INFO 310

Fall 2016

Week 5 – Lecture 2

HOUSEKEEPING

- Attendance
- Announcements

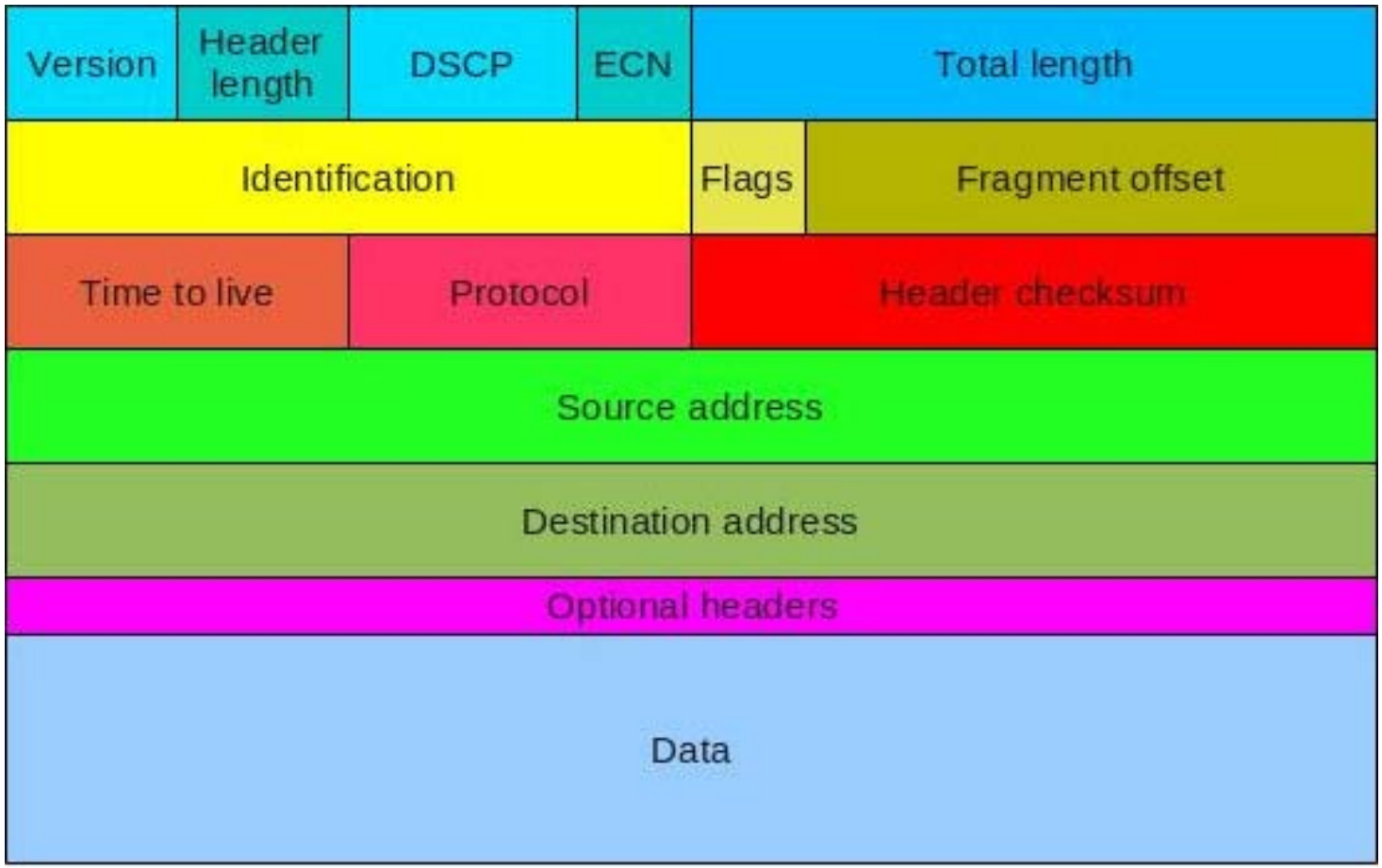
IPv4 Networking - Quick Review

- MAC addresses – 48bit HEX
- IPv4 addresses – 32bit, “dotted-quad”
- RFC 1918
- Sub-netting & Subnet Masks
- ARP
- TCP vs. UDP
  - 3-way handshake vs. connectionless
- ICMP & DHCP
- NAT

Network Packets

- A **network packet** is a formatted unit of data carried by a packet-switched network. When data is formatted into packets, the bandwidth of the communication medium can be better shared among users.
- A packet consists of control information and user data, which is also known as the payload. Control information provides data for delivering the payload, for example: source and destination network addresses, error detection codes, and sequencing information. Typically, control information is found in packet headers and trailers.

Typical IPv4 Packet (header + data)



IPv4 packets continued

- TCP & UDP packet headers are “special”
  - Contain source & destination port numbers
  - They are not the same as IP packet headers, but rather a subset thereof
- MTU – Maximum Transmission Unit
  - Typically 1500 bytes
- Jumbo Frames
  - Up to 9000 bytes

IP Ports

Internet socket ports (IP Ports) are used by protocols of the transport layer of the Internet Protocol Suite for the establishment of host-to-host connectivity.

- 16 bit space (65535 possible - 2^{16} minus 1 because 0 “counts”)
- Source Ports vs. Destination Ports
- Both TCP and UDP use them, they are not the same

IP Ports, continued…

- Official (IANA controlled) & Unofficial
- “Well know ports”: 0 to 1023
  - UNIX/LINUX requires SU/root to use
- “Registered Ports”: 1024 to 49151
- Ephemeral (also called private / dynamic)
  - IANA 49152 to 65535
    - (Linux 32768 to 61000)

The OSI Model – Created by ISO

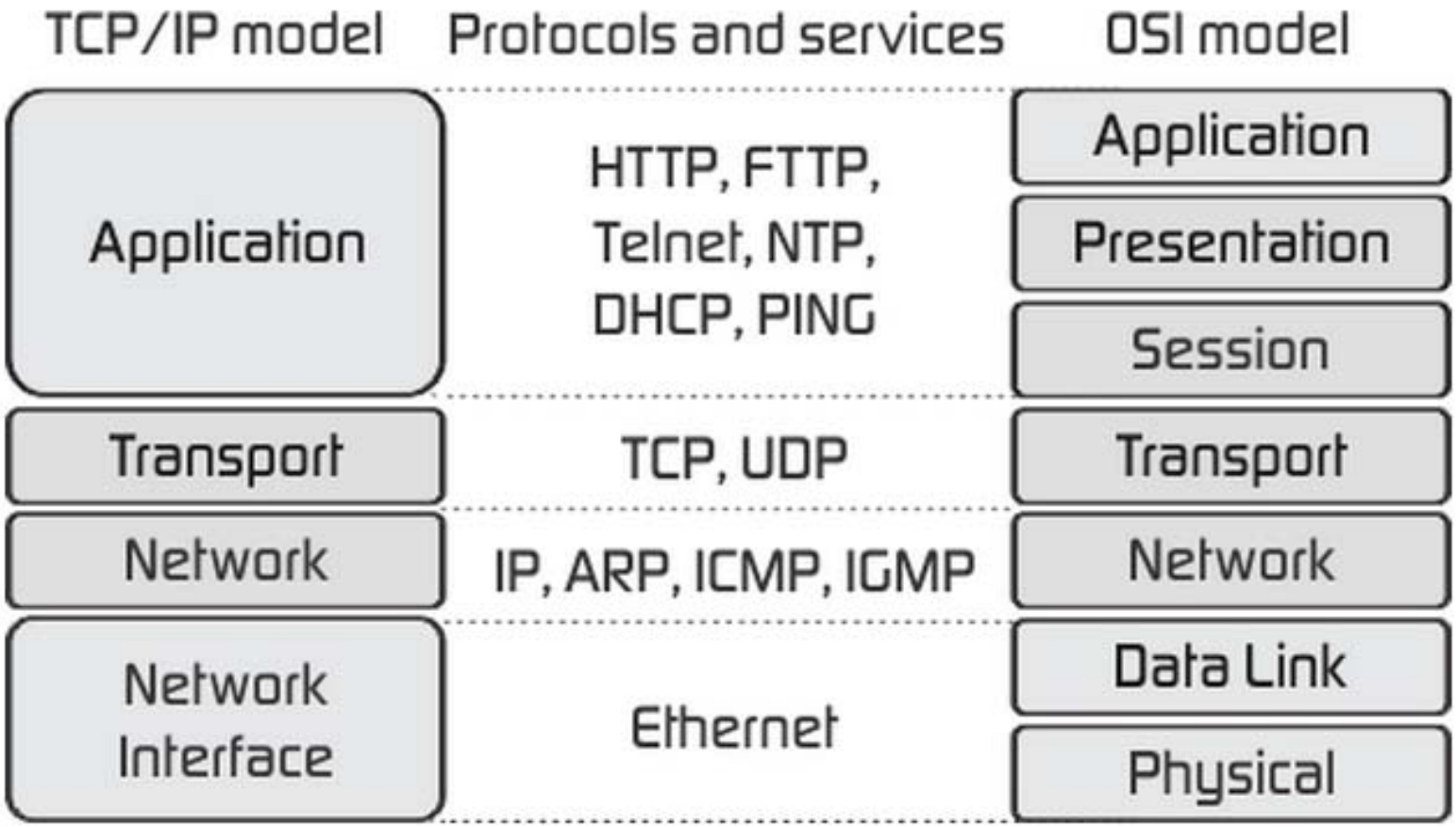
- The **Open Systems Interconnection model** (**OSI model**) is a conceptual model that characterizes and standardizes the communication functions of a telecommunication or computing system without regard to their underlying internal structure and technology.
- Its goal is the interoperability of diverse communication systems with standard protocols. The model partitions a communication system into abstraction layers. The original version of the model defined seven layers.
- A layer serves the layer above it and is served by the layer below it.

WIKIPEDIA
The Free Encyclopedia

OSI (Open Source Interconnection) 7 Layer Model

Layer	Application/Example		Central Device/ Protocols		
Application (7) Serves as the window for users and application processes to access the network services.	**End User layer** Program that opens what was sent or creates what is to be sent Resource sharing • Remote file access • Remote printer access • Directory services • Network management		**User Applications** SMTP		GATEWAY Can be used on all layers
Presentation (6) Formats the data to be presented to the Application layer. It can be viewed as the "Translator" for the network.	**Syntax layer** encrypt & decrypt (if needed) Character code translation • Data conversion • Data compression • Data encryption • **Character Set Translation**		JPEG/ASCII EBDIC/TIFF/GIF PICT		
Session (5) Allows session establishment between processes running on different stations.	**Synch & send to ports** (logical ports) Session establishment, maintenance and termination • Session support - perform security, name recognition, logging, etc.		**Logical Ports** RPC/SQL/NFS NetBIOS names		
Transport (4) Ensures that messages are delivered error-free, in sequence, and with no losses or duplications.	**TCP** Host to Host, Flow Control Message segmentation • Message acknowledgement • Message traffic control • Session multiplexing	PACKET FILTERING	TCP/SPX/UDP		
Network (3) Controls the operations of the subnet, deciding which physical path the data takes.	**Packets** ("letter", contains IP address) Routing • Subnet traffic control • Frame fragmentation • Logical-physical address mapping • Subnet usage accounting		**Routers** IP/IPX/ICMP		
Data Link (2) Provides error-free transfer of data frames from one node to another over the Physical layer.	**Frames** ("envelopes", contains MAC address) [NIC card — Switch — NIC card] (end to end) Establishes & terminates the logical link between nodes • Frame traffic control • Frame sequencing • Frame acknowledgment • Frame delimiting • Frame error checking • Media access control		**Switch Bridge WAP** PPP/SLIP	Land Based Layers	
Physical (1) Concerned with the transmission and reception of the unstructured raw bit stream over the physical medium.	**Physical structure** Cables, hubs, etc. Data Encoding • Physical medium attachment • Transmission technique - Baseband or Broadband • Physical medium transmission Bits & Volts		**Hub**		

Internet Protocol Suite vs. OSI Model



IP Protocol Suite Number Examples

- IP Protocols are numbered
  - ICMP = 1
  - TCP = 6
  - UDP = 17
- Don’t confuse with port numbers!

Common Application Layer Protocols

- HTTP
- HTTPS
- POP3 / POP3S
- IMAP / IMAPS
- SMTP / SMTPS
- SSH / SCP
- TELNET
- FTP / SFTP / FTPS

Also:

- NetBIOS
- AppleTalk
- IPS/SPX
- …

Common Port Numbers

Service Name	TCP (&UDP) Port(s)
FTP	21,20
SSH	22
TELNET	23
SMTP	25,465,587
DNS	53
HTTP	80
POP3	110
NTP	123
NetBIOS	135,137,138,139
IMAP	143
HTTPS	443
MS AD/SMB	445
IMAPS	993,585
POP3S	995
RDP	3389

Different types of Networks

- LAN – Local Area Network
  - Ethernet
  - 802.11 Wireless
- WAN – Wide Area Network
  - MLPS (Multiprotocol Label Switching)
  - Serial Circuits (T1, T3, OC-48,…)
  - Cellular / LTE
- MAN – Metropolitan Area Network
  - Interconnects geographical areas too large for LAN, but too small for WAN

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