Auto-negotiation for 10GBASE-T

10GBASE-T Study Group Meeting

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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 future clauses to support auto-negotiation for 10GBASE-T.
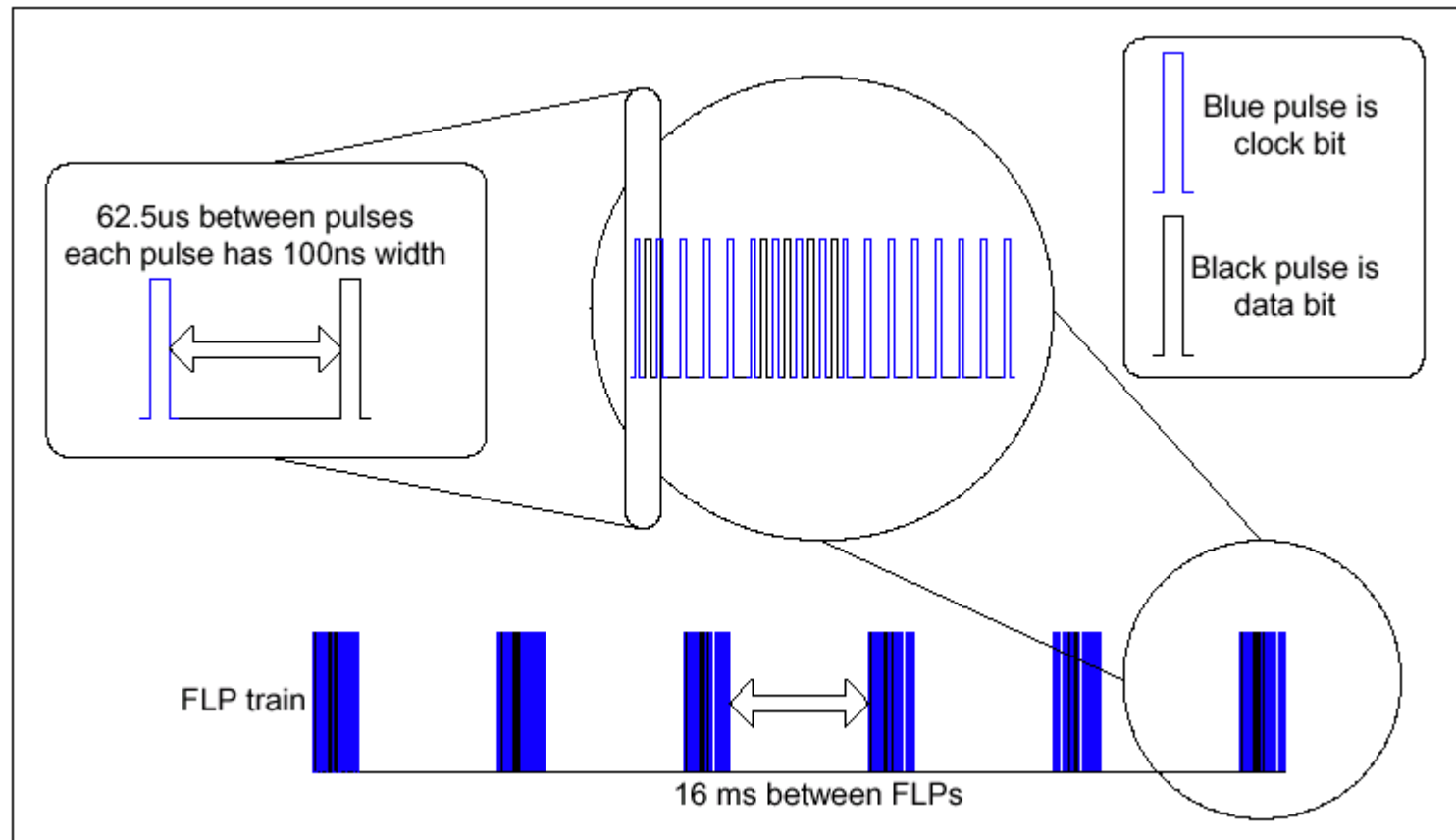
Link Test Pulse (LTP)
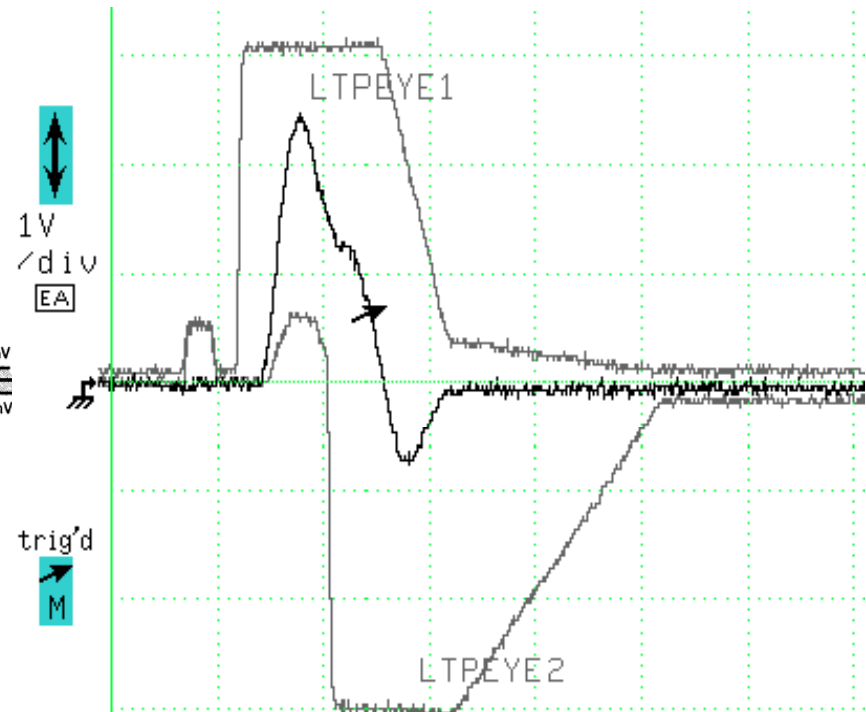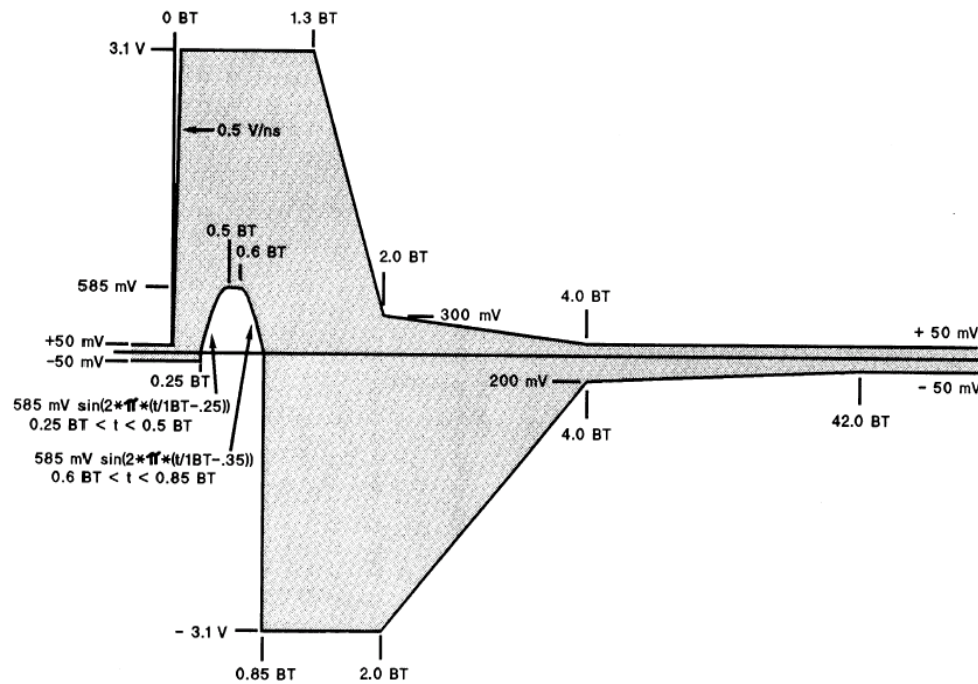
Template from Clause 14

Anatomy of an FLP

10/100 Exchange
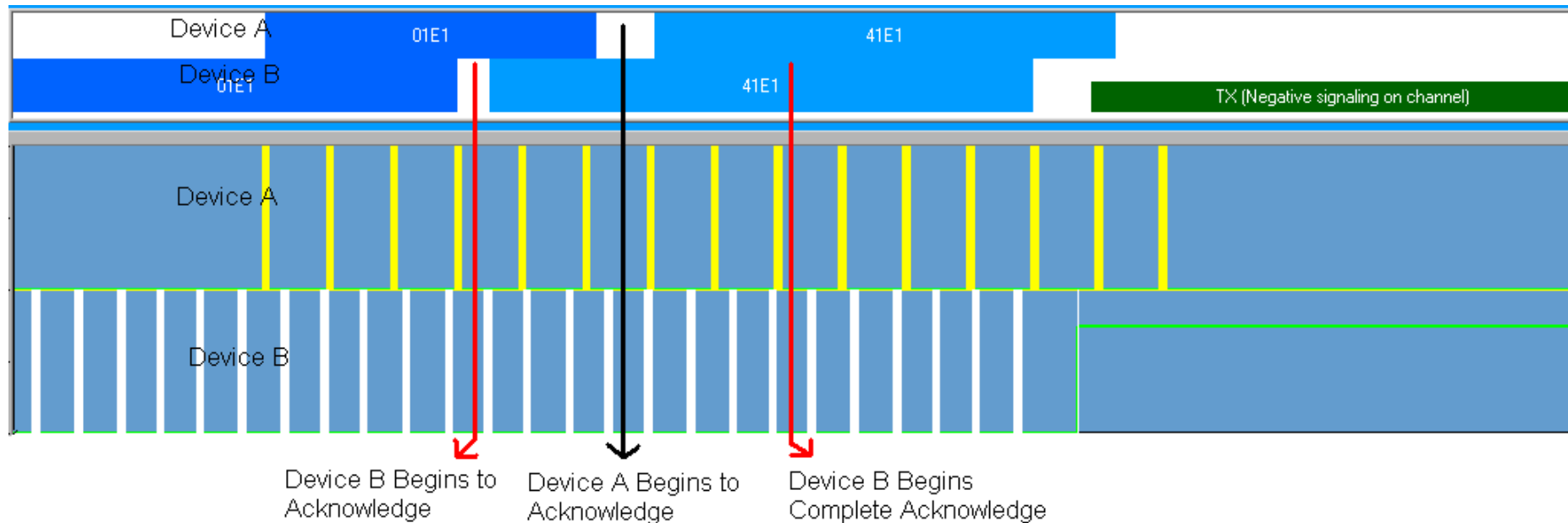
Time to completion is approximately ¼ second

1000BASE-T Exchange

Device A: 81E1 | C1B | A808 | E80 | 8018 | C01 | 096E | 496E

Device B: 810 | C101 | E808 | C008 | 4AF3

1000T (signaling on pair 7-8)

Base Page with Acknowledge bit set

First Next Page with Acknowledge bit set Message Page

Second Next Page with Acknowledge bit set Unformatted Page

Third Next Page with Acknowledge bit set Unformatted Page
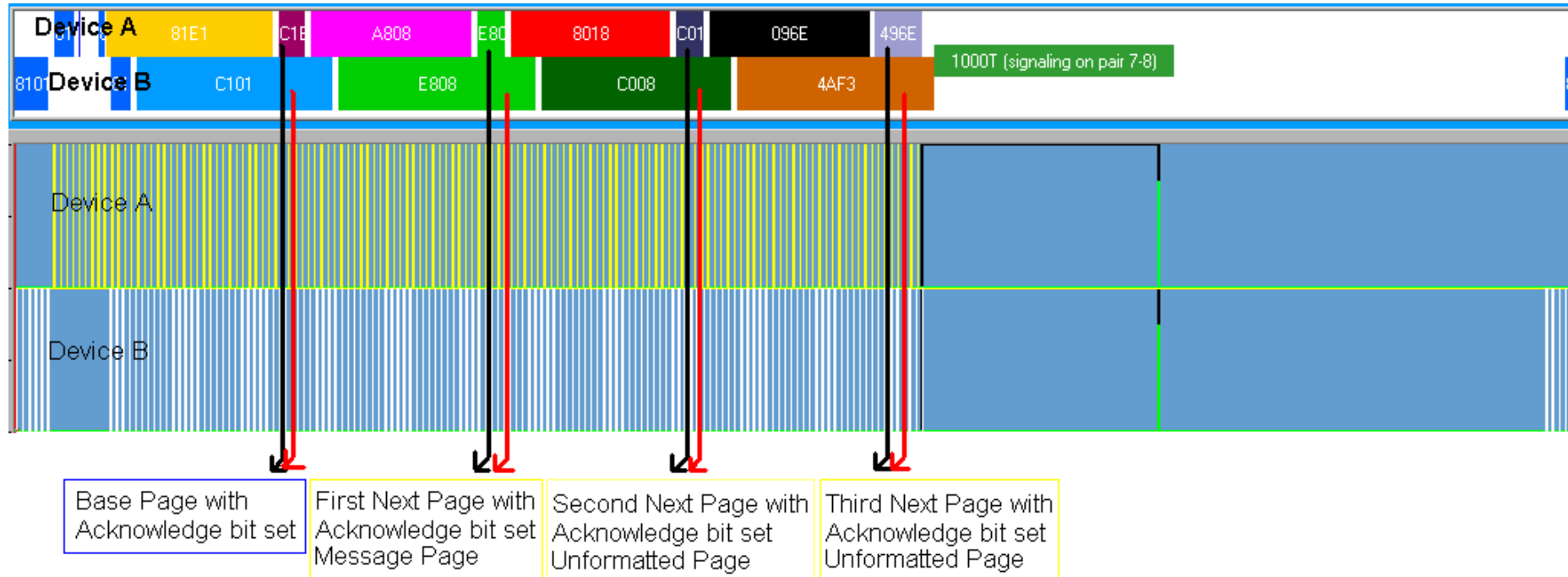
Time to completion is approximately 1 second

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

Option 1

- Rename message code 0x8 (Annex 28C)
  - 10GBASE-T/1000BASE-T technology message code. Two 10GBASE-T/1000BASE-T ability pages to follow using unformatted Next pages.

- Add 10GBASE-T abilities into first unformatted next page, using reserved bits

- Use identical second unformatted next page

Option 1 – use existing page

U0	U1	U2	U3	U4	U5	U6	U7	U8	U9	U10

U0 = 1000BASE-T MASTER/SLAVE Manual configuration enable
U1 = 1000BASE-T MASTER/SLAVE manual configuration value
U2 = Port type (multiport or single port)
U3 = 1000BASE-T full duplex
U4 = 1000BASE-T half duplex
U5:U10 = reserved

U0	U1	U2	U3	U4	U5	U6	U7	U8	U9	U10

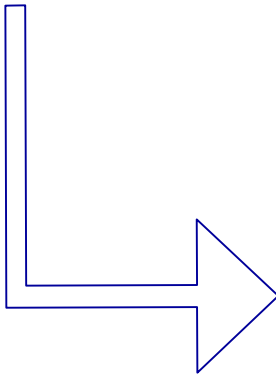U0 = 1000BASE-T MASTER/SLAVE Manual configuration enable
U1 = 1000BASE-T MASTER/SLAVE manual configuration value
U2 = Port type (multiport or single port)
U3 = 1000BASE-T full duplex
U4 = 1000BASE-T half duplex
U5 = 10GBASE-T full duplex
U6 = 10GBASE-T MASTER/SLAVE manual configuration enable
U7 = 10GBASE-T MASTER/SLAVE manual configuration value
U8:U10 = reserved

Option 2

- Create new message code for 10GBASE-T (0x9)

- Define new 10GBASE-T abilities page(s)

- Define new MASTER/SLAVE negotiation page, but use identical mechanism that 1000BASE-T uses

Option 2 – define new 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

U0:U10 = Random seed value (LSB:MSB)

Deciding between options

- Option 1 requires the fewest modifications to text

- Option 1 limits future extensions for 1000BASE-T and 10GBASE-T (3 reserved bits left)

- Option 2 increases (almost doubles) the amount of startup time if you support both 1000BASE-T and 10GBASE-T

- Option 2 has most flexibility for 10GBASE-T and leaves 1000BASE-T alone

Deciding between options

- What additional capabilities does 10GBASE-T need to negotiate besides duplex and manual configuration during the auto-negotiation process?
  - If the answer is none, then go with option 1
  - If the answer is quite a lot, then go with option 2

What about Annex 40C?

- Informative annex describing auto-negotiation for 1000BASE-T when you wish to send additional next pages (other than those required for 1000BASE-T operation).

- If we choose option 2, we will want to revisit 40C to make sure we don't break it and that it doesn't break what we want to do. It may be necessary to make modifications to this.

10GBASE-T Registers

- Clause 22 registers needed for auto-negotiation
  - Registers 0, 1, 4, 5, 6, 7, 8 needed for all auto-neg devices
  - 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

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
- …

What needs to be done next?

- Decide what information needs to be passed during the auto-negotiation process

- Decide on Option 1 or 2 (or something else)

- Prepare changes for Clauses 22, 28, 28B, 28C, 28D, 40, 40C, 45, and new ones for D1.0.

Backup slides

- List of necessary changes to existing clauses (not complete yet)

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 5.11 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

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

- If it is decided to add to 1000BASE-T pages
  - Rename message code 8 to include 10GBASE-T

- Else
  - 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 XX (10GBASE-T)
  - Summarize features of 10GBASE-T auto-negotiation and provide references to appropriate subclauses.