Networking

- Read Chapter 9

- Linux network utilities
  - finger, ftp, host, hostname, msg, 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

![Diagram of two computers connected with a serial connection]

Networking

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

![Diagram of three computers connected with Ethernet cables and cards]
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.

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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?

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

0    Network (7 bits)    Host (24 bits)  Class A

1 0    Network (14 bits)    Host (16 bits)  Class B

1 1 0    Network (21 bits)    Host (8 bits)  Class C

1 1 1 0    Multicast  Class D

1 1 1 1 0    Future Use  Class E

Internetworking

- So what network are we?

- 129.101.153.117
**IP Addresses - Class B**

- 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

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**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
/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*

```
/sbin/arp -a
```

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:~ klings$ 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

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]

- 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
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
- Word of wisdom: telnet and rlogin should be avoided! Use ssh and slogin!