

# Static Routing Exercise



# What will the exercise involve?

---

- Unix network interface configuration
- Cisco network interface configuration
- Static routes
- Default route
- Testing

# Routing

---

- Routing is done based on destination IP address
- Without routing, an interface can only reach destinations that are on their local network segment.
- A device with at least 2 interfaces can route

# Routing

---

## Static route

- specifically instructs router on which route to take to a particular destination network. This will almost always override anything else that the router knows.

## dynamic route

- learnt via routing protocols implemented on routers

## default route

- route that instructs a machine where to send packets for destinations that are not in the routing table. This is usually the 'last resort' that a router will take.

# Static Routing

---

## Advantages

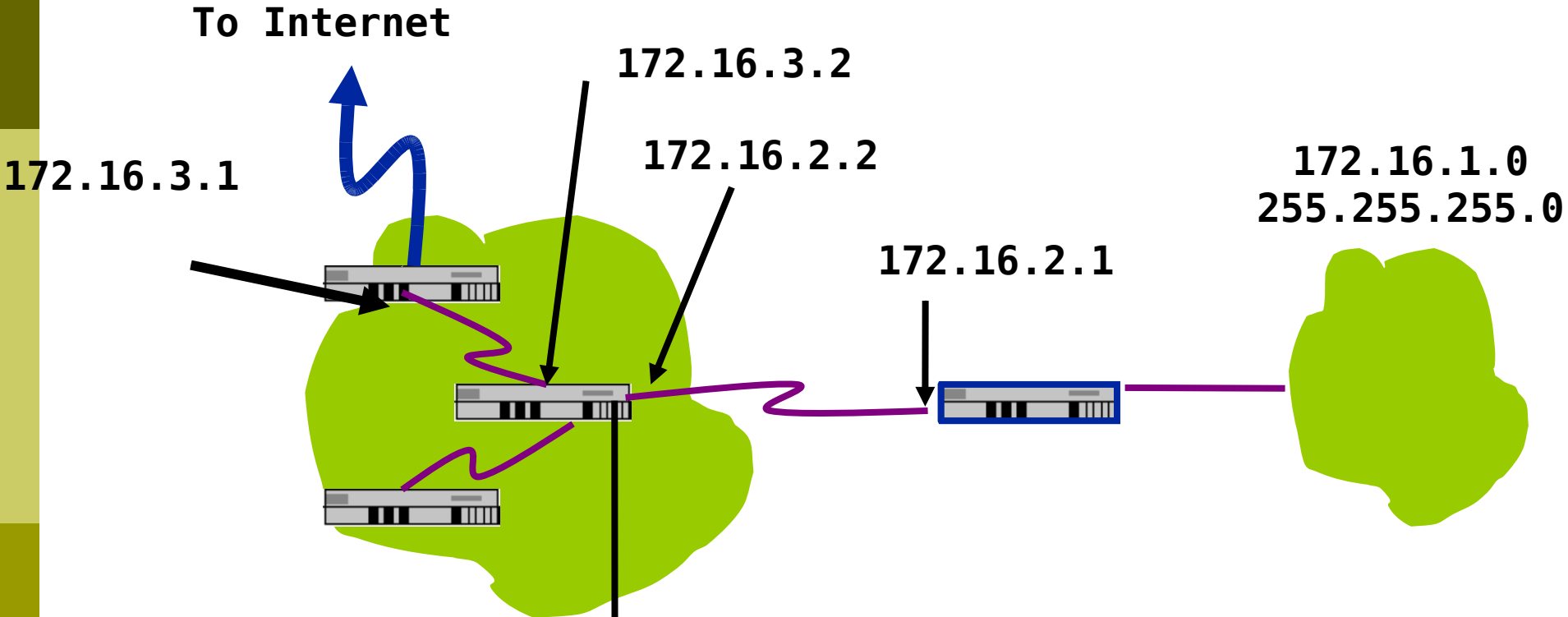
- Simple to configure and maintain
- Secure as only defined routes can be accessed
- Bandwidth is not used for sending routing updates

## Disadvantages

- Manual update of routes after changes
- Explicit addition of routes for all networks
- Potential for configuration mistakes

# IP Routing Configuration

## Static/default route example



```
ip route 172.16.1.0 255.255.255.0 172.16.2.1 - STATIC
```

```
ip route 0.0.0.0 0.0.0.0 172.16.3.1 - DEFAULT
```

# Exercise One



# IPv4 Address Assignments

SWITCH

**E**  
196.200.220.96/28

**D**  
196.200.220.80/28

**C**  
196.200.220.64/28

**B**  
196.200.220.48/28

**A**  
196.200.220.32/28

.5  
.4  
.3  
.2  
.1  
196.200.220.0/27  
.6  
.7  
.8  
.9  
.10

**F**  
196.200.220.112/28

**G**  
196.200.220.128/28

**H**  
196.200.220.144/28

**I**  
196.200.220.160/28

**J**  
196.200.220.176/28



# IPv4 Address Assignment

---

- You already have an IP address for your router's backbone link (A=.1, B=.2, ...)
- You have a /28 for your local network (PC and router connected back to back)
- Assign your own host addresses from your /28 to your local network.

# FreeBSD Network Interface Configuration

---

configure interface on Unix host

□ `Ifconfig em0 inet n.n.n.n netmask m.m.m.m`

*(you need to be root to change the IP address)*

- `em0` is the interface name
- `n.n.n.n` is IP address
- `m.m.m.m` is netmask

# Connect PC to router console port

---

- Connect cable to console port on router, serial port on FreeBSD box
- Use the **tip** command to connect your keyboard and screen to the serial port
  - e.g. **bash\$ tip com1**
- You may have to edit **/etc/remote**
- See man pages for **tip(1)** and **remote(5)**
  - **HINT: to exit tip, type ~.**

# Cisco Router Network Interface Configuration

---

•configure backbone interface on cisco router

**conf t**

**Interface fastethernet0/0**

**ip address *n.n.n.n m.m.m.m***

- fastethernet0/0 is interface name
- n.n.n.n is IP address
- m.m.m.m is netmask

•Now configure the local interface on your router that connects to your PC (ie. Fa0/1). Use the IP address assignments that you made 3 slides ago.

# Cisco Router Network Interface Configuration

---

Cisco **global** config should always include:

**ip classless**

**ip subnet-zero**

**ip cef**

Cisco **interface** config should usually include:

**no shutdown**

**no ip proxy-arp**

**no ip redirects**

**no ip directed-broadcast**

# Test Connectivity

---

PC can ping local interface of router

Router can ping PC

Router can ping other routers

- PC cannot ping backbone interface of router
- PC cannot ping other routers or other PCs
- Router cannot ping other PCs.

# Configure a default route

---

- Add route on PC

**route add default *g.g.g.g***

- *g.g.g.g* is the IP address of your gateway

*(which should be the local interface on your router)*

- Display forwarding table

**netstat -rn**

# Test connectivity

---

- All PCs should now be able to reach the backbone IP address of the other routers.
- But, you still can't reach other PCs.
  - why?
  - Run a "traceroute" to troubleshoot



# Configure static routes for the remaining classroom desks

---

On your router, add static routes to the other PCs, using their router IP addresses as the next-hop.

- ▣ `ip route n.n.n.n m.m.m.m g.g.g.g`

Do this for every PC/router cluster in the class.

Consult the map earlier to obtain the PC/router local subnet, and the corresponding router backbone IP address.

# Test Connectivity

---

- All routers can reach all PCs
- All PCs can reach all backbone IP addresses
- All PCs can reach PCs in other rows
- Test with traceroute

# Static Exercise using IPv6

---

- Now let's repeat this exercise using IPv6 addressing
- Consult addressing plan for IPv6 addresses
  - Link between router and PC gets a /64
    - Group A use 2001:4348:220:1::/64
    - Group B use 2001:4348:220:2::/64
    - etc
  - Backbone is numbered from 2001:4348:220:0::/64

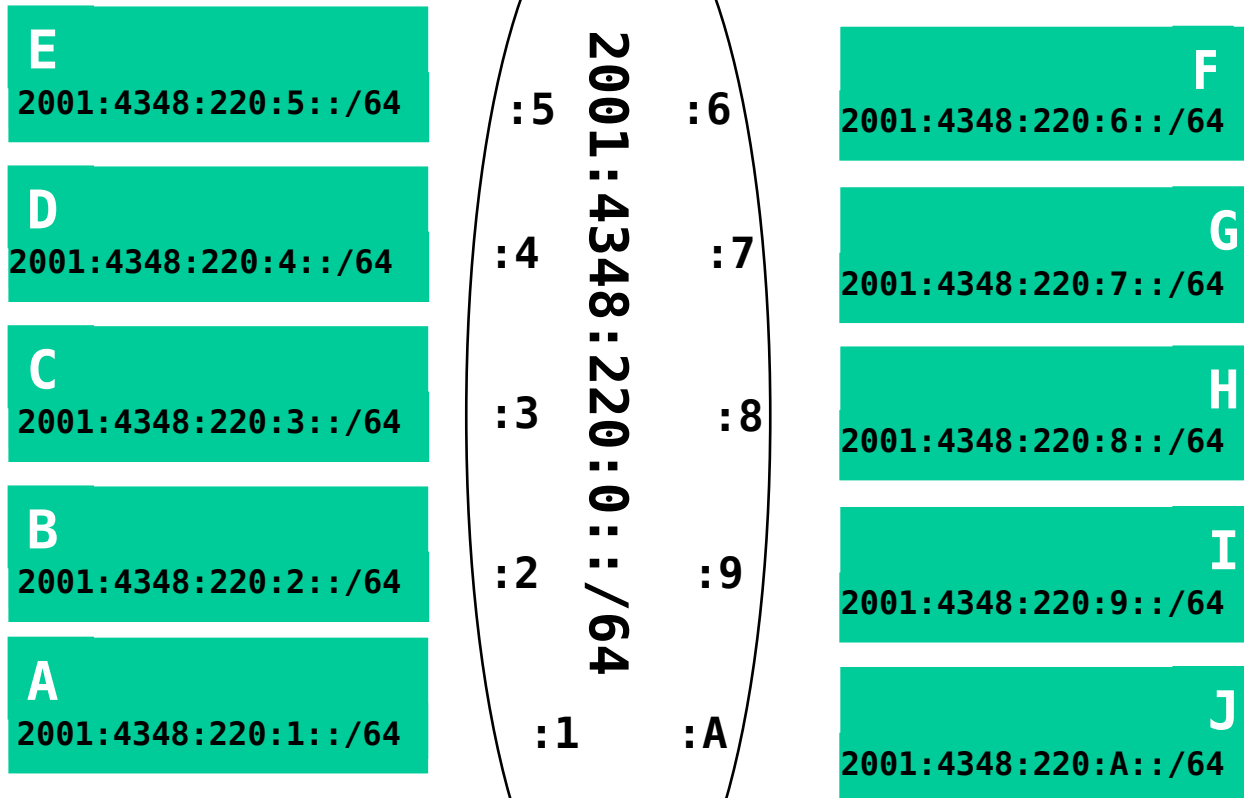
# Big Hint!

---

If you are not using **COPY/PASTE** and the **TFTP** method to upload your config, you are wasting a lot of your time!

# IPV6 Address Assignments

SWITCH



# FreeBSD Network Interface Configuration

---

- configure interface on Unix host

- ▣ `ifconfig em0 inet6 n:n:n:n/m`

- em0 is interface name
    - n:n:n:n is IPv6 address
    - m is netmask

# Cisco Router Network Interface Configuration

---

•configure the backbone interface on your router

**conf t**

**ipv6 unicast-routing**

**interface fastethernet0/0**

**ipv6 address *n:n:n:n/m***

- fastethernet0/0 is interface name
- n:n:n:n is IPv6 address
- m is netmask

•Now configure local (lan-facing) interface on your router too.

# Cisco Router Network Interface Configuration

---

- Cisco **ipv6 global** config should always include:  
**no ipv6 source-route**  
**ipv6 cef**
- Cisco **interface** config should additionally include:  
**no ipv6 redirects**



# Configure a default route

---

•Add route on PC

**route add -inet6 default *g:g:g:g***

- *g:g:g:g* is IPv6 address of gateway (which is on Cisco router)
- **-inet6** tells FreeBSD that this is an IPv6 route

•Display forwarding table

**netstat -rn**

# Configure static routes for the remaining classroom desks

---

- On your router, add static routes to the other clusters, similar to how you did for ipv4.
  - next hop is backbone interface of other row's router
    - ▣ `ipv6 route n:n:n:n/m g:g:g:g`
- Repeat several times until complete

# Test Connectivity

---

- All routers can reach all PCs
- All PCs can reach all backbone IP addresses
- All PCs can reach PCs in other rows
- Test with traceroute

# Exercise Two



# IPv4 Address Assignments

**SWITCH**

**SIE Router**  
196.200.220.30/27

**E**  
196.200.220.96/28

**D**  
196.200.220.80/28

**C**  
196.200.220.64/28

**B**  
196.200.220.48/28

**A**  
196.200.220.32/28

.5  
.4  
.3  
.2  
.1

**196.200.220.0/27**

.6  
.7  
.8  
.9  
.10

**F**  
196.200.220.112/28

**G**  
196.200.220.128/28

**H**  
196.200.220.144/28

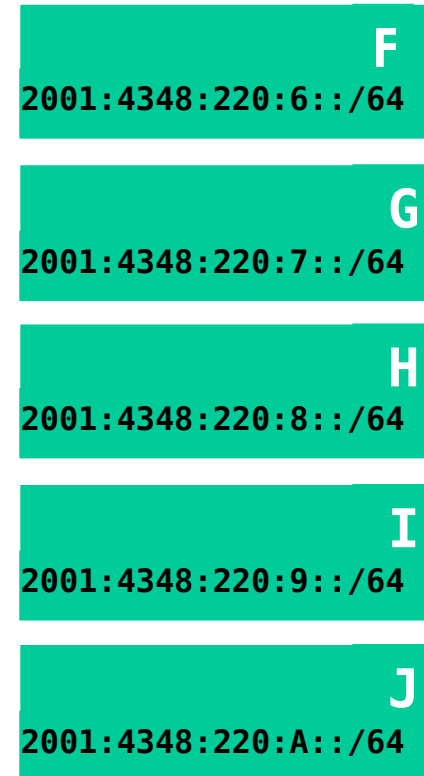
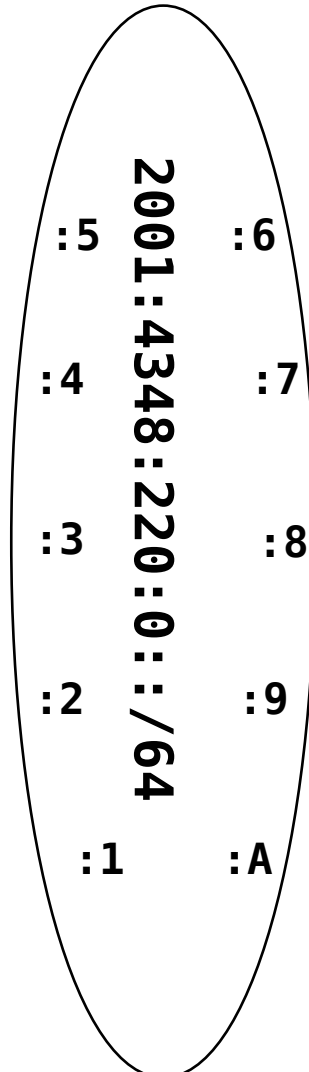
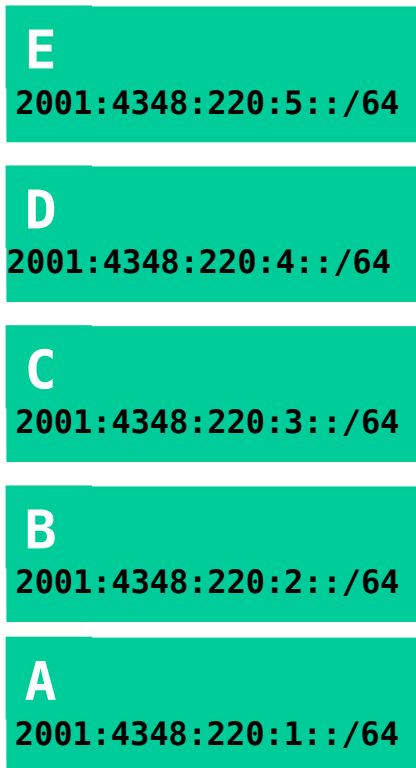
**I**  
196.200.220.160/28

**J**  
196.200.220.176/28

# IPV6 Address Assignments

**SWITCH**

**SIE Router**  
2001:4348:220::F/64



# Configure static routes to classroom router

---

•On your router, remove all static routes

```
no ip route n.n.n.n m.m.m.m g.g.g.g
```

•Repeat until complete

•Add a default route point to the SIE classroom router

*(next hop is backbone IP address of the SIE router)*

```
ip route 0.0.0.0 0.0.0.0 g.g.g.g
```

•Do the same for IPv6:

```
no ipv6 route n:n:n:n/m g:g:g:g
```

```
ipv6 route ::/0 a:a:a:a
```

# Test Connectivity

---

- All routers can reach all PCs
- All PCs can reach all backbone IP addresses
- All PCs can reach PCs in other rows
- Test with traceroute
  - Test both IPv4 & Ipv6
  
- How is this working?
  - All static routes have been added to the classroom router.



# Edit FreeBSD's `/etc/rc.conf` file

---

• On production machines, add lines to `/etc/rc.conf` to preserve network settings on reboot

- `hostname="porcupine.tomato.example"`
- `ifconfig_em0="inet X.X.X.X netmask Y.Y.Y.Y"`
- `ipv6_ifconfig_em0="X:X:X:X prefixlen 64"`
- `defaultrouter="G.G.G.G"`
- `ipv6_defaultrouter="G:G:G:G"`

• See `/etc/default/rc.conf` for more information

# Static Routing Exercise



The End