Simplifying High-Accuracy Timestamping Across Hybrid Networks Without Costly Hardware

October 29, 2024 · clockwork.io/blog/simplifying-high-accuracy-timestamping-across-hybrid-networks-without-costly-hardware/

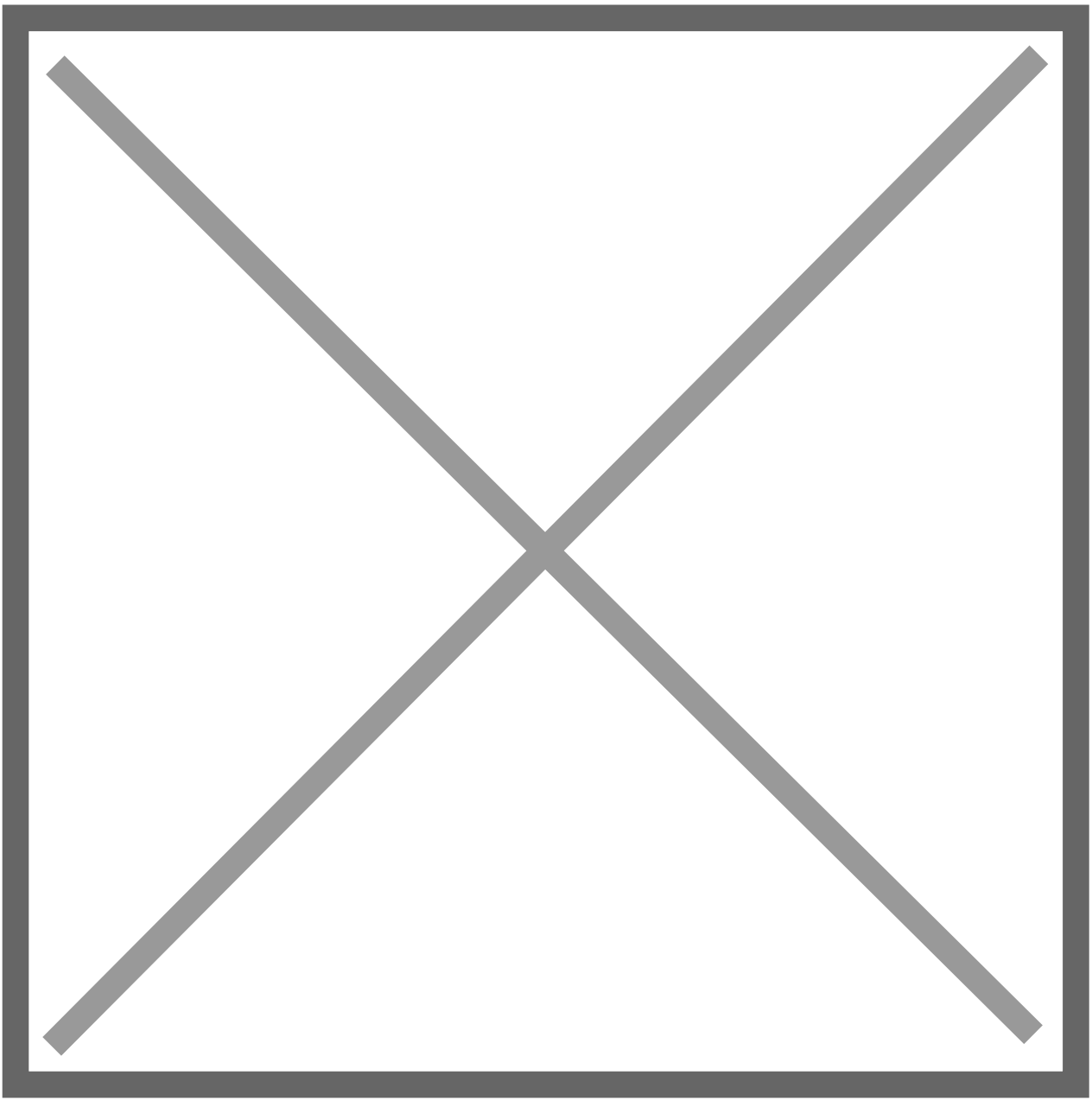
Precision Timing—A Game Changer for Real-Time Applications

In a digital ecosystem where milliseconds matter, precise timestamping isn't just a nice-to-have; it's a necessity. Whether you're managing a high-frequency trading platform, handling critical telecom infrastructure, responding to cybersecurity incidents, or operating latency-sensitive applications, the accuracy of your event timestamps can make or break your performance or limit your ability to consistently meet legal mandates requiring high precision time synchronization. Yet, synchronizing clocks across geographically dispersed locations has long been a costly, complex, and infrastructure-heavy challenge.

Let's dive into why exact time synchronization matters, the limitations of traditional methods, and how Clockwork is revolutionizing this space by making high-precision synchronization globally

© 2026 CLOCKWORK. All rights reserved.

accessible and easy to implement in on-premise, hybrid and multi-cloud environments without requiring specialized hardware.



The Stakes: Why Accurate Timestamping Matters for Latency-Sensitive Environments

© 2026 CLOCKWORK. All rights reserved.

Without accurate timestamps, event ordering becomes inconsistent, making it difficult to analyze data, troubleshoot errors, and maintain regulatory compliance. Here are some areas where exact timestamping is crucial:

1. **High-Frequency Trading (HFT)**: In financial markets, transactions happen in microseconds. Accurate time synchronization is a legal mandate under regulations like the EU's MiFID II, which requires sub-millisecond synchronization for HFT systems to prevent unfair advantages.
2. **Telecommunication Networks**: Especially with the rise of 5G, telecom providers rely on precise clock synchronization across nodes to ensure the timely delivery of voice, video, and data packets—imperative for avoiding latency and jitter.
3. **Cybersecurity Incident Response**: During a cyberattack, SREs and security teams need reliable timestamps to analyze and track the sequence of events across multiple systems. Without synchronized clocks, pinpointing the origin and progression of an attack becomes nearly impossible.

The Challenge: Why Traditional Synchronization Falls Short

Accurate global timestamping is difficult for several reasons. Traditional synchronization methods like the Network Time Protocol (NTP) only provide timing accuracy within tens or hundreds of milliseconds—too imprecise for most latency-sensitive applications. Here's a look at the core issues:

© 2026 CLOCKWORK. All rights reserved.

- **Complex Infrastructure Requirements**: Achieving sub-microsecond precision typically requires the Precision Time Protocol (PTP) with specialized hardware, demanding significant infrastructure investment.
- **Regulatory Compliance Pressures**: Financial institutions must comply with regulations like MiFID II (EU) and CAT (US), which mandate precise timestamping for market transparency. Non-compliance can lead to severe penalties.
- **Troubleshooting and Log Analysis Issues:** Inconsistent timestamps across systems make it challenging to analyze logs or troubleshoot incidents accurately, impacting operational efficiency and customer satisfaction.

Traditional methods just can't keep up. However, Clockwork offers a way forward.

Introducing Clockwork: Precision Timestamping Made Simple, Scalable, and Hardware-Free

Clockwork has developed an innovative approach to synchronize clocks across global networks with precision down to tens of nanoseconds—without the need for specialized hardware. Here's how:

© 2026 CLOCKWORK. All rights reserved.

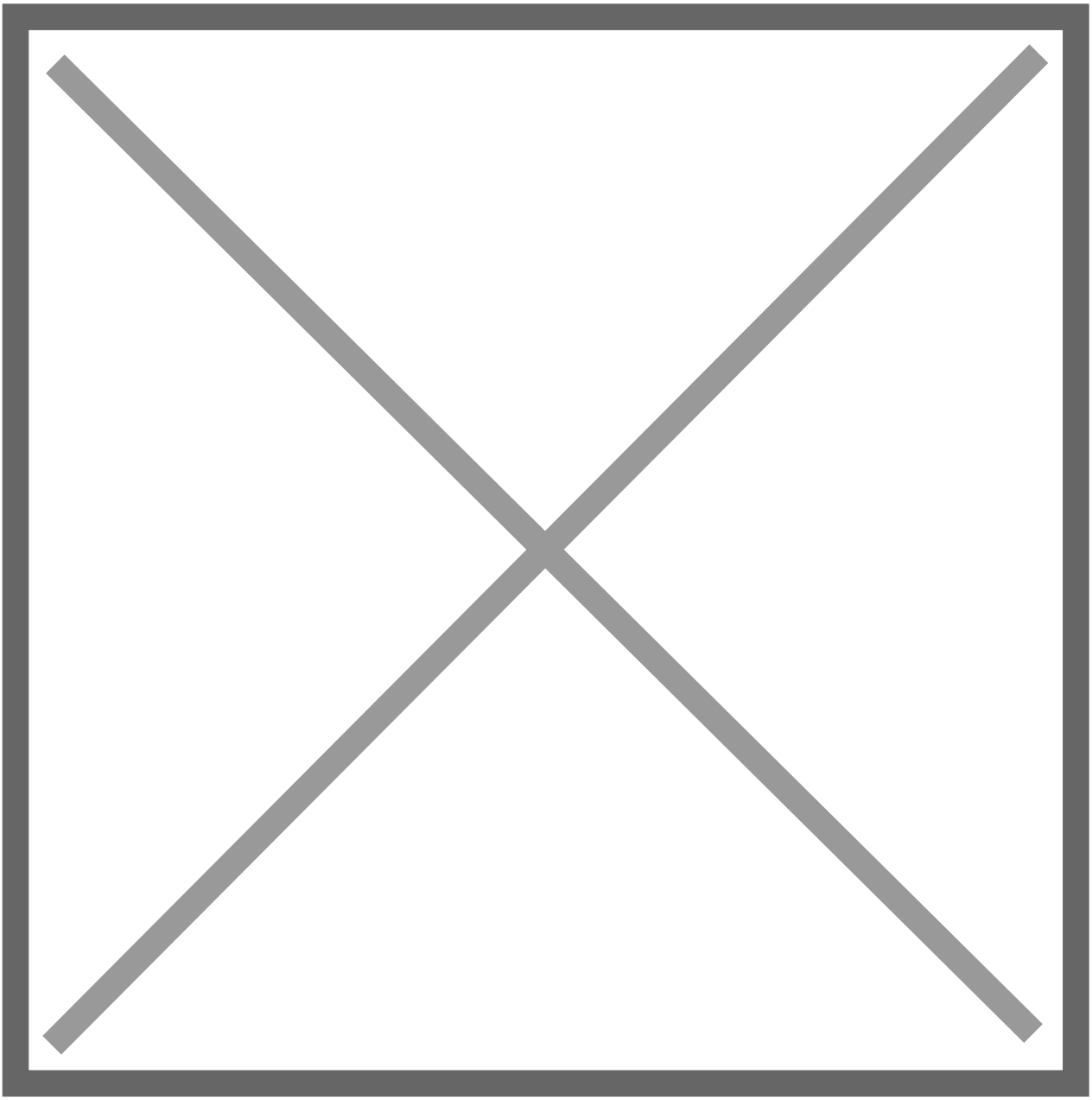
1. **High-Precision Synchronization**: Clockwork achieves timestamp accuracy within hundreds of nanoseconds via software and tens of nanoseconds with hardware, meeting the needs of the most latency-sensitive applications.

2. **Software-Only Implementation**: Clockwork operates as a plugin that can be installed on hosts, virtual machines, or Kubernetes pods, eliminating the need for costly hardware installations and complex network configurations.

3. **Global Consistency:** The software ensures that timestamps are accurately synchronized across all locations, making event ordering consistent globally.

4. **Ease of Integration**: Clockwork provides straightforward time primitives that are accessible by your applications on any host, so integration is seamless and deployment fast.

© 2026 CLOCKWORK. All rights reserved.



Real-World Impact: Clockwork in Action

© 2026 CLOCKWORK. All rights reserved.

Financial Market Data Providers

For companies like Bloomberg, which collect global financial data in real-time, precise timestamps are critical to ensuring that data streams are accurately ordered. With Clockwork, these organizations can achieve sub-microsecond timestamp accuracy, enhancing their trading strategies and maintaining compliance with regulations like MiFID II.

Regulatory Compliance Made Simple

Clockwork simplifies compliance with mandates like MiFID II and CAT by meeting stringent accuracy requirements without the need for specialized hardware. This means easier audit trails, reduced compliance costs, and confidence that systems meet regulatory expectations.

Enterprise Log Management

For application owners and SREs, troubleshooting can be time-consuming when logs from different systems have conflicting timestamps. Clockwork eliminates these discrepancies, providing consistent timestamps that streamline troubleshooting and speed up resolution times.

© 2026 CLOCKWORK. All rights reserved.

Latency-Sensitive Applications

In industries like online gaming, telecommunications, and real-time analytics, latency is a make-or-break factor. Accurate timestamping ensures that events are processed in the correct order, reducing latency and improving overall performance.

Case Studies: Clockwork's Impact Across Industries

Case Study: A Top Financial Market Data Provider Achieves Sub-Microsecond Timestamp Accuracy

A large US-based financial data provider needed a reliable solution to synchronize timestamps across multiple global data sources. With Clockwork, they achieved:

- Sub-Microsecond Timestamp Accuracy: Reliable timestamping for algorithmic trading.
- Improved Data Quality for Clients: Enhanced trust and reliability in data streams.

© 2026 CLOCKWORK. All rights reserved.

- Cost and Infrastructure Efficiency: By avoiding specialized hardware, the provider reduced operational costs while simplifying global deployment.

Case Study: Leading Global Bank Ensures Regulatory Compliance with Clockwork

A prominent bank faced stringent requirements under the CAT regulation in the US, demanding timestamp accuracy to within 50 milliseconds of the NIST time. They turned to Clockwork for a solution that met these requirements while keeping infrastructure costs in check. Clockwork provided:

- High-Precision Synchronization: Achieving sub-microsecond accuracy, surpassing CAT's requirements.
- Compliance Reporting: Providing detailed logs and reports to demonstrate compliance.
- Cost Efficiency: By avoiding the need for specialized hardware, the bank minimized costs and disruption to existing operations.

Case Study: Fortune 500 Insurance Company Resolves Latency Issues with Precision Timestamping from Clockwork

© 2026 CLOCKWORK. All rights reserved.

A Fortune 500 insurance company, dependent on real-time data insights, faced critical latency issues impacting their Vertica database performance, especially during peak renewal periods. These delays affected ETL pipelines and underwriter efficiency, leading to significant productivity losses for their data and SRE teams.

Challenge: Latency & Troubleshooting Overhead with Coarse Observability Tools

The company's AWS-based infrastructure, including Vertica database nodes and S3 storage, relied on monitoring tools like **New Relic**, **Sumo Logic**, and **Splunk**. However, despite very robust monitoring infrastructure, these tools failed to isolate the cause of the latency issues. Moreover, a dedicated team of 2 SREs and 1 Data Engineer spent an entire week manually investigating the latency issues.

Solution: Clockwork.io's Fine-Grained Timestamping for Rapid Isolation

Clockwork.io's fine-grained, high precision timestamping tightly correlated CPU spikes and application timeouts to a misbehaving client that was stuck in an infinite loop, making excessive data requests to Vertica.

© 2026 CLOCKWORK. All rights reserved.

Why Choose Clockwork?

Clockwork is transforming how organizations handle global timestamping. Here's why Clockwork is the top choice for application owners, SREs, data engineers, and data platform engineers alike:

1. **Simplified Deployment**: Clockwork's software-only solution eliminates the need for specialized hardware, making deployment fast and flexible.
2. **Scalability Across Any Network Size**: Whether you're working with localized data centers or global infrastructures, Clockwork adapts seamlessly to your setup.
3. **Regulatory Confidence:** Clockwork meets or exceeds timestamp accuracy requirements for compliance, keeping you in line with regulations and avoiding potential penalties.
4. **Enhanced Operational Performance**: With synchronized timestamps, log analysis, troubleshooting, and real-time application performance improve drastically.

If your infrastructure requires precise, accurate timestamping across a global network, Clockwork provides a straightforward solution. By moving beyond the limitations of NTP and the hardware demands of PTP, Clockwork offers the precision needed for compliance and optimal performance in real-time applications. To learn more about how Clockwork can support global synchronization for latency-sensitive environments, reach out to explore its potential fit for your operations.

© 2026 CLOCKWORK. All rights reserved.