

Auto-negotiation for 10GBASE-T

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Contributors and Supporters

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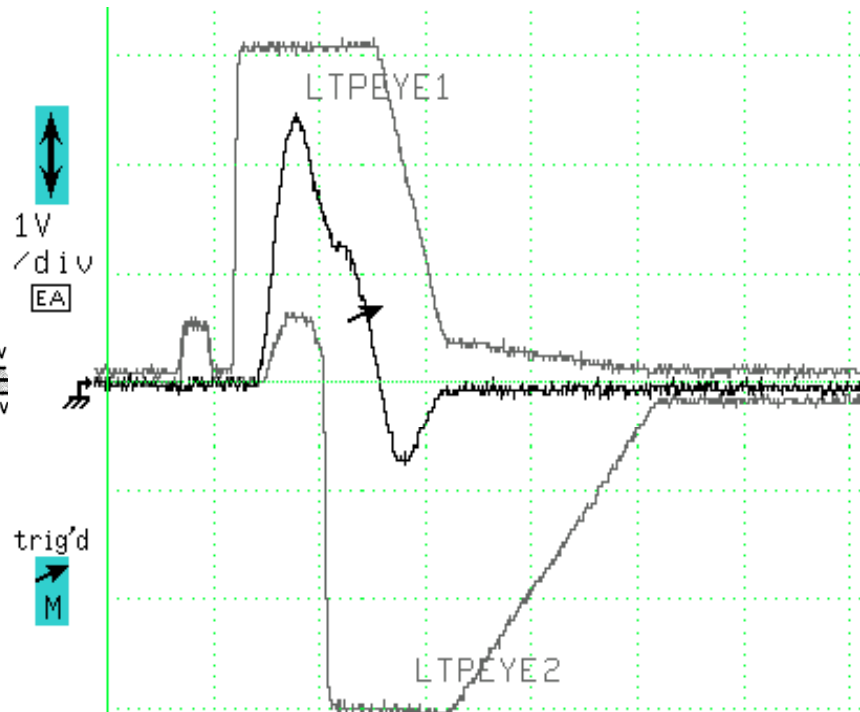
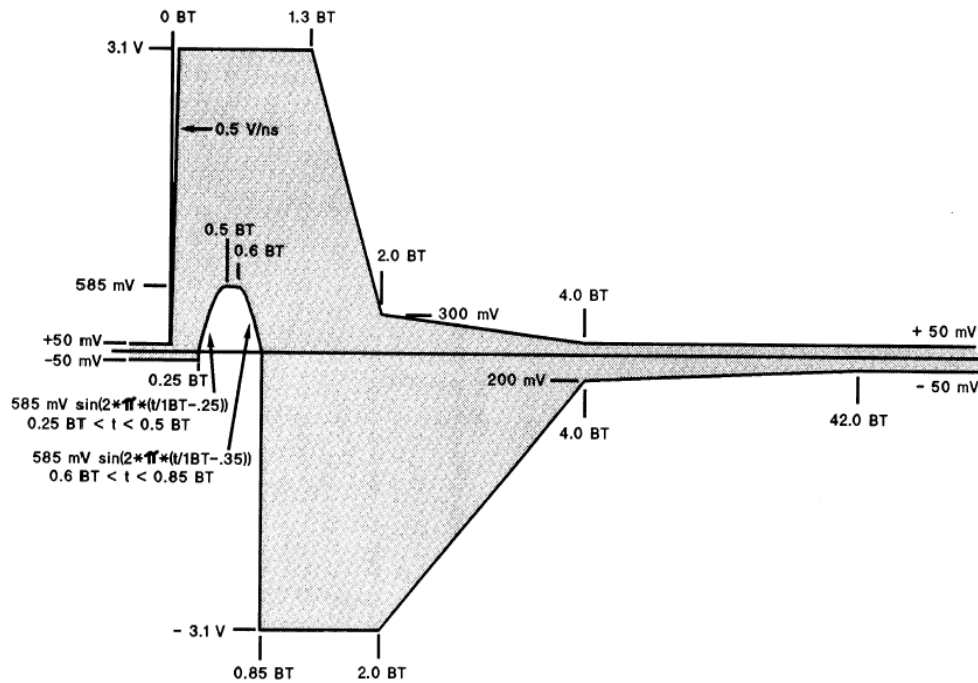
Purpose

- Address necessary modifications and extensions to Clauses 22, 28, 40, 45, associated Annexes, and Clause 55 to support auto-negotiation for 10GBASE-T.

Presentation Overview

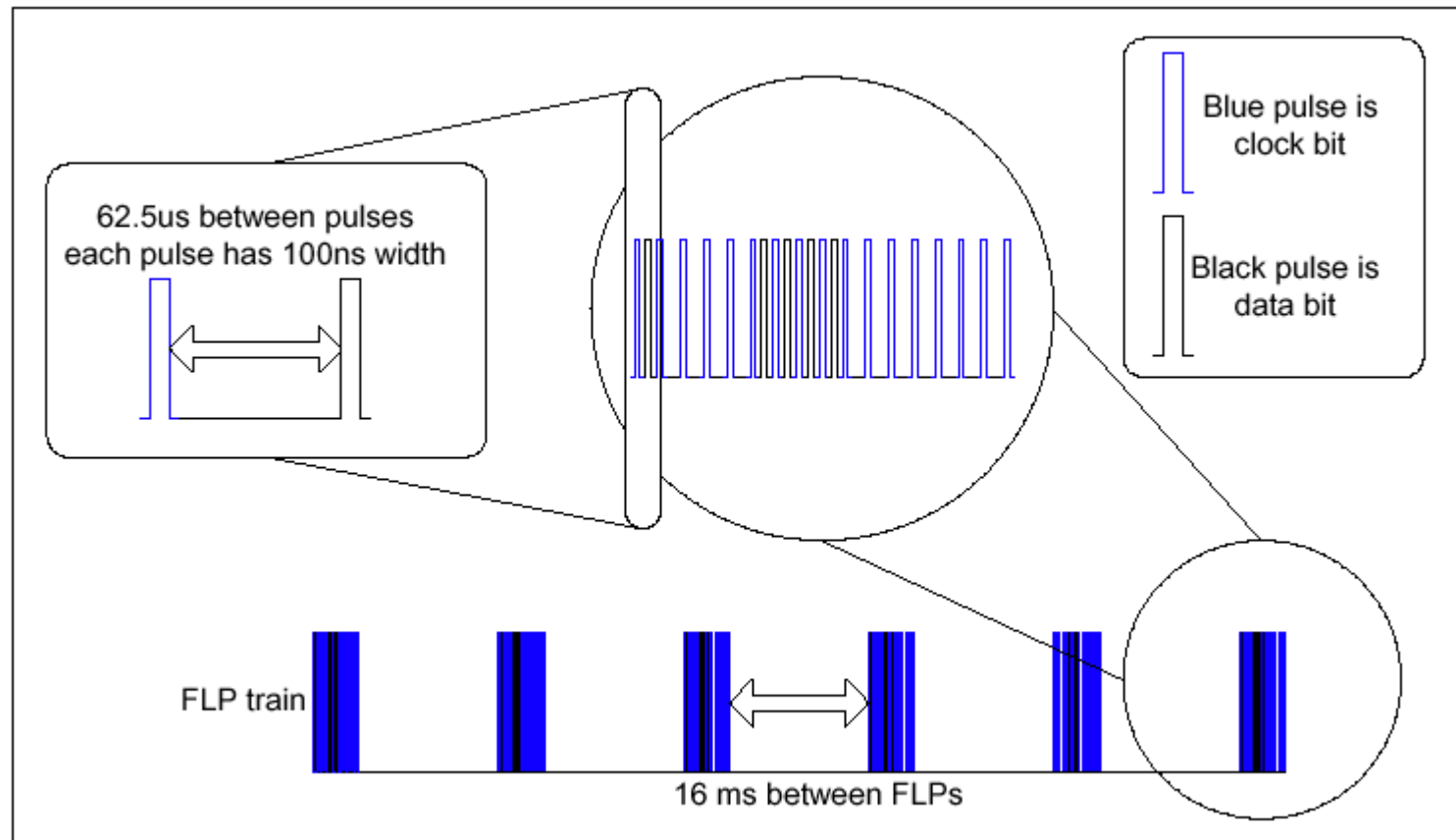
- Review of 10/100/1000 Auto-Negotiation
- Modifications necessary for 10GBASE-T

Link Test Pulse (LTP)

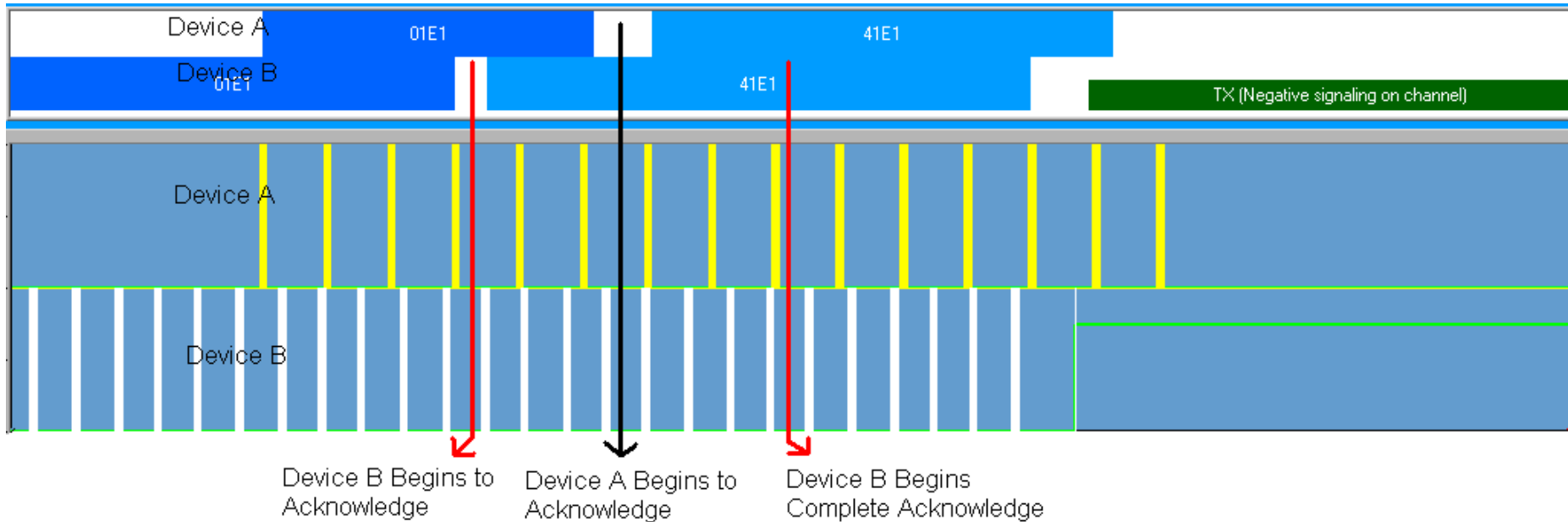


Template from Clause 14 (no changes will be made to this)

Anatomy of an FLP

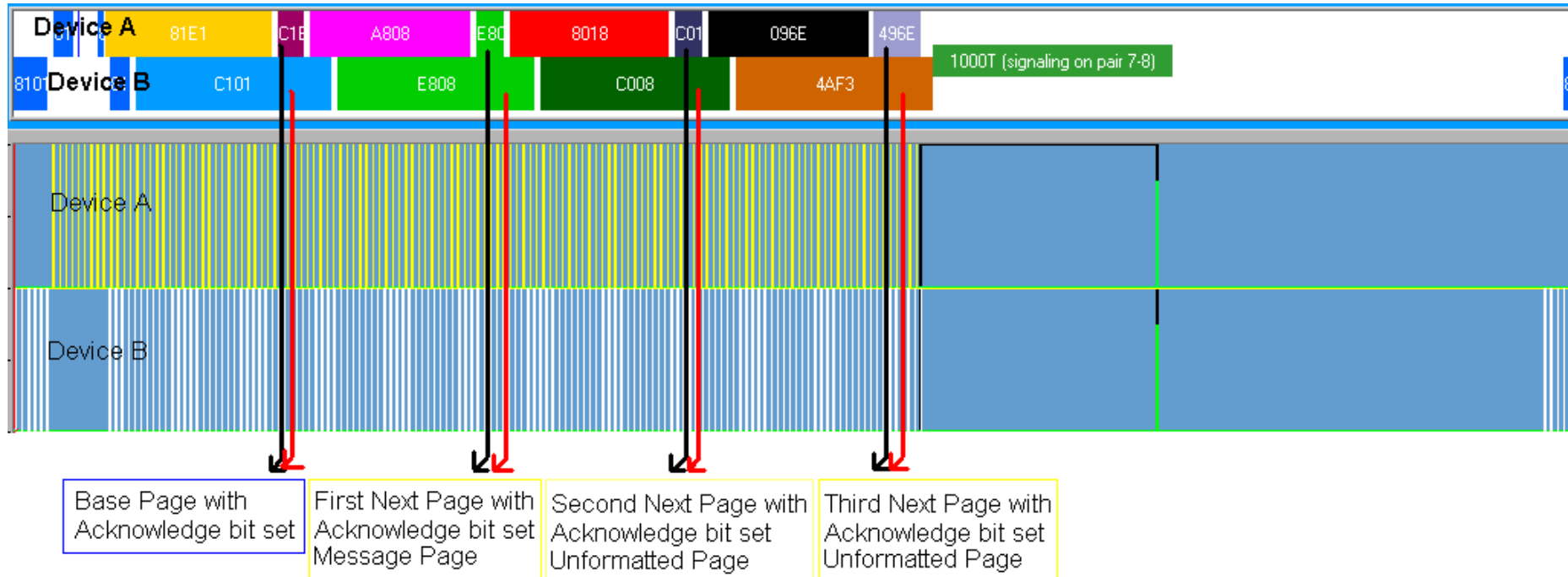


10/100 Exchange



Time to completion is approximately $\frac{1}{4}$ second

1000BASE-T Exchange



Time to completion is approximately 1 second

Device A

- 0x81E1, 0xC1E1
 - 802.3, 10/100 full and half
 - More pages to transmit
- 0xA808, 0xE808
 - 1000BASE-T message code
 - More pages to transmit
- 0x8018, 0xC018
 - 1000BASE-T full and half
 - Single port device
 - Manual configuration disabled
 - More pages to transmit
- 0x096E, 0x496E
 - Random value of 0x16E
 - No more pages to transmit

Device B

- 0x8101, 0xC101
 - 802.3, 100 full duplex
 - More pages to transmit
- 0xA808, 0xE808
 - 1000BASE-T message code
 - More pages to transmit
- 0x8008, 0xC008
 - 1000BASE-T full
 - Single port device
 - Manual configuration disabled
 - More pages to transmit
- 0x0AF3, 0x4AF3
 - Random value of 0x2F3
 - No more pages to transmit



Extensions for 10GBASE-T

- 10GBASE-T message code
 - Link partner knows 10GBASE-T information is coming
- 10GBASE-T abilities
 - Full duplex only (half duplex not supported)
 - TBD
- Master/Slave negotiation
 - Same method as 1000BASE-T (10-bit random seed)
- Automatic MDI/MDI-X Configuration
 - Use same mechanism as 1000BASE-T



10GBASE-T Message Code

M10	M9	M8	M7	M6	M5	M4	M3	M2	M1	M0
0	0	0	0	0	0	0	1	0	0	1

Uses reserved Message Code 0x09. And it becomes the 10GBASE-T Technology Message code. Two 10GBASE-T Ability pages to follow using Unformatted Next Pages.

10GBASE-T Unformatted pages

U0	U1	U2	U3	U4	U5	U6	U7	U8	U9	U10
----	----	----	----	----	----	----	----	----	----	-----

U0 = 10GBASE-T MASTER/SLAVE manual configuration enable

U1 = 10GBASE-T MASTER/SLAVE manual configuration value

U2 = Port type (multiport or single port)

U3 = 10GBASE-T full duplex

U4:U10 = reserved

U0	U1	U2	U3	U4	U5	U6	U7	U8	U9	U10
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U0:U10 = Random seed value (LSB:MSB)

10GBASE-T Registers

- Clause 22 registers needed for auto-negotiation
 - Registers 0, 1, 4, 5, 6, 7, 8 needed for all auto-neg devices
 - (note changes to some of these registers in IEEE 802.3aj-2003)
 - Registers 9, 10, 15 used for 1000BASE-T
- No additional Clause 22 registers exist for 10GBASE-T
- Clause 45 has plenty of extra space
 - Thanks to EFM, there exists a way to access Clause 45 registers with a Clause 22 mechanism.
- Will need to use combination of Clause 22 and 45 registers for 10GBASE-T

How to R/W Clause 45 from 22

- Register 13 MMD Access Control Register
- Register 14 MMD Access Address Data Register
- Subclauses 22.2.4.3.11 and 45.2.7 of IEEE 802.3ah D3.3 define the mechanisms to extend Clause 22 into 45.
- Will need to create registers in 45 to hold the 10GBASE-T information and then read them using Clause 22 management.

Additional Register information

- Test mode bits
- Manual master/slave configuration
- Port type
- Duplex
- Additional abilities
- Configuration faults
- Master/Slave resolution
- Local receiver status
- Remote receiver status
- Link Partner abilities
- Error counters
- ...

Clause 45 usage

- 1.5.0, Clause 22 registers present
- 1.7.3:0, PMA/PMD type selection
 - Add '1000' = 10GBASE-T PMA/PMD type
- 1.11.1, Add 10GBASE-T ability
- Additional registers may be necessary, in 1.X
(where X could be 12, 13, or 16-32767...plenty of space)

Clause 22 Register changes?

- Currently, bits 0.6 and 0.13 are speed select bits for manual configuration
 - 11 is reserved, but could become 10Gb/s
- Add bit 15.11 10GBASE-T Full Duplex
 - 1 = PHY able to perform full duplex 10GBASE-T
 - 0 = PHY not able to perform full duplex 10GBASE-T
- Determine what extensions need to be made into Clause 45, and whether or not we want to put all 10GBASE-T features in 45 or combination of 45 and 22.

Changes to Annex 28B

- 28B.3 Priority resolution
 - a) **10GBASE-T full duplex**
 - b) 1000BASE-T full duplex
 - c) 1000BASE-T
 - d) 100BASE-T2 full duplex
 - e) 100BASE-TX full duplex
 - f) 100BASE-T2
 - g) 100BASE-T4
 - h) 100BASE-TX
 - i) 10BASE-T full duplex
 - j) 10BASE-T

Changes to Annex 28C

- Add new message code 9 for to be 10GBASE-T message code followed by n unformatted pages
- Add 28C.10 Message Code #9 – 10GBASE-T

Clause XX uses next page message code 9 to indicate that 10GBASE-T implementations will follow the transmission of this page [the initial, Message (formatted) Next Page] with YY unformatted Next Pages that contain information defined in ZZ.

Changes to Annex 28D

- Add subclause 28D.6 Extensions required for Clause 55 (10GBASE-T)
 - Summarize features of 10GBASE-T auto-negotiation and provide references to appropriate subclauses.
 - Use 28.D.5 as a starting point to be added to later.

Additions to Clause 55

- Reference lynskey_2_0704 as a possible starting point for the management and auto-negotiation subclauses of clause 55.
 - Much of this is based off of subclause 40.5

What about Clause 40 and Annex 40C?

- We will want to revisit 40 and 40C to make sure we don't break it and that it doesn't break what we want to do. More review needs to be done in this area.