Advanced features on Ethernet networks

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Outline

- Autonegotiation
- Jumbo frames
- Power Over Ethernet (PoE)
Auto negotiation (1)

- Another plug-and-play oriented feature
- Auto negotiation possibilities:
  - speed (only over copper)
  - half/full duplex (over copper and fiber optic)
- Negotiation sequence:
  - 1 Gb/s full-duplex
  - 1 Gb/s half-duplex
  - 100 Mb/s full-duplex
  - 100 Mb/s half-duplex
  - 10 Mb/s full-duplex
  - 10 Mb/s half-duplex
Auto negotiation (2)

- Possible only if connected to another host, or to a bridge/switch
  - Hubs operate at fixed speed; hence, cannot negotiate anything!
- If, during the procedure, the other party does not respond, the negotiating station assumes it is connected to an hub
  - Fixed setting on one side may lead to unexpected errors
- Example
  - One side: fixed 100Mbps Full Duplex
  - The other party does not receive any message and it will assume it is connected to an hub
    - It will configure the interface in 100Mbps Half Duplex
    - There may be tons of false collisions on that host
**Ethernet max frame (1)**

- In theory, 1518 bytes (the original specs)
- In practice, it has been enlarged several times
  - VLAN tagging (IEEE 802.1Q), + 4 bytes
  - Provider Bridge (802.1ad) (also known as 802QinQ), + 8 bytes
- Ethernet Frame Expansion (802.3as) proposed a new size of 2000 bytes
  - Size of the data portion of the frame (46-1500 octets) does not change (MTU still 1500 bytes)
- T11 adopted an MTU of 2500 bytes for Fibre Channel over Ethernet (FCoE) frames.
- MPLS increases the max Ethernet frame size to 1518 + (n * 4 bytes), where n is the number of stacked labels.
We have to distinguish

- Larger frames because of more headers
  - No impact on the hosts
  - Required by new Ethernet extensions
- Larger frames because of more data
  - MTU impact
  - Desirable for different reasons (see later)

Ethernet 1500 bytes MTU for historical reasons

- Can enlarge the max frame without significant impact on latency
- Backward-compatibility issues
  - In fact, GbE has frame bursting
Ethernet giants

- Baby Giant
  - Often refers to the frame type used with MPLS, 802.1Q, 802.1ad and 802.3AE
  - Just headers

- Mini Jumbo
  - Often used to refer to an MTU size of 2500 bytes and has become specific to the frame size used by FCoE
  - Bigger data

- Jumbo (or “Giants” / “Giant Frames”)
  - Bigger data
  - Often up to 9KB frame
  - Non standard
Jumbo frames: advantages

- Reduced header overhead
- Supports 2500 bytes FCoE frames, 8192 NFS data blocks, 8K iSCSI blocks (derived from the typical TCP Windows size)
- Reduced operating system overhead (interrupt handling at each new packet)
  - Very significant cost for network-intensive servers
- Possibility to transport traffic coming from network with larger MTUs
  - Used long back in the past (e.g. to transport Token Ring frames on corporate backbones)
Jumbo frames: problems

- Increase network latency
- Increase buffer pressure on switches
  - Remember that usually switches have very small buffers
- Network stacks (and operating systems) often tuned for 1500 bytes
  - Internal buffers dimensioning
- Fragmentation (at the IP level)
  - If a jumbo frame has to be delivered to a traditional station
- A new CRC calculation had to be defined
  - The original algorithm was not robust enough with those sizes
Power over Ethernet

- Distributes electrical power on the Ethernet cable
  - Twisted pair only (no fiber)
- Useful to connect users with moderate power needs
  - VoIP phones
  - WiFi access points
  - Surveillance camera
  - Etc.
- Avoids additional cabling due to the power cord
- More power and longer distances than USB
Power over Ethernet: standards

- **IEEE 802.3af-2003**
  - Up to 15.4 W of DC power to each device
    - minimum 44 V DC and 350 mA
  - Only 12.95 W is assured to be available at the powered device as some power is dissipated in the cable

- Updated with IEEE 802.3at-2009
  - Known as PoE+ or PoE plus
  - Up to 25.5 W of power
  - Products available that provide even more power (e.g., 51W) over a single cable by utilizing all four pairs in the Cat.5 cable

- Compatible with non-PoE stations