

# 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, ...

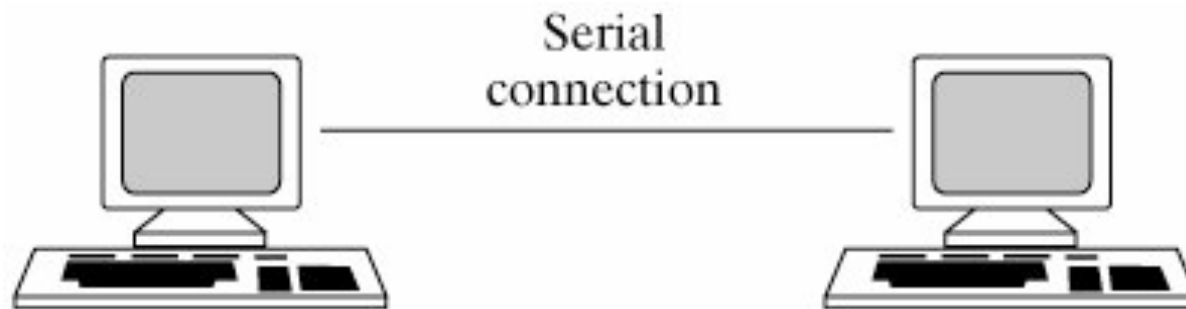
# Networking

- 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

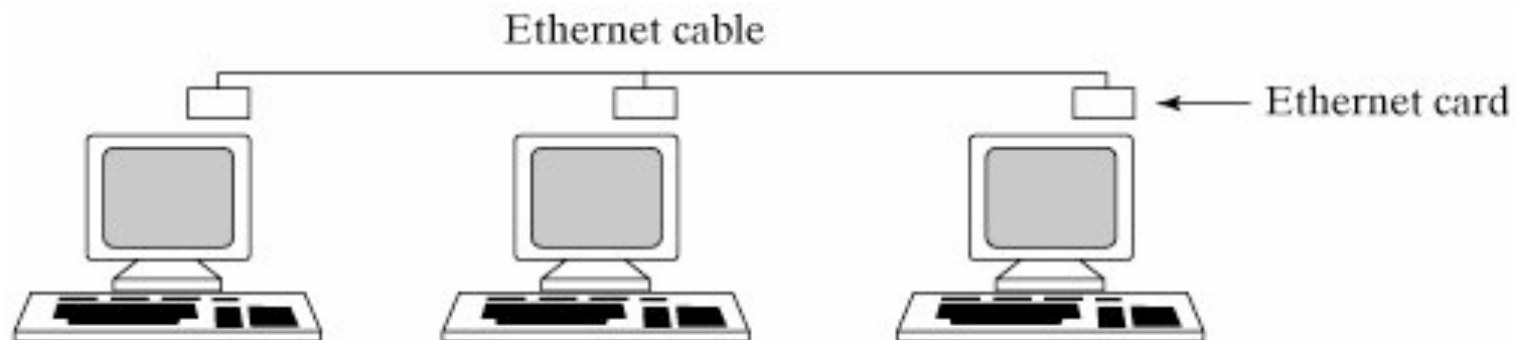
- Local Area Networks

- Simplest LAN



# Networking

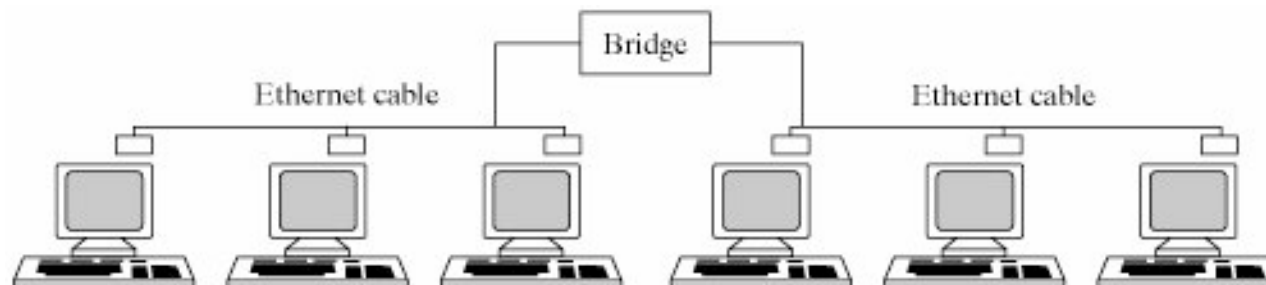
- Local Area Networks
  - Ethernet (Standardized as IEEE 802.3)
  - You have seen the RJ45 connectors



# Networking

## ■ Bridges

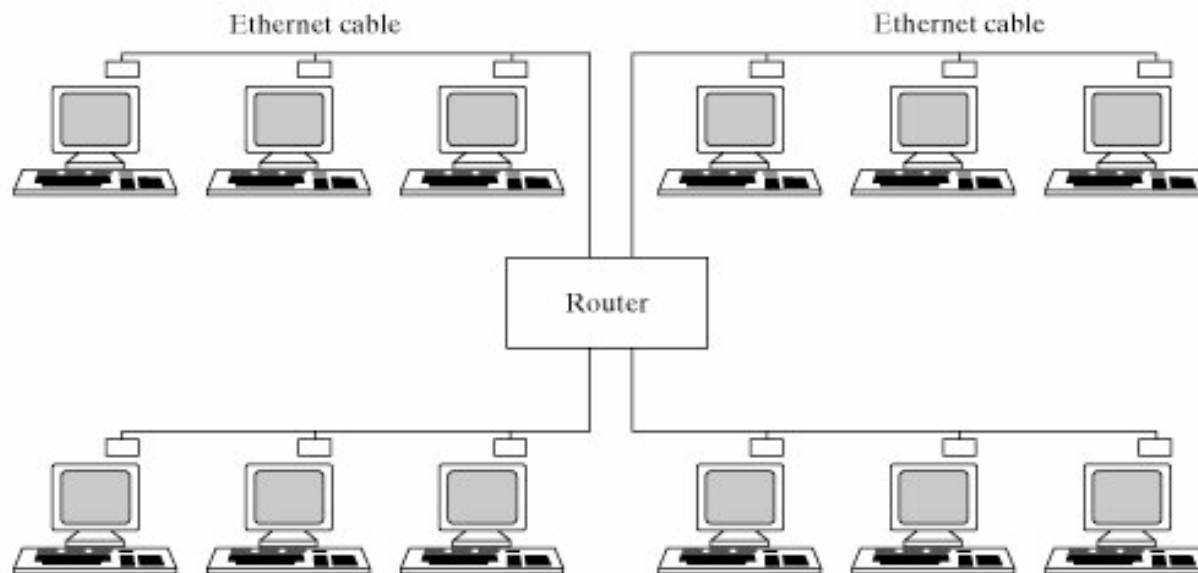
- Bridge passes Ethernet message between different segments of the network as if both segments were a single Ethernet cable.
- Used when one has to go beyond the allowed length of a single section of wire



# Networking

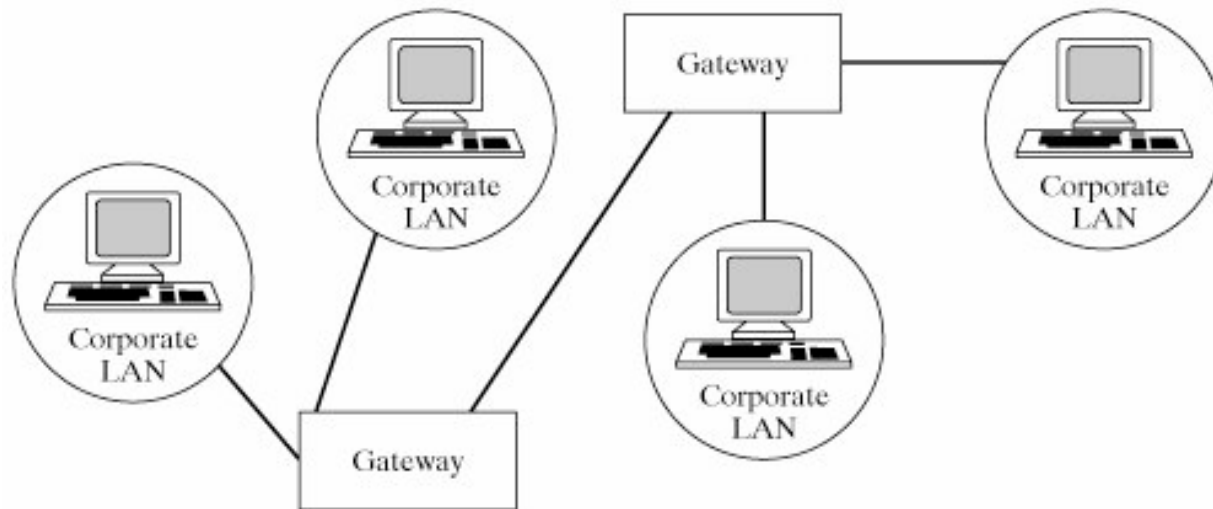
## ■ Routers

- 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



# Networking

- Gateway
  - High-capacity routers



# 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



# Internetworking

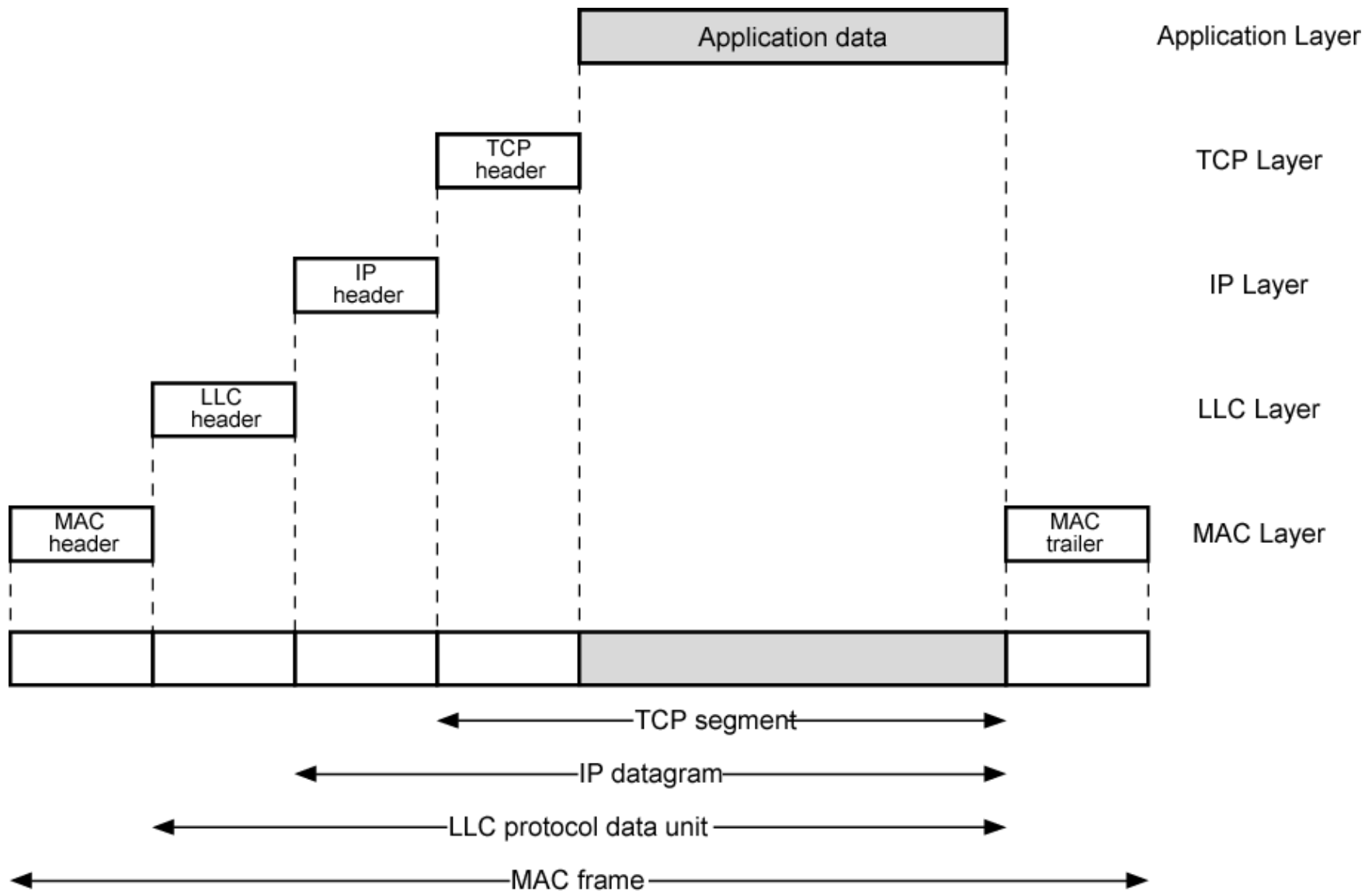
## ■ Packet Switching Issues

- 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)

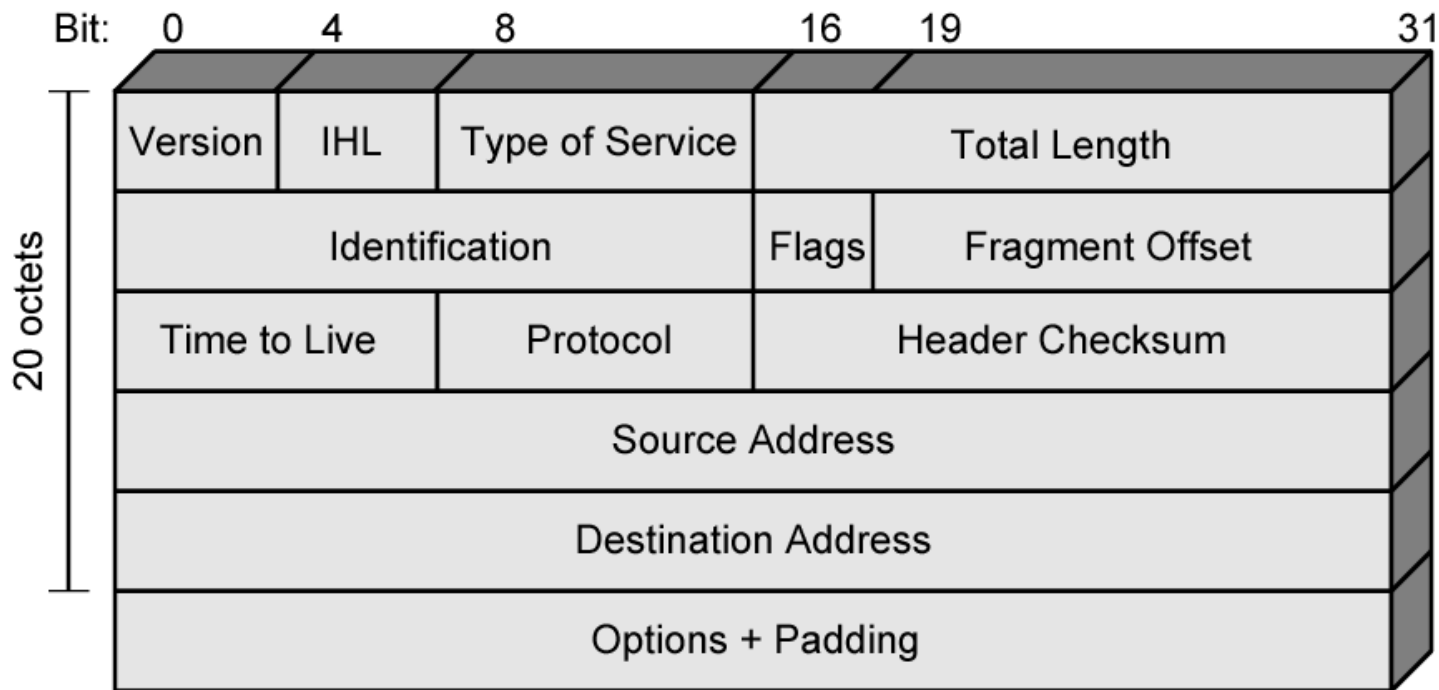
# LAN Protocols in Context



# Internetworking

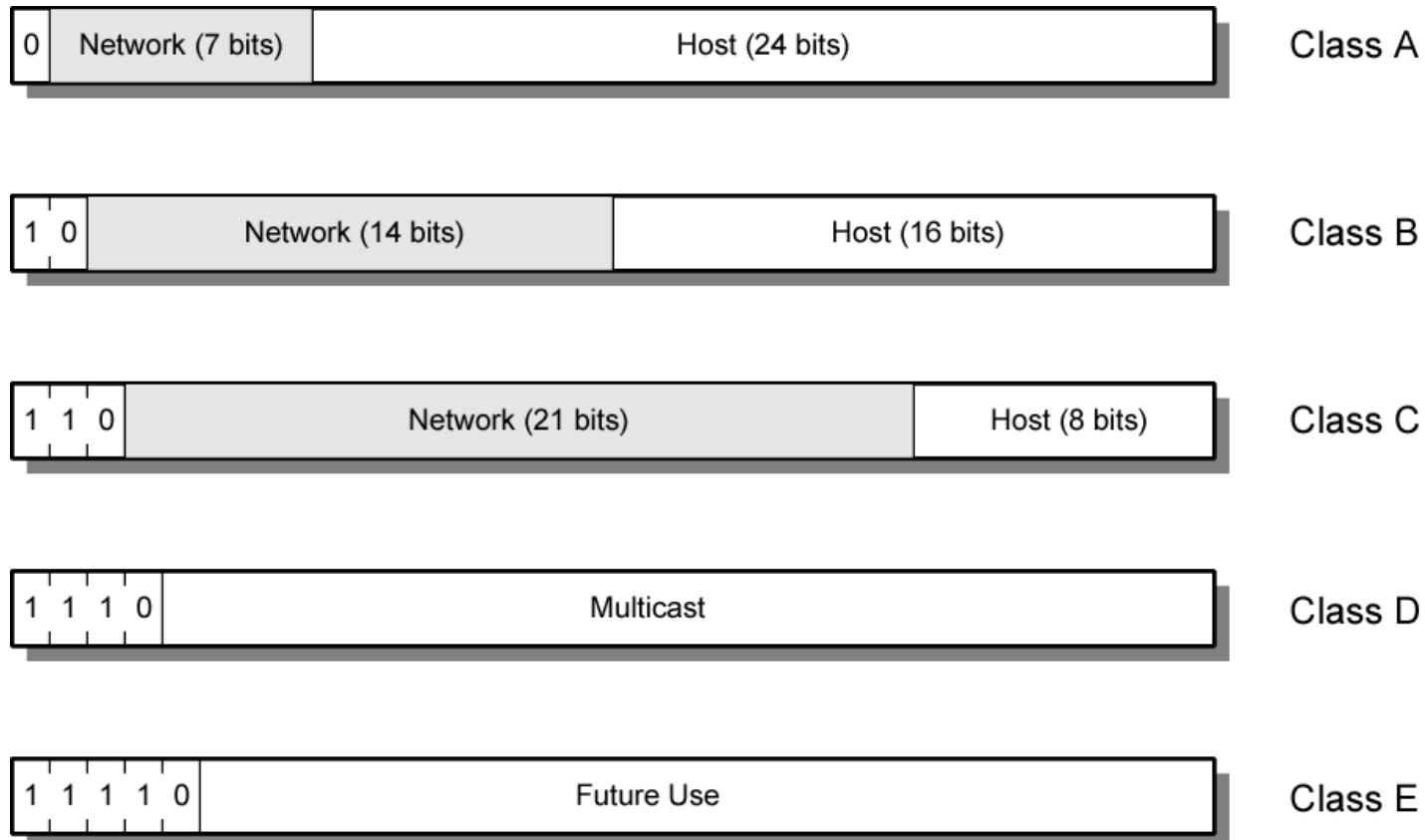
- Internet Protocol

- IPv4 Header



# Internetworking

## ■ IP Address Formats



# Internetworking

- So what network are we?
- 129.101.153.117

# 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:~ kring\$ 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 --- outch!
    - 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

# 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.



# Networking

## ■ Distributing Data

### ■ sftp

*sftp eternium.cs.uidaho.edu*

*Connecting to eternium.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@eternium.cs.uidaho.edu's password:*

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

# 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

# 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*

# Networking

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