Week 3 Section Notes: ARP and Lab 3

Overview

- High-level concepts from the week relevant to Lab 3
- VNS/Setting up Lab 3
- Where to start in Lab 3
- Advice and hints
- Questions

IP Addresses

- Each end host on the Internet is assigned an IP address.

- To send a packet to another host on the Internet, you must stamp the packet with the destination host's IP address*.

Question: Is this IP address fixed?

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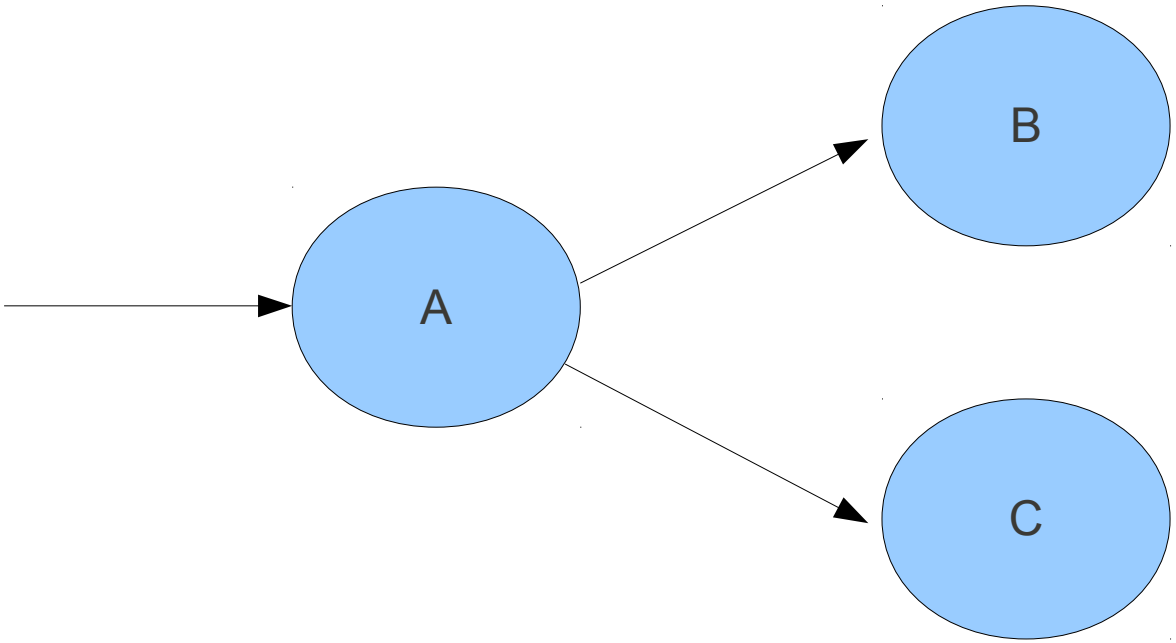
No. If I plug my computer into an Ethernet jack in Boston, I will receive a different IP than if I plug into Stanford's network.

Why?

Routing

- IP addresses contain information that routers use to determine how to forward a packet.
- Basic logic: a router that matches the second bit of an IP address is “closer” to the destination than a router that matches the first bit.

Simplified Example

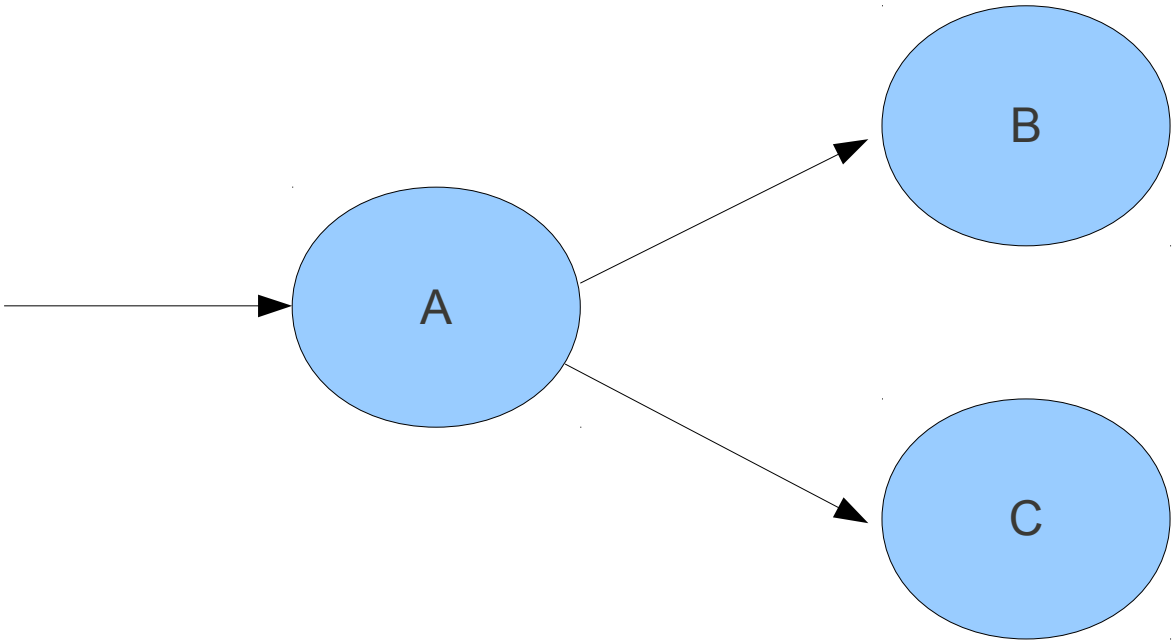


Advertises for:
18.243.1.0/30

18.243.1.0
18.243.1.1
18.243.1.2
18.243.1.3

Default link:
0.0.0.0/0

Simplified Example



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Default link:
0.0.0.0/0

IP Addr	Subnet	Next Hop
18.243.1.0	255.255.255.252	IP_B
0.0.0.0	0.0.0.0	IP_C

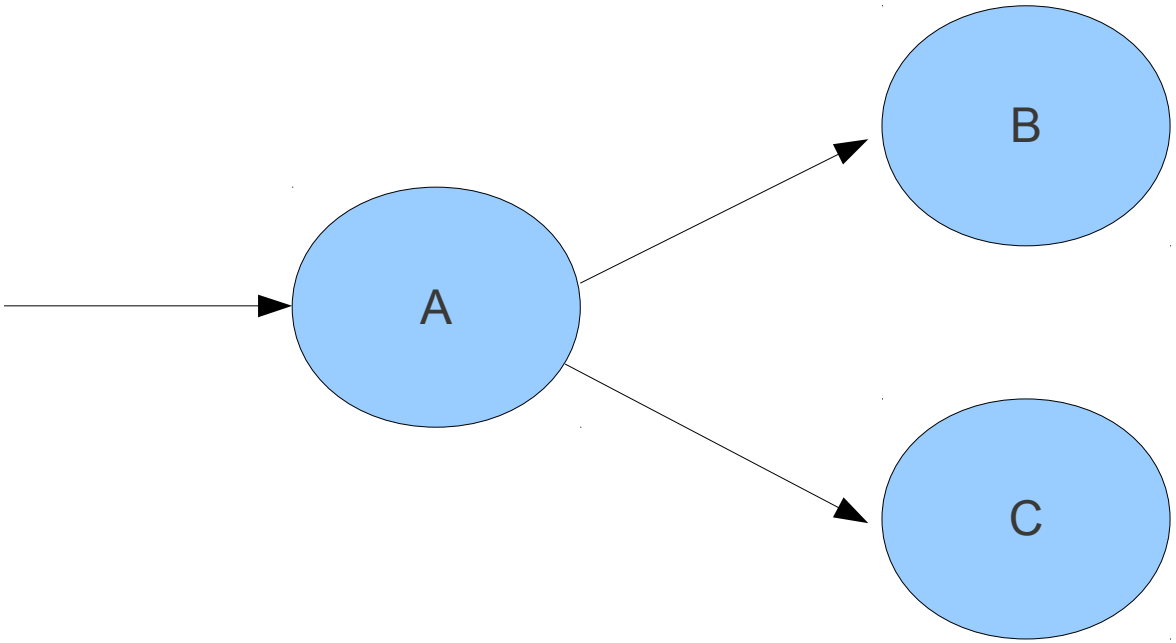
Longest Prefix Match

- Bitwise and the packet's destination with all subnets in the routing table:

$$X_i = (\text{Packet Dest IP}) \,\&\, (\text{Subnet}_i)$$

- Forward to next-hop of entry *n* with largest IP address that equals X_n .

Simplified Example



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- How do routers know where the next-hop is (IP_A and IP_B in figure)?

Address Resolution Protocol

- Maps next-hop IP address to which link-layer address to matches that IP.

- Basics. When have next-hop IP address:
  - Check if know corresponding link-layer address.
  - If don't, broadcast on link layer interfaces an ARP request for the IP address.
  - Listen for ARP responses, and route accordingly.

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VNS/Setting Up Lab 3

- Read ALL the instructions before beginning.

VNS/Setting Up Lab 3

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- You must test and your labs on the **myth machines**.
- Copy the auth_key file from

  /usr/class/cs144/lab3_10au/student_auths/<SUNET_ID@stanford.edu>/auth_key

-

  to your lab directory

VNS/Setting Up Lab 3 ctd.

- Create a routing table file. Example is online.

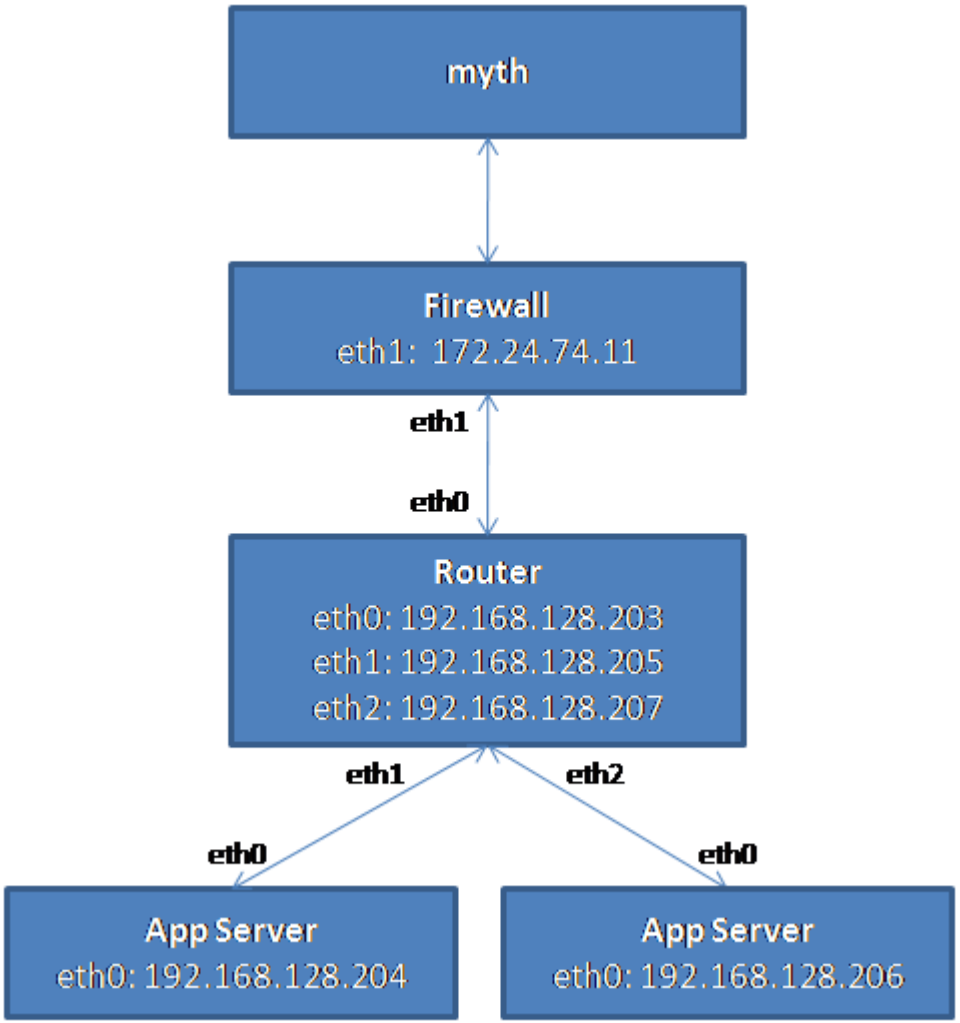
```
0.0.0.0             172.24.74.11          0.0.0.0 eth0
192.168.128.204 192.168.128.204 255.255.255.255 eth1
192.168.128.206 192.168.128.206 255.255.255.255 eth2
```

Prefix

Next hop

Mask

Interface


myth
Firewall
eth1: 172.24.74.11
eth1
eth0
Router
eth0: 192.168.128.203
eth1: 192.168.128.205
eth2: 192.168.128.207
eth1
eth2
eth0
eth0
App Server
eth0: 192.168.128.204
App Server
eth0: 192.168.128.206

VNS/Setting Up Lab 3 ctd.

- Run the command

```
./sr -u <username> -T '1-router 2-server' -s vns-2.stanford.edu -r rtable.vrhost -l logname
```

VNS/Setting Up Lab 3 ctd.

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  blame the TA.

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Lab 3 File Overview

- sr_arpcache.h / sr_arpcache.c
  - Handles all the ARP messaging alluded to previously.
- sr_router.h / sr_router.c
  - Where you receive incoming packets.

sr_arpcache

- Pseudocode is included in the sr_arpcache.h file.

sr_arpcache ctd.

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- If you don't find it, you:

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You get to write this!!!

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- Question 1: What layer is ARP?

  It's on the Link Layer.

- Question 2: When I send a packet on the Internet, does it always get to the destination?

  No! Remember Labs 1 & 2?

sr_arpcache

- sr_arpcache.c has a function called sr_arpcache_sweepreqs:
  - Called (roughly) every second.
  - If you haven't received a response for your ARP request in more than a second, send another...
  - Unless, you've requested 5 times. Then send an ICMP error message to all sources.

sr_arpcache: Things you'll have to do.

- Broadcast ARP requests.
- Write sr_arpcache_sweepreqs.
- Build a data structure tracking outstanding ARP requests.
- Send ICMP error messages when can't find next-hop router.
- Handle ARP responses.

sr_router.c: sr_handlepacket

- Where all packets enter your router implementation.
- Passed in raw Ethernet frames that may represent
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You will eventually have to send/generate/modify all of these.

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Advice and Hints: General

- Start the lab early.
- Read the documentation carefully before starting.
- Check out various packet formats linked to in the lab (ICMP, Ethernet, etc.).
- Come to office hours if you have questions.

Advice and Hints: Debugging

- Use Wireshark! Example.

```
./sr -u <username> -T '1-router 2-server' -s vns-
2.stanford.edu -r rtable.vrhost -l logname
```

Enable logging, and
open logs in wireshark.

But Wait! There's more!

- What we went over:
  - Basic concepts.
  - Setting up the lab.
  - Where to start.

- There's more:
  - Ping and traceroute.
  - FTP/HTTP

Extra Questions

- Who remembered when I said VNS gave you 8 IP addresses? How come there aren't that many in the figure?

Extra Questions

- What's a multihomed AS?

Extra Questions

- Why wouldn't a router always forward a packet to a router advertising a shorter path?

Extra Questions

- What is the difference between forwarding and routing?

Extra Questions

- What is Nagle's algorithm? Why would people use it?