TimeKeeper™ Linux PTP/NTP Software
Low Latency, Deterministic Time Transfer for Linux

Key Benefits
- Precision time synchronization to the Linux application (“Last-mile solution”)
- Improves timestamp accuracy on all Linux transactions (near zero latency, monotonic)
- All CPUs synchronized for distributed processing

Key Features
- Kernel-level PTP (IEEE-1588) and NTP time client
- Fastest calls to read time, no delays
- Improves local system clock stability and performance
- Leverages high performance time synchronization hardware
- Requires no kernel modification or application changes, no special libraries or calls
- Improves existing NTP infrastructure with point-to-point optimized NTP server/client
- Support for most standard Linux distributions out-of-the-box
- Special configurations and modifications available
- Easy back-out reduces risk

TimeKeeper™ is a suite of transparent Linux applications for industries where computer time synchronization requirements are moving beyond compliance-based record keeping and network security best practices. It is designed for high performance / low latency computing applications in industrial, defense and financial markets with an enhanced level of timing performance so management of real-time events over wide areas is drastically improved.

Precision Time Transfer to the Application
As synchronization protocols and hardware improve, and accuracy requirements get tighter, latencies due to normal mechanisms in the computer/server/OS are significant. TimeKeeper™ efficiently transfers time deterministically with low latency, without any configuration or modifications to the kernel or applications. Combining TimeKeeper Linux synchronization software with Spectracom synchronization hardware solves the “last-mile” problem to provide superior clock and time-stamp accuracy from the traceable time source all the way through to the time-stamp call in the Linux environment.

TimeKeeper vs. Standard LINUX Time

<table>
<thead>
<tr>
<th>TimeKeeper</th>
<th>Linux</th>
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<tbody>
<tr>
<td>Does not leave the processor to compute time</td>
<td>Goes “off-chip” to access precision timing resources introducing inaccuracy and delay</td>
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<tr>
<td>Maintains a smooth and continuous software clock rate and computes corrected time on every call</td>
<td>Only coarse time adjustment, at every timer tick, time is added or subtracted, creating discontinuities and time jumps</td>
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<tr>
<td>No OS overhead allows 10x faster calls to read time</td>
<td>Switch to OS opens the opportunity to reschedule and delay the application</td>
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<tr>
<td>Time never goes backward</td>
<td>Time not guaranteed to be monotonic</td>
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Fault Tolerant
TimeKeeper works with standard network time synchronization protocols NTP or PTP (IEEE-1588), or both. In addition to receiving time from NTP servers and PTP masters, it can use other sources including local hardware clocks via PCI express cards, or in a self-disciplining mode. It can periodically evaluate the quality of a variety of sources and select a new one if necessary. Alerts are configurable for change-of-state, out of tolerance, and other messages via SNMP.

Supports Existing NTP Infrastructure
For NTP performance improvement, TimeKeeper NTP Server is an enhancement to the standard NTP protocol to greatly improve NTP performance in a local area network when the client needs fast and precise synchronization.
Typical Application-level Synchronization Performance
(assuming network has no timing packet delay variation)

<table>
<thead>
<tr>
<th>Time Client</th>
<th>Time Source</th>
<th>Hardware Timestamp</th>
<th>Typical Accuracy</th>
</tr>
</thead>
<tbody>
<tr>
<td>TimeKeeper PTP/NTP Client</td>
<td>SecureSync PTP grandmaster</td>
<td>TSync-PCIe-PTP</td>
<td>1 μs</td>
</tr>
<tr>
<td>TimeKeeper PTP/NTP Client</td>
<td>SecureSync PTP grandmaster</td>
<td>none</td>
<td>4-5 μs</td>
</tr>
</tbody>
</table>

Protocols
- IEEE-1588:2002 (PTPv1)
- IEEE-1588:2008 (PTPv2)
- NTP v2,3,4
- SNMP

Operating Systems
- (64-bit unless noted)
- Fedora 12
- RedHat Enterprise 4 (32-bit/64-bit)
- RedHat Enterprise 5 (32-bit/64-bit)
- RedHat Enterprise 6
- SuSE Linux Enterprise 11
- Ubuntu Linux 10.04

Software and Licensing
- TimeKeeper applications are self-extracting executables shipped on a CD
- TimeKeeper SW is an annual license and is available per machine or as a site license

Configurations
- TimeKeeper NTP Client
- TimeKeeper PTP/NTP Client
- TimeKeeper NTP Server
- TimeKeeper Bus Level Client

How TimeKeeper Works
PTP Over LAN Architecture
TimeKeeper Clients improve the processing of time to the application and is compatible with PTP protocols, as well as NTP.

Server Architecture with PCIepress Card
For servers that can accept PCIepress hardware, Spectracom offers the TSync-PCIe to offer server applications the most accurate time, traceable to a number of different time sources.

NTP Improvement Architecture
TimeKeeper can improve performance of existing NTP infrastructure using the TimeKeeper NTP Server software with TimeKeeper NTP Client, which are optimized for point-to-point network time synchronization.