Solarflare 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 (e.g. NTP), offering sub-microsecond timing accuracy that can be implemented at a fraction of the

cost of specialized network time appliances (e.g. GPS receivers). 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 Solarflare PTP adapter customers and what benefit does Solarflare's PTP adapters offer them over their current solution?
Solarflare's PTP adapters are 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 PTP adapters, 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.

Solarflare's PTP adapters also enable installing and maintaining PTP equipment with standard Linux tools.

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 Solarflare's PTP adapters, and why?
Financial services customers will benefit the most, as they have both clock synchronization and ultra-low latency requirements. Utilizing the Solarflare's PTP adapters, these customers will benefit from the industry's lowest latency that they already receive from Solarflare's standard adapters, 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, Solarflare's PTP adapters require a hardware driver, and Solarflare's Linux driver supports the Linux derivatives mentioned above. Solarflare's PTP drivers are compatible with the non-PTP adapters.

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 Solarflare PTP adapters. This means that PTP can be deployed today, with currently available switches, and can achieve superior latency performance and PTP time accuracy with Solarflare PTP adapters.

The PTP protocol operates by sending protocol packets back and forth between the PTP master server 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 PTP User Guide documents the high accuracy measured under network load with standard switches that do not have any special PTP functionality.

7. How accurate are Solarflare PTP adapters 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. Solarflare PTP adapters 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 are Solarflare PTP adapters with a user space PTPd?
Solarflare's PTP 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 PTP adapter 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, Solarflare's PTP adapters demonstrated slave to master offsets of within 500ns. When the bursty condition cleared, the slave to master offsets returned to within 200ns.

11. Why do Solarflare PTP adapters have a Stratum 3 oscillator?
What sets Solarflare PTP adapters 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 do Solarflare PTP adapters synchronize the server's system clock?
Solarflare's PTP adapters use a two-step approach to synchronize server clocks. First, the PTP adapters synchronize their clock to the PTP master clock. Then the PTP adapters synchronize 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 Solarflare adapter would justify the additional PTP adapter cost, and what would be the usage model?
Solarflare PTP adapters ensure 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. Solarflare PTP adapters provide the same benefits for receiving market data feeds.

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

14. What are the benefits of utilizing Solarflare's PTP adapters over existing solutions now being deployed, such as 1GbE adapters with PTP support?
Solarflare offers a PTP 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 PTP adapter still requires deployment of SFN5122F for ultra-low latency along with the additional PCIe adapter for time synchronization over a separate dedicated network.

15. Can Solarflare PTP adapter customers use third party PTP 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 SFN6122F and SFN5122F?
Currently grandmasters with 100BASE-T and 1000BASE-T connections are available, and can connect to the 10GbE network through 10GbE switches that have compatible 1GbE or 100BASE-T connections. For a list of interoperable PTP masters, see http://www.solarflare.com/Precision-Time-Synchronization-PTP.

Additionally, Solarflare's PTP adapters along with its PTPd daemon and Stratum 3 clock can provide a PTP master clock. Refer to the Solarflare's PTP User Guide for details.

17. How do Solarflare PTP adapters function in conjunction with PTP grandmaster solutions?
Several vendors supply dedicated PTP appliances, which are grand master clock sources that provide synchronization to a GPS (or other Stratum 0) clock source. Solarflare's PTP adapters synchronize all PTP slave servers in the network to the grand master appliances.

18. What are the advantages of using Solarflare PTP adapters over other specialized time synchronization appliances?
Solarflare PTP adapters comprise 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, Solarflare PTP adapters 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.