xGBASE-T Auto-Negotiation Proposal

802.3bq - 40GBASE-T Task Force
802.3bz - 2.5/5GBASE-T Task Force

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Objectives

▶ **Propose an Auto-Negotiation scheme to unify 2.5/5/25/40GBASE-T**

▶ **Insures Auto-Negotiation protocol exchange time will not increase**

▶ **Preserve flexibility to configure optional features**

IEEE Current Status – Not enough bits

▶ **Message page 9 used for 10GBASE-T and will be extended for 40GBASE-T**

- ▪ **Yellow – can be shared for 2.5 / 5 / 10 / 25 / 40GBASE-T**
- ▪ **Blue – Need 3 bits per speed (Need 12 new bits)**
- ▪ **Tan – Only 8 bits left**

D0-10	M0-10	Message Code = 9	D34	U18	PHY Short Reach
D11	T	Toggle	D35	U19	Fast Retrain
D12	Ack2	Acknowledge 2	D36	U20	PMA Training Request
D13	MP	Message Page = 1	D37	U21	Reserved
D14	Ack2	Acknowledge	D38	U22	100BASE-TX EEE
D15	NP	Next Page	D39	U23	1000BASE-T EEE
D16-26	U0-U10	Master/Slave Seeds	D40	U24	10GBASE-T EEE
D27	U11	10GBASE-T Master/Slave manual	D41	U25	Reserved
D28	U12	10GBASE-T Master/Slave config	D42	U26	Reserved
D29	U13	Port Type	D43	U27	Reserved
D30	U14	1000BASE-T Full Duplex	D44	U28	Reserved
D31	U15	1000BASE-T Half Duplex	D45	U29	Reserved
D32	U16	10GBASE-T Ability	D46	U30	Reserved
D33	U17	LD Loop Timing	D47	U31	Reserved

Option 1: Add new message page

▸ **Use Page 9 for 1/10/25/40G**

▸ **Define new page X for 2.5/5G**

▸ **Legacy 10GBASE-T PHYs only recognizes page 9**

▸ **Use cases:**
- **10/25/40G PHY - Exchange page 9 – same time as 10GBASE-T only exchange**
- **2.5/5G PHY   - Exchange page X – same time as 10GBASE-T only exchange**
- **5/10/25G PHY   - Exchange page 9 and X – longer than 10GBASE-T exchange**
- **1/2.5/5G PHY   - Exchange page 9 and X – longer than 10GBASE-T exchange**
- **1/2.5/5/10G PHY - Exchange page 9 and X – longer than 10GBASE-T exchange**

▸ **Longer Auto-Negotiation time in some PHY configurations**

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Reduce configuration flexibility

▶ **Option 2: One bit advertised capabilities for all speeds**
- ▪ **i.e. if EEE advertised, then all advertised speeds must be capable of EEE**
- ▪ **i.e. Same for fast retrain**

▶ **Option 3: Make optional capabilities mandatory for given speed**
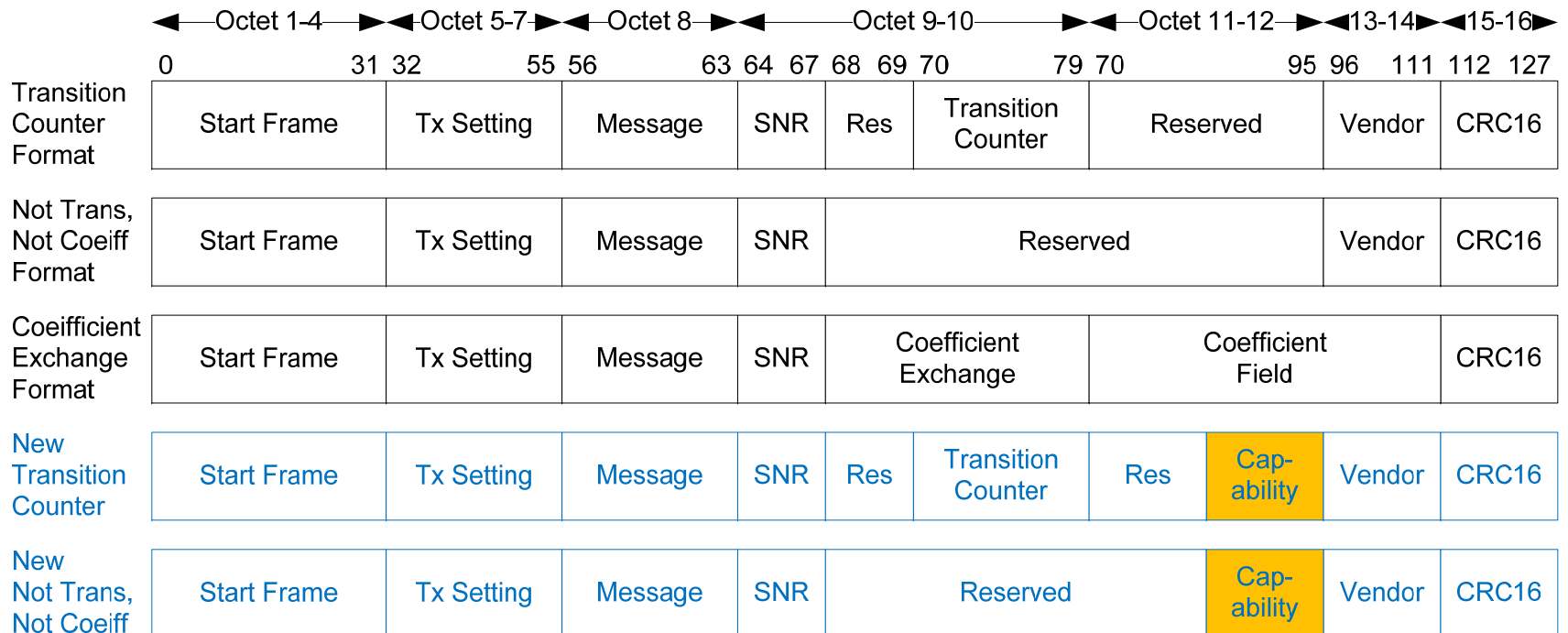- ▪ **i.e. EEE is mandatory, fast retrain is mandatory**

Option 4: Don't Pollute Auto-Negotiation Space

▶ **Option 4: Make use of extra bits already available somewhere else**
- ▪ **Optional capabilities advertised here**
- ▪ **1000BASE-T1 (802.3bp) does this**

▶ **Use Auto-Negotiation to advertise only speed**
- ▪ **2.5GBASE-T, 5GBASE-T, 25GBASE-T, 40GBASE-T**
- ▪ **EEE, fast retrain capabilities not exchanged during Auto-Negotiation**

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Use free bits in InfoField

▸ **Exchange optional capabilities during training InfoField exchange**
- **Octet 12 used to exchange EEE, fast retrain capabilities**
- **Octet 12 valid only during PMA_PBO_Exch state when Message<7:6> = 01**

▸ **No new circuit needed – use existing training circuit**

	Octet 1-4 (0–31)	Octet 5-7 (32–55)	Octet 8 (56–63)	SNR (64–67)	Res (68–69)	Octet 9-10 (70–79)	(70–95)	13-14 (96–111)	15-16 (112–127)
Transition Counter Format	Start Frame	Tx Setting	Message	SNR	Res	Transition Counter	Reserved	Vendor	CRC16
Not Trans, Not Coeiff Format	Start Frame	Tx Setting	Message	SNR		Reserved		Vendor	CRC16
Coeifficient Exchange Format	Start Frame	Tx Setting	Message	SNR		Coefficient Exchange	Coefficient Field		CRC16
New Transition Counter	Start Frame	Tx Setting	Message	SNR	Res	Transition Counter	Res	Cap-ability	Vendor	CRC16
New Not Trans, Not Coeiff	Start Frame	Tx Setting	Message	SNR		Reserved		Cap-ability	Vendor	CRC16

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Option 4: General Flow

▶ **First step - determine speed**

▶ **Second step – determine other capabilities**

▶ **Keep 10GBASE-T unchanged**

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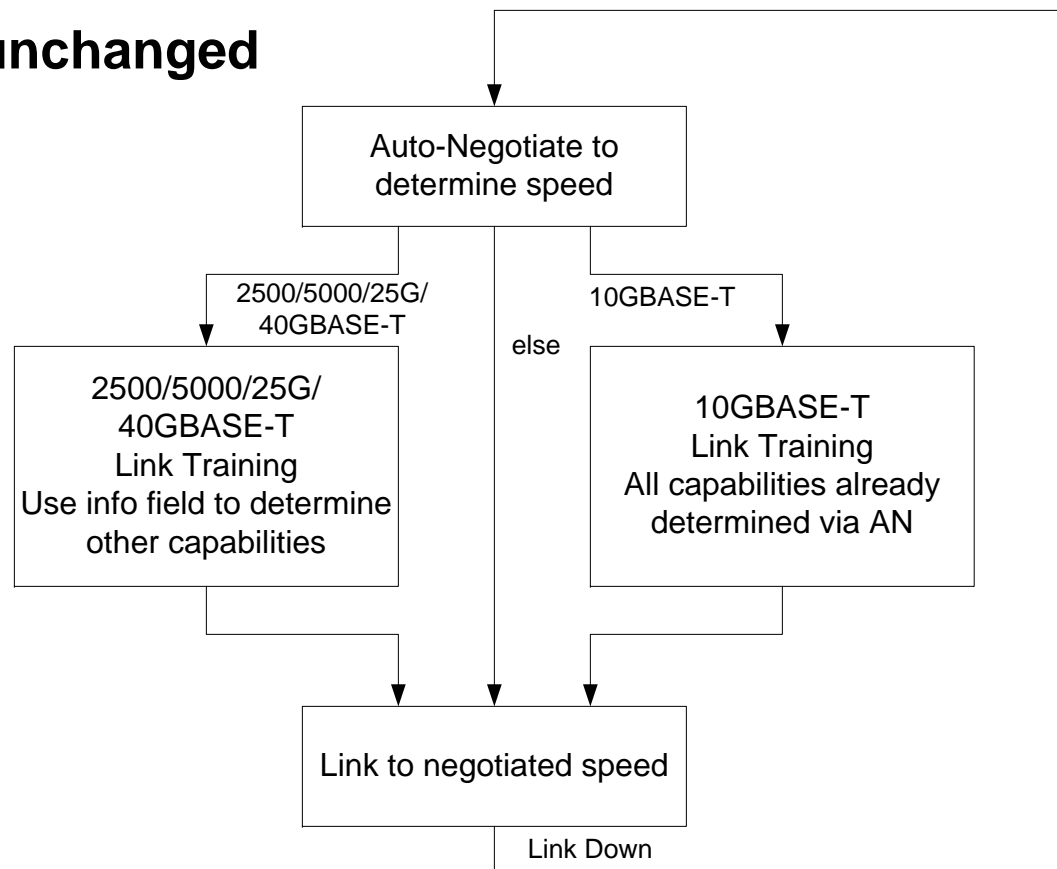
Octet 12 Format

▶ **Octet 12 valid when Message<7:6> = 01. Otherwise reserved**
- ▪ **Octet 12 must hold consistent value during exchange else behavior undefined**

▶ **Oct12<4:0> = Reserved**

▶ **Oct12<5> = Fast Retrain**
- ▪ **0 = Fast Retrain not supported**
- ▪ **1 = Fast Retrain supported**

▶ **Oct12<6> = THP Bypass Request in PMA_Coeff_Exch state**
- ▪ **0 = Local device requests link partner not to bypass THP during fast retrain**
- ▪ **1 = Local device requests link partner to bypass THP during fast retrain**

▶ **Oct12<7> = EEE Ability**
- ▪ **0 = EEE not supported**
- ▪ **1 = EEE supported**

▶ **EEE ability is enabled if both PHYs advertise EEE Ability**

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Fast Retrain Options

▶ **Device requests link partner's transmitter to behave a certain way during retraining.**

▶ **THP bypass request = 0**
- ▪ **link partner THP not bypassed in the PMA_Ceoff_Exch state during fast retrain**
- ▪ **Retrain link partner THP starting from current coefficient**
- ▪ **Current IEEE specified method for 10GBASE-T**

▶ **THP bypass request = 1**
- ▪ **link partner THP bypassed in the PMA_Ceoff_Exch state during fast retrain**
- ▪ **Retrain link partner THP from scratch**
- ▪ **Allows for better/faster retraining in some implementations**

▶ **Possible for one PHY to request one method and the other PHY to request other method**

IEEE Message 9 proposed mapping

▸ **Only use 4 out of 8 reserved bits (yellow)**

▸ **Only 10GBASE-T has EEE and Fast Retrain bits**

▸ **Loop Timing, no short reach assumed for 2.5, 5, 25, and 40G**

D0-10	M0-10	Message Code = 9	D34	U18	10GBASE-T PHY Short Reach
D11	T	Toggle	D35	U19	10GBASE-T Fast Retrain
D12	Ack2	Acknowledge 2	D36	U20	10GBASE-T PMA Training Request
D13	MP	Message Page = 1	D37	U21	Reserved
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D16-26	U0-U10	xGBASE-T Master/Slave Seeds	D40	U24	10GBASE-T EEE
D27	U11	xGBASE-T Master/Slave manual	D41	U25	40GBASE-T Ability
D28	U12	xGBASE-T Master/Slave config	D42	U26	25GBASE-T Ability
D29	U13	xGBASE-T Port Type	D43	U27	5GBASE-T Ability
D30	U14	1000BASE-T Full Duplex	D44	U28	2.5GBASE-T Ability
D31	U15	1000BASE-T Half Duplex	D45	U29	Reserved
D32	U16	10GBASE-T Ability	D46	U30	Reserved
D33	U17	10GBASE-T LD Loop Timing	D47	U31	Reserved

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Summary

▶ **Scheme allows 2.5 / 5 / 10 / 25 / 40GBASE-T to remain on Page 9**

  ▪ **No new page needed**

  ▪ **Retains per speed flexibility on optional capabilities**

  ▪ **Decouples optional capabilities from Auto-Negotiations**

  ▪ **Keeps spare bits available for future BASE-T speeds**

▶ **Info Field allows future expansion of optional capabilities independent of Auto-Negotiation**

▶ **Does not slow down Auto-Negotiation with new page**

▶ **Text of changes to 802.3bq D2.0 for this proposal can be found in McClellan_3bq_01_0515.pdf**

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THANK YOU