**CSC3002F Notes – Link Layer**

**4 April 2022**

Link Layer & LANs

* Nodes = hosts & routers
* Data link layer has responsibility of transferring datagram from one node to physically adjacent node over a link
* MAC addresses (MAC = Medium Access Control):
  + Function: used locally to get frame from one interface to another physically connected interface
  + 48-bit MAC address coded into NIC ROM
* Address Resolution Protocol (ARP):
  + ARP table -> each node on LAN has table: IP/MAC address mappings for some LAN nodes and TTL
  + Process of obtaining MAC address:
    - A wants to send datagram to B (B’s MAC address not in A’s ARP table)
    - A broadcasts ARO query packet, containing B’s IP address (all nodes on LAN receive ARP query)
    - B receives ARP packet, replies to A with its MAC address (frame sent to A’s MAC address – unicast)
    - A caches IP-to-MAC address pair in its ARP table until information becomes out
  + Addressing: routing to another LAN
    - Send datagram from A to B via R
    - Assume A knows B’s IP address (either already knows it, or uses DNS to get it)
    - Assume A knows IP address of first hop router, R
    - Assume A knows R’s MAC address (ARP)
    - A creates IP datagram with IP source A, destination B
    - A creates link-layer frame with R’s MAC address as destination; frame contains A-to-B IP datagram
    - R forwards datagram with IP source A, destination B
    - R creates link-layer frame with B’s MAC address as destination; frame contains A-to-B IP datagram
* Ethernet Switch
  + Link-layer device: takes an active role
    - Store, forward Ethernet frames
    - Examine incoming frame’s MAC address; selectively forward frame to one-or-more outgoing links when frame is to be forwarded on segment
  + Transparent: hosts are unaware of presence of switches
  + Plug-and-play: switches do not need to be configured
* Switch: multiple simultaneous transmissions
  + Hosts have dedicated, direct connection to switch
  + Switches buffer packets
  + Ethernet protocol used on *each* incoming link
  + Switching: A-to-A’ and B-to-B’ can transmit simultaneously, without collisions (each link is its own collision domain)
  + Each switch has a switch table (contains MAC address of host, interface of reach host, time stamp) – looks like a router forwarding table
  + Self-learning: switch learns which hosts can be reached through which interfaces
    - When frame is received, the switch learns location of sender
    - Records sender/location pair in switch table
  + Frame filtering/forwarding
    - Record incoming link, MAC address of sending host
    - Index switch table using MAC destination address
    - If entry is found for destination:
      * If destination is on segment from which frame arrived: drop frame)

Else, forward frame on interface indicated by entry

* Else, flood/forward on all interfaces except arriving interface
* **(See slides/textbook for example)**
* Interconnecting switches:
  + Switches can be connected together (eg. Each computer lab has a switch, these are all connected to a main department switch)