syn1588 ®

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Abstract

This application note describes the synchronization performance of a PTP enabled network with a number of cascaded syn1588® 1-step E2E Transparent Clocks in presence of other network traffic.

Measurement Setup

The tests were performed with two PC based PTP end nodes both equipped with syn1588® PCIe NIC network cards (version 2.0). The syn1588® PCIe cards themselves had a standard TCXO assembled rather than relying on the high quality OCXO option for this measurement. The time stamp resolution of both PTP end nodes was 10ns.

Both PTP end nodes were running Linux as an operating system, the syn1588® PTP Stack was invoked on both nodes by statically selecting one to become the PTP Master and the other the PTP Slave via respective command line parameters. The rate both for Sync and Delay_Request messages were set to 8/s. The rate for all Announce messages was set to 1/s.

Network Topology

11 syn1588® E2E TCs were cascaded by connecting port 1 and port 8 respectively of two adjacent devices with each other via a short network cable. The topology is shown in figure 1 and picture of the actual test bed is given in figure 2.
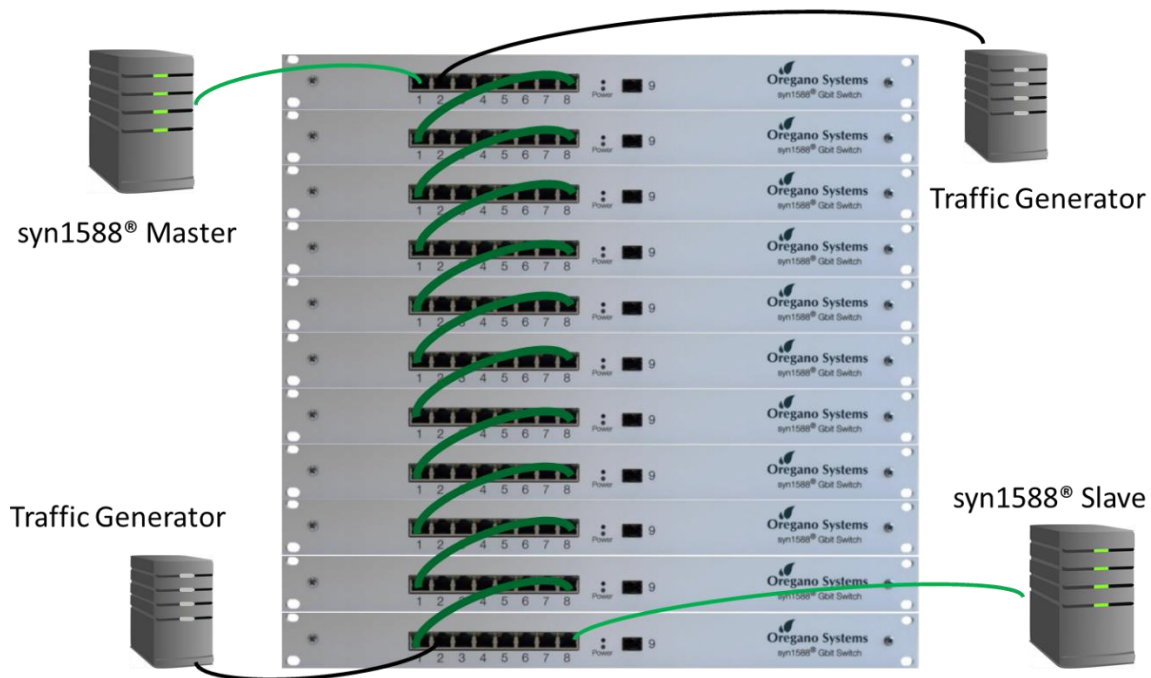
Figure 1: Schematic of network topology

Figure 1: Picture of the test bed in the Oregano Systems lab

Network Load

In addition to the two PTP nodes two separate PCs were attached to the network at opposite ends. Both PCs were running Linux as well. Traffic was generated using flood ping with a preload of 10 which will cause the sending PC to transmit up to 10 ping messages to the receiver before waiting for a reply thus increasing the burst traffic load.

Results

The test was performed over a period of about 6000 seconds. The data collected by the syn1588® PTP Slave was analyzed using the four PTP time stamps as well as the correction fields in the Sync and Delay_Request messages, respectively. Figure 4 shows the value of the correction field of every Sync message which equals the accumulated residence time over 11 hops as

it has been measured by cascade of syn1588* E2E TCs. Figure 4 shows the same data for the upstream path i.e. the Delay_Request messages.

The mean value of the accumulated residence time is 30µs for both directions, Due to the network loading it varies within a range of some 3 µs.
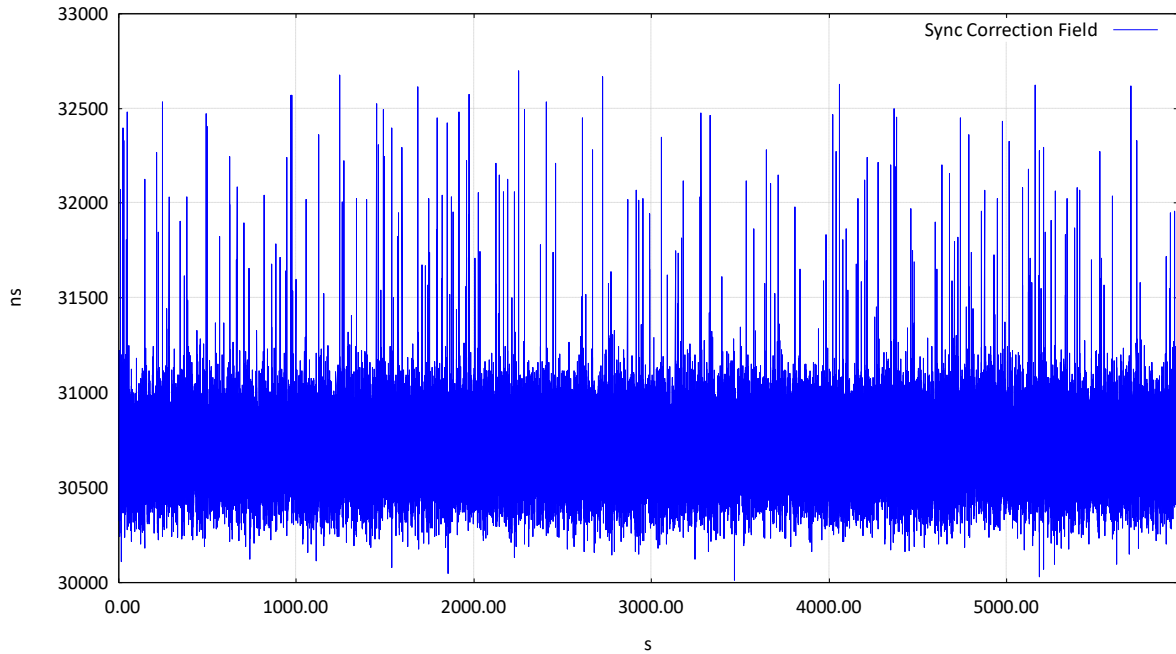

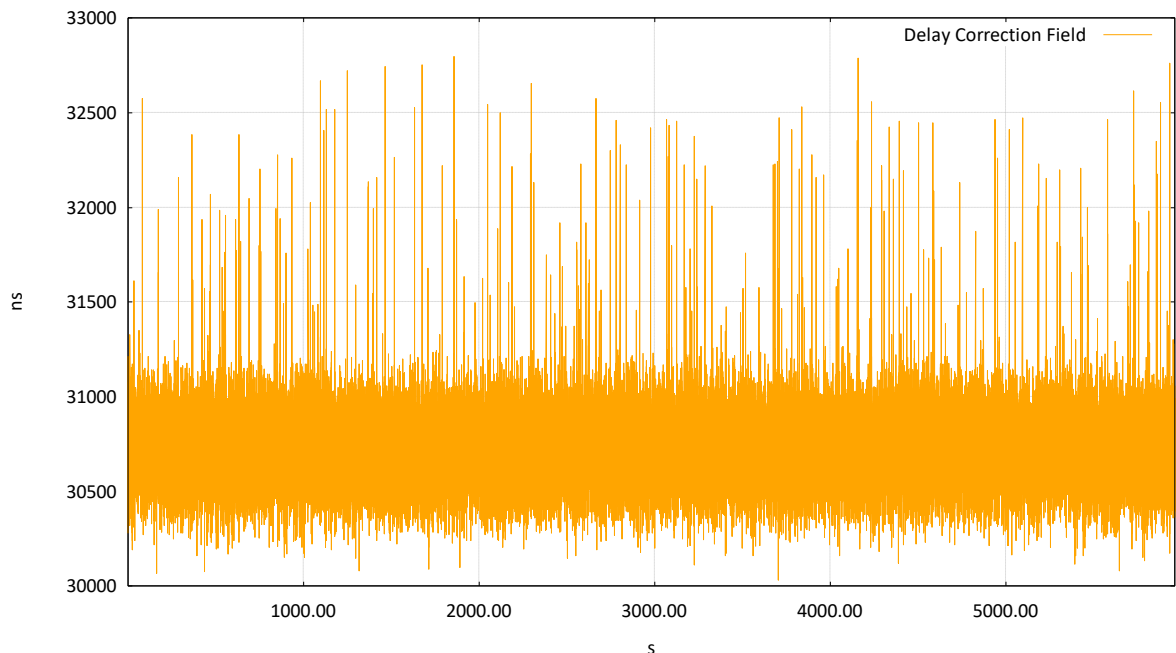
Figure 3: Correction field data of the Sync messages

Figure 4: Correction field data of the Delay_Request messages

Figure 6, shows the offset of the PTP Slave with respect to the Master. Although the residence time varies significantly, the Slave still manages to synchronize to the Master extremely accurately. The offset of the Slave varies

between +/- 20ns with a standard deviation of less than 10ns. It should be noted that a direct connection of the syn1588® PTP nodes without any network in between via a simple network cable yields the same level of variation with a standard deviation of 4.6 ns.
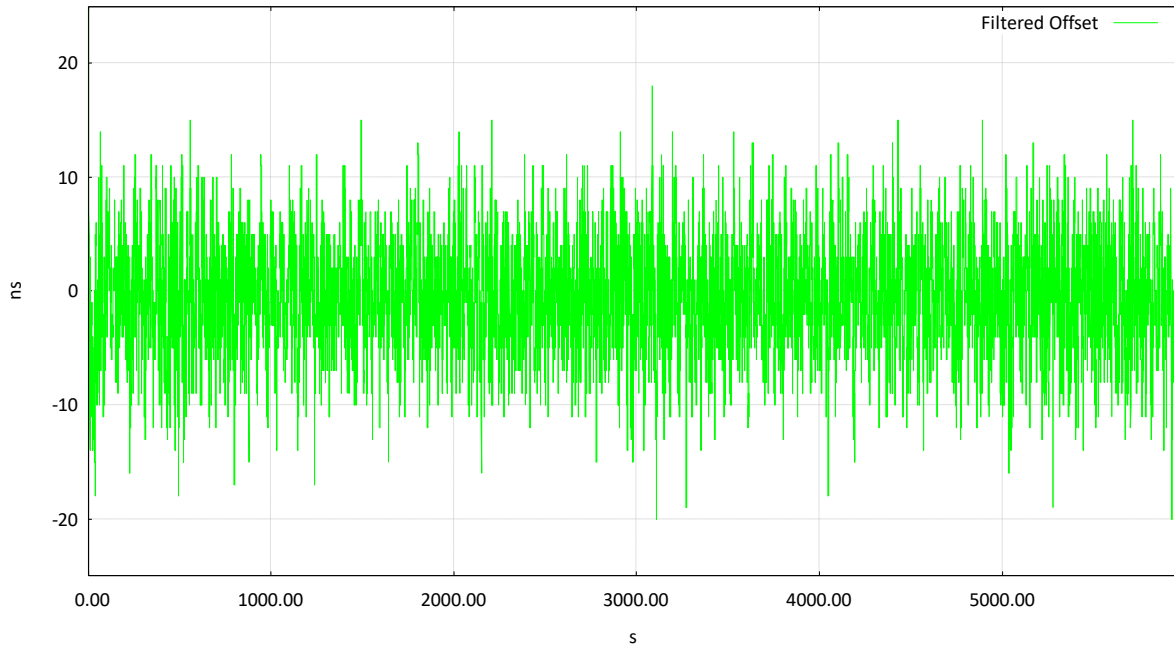

Figure 6: Offset of the PTP Slave

Conclusions

The extremely high time stamp resolution of 2ns in combination with the patented 1-step time stamping technology allows cascading more than 10 syn1588® E2E TCs without deteriorating the synchronization accuracy even if the network is loaded with other traffic in parallel to PTP.

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