WHITE PAPER

Metro Ethernet Forum Layer 2 Control Protocol Handling

Executive Summary

This white paper provides information about Layer 2 control protocols (L2CP) according to the Metro Ethernet Forum specifications.

Most of the information in this paper is based on contents in the MEF 45 technical specification "Multi-CEN L2CP" from August 2014 and MEF 6.1.1 "Layer 2 Control Protocol Handling Amendment to MEF 6.1".

In summary, this paper describes:

1. What L2CP is, and why certain rules apply to such protocols in a Carrier Ethernet network (CEN);
2. How the different L2CP destination MAC addresses and protocol types should be handled according to Metro Ethernet Forum for EPL options 1 and 2, E-Tree, E-LAN, EVPL, EVP-LAN, and EVP-Tree.

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1 Introduction

The Layer 2 control plane is separated into multiple customer and provider control planes. It allows a certain Layer 2 control protocol to operate only within a provider network, to allow interaction between the customer and the provider network, or to pass transparently through a provider network in complete isolation from other customer networks.

A L2CP frame is defined as any frame containing a destination MAC address that is one of the 32 addresses reserved for control protocols by the IEEE standard 802.1Q-2011. The handling of different L2CP frames, that is, whether they should be peered[1] , forwarded, or discarded, is specified in MEF 45 and MEF 6.1.1 for the different standardized carrier Ethernet services.

There are two types of Layer 2 control protocols, as laid out in Table 1:

Table 1: Layer 2 control protocol types.

L2CP MAC Destination Address	Description
01:80:C2:00:00:00 … 01:80:C2:00:00:0F	Bridge protocols
01:80:C2:00:00:20 … 01:80:C2:00:00:2F	Multiple Registration (MRP) protocols

In IEEE 802.1 bridges, these addresses have special forwarding rules that facilitate the deployment and operation of Layer 2 control protocols. While a protocol that affects the configuration or the operation of a Layer 2 network can use any type of frame with ordinary unicast or multicast addresses, the protocols that are considered Layer 2 control protocols (using the reserved addresses above) can take advantage of special forwarding rules.

2 Bridge Protocols Group of Destination MAC Addresses

The special forwarding rule for L2CP frames with a destination address from the “Bridge protocols” block is that a bridge will not normally propagate the frame from the ingress port to any other port of the bridge. The reason for this rule is that a device should be able to send a frame intended to reach a neighboring device and be confident that the frame will not propagate beyond the neighboring device, even if the neighbor does not recognize the protocol. This mechanism prevents the frame from ending up at some other device for which it was not intended. Many protocols, such as Link Aggregation Control Protocol (LACP), Link Layer Discovery Protocol (LLDP), and Link Operation Administration and Management, rely on this forwarding behavior.

Now of course, things are not quite as straightforward. As explained in chapter 1, the Layer 2 control plane is separated into multiple customer and provider control planes. For example, the MAC address 01:80:C2:00:00:0E has the scope of “Nearest bridge”, and thus it should be filtered by the Service provider PE (provider edge), while the address 01:80:C2:00:00:00 has the scope of “Nearest Customer Bridge”, and that address will be filtered at the other CE (customer edge) on the other side of, for example, an Ethernet Private Line (EPL) service.

[1] Peered means that the provider network will take an active part in the signaling flow, and not just drop or forward transparently.

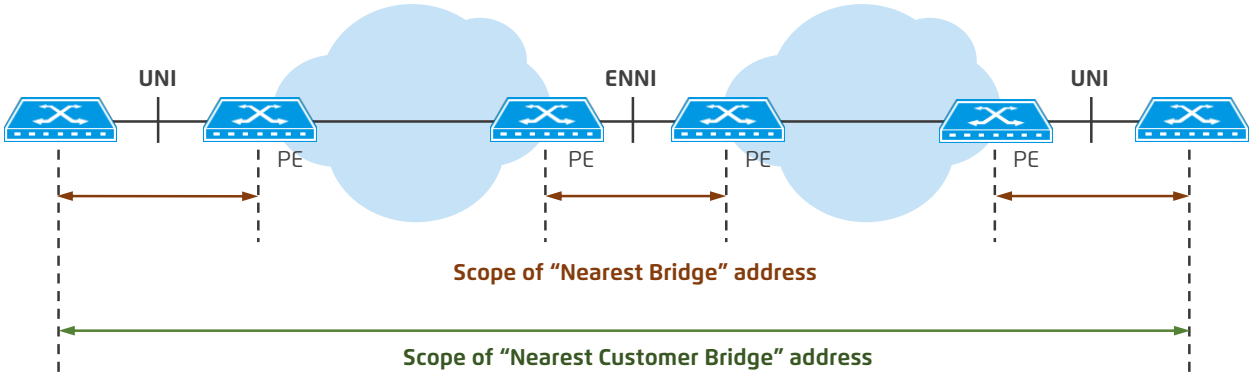

Figure 1: Illustration of the concepts "Nearest Bridge" and "Nearest Customer Bridge".

3 MRP Group of Addresses

The **Multiple Registration Protocol (MRP)** enables bridges, switches, and other similar devices to register and deregister attribute values, such as VLAN identifiers and multicast group membership across a Layer 2 network. MRP replaced Generic Attribute Registration Protocol (GARP) and is a generic registration framework defined by the IEEE 802.1ak amendment to the IEEE 802.1Q standard.

The **Multiple MAC Registration Protocol (MMRP)** is an MRP protocol for registering group MAC addresses (i.e. multicast) on multiple switches. MMRP replaced GMRP, GARP Multicast Registration Protocol.

The **Multiple VLAN Registration Protocol (MVRP)** is an MRP protocol for automatic configuration of VLAN information on switches. MVRP replaced GVRP, GARP VLAN Registration Protocol.

The forwarding rule for the MRP range of protocols is that any frame with a MAC destination address in the MRP range must pass through the service provider network only if it does not peer any protocol sent with a destination address within that range.

If the bridge peers any protocol within this address range, then it should either peer the incoming frame or discard it. This forwarding rule allows a protocol entity to send a frame to the nearest device that understands the protocol. Any intervening devices that do not understand the protocol will forward it. This in contrast to the bridge type of protocols.

4 L2CP Behavior According to MEF

From the customer's point of view, it is important to know how these protocols (especially some, such as STP) are handled when purchasing a link from a service provider.

From the operator's or service provider's point of view, it is also important to know where actions are taken on L2CP frames, especially from an interoperability perspective, since many deliveries span several operator networks (off-net deliveries).

- Peer means that the L2CP frame will be processed.
- Pass (or forwarded) means that the frame will be passed transparently in the same way as normal data frames.
- Discard means that the L2CP frame is neither peered nor forwarded.

4.1 Port-based Services

In Table 2, we summarize the required behavior for various *port-based* services according to MEF 6.1.1.

Table 2: Port-based services: Required L2CP actions as a function of destination MAC address.

Destination MAC Address	L2CP Action for EPL Option 1, EP-Tree and EP-LAN (port-based services)
01:80:C2:00:00:00	MUST Tunnel
01:80:C2:00:00:01 … 01:80:C2:00:00:0A	MUST NOT[2] Tunnel (see Table 3)
01:80:C2:00:00:0B … 01:80:C2:00:00:0D	MUST Tunnel
01:80:C2:00:00:0E	MUST NOT Tunnel (see Table 3)
01:80:C2:00:00:0F	MUST Tunnel
01:80:C2:00:00:20 … 01:80:C2:00:00:2F	MUST Tunnel

Where Table 2 says "MUST NOT Tunnel", the prescribed L2CP action is according to Table 3 below.

Table 3: Port-based services: Required L2CP actions as a function of protocol type.

Protocol Type	L2CP Action for EPL Option 1	L2CP Action for EPL Option 2	L2CP Action for EP-LAN and EP-Tree
STP/RSTP/MSTP (LLC: 0x42)	MUST Tunnel	MUST Tunnel	MUST Peer or Discard
Pause (0x8808)	MUST Discard	SHOULD Discard	MUST Discard
LACP/LAMP (0x8809, subtypes 0x01, 0x02)	MUST Peer or Discard	SHOULD Tunnel	MUST Peer or Discard
Link OAM (0x8809, subtype 0x03)	MUST Peer or Discard	SHOULD Tunnel	MUST Peer or Discard
Port Authentication (0x888E)	MUST Peer or Discard	SHOULD Tunnel	MUST Peer or Discard
E-LMI (0x88EE)	MUST Peer or Discard	MUST Tunnel	MUST Peer or Discard
LLDP (0x88CC)	MUST Peer or Discard	MUST Tunnel	MUST Discard
PTP Peer Delay (0x88F7)	MUST Peer or Discard	SHOULD Tunnel	MUST Peer or Discard
ESMC (0x8809, subtype 0x0A)	MUST Peer or Discard	MUST Tunnel	MUST Peer or Discard

As can be seen, the L2CP Action for EPL Option 2 is more transparent. In order to support SONET/SDH-like EPL services, the MEF defined a more transparent option for EPL. In this option, known as option 2 in MEF 6.1.1, the service is provided transparently, not passing bridges which block some L2CP frames.

4.2 VLAN-based Services

In the case of *VLAN-based* services, the required behavior according to MEF 6.1.1 appears from Table 4 and Table 5.

[2] This is to be interpreted as "does not have to" in accordance with the conventions of the specification.

Table 4: VLAN-based services: Required L2CP actions as a function of destination MAC address.

Destination MAC Address	L2CP Action for EVPL, EVP-LAN, and EVP-Tree (VLAN-based services)
01:80:C2:00:00:00 … 01:80:C2:00:00:2F	MUST NOT Tunnel

The behavior is thus given by Table 5 below for all destination MAC addresses, depending on protocol type.

Table 5: VLAN-based services: Required L2CP actions as a function of protocol type.

Protocol Type	L2CP Action for EVPL , EVP-LAN, and EVP-Tree
STP/RSTP/MSTP (LLC: 0x42)	MUST Peer or Discard
Pause (0x8808)	MUST Discard
LACP/LAMP (0x8809, subtypes 0x01, 0x02)	MUST Peer or Discard
Link OAM (0x8809, subtype 0x03)	MUST Peer or Discard
Port Authentication (0x888E)	MUST Peer or Discard
E-LMI (0x88EE)	MUST Peer or Discard
LLDP (0x88CC)	MUST Discard
PTP Peer Delay (0x88F7)	MUST Peer or Discard
ESMC (0x8809, subtype 0x0A)	MUST Peer or Discard

5 About Netrounds

Netrounds is a pioneer in solutions for software-based test, measurement and monitoring of a wide range of quality-sensitive services, covering IPTV, VoIP and business VPNs over fixed, mobile, and virtual networks. Netrounds helps carriers to control their customers' experience, by offering assurance capabilities when they want it, wherever they want it.

Netrounds was born in the software domain, with no legacy bindings to bulky, complex and expensive hardware solutions. Offered as a self-serviced SaaS solution, Netrounds has set forth to transform the test and measurement industry in a way similar to Salesforce with customer relationship management (CRM) solutions.

For the purpose of carrier Ethernet service turn-up and troubleshooting, Netrounds' downloadable Test Agents can be quickly deployed anywhere in the world and used to verify all relevant parts of a carrier Ethernet compliant connection, including Layer 2 control protocol handling, VLAN and CoS preservation, and performance according to Y.1564. As the powerful Test Agents can be instantly downloaded for service turn-up anywhere in the world, it is perfectly suited for "off-net" international deliveries, for agile service providers that aim to shorten the time from ordering to activation.