ANALOG DEVICES

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100BASE-T1L Auto-Negotiation

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Overview

- Use Clause 98 Auto-Negotiation for 100BASE-T1L
  - In common with other SPE PHY technologies, including 10BASE-T1L
  - Expected to rely on low-speed mode (LSM) of Clause 98 Auto-Negotiation to cover longer cable length
  - High-speed mode (HSM) optional for 100BASE-T1L

- Make Auto-Negotiation mandatory for 100BASE-T1L
  - Auto-Negotiation will provide robust synchronization of PHYs' link startup processes
    - Will not specify separate link synchronization mechanism for 100BASE-T1L PHY, which might introduce corner cases
  - Auto-Negotiation will resolve LEADER/FOLLOWER configuration
  - Clause 98 Auto-Negotiation is silicon proven
  - Clause 98 Auto-Negotiation is mandatory for APL

- 100BASE-T1L to include low and high transmit level operating modes
  - Similar to 10BASE-T1L transmit levels: Low 1.0 Vpp level (default), and High 2.4 Vpp level (optional)
  - 100BASE-T1L transmit level should be resolved by Auto-Negotiation, before 100BASE-T1L transmission starts
  - High transmit level for 100BASE-T1L is still to be determined
    - 2.0 Vpp might be better choice in interest of transmit linearity at 80 MSym/s transmit rate

Technology Ability Field bit assignments

- IEEE Std 802.3-2022 Table 98B-1
  - Currently 15 of 27 bits unused
- Use 2 bits:
  - A10 – 100BASE-T1L ability
  - A21 – 100BASE-T1L increased transmit level ability
- 100BASE-T1L InfoField for:
  - Sequence ordered sets support
  - EEE ability
  - Reed-Solomon error-correcting code ability

bit	Selector description
…	…
A9	10BASE-T1L capability
A10	100BASE-T1L ability
A11 through A20	Reserved
A21	100BASE-T1L increased transmit level ability
A22	10BASE-T1S half-duplex capability
A23	10BASE-T1L increased transmit level request
A24	10BASE-T1L increased transmit/receive level capability
A25	10BASE-T1L EEE ability
A26	Reserved

100BASE-T1L transmit level negotiation

- 100BASE-T1L link will use high transmit level when both sides advertise 100BASE-T1L increased transmit level ability in bit A21
- 100BASE-T1L link will use low transmit level when either side (or both) does not advertise 100BASE-T1L increased transmit level ability
  - For intrinsically safe application this ability will not be advertised
  - For other applications not desiring/needing high transmit level this ability will also not be advertised
- Simplified approach compared to 10BASE-T1L (which used two bits for transmit level negotiation)
- More consistent approach compared to other negotiated abilities and uses fewer bits

Priority Resolution

- 100BASE-T1L PHY to be added to priority resolution function described in IEEE Std 802.3-2022 Annex 98B.4
- New order, listed from highest to lowest priority:
  - 10GBASE-T1
  - 5GBASE-T1
  - 2.5GBASE-T1
  - 1000BASE-T1
  - 100BASE-T1L
  - 100BASE-T1
  - 10BASE-T1S full duplex
  - 10BASE-T1S half duplex
  - 10BASE-T1L

Link startup time

- Low-speed mode Auto-Negotiation completes in less than ~12 ms
  - Time for Arbitration state machine of IEEE Std 802.3-2022 Figure 98-7 to enable PHY technology, in AN GOOD CHECK state
  - Includes break_link_timer duration of 8.133 ms

- Target overall link startup time of 100 ms
  - Leaves 88 ms for 100BASE-T1L link startup
  - Propose 85 ms duration for link_fail_inhibit_timer for 100BASE-T1L
    - link_fail_inhibit_timer sets the maximum time allowed for the PHY link startup to complete

Questions ?