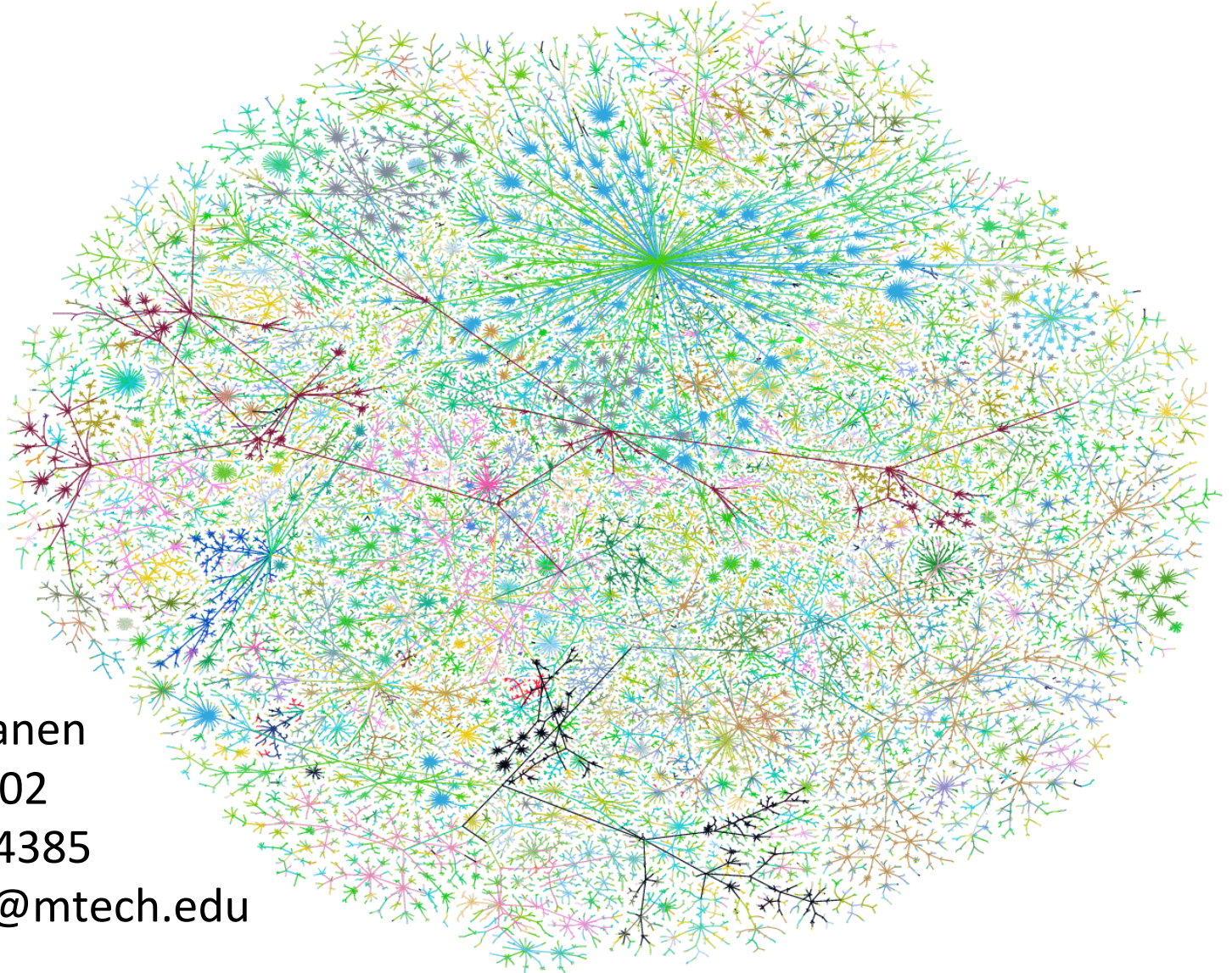


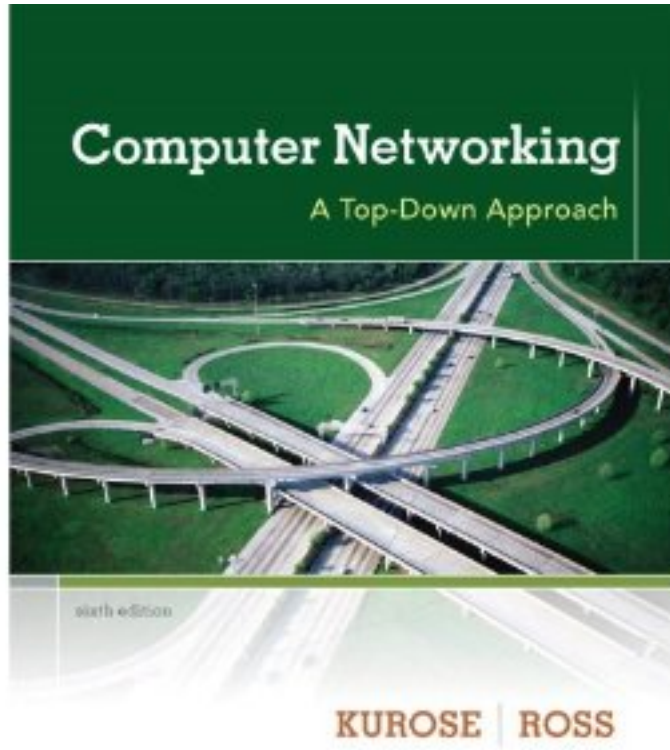
CSCI 466: Networks

Fall 2012



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The book



Chapter

1. Computer Networks and the Internet
2. Application Layer
3. Transport Layer
4. Network Layer
5. The Link Layer: Links, Access Networks, and LANs
6. Wireless and Mobile Networks
7. Multimedia Networking (maybe)
8. Security in Computer Networks (maybe)
9. Network Managements (probably not)

Course web site

<http://katie.mtech.edu/classes/csci466/>

Moodle for grades and submitting programs.

Expectations (what you should already know)

- Programming experience
 - Advanced data structures
 - OOP design in a high-level language
- Technical writing ability

Course outcomes (what you'll learn)

- Network **layers and protocols**
- Understand **common protocols**
 - IP, TCP, UDP, HTTP, SMTP, IMAP, RPC, DNS, DHCP
- **Physical and logical connectivity** of Internet
- **Presentation**
 - Show understanding of networking principles

Introductions

- Network experience
 - Built any networked software?
 - Built any physical networks?
- Programming experience
 - Languages?
 - Development environments?
- Your expectations for the class
 - Specific technologies of interest
 - What do you want to take away?

Twitter mining

```
C:\Windows\system32\cmd.exe

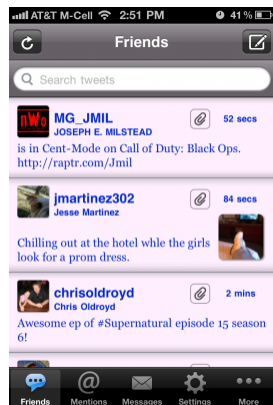
[-5.8614969,54.6106767] You know its @bangorworldwide when Mrs @al_Ralph makes
good buns!!! #wwmc11 @ Hamilton Road Presbyterian Church http://t.co/a7rOKrF

[-2.185708,53.491138] Moving into Preston this week! Man i need some bedding
and shit!
[-46.826,-24.008814] I'm at Etna (Av. Eng. Luis Carlos Berrini, 2001, S\u00
e3o Paulo) w/ 10 others http://t.co/u3J2spA
[-118.017597,33.788835] The one time I am brave enough to talk to a beautiful g
irl.. She has a boyfriend. :P
[-83.675415,36.540759] But ill pass prolly been n that # dirtyjoint
[-1.639698,54.982951] I met the Seahorses once in a hotel in Cardiff. Lovely
chaps. Stayed up drinking with them until 4am. John Squire stayed in his room th
ough.
[-1.780179,52.213692] @jonesmegann I think your closing with me tomoz :>
[-77.528884,39.00709] Sneaky bastard! :-> @sonnench Am I going to Rio? \"The
greatest trick the Devil ever did, was getting the world to believe he didn't ex
ist.\"
[-79.76259,40.477399] Interview with Daniel of LA Riots was EXCELLENT! Got to
hear some unreleased tracks and remixes. :D
[-75.280303,39.867004] @OhMySTARR Lol Love ya baby!
[-111.964499,33.383187] I'm at Arizona Mills Mall (5000 S Arizona Mills Circle,
at I-10 & Baseline Rd, Tempe) w/ 3 others http://t.co/Ggn1j95
[-73.244168,41.139896] Still Layin in bed Nd I didn't even paRty Last night. H
aha #Chillaxin
```

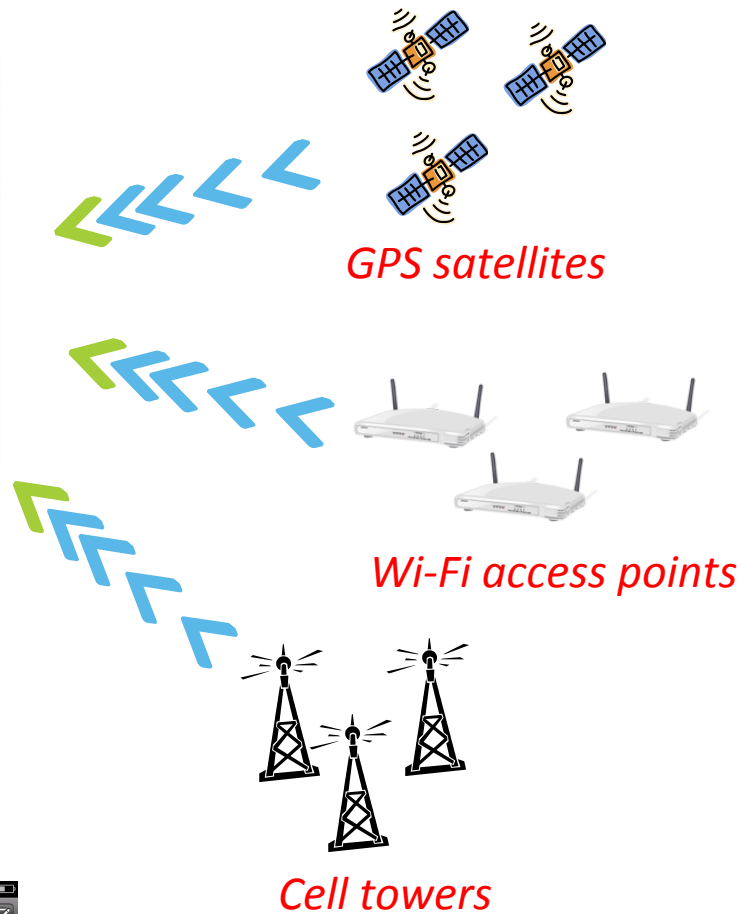


iPhone 4

Geographic location
[37.1316, 55.4908]

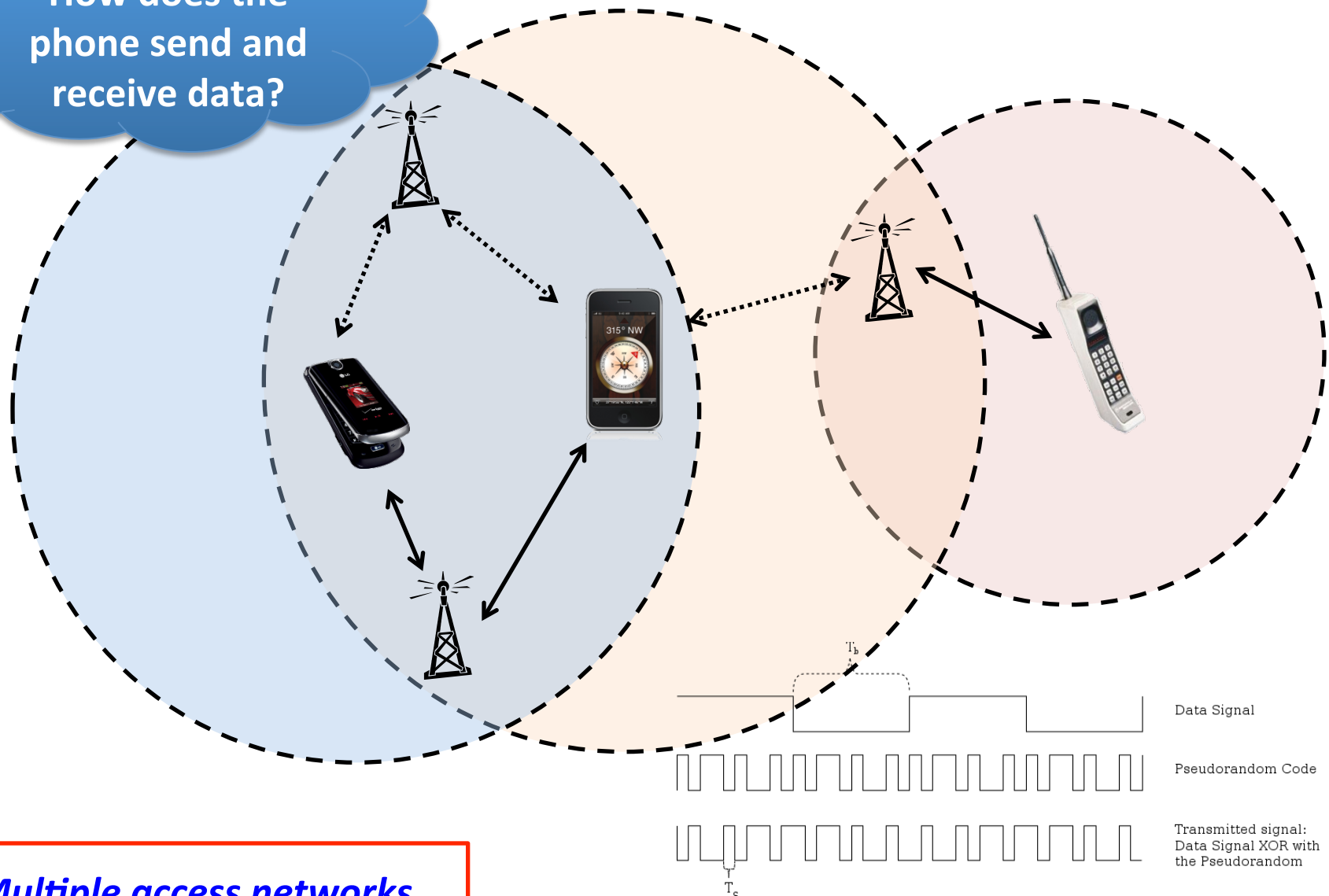


Twitter client



How does the
phone know
where it is?

How does the phone send and receive data?



Multiple access networks
3G
CDMA

Ch. 6: Wireless and Mobile Networks



I need an IP address

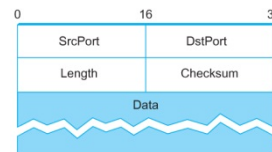


Verizon's server

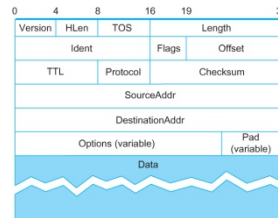
How does the network identify the phone?

Operation	HType	HLen	Hops
Xid			
Secs	Flags		
ciaddr			
yiaddr			
siaddr			
giaddr			
chaddr (16 bytes)			
sname (64 bytes)			
file (128 bytes)			
options			

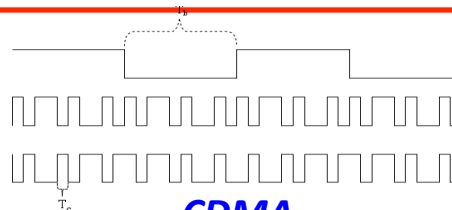
DHCP packet



UDP packet



IP packet



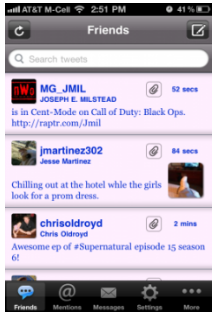
CDMA

Ch. 5: The Link Layer

Ch. 3: Transport Layer

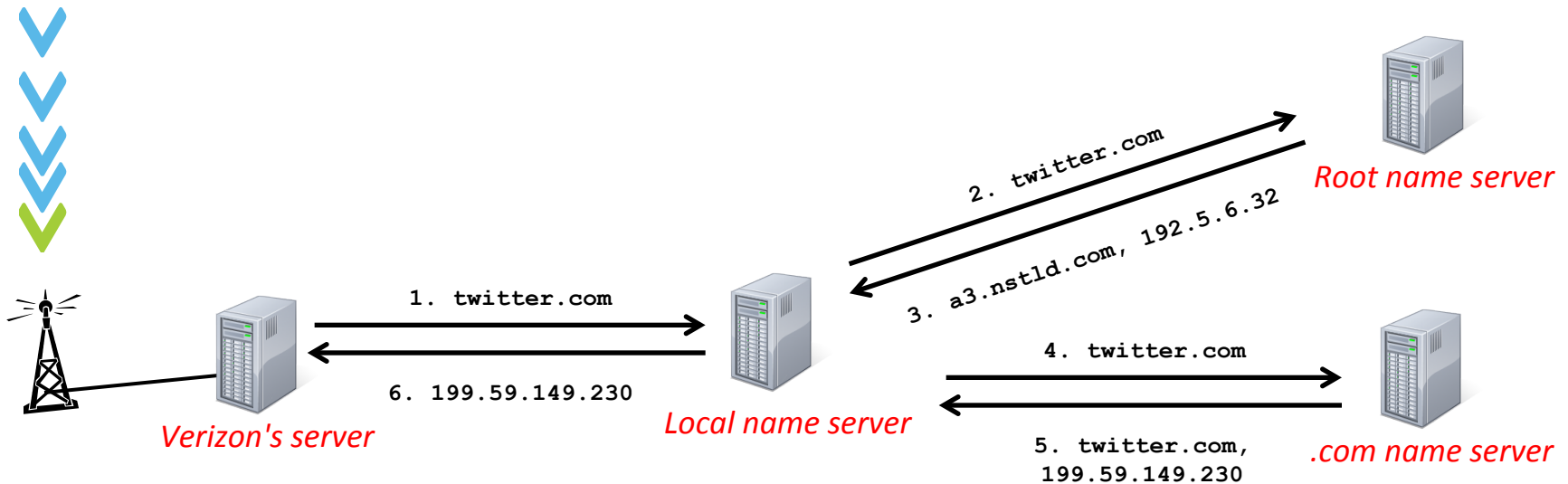
Ch. 4: The Network Layer

Ch. 6: Wireless and Mobile Networks



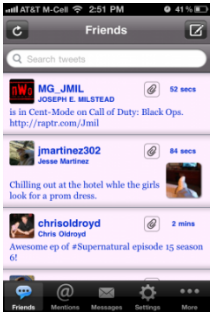
Twitter client

What is the IP address of twitter.com?



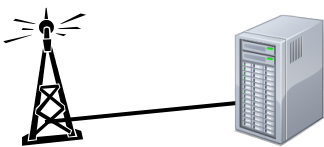
Domain name system (DNS)

Ch. 2: Application Layer



Twitter client

“I just bought some milk!”

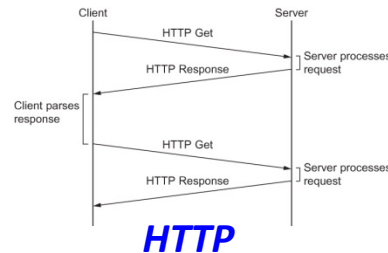


Verizon's server

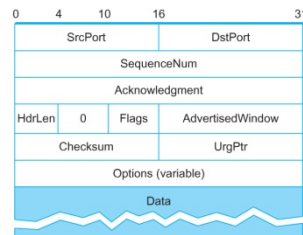
How does the phone package up a new tweet?

twitter

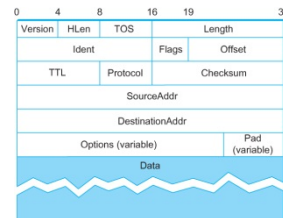
REST API



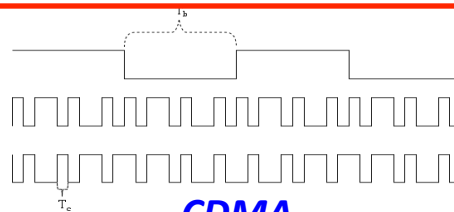
HTTP



TCP packet



IP packet



CDMA

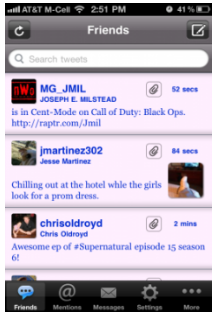
CSCI 470: Web Science

Ch. 2: Application Layer

Ch. 3: Transport Layer

Ch. 4: The Network Layer

Ch. 6: Wireless and Mobile Networks

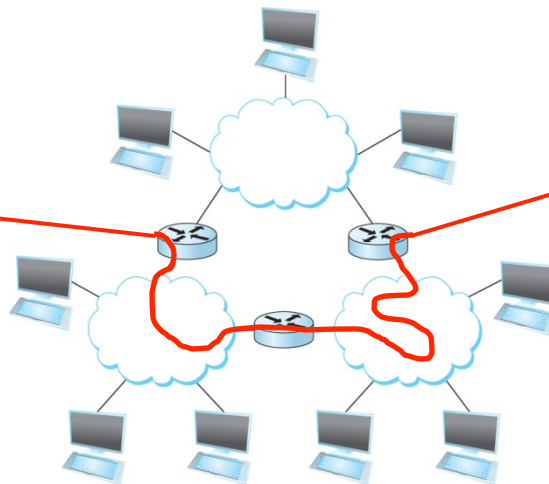


Twitter client

“I just bought some milk!”



Verizon's server



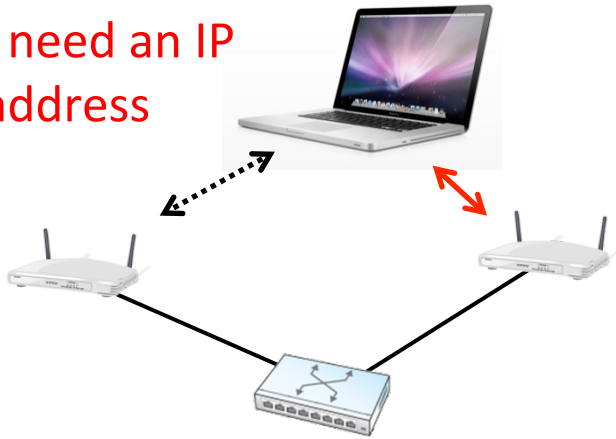
Twitter's server

How does the packet get transported along a path in the network?

Bit encoding
Error detection/correction
Flow control
Congestion control
Wired links - Ethernet
Optical links - SONET

Ch. 3: Transport Layer
Ch. 5: The Link Layer

I need an IP address



Operation	HType	HLen	Hops
Xid			
Secs	Flags		
ciaddr			
yiaddr			
siaddr			
giaddr			
chaddr (16 bytes)			
sname (64 bytes)			
file (128 bytes)			
options			

DHCP packet

0	16	32
SrcPort		DstPort
Length		Checksum
Data		

UDP packet

0	4	8	16	19	
Version	HLen	TOS	Length		
Ident		Flags		Offset	
TTL		Protocol		Checksum	
SourceAddr					
DestinationAddr					
Options (variable)					Pad (variable)
Data					

IP packet

16	16	48	48	48	16	48	0-18,496	32
Control	Duration	Addr1	Addr2	Addr3	SeqCtrl	Addr4	Payload	CRC

802.11 frame format

Now the other side:
What does the
network name my
laptop?

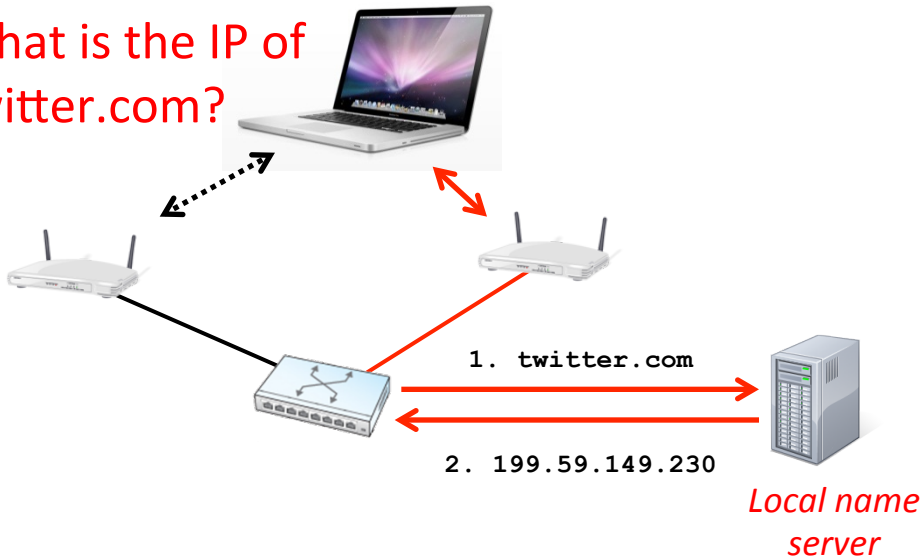
Internetworking
(Ch. 3)

End-to-End Protocols
(Ch. 5)

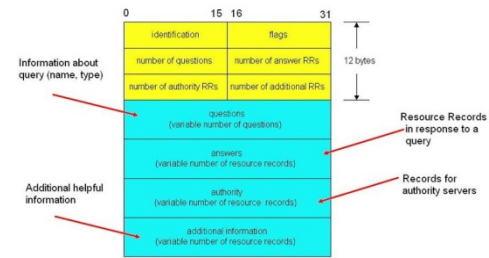
Internetworking
(Ch. 3)

Getting Connected
(Ch. 2)

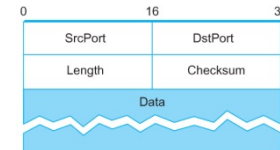
What is the IP of
twitter.com?



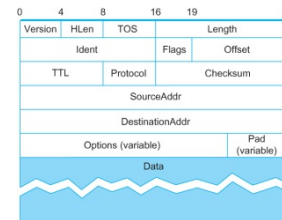
How does the
laptop find the
Twitter server?



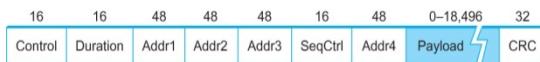
DNS message



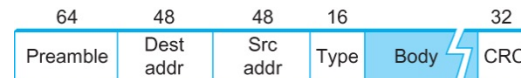
UDP packet



IP packet



802.11 frame format



802.3 Ethernet frame format

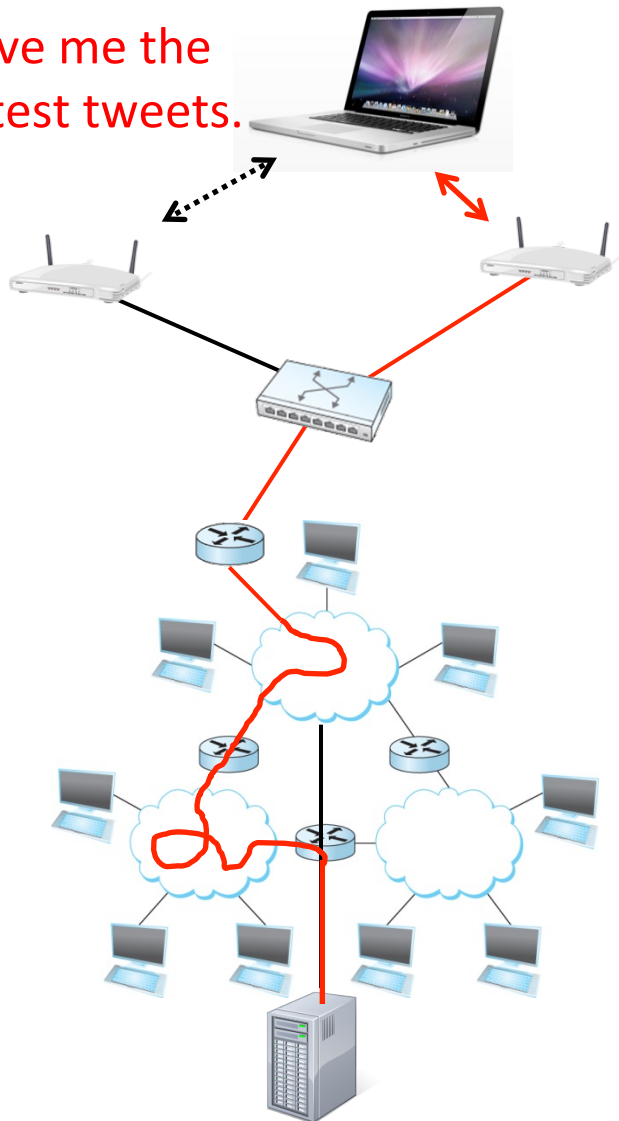
Ch. 2

Ch. 3

Ch. 4

Ch. 6

Give me the latest tweets.



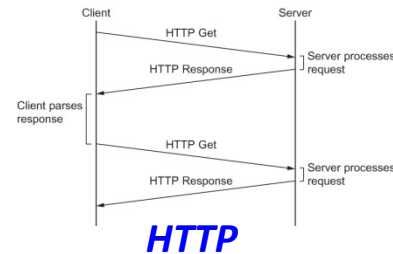
Twitter's server

How does the laptop request latest tweets?

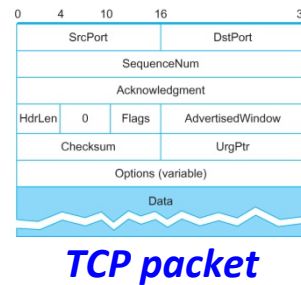
twitter
REST API

CSCI 470: Web Science

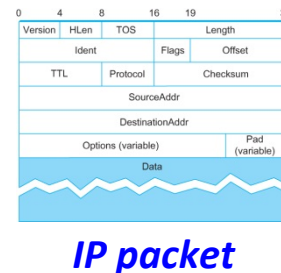
Ch. 2: Application Layer



Ch. 3: Transport Layer

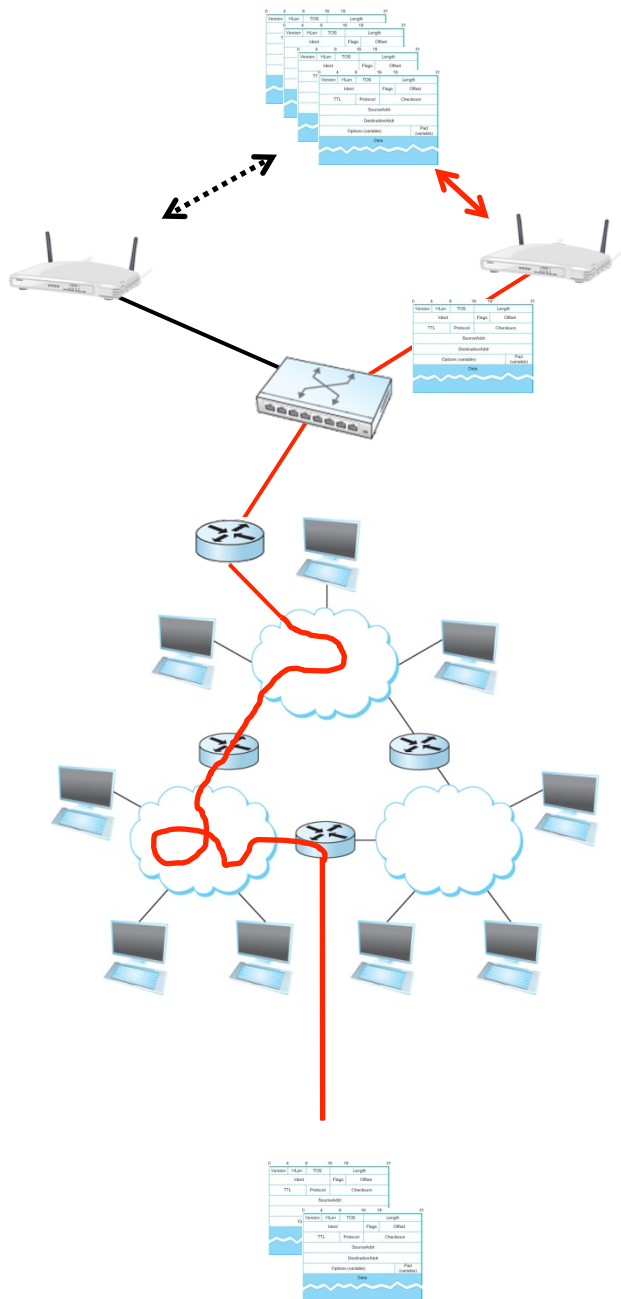


Ch. 4: The Network Layer



Ch. 6: Wireless and Mobile Networks





How do the packets find their way through the network?

- Ch. 4: The Network Layer

What if my packets contain secrets?

- Ch. 8: Security in Computer Networks