

How confident are you
that you could explain
how the internet works?

CS 340

Network Introduction

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Q1

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Updates

1. MP6 Wallet due Tuesday

2. Exam 2 grades out next Tuesday

Agenda

1. What is a System 

2. The internet 

a. Ports

b. Client-Server

c. IP addresses

d. Packet format

e. IP

f. UDP

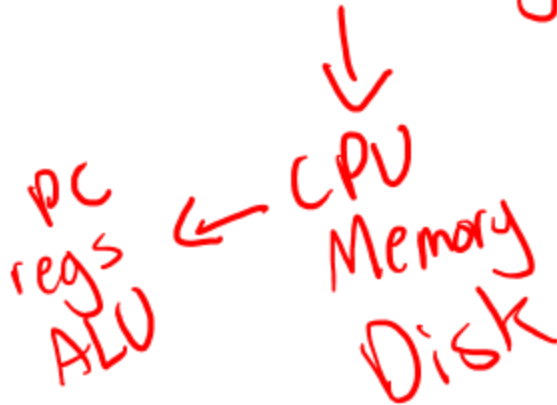
g. TCP

How would you define a System?

is a CPU a system? ✓

is a transistor a system? X

is a computer a system? ✓



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So Far

Individual computer system -

not always simple

VM, thread scheduling, ect...

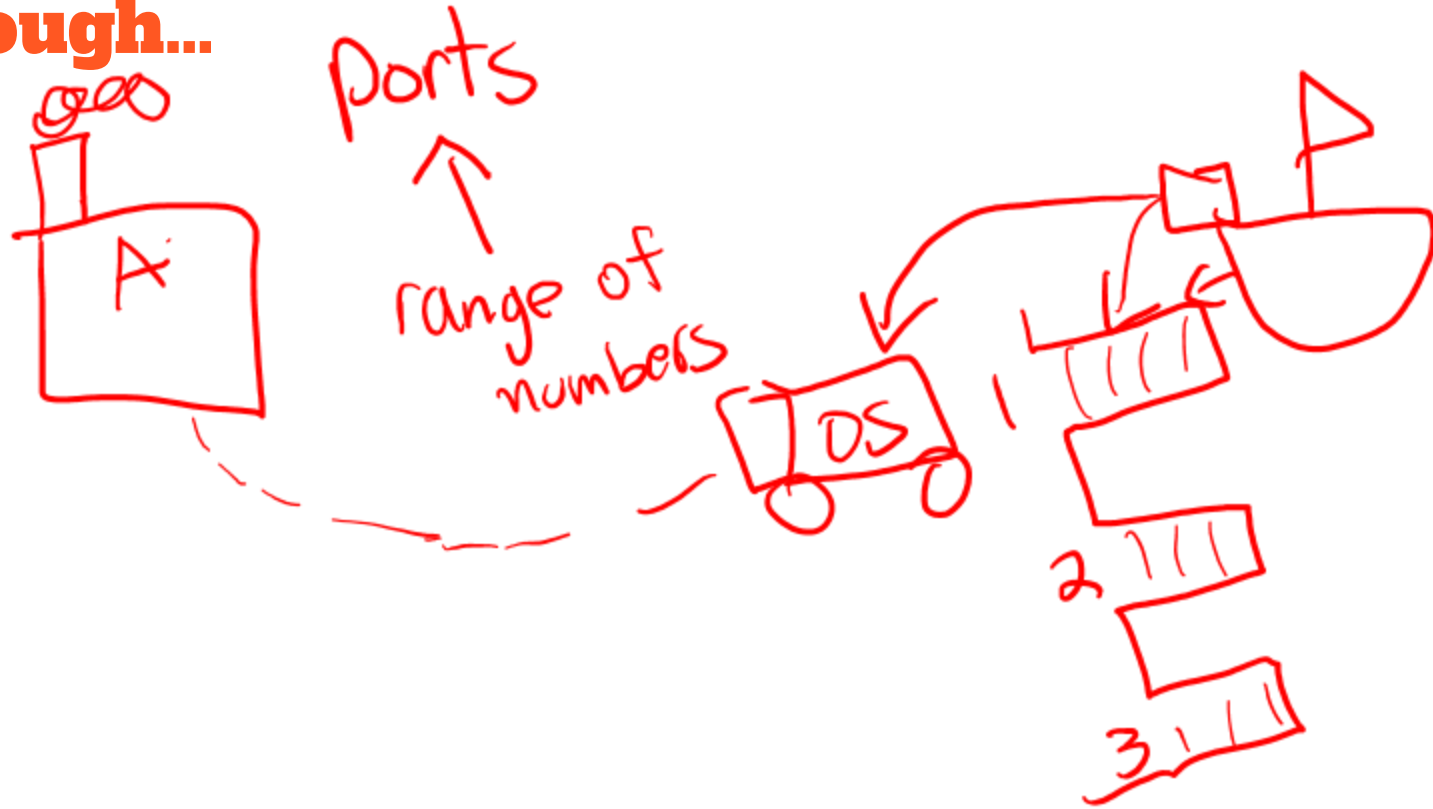
The OS kernel code manages...

VM, hardware interaction, scheduling

↓
Talking to another process ← maybe on a different machine



The OS manages incoming information through...



Some ports are...

port 80 - incoming server
requests ~~are~~
for HTTP

50,000 - 65,000 random, free ports
OS hands them out

Who manages the port system on your computer?

OS/Kernel

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Client-Server Design

→ One process is running and listening on a port A
server

another process is running, gets a local port^B, sends
✓ a message to port A, requesting a connection.
Client

• Port C is now your connection

Client port B $\longleftrightarrow$ Port C

Client-Server Design Example

Google is running a server - listening on its
port 80 for HTTP
in california

Open my browser / process / client

- get port 54203 — send —> google
port 80

What are some follow up/next questions?

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Q4

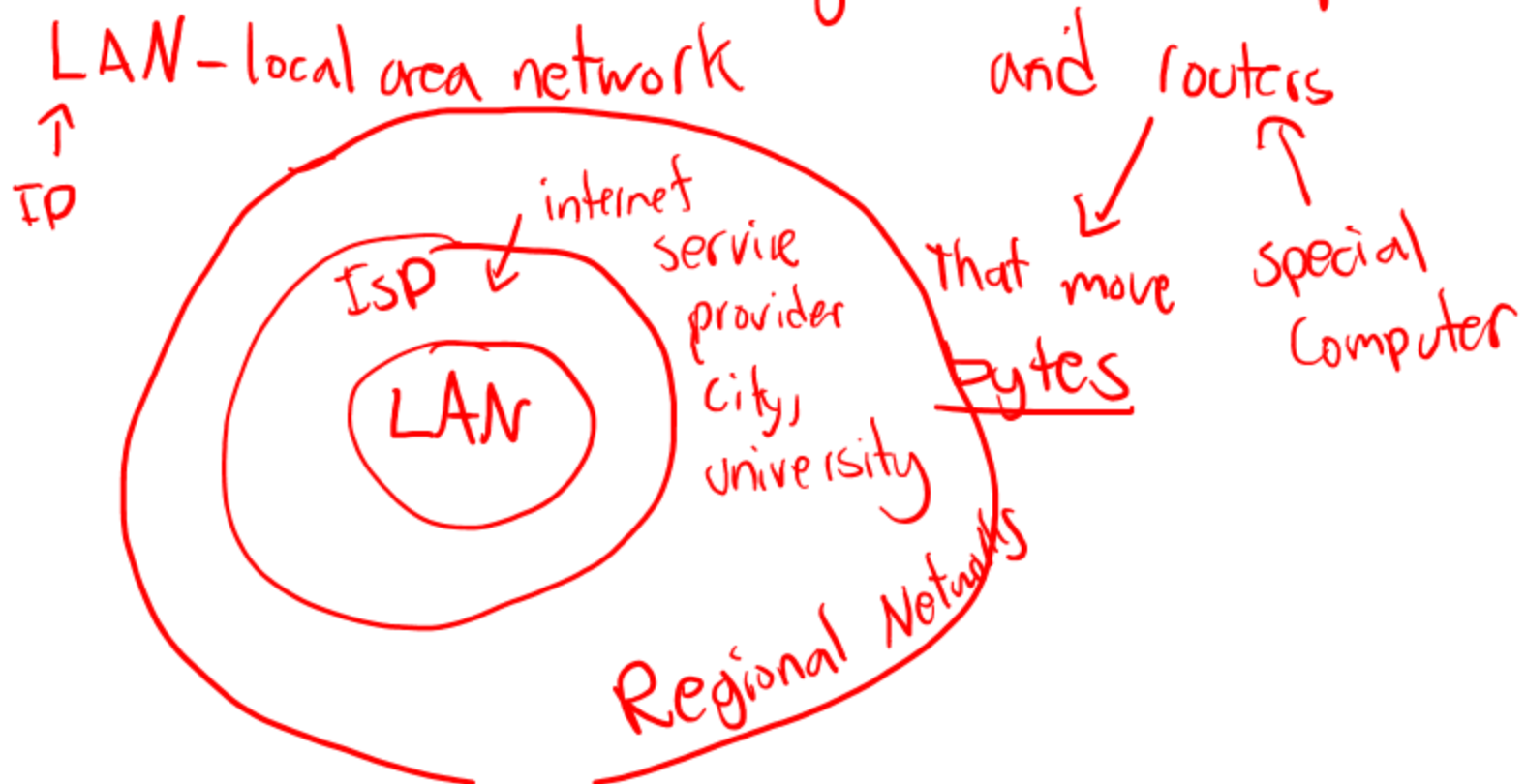
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- run out of ports?
- 2 apps $\rightarrow$ 1 port or 2 servers to $\rightarrow$ 1 port
- where are the ports?
- how does the data move? $0 \times 0BCA5$
- Can I run a server?
- Can you change the port after starting?

Internet

The internet is... connected system of computers



Let's say the router...

Gets the bytes: ↵

0x504DF45A1BB3194BE504DF45A1BB3194BE504DF45A1BB3194BE50
4DF45A1BB3194BE504DF45A1BB3194BE504DF45A1BB3194BE504DF4
5A1BB3194BE504DF45A1BB3194BE504DF45A1BB3194BE504DF45A1B
B3194BE504DF45A1BB3194BE504DF45A1BB3194BE504DF45A1BB319
4BE504DF45A1BB3194BE

We need a protocol
or format

What do you think is being sent through wires and radio signals from router to router?

~~1's~~ 1's, 0's

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Internet Protocol (IP)

Describes and provides addresses for finding a computer



IP address



How many IP addresses do you think we currently need? Roughly around...

8.2 billion people

2022

2.97 billion
personal
computers

30% billion

59% trillion

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IP Addresses

IPv4 — 32 bit addresses ~ 4 billion

IPv6 — 128 bit addresses



↓
172.16.0.1 → IPv4

2001:0db8:85a3:0000:0000:8a2e:0370:7334

↙ IPv6

If IPv4 with 32 bit addresses can represent ~4 ~~million~~ billion addresses, how many can IPv6 with a 128 bit address represent?

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represent?

1 bit

2 bits

2^{128}

every grain sand on earth

4×10^{14} IP addresses

→ 1 0

→ 0 1

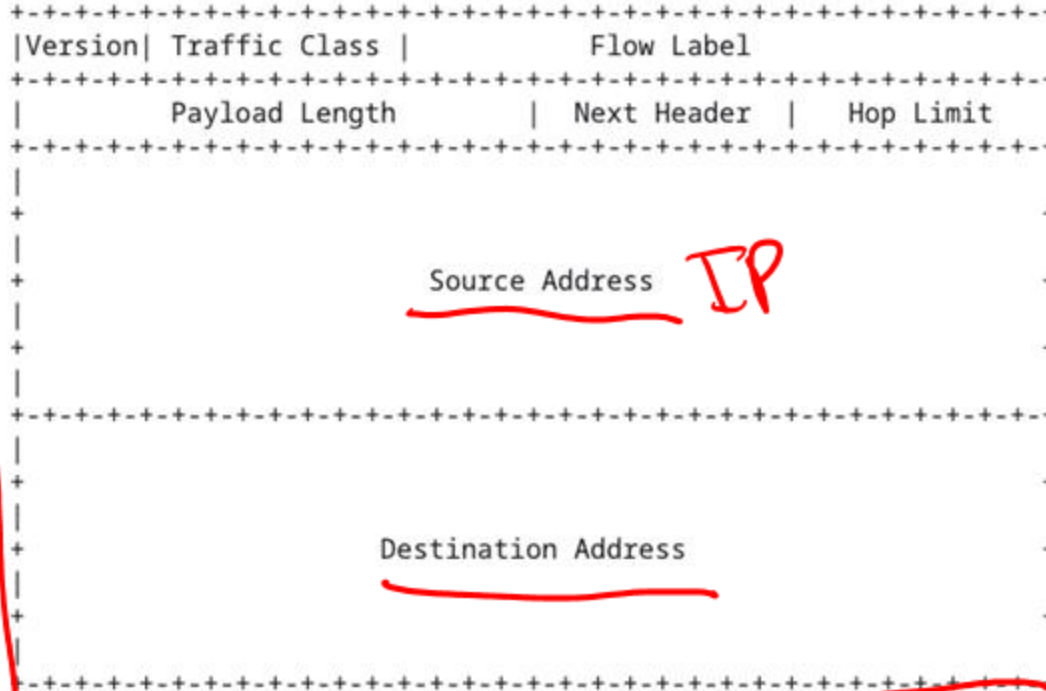
→ 1 1

→ 0 0

> 4 things

IPv6 Packet

3. IPv6 Header Format



40 bytes IP header
20 bytes TCP header
1.4 KB - payload

Why do you think there is a size limit to packets?

error recovery

fairness

physical constraints

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Layers of a packet

Layer	Protocols	Use
Application	<u>HTTP, SSH, SMTP, etc.</u>	programmer-visible messages
<u>Transport</u>	<u>TCP, UDP</u>	reach a specific program <i>port</i>
Internet <u>Outer</u>	IP, which has two versions: IPv4 and IPv6	reach a specific computer

UDP - User Datagram Protocol

Always with IP header

16-bit source, dest port #'s

not guaranteed to arrive or in any order
fast

Video calling
(small glitch > freeze or lag)

TCP - Transmission Control Protocol

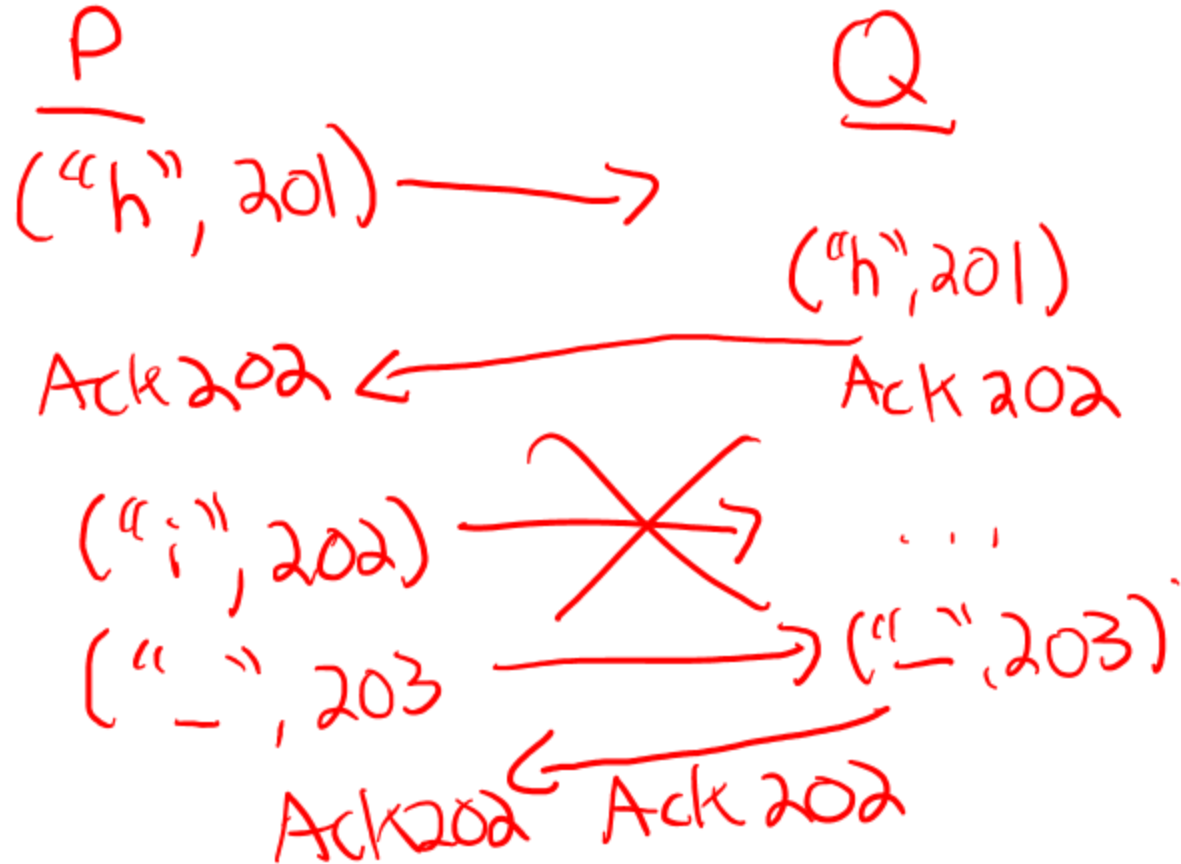
IP reliable and ordered

client → "hi I want to start at 201"

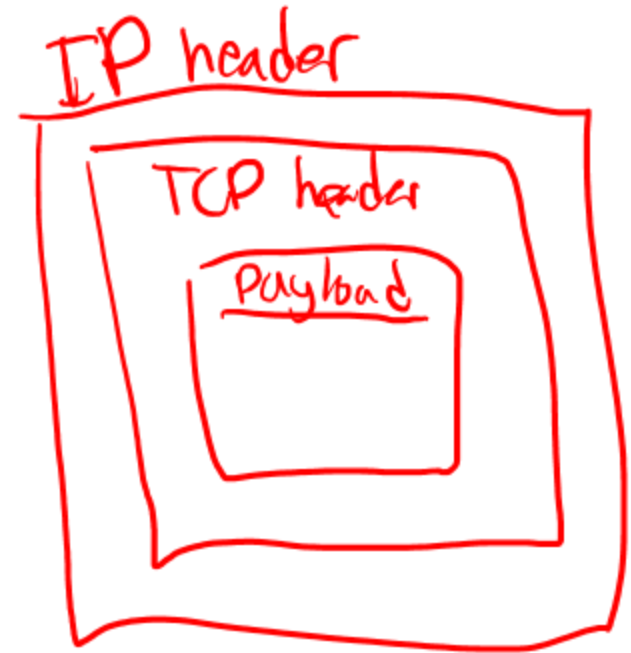
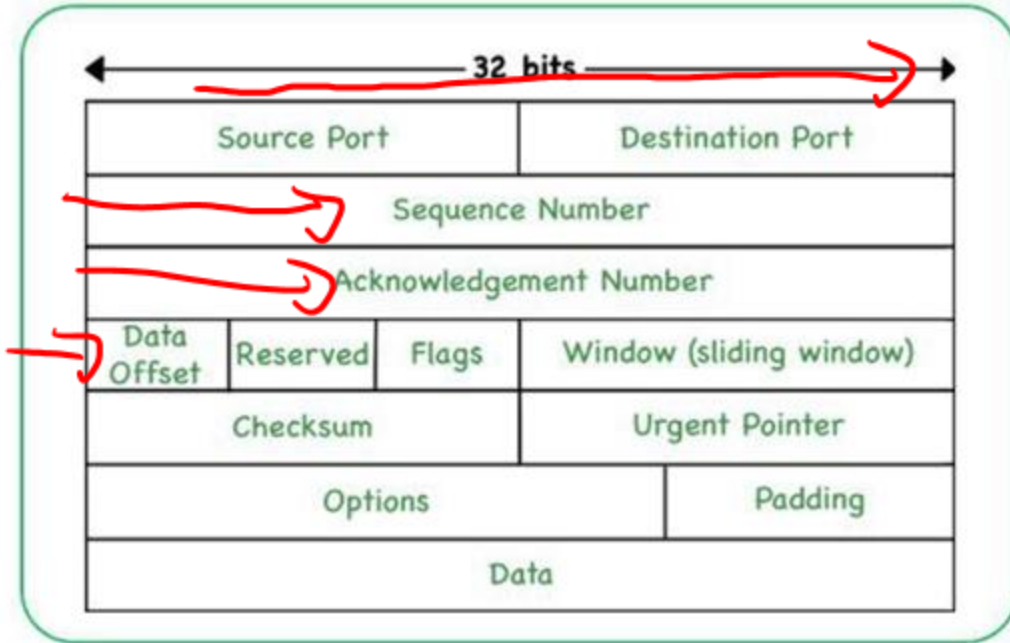
server → "I see you, I start at 4000"

client → "I see YOU"

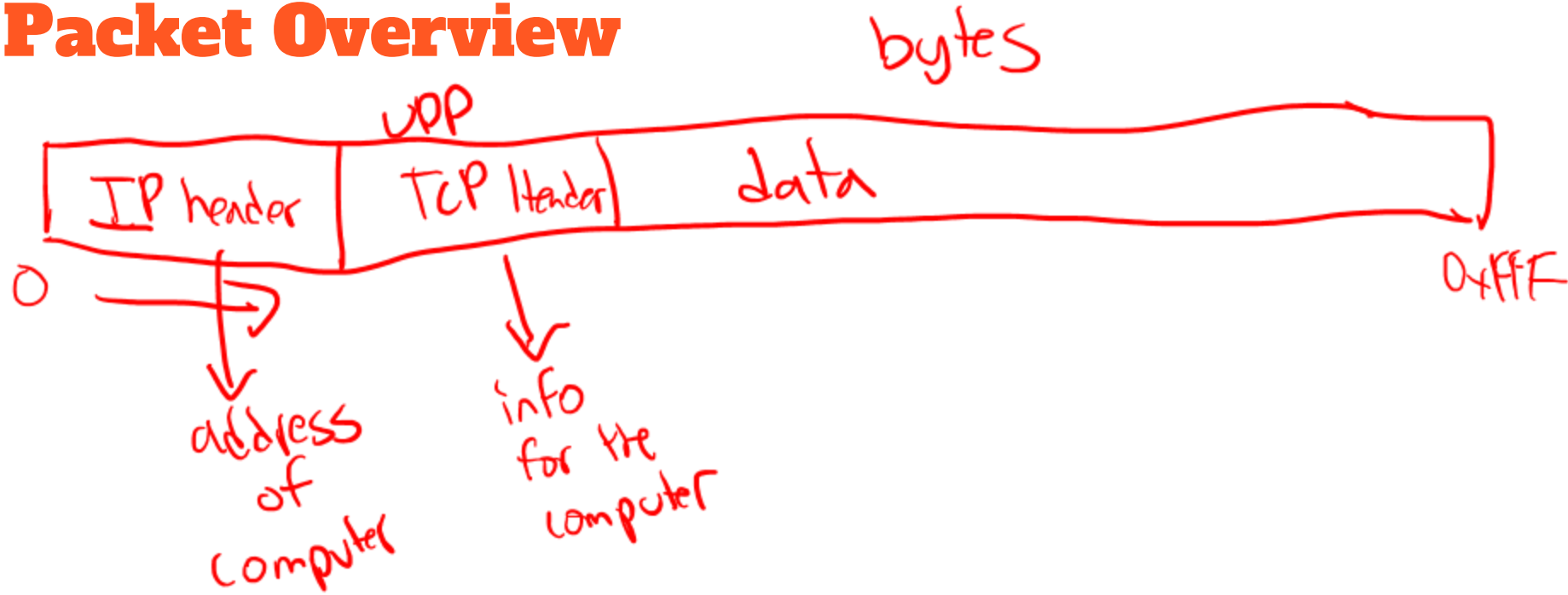
TCP Example



TCP Header Format



Packet Overview



**Which do you think is
faster for getting data from
a server to your computer?**

Need IP (UDP)

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True or False

- A) Packets are just bytes **T**
- B) I need to use the IP protocol to send data over the internet. **T**
- C) I need to use the TCP protocol to send data over the internet **F** *ports*
- D) My computer uses ~~IP addresses~~ to figure out where to send incoming data **F**
- E) My LAN/Modem has a ~~private~~ IP address **F**
~~only I know~~ *Public*
- F) The internet is a system of computers **T**

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