



# Link Retry Study for 1000BASE-T1

IEEE 802.3bp – Interim Meeting - May 2014

William Lo, Marvell

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## Supporters

- ▶ **George Zimmerman - CME Consulting**
- ▶ **Tom Brown - Vitesse**

## 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**

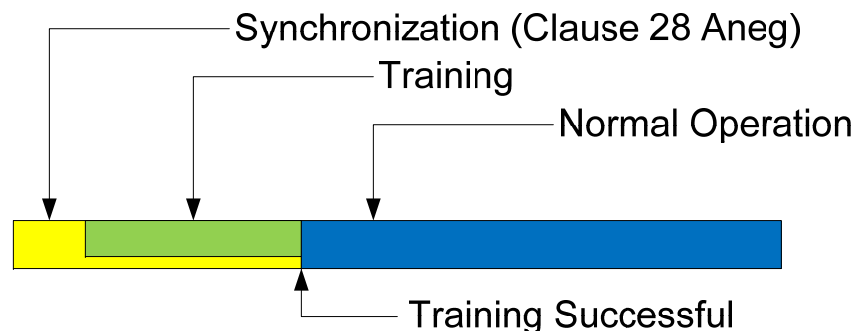
## Link Retry Study - Setup

- ▶ 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

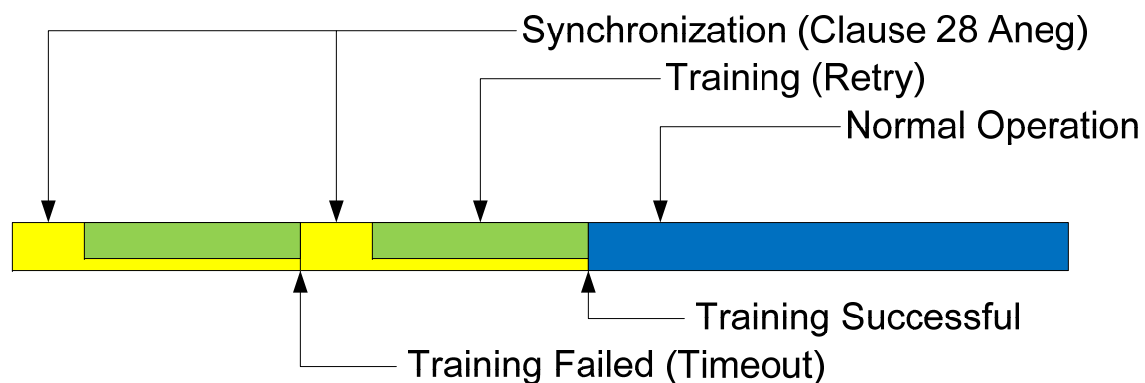
# Link Retry Study – What we are measuring

## ▶ 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%

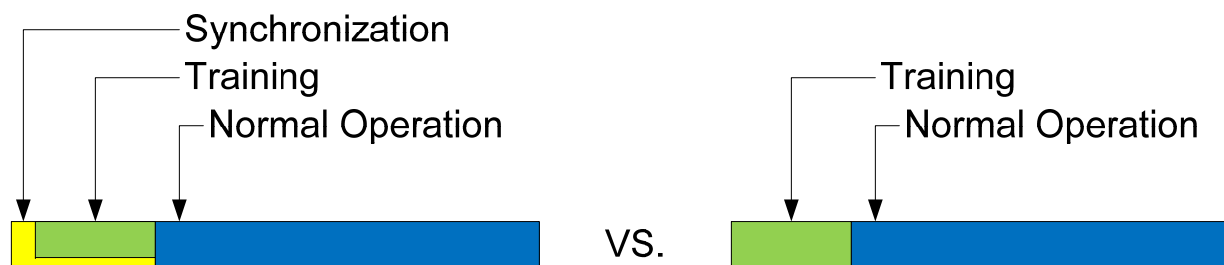
- ▶ All PHYs needed multiple attempts with at least two other company's PHYs
- ▶ Numbers worse at longer cable lengths

## 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?

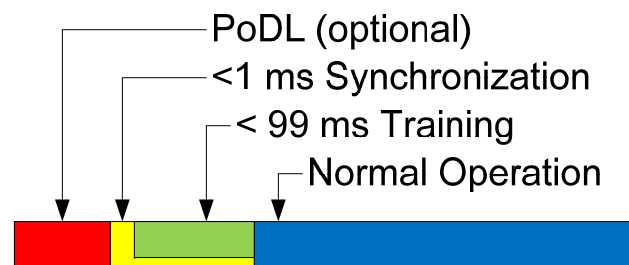


- Clause 28 timeout not in 1000BASE-T1
- Noisier environment, shorter training time → possible increased probability of retry
- No standardized mechanism → interoperability issues during retry attempts, or lockups



## 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