Link Retry Study for 1000BASE-T1

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Supporters

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Question to be answered

- **Do we need a standardized mechanism to synchronize the PHYs in cases where multiple link attempts are necessary to bring up the PHYs?**

Agenda

- Comparison of 1000BASE-T1 vs. 10GBASE-T and 1000BASE-T
- 10GBASE-T Link Retry Experimental Results
- Next Steps

1000BASE-T1 vs. 10GBASE-T and 1000BASE-T

	1000BASE-T1	10GBASE-T	1000BASE-T
Baud Rate	700ish MHz	800 MHz	125 MHz
PAM	3	16	5
Training PAM	TBD 2 or 3	2	3
Time for Training	< 100 ms	2000 ms	750 ms
Channels	1	4	4
TX shaping	??? TBD	PBO/THP	Partial Response
Echo	Yes	Yes	Yes
NEXT/FEXT	No	Yes	Yes
ANEXT	Yes	Yes	Yes
Noise Sources	AWGN, NBI, Burst	AWGN	AWGN
Max Distance	15 m	100 m	100 m

- **1000BASE-T1 is close to single channel 10GBASE-T**
- **1000BASE-T1 operates in a noisier environment**

Link Retry Study - Setup

- 4 pairs of 10GBASE-T PHYs from 4 different PHY manufacturers
- PHYs commonly available for sale in market

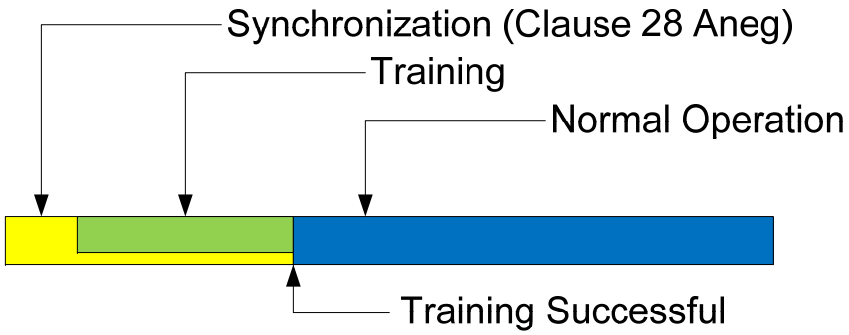
- Link all 4 x 4 combinations of master/slave
- Statistics collected on 10000 of link ups for each combination

- Did NOT stress the channel
- 8 meter cable – single cable, no patch cord
- Quiet environment – no ANEXT or injected noise sources

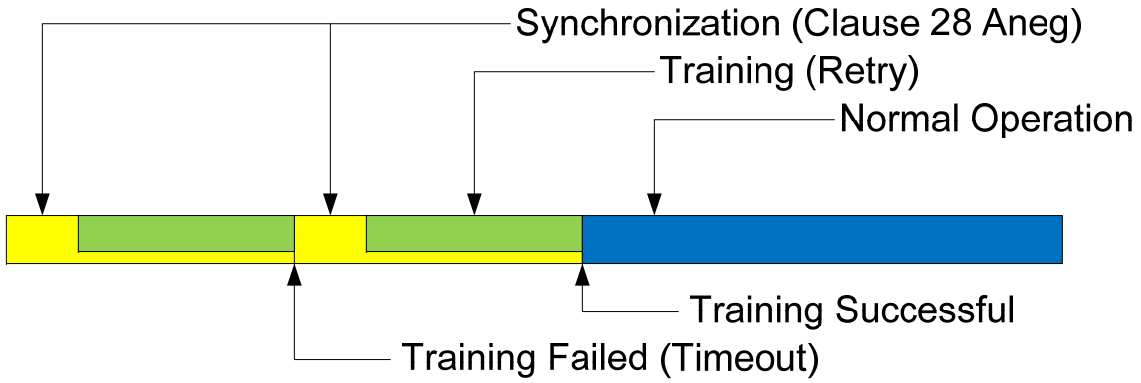
Link Retry Study – What we are measuring

- **More than 1 attempt / Total linkups**

- **1 Attempt**



- **2 (or more)**



10GBASE-T Link Retry Study - % Retry

		Slave			
	Vendor	A	B	C	D
Master	A	0.0%	0.0%	0.08%	0.0%
	B	0.0%	0.9%	0.10%	1.0%
	C	0.05%	0.0%	0.16%	0.15%
	D	0.02%	1.2%	0.17%	0.0%

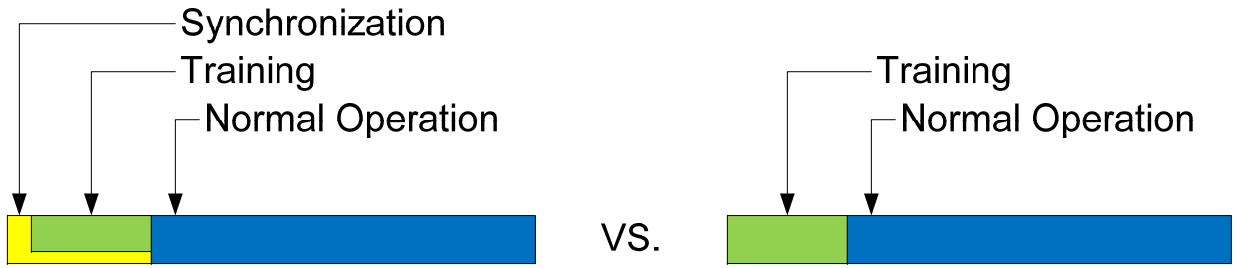
- All PHYs needed multiple attempts with at least two other company's PHYs
- Numbers worse at longer cable lengths

Other Considerations

- Clause 28 Auto-Negotiation is the standard mechanism to trigger link training retry
- Each failed link attempt had 2.0 to 2.25 seconds of training time before Auto-Negotiation timed out
  - 1000BASE-T1 needs to link in under 100ms
- Statistics do not show reason for failed link
  - Stuck due to PAM 2 training
  - Stuck due to PAM 2 to PAM 16 transition
  - Lock up for other reasons

Question for the Task Force

- **Do we need a standardized synchronization mechanism for 1000BASE-T1?**



  - **Clause 28 timeout not in 1000BASE-T1**
  - **Noisier environment, shorter training time ➔ possible increased probability of retry**
  - **No standardized mechanism ➔ interoperability issues during retry attempts, or lockups**

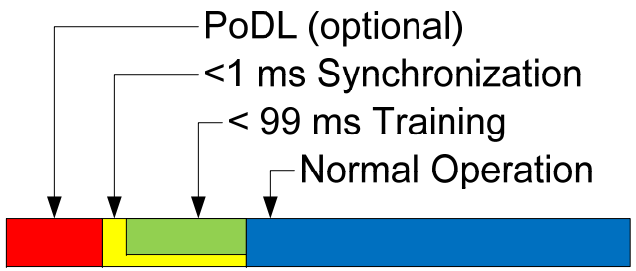
Questions for the Task Force

- **If a standardized synchronization mechanism for 1000BASE-T1 is needed then should we**
  - **A) Leverage and modify existing IEEE standards or**
  - **B) Invent something new**

- **Is Clause 73 Auto-Negotiation an acceptable starting point to leverage existing standards?**
  - **< 1ms synchronization time**
  - **Beijing presentations :**

    Lo_3bp_03_0314.pdf,

    Lo_3bp_04_0314.pdf



THANK YOU