In 60 Days – CCENT ICND 1 (100-101)

The Ultimate Cram Guide

You can print these slides if you have joined the program at www.in60days.net

Warning

- You need to know everything on this video before you attempt the exam.
- This cram guide is NOT a replacement for studying and doing lots of labs.

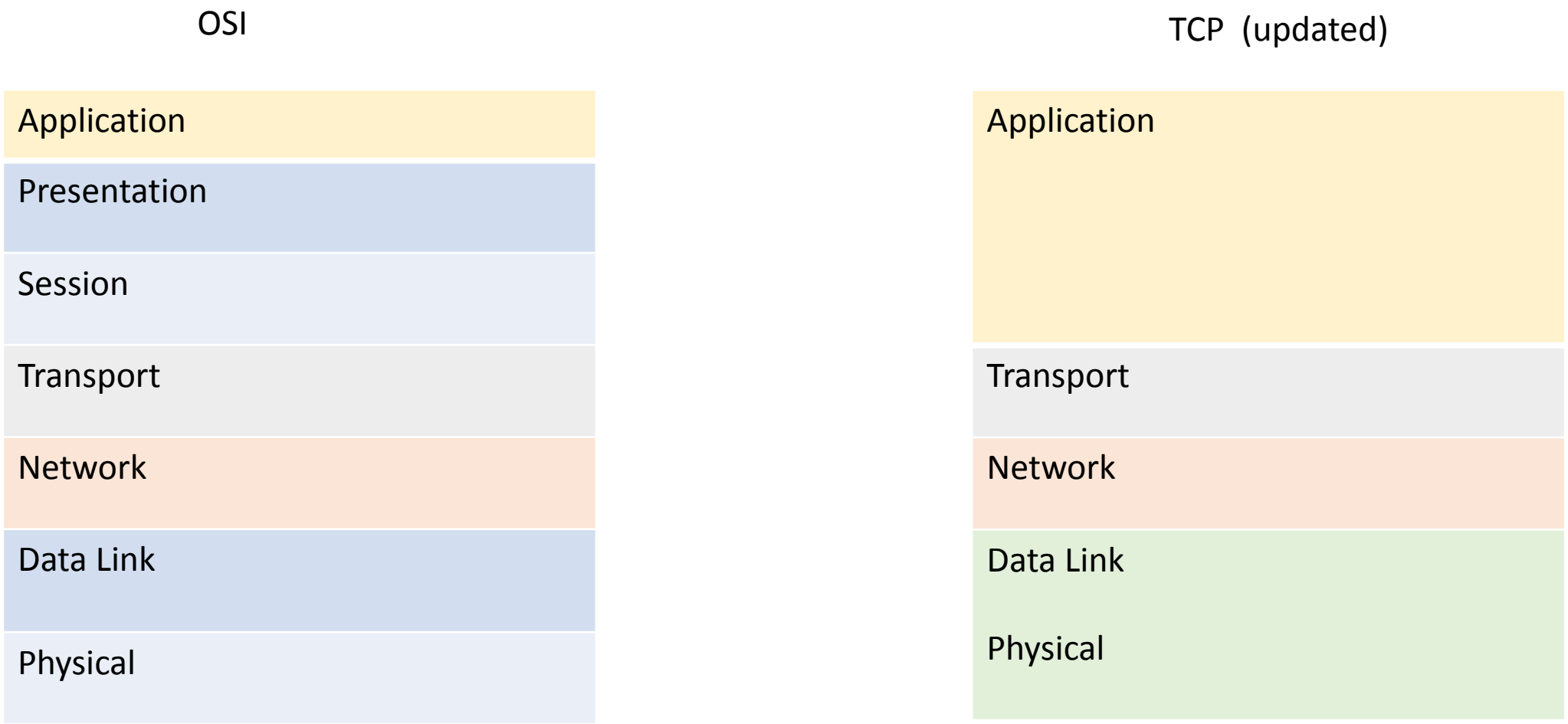
How to...

- Stop the video as required
- Print the slides (members only)

OSI/TCP Model

Layer	Purpose	Data	Applications	TCP
7. Application	Establishes resources.	Data	E-mail	Application
6. Presentation	De/Encryption & data compression.	Data	MP3, MP4	Application
5. Session	Establishes sessions.	Data	SQL, NFS	Application
4. Transport	Data delivery.	Segment	TCP/UDP	Host-to-host
3. Network	Best path to destination.	Packet	IP/RIP	Internetwork
2. Data Link	MAC address/error detection.	Frame	Frame relay	Network Interface
1. Physical	Data onto wire.	Bits	Cables & devices	Network Interface

OSI & TCP Model comparison



All People Seem To Need Data Processing – Don't Some People Fry Bacon

Common Ports

Port	Service	Port	Service
20	FTP Data	80	HTTP
21	FTP Control	110	POP3
22	SSH	119	NNTP
23	Telnet	123	NTP
25	SMTP	143	IMAP
53	DNS	161/162	SNMP
69	TFTP	443	HTTPS

TCP/IP

TCP	Protocol 6	Reliable delivery of data. 20 byte header
UDP	Protocol 17	Connectionless, no delivery guarantee, 8 byte header
FTP	TCP 20/21	Used to send large files reliably
TFTP	UDP 69	Sends small files across network
SNMP	UDP 161/162	Remotely manages network devices
ICMP	Protocol 1	Sends query and error messages. Used by PING
ARP	Network protocol	Maps a known IP address to a MAC address
DNS	UDP 53	Resolves hostnames to IP addresses
DHCP	UDP 67/68	Sends network configuration parameters

Configure DHCP

```
Router(config)#ip dhcp pool NAME_DHCP_Pool
Router(dhcp-config)#network 10.10.10.0 255.255.255.0
Router(dhcp-config)#dns-server 24.196.64.39 24.196.64.40
Router(dhcp-config)#domain-name mydomain.com
Router(dhcp-config)#default-router 10.10.10.254
Router(dhcp-config)#lease 1
```

Router Modes

Mode	Prompt
User exec	Router>
Privileged exec	Router#
Global config	Router(config)#
ROM monitor	rommon>
Set Up	[series of questions]
RXBoot	Router<boot>

Keyboard Shortcuts

Ctrl+W	Erases a word	Ctrl+P (up arrow)	Recall last command
Ctrl+U	Erases a line	Ctrl+N	Recall next command
Ctrl+A	Curser to line start	Esc+B	Move back one word
Ctrl+E	Curser to end of line	Esc+F	Forward one word
Ctrl+F (right arrow)	Forward one character	Tab	Finish the command
Ctrl+B (left arrow)	Back one character		

Router Elements – Internal components

DRAM	Buffers, routing tables, running config	Wiped on power down
ROM	Mini OS	Rommon mode
Flash	Compressed IOS	
NVRAM	IOS expanded	Start up config
Config-register	Defines booting process	Default value – 0x2102 (0x2142 skips startup config)

Cabling

	Hub	Switch	Router	PC
Hub	Crossover	Crossover	Straight	Straight
Switch	Crossover	Crossover	Straight	Straight
Router	Straight	Straight	Crossover	Crossover
PC	Straight	Straight	Crossover	Crossover

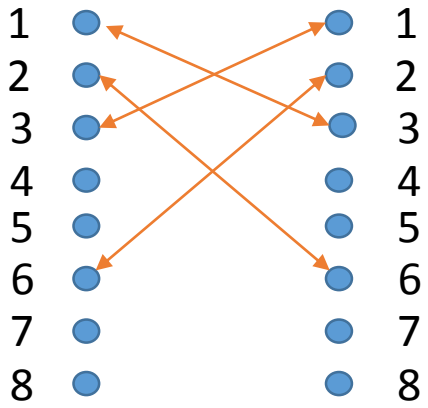
Like to like is usually a crossover apart from PC to Router

Crossover – pin 1 to 3 , pin 2 to 6

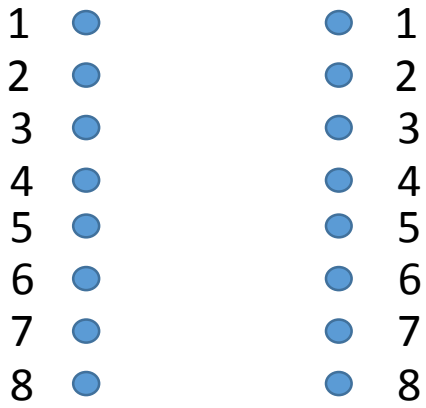
Straight – all pins match each side

Rollover – all pins reversed so 1-8, 2-7, etc.

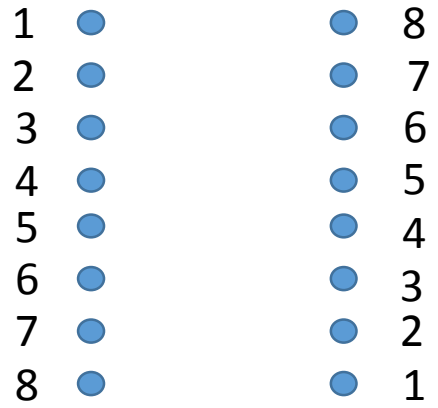
Crossover Cable



Straight Cable



Rollover Cable



Connection to the Router

Console	Rollover cable. Initial config/disaster recovery
Aux port	Usually modem connections
VTY	Telnet ports. Usually 0-4 inclusive on routers
TFTP	Send small files to and from router
NMS	SNMP to report on router usage/interfaces

Cisco Discovery Protocol (CDP)

- Gathers info about nearby connected devices
- Turn off cdp on entire router – `(config)#no cdp run`
- Turn off cdp on interface – `(config-if)#no cdp enable`
- `show cdp neighbor [detail]`
- Can be used for troubleshooting to discover neighbour details
- Please try the show commands as you may be asked what they tell you

LAN Switch

1. Learns addresses – `show mac-address-table`
2. Filters and forwards frames out of correct port
3. Avoids network/switching loops with STP (spanning tree protocol).

Transmitting Frames

Store-and-Forward	Copies entire frame into buffer, checks CRC. High latency
Cut-Through	Reads only destination address and forwards frame. Lowest latency.
Fragment-Free	Switch reads first 64 bytes of frame.

Spanning Tree Protocol (STP)

- Provides redundant paths for traffic
- Prevents loops on those paths
- Uses Bridge Protocol Data Units (BPDU)
- Force switch to become root:

```
Switch(config)#spanning-tree vlan 2010 priority 8192
(Or)
Switch(config)#spanning-tree vlan 2010 root primary
```

Port Security

- Protects switch ports
- Can permit static mac address(es)
- Violation action is shutdown/protect/restrict
- Restrict interface so only expected devices can be connected
- Port security identifies devices based on MAC address
- Port security is enabled on switch ports with different settings available per port
- Each port can be defined with maximum allowed MAC address

Mode	Port Action	Traffic	Syslog	Violation Counter
Protect	Protected	Unknown MACs discarded	No	No
Shutdown	Errdisabled	Disabled	Yes & SNMP	Incremented
Restrict	Open	# of excess MAC traffic denied	Yes & SNMP	Incremented

Port Security features

- MAC address limitation.
- Sticky MAC address.
- Static and Dynamic MAC address entry.
- Violation modes:
    - Error disable
    - shutdown
    - Protect restrict
- Shutdown unused ports
- Assign all unused ports to unused VLAN.

Configure Port Security

```
Sw(config)#interface fast 0/1
Sw(config-if)#switchport port-security
```
→ enable port security

```
Sw(config-if)# switchport port-security mac-address sticky
```
→ Sticky MACs

(or)

```
Sw(config-if)#switchport port-security violation [shutdown/protect/restrict]
```
→ violations modes

(or)

```
Sw(config-if)#switchport port-security maximum 4
```
→ Limiting access to only 4 MACs

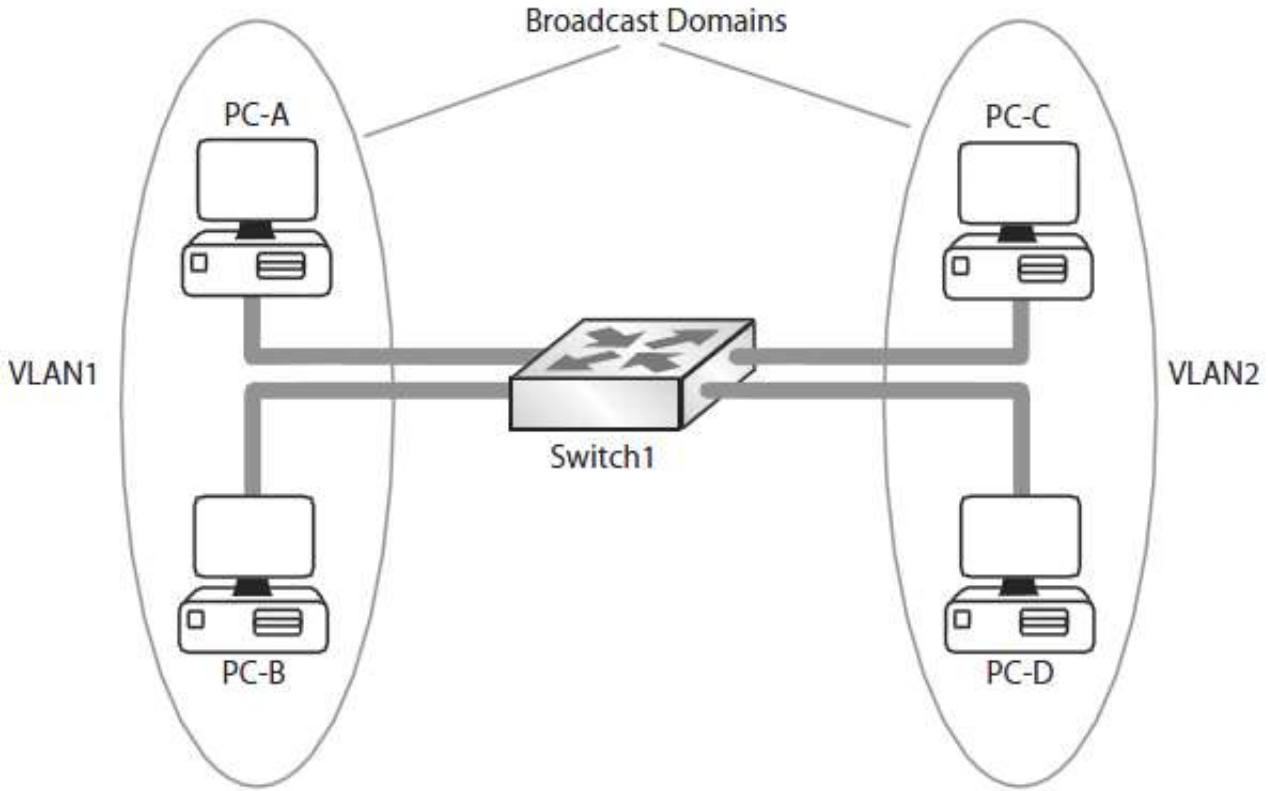
(or)

```
Sw(config-if)#switchport port-security mac-address xxx
```
→ hard codes mac address

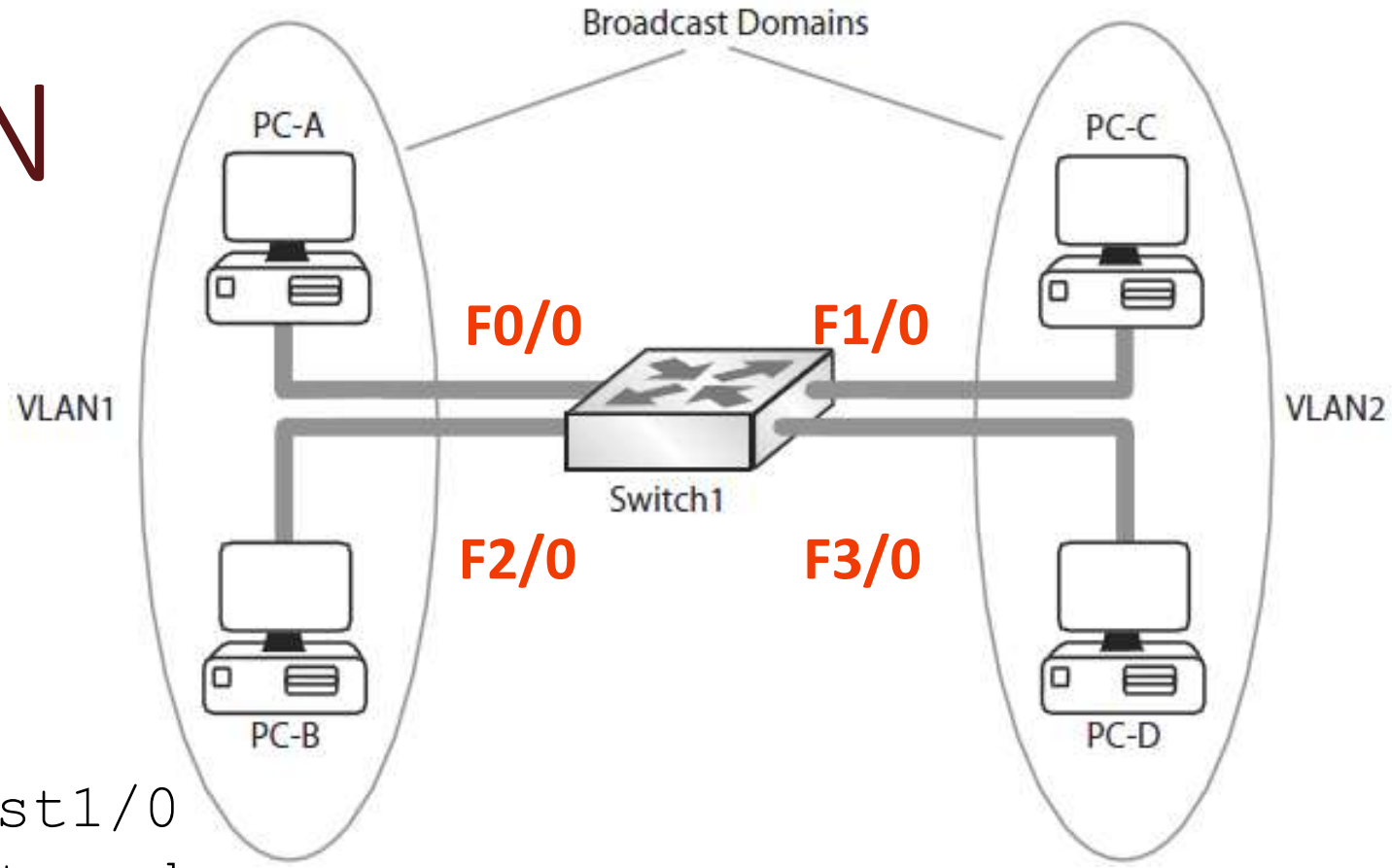
```
Sw#show port-security
```
you can add `[interface fast 0/1]`

VLANs

- Logically divide your LAN
- Cuts down broadcast domains
- Improves security
- Easier admin
- VLAN info goes over trunk links



Configure a VLAN

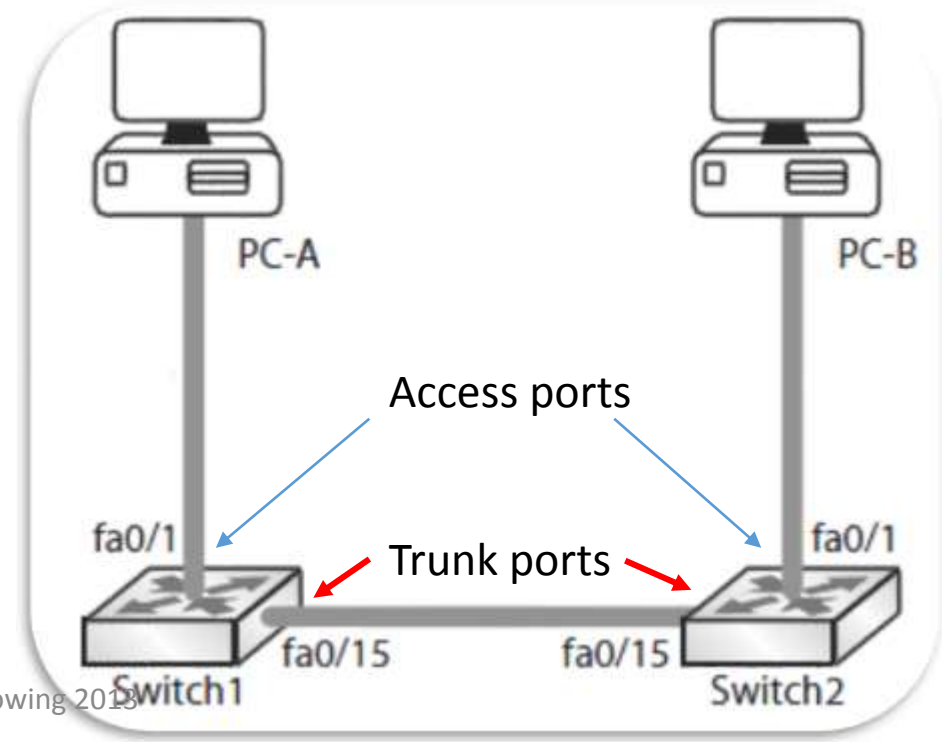



```
Switch(config)#vlan 2
Switch(config)#interface fast1/0
Switch(config-if)#switchport mode access
Switch(config-if)#switchport access vlan 2
Switch(config-if)#interface fast3/0
Switch(config-if)#switchport mode access
Switch(config-if)#switchport access vlan 2
```

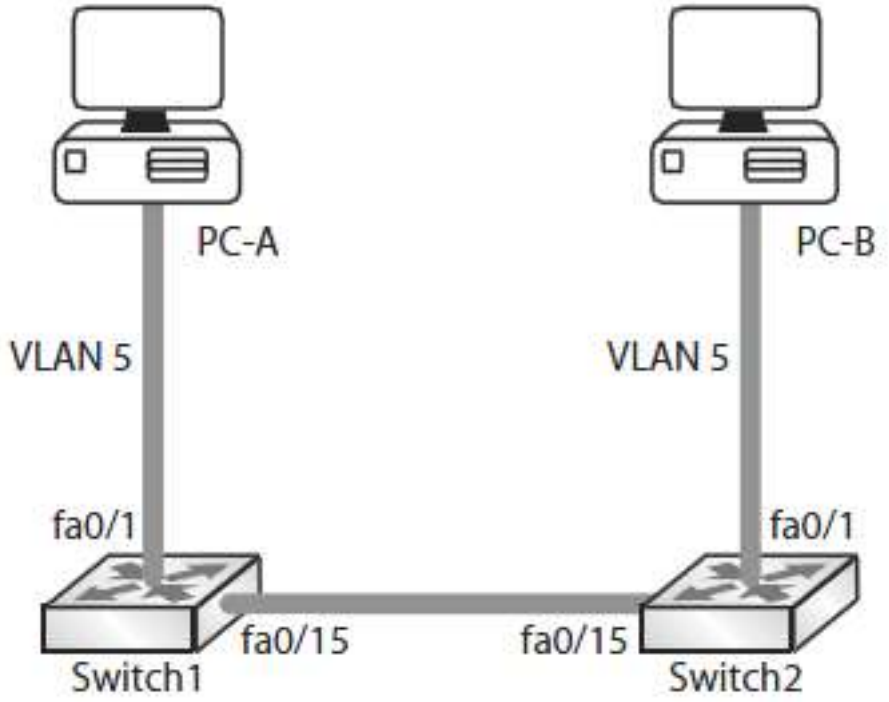
Types of ports on Switch

- Access port: Endpoints are usually connected on access ports.

- Trunk port: Other switch/non-edge devices connect to this port.



Configure a Trunk/Access port



Trunk link required to pass VLAN info across switches

Encapsulation either ISL or 802.1q (default on 2950 switch)

Link usually needs to be at least 100Mbps but usually 1000Mbps (can be 10Mbps!!)

Access port

```
Switch1(config)#vlan 5
Switch1(config)#interface fast0/1
Switch1(config-if)#switchport mode access
Switch1(config-if)#switchport access vlan 5
```

Trunk port

```
Switch1(config-if)#interface fast0/15
Switch1(config-if)#switchport mode trunk
Switch1(config-if)#switchport trunk encapsulation isl
```

VLAN Trunking Protocol (VTP)

- Carries VLAN update between switches
- All must be configured in the same VTP domain
- VTP modes are client/server/transparent
- Never connect a new switch while it is in server mode

```
SwitchA(config)#vtp mode server [this is the default]
SwitchA(config)#vtp domain Cisco
SwitchA(config)#vtp password ccna
```

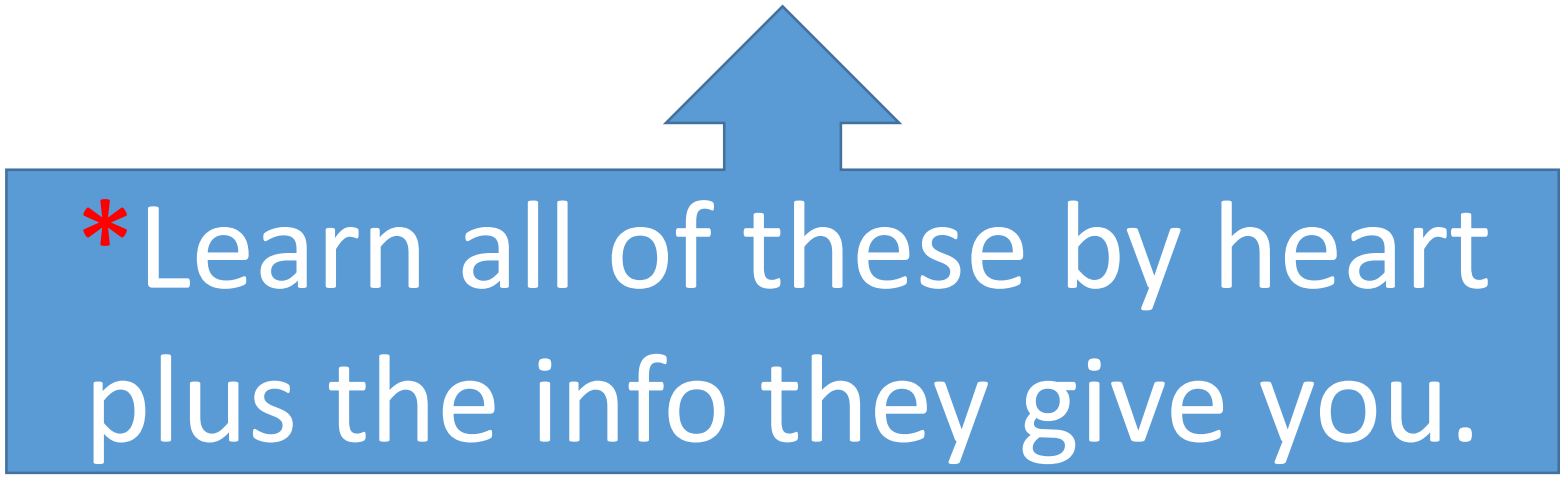
Switch Commands

`Switch(config)#vlan 2` (creates VLAN 2)
`Switch(config-vlan)#name SALES` (names VLAN)

`Switch(config)#interface fast 0/1`
`Switch(config-if)#switchport access vlan 2` (puts interface into VLAN 2)
`Switch(config-if)#switchport mode trunk` (sets interface to trunk)
`Switch(config)#vtp mode transparent/client/server` (sets switch mode)
`Switch(config)#vtp domain howtonetwork.net` (sets VTP domain name)
`Switch(config)#spanning-tree portfast` (sets portfast) `Switch(config)#ip default-gateway 192.168.1.1` (switch default gateway)

Switch Show Commands

`Switch#show vlan brief` → shows summary of VLAN info
`Switch#show vtp status` → shows various VTP info including mode/version
`Switch#show interfaces trunk` → shows trunk interfaces
`Switch#show mac-address-table[dynamic]` → shows mac table (dynamic)



DTP

- Tries to negotiate the port to become a trunk
- Always on unless you manually turn off

```
Switch1(config)#intf0/2
Switch1(config-if)#switchportnonegotiate
Command rejected: Conflict between 'nonegotiate' and 'dynamic'
status.
Switch1(config-if)#switchportmode trunk
Switch1(config-if)#switchport nonegotiate
Switch1(config-if)#
```

Auto = become a trunk if the other end is a trunk or set to desirable (passive)
Desirable = attempt to become a trunk (active)
Auto/Auto = no trunk. Must at least have one end as desirable or manually set to trunk

IP Addressing

Class	Mask	Leading Bits	Networks	Networks	Hosts
A	255.0.0.0 *127.0.0.0 reserved for loopback testing	0	1-126	126	16,777,214
B	255.255.0.0	10	128-191	16,384	65,534
C	255.255.255.0	110	192-223	2,097152	254
D	NA	1110	224-239		
E	NA	11110	240-255		

Subnets	BITS	128	64	32	16	8	4	2	1
128									
192									
224									
240									
248									
252									
254									
255									
2-2									
4									
8									
16									
32									

For working out which subnet a host is in

Subnetting Secrets Chart ™

For working out how many subnets and hosts per subnet

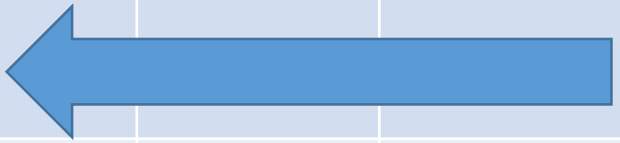
Easy Subnetting

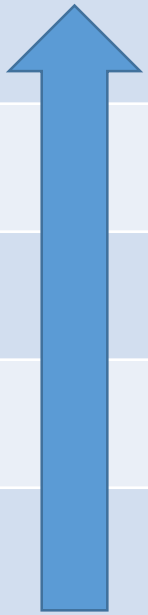
1. Change the slash number to subnet mask
2. Tick down and across the chart
3. Count up increments to get correct subnet

Which subnet is 172.16.100.11 /19 in?

- To get to /19 we steal 3 bits (from /16)
- Tick 3 down and 3 across the top
- Count up in 32 until you get to 100.11 subnet

	BITS	128	64	32	16	8	4	2	1
Subnets		✓	✓	✓					
128	✓								
192	✓								
224	✓								
240									
248									
252									
254									
255									





The top ticks reveal the subnet increments

So we can see that stealing 3 bits gives us a mask of 255.255.224.0

Next Steps

172.16.100.11	Our subnet host address
172.16.0.0	Our first subnet
172.16.32.0	Our second subnet
172.16.64.0	Our third subnet
172.16.96.0*	Our fourth subnet (100.11 in here)
172.16.128.0	

To Work Out All IPs

172.16.100.11	Our subnet host
172.16.96.0	Our subnet
172.16.96.1	Our first host
172.16.127.254	Our last host
172.16.127.255	Our broadcast address

VLSM

Lets you chop your network into subnets

200.100.100.0 /24
Change mask from /24 to /25 – Now you get:

Original mask (last octet) 00000000 1 Subnet 254 hosts

New mask (subnet 1) 00000000 200.100.100.0 - subnet 1 126 hosts
New mask (subnet 2) 10000000 200.100.100.128 - subnet 2 126 hosts

Route Summarization

- Find the common bits and advertise this.

172.16.8.0 10101100.00010000.00001000.00000000
172.16.9.0 10101100.00010000.00001001.00000000
172.16.10.0 10101100.00010000.00001010.00000000
172.16.11.0 10101100.00010000.00001011.00000000
172.16.12.0 10101100.00010000.00001100.00000000
172.16.13.0 10101100.00010000.00001101.00000000
172.16.14.0 10101100.00010000.00001110.00000000
172.16.15.0 10101100.00010000.00001111.00000000

Matching Bits 10101100.00010000.00001 = 21 bits

Advertise - 172.16.8.0
255.255.248.0

Router

- Packet forwarding on route lookup.
- Maintaining routing table
- Never forwards broadcast

Routes learned :

- Connected routes
- Static routes
- Routing protocols (dynamic routing)

Routing Protocol

- Types of protocol :
  - Routed protocol

    It moves data from the best path like IP, IPX and appletalk.
  - Routing protocol

    It finds the best route to the destination.
- IP routing is intercommunication of two different networks.
- It can be divided into :
  - IGP – Interior gateway protocol
  - EGP – Exterior gateway protocol

Administrative Distances

Directly Connected Interface	0	ISIS	115
Static Hop	1	RIP	120
EIGRP Summary	5	Exterior Gateway Protocol (EGP)	140
External BGP	20	External EIGRP	170
EIGRP (Internal)	90	Internal BGP	200
OSPF	110	Unknown	255

Static Routing

- Use if only a handful of routes
- Useful for stub networks (only one way in and out)
- Destination network/mask – next hop/interface

```
ip route 172.16.5.0 255.255.255.0 172.16.12.8
ip route 172.16.5.0 255.255.255.0 serial 0/0
```

OSPF – Open Shortest Path First

- Uses IP protocol 89
- Classless
- Uses Dijkstras shortest path first algorithm (SPF)
- Router ID is the highest IP address
- But loopback address is used as ID if present
- Backbone area is area 0
- All non backbone areas must connect directly to area 0
- Areas can be numbered from 0 to 65535
- Multicasts on 224.0.0.5
- OSPF uses cost as a metric (10^8/bandwidth)

OSPF basic terms

- LSA – OSPF uses Link Sate Advertisement (LSA) to organize the topology information, it is a data structure with specific information about the network.
- LSDB – Link State Database (LSDB) is the collection of LSAs known to the router.
- ABR – In multiple area OSPF design some router sits at the border of multiple OSPF area so they are known as Area Border router (ABR).
- Router id - Every router in the OSPF network is identified by router id which can be manually assigned or automatically based on highest IP address of physical/loopback interface on the router.

Configure OSPF

```
R1(config)#router ospf 20
R1(config-router)#network 172.16.0.0 0.0.255.255 area 0
```

Uses wildcard masks with network address.

`R1(config-router)#router-id 1.1.1.1` [manually sets router ID]

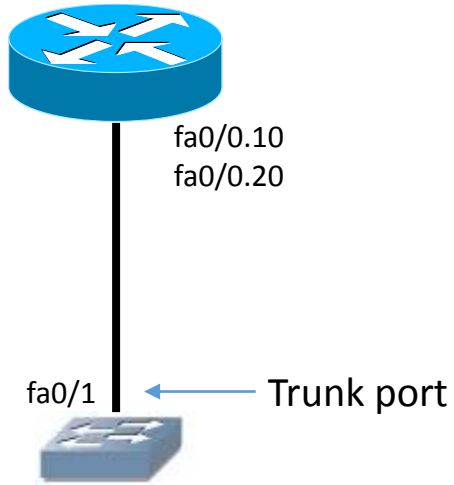
Inter-vlan routing

-Using a layer 3 switch or

-Router, with a VLAN trunk connecting switch.

- Create sub-interface for each VLAN that is required to be routed.
- Use 802.1Q and associate VLAN with sub-interface.
- Configure IP address for each.
- Also called router-on-a-stick
- Example:

```
R1(config)#interface fast 0/0.10
           encapsulation dot1q 10
           ip address 1.1.1.1 255.255.255.0
           !
           interface fast 0/0.20
           encapsulation dot1q 20
           ip address 1.1.2.1 255.255.255.0
```



ACL – Access Control List

- ACL works on packet filtering method.
- ACL filters packet based on below parameters:
  - Source IP
  - Destination IP
  - Source port
  - Destination port
- ACL works under the concept of implicit deny property.
- Types: Standard ACL & Extended ACL

ACL port range

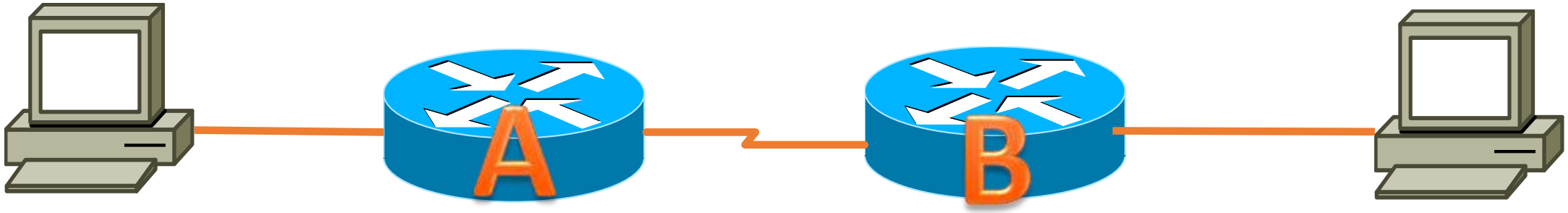
- 1-99 IP standard
- 1300-1999 IP standard (expanded range)
- 100-199 IP extended
- 2000-2699 IP extended (expanded range)

Must be applied to an interface to work.

Named ACLs are case sensitive

You can only edit a named ACL (changed in later IOS)

Can apply to ports such as vty 0 4 (`ip access-class`)



172.16.1.1/26

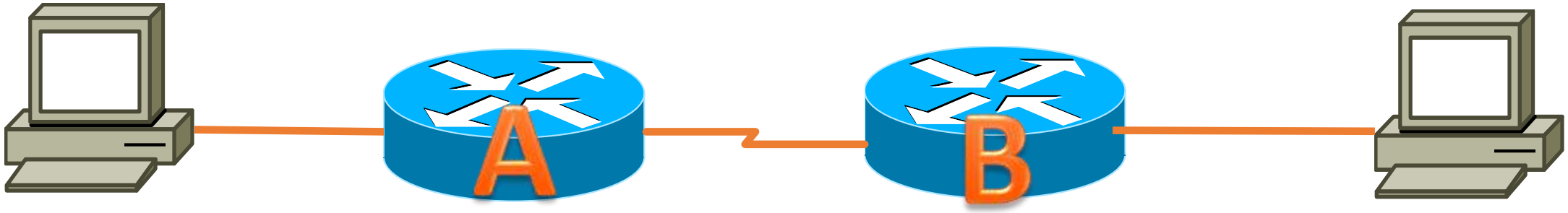
192.168.1.1/26
Web Server

EXTENDED ACL Router A

```
interface serial 0/0
access-group 100 in
!
access-list 100 permit tcp host 192.168.1.1 host 172.16.1.1 eq 80
```

STANDARD ACL Router A

```
interface serial 0/0
access-group 1 in
!
access-list 1 permit 192.168.1.1
```



172.16.1.1/26

192.168.1.1/26
Web Server

NAMED ACL Router A

```
interface serial 0/0
ip access-list blockweb in
!
ip access-list extended blockweb
permit tcp host 192.168.1.1 host 172.16.1.1 eq 80
```

Wildcard Masks

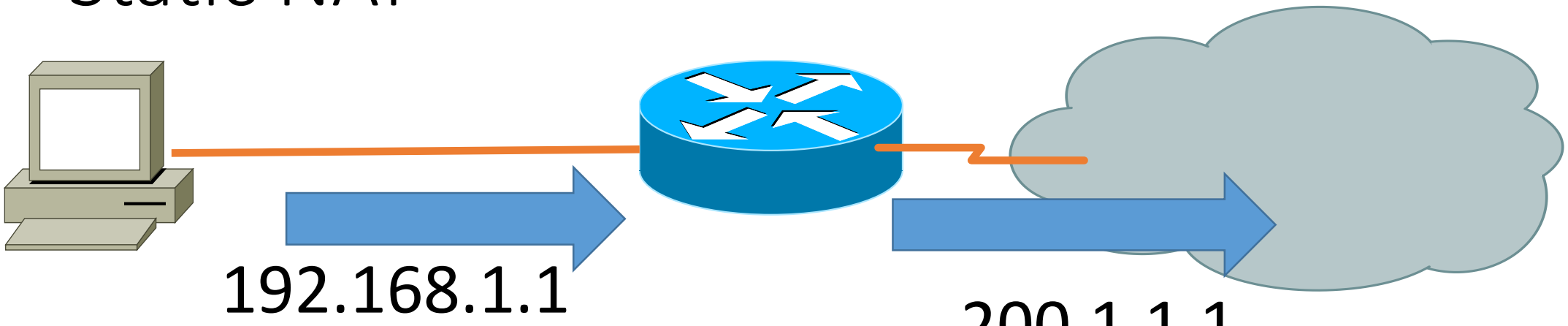
- Used for access lists and routing
- Take the subnet away from 255

	255	255	255	255
Subnet	255	255	224	0
Equals	0	0	31	255

Network Address Translation (NAT)

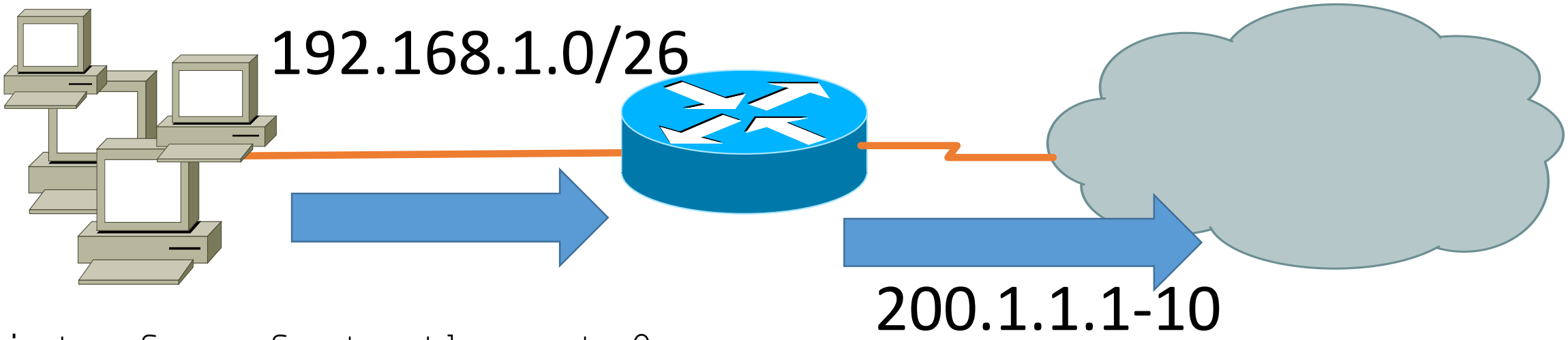
- Translates internal addresses to external
- Used for network security
- Used for address preservation

Static NAT



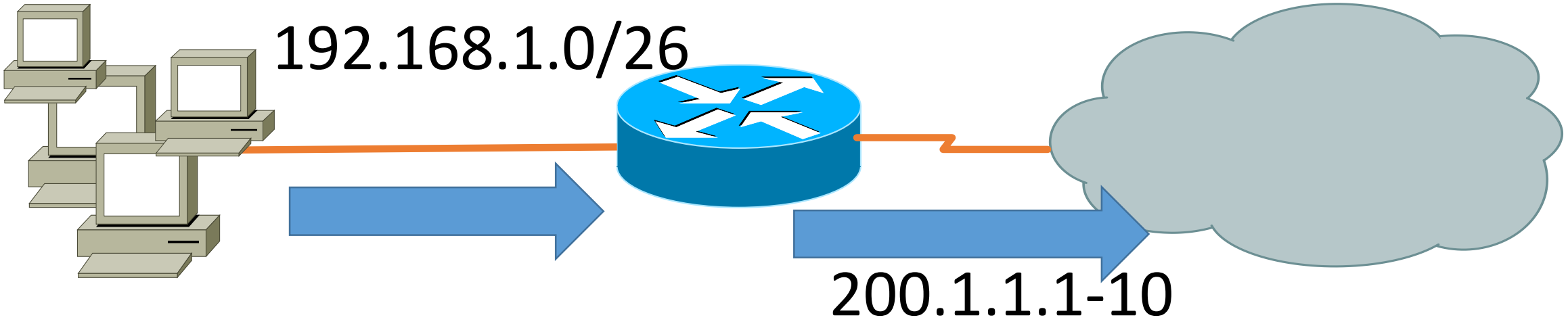

```
interface fast ethernet 0
ip nat inside
!
interface serial 0/0
ip nat outside
!
ip nat inside source static 192.168.1.1 200.1.1.1
```

Dynamic NAT/NAT Pool




```
interface fast ethernet 0
ip nat inside
!
interface serial 0/0
ip nat outside
!
ip nat pool internet_out 200.1.1.1 200.1.1.10 prefix-length 24
ip nat inside source list 1 pool internet_out
access-list 1 permit 192.168.1.0 0.0.0.63
```

PAT




```
interface fast ethernet 0
ip nat inside
!
interface serial 0/0
ip nat outside
!
ip nat pool internet_out 200.1.1.1 200.1.1.10 prefix-length 24
ip nat inside source list 1 pool internet_out overload
access-list 1 permit 192.168.1.0 0.0.0.63
```

Network Time Protocol

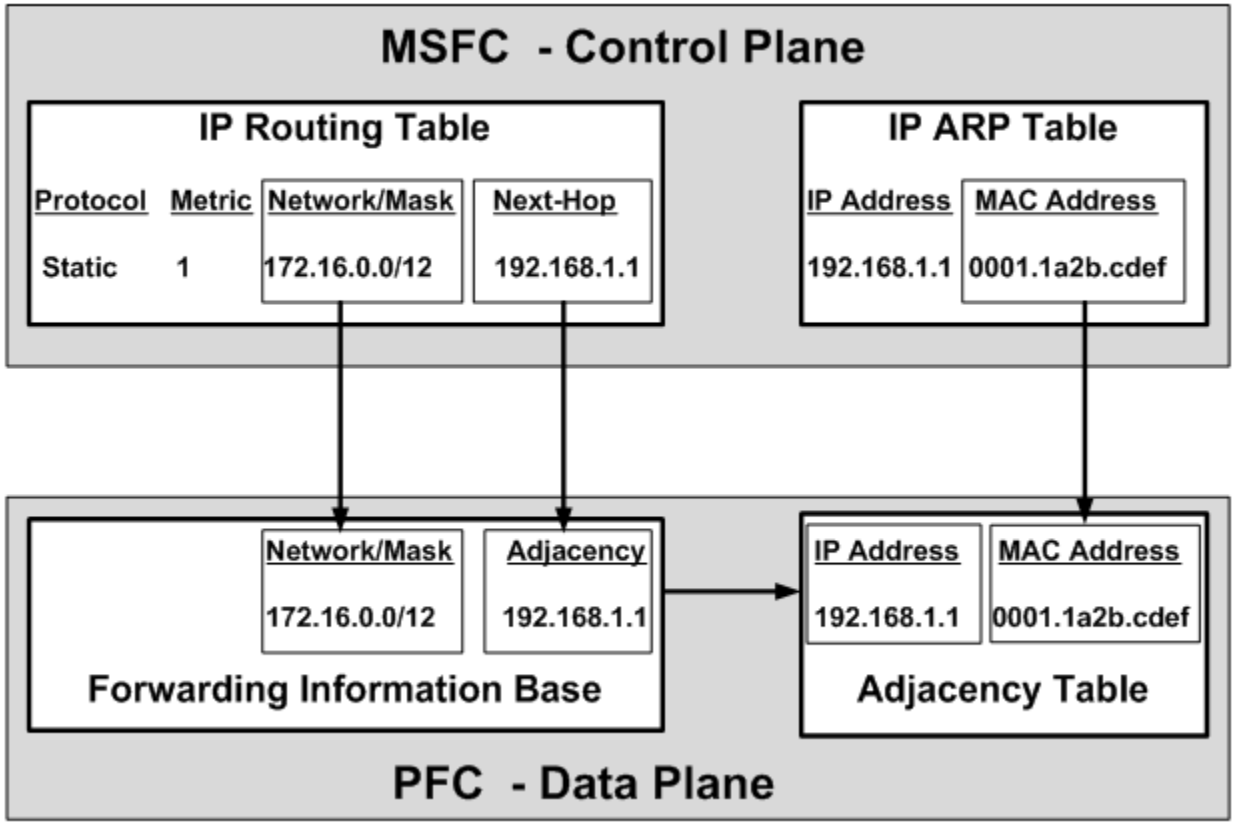
```
R2(config)#ntp server 10.0.0.1
```

```
R2#show ntp associations
  address         ref clock       st  when  poll reach  delay  offset    disp
*~10.0.0.1        127.127.7.1     5    44    64  377     3.2    2.39     1.2
* master (synced), # master (unsynced), + selected, - candidate, ~
configured
```

```
R2#show ntp status
Clock is synchronized, stratum 6, reference is 10.0.0.1
nominal freq is 249.5901 Hz, actual freq is 249.5900 Hz, precision is 2**18
reference time is C02C38D2.950DA968 (05:53:22.582 UTC Sun Mar 3 2002)
clock offset is 4.6267 msec, root delay is 3.16 msec
root dispersion is 4.88 msec, peer dispersion is 0.23 msec
```

CEF Components

```
VTP-Server-1(config)#ip cef
VTP-Server-1(config)#exit
```



IPv6

- 128 bit address in 8 parts (each 16 hex bits)
- EEDE:AC89:4323:5445:FE32:BB78:7856:2022
- Uses multicast/anycast/unicast (no broadcasts)
- Use with IPv4 using tunnelling or dual stack
- Transition from IPv4 with Static, 6to4, Automatic, ISATAP, GRE

Compress IPv6 Address

1. Use double colon (only once per address)
2. Replaces leading double zeros

Complete Representation	**Compressed Representation**
0000:0000:0000:0000:0000:0000:0000:0001	::0001
2001:0000:0000:1234:0000:5678:af23:bcd5	2001::1234:0000:5678:af23:bcd5
3FFF:0000:0000:1010:1A2B:5000:0B00:DE0F	3FFF::1010:1A2B:5000:0B00:DE0F
FEC0:2004:AB10:00CD:1234:0000:0000:6789	FEC0:2004:AB10:00CD:1234::6789
0000:0000:0000:0000:0000:FFFF: 172.16.255.1	::FFFF: 172.16.255.1
0000:0000:0000:0000:0000:0000:172.16.255.1	::172.16.255.1
0000:0000:0000:0000:0000:0000:0000:0000	::

Compression Method 2

- Omit leading zeros

Complete IPv6 Address Representation	Compressed IPv6 Address Representation
0000:0123:0abc:0000:04b0:0678:f000:0001	0:123:abc:0:4b0:678:f000:1
2001:0000:0000:1234:0000:5678:af23:bcd5	2001:0:0:1234:0:5678:af23:bcd5
3FFF:0000:0000:1010:1A2B:5000:0B00:DE0F	3FFF:0:0:1010:1A2B:5000:B00:DE0F
fec0:2004:ab10:00cd:1234:0000:0000:6789	fec0:2004:ab10:cd:1234:0:0:6789
0000:0000:0000:0000:0000:FFFF:172.16.255.1	0:0:0:0:0:FFFF: 172.16.255.1
0000:0000:0000:0000:0000:0000:172.16.255.1	0:0:0:0:0:0:172.16.255.1
0000:0000:0000:0000:0000:0000:0000:0000	0:0:0:0:0:0:0:0

IPv6 routing

- Using Static routes

```
Router(config)# ipv6 route 2001:fa8:1231:1::/64 2001:cc8:1789:2::2
```

- Using OSPF v3

```
ipv6 unicast-routing
!
ipv6 router ospf 2
router-id 1.1.1.1
!
interface serial0/0/1
ipv6 address 2001:fa8:1231:1::1
ipv6 ospf 2 area 0
!
interface GigabitEthernet0/0
ipv6 address 2001:cd8:1711:1::2
ipv6 ospf 2 area
```

IPv6 important commands to remember.

- Router# show ipv6 route
- Router# show ipv6 interface brief
- Router# show ipv6 route static
- Router# show ipv6 ospf
- Router# show ipv6 ospf interface brief
- Router# show ipv6 ospf neighbor