S800-T
Suspend Mode

Update: December 15, 2003
Overview of Scheme (Alternate Link Pulses)

• Use a modified form of 802.3 Normal Link Pulses ("NLPs") to signal transitions and maintenance of Standby mode

• 802.3 specifies that NLPs are sent on pairs A and B of a four pair, 8 conductor channel
  – Transmitted on conductors 1 and 2 (pair A), or on conductors 3 and 6 (pair B)

• New scheme will use NLP signal on the alternative pairs C and D
  – Transmitted on conductors 4 and 5 (pair C), or on conductors 7 and 8 (pair D)
  – Such signals will never appear in any legacy 802.3 application
**INITIATION:**

**Transition from Active to Standby**

Local PHY Sends NLP pattern on pair C or D
To Link Partner to Initiate Suspend
“Alternate Pair Link Pulses”, or APLPs

Link partner recognizes APLPs on pairs C, D
and responds with similar transmission of
APLPs on pair C or D

Both ends enter Suspend mode
Suspend MODE

• Both PHYs Enter Suspend
  - Continue Transmitting APLPs on pairs C or D
• Each PHY powers down critical circuitry
  - 3 of 4 Transmitters are powered off
  - 3 of 4 Receivers are powered off almost completely
    • NEXT / FEXT cancellers, adaptive filters, ADCs are powered off
      - Pads and signal detect functions remain powered
    - Power reduced by >80%, to <100mW (implementation specific)
• Suspend SIGNAL allows detection of physical disconnect
  • e.g., cable pulled out of connector, link partner loses power
Suspend MODE Critique

- “Alternate Link Pulses” look just like 10BASE-T, but on the opposite pair
- Is it possible that any legacy device could get confused?
- There are cable installation that run 2 legacy links in parallel on a single 4 pair cable:
  - Link # 1 on pair A, B
  - Link # 2 on pair C, D
- When one end of link initiates Resume, it may take up to 750ms for other end to respond
  - Time for cable to be disconnected and reconnected to a legacy part
- Is there a way to avoid any confusion?
Enhancement

• Make Alternate Link Pulses inherently unique.
• Leverage Fast Link Pulses, which allow information encoding
• Send Fast Link Pulse with all zeroes for data to initiate Suspend
• Send Fast Link Pulses with all ones for data to exit Suspend and initiate resume
• Power difference between NLPs and FLPs is negligible
Fast Link Pulses

Not drawn to scale
Fast Link Pulses (100BASE-TX) vs Normal Link Pulses (10BASE-T)

Not drawn to scale
Disconnect

• If the cable is disconnected, or either end ceases functioning, then the APLPs will cease

• A PHY that no longer receives APLPs will disconnect and re-start Auto-negotiation

• Disconnection can be forced through software commands at either end, if desired to restart Auto-negotiation
RESUME:
Exiting Standby and Returning to Active Mode

• “Can we go straight to PAM-5 signaling on exit from suspend mode, or is an interim state required to make sure the master signals first?”

• Master node must initiate PAM-5 signalling before Slave.

• Master could exit by just starting PAM-5, but Slave should not

• Slave must send some “resume signal” prior to Master, and Master responds with PAM-5
RESUME: Exiting Standby and Returning to Active Mode

- In Suspend mode, both ends retain their Master / Slave status
- If Master initiates Resume, it just starts sending PAM-5
  - Slave synchronizes and responds with PAM-5 idle
- If Slave initiates Resume, it send FLPs with all 1’s in the data
  - Master responds by sending PAM-5
  - Slave synchronizes and responds with PAM-5 idle
Enhancement

• Make Alternate Link Pulses inherently unique.
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• Send Fast Link Pulse with all zeroes for data to initiate Suspend
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Advantages

• Allows entering and exiting Suspend mode

• Enables low power operation when data is not being transmitted

• Keeps physical connection active, allows cable disconnects to be detected

• Leverages existing signaling levels and timing of FLPs
  – Allows 1000BASE-T PHY architecture to be used with only small modifications

• Uses an alternate pair for signaling Suspend, to prevent any confusion with NLPs or with legacy 802.3

• Key concept: Use pairs C and D, which are normally “unused” for Link Pulse Signaling