

Network

E155

Project Status

- 11/6: Project Proposal Due
- **11/11: TODAY**
- 11/25: Project Status Report Due
- 11/25-12/4: Project Presentations
- 12/9-10: Project Checkoffs
- 12/11: Public Demonstration
- 12/10: Final Report Due

Sources

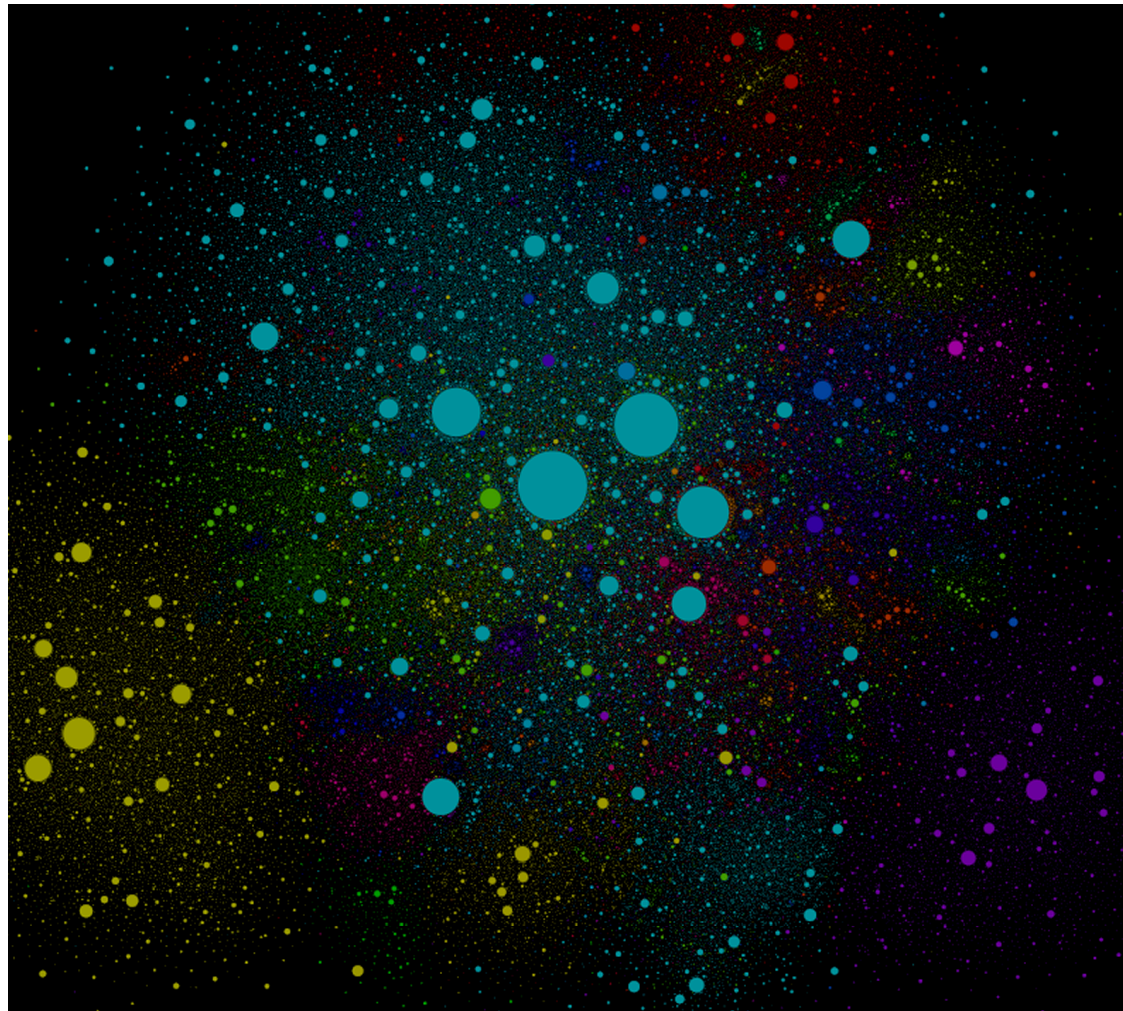
- Harris and Harris 2nd Edition Chapter 8
- <http://standards.ieee.org/about/get/802/802.3.html>
- <http://standards.ieee.org/about/get/802/802.11.html>
- http://en.wikipedia.org/wiki/OSI_model

Internet

- Transmission Control Protocol and Internet Protocol (TCP/IP)
- Physically Ethernet cable or wireless wi-fi

How Big is the Internet?

- <http://internet-map.net/>



Internet Users

WORLD INTERNET USAGE AND POPULATION STATISTICS						
June 30, 2012						
World Regions	Population (2012 Est.)	Internet Users Dec. 31, 2000	Internet Users Latest Data	Penetration (% Population)	Growth 2000-2012	Users % of Table
<u>Africa</u>	1,073,380,925	4,514,400	167,335,676	15.6 %	3,606.7 %	7.0 %
<u>Asia</u>	3,922,066,987	114,304,000	1,076,681,059	27.5 %	841.9 %	44.8 %
<u>Europe</u>	820,918,446	105,096,093	518,512,109	63.2 %	393.4 %	21.5 %
<u>Middle East</u>	223,608,203	3,284,800	90,000,455	40.2 %	2,639.9 %	3.7 %
<u>North America</u>	348,280,154	108,096,800	273,785,413	78.6 %	153.3 %	11.4 %
<u>Latin America / Caribbean</u>	593,688,638	18,068,919	254,915,745	42.9 %	1,310.8 %	10.6 %
<u>Oceania / Australia</u>	35,903,569	7,620,480	24,287,919	67.6 %	218.7 %	1.0 %
<u>WORLD TOTAL</u>	7,017,846,922	360,985,492	2,405,518,376	34.3 %	566.4 %	100.0 %

NOTES: (1) Internet Usage and World Population Statistics are for June 30, 2012. (2) CLICK on each world region name for detailed regional usage information. (3) Demographic (Population) numbers are based on data from the [US Census Bureau](#) and local census agencies. (4) Internet usage information comes from data published by [Nielsen Online](#), by the [International Telecommunications Union](#), by [GfK](#), local ICT Regulators and other reliable sources. (5) For definitions, disclaimers, navigation help and methodology, please refer to the [Site Surfing Guide](#). (6) Information in this site may be cited, giving the due credit to www.internetworldstats.com. Copyright © 2001 - 2012, Miniwatts Marketing Group. All rights reserved worldwide.

<http://www.internetworldstats.com/stats.htm>

Ethernet

- IEEE 802.3 standard
- Xerox Palo Alto Research Center (PARC) 1974
- 10 Mb/s originally
- Now also 100 Mb/s and 1 Gb/s
- Category 5 cables
- 10 Gbit on fiber optic cables

Wi-Fi

- IEEE 802.11 standard
- 2.4 and 5 GHz bands
 - Unlicensed
 - Can transmit at low power

Wi-Fi Speeds

Protocol	Release	Frequency Band (GHz)	Data Rate (Mb/s)	Range (m)
802.11	1997	2.4	1-2	20-100
802.11a	1999	5	6-54	35-120
802.11b	1999	2.4	5.5-11	35-140
802.11g	2003	2.4	6-54	38-140
802.11n	2009	2.4/5	7.2-150	70-250
802.11ac	2011 (draft)	5	87.6-866.7	??

On Standards

- Designed by committee
- Very specific
- Many contributors
 - 802.3: 6 pages of names
 - 802.11: 4 pages of names

A look at the Standards

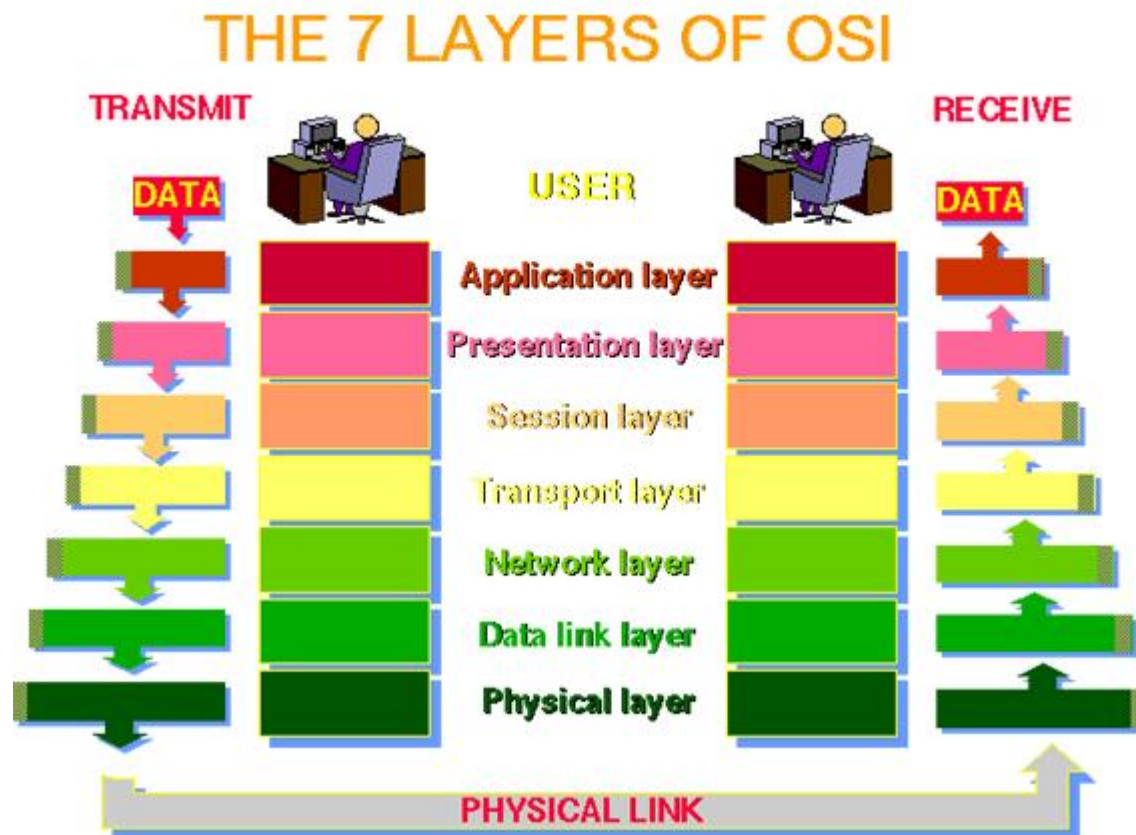
- 802.3:
 - 53 pages of ToC
 - Section 1-5 are 596, 789, 315, 584 and 613 pages
- 802.11: 55 pages of ToC
 - 55 pages of ToC
 - 2695 pages of content

OSI Standard

- ISO/IEC 7498-1
- Open Systems Interconnection
- Abstraction layers

OSI model

- Specifies 7 layers of network communication



http://www.petri.co.il/osi_concepts.htm

1. Physical Layer

- Operates on bits
- IEEE 802.3
- IEEE 802.11
- USB
- Bluetooth
- DSL
- RS-232, RS-449, IEEE 802.16, IEEE 1394, etc.

2. Data Link Layer

- Means to transfer data between entities
- IEEE 802.3
- IEEE 802.2
- PPP
- LLC
- Many more...

3. Network Layer

- IP
 - IPv4 (127.0.0.1)
 - IPv6 (0:0:0:0:0:0:0:1) (::1 for short)
- AppleTalk
- IPsec
- Many more...

4. Transport Layer

- TCP
- UDP
- SCTP
- Others...

5. Session Layer

- TLS/SSL
- SOCKS
- RTP
- PPTP
- Others...

6. Presentation Layer

- MIME
- XDR

7. Application Layer

- HTTP
- DNS
- SMTP
- Telnet
- DHCP
- Others...

TCP Segment Header

Offsets	Octet	0							1							2							3										
Octet	Bit	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
0	0	Source port														Destination port																	
4	32	Sequence number																															
8	64	Acknowledgment number (if ACK set)																															
12	96	Data offset	Reserved	N	C	E	U	A	P	R	S	F	Window Size																				
			0	0	0	S	W	C	R	C	S	S	Y	I																			
							R	E	G	K	H	T	N	N																			
16	128	Checksum														Urgent pointer (if URG set)																	
20	160	Options (if Data Offset > 5, padded at the end with "0" bytes if necessary)																															
...																															

http://en.wikipedia.org/wiki/Transmission_Control_Protocol

Recommendation

- Use something you know
- SPI-to-Ethernet Module <\$20
- MRF24WG0MA/MB
 - 802.11b/g
 - Product from Microchip
 - Datasheet

Peripheral Speeds

Protocol	Throughput
SPI	Variable
USB	1.5 Mb/s to 5 Gb/s
PCI	133 MB/s to 533 MB/s
PCIe	250 MB/s to 16 GB/s
Ethernet	10 Mb/s to 10 Gb/s
Wi-Fi	1 Mb/s to 866.7 Mb/s