# Chapter 1 - Internetworking

### Concepts

* Broadcast domain -- set of all devices able to receive a broadcast
* Collision domain -- set of all devices where a collision can occur due to multiple send/receive transactions
* Internetwork -- network composed of other, smaller networks
* Models:
  + OSI (Open Systems Interconnection) Model
  + DOD (TCP/IP) model
  + Both of above hierarchical/layered models

### Device Types

* Hub -- repeated, rebroadcasts all packets. All devices connected to it are in the same broadcast and collision domain.
* Switch -- “intelligently” switches packets to only devices supposed to be receiving the packet. One broadcast domain for entire device, one collision domain *per interface*.
* Router -- Switches packets between logically distinct subnets. 1 broadcast domain and collision domain per interface. Also selects paths for routing packets and filters packets.

## OSI Reference Model

* OSI Seven Layer Dip -- 7 layers, 9 if you’re sarcastic
* Most devices only operate on a certain subset of the model

### Layer 7 -- Application

* Layer closest to the user -- provides applications methods for traversing the full stack.
* Confirms partner availability and required resources for communication

### Layer 6 -- Presentation

* Translates data -- encodes to a generic format for sending
* Includes protocols for standardized data transmission (compression, decompression, encryption, decryption, &c)

### Layer 5 -- Session

* Sets up, manages, dismantles sessions (sound familiar?)
* Manages keeping user data separate between sessions
* Sets duplexing for higher layers

### Layer 4 -- Transport

* *Segments* and reassembles datastreams
* Handles end-to-end data transit, establishes *logical* connections
* Protocols on this layer: TCP and UDP

#### Connection-Oriented Communications

* Three-way handshake to establish
  + → SYN -- request for synchronization
  + ← ACK -- acknowledgment and establishment of session parameters
  + → SYN/ACK -- the terms are accepted and connection established
* Sets flow control for data streams to ensure transmission over potentially congested networks
  + Delivered segments are acknowledged by recipient and undelivered segments are resent
  + Segments resequenced on arrival using sequence numbers
  + Endpoint can send not ready/stop and ready/go signals to manage traffic flow
* Connection oriented services *must*:
  + Establish a virtual circuit over intervening topology
  + Use sequencing, acknowledgement, and flow control
* Windowing
  + Session parameters establish how much sent data between acknowledgements
  + TCP/IP uses # of bytes sent
* Acknowledgement
  + Receiver informs sender of lost data by transmitting next piece it expects
    - E.g.: “I got 1-5, send 6 now”
    - Or: “I got 1-4 and 6, send 5”
* Session multiplexing
  + Layer keeps different sessions separate so you don’t get your Redtube in your VoIP

### Layer 3 -- Network

* Manages *logical* addressing
* Determines best route to move data in and out of a network
* Routers live mostly on this layer
* Unit of data is the *packet*
  + Data packets
  + Route update packets
* Routing tables store, on a basic level:
  + Network address of reachable network
  + Which interface that network is attached to
  + The “distance” to that network
* Routers also…
  + Don’t forward broadcast/multiplex traffic by default
  + Use the *logical* address to determine destination, not physical
  + Can implement ACLs
  + Can bridge/route through the same interface
  + Can route VLANs
  + Provide QOS

### Layer 2 -- Data Link

* Provides physical data transmission
* Handles…
  + Error notification
  + Physical topology
  + Flow control over local network
* Encapsulates packets in *frames* with physical address in header
* Standards:
  + Media Access Control: 801.11, 802.3
  + Logical Link Control: 802.2
* Sublayers
  + Media Access Control
    - Controls *access* to *media* -- how packets are placed on the physical network (duh, mcfly!)
    - Bandwidth first come first served
    - Defines physical addressing and logical topology (signal path through physical topology)
    - Sets line discipline, error notification (not correction), ordered delivery, and flow control
  + Logical Link Control
    - Identifies relevant layer 3 protocol and encapsulates appropriately
    - Header with logical address tells recipient what to do with frame
    - Provides flow control/control bit sequencing
* Switches/bridges live here
* Switches segregate traffic by looking at logical address and matching to entry on ARP table, then forwarding the frame out the appropriate interface
* If entry not found on ARP table, switch forwards frame out *all* interfaces and seeing if anyone acknowledges it -- ARP table then populated with new entry
* Otherwise, only broadcasts forwarded by default

### Layer 1 -- Physical

* Provides for sending and receiving bits
* Layer 1 protocols specify electrical, mechanical, procedural, and functional requirements for the above
* Interface between DTE/DCE identified at this layer
  + DTE -- Data Terminal Equipment (usually at prem)
  + DCE -- Data Communication Equipment (usually at service provider end)
  + Network connected to DTE/DCE via CSU/DSU (Channel Service Unit/Data Service Unit -- fancy word for “the modem”)
* Physical layer connections defined by OSI standards -- only one concerned in CCNA is IEEE Ethernet.
* Hubs operate at this layer

#### Physical Topologies

* Bus
* Ring
* Star
* Mesh