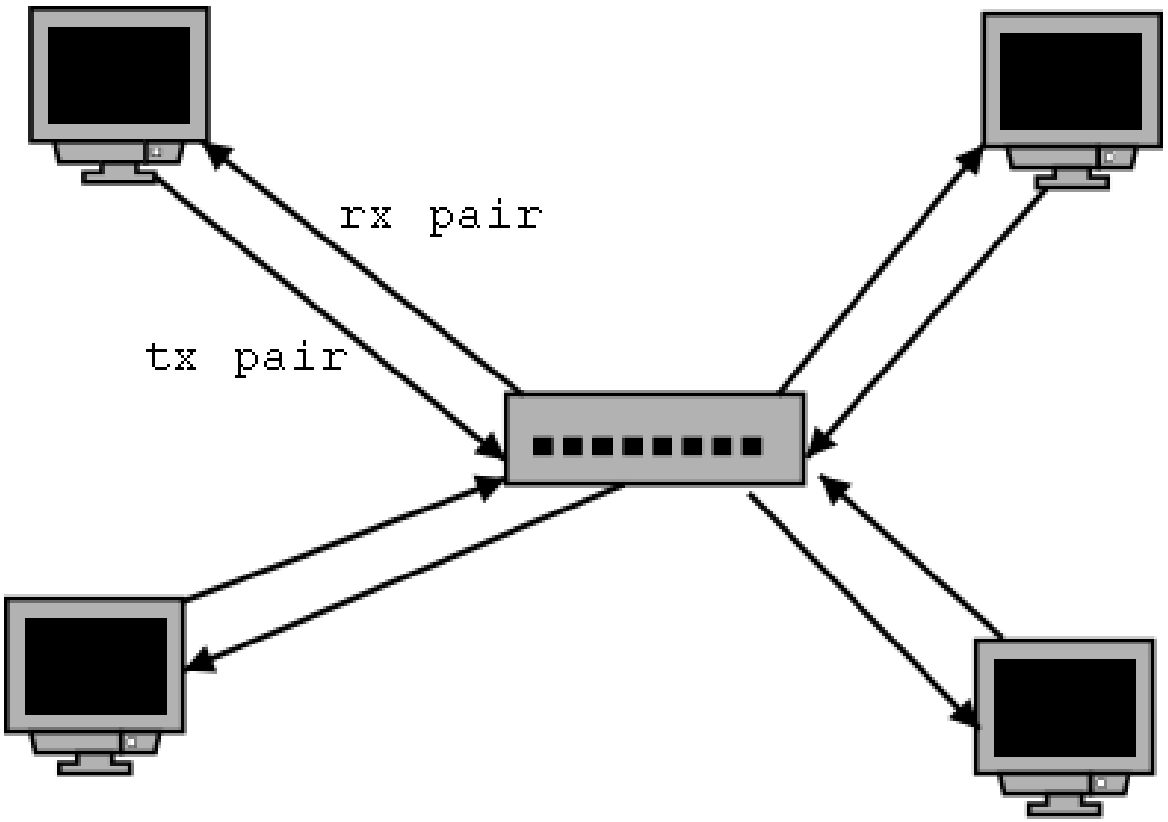
Interconnection Technologies

Bridging III

Full duplex LAN connections

- No more *shared* LAN media/access
- Dedicated media between station and switch
- Allows simultaneous transmit and receive
- Connection becomes a point−to−point link
- Removes need for a MAC
  - Ethernet/token ring relegated to frame formats
  - No need for CS, MA, CD nor a token

Full duplex illustrated



Link Aggregation

- Combines parallel links to use as one
- Increases connection capacity
- Provides link redundancy
- Enables relief from *forklift* upgrades
- Often used for switch−to−switch connection
- May be used for station to switch connection
- Specified in IEEE 802.3ad
  - Yes, standard only exists for Ethernet

Introduction to LAN multicast

- Ethernet supported multicast from the start
  - Half of 48−bit addresses are multicast addresses
  - Token ring has *functional addresses* − *sigh*
- Assigned to groups of apps/processes
- Allows greater communication without an incremental increase in LAN load
- Part of the IEEE 802.1p standard
- Independent of layer 3 protocl (IP multicast)

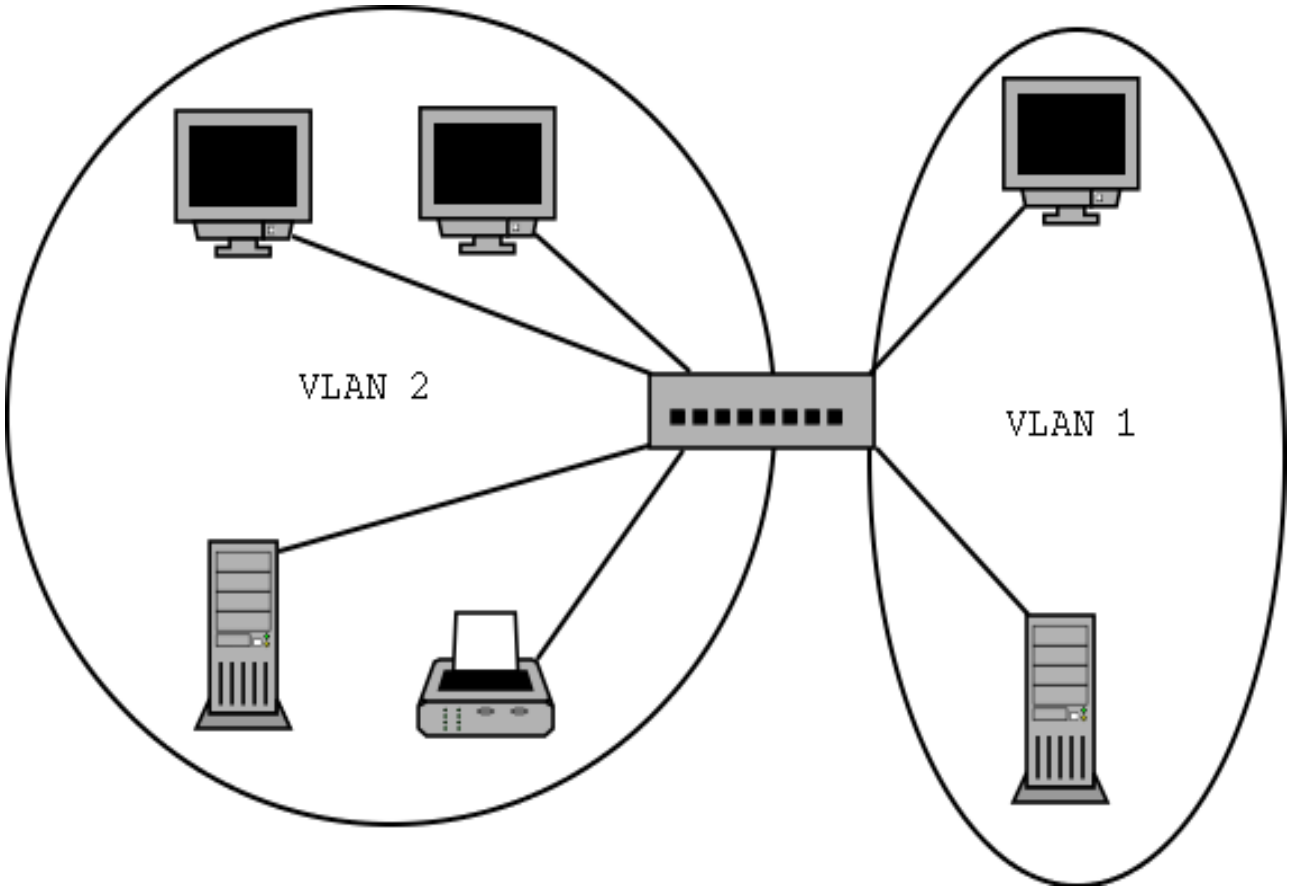
Multicast registration and pruning

- Flooding multicast traffic is wasteful
- Need a mechanism to prune spanning tree
- Receiver sends a multicast group registration
- Switches propogate registration info
- Switches prune links that have no active multicast receivers
- We'll talk more when we get to IP multicast

Virtual LANs

- Allows separation of physical LAN from a logical LAN
- Allows the configuration of *virtual* switches
- Each VLAN isolated from each other
- Need a layer 3 protocol to cross VLAN boundaries
- A VLAN can be configured by physical port, protocol, address, etc.

VLANs illustrated



VLAN frame tags

- Used to determine which VLAN a frame is on
- May be implict or explicit
  - Implicit – parse frame base decision on contents
  - Explicit – examine a VLAN id field within frame
- End stations can be VLAN−aware
- VLANs can span multiple switches
- Often used to group hosts into a particular IP subnet for management/security reasons

IEEE 802.1Q

- Standard for VLAN−aware switches
- Extends IEEE 802.1D standard
  - Address table must know associated VLAN
  - Includes support for frame tagging
  - Priority standard included
  - Other network management functions
- *Spanning forest* is being worked on

IEEE 802.1p

- LAN priority tagging mechanism
- Goes hand−in−hand with 802.1Q
- Provides 8 levels of priority
  - 7 is the highest − network management
  - 0 is the default − best effort
  - 1 is the lowest − background traffic
- Not widely used
- We'll talk about class/quality of service later

LAN switch management

- In−band
  - TELNET, SNMP, web browser
- Out−of−band
  - Modem (RS−232)
- Port mirroring
- Software/firmware
- Configuration

Simple Network Management Protocol (SNMP)

- Manager/agent
- Management information base (MIB)
- Network protocol
- Agent MIB values can be queried, maybe set
- Objects arranged in MIB according to OID
- SNMP *traps* can be generated automatically
- SNMPv1 most popular, but very insecure

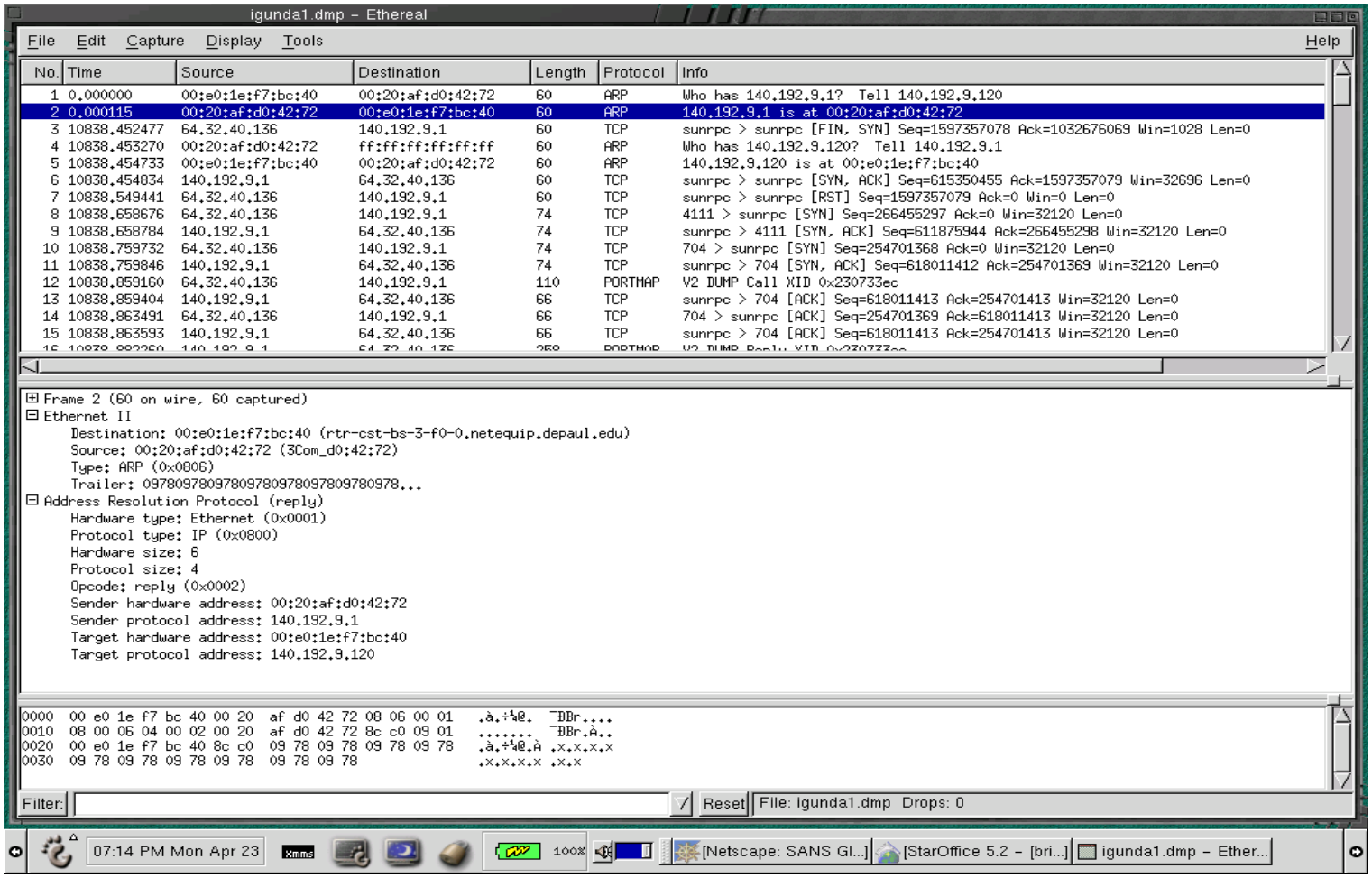
Remote monitoring (RMON)

- An extensive MIB for gathering switch info
  - Ethernet statistics group
  - HostTopN group
  - Matrix group
  - Packet capture group
- Internal switch RMON probes often limited
- Additional external hardware can be used to get additional functionality

Protocol analysis

- Many LAN frame capture and analysis exist
- When you have an idea of what you're looking for
- This is the *network microscope* tool
- Privacy issues may crop up
- Very good for understanding how networks *really* work

Protocol analysis illustrated



Final thoughts

- Bridges/switches are simple
- You generally don’t have to spend much time with them once they are initially setup
- With standard Ethernet they’re commodity products
- In TCP/IP networks the really interesting stuff mostly happens at layer 3 and layer 4