

**ENT-AN1040**  
**Application Note**  
**Encapsulation Support in Microsemi IEEE 1588v2 PHYs**

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# 1      **Revision History**

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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

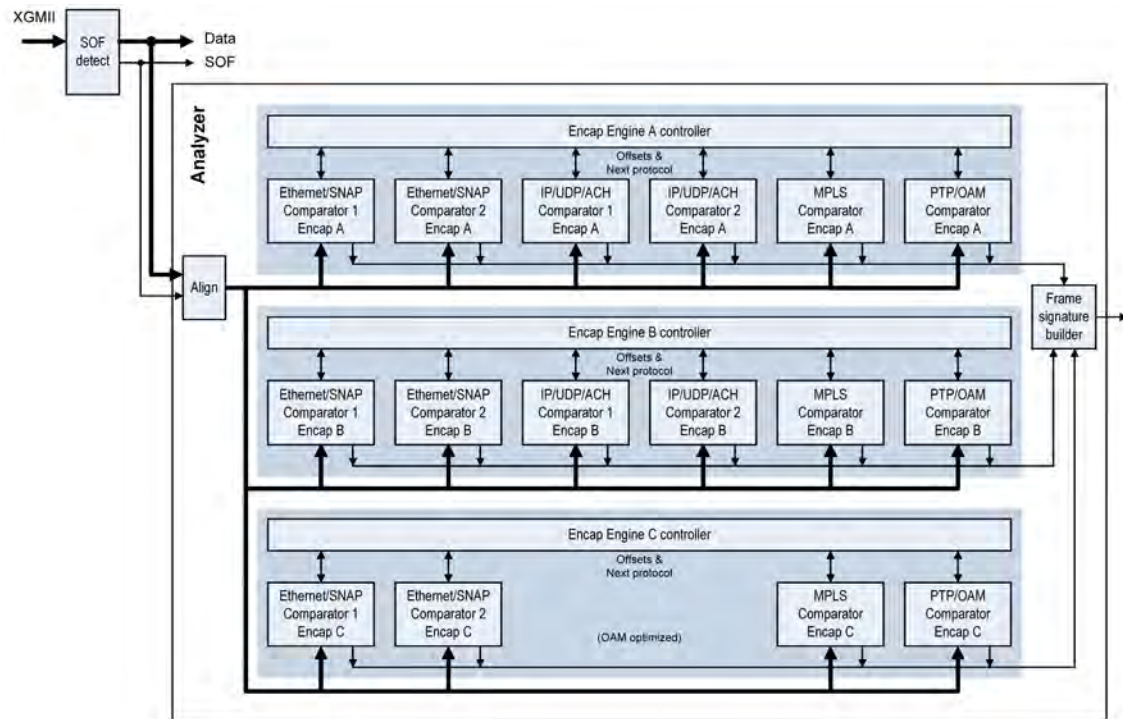
Microsemi 1588v2 PHYs support the following encapsulations for OAM/Y.1731 frames:

- 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

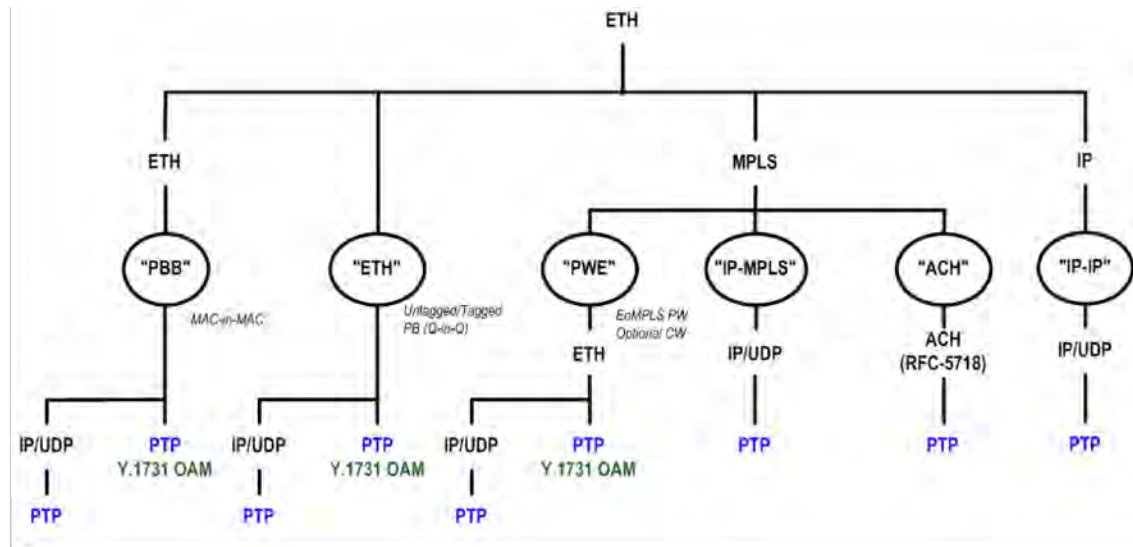
Microsemi 1588v2 PHYs use 3 programmable encapsulation engines (A, B, and C), and each engine can classify up to 8 flows (24 total) in each direction (ingress and egress). PTP/Y.1731 frames are parsed from each flow, as shown in the following illustration:

**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**



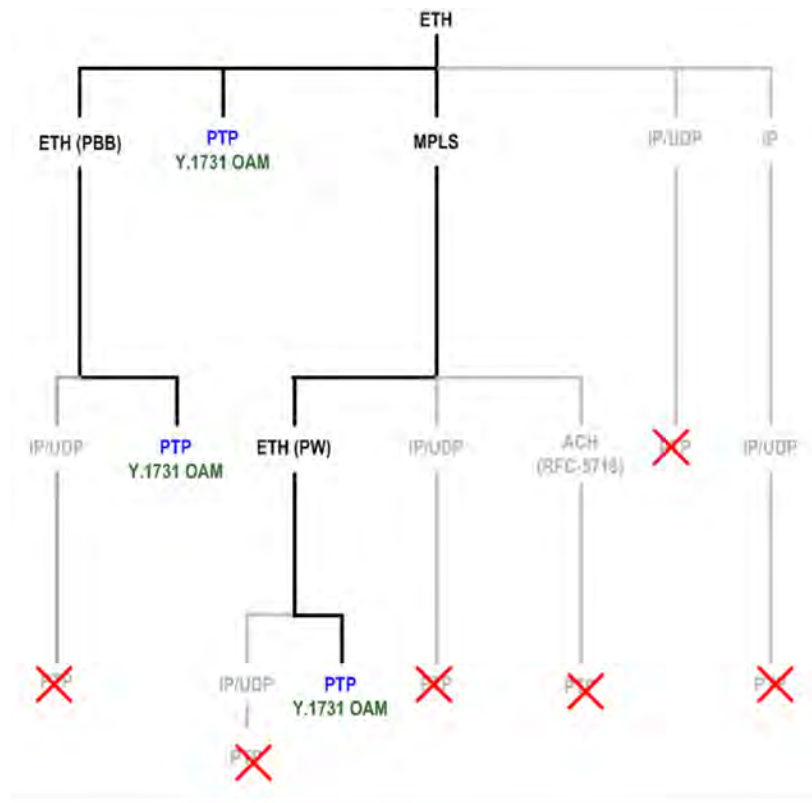
Each engine has 6 programmable comparators used to match each protocol in an encapsulation stack. Each engine comparator can match up to 8 different flows, as shown in the following table:

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

## 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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