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RTP and Leap Seconds
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Abstract

This document discusses issues that arise when RTP sessions span (UTC) leap seconds. It updates RFC 3550 to describe how RTP senders and receivers should behave in the presence of leap seconds.

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1. Introduction

In some applications, RTP streams are referenced to a walllock time (absolute date and time). This is typically accomplished through use of the NTP timestamp field in the RTCP sender report (SR) to create a mapping between RTP timestamps and the wallclock. When a wallclock reference is used, the playout time for RTP packets is referenced to the wallclock. Smooth and continuous media playout requires a smooth and continuous timebase. The timebase used by the wallclock may include leap seconds which, in many cases, are not rendered smoothly.

This document provides recommendations for smoothly rendering streamed media referenced to common wallclocks which may not have smooth or continuous behavior in the presence of leap seconds.

2. Terminology

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 [RFC2119] and indicate requirement levels for compliant implementations.

3. Leap seconds

Leap seconds are intended to keep UTC time synchronized with the rotation of the earth. Leap seconds are scheduled by the International Earth Rotation and Reference Systems Service. Leap seconds may be scheduled at the last day of any month but are preferentially scheduled for December and June and secondarily March and September.[TF.460-6] Because earth's rotation is unpredictable, leap seconds are typically not scheduled more than six months in advance. Leap seconds can be scheduled to either add or remove a second from the day. All leap second events thus far have been scheduled in June or December and have all added seconds. This is a situation that is expected but not guaranteed to continue.

NOTE- The ITU is studying a proposal which could eventually eliminate leap seconds from UTC. As of January 2012, this proposal is expected to be decided no earlier than 2015.

3.1. UTC behavior during leap second

UTC clocks insert a 61st second at the end of the day when a leap second is scheduled. The leap second is designated "23h 59m 60s". The sequence of the second markers near the UTC leap second transition are:

Day 0, 23h 59m 59s

Day 0, 23h 59m 60s <-- leap second

Day 1, 0h 0m 0s

3.2. NTP behavior during leap second

Under NTP [RFC5905] a leap second is inserted at the beginning of the last second of the day. This results in the clock freezing or slowing for one second immediately prior to the last second of the affected day. This results in the last second of the day having a real-time duration of two seconds.

3.3. POSIX behavior during leap second

Most POSIX systems insert the leap second at the end of the last second of the day. This results in repetition of the last second. A timestamp within the last second of the day is therefore ambiguous in that it can refer to either of the last two seconds of a day containing a leap second.

4. Recommendations

Senders and receivers which are not referenced to a wallclock are not affected by issues associated with leap seconds and no special accommodation is required.

RTP implementation using a wallclock reference is simplified by using a clock with a timescale which does not include leap seconds. IEEE 1588 [IEEE1588-2008], GPS [IS-GPS-200F] and other TAI (International Atomic Time) [CircularT] references do not include leap seconds. NTP time, operating system clocks and other UTC (Coordinated Universal Time) references include leap seconds.

All participants working to a leap-second-bearing reference SHOULD recognize leap seconds and have a working communications channel to receive notification of leap second scheduling. Without prior knowledge of leap second schedule, NTP servers and clients may become offset by exactly one second with respect to their UTC reference. This potential discrepancy begins when a leap second occurs and ends when all participants receive a time update from a server or peer. Depending on the system implementation, the offset can last anywhere from a few seconds to a few days. A long-lived discrepancy can be particularly disruptive to RTP operation.

Because of the ambiguity leap seconds can introduce and the

inconsistent manner in which different systems accommodate leap seconds, generating or using NTP timestamps during the entire last second of a day on which a leap second has been scheduled SHOULD be avoided. Note that the period to be avoided has a real-time duration of two seconds.

4.1. RTP Sender Reports and Receiver Reports

RTP Senders working to a leap-second-bearing reference SHOULD NOT generate sender reports containing an originating NTP timestamp in the vicinity of a leap second. Receivers SHOULD ignore timestamps in any such reports inadvertently generated.

4.2. RTP Packet Playout

Receivers working to a leap-second-bearing reference SHOULD take leap seconds in their reference into account in determining playout time from RTP timestamps for data in RTP packets.

5. Security Considerations

It is believed that the recommendations herein introduce no new security considerations beyond those already discussed in [RFC3550].

6. IANA Considerations

This document has no actions for IANA."

7. Acknowledgements

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8. Normative References

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