CP 476
Internet Computing

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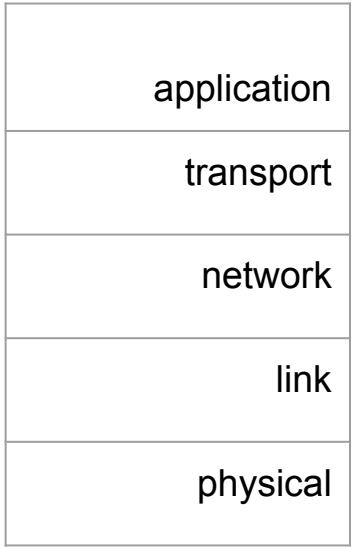
Internet Architecture

Agenda

- Internet protocols
- TCP/IP
- Application layer
- WWW vs Internet

Internet Protocols

- A design philosophy and architecture
  - Expressed in a set of protocols
- Protocol
  - Standard for data communication
- Adopt and absorb new technologies
  - A new technology just needs to know which protocols to work with

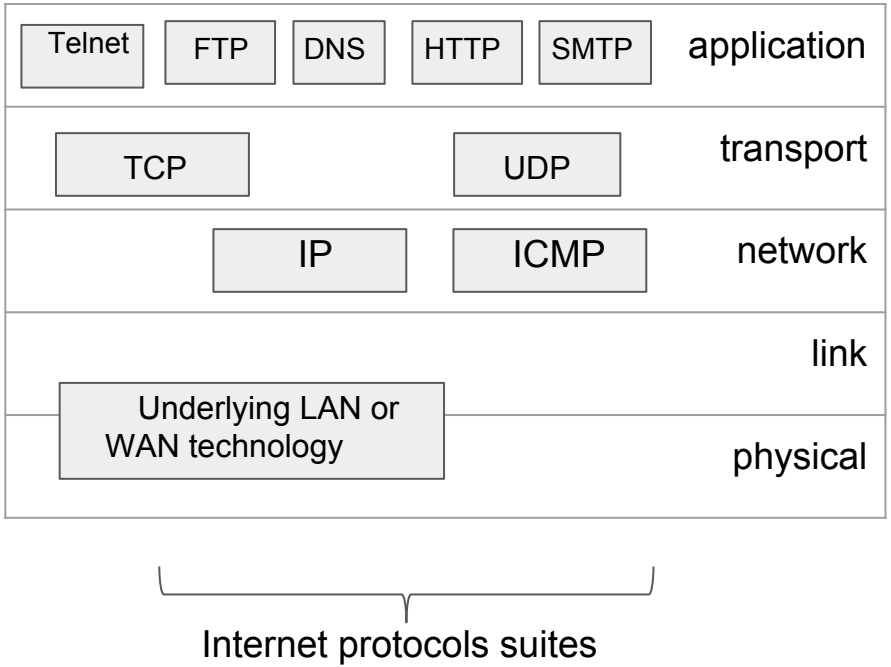


Internet suites / TCP/IP suites

- Groups of protocols designed to work together to send data across Internet
- Major protocols: TCP/IP
- TCP/IP suites are open protocol:
  - Available to be freely used by anybody anywhere without having to pay a company or pay the licensing fee
  - new protocols can be freely developed as new technologies are developed to allow those new technologies to access the larger network as well.
  - Define in RFC
  - TCP protocol: https://tools.ietf.org/html/rfc793
  - IP protocol: https://tools.ietf.org/html/rfc791

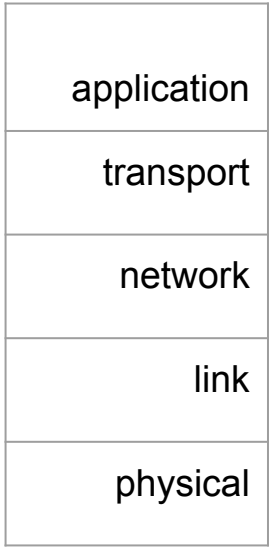
Internet Protocol suite

- Application
  - Supporting Network applications
- Transport
  - Process-to-process data transfer
- Network
  - Routings of datagram from source to destination
- Link
  - Data transfer between neighboring network elements
    - Ethernet, 802.111
- Physical: bits on wire

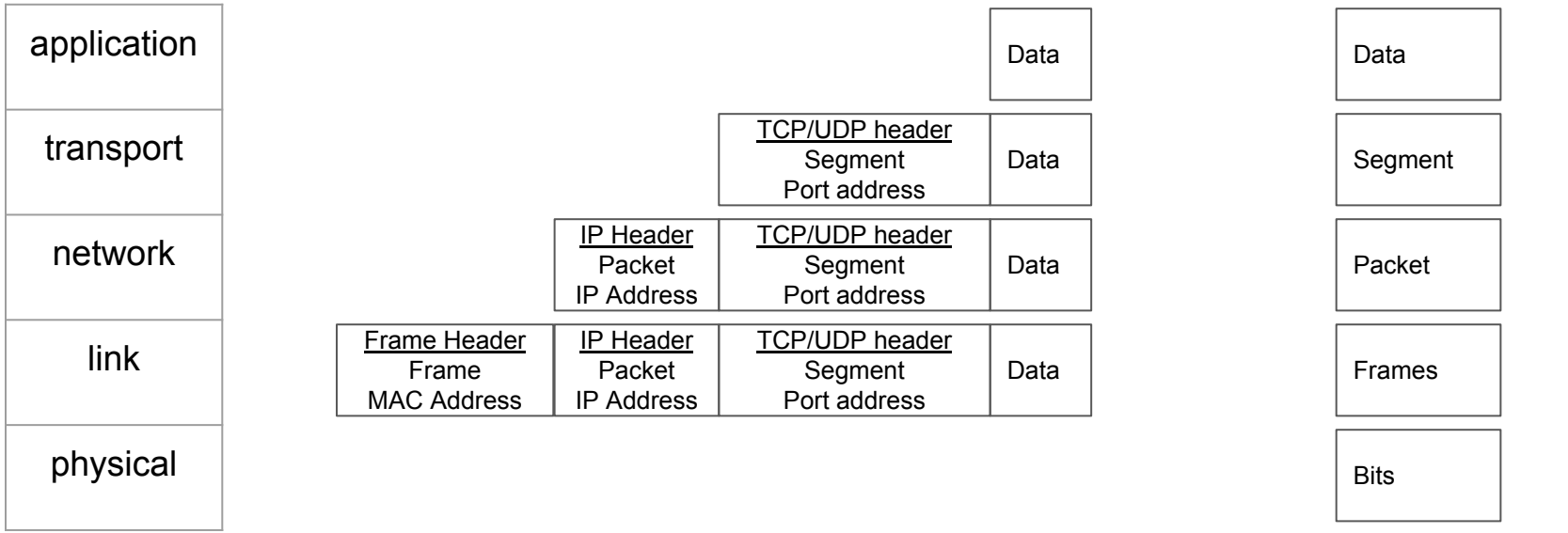


How the layers work together?

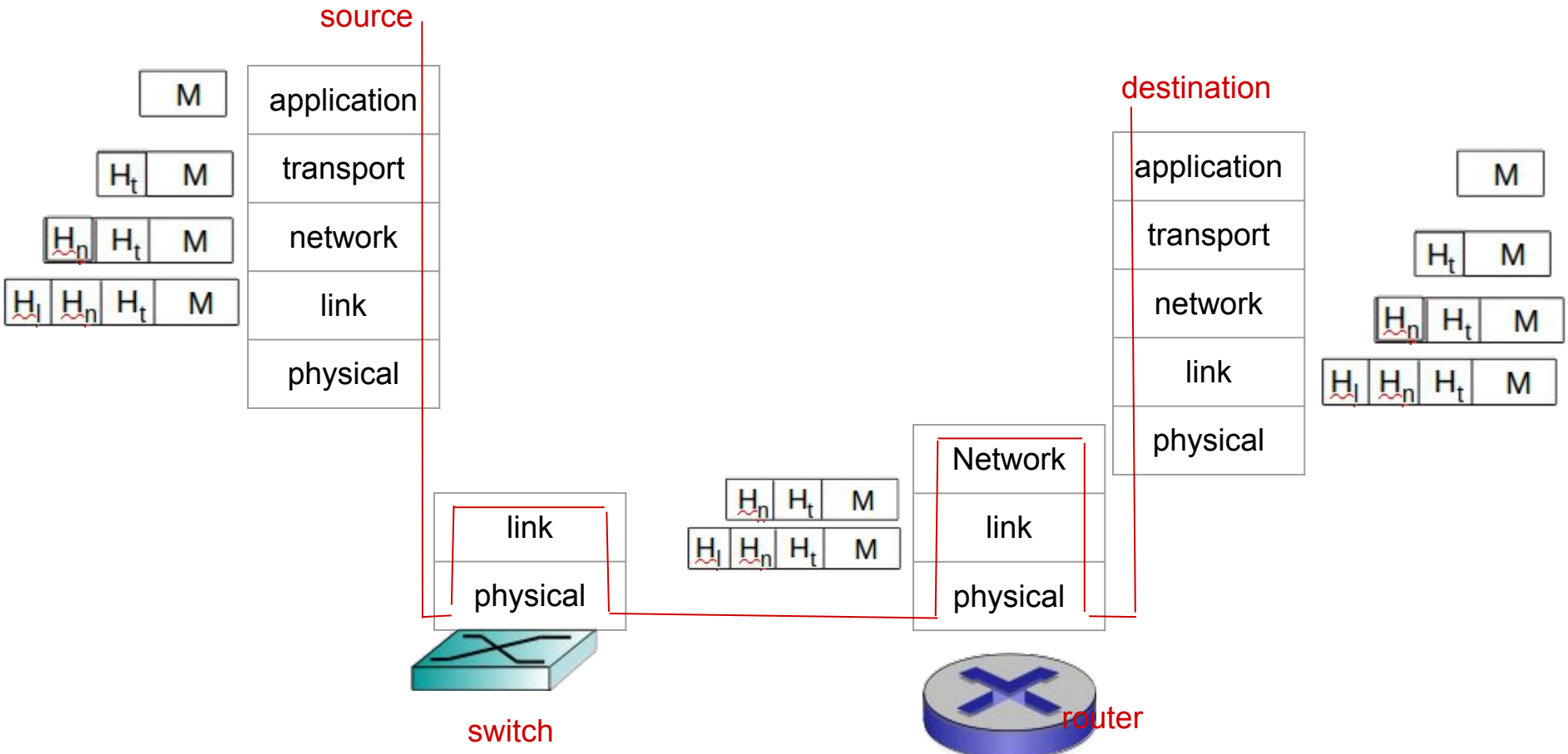
- Encapsulation/De-capsulation
  - Transport Layer
    - Break up the data into smaller unit (segments)
    - MTU is used to determine the size of each segment of data
    - Passes the segments it generates down to the network layer
  - Network Layer
    - Adds a new header to help it finds its destination.
    - The segment becomes packet
  - Data link layer
    - Adds another header
    - containing the physical address of the next node along the network
    - The packet becomes frame
    - Error correction information at the end (trailer)
  - Physical Layer
    - Takes the frame and encodes it into ones and zeroes to be transmitted across the media



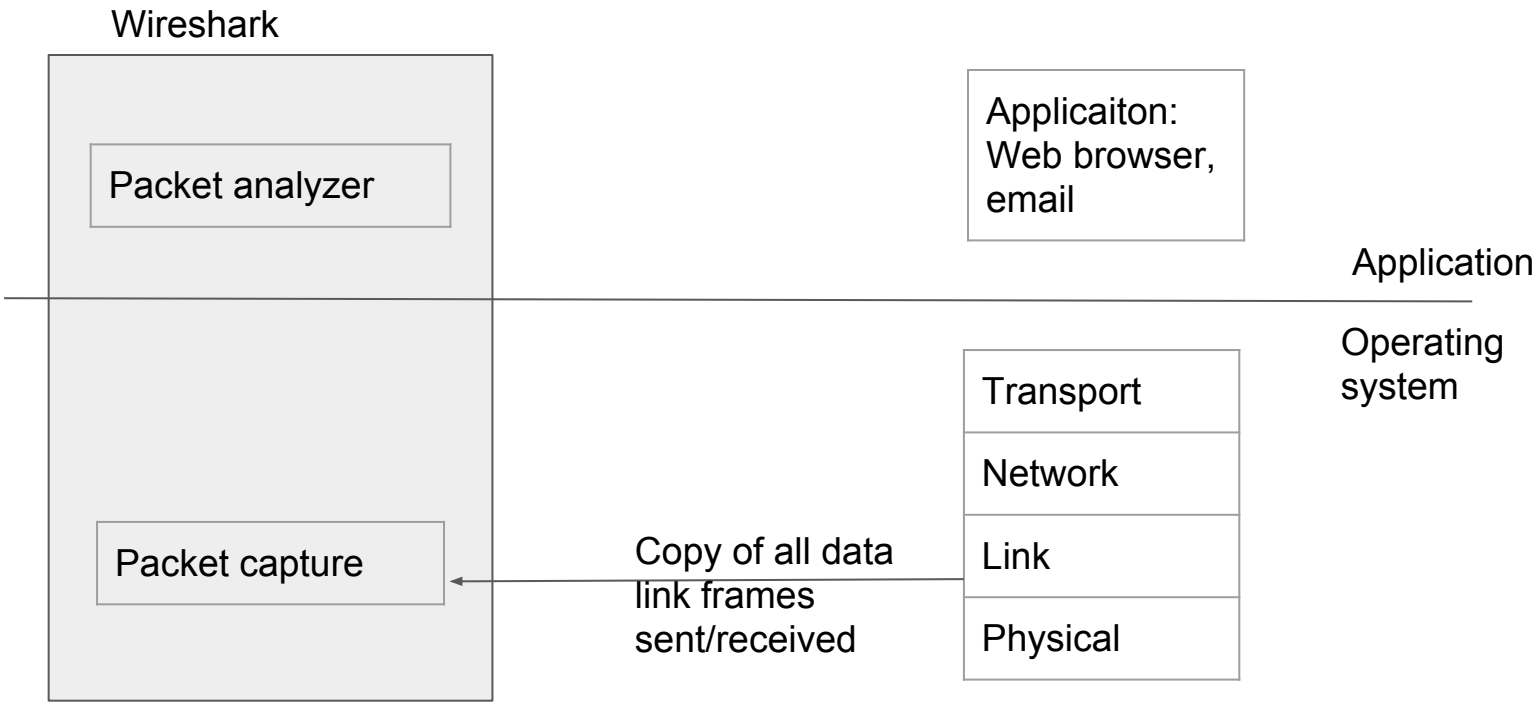
Network layers: Encapsulation



Encapsulation / Decapsulation



Packet analysis Tools



Application Layer

- Defines the protocols,services, and processes that allow both programs and users to interface with the network.
- Implements specific communications for each kind of program
- Application architecture
  - Client-server architecture
  - Server:
    - always-on host
    - permanent IP address
    - data centers for scaling
  - Clients:
    - communicate with server
    - may be intermittently connected
    - may have dynamic IP addresses
    - do not communicate directly with each other

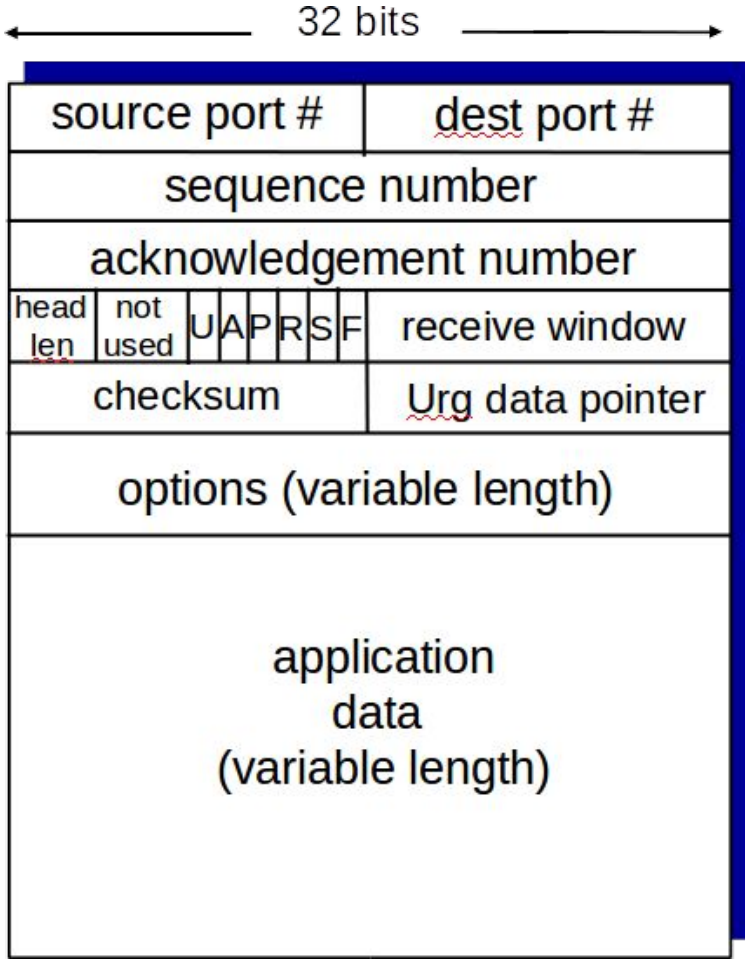
Transport Control Protocol (TCP)

- A connection-oriented protocol
- Responsible for process-to-process communication
- Reliability
- Reliable transport service between two application programs

- Multiplexing: multiple programs using the same IP address
  - Source IP, destination IP, source port, source destination
- Flow control
  - A sender is not overwhelming a receiver by sending packets faster than it can consume
- How is a process identified? Port number + ip address

TCP segment

- Source port
  - Chosen by client TCP process
- Destination port
  - Well known or chosen by server TCP process
- Sequence number
  - Initial seq number for first byte of data



Internet Protocol (IP)

- protocol for host-to-host datagram transmission
- Routing function
- Every node on the internet has a unique numeric address:
  - 174.129.14.120
  - IPV4: 32 bits binary number: four numbers separated by periods
    - Provide for more than 4 billion unique addresses
    - Each number may range between 0 and 255.

Internet Protocol (IP)

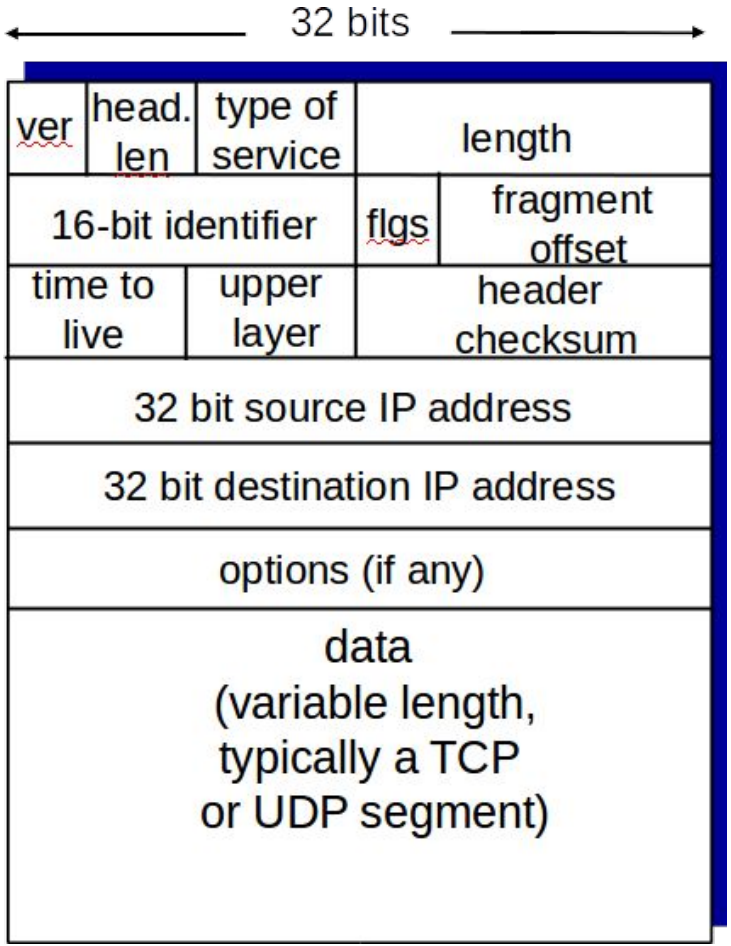
- Every node on the internet has a unique numeric address:
  - IPV6: 128 bits binary number
    - Eight four-character numbers (each represenet 16 bits)
      - 2607:f8b0:400b:808::2002
      - 2607:fea8:1ce0:afb:ad4:cff:fe0c:b043
    - Provides over 340 undecillion unique addresses, That’s more than enough for every grain of sand on Earth to have its own IP address.

Internet Protocol (IP)

- Find your internet IP address?
  - Whatismyip.com
  - Find your local ip address:
  - In a terminal type Ifconfig (linux/MAC) / ipconfig (windows)

IP datagram

- TTL
  - time to live
  - Every hop decrements it
  - Drop packet if value=0
- Checksum
  -

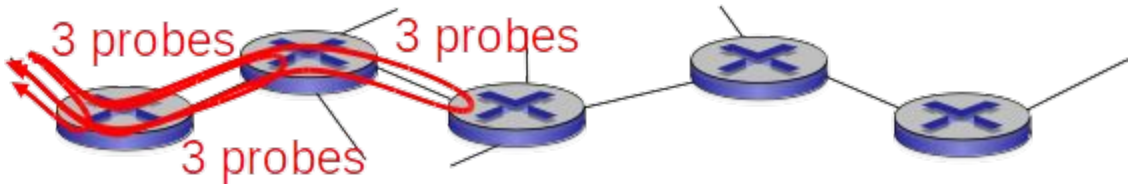


Domain Name System (DNS)

- A set of servers that converts domain names names to IP addresses
  - hostname to IP address translation
  - canonical, alias names
- -dig: DNS Lookup utility
- dig www.wlu.ca 216.249.48.130
- dig google.com 172.217.0.14

traceroute

- A utility that records the exact path of a data packet on its way to destination
- -traceroute goolegle.com
  - Tracert (windows)
- Delay measurement



Taken from [1]

Some network commands

- -ping :To verify that your TCP/IP network services are operating correctly
- -netstat
  - To display status information about the network interfaces on the host machine: netstat -a
- -ifconfig: to display the local interface configuration
- -traceroute
  - To display the routers that are passed through to reach the destination
  - Traceroute “ip address or domain name”
- -dig
  - To find the ip address of a given host name

Internet vs WWW

- Web uses one of the protocols that runs on the internet: **http**
  - There are several other protocols telnet, mailto, etc.