**Layers of OSI**

* Physical Layer (1)
  + Concerned with transmitting raw bits over a communication channel
* Data Link Layer (2)
  + Main task is to transform a raw transmission facility into a line that appears free of undetected transmission errors
* Network Layer (3)
  + Routing layer
* Transport Layer(4)
  + Accepts data from above it, splits it up into smaller units if need be, passes off
* Session Layer(5)
  + Allows users to establish sessions and have dialogue between counters
* Presentation Layer(6)
  + IS concerned with the syntax and semantics of the information transmitted
* Application Layer(7)
  + Top of the stack layer
  + Provides services to applications

**TCP/IP Protocol**

* Transmission Control Protocol/ Internet Protocol
* Too complex to be in a single layer of OSI
* A series of Tools that works on different layers and is used by many other application layer protocols
  + HTTP and DNS for example, rely on TCP/IP to work properly
  + Most current networking uses TCP/IP
* Specifies how data should be packetized, addresses, transmitted, routed and received
* Organized into abstraction layers as OSI
* The application on each Host executes read and write operations as if the processes were directly connected to each other by some sort of data pipe
* Has layers
  + Link Layer
    - Provides connectivity functions
  + Internet Layer
    - Communication methods between multiple links of a computer
    - Facilitates interconnection of networks
  + Transport Layer
    - General framework to transmit data
  + Application Layer
* Internet Protocol v4
  + Most Common internet layer protocol
    - Main task: routing information
  + Routable protocol
  + Uses 32-bit addresses yields 2^32 addresses
  + Limitation of addresses motivated the development of IPv6
* In Feb 2011 the global Internet Assigned Numbers Authority allocated the last blocks of IPv4 address space to the five regional internet registries.
  + Experts warned that within months all available IPv4 addresses would be distributed to ISPs
* This day was pushed back as the major internet players have developed ingenious ways to stretch those available numbers.
* Addresses have two portions
  + Network ID
    - A certain number of bits, starting from the leftmost bit, used to identify the network the host is on
  + Host ID
    - The remaining bits on the right, used to identify the host on the network
  + Networks are organized in classes
    - A,B,C are the most common
    - D is for multi-cast and E is for future applications
* Problems with Classful Addressing
  + Lack of internal Address Flexibility
  + Inefficient Use of Address Space
  + Proliferation of Router Table entries
* Subnetting
  + Introduced in RFC 950
  + Instead of just having hosts, the network has subnets and hosts
  + Allows an organization to have internal networks within the internet
  + Now we need to know which bits in the address are used for the subnet ID and host ID
    - Solution: a subnet mask, a 32-bit number
  + The network ID is found by doing a binary conversion AND between the subnet mask and IP address.
  + Subnet masks can be represented with
    - Binary
      * 11111111.00000000.00000000.00000000
    - Dotted Decimal
      * 255.0.0.0
    - Slash notation
      * CIDR notation (classless Inter-Domain Routing)
* Example Question
  + How many Subnets and hosts per subnets can you get from the network 192.168.92.0/28
    - Determine Class
    - Convert subnet mask to binary
    - Draw the great divide and subdivide
    - Count by the powers of 2
* Routing
  + Router is a device with 2 separate IP addresses: one for LAN one for WAN
  + LAN address is your “gateway:
  + When a host is not found, the gateway is asked
  + Router Checks its routing table to know which IP to ask (Probably the WAN port)
  + NAT (Network Address Translation) allows to modify IP headers to provide the WAN address
  + Can also use port forwarding / static NAT
* IPv6
  + Becoming increasing popular due to the large number of hosts on the internet
  + Uses 128-bit addresses
  + About 3.4x!0^38 addresses
    - That’s enough for many trillions to be assigned to every person on the planet
  + No need for NAT
  + Subnet mask fixed to 64 bit
  + Stateless Address Auto configuration (SLAAC)
  + Address types
    - * Standard unicast addresses as in IPv4
    - Multicast
      * A message sent to a multicast address goes to all devices in a group
  + Addresses written as 8 groups of 4 hex digits, separated by colons
    - 2011:0BCD:0000:0000:0000:A3BD:0192:BA89
  + TO simplify, leading 0s in each word can be omitted and strings of 0s can be replaced by 2 colons
  + Ex
    - 2011:BCD::A3BD:192:BA89
* ST
  + Late 1970s a protocol named ST (Stream protocol)
  + Two decades later this protocol was revised to be ST2 and was implemented in commercial projects
* TCP
  + Core protocol
  + Provides reliable, ordered and error checked delivery of a stream of octets between programs on computers connected by a LAN.
  + It resides at the transport layer.
  + Accepts data from a data stream, segments it into chunks, and adds a TCP header, creating a TCP segment.
  + TCP segment is encapsulated into an IP datagram.
* Sockets
  + A socket is a combination of an IP address and a port number
  + Ports are like doors on your computer, they can be opened or closed.