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IEEE 1588/802.1AS Synchronisation for RTP Streams
draft-williams-avtext-avbsync-01

Abstract

Specification of an RTP header extension for carrying in-band synchronization metadata provided by the IEEE1588/802.1AS Precision Time Protocols.

Requirements Language

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in RFC 2119 [1].

Status of this Memo

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1. Introduction

Synchronisation between RTP flows and between devices rendering RTP flows is currently facilitated by means of NTP format timestamps taken with respect to a shared reference clock. In many applications (e.g. professional, commercial and automotive AV), the NTP clock synchronisation protocol does not meet the necessary time alignment and synchronisation speed requirements.

Like NTP, the IEEE1588 family of clock synchronisation protocols provide a shared reference clock in an network - typically a LAN. IEEE1588 provides sub-microsecond synchronisation between devices on a LAN and typically locks within seconds at startup rather than minutes. With support from Ethernet switches, IEEE1588 protocols can achieve nanosecond timing accuracy in LANs. Network interface chips and cards supporting hardware time-stamping of timing critical protocol messages are also available.

When using IEEE1588 clock synchronisation, networked AV systems can achieve sub 1 microsecond time alignment accuracy when rendering AV signals and can support latencies less than 1ms through a gigabit LAN.

Three flavours of IEEE1588 are in use today:

- IEEE 1588-2002 [3]: the original "Standard for a Precision Clock Synchronization Protocol for Networked Measurement and Control Systems". This is often called IEEE1588v1 or PTPv1.

- IEEE 1588-2008 [4]: the second version of the "Standard for a Precision Clock Synchronization Protocol for Networked Measurement and Control Systems". This is a revised version of the original IEEE1588-2002 standard and is often called IEEE1588v2 or PTPv2.

- IEEE 802.1AS [5]: "Timing and Synchronization for Time Sensitive Applications in Bridged Local Area Networks". This is a Layer-2 only profile of IEEE 1588-2008 for use in Audio/Video Bridged LANs.

By using an IEEE 1588 derived reference clock, synchronisation of RTP streams and devices in LANs can be considerably improved.

2. Timestamp formats

A global IEEE 1588/802.1AS timestamp is 80 bits in total, divided into two parts:

AS_sec: 48 bits seconds since epoch

AS_nsec: 32 bits nanoseconds

A shorter 32 bit timestamp is defined for use in streaming media protocols in the following way:

as_timestamp = (AS_sec * 10^9 + AS_nsec) modulo 2^32

The shorter as_timestamp field covers just over 4 seconds of time.

3. Header Extension

Figure 1 shows the fields of the AVB sync header extension. It uses the standard RTP header extension mechanism defined in RFC 5285 [2].

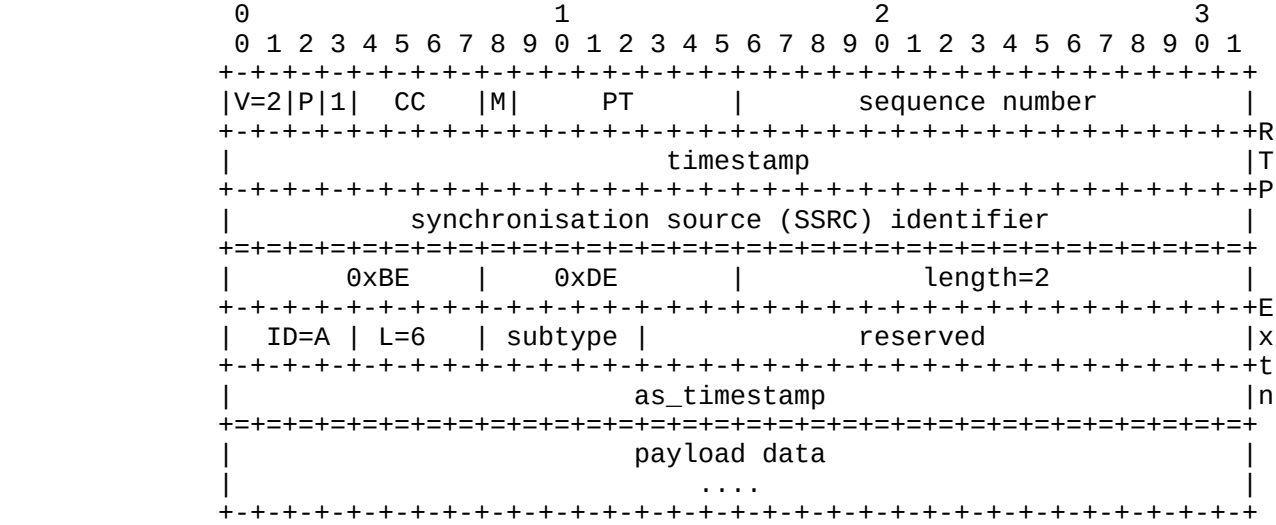

Figure 1: IEEE 1588/802.1AS Synchronisation Header Extension

The fields are defined as follows:

subtype: RTCP AVB packet subtype field, see Section 4.

as_timestamp: a 32 bit IEEE 1588/802.1AS timestamp as defined in Section 2.

reserved: as this specification evolves, additional fields are expected to be included in this header.

The as_timestamp MUST correspond to the same instant as the RTP timestamp in the packet's header, and MUST be derived from the same clock used to generate the as_timestamps in the RTCP AVB packets. Provided that it has knowledge of the SSRC to CNAME mapping, either from prior receipt of an RTCP CNAME packet or via out of band signalling [RFC5576], the receiver can use the information provided as input to the synchronization algorithm, in exactly the same way as if an additional RTCP AVB packet had been received for the flow.

4. IEEE 1733 / RTCP AVB Packet

IEEE 1733 [6] defines the "AVB RTCP packet" type reproduced in Figure 2. RTCP AVB packets contain a mapping between RTP timestamp and an 802.1AS timestamp as well as additional clock and QoS information.

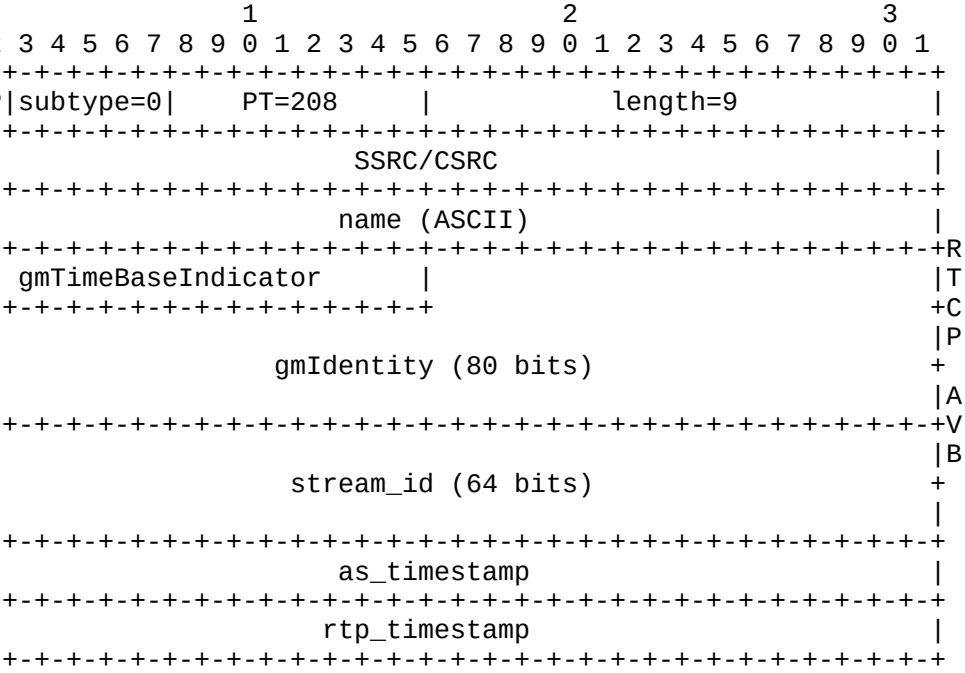

Figure 2: IEEE 1733/RTCP AVB packet format

A brief description of the major fields follows:

gmIdentity an 80 bit field uniquely identifying the current 802.1AS grand master clock used by the source to generate as_timestamps for this flow

stream_id a 64 bit number identifying the 802.1Qat [7] stream associated with this RTP flow

as_timestamp the 32 bit 802.1AS timestamp (Section 2) associated with the RTP timestamp carried in this packet

rtp_timestamp the RTP timestamp of a media packet

Please consult the IEEE 1733 specification [6] for more details.

5. IANA Considerations

TBD: A URN will be required to signal the presence of this header extension, such as:

urn:ietf:params:rtp-hdrext:avb-sync

6. Acknowledgements

7. References

7.1. Normative References

[1] Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels", BCP 14, RFC 2119, March 1997.

[2] Singer, D. and H. Desineni, "A General Mechanism for RTP Header Extensions", RFC 5285, July 2008.

7.2. Informative References

[3] Institute of Electrical and Electronics Engineers, "IEEE Standard for a Precision Clock Synchronization Protocol for Networked Measurement and Control Systems", IEEE Std 1588-2002, 2002, <http://standards.ieee.org/findstds/standard/1588-2002.html>.

[4] Institute of Electrical and Electronics Engineers, "IEEE Standard for a Precision Clock Synchronization Protocol for Networked Measurement and Control Systems", IEEE Std 1588-2008, 2008,

<http://standards.ieee.org/findstds/standard/1588-2008.html>.

[5] Institute of Electrical and Electronics Engineers, "IEEE Standard for Local and Metropolitan Area Networks - IEEE Draft Standard for Local and Metropolitan Area Networks - Timing and Synchronization for Time-Sensitive Applications in Bridged Local Area Networks", IEEE Std 802.1AS-2011, 2011, <http://standards.ieee.org/findstds/standard/802.1AS-2011.html>.

[6] Institute of Electrical and Electronics Engineers, "IEEE P1733/ D7.0 Draft Standard for Layer 3 Transport Protocol for Time Sensitive Applications in Local Area Networks", IEEE Draft Std 1733/D7.0, February 2011, <http://grouper.ieee.org/groups/1733/>.

[7] Institute of Electrical and Electronics Engineers, "IEEE Standard for Local and Metropolitan Area Networks---Virtual Bridged Local Area Networks Amendment 14: Stream Reservation Protocol (SRP)", IEEE Std 802.1Qat-2010 (Revision of IEEE Std 802.1Q-2005), 2010, <http://standards.ieee.org/about/get/>.

Appendix A. An Appendix

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