

# Networking

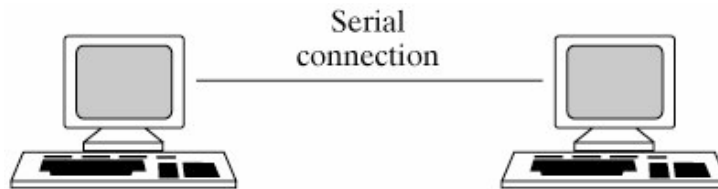
- Read Chapter 9
- Linux network utilities
  - finger, ftp, host, hostname, mesg, rcp, rlogin, rsh, scp, sftp, slogin, ssh, talk, telnet, users, w, walla, who, write, ...

# Networking

- Important to know
  - common network terminology
  - how networks are built
  - how to talk to other people on the network
  - how to use other computers on the network

# Networking

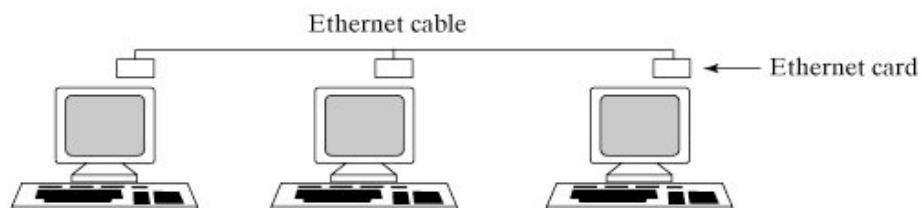
- Local Area Networks
  - Simplest LAN



3

# Networking

- Local Area Networks
  - Ethernet (Standardized as IEEE 802.3)
  - You have seen the RJ45 connectors

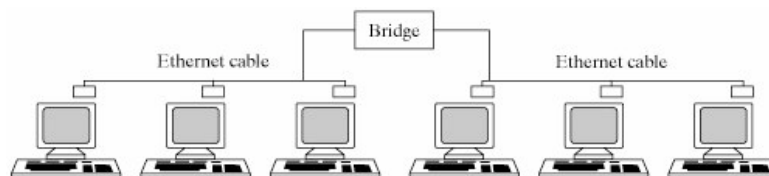


4

# Networking

## ■ Bridges

- Bridge passes Ethernet message between different segments of the network as if both segments were a single Ethernet cable.
- Used when one has to go beyond the allowed length of a single section of wire

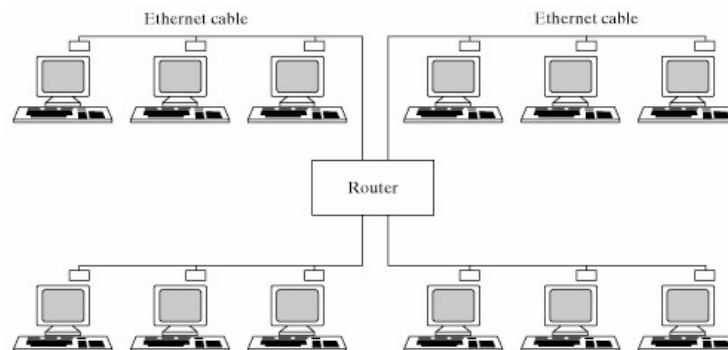


5

# Networking

## ■ Routers

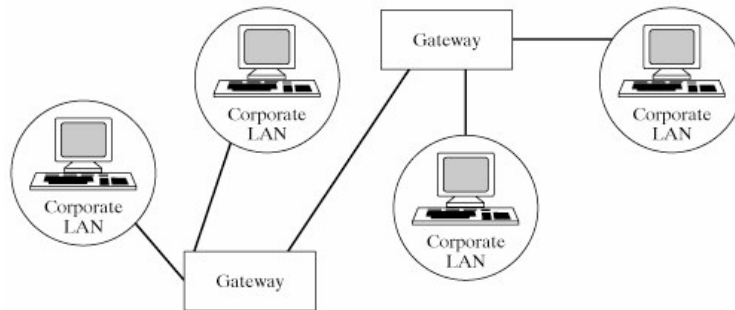
- Route traffic to where it is needed. Or, does not route messages where they are not needed.
- Example of 4 networks: now argue router vs bridge



6

# Networking

- Gateway
  - High-capacity routers



7

# Internetworking

- Packet Switching and Circuit Switching
  - Circuit Switching
    - establish, maintain and terminate dedicated circuit
    - e.g., traditional telephone networks
  - Packet Switching
    - network nodes send messages that are split up into small packets
    - packets get routed from source to destination

8

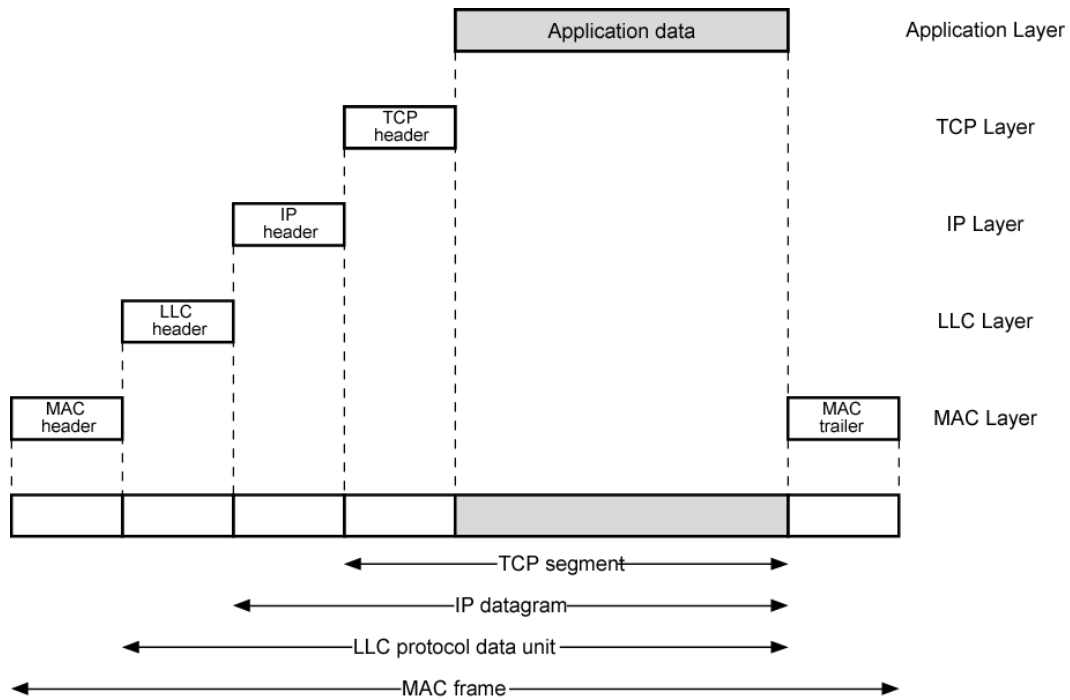
# Internetworking

- Packet Switching Issues
  - How big are the packets
  - How do packets get routed, all along the same route or not
  - What if packets get lost, arrive out of order
  - What if packet sizes change
  - Who's packet is it?

# Internetworking

- Most of the Internet revolves around:
  - Transmission Control Protocols (TCP/UDP)
  - Internet Protocol (IP)

# LAN Protocols in Context



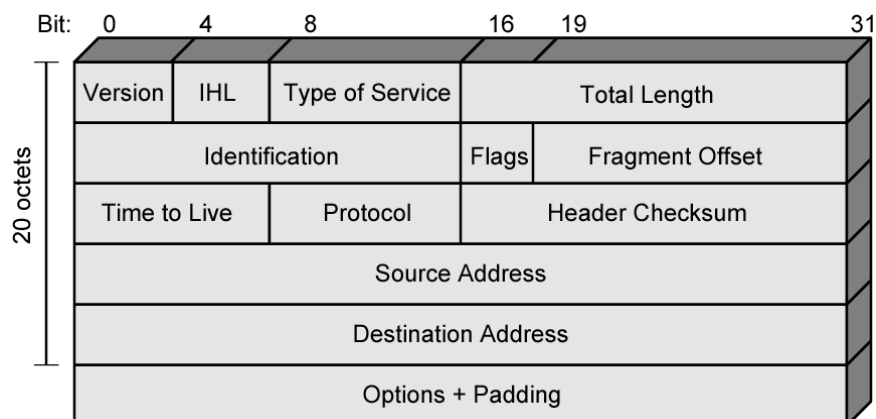
CS420/520 Axel Krings

Sequence 17

# Internetworking

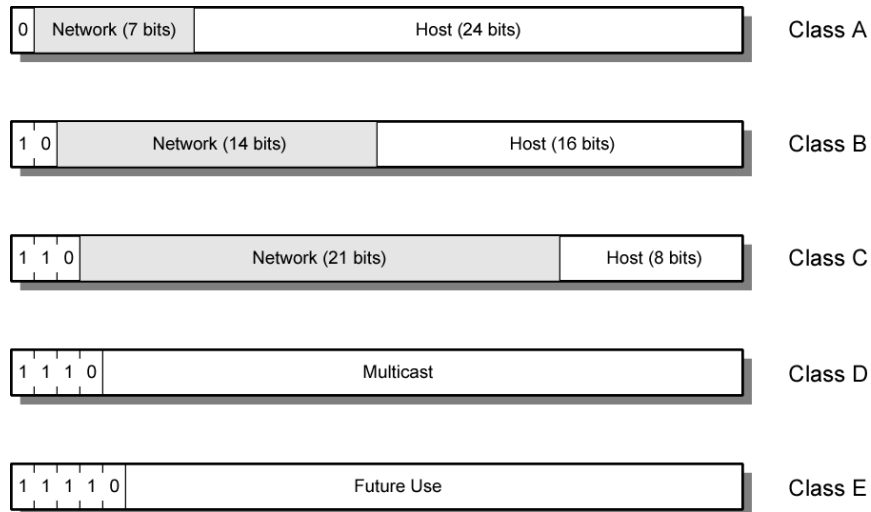
## ■ Internet Protocol

### ■ IPv4 Header



# Internetworking

## ■ IP Address Formats



13

# Internetworking

■ So what network are we?

■ 129.101.153.117

14

## IP Addresses - Class B

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- Start with binary 10
- Range 128.x.x.x to 191.x.x.x
- Second Octet also included in network address
- $2^{14} = 16,384$  class B addresses
- All allocated

## Internetworking

- IPv6
  - extended addressing
    - 128-bit addresses
  - but that is not all, e.g., security, ...



# Networking

- Naming

- What associations exist?

- hostname, IP address, MAC address

- address resolution protocol (arp)

```
-bash-3.2$ /sbin/arp -a
```

```
bender.cs.uidaho.edu (129.101.153.101) at 00:0E:0C:69:7B:E7 [ether] on eth0
```

```
bunyan.cs.uidaho.edu (129.101.153.110) at 00:D0:B7:B6:C1:5C [ether] on eth0
```

```
varanid.cs.uidaho.edu (129.101.153.119) at 00:03:BA:5C:48:0E [ether] on eth0
```

```
granite.cs.uidaho.edu (129.101.153.125) at 00:03:BA:5C:48:17 [ether] on eth0
```

```
-bash-3.2$
```

# Networking

- Routing

- Dynamic routing

- Static routing

# Networking

## ■ Security

### ■ User Authentication

- e.g., login with username and password
- e.g., remote procedure call

### ■ RPC: execute a command, say *date* on another computer

- `commet:~ krings$ rsh eternium.cs.uidaho.edu date`
- works if one establishes “machine equivalence”
- this is defined in `.hosts` file
- can also be done in `/etc/hosts.equiv`

# Networking

## ■ Security

### ■ Data Encryption

### ■ Example

- use `telnet` to connect to other computer and all communication is in clear-text --- ouch!
- use secure shell, e.g., based on Open Secure Socket Layer  
OpenSSL

# Networking

- Ports and Common Services
  - Services like ftp, mail or http use TCP or UDP
  - `/etc/services` shows the ports and their services
    - take a look
  - Linux interprocess communication allows you to communicate with other programs at a known IP address and port. See Chapter 12 “Systems Programming”

# Networking

- Network Users
  - `users`, list the users on the local host
  - `who`, like `users` except that it gives you more information
  - `w`, like `who` except that it gives you even more information
  - `hostname`, displays your local host's name
  - `finger`, gives information about specific users

# Networking

- Communication with Network Users
  - *write*, allows you to send individual lines to a user, one at a time
  - *talk*, allows you to have an interactive split-screen two-way conversation
  - *wall*, allows you to send a message to everyone on the local host
  - *mail*, allows you to send mail messages

23

# Networking

- Distributing Data
  - *rcp* (remote copy) and *scp* (secure copy) allow you to copy files between your local Linux host and another remote Linux or UNIX host.
  - *ftp* (file transfer protocol or program) and *sftp* (secure ftp) allow you to copy files between your local Linux host and any other host (possibly non-Linux) that supports FTP (the File Transfer Protocol). *ftp* is thus more powerful than *rcp*.
  - *uucp* (unix-to-unix copy) is similar to *rcp*, and allows you to copy files between any two Linux or UNIX hosts.

24

# Networking

## ■ Distributing Data

### ■ sftp

*sftp eternity.cs.uidaho.edu*

*Connecting to eternity.cs.uidaho.edu...*

\*\*\*\*\*

*\* WARNING: To protect the system from unauthorized use and to \**

*\* ensure that the system is functioning properly, activities \**

*\* on this system are monitored recorded and subject to audit. \**

*\* Use of this system is expressed consent to such monitoring \**

*\* and recording. Any unauthorized access or use of this system \**

*\* is prohibited and subject to criminal and civil penalties. \**

\*\*\*\*\*

*krings@eternity.cs.uidaho.edu's password:*

*sftp> ?* [check out the commands displayed with the “?” option]

25

# Networking

## ■ Distributed Processing

- *rlogin* and *slogin*, which allow you to log in to a remote Linux or UNIX host

- *rsh* and *ssh*, which allow you to execute a command on a remote Linux or UNIX host

- *telnet*, which allows you to execute commands on any remote host that has a telnet server

26

# Networking

- *rlogin* how does it work?
  - *rlogin* asks for password
    - -l option is used to specify username other than current one
    - if remote hosts has local host in */etc/rhosts* file then no passwd needed
    - what are the advantages or disadvantages of this?
  - what is the difference to *telnet*?
    - similar but less customizable, connects only to unix hosts
  - wisdom: *telnet* and *rlogin* should be avoided. Use *ssh* and *slogin*

27

# Networking

- *rlogin* how does it work?
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- Word of wisdom:
  - *telnet* and *rlogin* should be avoided! Use *ssh* and *slogin*!

28