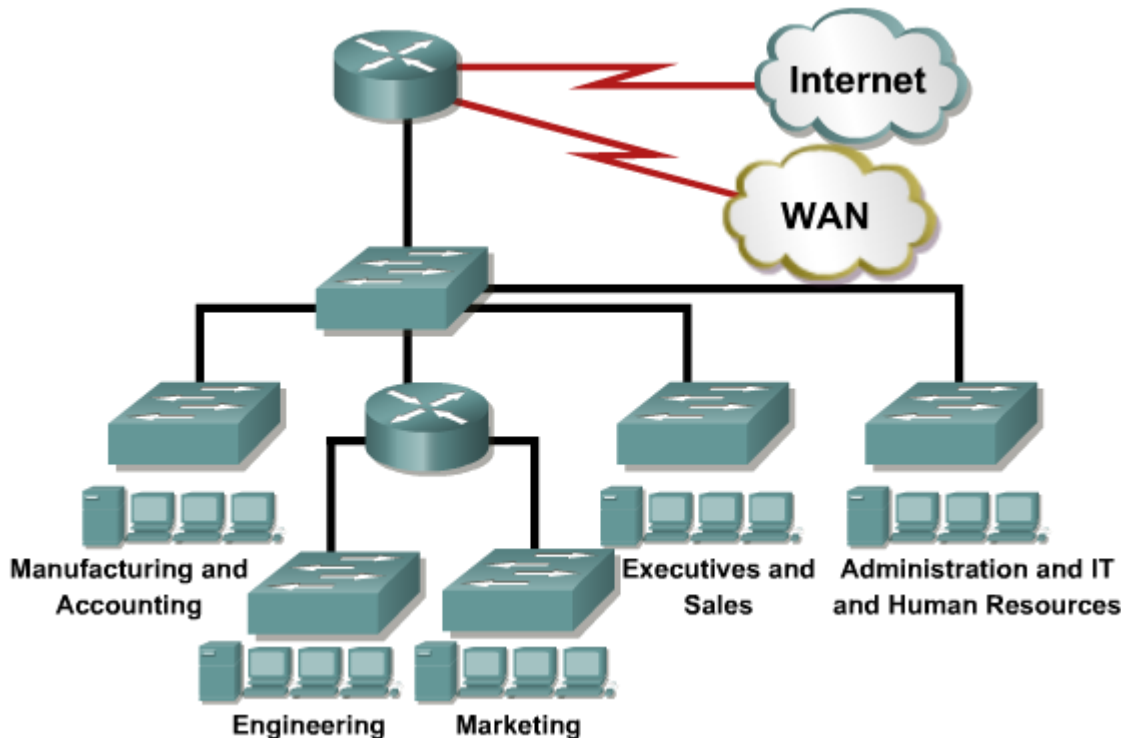
- With help of router
  - Smaller broadcast domains
  - More control over transferred traffic

- *Unfortunately routers are quite expensive*
  - Price for port is high
  - Number of ports on usual router is limited

Introducing Multilayer Switching
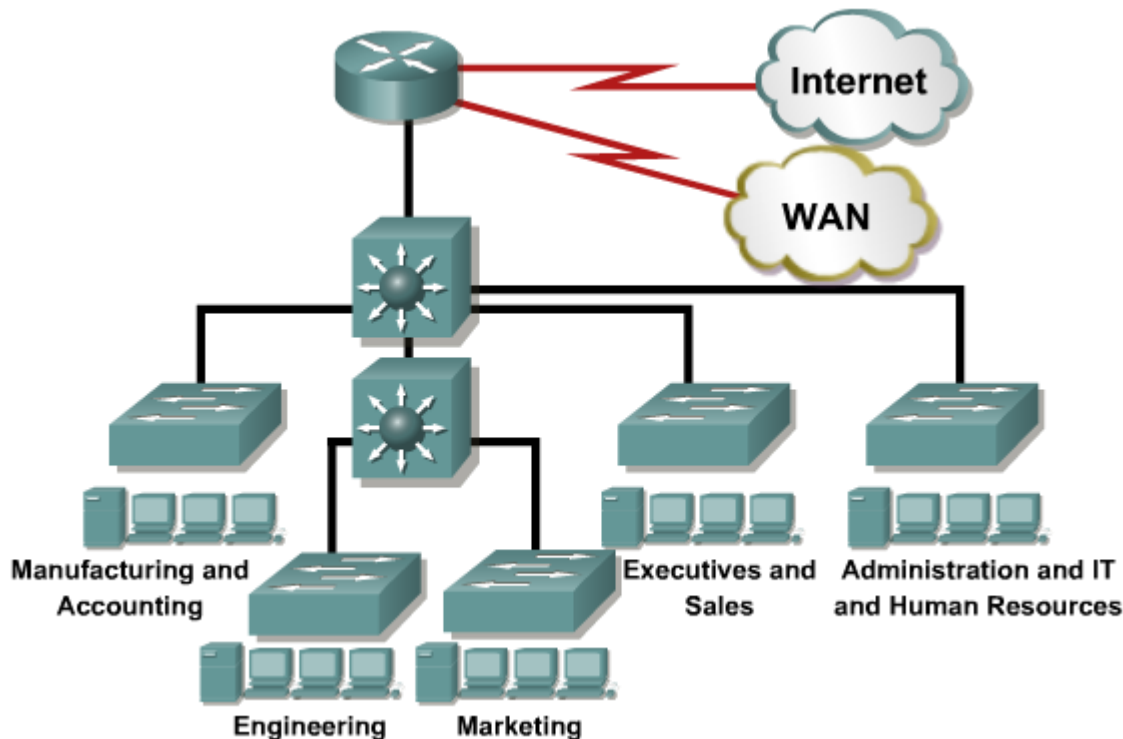
- Multilayer switches replace routers as integrated devices

- 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
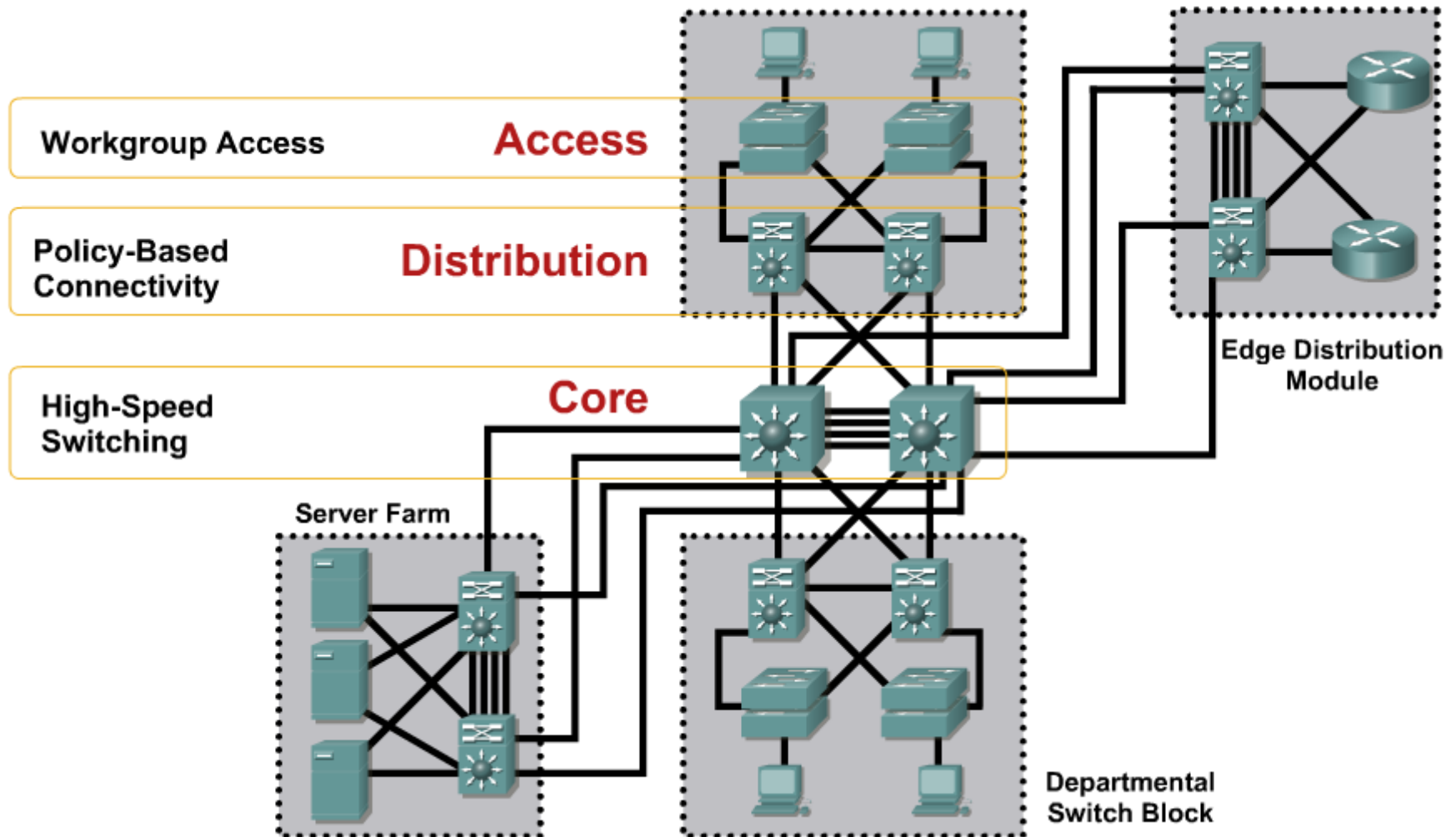
Access Layer

- 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
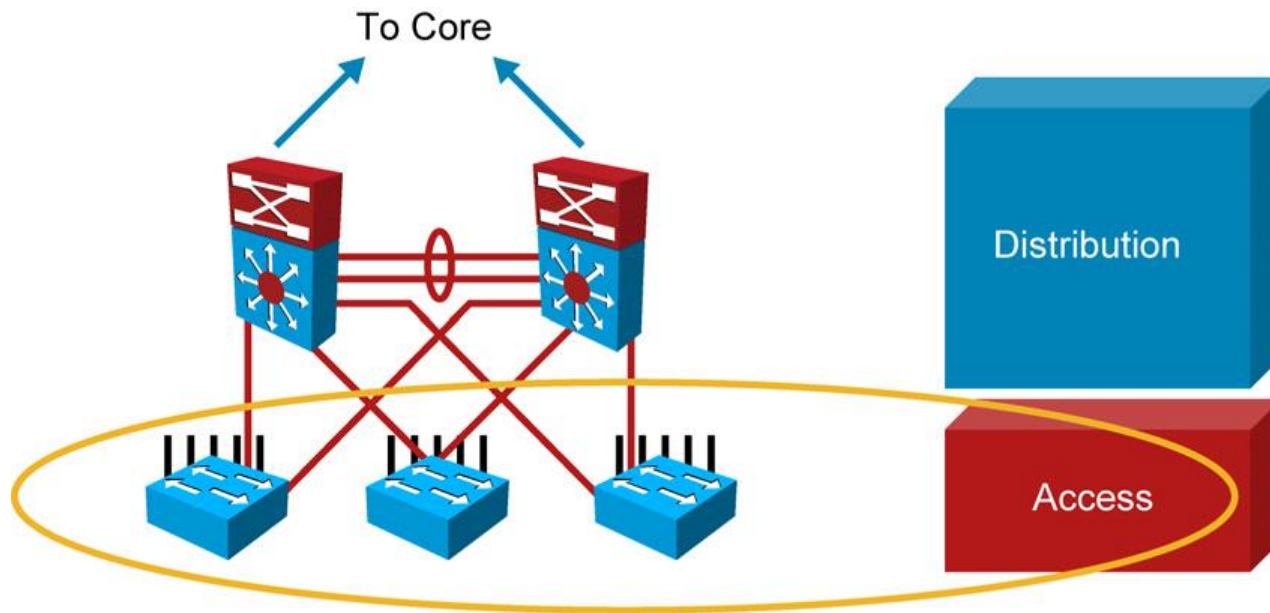
Distribution Layer

- 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
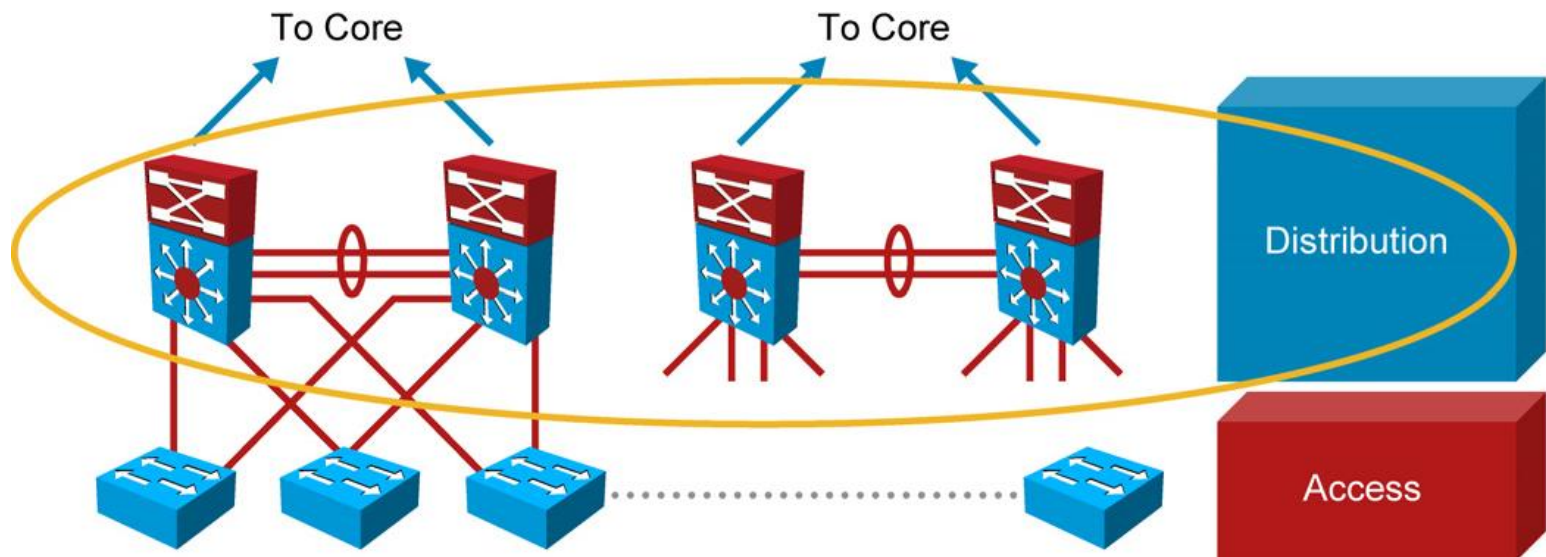
Core Layer (Backbone)

- 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
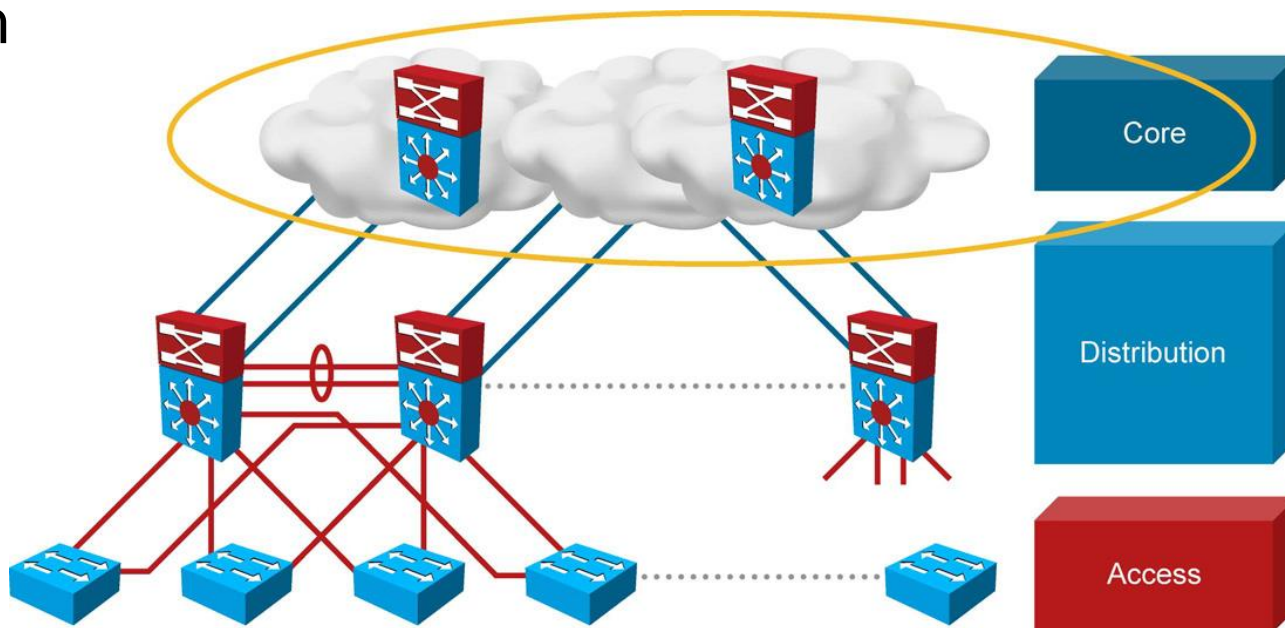
Small Size Network – SOHO

- Less than 200 end stations

- **Collapsed core** (core and distribution form one layer

- Access Layer: Catalyst 3560 and 2960G

- WAN connection: C1900 and C2900
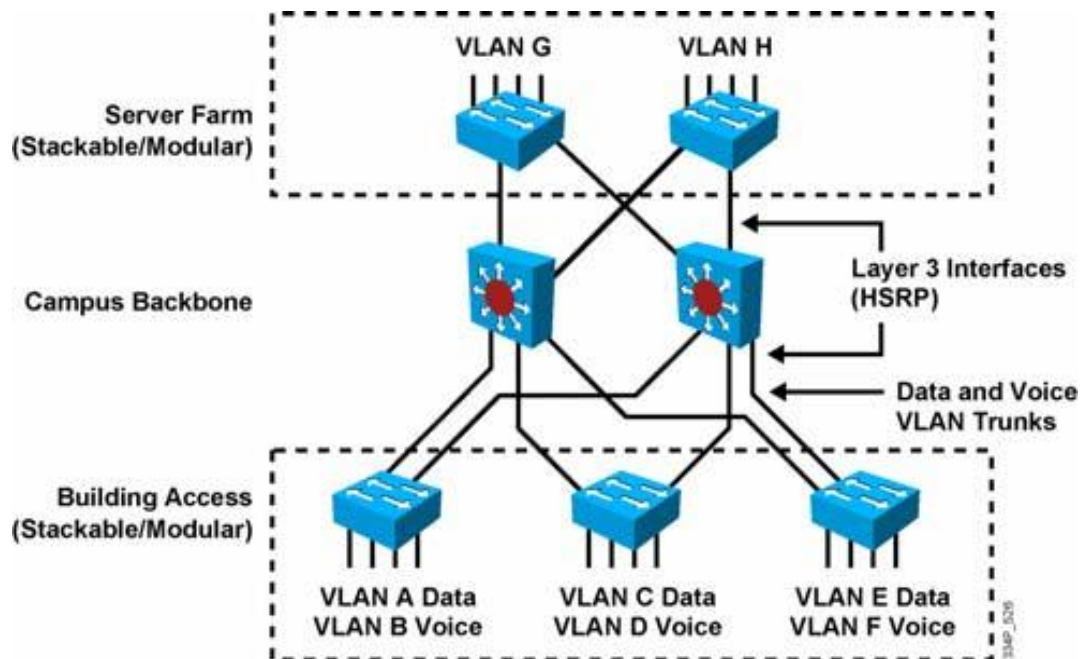
Medium Size Network

- Cca 200 up to 1000 end stations

- Redundancy of switches on distribution layer

- Usage for Catalyst 4500 or 6500
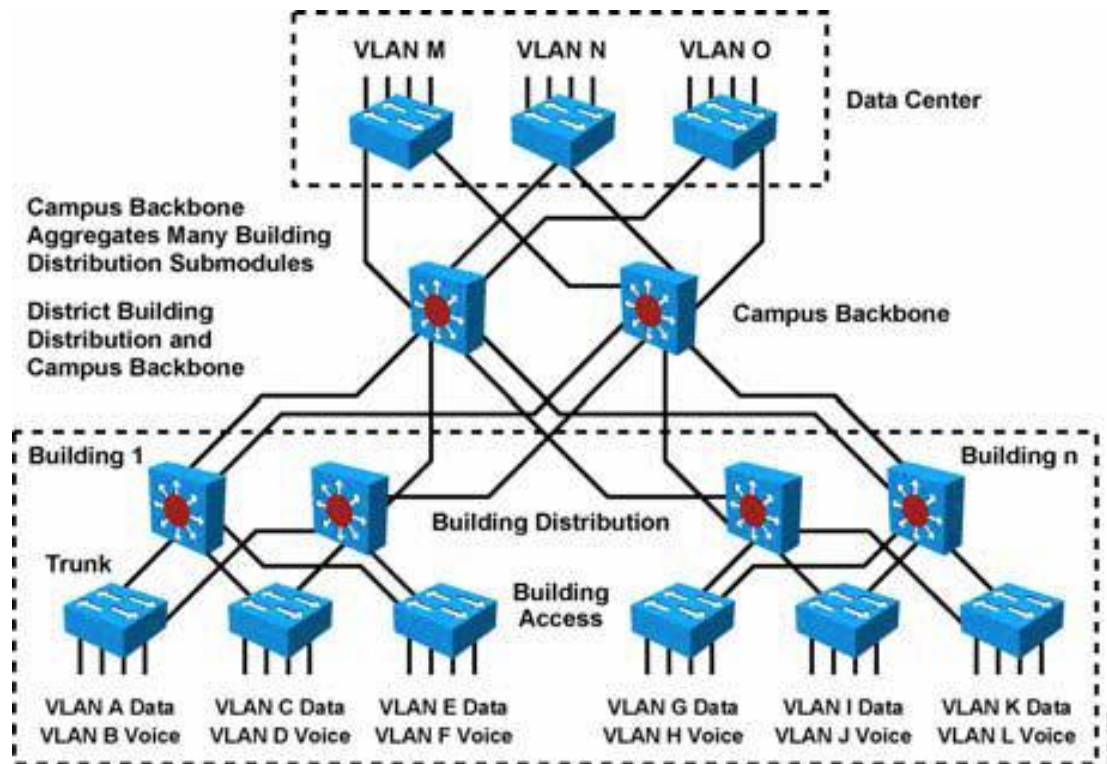
Large Size Networks

- Strictly following hierarchical design and boundaries between layers

- Backbone and on distribution layer is usually place for Catalyst 6500 switches or high-end routers like C7600 or GSR

- In datacenters specialized switches Nexus 5000/7000

Data Center Network

- Fastspeed switching infrastructure in the backbone
- Aggregation layer consists of service modules integration, FHRP, security, load-balancers, content switching, FW, SSL offload, NetFlow and monitoring, IDS and IPS systems
- The goal of access layer is to provide access for servers
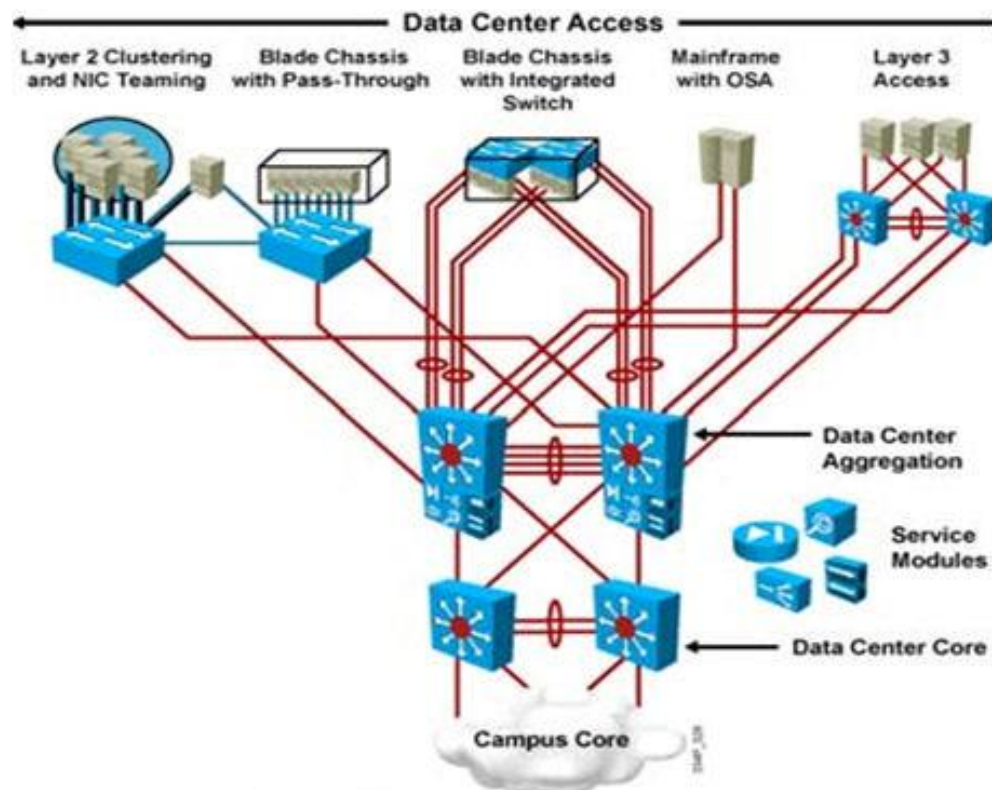
Large Networks Design

- *It's not an easy thing to delivery…and usually it requires more than just 3Layered Network Model*

- *There are many good methodologies pretending to be best!* They're based on
    - network architecture (topology)
    - valid directives, regulation and rules
    - service providing
    - intelligence of interconnection with different systems

- **Cisco Enterprise Architecture** is model blessed by Cisco
    - 6 parts: Enterprise Campus, Enterprise Edge, Provider (Edge), Enterprise Branch, Enterprise Data Center, Enterprise Teleworkers

Cisco Enterprise Architecture
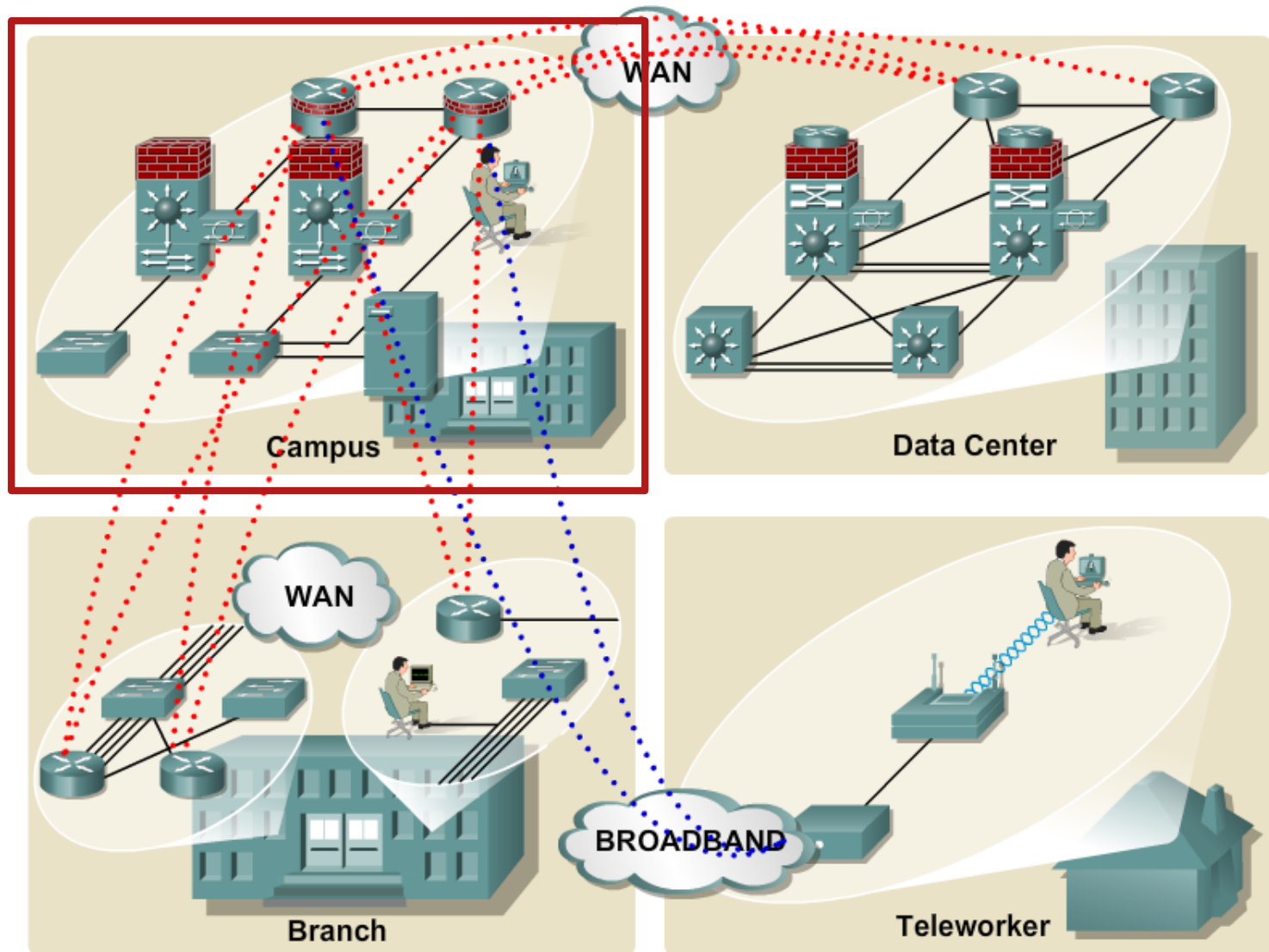
Enterprise Composite Network Model (ECNM) Building Blocks
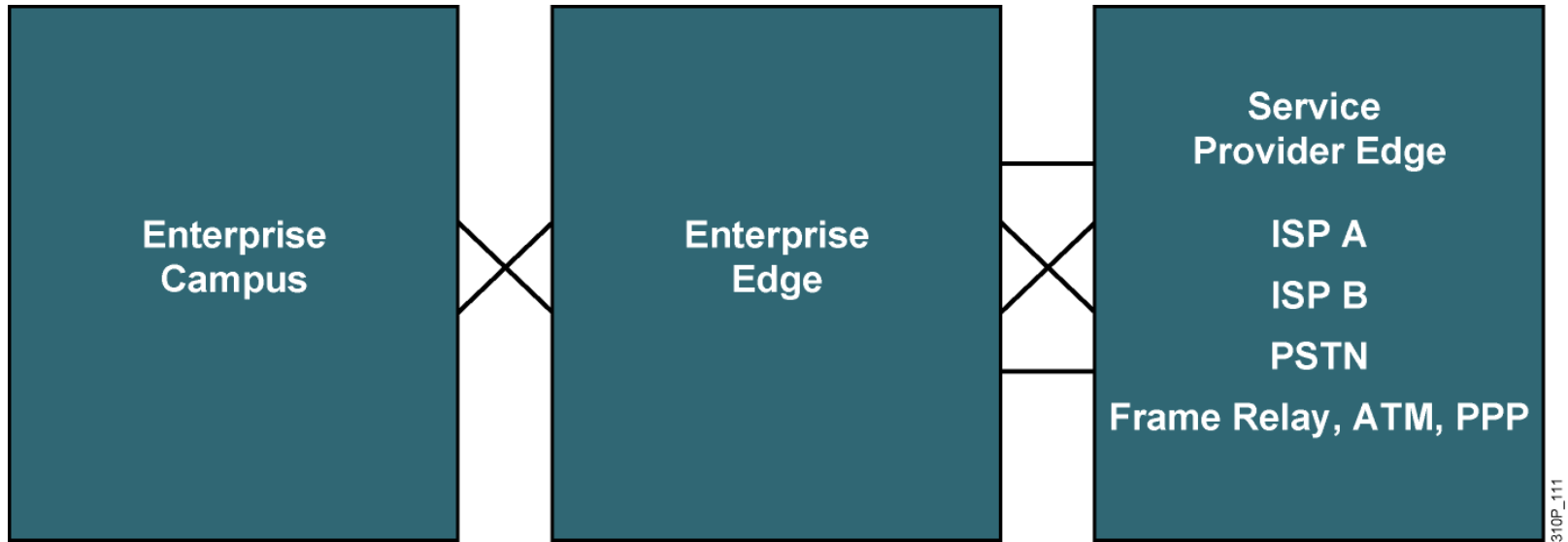
- **Enterprise Campus**
  - Contains the modules required to build a hierarchical, highly robust campus network

- **Enterprise Edge**
  - Aggregates connectivity from the various resources external to the enterprise network

- **Service Provider Edge**
  - facilitates communication to WAN and Internet service provider technologies

Enterprise Campus Block Modules
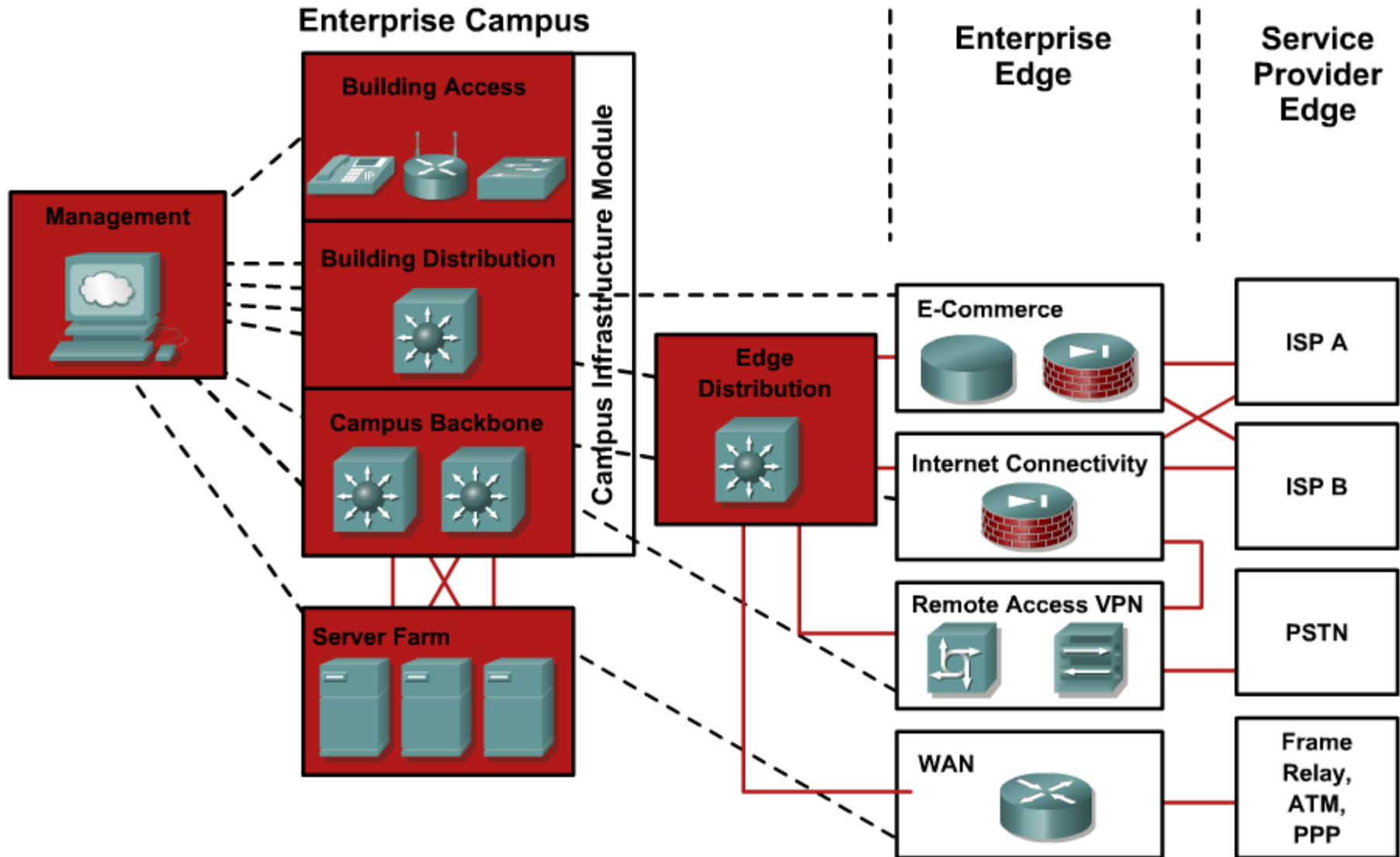
Best-practices to Design and Operate

- Known methodologies
  - FCAPS – Fault, Config, Accounting, Performance, Security (ISO)
  - TMN – Telecommunication Management Network (ITU-T)
  - ITIL – IT Information Library
  - Cisco Lifecycle Services

- Cisco Lifecycle Services a.k.a. **PPDIOO** named by phases
  - Prepare
  - Plan
  - Design
  - Implement
  - Operate
  - Optimize

Cisco Lifecycle Services

Coordinated planning and strategy
Make sound financial decisions

Assess readiness
Can the network support the proposed system?

Design the solution
Products, service, and support aligned to requirements

Implement the solution
Integrate without disruption or causing vulnerability

Maintain network health
Manage, resolve, repair, and replace

Operational excellence
Adapt to changing business requirements

Prepare
Plan
Design
Implement
Operate
Optimize

334P_501

Implementation Plan Example

	Date, Time	Description	Implementation Details	Complete
Phase 3	04/02/2007	Install campus hardware	Section 6.2.3	✓
Step 1		Connect switches	Section 6.2.3.1	✓
Step 2		Install routers	Section 6.2.3.2	✓
Step 3		Complete cabling	Section 6.2.3.3	✓
Step 4		Verify data link layer	Section 6.2.3.4	✓
Phase 4	04/03/2007	Configure campus hardware	Section 6.2.4	
Step 1		Configure VLANs	Section 6.2.4.1	
Step 2		Configure IP addressing	Section 6.2.4.2	
Step 3		Configure routing	Section 6.2.4.3	
Step 4		Verify connectivity	Section 6.2.4.4	
Phase 5	04/05/2007	Launch campus updates into production	Section 6.2.5	
Step 1	…	Complete connections to existing network	Section 6.2.5.1	
Step 2		Verify connectivity	Section 6.2.5.2	

Where to seek further?

- Service-Oriented Network Architecture

  - http://cisco.com/go/sona

- Cisco Lifecycle Services

  - http://www.cisco.com/warp/public/437/services/lifecycle/index.html

  - http://cisco.com/go/lifecycle

- SAFE Blueprint

  - http://cisco.com/go/safe

- Cisco Validated Design

  - http://cisco.com/go/cvd

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:

Dst MAC	Src MAC	Type/Length	Data	FCS

- 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

DM	SM	T	Data	FCS

Ethernet 802.2 LLC

DM	SM	L	DSAP	SSAP	Control	Data	FCS

Ethernet 802.3 SNAP

DM	SM	L	DSAP	SSAP	Control	SNAP	Data	FCS

Vendor	Type
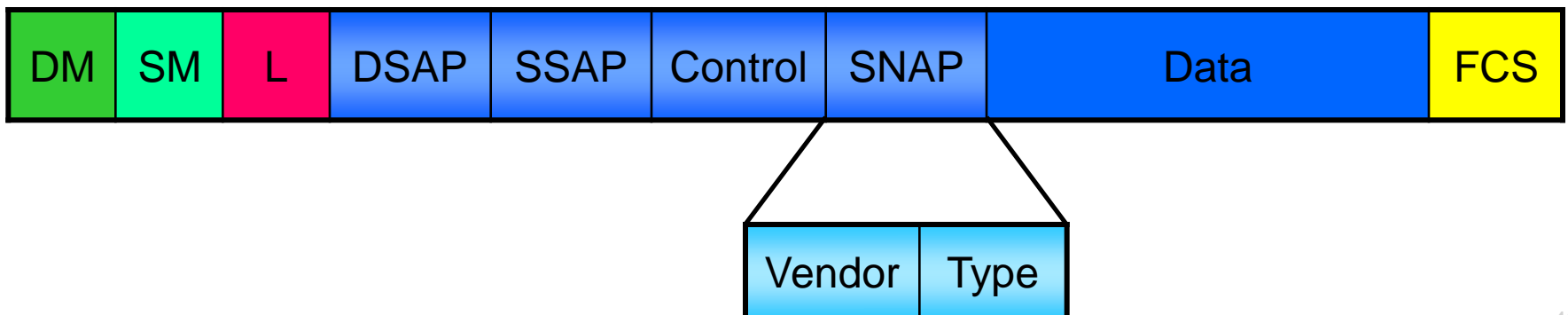
Enterprise Campus L2 Devices

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

- For access layer
  - Catalyst 2960 (L2 switch)
  - Catalyst 3560, 3750 (L3 switch)
  - Wifi APs

- For distribution layer
  - Catalyst 3560, 3750, 4500, 6500 (L3 switches)

- For core layer
  - Catalyst 4500, 6500, or high-end routers

- For data centers
  - Nexus 5000, 7000 with FCoE support
  - Nexus 7000 (highest port density among all Cisco switches)

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
```

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
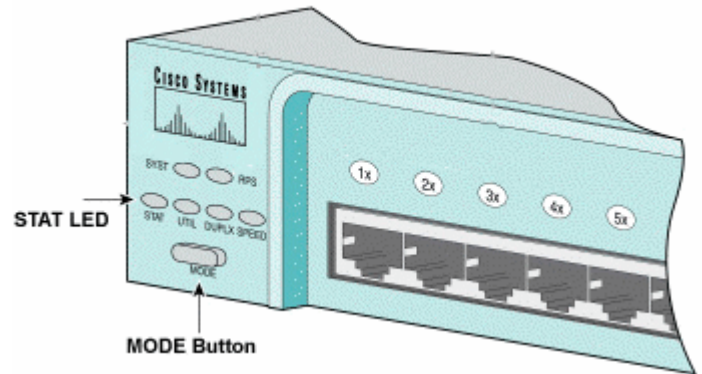
3) Enter following commands:

```
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
```

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

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!*

L2 Traceroute

- Use-case – A administrator needs to identify the performance and path on a hop-by-hop basis for a specific server and client exhibiting slow file-transfer performance

- To perform an L2 traceroute, administrator can choose any switch in the network as long as that switch has both the source and destination MAC addresses in the MAC address table
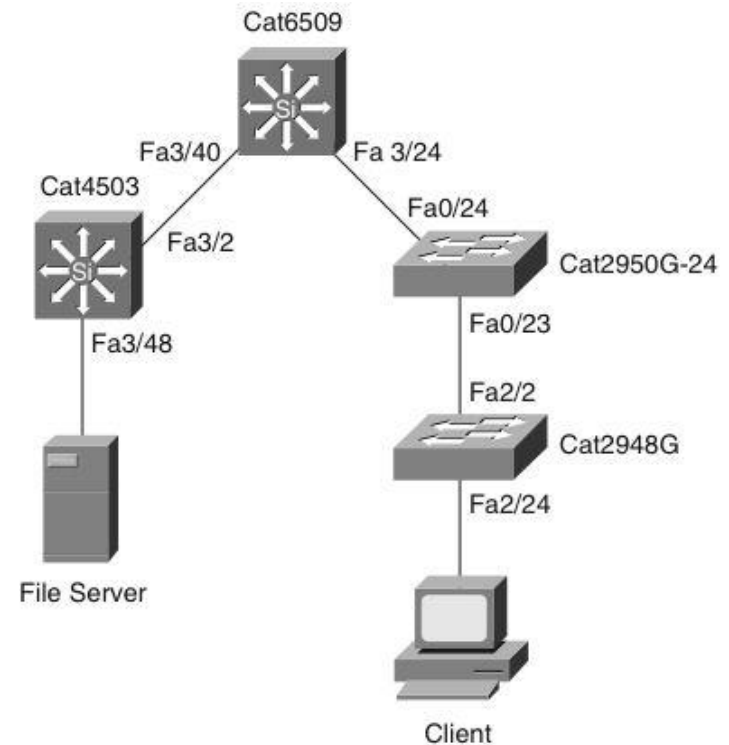

```
2950G# traceroute mac 0000.0000.0007 0000.0000.0011
Source 0000.0000.0007 found on 4503
4503 (14.18.2.132) : Fa3/48 => Fa3/2
6500 (14.18.2.145) : 3/40 => 3/24
2950G (14.18.2.176) : Fa0/24 => Fa0/23
2948G (14.18.2.91) : 2/2 => 2/24
Destination 0000.0000.0011 found on 2948G Layer 2 trace completed
```

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
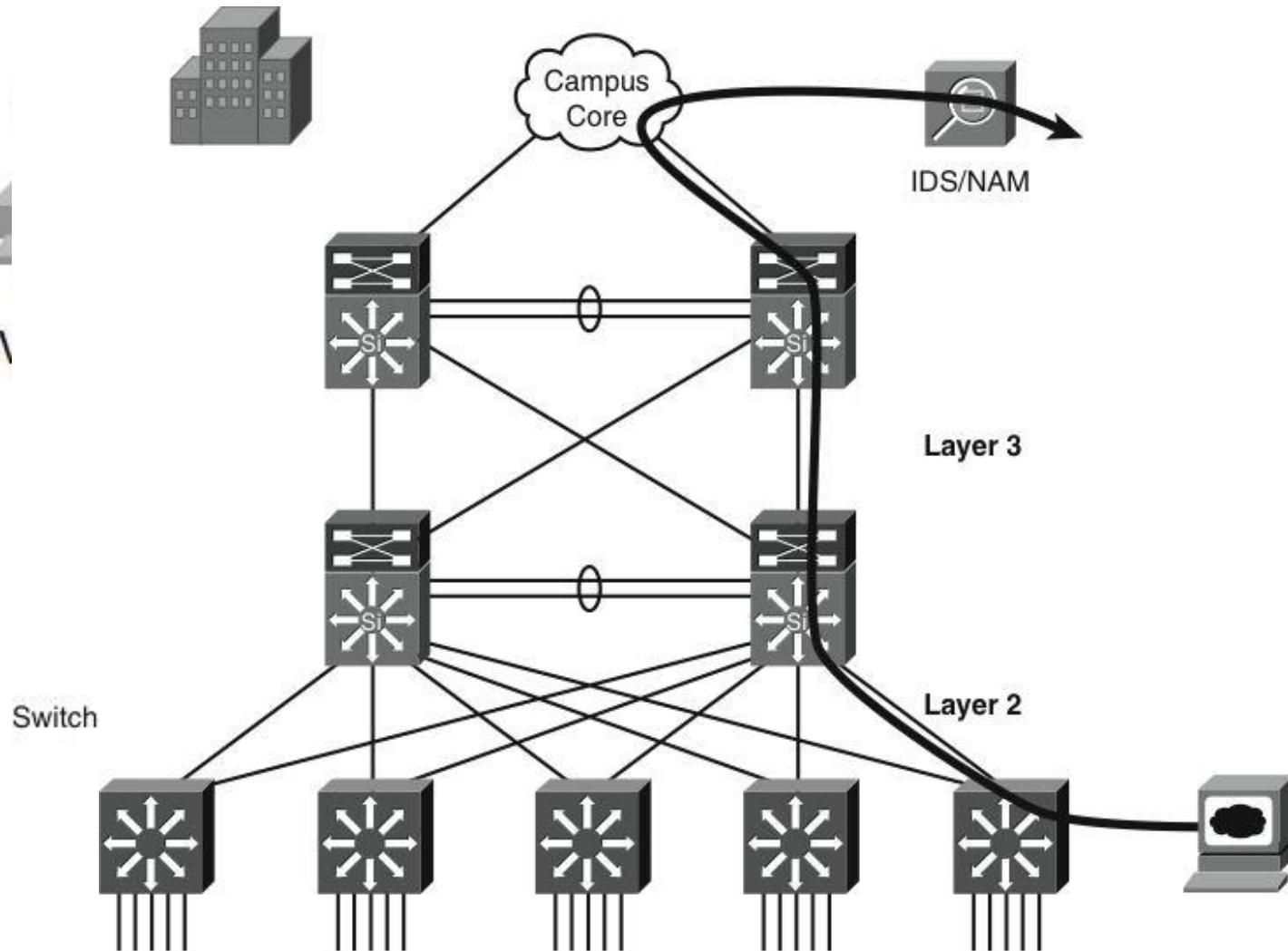
Configuring (V)SPAN

- 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
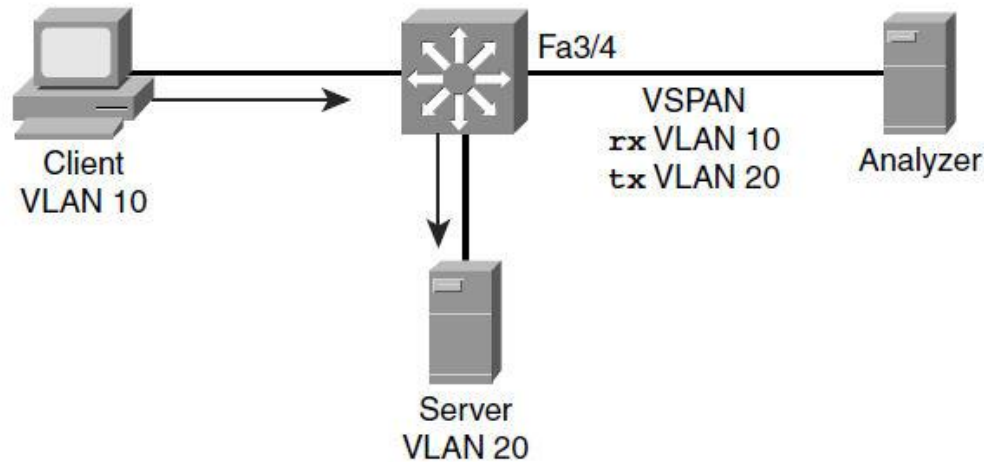

```
cat4k(config)# monitor session 1 source vlan 10 rx
cat4k(config)# monitor session 1 source vlan 20 tx
cat4k(config)# monitor session 1 destination interface FastEthernet 3/4
cat4k# show monitor session 1
Session 1
-----
Type                    : Local Session
Source VLANs    :
  RX Only       : 10
  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:
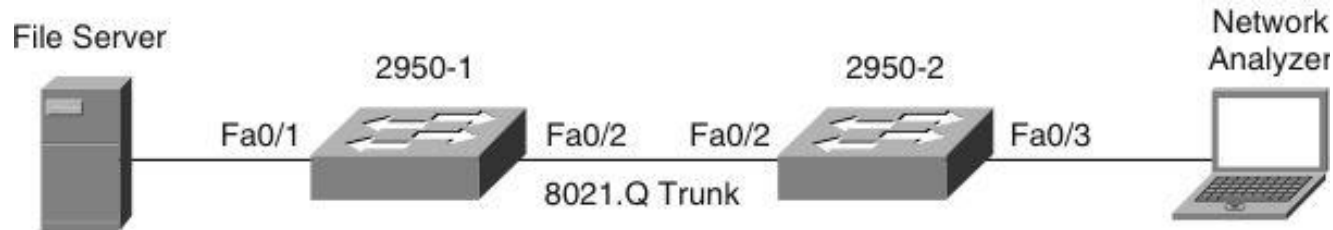
```
Switch(config)# monitor session session-id source {interface
IFACE | vlan vlan-id [,][-] {rx | tx | both}
Switch(config)# monitor session session-id destination interface
IFACE [encapsulation {dot1q | isl}] [ingress vlan vlan-id]
```

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
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
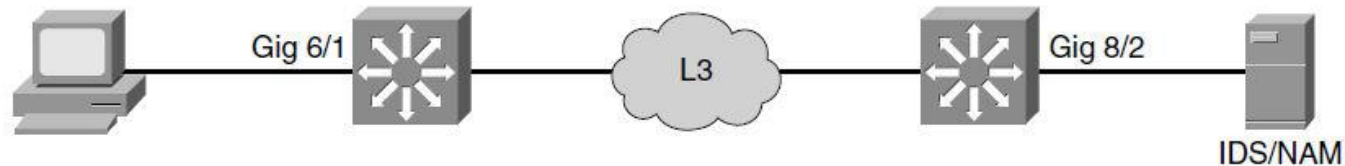

```
Switch1(config)# monitor session 66 type erspan-source
Switch1(config-mon-erspan-src)# source interface gigabitethernet 6/1
Switch1(config-mon-erspan-src)# destination
Switch1(config-mon-erspan-src-dst)# ip address 10.10.10.10
Switch1(config-mon-erspan-src-dst)# origin ip address 20.20.20.200
Switch1(config-mon-erspan-src-dst)#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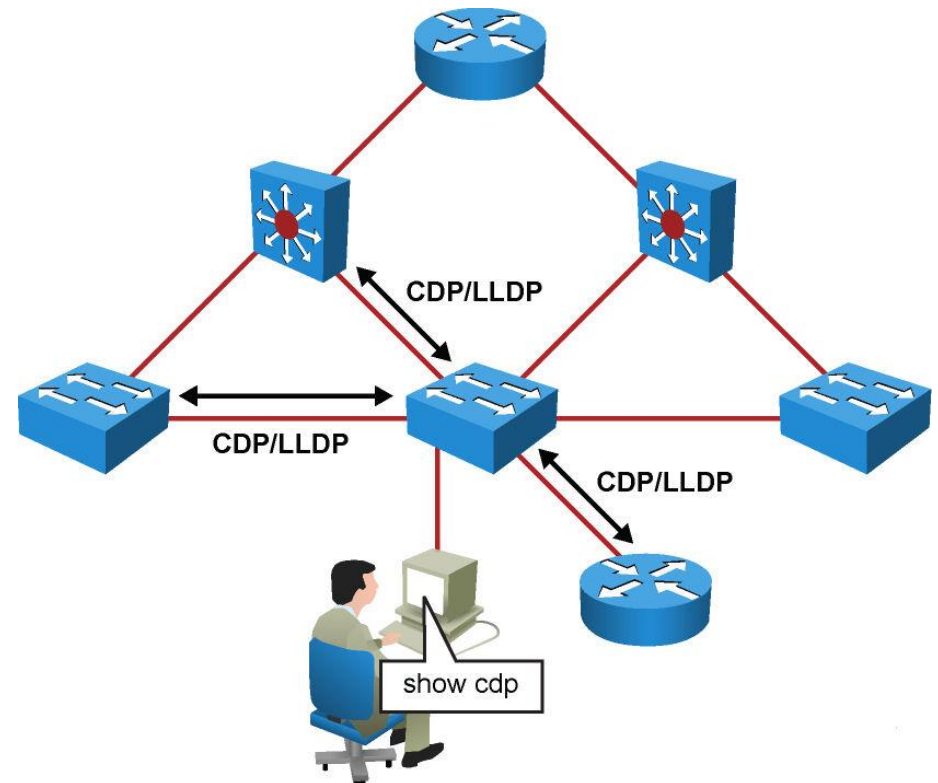
Neighbor Discovery Protocols

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 partially from official course materials
but the most of the credit goes to CCIE#23527 Ing. Peter Palúch, Ph.D.

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