Asymmetric Flow Control (AFC) and Gigabit Ethernet

Bill Bunch
National Semiconductor Corp.
Phone: (408)721-7274
Email: Bill.Bunch@nsc.com
Adding Asymmetric Ability

- 802.3x defines extensions to Clause 28 that allows configuration of PAUSE function
- The single bit definition only supports symmetric PAUSE ability
  - PAUSE=1 means “I can transmit & receive PAUSE frames"
  - PAUSE=0 means “Not only can’t I transmit PAUSE frames, but I won’t understand them”
  - Turn on PAUSE functionality only if PAUSE=1 on both ends
- Asymmetric PAUSE requires an additional bit
- Solution: Add ASM_DIR bit
  - PAUSE=0, ASM_DIR=1 -> Advertises transmitter but no receiver
  - PAUSE=1, ASM_DIR=1 -> Advertises receiver but no transmitter
Resolution & Compatibility

- Resolution is identical to 802.3x except:
  - Asymmetric cases (#4 & #9)
  - No Receiver case (part of #2)
- In Cases 4 & 9 both devices are aware of new asymmetric flow control
AFC to End Stations

- Stop traffic at its source
  - Eliminates potential for network congestion (a good thing)
  - Flow Control below the application causes potential for congestion within the end station
    - Generally more buffers inherent in End Stations
    - Switches will not need to replicate these buffers
  - Abuse of upstream PAUSE will lead to network congestion
  - AFC allows enforcement that End Stations not apply backpressure to the network
AFC Between Switches

- Effects are dependent on traffic flows and topology
- Asymmetry causes a burden on switch design
  - Switch B “saves” the cost of a PAUSE receiver
  - Switch A can be shut down by Switch B
    - Congestion in Switch A more likely
    - Switch A designer must account for additional probability of congestion
- Asymmetry causes a burden on the user
  - Requires awareness of individual switch resource limitations
  - Cannot assume a given topology will work
  - Too many options
  - At least one of the switches must support PAUSE
AFC and “Gigabuffer”

• Gigabuffer performs much like a traditional repeater
  • Both cause congestion in switches below them in the network hierarchy

• Requires the attached device to implement the PAUSE receiver
  • Otherwise, it cannot function correctly
  • Implies that all switches must implement PAUSE receiver or not be compatible with Gigabuffer

• Who saves?
  • “No receiver” benefactors are switch ports dedicated to end station connections and Gigabuffer Repeaters
  • Switches must implement PAUSE receiver to allow Gigabuffer interoperation
  • Switch to Switch AFC will cause more user pain than switch savings
The Bottom Line

• Gigabuffer Repeaters require AFC to function
  • Cannot act on PAUSE receive (without stopping the network)
  • Requires switches to implement PAUSE receiver

• Switch to Switch links
  • AFC is bad for the (l)user and switch designer
  • Symmetric Flow Control puts design burden on all switches equally

• AFC from switch to end stations
  • Denies end stations the ability to apply backpressure
  • Reduces probability of network congestion
  • This is really a means to enforce a PAUSE transmit policy
  • Cost savings not present if all switch ports are designed to connect to either an end station or switch port
Recommendations

• If Gigabuffer Repeaters are to be supported, then PAUSE receive needs to be mandated for all uplink switch ports

• Allow switch ports connected to end stations to ignore and discard PAUSE frames
  • Through ASM_DIR bit and special defaults for end stations and switch ports, or
  • Through policy definitions (may need a “standard” distinction between end station and switch port)

• Disallow asymmetric Flow Control on switch to switch links

• Require PAUSE receiver in Gigabit end stations???
  • We have the opportunity to reduce optionality and provide services that can be relied on