## Contribution To Precise Networked Clock Synchronization Working Group- IEEE 1588 revision

**TITLE:**    Addresses and Assigned numbers – Working Technical Description

**WORKING ITEM:**    Addresses and Assigned numbers
**Revision**:    1

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This document proposes an addressing scheme and assigned numbers for PTPv2.

# 1 Background

## PTPv1

1. There are five kinds of messages defined for PTPv1: Sync, Delay_Req, Follow_Up, Delay_Resp and Management messages.
2. Multicast addressing is used for all PTPv1 messages.
3. Timestamping is required for PTP event messages (Sync, Delay_Req), but not for PTP general messages (Follow_Up, Delay_Resp and Management messages).
4. PTPv1 can only be mapped into UDP/IPv4/Ethernet using
    a. Four dedicated multicast IPv4 addresses (one per PTP subdomain), registered by IANA as PTP-primary, PTP-alternate1, PTP-alternate2, PTP-alternate3.
    b. Two UDP port numbers (one per port type), registered by IANA as ptp-event and ptp-general.
    c. Time to Live (IPv4) and hop limit (IPv6) defined as 0.

## PTPv2

1. There are 10 kinds of messages defined for PTPv2: Announce, Sync, Delay_Req, PDelay_Req, Follow_Up, Delay_Resp, PDelay_Resp, PDelay_Follow_Up, Transport and Management messages.
2. Multicast addressing is used for all PTPv2 messages by default. Optional unicast addressing can be used for Sync, Follow_Up, Delay_Req and Delay_Resp messages.
3. Time stamping is required for PTP event messages (Sync, Delay_Req, PDelay_Req), but not for PTP general messages (Announce, Follow_Up, Delay_Resp, PDelay_Follow_Up, PDelay_Resp, Transport and Management messages).
4. PDelay_Req, PDelay_Resp and PDelay_Follow_Up (called PDelay messages in this document) follow special processing rules at Layer 2 and shall
    a. not be forwarded to other ports, if present
    b. be transmitted and received on ports blocked by Spanning Tree or similar protocol.
5. PTPv2 requires mappings into different Layer 2 (IEEE 802.3/Ethernet, DeviceNET, ProfiNET) and higher layer protocols (UDP/IPv6).
6. Special processing of PDelay messages at Layer 2 shall be maintained for all PTPv2 mappings.
7. PTPv2 requires new management capabilities (e.g. using SNMP possibly with multiple managers).
8. It may be desirable for PTPv2 messages to traverse IP routers.

# 2 Technology independent PTPv2 mapping

1. Within a single PTP subdomain PTPv2 requires
   a. One dedicated multicast address for event and general PTP messages.
   ==Is separation required between PTP event and general messages?==
   b. One dedicated multicast address for PDelay messages.
   ==Would use of a known address, which meets PTPv2 requirements, but is owned by another standard, be encouraged?==
2. For multiple PTP subdomains PTPv2 requires
   a. One dedicated multicast address per PTP subdomain for event and general PTP messages.
   ==To be discussed.==
   b. One dedicated multicast address for PDelay messages in all PTP subdomains.
3. One PTPv2 protocol identification.
4. Two PTPv2 port identifications: one for general and one for event ports.
5. L3/L2 PTP mappings shall use addresses and assigned numbers defined for both L3 and L2 protocols. This is of particular importance for PDelay messages.
   ==Would mapping dedicated L3 multicast addresses into dedicated L2 multicast addresses be a problem?==
6. Other fields' values required by underlying protocol.

# 3 PTPv2 over IEEE 802.3/Ethernet

1. IEEE OUI (3 bytes) shall be requested for PTP. Once granted, PTP will own 2^24 unicast and 2^24 multicast MAC addresses.
2. From the list of addresses dedicated to PTP, five addresses shall be used as follows.
   a. Four dedicated multicast MAC addresses shall be assigned for PTP general and event messages in each PTP subdomain (PTP-primary, PTP-alternate1, PTP-alternate2, PTP-alternate3).
   ==Should we consider using 802.1D -2004 Table 12-1 addresses?==
   b. One multicast MAC address shall be assigned to PDelay messages in all PTP subdomains.
   ==Should we consider using 802.1D-2004  Table 7-10 address?==
3. IEEE Ethertype for PTP (has been requested) shall be used.
4. Differentiation between PTP event and general messages can be done by
   a. Decoding bit 3 (messageID field) in the first byte of PTP header, or
   b. Decoding control byte (offset 32 from the start of PTP header).
   ==Is it Ok for hardware-only on-the-fly TC implementations?==
5. Other values: IEEE 802.1Q tagged frames (optionally) can use
   a. VLAN ID = 1 (enabled by default)
   ==Would VLAN ID = 0 (no VLAN, only Priority) be better?==
   b. Priority = 7 (high)

# 4 PTPv2 over UDP/IPv4

1. Four dedicated multicast IPv4 addresses, already assigned to PTPv1, can be used for PTPv2 general and event messages in four PTP domains (PTP-primary, PTP-alternate1, PTP-alternate2, PTP-alternate3).
2. One additional dedicated multicast IPv4 address shall be requested for PDelay messages in all PTP subdomains. The new address can be registered by IANA as, e.g. PTP-pdelay.
3. Two UDP port numbers, already defined for PTPv1, can be used.
==To support multiple SNMP managers should we add undefined port number or at least a note about it?==
4. UDP/IPv4/L2 mappings shall also use dedicated multicast addresses and other parameters of L2 mapping, e.g. use dedicated multicast MAC addresses and PTP Ethertype, if Layer 2 protocol is IEEE 802.3/Ethernet.
==Would mapping dedicated multicast IPv4 addresses into dedicated multicast L2 addresses be a problem?==

5.  To allow PTPv2 messages traverse through IP routers, TTL value can be set to > 0.
    TTL = 64, 10 and 0 (as in PTPv1 with Boundary clock performing subnet translation) were also suggested. To be discussed.

# 5   PTPv2 over UDP/IPv6

1.  Five dedicated multicast IPv6 addresses shall be requested for PTPv2.
    a.  Four addresses will be used for general and event messages in four PTP subdomains (PTP-primary, PTP-alternate1, PTP-alternate2, PTP-alternate3).
    b.  One dedicated multicast IPv6 address will be used for PDelay messages in all PTP subdomains.
2.   Two UDP port numbers, already defined for PTPv1, can be used.
    To support multiple SNMP managers should we add undefined port number or at least a note about it?
3.  UDP/IPv6/L2 mappings shall also use dedicated multicast addresses and other parameters of L2 mapping, e.g. use dedicated multicast MAC addresses and PTP Ethertype, if Layer 2 protocol is IEEE 802.3/Ethernet.
    Would mapping dedicated multicast IPv6 addresses into dedicated multicast L2 addresses be a problem?
4.  To allow PTPv2 messages traverse through IP routers, hop limit value can be set to > 0.
    To be discussed.

# 6 PTPv2 over DeviceNET

1.  To be defined.

    DeviceNET addressing, required fields, equivalent of STP.
    Could PTP over UDP/IP map into DeviceNET?

# 7 PTPv2 over ProfiNET

1.  To be defined.

    ProfiNET addressing, required fields, equivalent of STP.
    Could PTP over UDP/IP map into ProfiNET?

# 8 Conclusion: PTPv2 assigned numbers

Following assigned numbers are required for PTPv2:

1. One IEEE OUI with five dedicated multicast MAC addresses assigned as follows:
   a. Four addresses (one per subdomain) for PTP event and general messages.
   b. One address for PDelay messages in all PTP subdomains.
   Status: to be requested.

2. One IEEE Ethertype.
   Status: requested (update request status).

3. Five dedicated IPv4 multicast addresses.
   Status: four addresses were obtained for PTPv1, one more address to be requested.

4. Five dedicated IPv6 multicast addresses.
   Status: to be requested.

5. Two UPD port numbers.
   Status: obtained.

6. DeviceNET numbers.
   Status: to be defined.

7. ProfiNET numbers.
   Status: to be defined.