ENT-AN1040

Application Note

Encapsulation Support in Microsemi IEEE 1588v2 PHYs

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Contents

1 Revision History

The revision history describes the changes that were implemented in the document. The changes are listed by revision, starting with the most current publication.

1.1 Revision 2.0

In revision 2.0 of this document, formatting was updated.

1.2 Revision 1.0

Revision 1.0 was the first publication of this document.

2 Encapsulation Support in Microsemi IEEE 1588v2 PHYs

This document gives a general overview of IEEE 1588v2 PTP and Y.1731 OAM encapsulation support in Microsemi PHYs.

The documents for the following products are available for reference: VSC8492 Dual Channel Universal 10G PHY or 10 GbE PHY with OTN/FEC and IEEE 1588; VSC8494 Quad Channel Universal 10G PHY or 10 GbE PHY with OTN/FEC and IEEE 1588; VSC8488-15 Dual Channel WAN/LAN/Backplane XAUI to SFP+/KR Transceiver; and VSC8487-15 WAN/LAN/Backplane XAUI to SFP+/KR Transceiver.

Microsemi 1588v2 PHYs support the following encapsulations for 1588v2/PTP frames:

- Ethernet with 0, 1, or 2 VLAN tags
- UDP over IPv4
- UDP over IPv6
- MPLS
- Pseudo-wires
- PBB and PBB-TE tunnels
- IP/IP tunnel

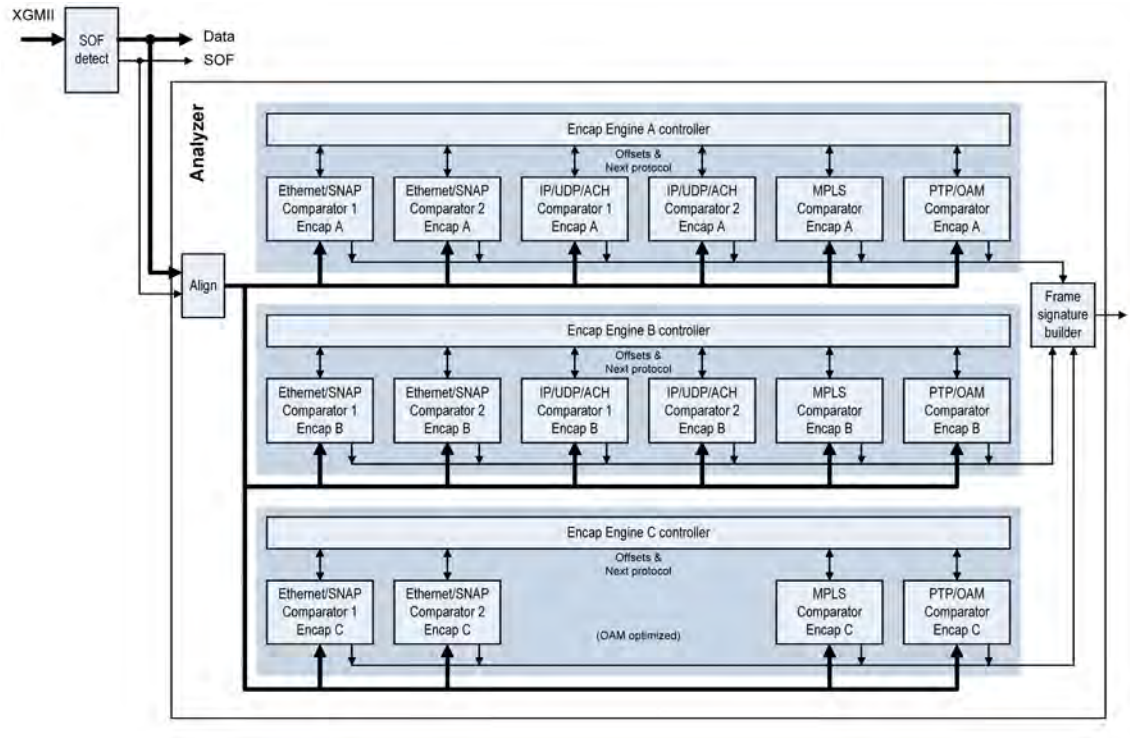
Microsemi 1588v2 PHYs support the following encapsulations for OAM/Y.1731 frames:

- Ethernet with 0,1, or 2 VLAN tags
- PBB: Y.1731 OAM over PBB
- MPLS PWE: Y.1731 OAM delivery over MPLS PWE

2.1 Encapsulation Engines

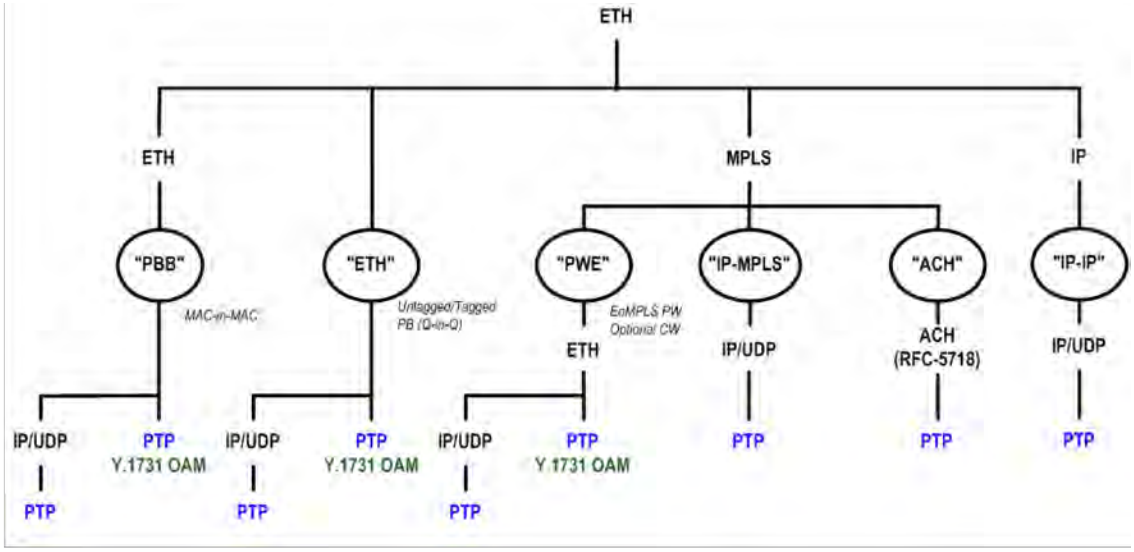
Microsemi 1588v2 PHYs use 3 programmable encapsulation engines (A, B, and C), and each engine can classify up to 8 flows (24 total) in each direction (ingress and egress). PTP/Y.1731 frames are parsed from each flow, as shown in the following illustration:

Figure 1 • Encapsulation Engines



Engines A and B support one encapsulation each and are shared across two ports in a PHY. Engines A and B support both PTP and OAM/Y.1731 in the encapsulations shown in the following illustration:

Figure 2 • Engines A and B Encapsulation Support



Each engine has 6 programmable comparators used to match each protocol in an encapsulation stack. Each engine comparator can match up to 8 different flows, as shown in the following table:

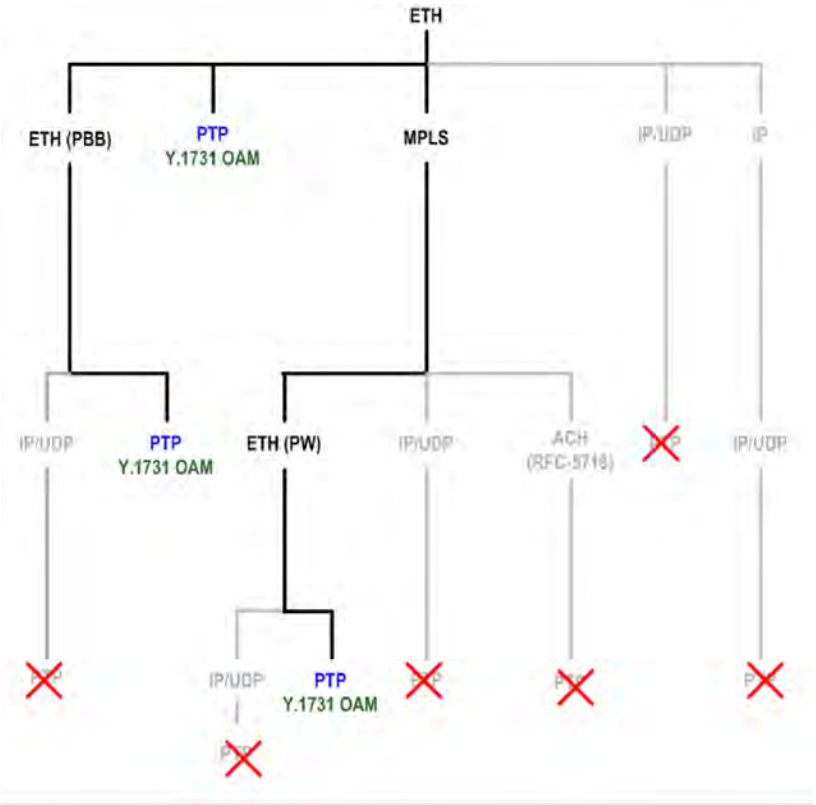
Table 1 • Comparators

Comparator Name	Sequence	Engine A/B Flows	
Ethernet Comparator 1	First	8	8
Ethernet Comparator 2	Intermediate	8	8
IP/UDP/ACH Comparator 1	Intermediate	8	NA
IP/UDP/ACH Comparator 2	Intermediate	8	NA
MPLS Comparator	Intermediate	8	8
PTP/Y.1731 OAM Comparator	Last	6	6

The comparators must be programmed in a sequence based on the desired encapsulation in the previous illustration, where Ethernet is always first and PTP/OAM is last. The last stage PTP/OAM comparator executes one of six timestamp actions based on message types.

The following illustration shows that engine C supports a subset of encapsulations and is shared across two ports in a PHY.

Figure 3 • Engine C Encapsulation Support



Engine C can support two encapsulations simultaneously, but one encapsulation must be Ethernet while the others can be PBB or MPLS PW. Engine C has only four comparators, and it does not support IPv4 /IPv6. Engine C supports both PTP and Y.1731/OAM, but it is optimized for OAM and only supports 1-step PTP (no 2-step).

2.2 Comparator Stages and Flows

Each comparator matches up to 8 different flows based on the following:

- Ethernet/PBB: source address (SA) and destination address (DA), and VLAN/PBB tags
- IPv4/IPv6: SA/DA
- MPLS labels

Matching continues until a PTP/OAM message is parsed from each flow in the encapsulation. Finally, the last stage PTP/OAM comparator executes one of six time stamp actions or no operation (NOP) based on the following message types:

- PTP: Sync, Delay_Req, Pdelay_Resp
- Y.1731/OAM: 1DM, DMM, DMR

The first 8 bytes in the PTP header are used to determine the time stamp action for PTP frames. Likewise, the first 4 bytes in the Y.1731 header are used to determine the time stamp action for Y.1731 frames.

The following table shows supported encapsulations with comparator stages and associated flow matching fields.

Table 2 • Encapsulation Engine Comparator Stages and Flow Match Fields

#	Encapsulation	Stage 1 Comp	Stage 2 Comp	Stage 3 Comp	Stage 4 Comp	Stage 5 Comp	Engine
1	PTP-OAM /Ethernet Type I and II w/ LLC or LLC and SNAP	Ethernet 8 flows match on SA/DA, 0, 1, or 2 VLANs	PTP-OAM				A, B, C
2	PTP/UPD/IP /ETH IPv6 or IPv4	Ethernet 8 flows match on SA/DA, 0, 1, or 2 VLANs	UDP/IP 8 flows match on IP SA/DA	PTP			A, B
3	PTP-OAM/ETH /ETH PBB: No B-Tag, or 1 B-Tag	Ethernet 8 flows match on B-SA/B-DA and I-Tag, and B-Tag if present	Ethernet 8 flows match on C-SA/C-DA	PTP-OAM			A, B, C
4	PTP/UDP/IP/ETH /ETH PBB: No B-Tag, or 1 B-Tag	Ethernet 8 flows match on B-SA/B-DA and I-Tag, and B-Tag if present	Ethernet 8 flows match on C-SA/C-DA	UDP/IP 8 flows match on IP SA/DA	PTP		A, B
5	PTP-OAM/ETH /MPLS/ETH “MPLS PW” MPLS with optional CW	Ethernet 8 flows match on SA/DA, 0, 1, or 2 VLANs	MPLS 8 flows match on 1-4 labels (exact value, range, or don’t care)	Ethernet 8 flows match on SA/DA, 0, 1, or 2 VLANs	PTP-OAM		A, B, C
6	PTP/UDP/IP/ETH /MPLS/ETH “MPLS PW” IPv6 or IPv4 MPLS with optional CW	Ethernet 8 flows match on SA/DA, 0, 1, or 2 VLANs	MPLS 8 flows match on 1-4 labels (exact value, range, or don’t care)	Ethernet 8 flows match on SA/DA, 0, 1, or 2 VLANs	UDP /IP 8 flows match on IP SA /DA	PTP	A, B
7	PTP/UDP/IP /MPLS/ETH “IP-MPLS” IPv6 or IPv4 MPLS with optional CW	Ethernet 8 flows match on SA/DA, 0, 1, or 2 VLANs	MPLS 8 flows match on 1-4 labels (exact value, range, or don’t care)	UDP/IP 8 flows match on IP SA/DA	PTP		A, B
8	PTP/ACH/MPLS /ETH	Ethernet	MPLS	ACH	PTP		A, B

#	Encapsulation	Stage 1 Comp	Stage 2 Comp	Stage 3 Comp	Stage 4 Comp	Stage 5 Comp	Engine
	"MPLS-TP" IPv6 or IPv4 MPLS with optional CW	8 flows match on SA/DA, 0, 1, or 2 VLANs	8 flows match on 1-4 labels (exact value, range, or don't care)	No flows in ACH ACH protocol verified			
9	PTP/UPD/IP/IP "IP-in-IP" IPv6 or IPv4	Ethernet 8 flows match on SA/DA, 0, 1, or 2 VLANs	IP 8 flows match on IP SA/DA	UDP/IP 8 flows match on IP SA/DA	PTP		A, B

2.2.1 Example Encapsulations

The following examples show a few typical encapsulations. There are many more encapsulations supported.

2.2.1.1 PTP-OAM/ETH

- Without VLAN tags
  - Ethernet comparator is set to match flows based on SA/DA and no VLAN tags.
- With 802.1Q tagged frames
  - Ethernet comparator is set to match flows based on SA/DA and 1 VLAN tag.
- With 802.1ad double-tagged frames
  - Ethernet comparator is set to match flows based on SA/DA, and 2 VLAN tags.

2.2.1.2 PTP/UPD/IP/ETH

- Without VLAN tags
  - Ethernet comparator is set to match flows based on SA/DA and no VLAN tags.
  - UDP/IPv6 (or IPv4) comparator matches flows based on IP SA/DA.
- With 802.1Q tagged frames
  - Ethernet comparator is set to match flows based on SA/DA and 1 VLAN tag.
  - UDP/IP comparator is set to match flows based on IPv6 (or IPv4) SA/DA.
- With 802.1ad double-tagged frames
  - Ethernet comparator is set to match flows based on SA/DA and 2 VLAN tags.
  - UDP/ IP comparator is set to match flows based on IPv6 (or IPv4) SA/DA.

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