Enhanced Multidrop with Interoperability – what do we need?

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802.3da Objectives: Suggest PHY Enhancements

IEEE P802.3da Objectives

1. Define performance characteristics of a mixing segment for 10Mb/s multidrop single balanced pair networks supporting up to at least 16 nodes, for up to at least 50m reach.
2. Maintain a bit error ratio (BER) at the MAC/PLS service interface of less than or equal to 10^{-10} on the new mixing segment.
3. Specify an optional PLCA node ID allocation method
4. Support interoperability with Clause 147 multidrop
5. Support optional Time Synchronization Service Interface (TSSI)
6. Select a single MDI connector

IEEE 802.3 SPMG SG

IEEE P802.3da Objectives - continued

7. Specify improvements for Energy Efficient Ethernet compared to current 10Mb/s multidrop single balanced pair networks
8. Support operation in the noise environments for building, industrial, and transportation applications
9. Specify optional plug-and-play power distribution over the mixing segment
10. PSE shall only energize the mixing segment when at least one PD is connected
11. Support addition and removal of a node or set of nodes to a continuously operating powered mixing segment

IEEE 802.3 SPMG SG

802.3da Objectives: Require interoperability with Clause 147

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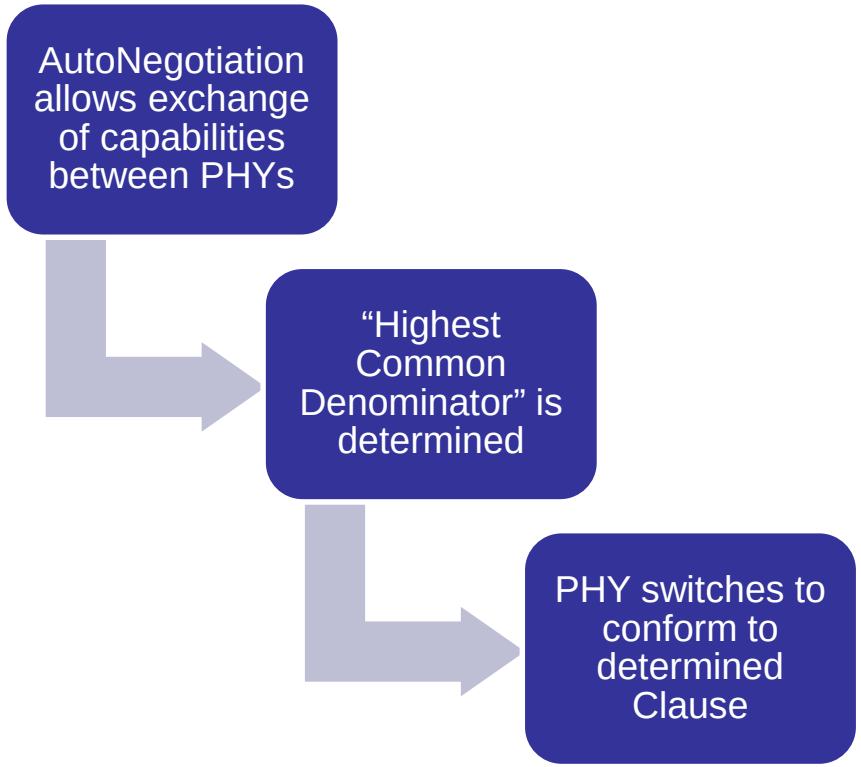
Value in supporting interoperability

- Existing standard PHYs can be installed without fear of needing wholesale replacement
- Upgrades can be made on existing mixing segments already populated with old PHYs, one-by-one

Forklift upgrades of mixing segments have no need for interoperability

Auto-Negotiation of Capabilities at Start up

Auto-Negotiation Process



Does Auto-Neg = Interoperability?

- Enables a vendor to make multi-protocol PHYs
- Does not require it

- BUT: true interoperability is:
  - One PHY type (say 802.3da) can transmit to and receive from the other PHY type (say Clause 147)

Approaches to meeting objectives with interoperability

- Upgrade medium only
- Receiver-only PHY enhancement
- Auto-Negotiation-like Mode Switching
- Compatible signaling

Upgrade the medium – one way to do it...

- Increased reach/node count
  - Use thicker (lower-loss) wire
- Improved EMC
  - Use better balanced/shielded media to improve EMC
- RESULT:
  - Relative cost of infrastructure increases
  - No difference in PHYs

- Until we see proposals on this, let us consider how to enhance the PHY...

Change in transmission / encoding creates interoperability issues with Clause 147 PHYs

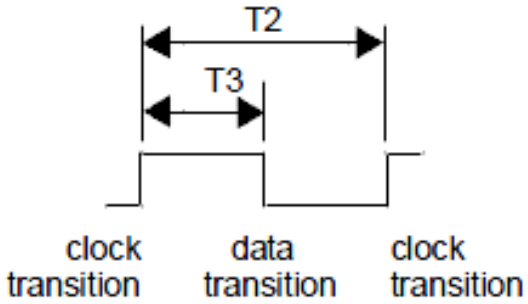
- Mixing PHYs on a mixing segment creates an operating mode issue
- Standard autoneg only deals with 2 PHYs in a link
- Multidrop deals with multiple nodes to upgrade
- Highest common denominator leads to:
  - No ability to see upgrade until all nodes are upgraded
  - Ability to bring entire segment's performance down by plugging in an older-style unit

Some (Seemingly) Inescapable Conclusions

- 802.3da PHYs must be able to transmit and receive according to Clause 147 specifications
- Any new 802.3da PHY capabilities must be either:
  - Receiver-only (increase signal processing margin)
  - OR, encoded so either are understandable by Clause 147 PHYs or do not result in errored frames when received by unintended PHYs
- Detecting and maintaining a table of PHY types on the mixing segment could require work above the PHY

Clause 147 Signaling

- DME at fixed rate



- T2 = 80 ns +/- 100ppm
- 38ns < T3 < 42 ns
- Link segment loss of 2.85dB at 12.5MHz
  - NOT noise limited

- 4B/5B encoding (80% rate)
- 5 bits encodes 4 data bits & 8 special symbols:
  - Actually 7 – (SILENCE should never be transmitted as a bit stream)

I	N/A	11111	SILENCE
J	N/A	11000	SYNC / COMMIT
K	N/A	10001	ESDERR
T	N/A	01101	ESD / HB
R	N/A	00111	ESDOK / ESDBRS
H	N/A	00100	SSD
N	N/A	01000	BEACON
S	N/A	11001	ESDJAB

Is FEC the solution?

- Adding FEC requires redundancy
  - Clock rate can't be increased & modulation can't be changed while maintaining interoperability
  - 4B/5B redundancy may be reused – it's a possibility
- Does "coding gain" get us out of this?
  - FEC corrects errors, regardless of the source
- FEC improves tolerable insertion loss when noise-limited
  - Requires statistical randomness of errors
  - Can fail catastrophically when equalization-limited
    - Intersymbol interference from correlated bit sequences combines predictably

Where does this leave us

- Propose:
  - Chair charter a ‘channel and noise model ad hoc’ to solicit contributions to build consensus around:
- A parametric channel model (LTspice or other parametric – not S4P)
  - Ability to vary topology will be key
  - Simulation-capable, but with measurement validation
  - Simulation evaluation with reference receivers for complexity trades
  - Can also include:
    - ‘broken termination’ (see presentation this meeting from Gergely Huszak)
    - Power coupling and node-loading analysis
- Need: Classes of noise model
  - Industrial: see http://www.ieee802.org/3/SPMD/public/jan20/Koczwara_Zimmerman_3SPMD_01_0120.pdf
  - Need references for Automotive & Building Automation