Timing Performance of a Network of Low-cost IEEE 802.1AS Network Elements

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Summary

One of the new parts of the revised IEEE 1588 standard is an IEEE 802-specific layer 2 profile. This profile, along with additional requirements for ordinary clocks, point-to-point transparent clocks, and a new type of boundary clock designed for 802.11 (WiFi) LANs, is encompassed in the new IEEE 802.1AS standard for "Timing and Synchronization for Time-Sensitive Applications in Bridged Local Area Networks". The 802.1AS standard provides for very few options and very simple operation, intended to keep costs low without compromising on quality. This paper describes an early implementation of an IEEE 802.3 (Ethernet) bridge that incorporates an 802.1AS transparent clock along with a corresponding ordinary clock in an endpoint device. The timing performance of different sized networks of these devices is presented, where there is both random and periodic interfering traffic.

Motivation

In modern consumer electronics, audio and video data are increasingly gathered, transmitted, and stored in digital form, yet the most common networking technologies, those based on the IEEE 802 family, do not provide adequate quality of service for live streaming. In the past two years, however, the IEEE 802.1 Audio Video Bridging Task Group (AVB TG) has been assembling a set of new standards that allows very high quality streaming services with only a modest increase in complexity. One of the most important of these standards will be IEEE 802.1AS which will provide timing and synchronization within a bridged local area network that consists of mixed IEEE 802.3 (Ethernet) and IEEE 802.11 (WiFi) segments.

The requirements used by the AVB TG for timing and synchronization are based both on formal MTIE masks[1] and stated requirements by representatives from important markets[2]. The worst case requirements were to meet the MTIE mask for uncompressed high-definition video and to guarantee an absolute synchronization error of less than one microsecond.

Simulations of systems using the proposed IEEE 802.1AS standard demonstrate that it was possible to meet those requirements[3], so a number of projects have been launched to build actual systems. The first integrated circuits that implement 802.1AS are now available [zz], and testing is underway to evaluate how well networks build with those circuits meet the stated requirements. The system used for that testing is shown in Fig. 1.

Results

The results of initial testing are not currently available, but should be by the publication date. The format of the results will follow the style of the simulation results shown in Fig 2.

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1. Geoffrey M. Garner, End-to-End Jitter and Wander Requirements for ResE Applications, presentation at May, 2005 IEEE 802.3 ResE SG meeting, Austin, TX, May 16, 2005
2. Dave Olsen, Time Accuracy Requirements in Audio Networks, presentation for 802.1AVB conference call, April 2007
3. Geoffrey M. Garner, Further Simulation Results for AVB Synchronization Transported using IEEE 1588 Peer-to-Peer Transparent Clocks, presetation at IEEE 802.1AVB meeting, July 12, 2006

Figures

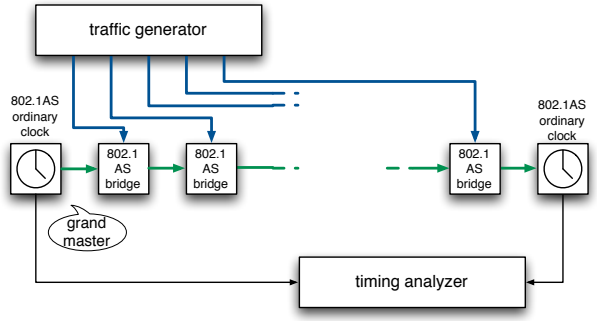

Figure 1 - Experimental setup

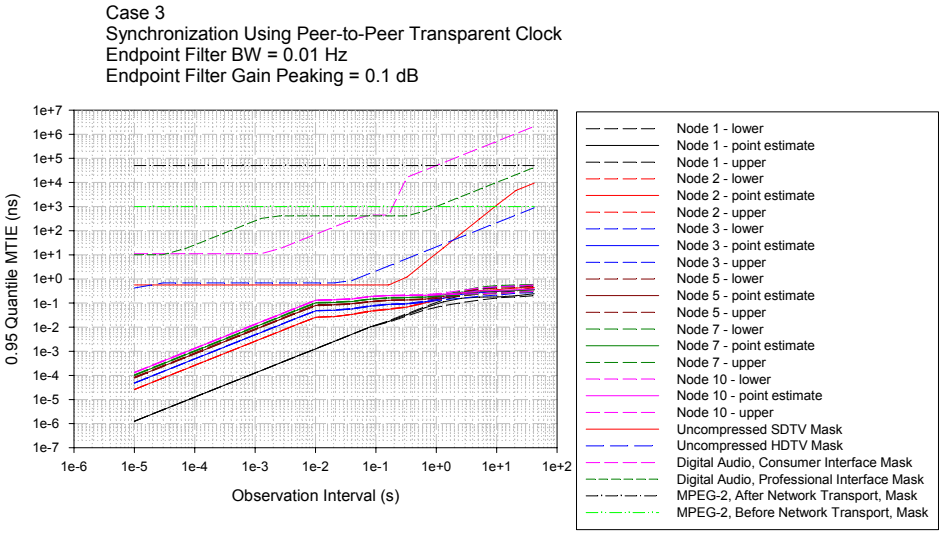

Figure 2 - MTIE results (example from simulation, actual results TBD)

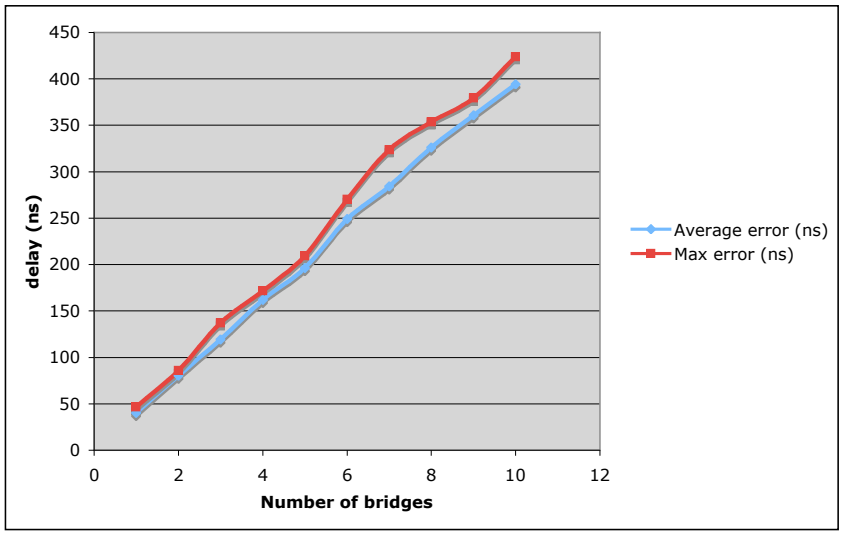

Figure 3 - Synchronization results (example)