

Experimental Networking (ECSE 4690)

Lab 1, Basic Linux and Networking Commands

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Google: "SHIV RPI"

Basic Commands

- Linux commands
- Networking commands and tools
- Socket programming
- An introduction project
- Preview of the next lab

Basic Linux Commands

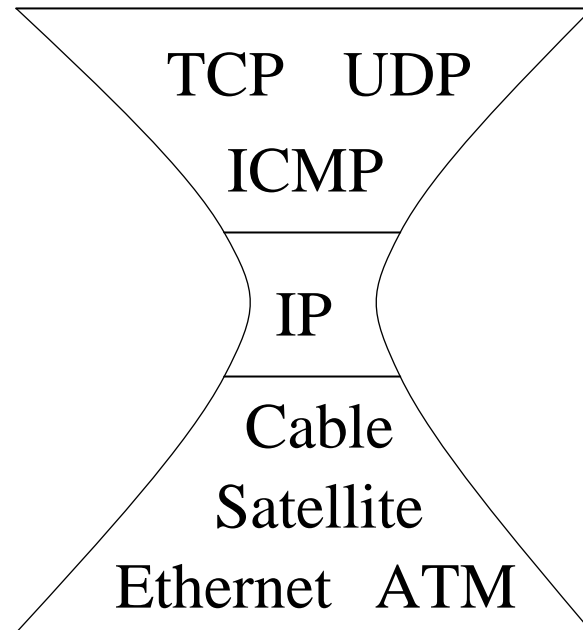
- man – manual page (help info)
- pwd – present working directory
- ls – list content in current directory
- mv / cp / rm – move(rename) / copy / delete file
- mkdir / rmdir – create / delete a new directory
- chmod – change w/r/x modes of file
- ps – check process status
- kill – terminate process
- pipe operator >, >>, |

Longer list: please explore if unfamiliar!

- ls show directory, in alphabetical order
- logout logs off system
- mkdir make a directory
- rmdir remove directory (rm -r to delete folders with files)
- rm remove files
- cd change current directory
- man (command) shows help on a specific command
- more (file) views a file, pausing every screenful
- telnet (host) connect to another Internet site
- ftp (host) connects to a FTP site
- passwd change your password
- grep search for a string in a file
- tail show the last few lines of a file
- who shows who is logged into the local system
- df shows disk space available on the system
- du shows how much disk space is being used up by folders
- chmod changes permissions on a file
- bc a simple calculator
- make compiles source code
- gcc (file.c) compiles C source into a file named 'a.out'
- gzip best compression for UNIX files
- tar combines multiple files into one or vice-versa

Internet Protocols Stack

- Packet-switched network
- IP is the glue
- Hour-glass architecture
 - all hosts and routers run IP
 - IP runs over everything
- Common Intermediate Representation



TCP / UDP / IP

- IP
 - Unreliable, best-effort service
 - Connectionless: no per-packet or per-session state information inside network, each IP packet is delivered independent of all other packets
 - Like post-office (USPS) mail

TCP / UDP / IP

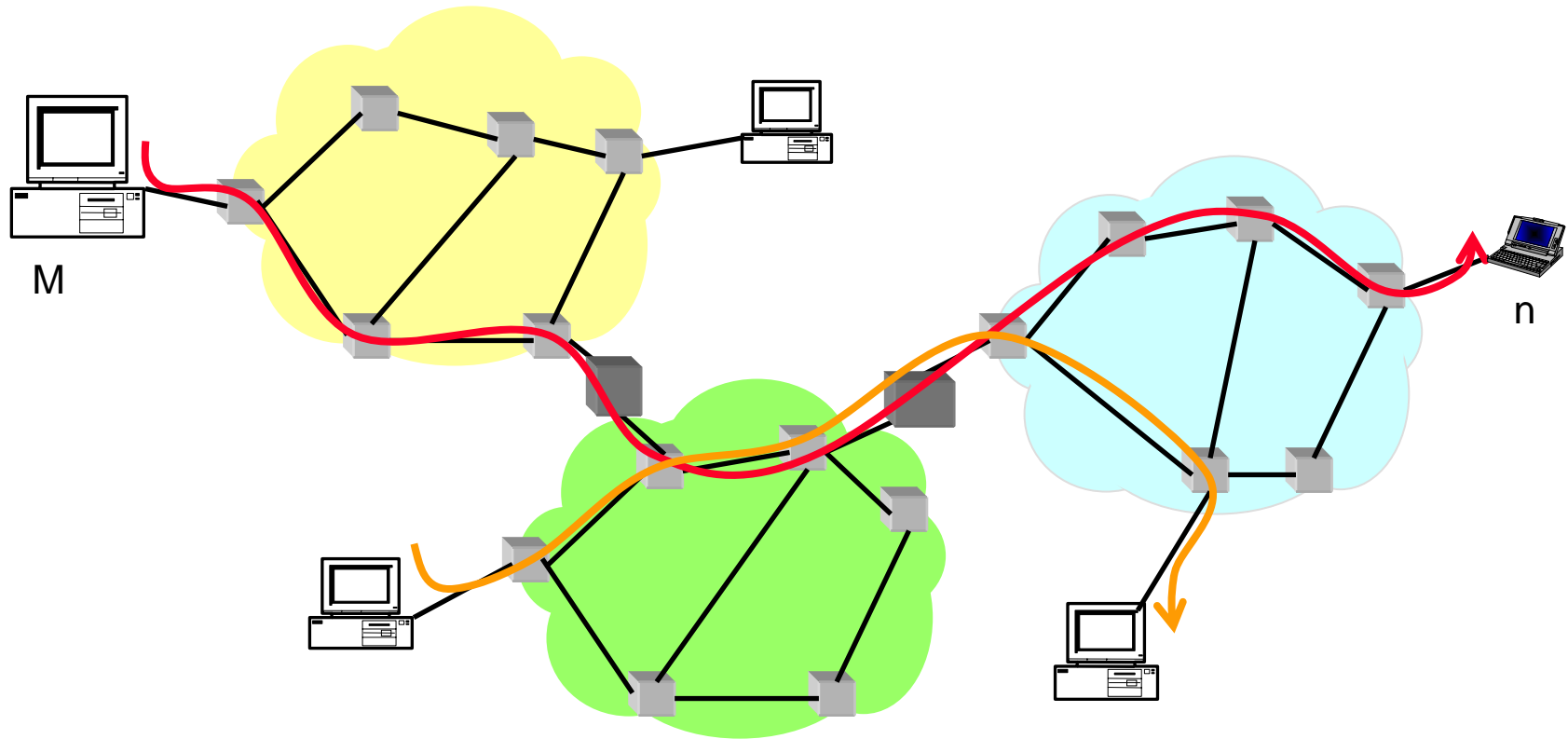
- UDP
 - Datagram service: ***explicit boundary*** between packets
 - What's more than IP?
 - Port number: multiplexing for applications
 - Checksum: weak error detection (not correction!)

TCP / UDP / IP

- TCP
 - Many versions: Tahoe, Reno, SACK, Vegas ...
 - Connection-oriented: ***per-session*** state variables maintained at end-hosts (but not in network, unlike circuit-switched and virtual-circuit approaches)
 - Aka ***end-to-end*** “connection” or “association”
 - Reliably setup and tear down the end-to-end association
 - Reliable: uses ACK (“sender: receiver **correctly got this packet**”), checksum (“receiver: is this packet is **correct or wrong?**”) and window (multiple packets in flight: pipelined)
 - Byte-stream: no application-packet boundary like UDP
 - Congestion control: reduce demand during overload, to ensure stable statistical multiplexing of the network

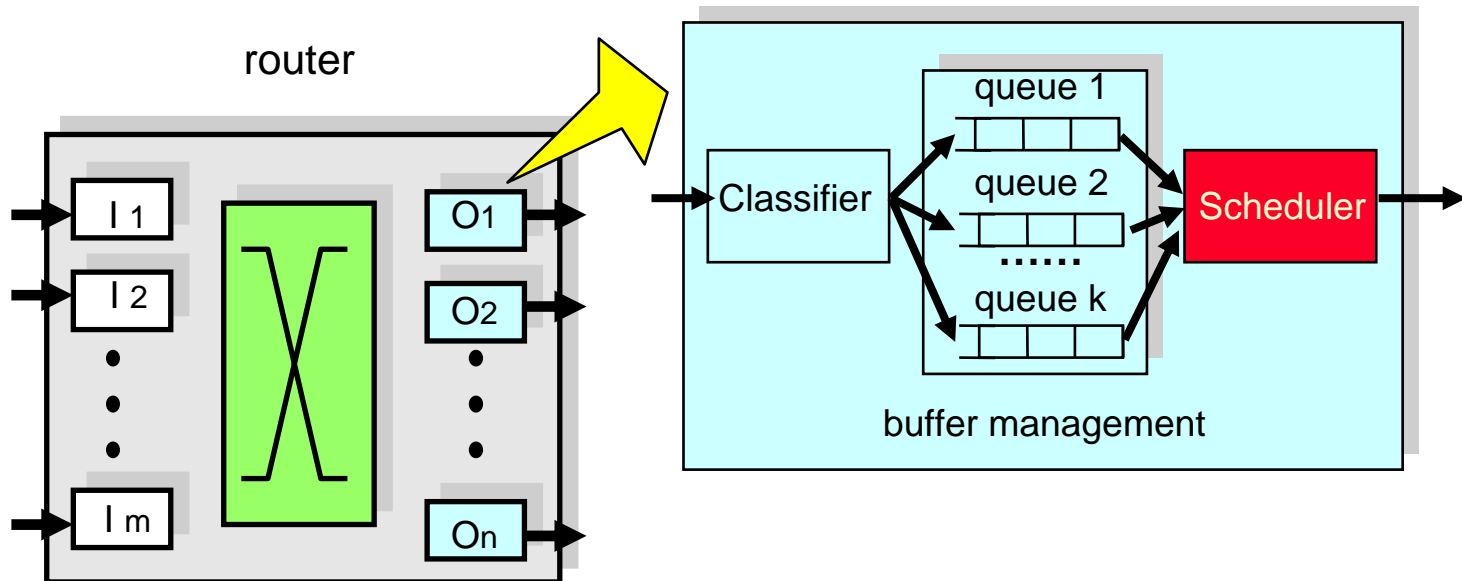
Basic Networking Commands

- How to detect if another machine is alive, the path to it, and resolve its DNS name to ip address, etc. ...?



A Router Model

- Input and output queues (buffers)
- Switch fabric (forwarding / routing)



Basic Networking Commands

- ping – check if machine is alive
- ifconfig – interface (ip addr / mask) configuration
- arp – link / network layer address mapping
- netstat – status info of network configuration
- telnet – remote terminal
- ftp – file transfer tool
- route – set static route of a machine
- traceroute – gather route information
- tcpdump – dump packet header
- nslookup – resolve DNS name of target hostname

Key : What can you infer about the network or end-to-end properties with these commands?

Consider a Packet's Life in a Router

- Packet is processed at a router:
 - Packet enters at IP input queue from an interface (**ifconfig**)
 - Calculate next hop router based on **longest-prefix match** of packet header destination IP address with **routing table** entry
 - Routing table is maintained dynamically by a daemon (e.g. gated), or statically by **route** command
 - View routing info etc. via **netstat** command
 - If it's an ICMP packet, further processing
 - ICMP echo → **ping**
 - Decrement Time_To_Live (**TTL**), discard packet if it's zero and send ICMP error back to source → **traceroute**
 - Send packet to output queue (**forwarding**)
 - Nslookup: gives ip address of a host (or router I/f) name
 - Tcpdump can be used to view the whole packet!

Project: Measuring RTT

- Write program to measure round-trip time between two end host on the Internet;
 - Refer to ping: write a simple wrapper program..
- Propose a model for RTT prediction, i.e., give a sequence of RTT measures, estimate the next RTT value.
 - Measure several values of RTT. What can you say about the samples? If they are variable, what can you do to reduce the variability of the RTT estimate?
 - Time series model

Advanced Ideas: For Fun!

Can you correlate info across measurements using different techniques?

- “Rocketfuel”: ISP maps
 - <http://www.cs.washington.edu/research/networking/rocketfuel/>
- Skitter: Internet Maps
 - <http://www.caida.org/tools/measurement/skitter/>
- Pathchar: bandwidth measurement
 - <http://www.caida.org/tools/utilities/others/pathchar/>
- Pathrate/Pathload: load/available bandwidth measurement
 - <http://www.pathrate.org/>
- Visualization tools & utilities:
 - <http://www.caida.org/tools/visualization/>
 - <http://www.caida.org/tools/utilities/>
- King: end-to-end latency estimator
 - <http://www.cs.washington.edu/homes/gummadi/king/>
- Internet Traffic Archive:
 - <http://ita.ee.lbl.gov/index.html>

New Book on Internet Measurement

- Mark Crovella, Bala Krishnamurthy, “Internet Measurement” John Wiley, July 2006.
- http://www.amazon.com/Internet-Measurement/dp/047001461X/sr=8-1/qid=1156883575/ref=pd_bbs_1/103-0724620-5882241?ie=UTF8
- Consider this if your term project will involve measurement etc...