SFN5322F Precision Time Synchronization Server Adapter FAQ

List of Frequently Asked Questions:

Frequently Asked Questions with Responses:

1. What are PTP and IEEE 1588?

PTP stands for "Precision Time Protocol", which is used to synchronize server clocks throughout a computer network. On a local area network PTP can achieve clock synchronization accuracy in the sub-microsecond range, making it suitable for financial services (e.g. monitoring, auditing and analyzing high-frequency trading applications) and precision synchronization for distributed computing environments.

PTP was originally defined in the IEEE 1588-2002 standard, officially entitled "Standard for a Precision Clock Synchronization Protocol for Networked Measurement and Control Systems", and revised as IEEE 1588-2008, also known as PTP version 2 (PTP v2), which improves accuracy, precision and robustness.

IEEE 1588 is designed to fill a niche not well served by either of the two dominant protocols, Network Time Protocol (NTP) and Global Positioning System (GPS). IEEE 1588 is designed for local systems requiring accuracies beyond those attainable using NTP (sub-millisecond range). It is also designed for applications that cannot bear the cost of a GPS receiver at each node, or for which GPS signals are inaccessible.

The IEEE 1588 precision time protocol (PTP) is approximately three orders of magnitude (1000 times) more precise than previous technologies, offering sub-microsecond timing accuracy that can be implemented at a fraction of the cost of specialized network time appliances. The PTP adapter participates in an automated time distribution and messaging scheme to accurately and consistently set time on all servers in the network to the correct time.

2. Why would I want PTP rather than NTP?

PTP is capable of much higher precision and accuracy than NTP.

PTP is used for precision synchronization of mission-critical applications with microsecond resolution. For example, PTP can be used for a server farm that processes financial transactions.

NTP is used for user application synchronization with millisecond resolution. For example time-stamping error log files or synchronizing applications for human-readable time, like Windows Time Services.

3. Who are the SFN5322F customers and what benefit does Solarflare's SFN5322F offer them over their current solution?

Solarflare's SFN5322F is targeted at customers that need both high-performance, ultra-low latency 10GbE and clock synchronization. This includes financial services networks and distributed computing.

With Solarflare's SFN5322F, customers no longer need to deploy a separate time synchronization network since now time synchronization can operate over the ultra-low latency 10G Ethernet data network. Combining these two technologies not only decreases deployment costs by eliminating a separate specialized network, but also reduces server utilization by consolidating multiple PCIe slots for separate functions into one.

PTP can now operate over the data network and in a single PCIe slot in each server, saving the associated deployment and power costs.

4. What customers will benefit the most from SFN5322F, and why?

Financial services customers will benefit the most, as they have both clock synchronization requirements and ultra-low latency problems to solve. Utilizing the SFN5322F, these customers will benefit from the industry's lowest latency that they already receive from SFN5122F, now combined with sub-microsecond clock synchronization in a single card operating across a single network.

5. Are there operating system dependent drivers needed for RHEL, SUSE, CentOS, Debian, Ubuntu, etc.?

Yes, SFN5322F requires a hardware driver, and Solarflare's Linux driver supports the Linux derivatives mentioned above.

6. Are there special network switches that must be utilized for superior accuracy?

No, special switches with transparent clocks are not required for PTP functionality, as the PTP protocol works end to end. Any non-blocking, cut-through switch with low port to port latency and sufficient line rate will perform well with SFN5322F. This means that PTP can be deployed today, with currently available switches, and can achieve superior latency performance and PTP time accuracy with SFN5322F.

The PTP protocol operates by sending protocol packets back and forth between PTP master servers and each PTP slave server. However, the most important parameter is consistent network latency, as the PTP protocol measures time delays between protocol packets. Thus, having a consistent latency for packets crossing the network is critical to ensure greater time synchronization precision. Please note that latency does NOT need to be low latency for PTP, rather consistent latency.

Solarflare's SFN5322F User Guide documents the high accuracy measured under network load with standard switches that are do not have any special PTP functionality.

7. How accurate is the SFN5322F in synchronizing time and what level of accuracy is required for customers?

Solarflare customers are receiving data at microsecond latencies, and thus require sub-microsecond accuracies to measure these received packets. The SFN5322F can synchronize slave server clocks to the master clock server to within 200ns, thus ensuring accurate recording of packet arrival times.

8. Is latency affected if a 1000BASE-T SFP+ transceiver is utilized, and will this affect PTP precision?

The 1000BASE-T transceiver does add a small amount of latency over 10GbE optical SFP+ transceivers. However, this does not affect the precision of clock synchronization, as the 1000BASE-T module latency is consistent.

9. How accurate is SFN5322F with a user space PTPd?

Solarflare's SFN5322 User Guide documents the performance, which is within 200ns. Solarflare's optimized PTPd runs in user space, and it utilizes hardware timestamps and a high precision oscillator on the adapter to precisely synchronize slave server clocks to within 200ns of each other.

10. How good is Solarflare's SFN5322F accuracy with a loaded bursty network?

The PTP protocol requires a network with constant latency. Solarflare has demonstrated slave to master offsets of within 200ns. However, even under bursty conditions of up to 50% load, the SFN5322F demonstrated slave to master offsets of within 500ns. When the bursty condition cleared, the slave to master offsets returned to within 200ns.

11. Why does SFN5322F have a Stratum 3 oscillator?

What sets the SFN5322F apart from other solutions is its high-precision, highly stable Stratum 3 clock, which not only enables higher precision time synchronization than can be obtained using software and standard crystal oscillators, but also enables highly accurate time synchronization even when the PTP network becomes bursty or disconnected for short periods.

12. How does SFN5322F synchronize the server's system clock?

Solarflare's SFN5322 uses a two-step approach to synchronize server clocks. First, SFN5322F synchronizes its adapter clock to the PTP master clock. Then SFN5322F synchronizes the server clock to its adapter clock.

The benefits of this approach are:

1. Significantly higher server synchronization accuracy
2. PTP operates over bursty networks without any need for special switch support
3. Network jitter is filtered out with the assistance of the high-precision Stratum 3 oscillator
4. PTP can operate over data networks

13. What major features and benefits added to the standard SFN5122F card would justify the additional SFN5322F cost, and what would be the usage model?

SFN5322F ensures servers will be synchronized to within hundreds of nanoseconds. This enables financial exchanges to track the order that transaction requests are received across a set of servers. As latencies are in the microseconds, having a sub-microsecond time synchronization to discriminate packet arrival times is paramount. SFN5322F provides the same benefits for receiving market data feeds.

Furthermore, Solarflare's SFN5322F consolidates high-precision server clock synchronization with the ultra-low latency of SFN5122F into a single server adapter that operates in a single PCIe slot and over a single 10G Ethernet data network. The combined features of SFN5322F decrease deployment costs and reduce server utilization which benefits many industries, such as High Frequency Trading (HFT), telephony service providers, and smart grid providers, etc.

14. What are the benefits of utilizing Solarflare's SFN5322F over existing solutions now being deployed, such as 1GbE adapters with PTP support?

Solarflare offers a solution with a high precision oscillator yielding superior time synchronization to within 200ns, integrated with the industry's lowest latency server adapter, which operates over a single 10GbE data network residing in a single PCIe slot.

Other solutions offer PTP offload, with 1GbE (or 100BASE-T) connections, inferior offsets, and require a separate dedicated network and separate PCIe slot. For example, utilizing a 1GbE NIC with PTP still requires deployment of SFN5122F for ultra-low latency along with an additional PCIe adapter for time synchronization over a separate dedicated network.

15. Can SFN5322F customers use FSMLabs Timekeeper software?

Yes, it is possible to utilize the PTP software of a Solarflare's partner, such as FSMlabs TimeKeeper software. (See FSMLabs / Solarflare Press Release on MarketWire - 12.5.11).

16. Where can I find 10GbE PTP masters to use with SFN5122F?

Currently the only 10GbE grandmaster available is Solarflare's SFN5322F along with its PTPd daemon. Refer to the SFN5322F User Guide for details.

Alternatively, 1GbE or 100BASE-T grandmaster can connect to the 10GbE network through a 10GbE switch that is also compatible with 1GbE or 100BASE-T connections.

17. How does SFN5322F function in conjunction with PTP grand master solutions offered by Meinberg, Symmetricom, or Spectracom?

All three companies supply dedicated PTP appliances, which are grand master clock sources that provide synchronization to a coordinated universal time source. The SFN5322F synchronizes all PTP slave servers in the network to the grand master appliances.

18. What are the advantages of using SFN5322F over other specialized time synchronization appliances?

SFN5322F is a standard Linux device utilizing a standard Linux driver, which means that IT managers can now manage time synchronization utilizing standard Linux management tools remotely at all worldwide locations. For example, SFN5322F can be initially deployed as an ultra-low latency data device, and the PTP features can then be enabled at a later date. None of this is possible with special-purpose time synchronization solutions.

