TCP/IP Networking

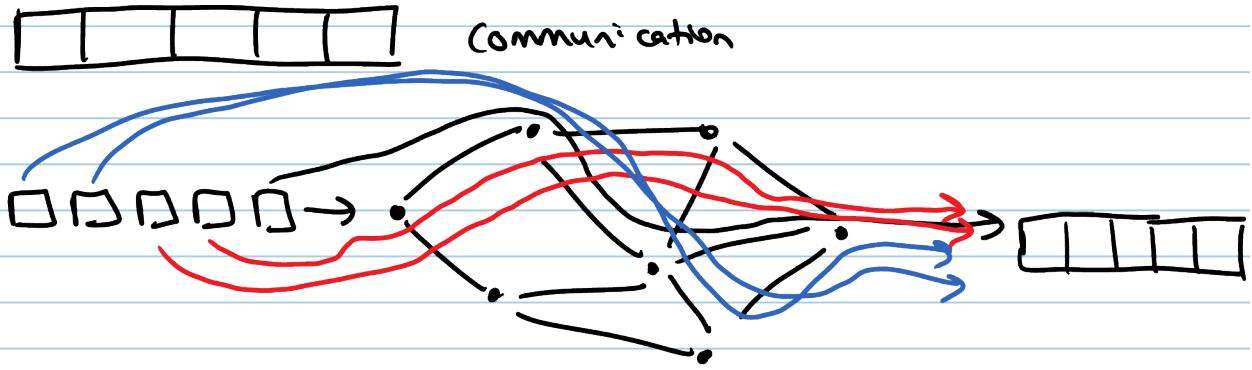
Tuesday, July 23, 2013
9:11 AM

History of the Internet

Discussed in 1950's
- survivable communication

Paul Baran - RAND Corp - 1960
- discussed distributed, fault tolerant design

ARPA - 1960s
- Defense research agency
- Larry Roberts was a director at ARPA
  - helped put together team that built ARPANET
  - Wesley Clark (packet switching)
  - Donald Davies - England (also packet switching)
- Design



ARPANET - late 1960s (deployed 1969)
- each node connected by 56kbps lines to 2 or more other nodes

Dec 1969	- 4 nodes	total
July 1970	- 8 nodes	total
Mar 1971	- 15 "	"
Apr 1972	- 25 "	"
Sep 1972	- 34 "	"

Software was not scaling, working on replacement
- Vint Cerf & Robert Kahn starting in 1972
- Cerf developed original software too
- prototype done by 1975, called TCP/IP
  - Code was part of BSD 4.2

NSFNET - 1970s to 1990
- took over ARPANET
- opened up to all universities & non-profits

no commercial orgs though

ANSNET - 1990 to 1995
took over NSFNET
allowed anyone on it

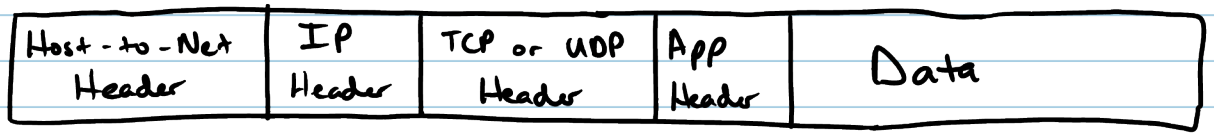
"Internet" mid 1990s
same concept as ANSNET but more efficient
rebuilt network as commercially controlled
original rebuilders: PacBell in CA (now AT&T)
Ameritech in Chicago (now AT&T)
MFS in DC (now Verizon)
Sprint in NS

TCP/IP in a Nutshell

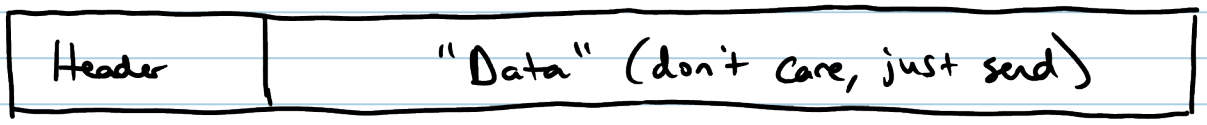
Data is organized into packets
Within packets are a series of headers for the different "layers" (tasks) for TCP/IP
- header has info needed to perform task

Layers
"Host-to-network" - physical connection between two machines
e.g. WiFi
Ethernet
ISP connection (e.g. DSL, cable, fiber, etc.)
"Network" - subnet of links that get data to destination
Internet Protocol (IP)
"Transport" - communication between programs
Transport Control Protocol (TCP)
User Datagram Protocol (UDP)
"Application" - headers specific to particular programs
e.g. DNS, WWW, email, etc.

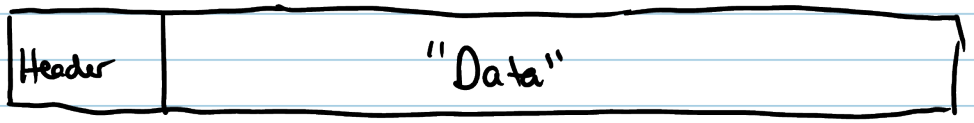
Packet Format



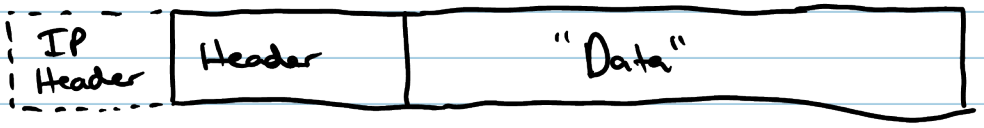
Host-to-Network layer sees:



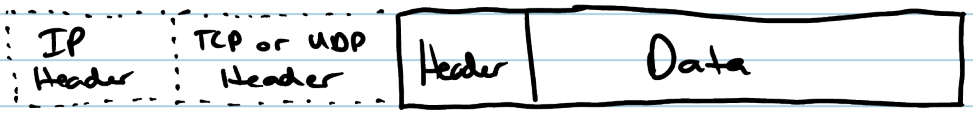
Network layer sees:



Transport layer sees:



Application layer sees:



Example Headers

Ethernet (wired host-to-network protocol)

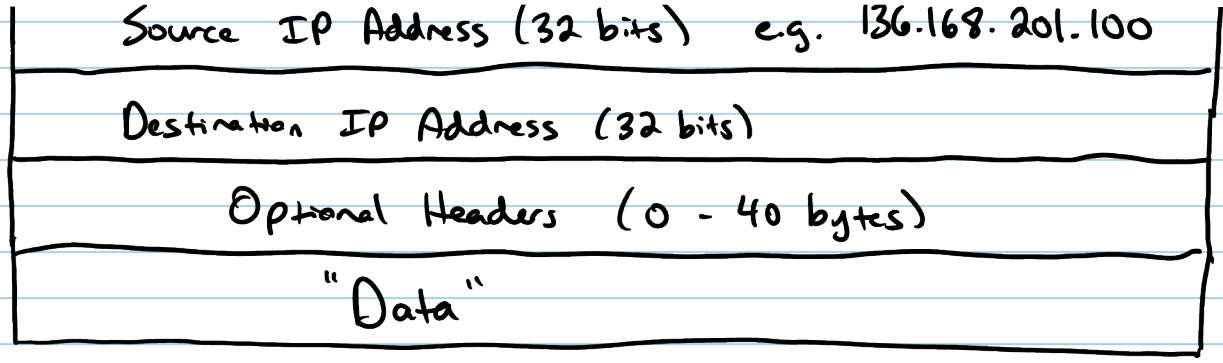
Synchronization	Dest MAC Address	Src MAC Address	Type	Data + Pad	Checksum
8 bytes	6 bytes	6 bytes	2 bytes	46-1500 bytes	4 bytes

Wi-Fi:

Control	Duration	MAC Addr 1	MAC Addr 2	MAC Addr 3	Sequence Number	MAC Addr 4	Data	Checksum
2 bytes	2 bytes	6 bytes	6 bytes	6 bytes	2 bytes	6 bytes	0-2312 bytes	4 bytes

IP Header - organized into rows of 4 bytes (32 bits)

Version (4 bits)	IHL (4 bits)	TOS (6 bits)	Unused (2 bits)	Total Length (16 bits)	
Fragment Identification (16 bits)			1	DF 1	MF 1	Fragment Offset (13 bits)
Time to Live (TTL) (8 bits)	Protocol (8 bits)		Header Checksum (16 bits)		
Source IP Address (32 bits) e.g. 136.168.201.100					



TCP Header - same organization as IP header