Application Oriented High Precision Delay and Jitter Measurement

draft-yang-ippm-ptp-measurement-00

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Introduction

- To satisfy the requirements for high precision delay and jitter measurement in many industrial scenarios.

- Get close to the messages of actual services from two aspects, length and priority.

Adjustments on PTP Sync and Delay_Req Message

- PTP header
  - Default Settings are for Time Synchronization
  - Modified Messages are for Measurement Only

- Customizing message length

- Tuning message priority
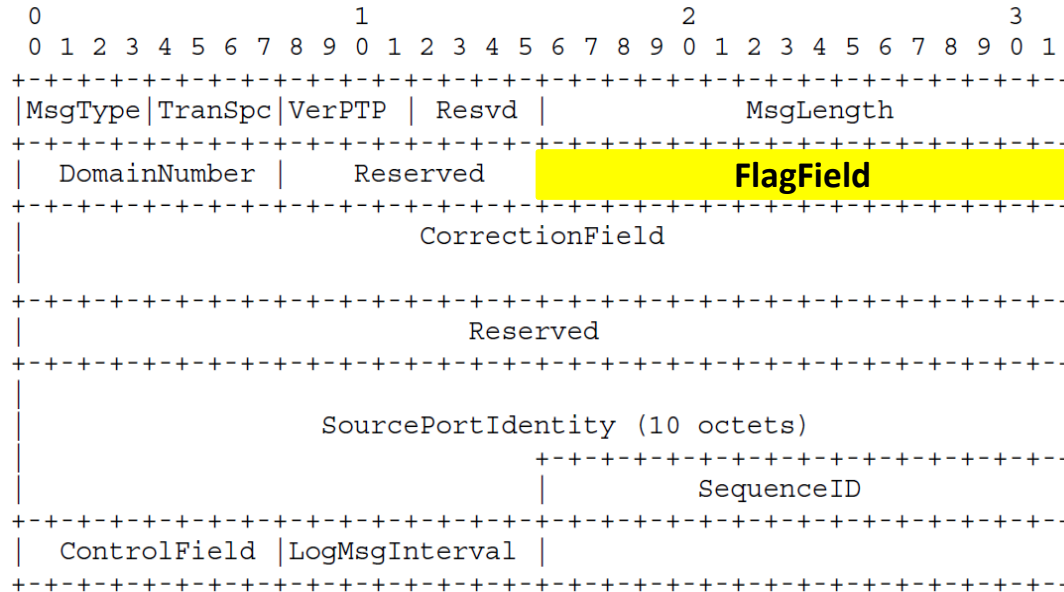
Adjustments on PTP Header

Figure 1: PTP Header Format
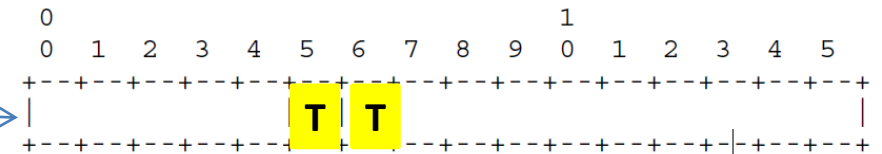
Figure 2: Modified FlagField

- The function of PTP message is determined by the two-octet field, FlagField, in header.
- Two consecutive bits in FlagField, the sixth and the seventh, whose names are PTP profile specific 1 and PTP profile specific 2 respectively, determine the function of the message.
- When **both** of their values are **False**, the message is for **synchronization**. When **both** the values are **True**, the message is for **measurement**.

Customizing Message Length

- PTP Sync and Delay_Req message have three parts, header, body, and suffix. We try to modify suffix.

- The default length of suffix is zero, but it can be extended to be equal size as actual message.

```
 0                   1                   2                   3
 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
~                                                               ~
|                       header (34 octets)                      |
~                                                               ~
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                                                               |
|                      TimeStamp  (10 octets)                   |
|                       +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+      |
|                       |                                       |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
~                                                               ~
|                     Suffix (customized)                       |
~                                                               ~
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+

       Figure 3: PTP Sync or Delay_Req Message Format
```
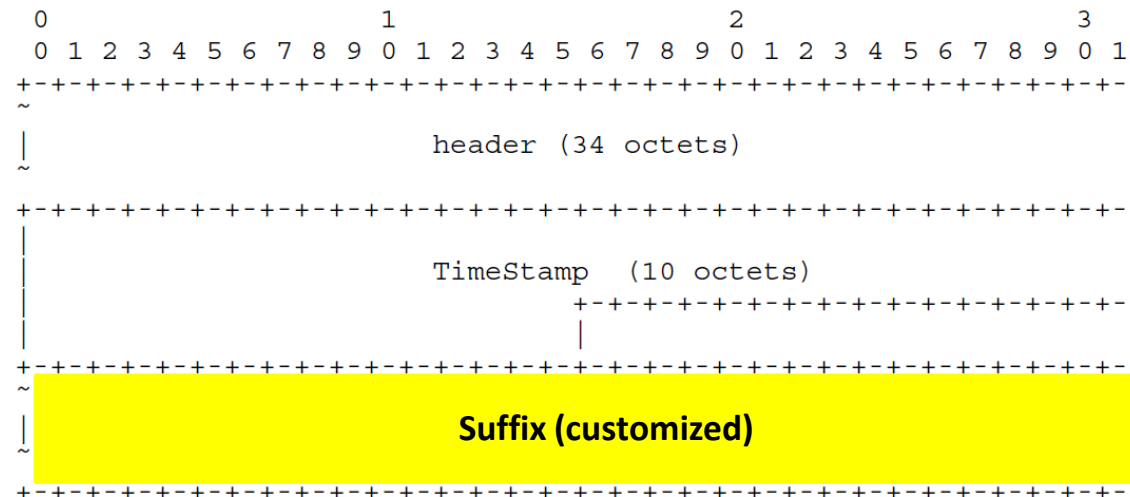
Set the Priority of Modified Message

- Priority is set by field, DS, in IP header
- The first six bits of DS, called DSCP, representing at most 64 priorities, to a great extent, simulating different types of messages in actual services.
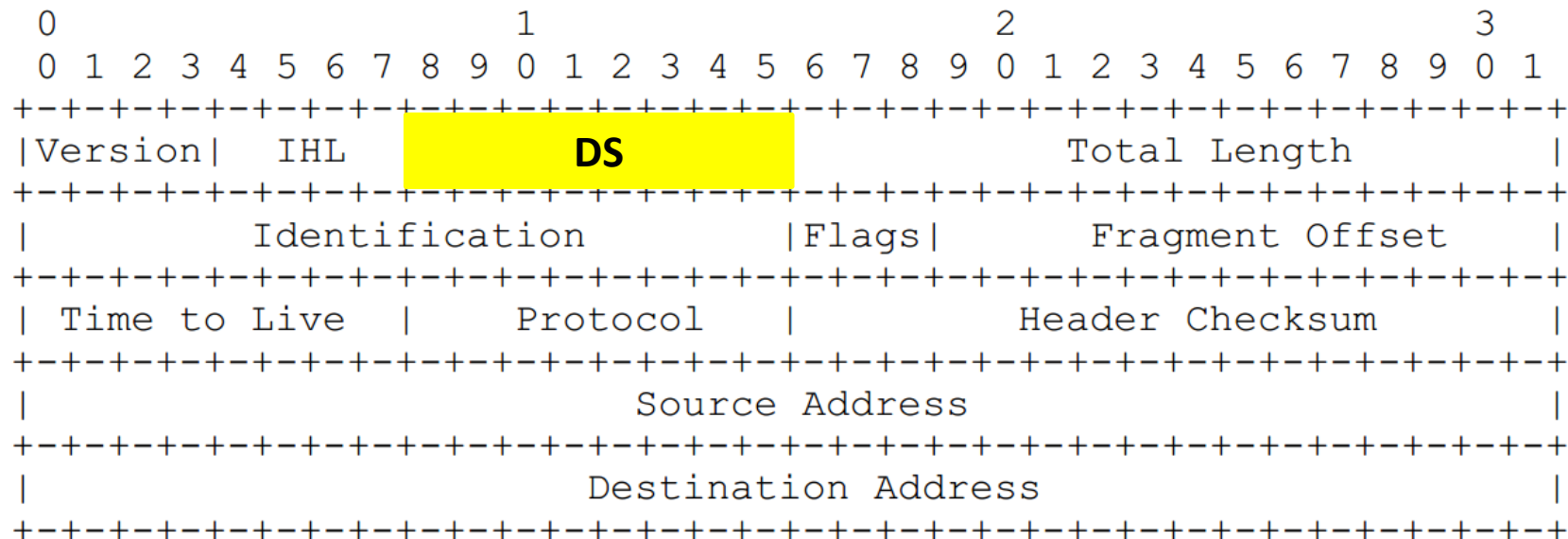
```
 0                   1                   2                   3
 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|Version|  IHL  |       DS      |          Total Length         |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|         Identification        |Flags|      Fragment Offset    |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|  Time to Live |    Protocol   |         Header Checksum        |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                       Source Address                          |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                    Destination Address                        |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

Figure 4: IP Header Format

Message Encapsulation and Transmission

- PTP over Ethernet ends every hop, not suitable for very large scale networks.

- We choose **PTP over UDP**. The modified message is encapsulated by UDP header, IP header, and Ethernet header.

- Prerequisite for Measurement: the network **MUST** be synchronized first, which could be done by sending usual PTP messages.

- Then use modified PTP messages to measure the time delay and jitter between two ends.
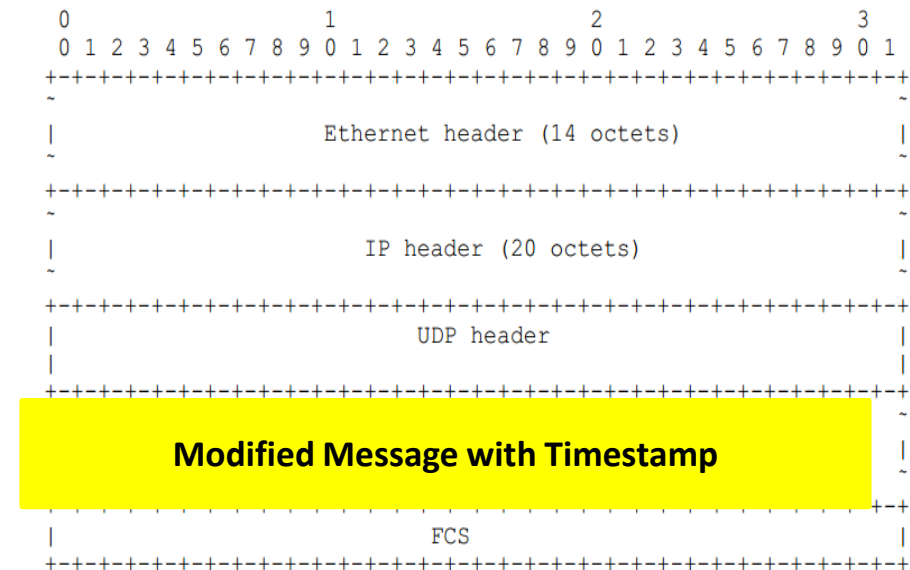
```
 0                   1                   2                   3
 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
~                                                               ~
|                 Ethernet header (14 octets)                  |
~                                                               ~
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
~                                                               ~
|                   IP header (20 octets)                       |
~                                                               ~
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                        UDP header                             |
|                                                               |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

Modified Message with Timestamp

```
|                           FCS                                 |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

Figure 5: Format of PTP Message over UDP

Key Features

- **Flexibility**: design for any synchronization device. No need for special measurement devices. No need for other measurement protocol.

- **Lightness**: less modification in software and hardware in current large scale networks.

- **Scalability**: the method can be used in any network which supports PTP.

Next Steps

- Consider about security and reliability issues

- Timely simulation of the transmission of actual services to achieve much better measurement results.

- How to incorporate this method with other measurement protocol …