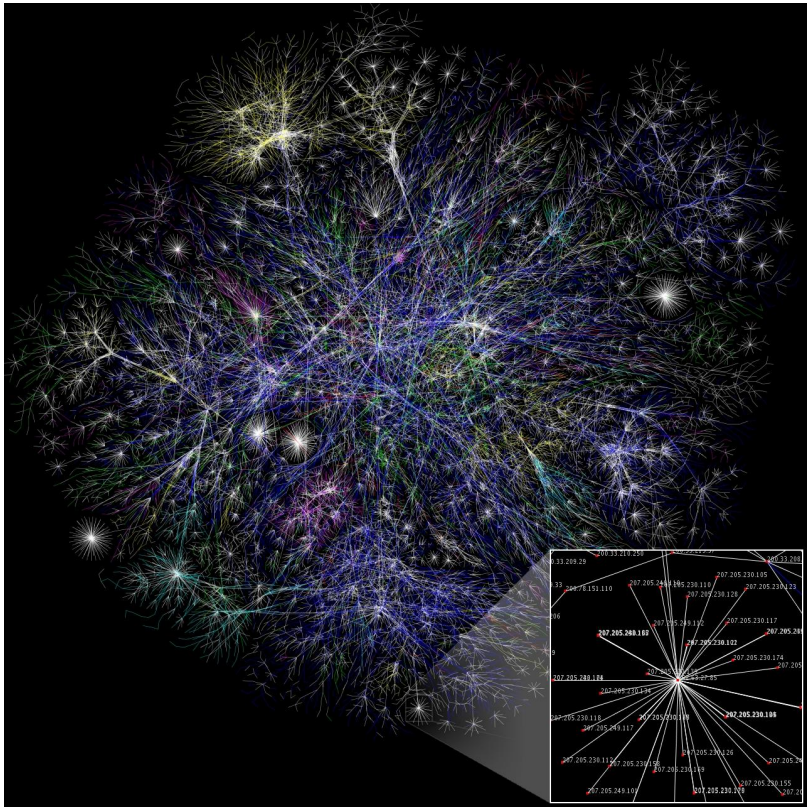
Intro to Networking

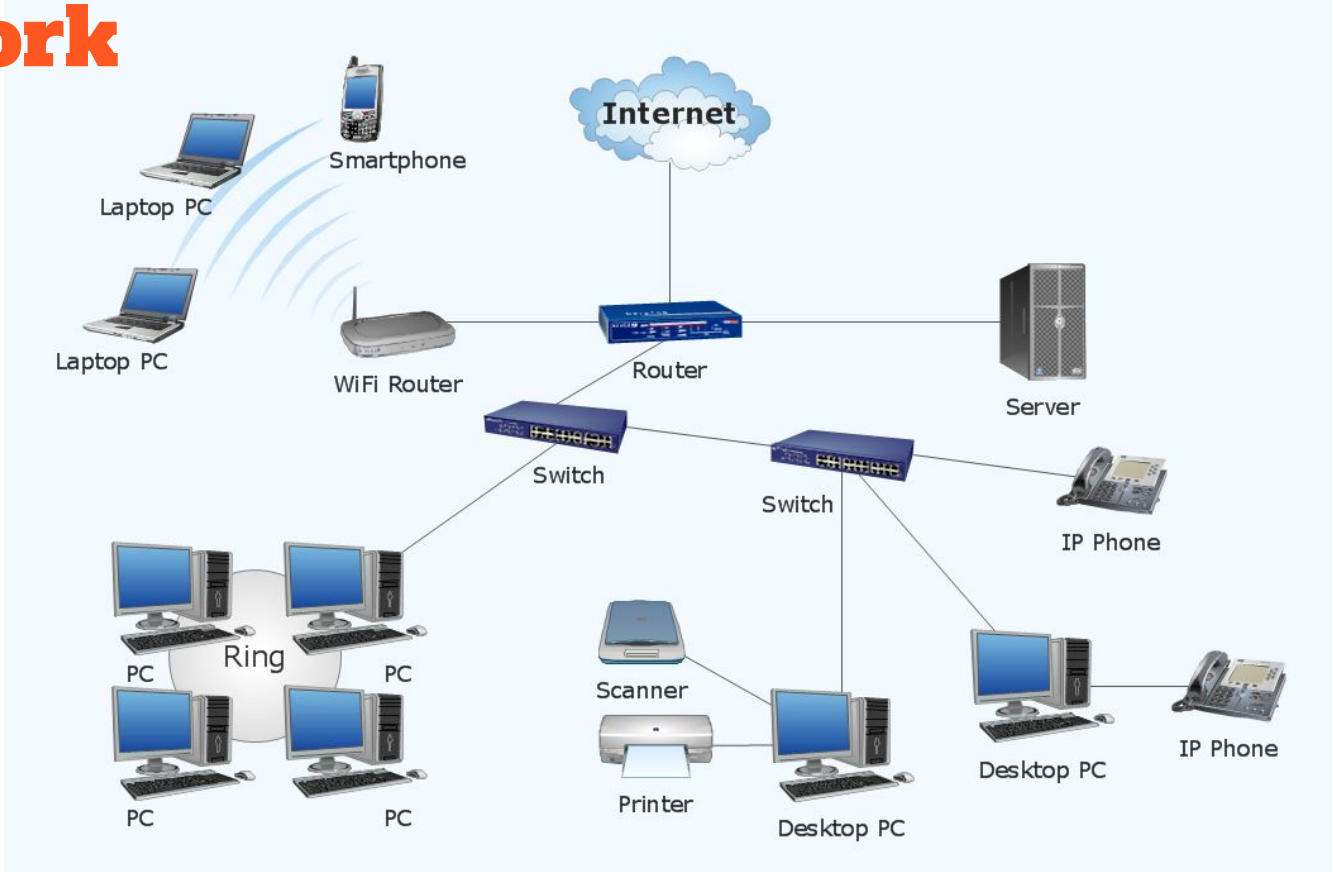
ECE 422/CS 461

The Internet



https://upload.wikimedia.org/wikipedia/commons/d/d2/Internet_map_1024.jpg

Network



http://www.conceptdraw.com/samples/resource/images/solutions/network-diagram/Network-Diagram.png

How do computers communicate?

Concepts

- Packets
- Protocols
- Encapsulation

TCP/IP

Packets

A network packet is a formatted unit of data

- Data is split into packets

Header and footer hold information like

- Source
- Destination
- How to handle payload (payload = data)

How can computers agree on packet format?

Protocols

A protocol defines **rules for communication** between computers

What if everyone implements their own protocol? No Internet

- Need a **reference model**

What if multiple services on one system or same service on different systems? A new protocol for each case?

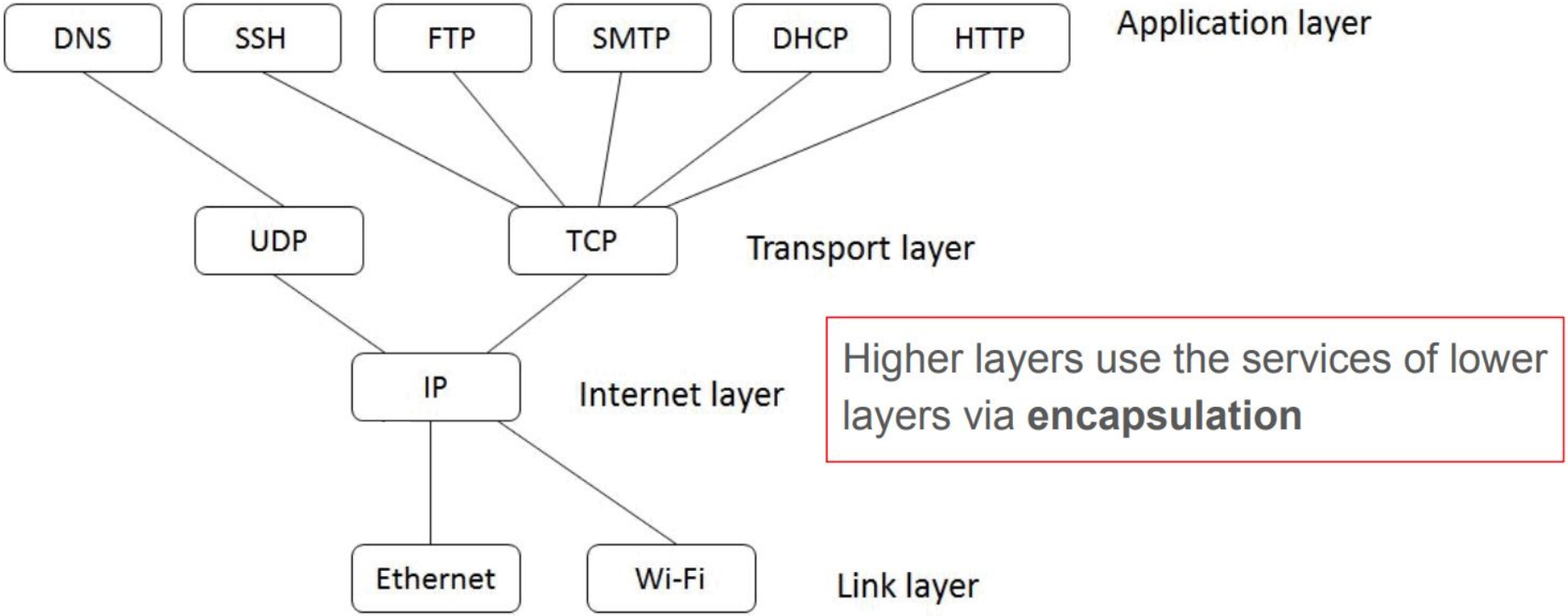
- No, we need **abstraction layers**

OSI Model

OSI Model
Application
Presentation
Session
Transport
Network
Data Link
Physical

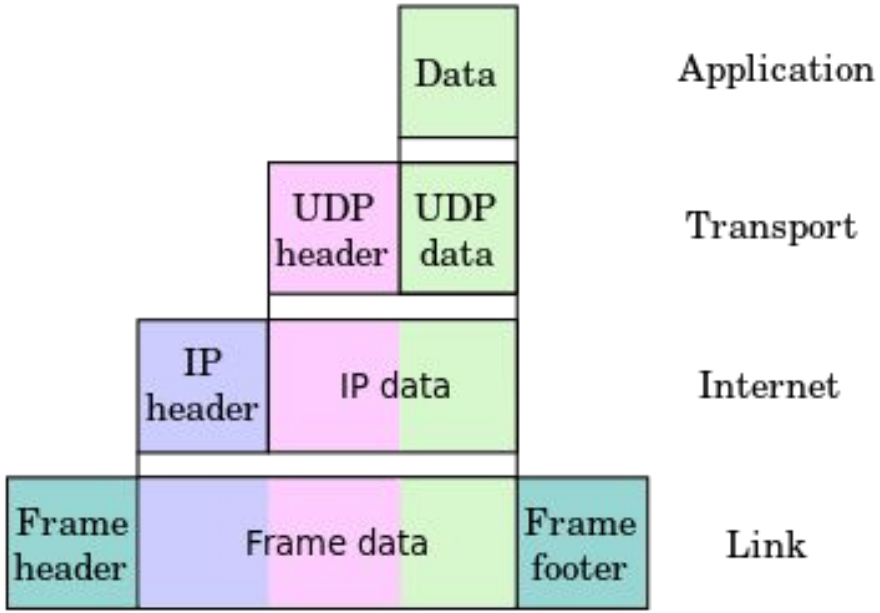
Internet Model
Application
Transport
Network (Internet)
Network

Protocol Layers



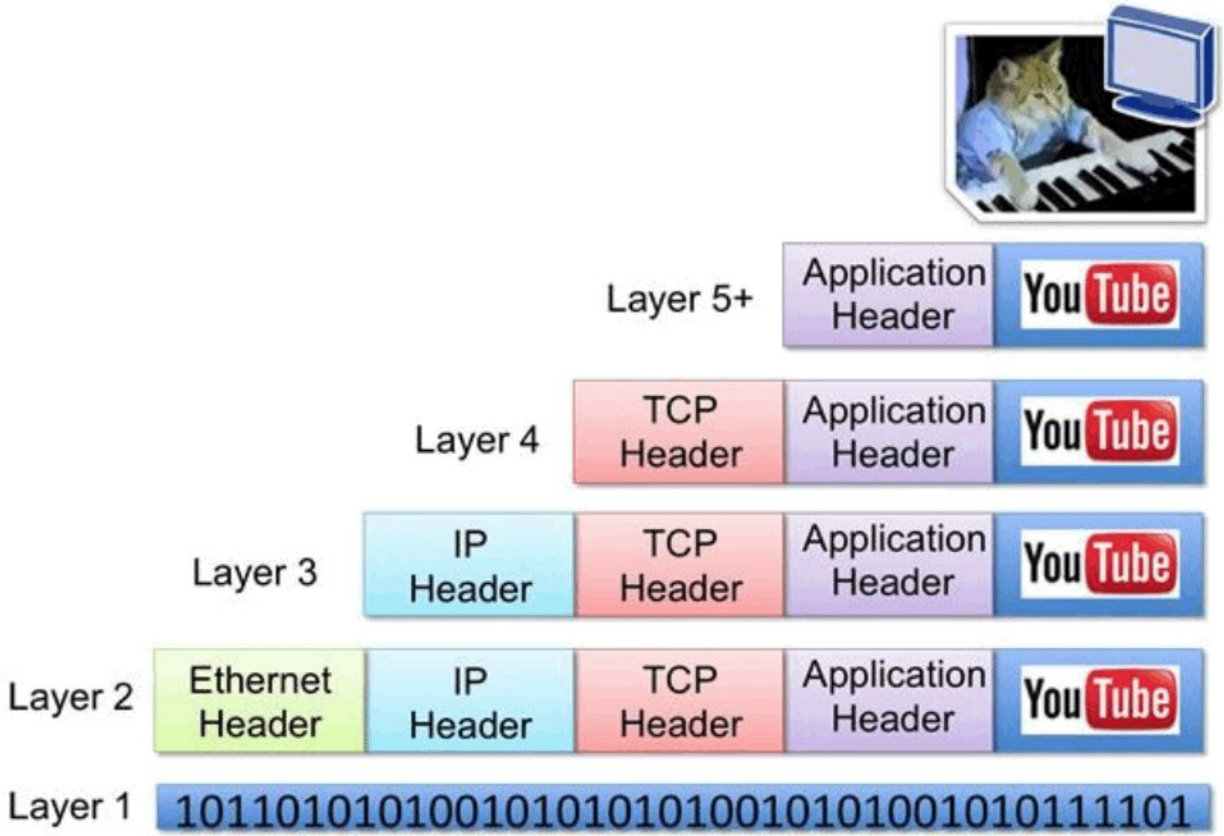
Higher layers use the services of lower layers via **encapsulation**

Encapsulation



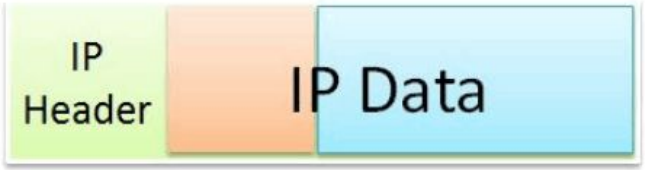
https://upload.wikimedia.org/wikipedia/commons/thumb/3/3b/UDP_encapsulation.svg/420px-UDP_encapsulation.svg.png

TCP/IP



http://networkstatic.net/how-headers-encapsulate-in-the-osi-stack/

IP (Internet)



Network Layer

Encapsulate Transport layer (i.e. TCP) packets

Encapsulated into Data Link layer (i.e. Ethernet) frames

Each packet is transported independently from others (connectionless)

Unreliable

- No acknowledgments
- May be lost, out-of-order, corrupted, or duplicated

Header includes:

- Protocol version (i.e. IPv4)
- Packet length (up to 64 KB)
- Fragmentation information
- Time to live (TTL)
- Transport layer protocol information (i.e. TCP)
- Source and destination IP addresses

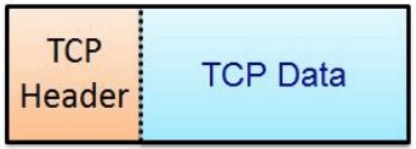
TCP (Transmission Control)

Encapsulate Application layer protocols (i.e. HTTP) packets

Encapsulated into Internet layer (i.e. IP) packets

Connection-oriented

Reliable



Transport Layer

- Order maintained by **sequence number**
- Receipt confirmed with **acknowledgment number**
- Data integrity checked with **checksum**

TCP Handshake – http://www.omnisecu.com/tcpip/tcp-three-way-handshake.php

UDP (User Datagram)

Another Transport layer protocol

Connectionless

Suitable for applications that

- Need fast transmission
- Can suffer from data loss

Unreliable

- No acknowledgments
- May be lost or out of order

Ports

Allow multiple concurrent applications

Both TCP and UDP include source and destination port numbers in header

16 bit ➔ 65,535 numbers

Ports 0 through 1023 are reserved for use by known protocols

List of port numbers – https://en.wikipedia.org/wiki/List_of_TCP_and_UDP_port_numbers

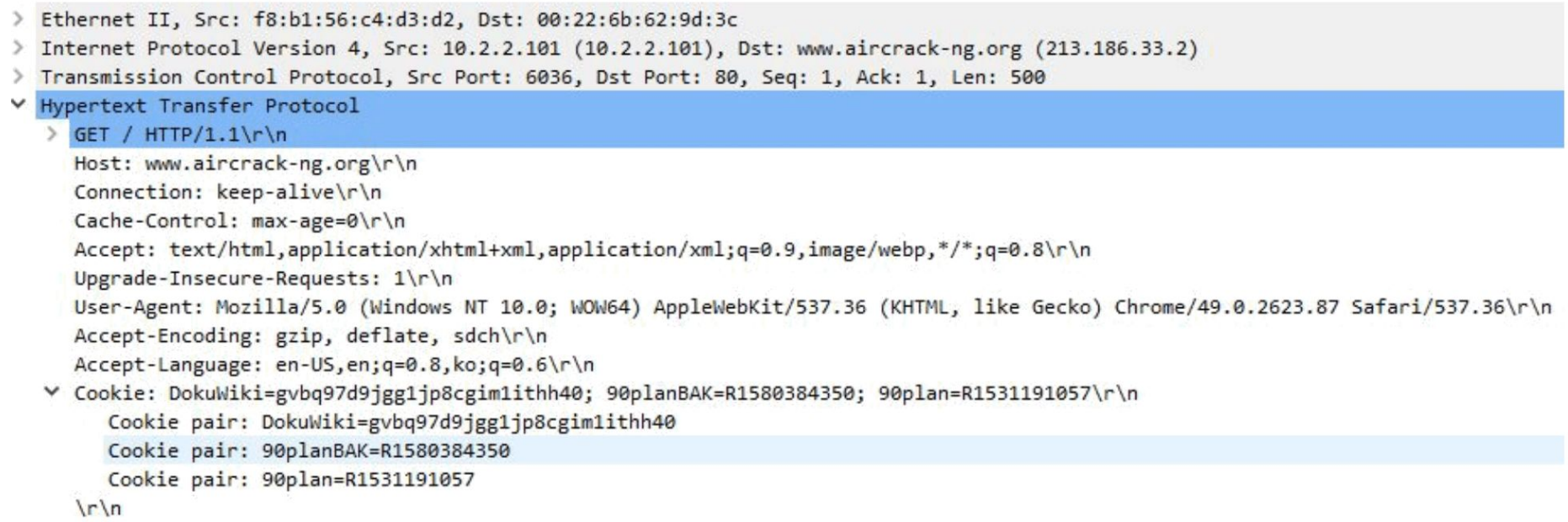
Common Protocols

TCP/IP:

- FTP (port 21)
- SSH (port 22)
- Telnet (port 23)
- DNS (port 53)
- DHCP (port 67)

List of protocols – https://wiki.wireshark.org/ProtocolReference

Wireshark Example



Other useful terms to know

MAC address (i.e. 01:23:45:67:89:ab)

CIDR notation (i.e. 192.168.100.0/24)

Network components

- DNS server
- Ethernet hub
- Switch