ACT Training Sequence Proposal

William Lo January 22, 2025

IEEE 802.3dm Asymmetrical Electrical Automotive Ethernet Task Force



General Training Sequence Proposal

- Keep as much of 802.3ch training sequence unchanged as possible
 - Same scrambling sequence
 - Same PHY Control and Link Monitor state diagrams
 - Same Infofield
 - Same Downstream Training Frame
 - Preserve the PFC24 increment rate in both directions
 - Not really required
- What is new
 - Upstream Training Frame

octet 1	octet 2	octet 3	octets 4/5/6	octet 7	octets 8/9/10	octets 11/12
0xBB	0xA7	0x00	PFC24	Message	PHY Capability Bits	CRC16

PMA state = 00

Figure 149–27—Infofield TRAINING format

 $PMA_state = 01$ octet 1 octet 2 octet 3 octets 4/5/6 octet 7 octets 8/9/10 octets 11/12 $0xBB \quad 0xA7 \quad 0x00 \quad PFC24 \quad Message \quad DataSwPFC24 \quad CRC16$

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Figure 149–28—Infofield COUNTDOWN format



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802.3ch Training Frame

- Training frame is continuous LFSR stream of 7200 bits or 1280ns, 2560ns, 5120ns in 10G, 5G, 2.5G ٠
- A partial frame is defined to be 450 bits long. Each partial frame duration increments the PFC by 1. ۲
- Training frame is aligned to the 16Nth partial frame boundary ٠
- Infofield is 12 bytes or 96 bits XOR into the LFSR bit stream and aligned to the start of the 16N+15th ٠ partial frame. PFC24 field of Infofield starts at 15 and increments by 16 for each training frame
- The bits of the LFSR stream corresponding to the start of each partial frame is inverted as shown in ٠ red except at the infofield.
- Four Reed Solomon frames are aligned to each training frame boundary after training finishes. ۲

PFC24	0 1 2 3	4 5 6 7	8 9 10 11	12 13 14 15	16 17 18 19	20 21 22 23	24 25 26 27	28 29 30 31		
	Trai	ning frame (Pl	C24 = 15)		Training	rame (PFC24	= 3 .)		Infofield	
	RS-FEC frame	RS-FEC frame	RS-FEC frame	RS-FEC frame	RS-FEC frame	RS-FEC frame	RS-FEC frame	RS-FEC frame		
	L = 2 su	perframe	L = 2 su	perframe	L = 2 su	perframe	L = 2 su	perframe		
		L = 4 super-								
RS-FEC frame count	0	1	2	3	4	5	6	7		•
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Ethernet Task Force		Fig	ure 149-	-12—Tim	ing ⁵ relat	ionship t	o PFC24	L ZZ Ja	in 2025	

100M Training Frame in relationship to 2.5G

- 100M training frame duration same as 2.5G training frame at 5120ns
- 100M training frame is 600 bits or two RS(50, 46, GF(2⁶)) frames
 - Each bit is DME encoded
- 100M partial frame duration = 300 bits
- Infofield definition is the same
- Infofield placed at bits 400 to 495 bits of training frame
 - Leaves about 100 bits either side of inversion

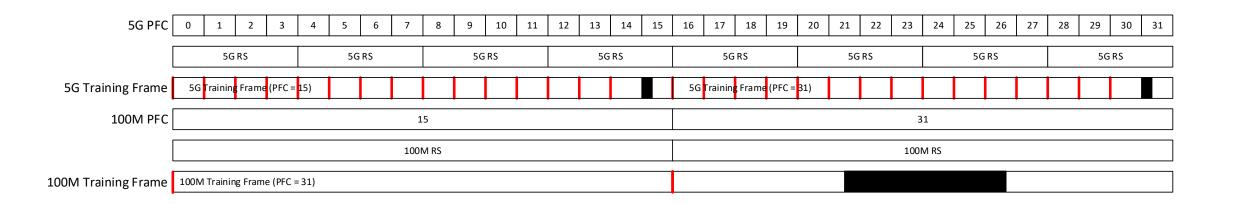
- The bits of the LFSR stream corresponding to the start of each partial frame is inverted as shown in red
- Partial frame count starts at 7 and increments by 8
 - PFC24 field is 16N+15 for the Nth training frame

2.5G PFC	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15		
[2.50	G RS			2.5	G RS			2.50	G RS		2.5G RS					
2.5G Training Frame	2.5G Train	ing Frame							2.5G Traini	ng Frame (PFC	= 15)							
100M PFC				-	7				15									
[1001	VI RS				100M RS									
100M Training Frame	100M Traini	ng Frame (PFC =	: 15)															



100M Training Frame in relationship to 5G

- No change to the 100M training frame in 2.5G except as discussed below
- 100M training frame duration same as two 5G training frame at 2 x 2560ns = 5120ns
- To keep pace with the 5G PFC24 count
 - Partial frame count starts at 15 and increments by 16
 - PFC24 field is 32N+31 for the Nth training frame





100M Training Frame in relationship to 10G

- No change to the 100M training frame in 2.5G except as discussed below
- 100M training frame duration same as four 10G training frame at 4 x 1280ns = 5120ns
- To keep pace with the 5G PFC24 count
 - Partial frame count starts at 31 and increments by 32
 - PFC24 field is 64N+63 for the Nth training frame

10G PFC [0 1 2 3	4 5 6 7	8 9 1 1 0 1	1 1 1 1 2 3 4 5	1 1 1 1 6 7 8 9	2 2 2 2 0 1 2 3	2 2 2 2 4 5 6 7	2 2 3 3 8 9 0 1	3 3 3 3 2 3 4 5	3 3 3 3 6 7 8 9	4 4 4 4 0 1 2 3	4 4 4 4 4 5 6 7	4 4 5 5 8 9 0 1	5 5 5 5 2 3 4 5	5 5 5 5 6 7 8 9	6 6 6 6 0 1 2 3	
[10G RS	10G RS	10G RS	10G RS	10G RS	10G RS	10G RS	10G RS	10G RS	10G RS	10G RS	10G RS	10G RS	10G RS	10G RS	10G RS	
10G Training Frame	10G Training	; Frame (PFC =	15)		10G Trainin	; Frame (PFC =	31)		10G Training	; Frame (PFC =	47)		10G Trainin	; Frame (PFC =	63)		
100M PFC				3	1				63								
[10G RS											100	M RS				
100M Training Frame	100M Trainin	g Frame (PFC =	63)														



PHY Capabilities

- Some bits in Infofield changed to reserved
 - i.e. Interleave and Precoder does not apply to upstream receiver

octet 8									octet 9							octet 10								
0	1	2	3	4	5	6	7	0	0 1 2 3 4 5 6 7 0 1 2 3 4 5 6													6	7	
					Ve	endo	orSp	ecif	icDa	ata						Reserved		InterleaverDenth		DracodaSal	SlowWakeRequest	EEEen	OAMen	

Table 149–12—PHY capability bits



Core Text Describing Training Frame

• Use 802.3ch – unchanged for downstream

$$S_n = \begin{cases} Scr_n[0] \oplus InfoField_{(n \mod 450)} 6750 \le (n \mod 7200) \le 6845 \\ Scr_n[0] \oplus 1 & \text{else if } (n \mod 450) = 0 \\ Scr_n[0] & \text{otherwise} \end{cases}$$
(149–7)

• For upstream

$$S_n = \begin{cases} Scr_n[0] \oplus InfoField_{(n \mod 100)} & 400 \le (n \mod 600) \le 495 \\ Scr_n[0] \oplus 1 & \text{else if } (n \mod 300) = 0 \\ Scr_n[0] & \text{otherwise} \end{cases}$$

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Summary

- Preserve 802.3ch training mechanism
- Adjust the upstream training frame to fit the 100M timing
- Upstream training frame duration integer multiples of downstream training frame duration
- Preserves rate at which PFC24 increments
- Some adjustments may be required on PHY capability bits in Infofield



THANK YOU

