Clarification on Use of tu Bit

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History

This topic was originally discussed on the AVBTP reflector. It is recorded here in presentation format to facilitate access to the 1722 group members.

Clarification on use of tu bit

Background

I believe there is a very important use case which is not covered by the standard yet and that we should address. Let's take the following example:

- Initially, the AVB network is in a gPTP steady state. All devices are using the same grandmaster and have a stable gPTP time.

- There is a stream running between a Talker and a Listener. The Listener is interpreting the timestamps of the stream correctly.

- At some point, there is a change of grandmaster. One reason can be that the current grandmaster has been shut down, or a new device with better priority has just been plugged to the network.

- Due to non-instantaneous propagation time of the grandmaster change information throughout the network, there will be a period of time when the Talker and the Listener are not using the same gPTP time reference. Although this period of time is generally short, there is no performance requirement in 802.1AS that would allow us to give an upper bound to this period of time. In practice, it can be several seconds. If several changes of grandmaster occur in chain (if, for example, we plug several new devices almost at the same time), then it can be even longer.

The question is: how to ensure that during this period of time, the Listener will not misinterpret the timestamps transmitted by the Talker and thus produce audible/visible artifacts to the user? Should we try to use the "tu" bit (timestamp uncertain) to resolve this issue?

Background (2)

About this bit, the IEEE 1722-2016 standard says (section 4.4.4.7):

- "When a Talker detects a discontinuity in gPTP time, it should set the tu (timestamp uncertain) field to one (1)".
- "Once the Talker has determined that the gPTP clock has returned to a normal state, the tu field should be reset to zero (0)".
- The standard also mentions that gPTP discontinuities may be caused by events such as changes in the identity of the gPTP grandmaster clock, changes in the timing source of the grandmaster clock, or other events encountered by a Talker.
- The standard also describes how the Listener may behave to take advantage of the "tu" information and avoid artefacts in the rendered stream.

Examples

Let's take the two possible scenarios when a change of grandmaster occurs:

- Scenario 1: the Talker detects the change of grandmaster before the Listener. It starts locking on the new grandmaster, and for some time, it sets the "tu" bit to 1, then it clears it to 0. The period when tu=1 depends on the implementation of the Talker. Let's say it's 500ms. What if, after 500ms, the Listener is still using the old grandmaster because the gm change information has not propagated yet to it? The problem exists even if the Talker sets the "tu" bit for a longer time because there is no specified time limit to propagate a change of grandmaster in a network. If the Talker sets the "tu" bit for a very long period of time to be sure the new gm information has propagated everywhere, it's not better as well because this may result in the Listener staying in a holdover mode for more time than needed and potentially provoke stream unlock from the Listener.

- Scenario 2: the Listener detects the change of grandmaster before the Talker. It goes to a holdover mode where it ignores the timestamps received from the Talker and just continues to render the stream using its latest media clock information. How long should the Listener stay in the holdover mode if the Talker doesn't set the "tu" bit, or if it sets it late due to the propagation time of the gm change information?

Recommendations

My current feeling is that:

- The "tu" bit should be used by a Talker to report short bounded uncertainties in its gPTP time (for example the short period of time when the Talker is locking on a new grandmaster). It should not be specially extended by the Talker to cover the propagation time of the gm change information to the Listener.

- There should be a new mechanism (ideally a new grandmaster_id field in the AVTP header, like proposed by Ashley) to report the ID of the grandmaster used by the Talker to fill in the AVTP timestamp. That mechanism will cover the problem of the propagation time of the gm change information to the Listener.

Best regards,

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