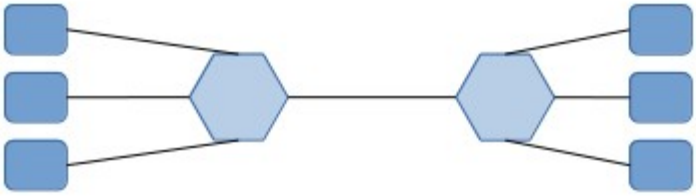
CSE 461 - Module 8: LAN Structure



What is a LAN?

- Direct delivery of frames
  - Frame header has a destination address field (and a source field and …)
  - Sender emits the frame
  - All stations see the frame
    - Each checks if the destination address in the frame header matches its own address
- Broadcast domain
  - There is a designated address meaning “everyone”
    - Often the address with all 1 bits (e.g., FF.FF.FF.FF.FF.FF)
  - Broadcast frames never pass through routers
    - Routers connect one LAN to another LAN
    - The Internet is a collection of inter-connected LANs

Overview: Repeaters, Hubs, Bridge, VLANs

- A repeater recreates the analog signal it hears as input on all output ports
  - Used to extend range of LAN
- A hub
  - Operates on frames (i.e., digital data)
  - Repeats the frame on all ports other than the one it came in on
  - Still a single collision domain
- A bridge
  - Operates on frames
  - Can buffer frames
  - Can try to avoid repeating frames on ports that won't be interested in it
  - Creates multiple collision domains

- Virtual LANs (VLANs):
  - Overlay multiple (logical) LANs on the same physical media (wires, RF spectrum, …)
    - Remember what a (logical) LAN is: direct deliver + broadcast domain
  - It's about making sure a station does not tsee some frames (not about making sure it does)
    - However, distinct VLANs may be in the same collision domain (because they share phsical media)

(Learning) Bridges

- Goals:
  - maximize the peak possible useful transmission rate
    - Example: Allow a transmission between two stations on the left to occur at the same time as a transmission between two stations on the right (in the figure at the beginning of these notes)
  - require no setup or management
    - Plug and play...
- Operation
  - Bridge builds a map from station address to port
    - Example: 21.45.F7.33.28.10 is reachable through my port 3
  - When a frame arrives, look up destination address in your map
    - If you find an entry, send the frame out the port given by the map (if that isn't the port it arrived on)
    - If you don't find an entry, you don't know where the station might be
      - Send it everywhere (except the port it came in on)
        - This is called “flooding”
  - How is the map created?
    - Learn it
    - Each time a frame arrives, it carries a source addresses
      - Make sure your map has an entry for the source address indicating that port
  - How do you get rid of map entries
    - You have to get rid of them for garbage collection and in case a station moves
    - “Aging” – entries have a limited lifetime before they're deleted, unless you hear that source address on that port in the mean time

Bridge Spanning Tree Algorithm

- Motivation: if you create a cycle among bridges, you have a problem
  - What problem? Why?

- Goals:
  - Have bridges agree on a spanning tree that overlays the physical topology
    - Ignore some bridge-bridge links
  - Now operate as normal learning bridges, but just over the links of the spanning t ree
- Finding the spanning tree: strategy
  - We'll create a minimum cost spanning tree
    - Because it's easy to do in a distributed way more than because it's minimum cost
  - Need to:
    - Agree on a root
    - Find a single parent (unless you're the root)
    - Remain connected
  - Agree on a root
    - We'll choose the bridge with the lowest ID
  - Find a single parent
    - We'll choose the neighbor that is closest to the spanning tree root
  - Remain connected
    - Everyone can reach the root, so everyone can reach each other
- Finding the spanning tree: procedure
  - Each node sends control message containing a triple:
    (who I think the root is, who I am, how far I am from the root)
  - Start with (my ID, my ID, 0)
  - When you hear from a neighbor, “accept” its advertisement if the root is smaller than the one you know about
    - Update your state to (new root id, my id, neighbor's distance to new root id + 1)
    - Your uplink is to that neighbor
  - Also accept if neighbor lists the same root you already know of but the neighbor is closer to the root than your existing parent
    - update your state and make that neighbor your uplink

VLANs

- 802.1Q
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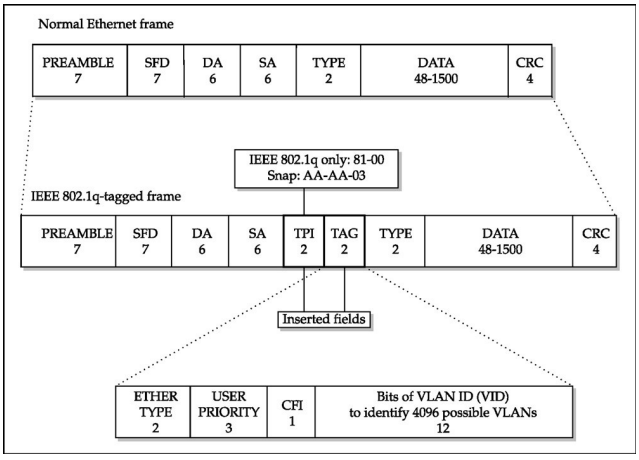

- “Normal” Ethernet frame has a 16-bit field that carries either:
  - frame length, or
  - type field (for demultiplexiing)
- If the bits in that position are 0x8100, it means an 802.1Q tag is included in the frame
  - That tag is 32 bits, and is inserted ahead of the actual type/length field
  - Low order 12 bits are a VLAN ID number
- Hosts assigned to a particular VLAN form frames that include the 802.1Q tag
- VLAN bridges
  - Have one or more VLAN IDs associated with each output port
  - Forward an incoming frame with a particular VLAN ID only on those ports that are marked with that ID
  - Perform learning in the normal way
    - But flooding is only over ports that include the VLAN ID
- Why do all this?
  - Security
  - Separate logical connectivity from physical layout
  - Distinct broadcast domains
  - Multiplex hardware resources