Network and protocols

Lecture 09:

Operating Systems and Networks

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recap

- Finished preliminaries of OS
- CPU, Registers, System calls, traps and interrupts
- What happens when computer starts?
- Device controllers
- CPU mutlitasking and Time sharing
- program, process, stack, heap
- process Control, context switching
- threads
- process and thread in linux
- End part one... move to networking

Contents

- shared object and pipe
- standard input, output and error
- processes communicating
- need network to communicate
- Different type of network
- Modes of transmission
- protocols
- OSI view

pipe |

- How do processes communicate?
- command1 |command2 (both in window and linux | dir |more)
- pipes allow to process to communicate
- but how?
- a temporary file is generated on disk
- command1 writes into it and command2 reads?
- but how?
- standard input, standard output and standard error. (next lecture)
- ordinary pipe (anonymous pipe in Windows)
- named pipe (mkfifo) we dont study this.

standard input, output and error

starting a shell result in creation of three files

- stdin: file that the process gets its input (e.g. from keyboard)
- stdout: file that the process puts its output (e.g. to monitor)
- stderr: file that the error goes to (e.g. to monitor)

standard input, output and error

- make a directory and change to it

$cd a

$ mkdir mydir

- The following gives one stdout and stderr to terminal

$(ls -ld mydir ; ls -ld mydir1)

- put stdout to temp1

$(ls -ld mydir ; ls -ld mydir1) > temp1

- see it

$ cat temp1

put second output to another file

- (ls -ld mydir ; ls -ld mydir1) 2> temp2

see it

- $ cat temp2

standard input, output and error

put steout to temp3 and the second output (stderr) to the same place as 1st output (i e temp3)

- $(ls -ld mydir ; ls -ld mydir1) > temp3 2>&1

see it

- cat temp3
- what does this one do?

$(ls -ld mydir ; ls -ld mydir1) 2>&1 > temp4

$cat temp4

standard input, output and error

- what does this one do? [second output (stderr) to first output (terminal) … well second output of the command goes to temp4]

$(ls -ld mydir ; ls -ld mydir1) 2>&1 > temp4

$cat temp4

temp is only for teaching pruposes! use bit bucket (black hole of null device)

/dev/null

- a special file that discards all data written to it but reports that the write operation succeeded.

you often see

$mycommand > /dev/null

- redirect channel stdout of mycommand to /dev/null

$ mycommand 2> /dev/null

- redirect channel stderr to /dev/null

$ mycommand > /dev/null 2>&1

redirect stdout to /dev/null and then bind channel 2 (stderr) to channel 1 (stdout). Both will go into /dev/null

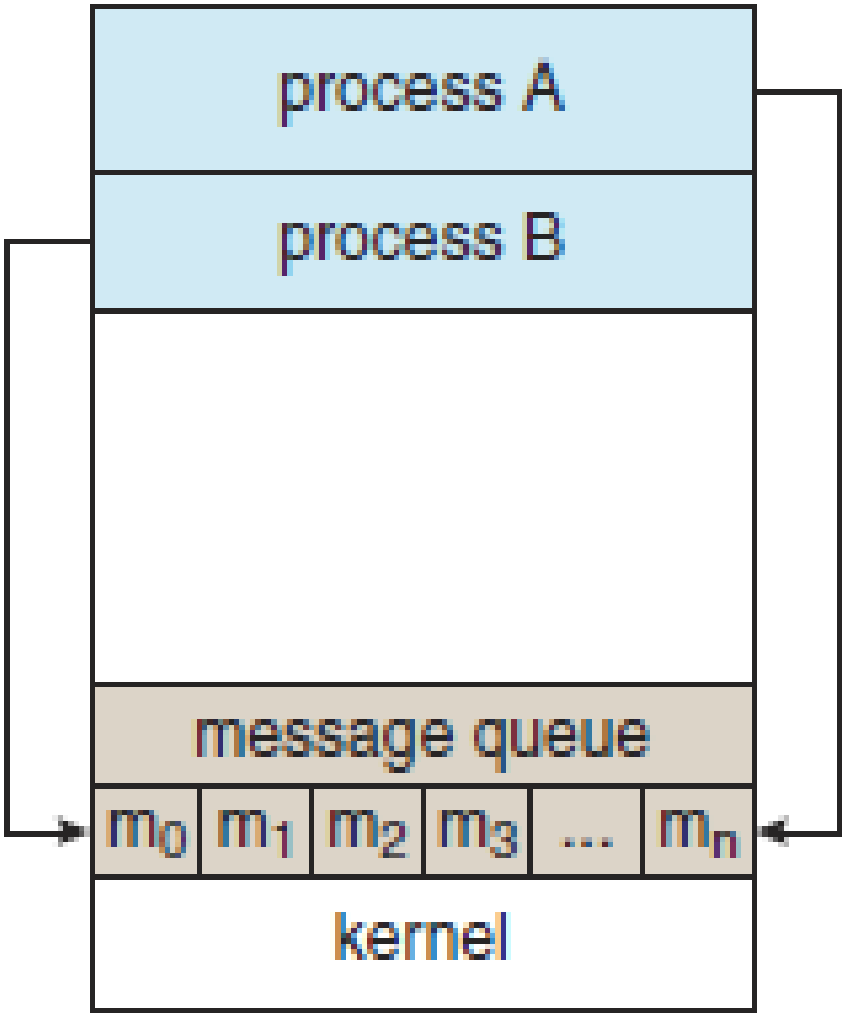
back to pipe

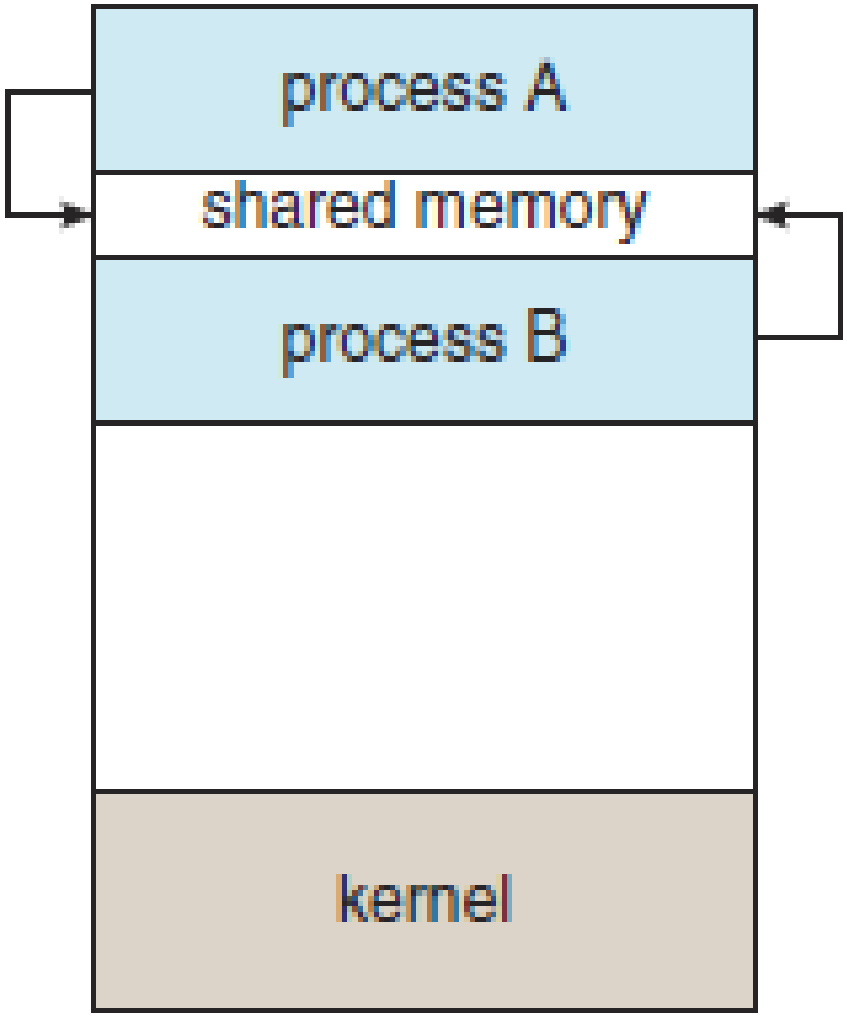
command1 | command 2

- a temporary file is created
- stdout of command1 is redirected to the temp file
- stdin of command2 comes from the file

- pipe is an example of communication via shared file.
- Any other way of processes communicating?

processes communicate in two ways





Between machines we need a network or communication medium!

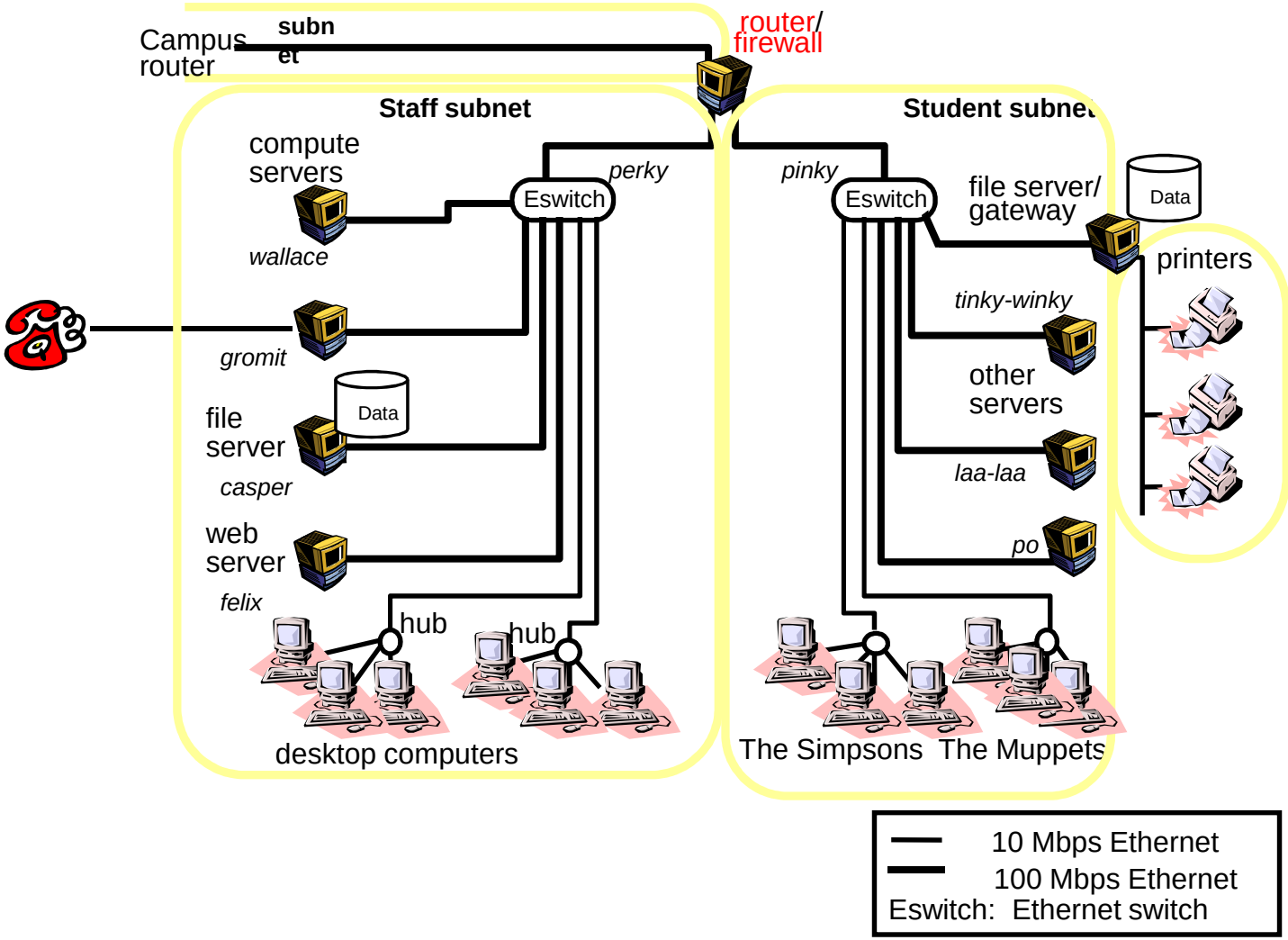
Types of Networks

- PAN (Personal Area Network)
- LANs (Local Area Networks)
- WANs (Wide Area Networks)
- MANs (Metropolitan Area Networks)
- WPAN (Wireless PAN)
- WLAN (Wireless LAN)
- WMAN (Wireless MAN)
- WWAN (Wireless WAN)

LAN

- messages are carried in high speed between connected nodes by a single communication medium
- Suitable for home office ,… radius of 1-2 km
- High bandwidth 10-1000Mbps (total amount of data per unit of time)
- Low latency 1-10 ms (time taken for a bit to reach destination)
- Technology: predominantly Ethernet

LAN example: the old SoCS



WAN

- Covers Worldwide,
- Low bandwidth 0.01-600 Mbps,
- high latency (100-500 ms)
- Satellite/wire/cable, use of routers which also introduce delays

MAN

Wire/cable, uses Digital Subscriber Line (DSL) and cable modem

Range of technologies (ATM, Ethernet)

Wireless networks

- WLANs (Wireless Local Area Networks)
  - to replace wired LANs
  - WaveLAN technology (IEEE 802.11)
- WPANs (Wireless Personal Area Networks)
  - variety of technologies
  - GSM, infra-red, BlueTooth low-power radio
  - WAP (Wireless Applications Protocol)

Network comparison

	Range	*Bandwidth (Mbps)*	*Latency (ms)*
LAN	1-2 kms	10-1000	1-10
WAN	worldwide	0.010-600	100-500
MAN	2-50 kms	1-150	10
Wireless LAN	0.15-1.5 km	2-11	5-20
Wireless WAN	worldwide	0.010-2	100-500
Internet	worldwide	0.5-600	100-500

Fastest ever internet transfer is 1.4 terabits per sec (BT, 2014)

Guinness world record (Cisco):

South Korea has average download 33.5 megabits per second

second-place Hong Kong – 17 megabits per second

Network principles

- Mode of transmission
- Switching schemes
- Protocol suites
- Routing
- Congestion control

Mode of transmission

- Packet Transmission
  - messages divided into packets. Example: 01101110
  - packets queued in buffers before sent onto link
  - QoS not guaranteed
- Data streaming
  - links guarantee QoS (rate of delivery)
  - for multimedia traffic
  - higher bandwidth

Switching schemes

- Broadcasts (Ethernet, wireless)
  - send messages to all nodes
  - nodes listen for own messages (carrier sensing)
- Circuit switching (phone networks)
- Packet switching (TCP/IP)
  - store-and-forward
  - unpredictable delays
- Frame/cell relay (ATM)
  - bandwith & latency guaranteed (virtual path)
  - small, fixed size packets (padded if necessary)
  - avoids error checking at nodes (use reliable links)

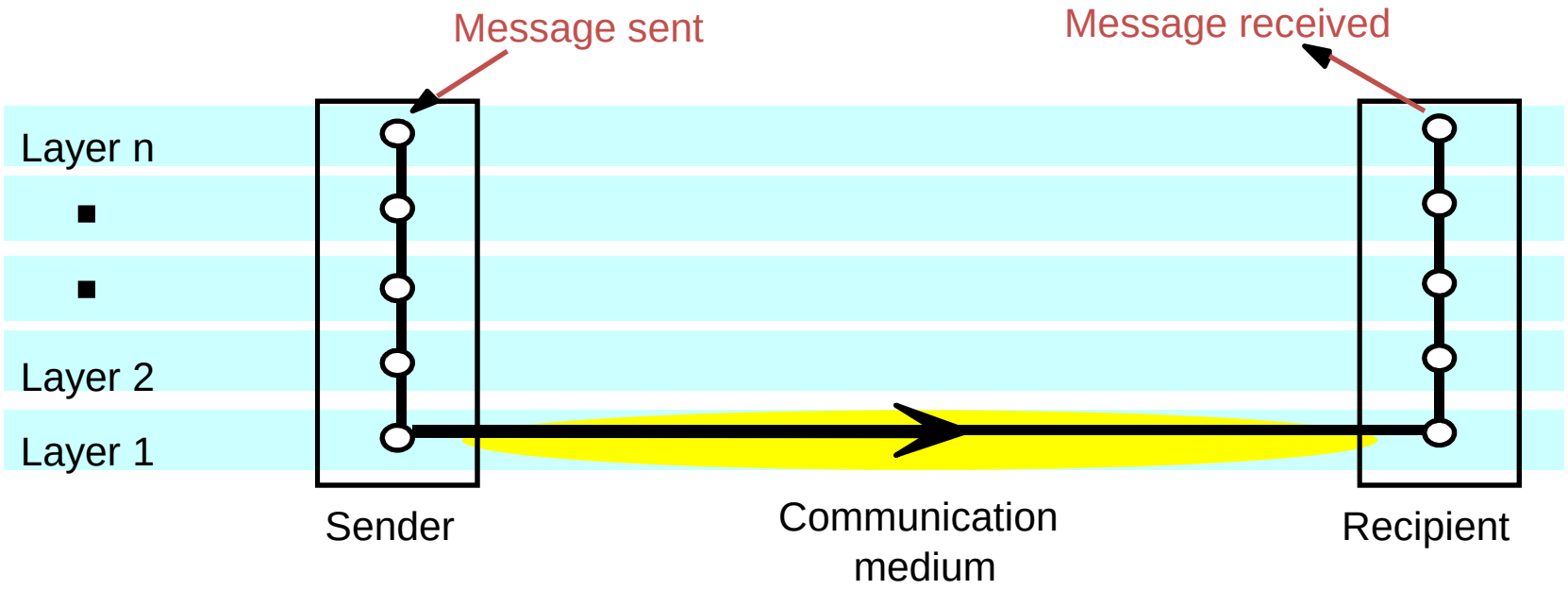
Protocol

- well-known set of rules and formats to be used for communication between processes to perform a given task
- Two parts:

❑specification of sequence of messagegs that must be exchanged

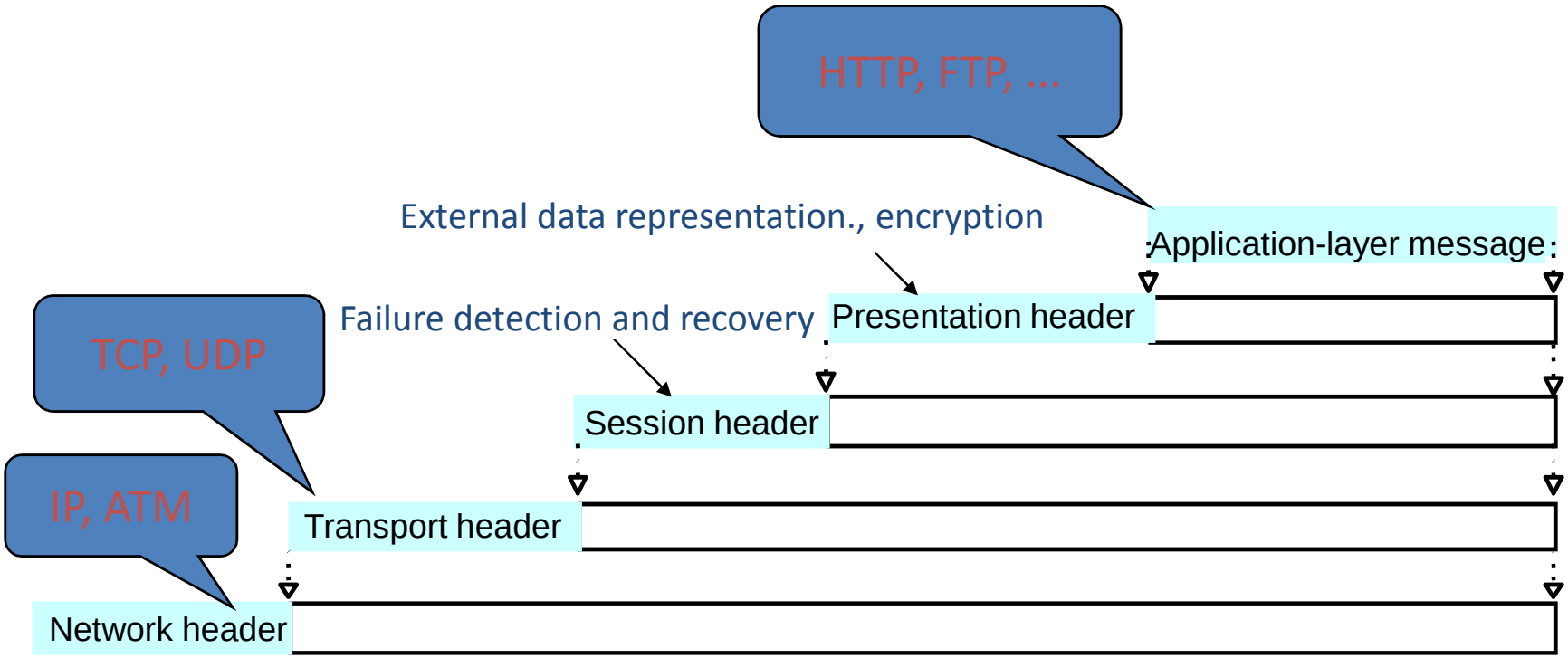
❑specification of the format of the data in each message

Protocols (OSI view)



Definition: set of rules and formats for exchanging data, arranged into layers called protocol suite/stack.

Message encapsulation



Headers appended/unpacked by each layer.

OSI protocol summary

Layer	*Description*	*Example*
Application	Protocols for specific applications.	HTTP, FTP, SMTP
Presentation	Protocols for independent data representation and encryption if required.	Secure Sockets, CORBA CDR
Session	Protocols for failure detection and recovery.	
Transport	Message-level communication between ports attached to processes. Connection-oriented or connectionless.	TCP, UDP
Network	Packet-level transmission on a given network. Requires routing in WANs and Internet.	IP, ATM
Data link	Packet-level transmission between nodes connected by a physical link.	Ethernet MAC, ATM cell transfer
Physical	transmit sequence of binary data using various mediums	Signalling, ISDN