



Standard

High-frequency trading (HFT) requires absolute accuracy in timing because trades are executed in nanoseconds, where even a microsecond can be the difference between profit and loss.



Technology

High-speed computers, dedicated hardware based on FPGAs, algorithms and PTP are the heart of HFT.



Solving High-Frequency Trading Synchronization at nuam Chile

nuam is the regional holding company that brings together the Santiago, Colombia and Lima Stock Exchanges into a single market. Nuam is implementing new, High-Performance Trading (HFT) engines (such as Nasdaq Eqlipse) and trading interfaces (TWS) to speed up order execution and improve market efficiency. This is crucial for reducing operational errors and facilitating faster, high-volume trading.

High-frequency Trading (HFT) systems are complex ecosystems built for speed and precision. They rely on a combination of hardware, software and infrastructure to minimize latency.

Timing inaccuracy can lead to:

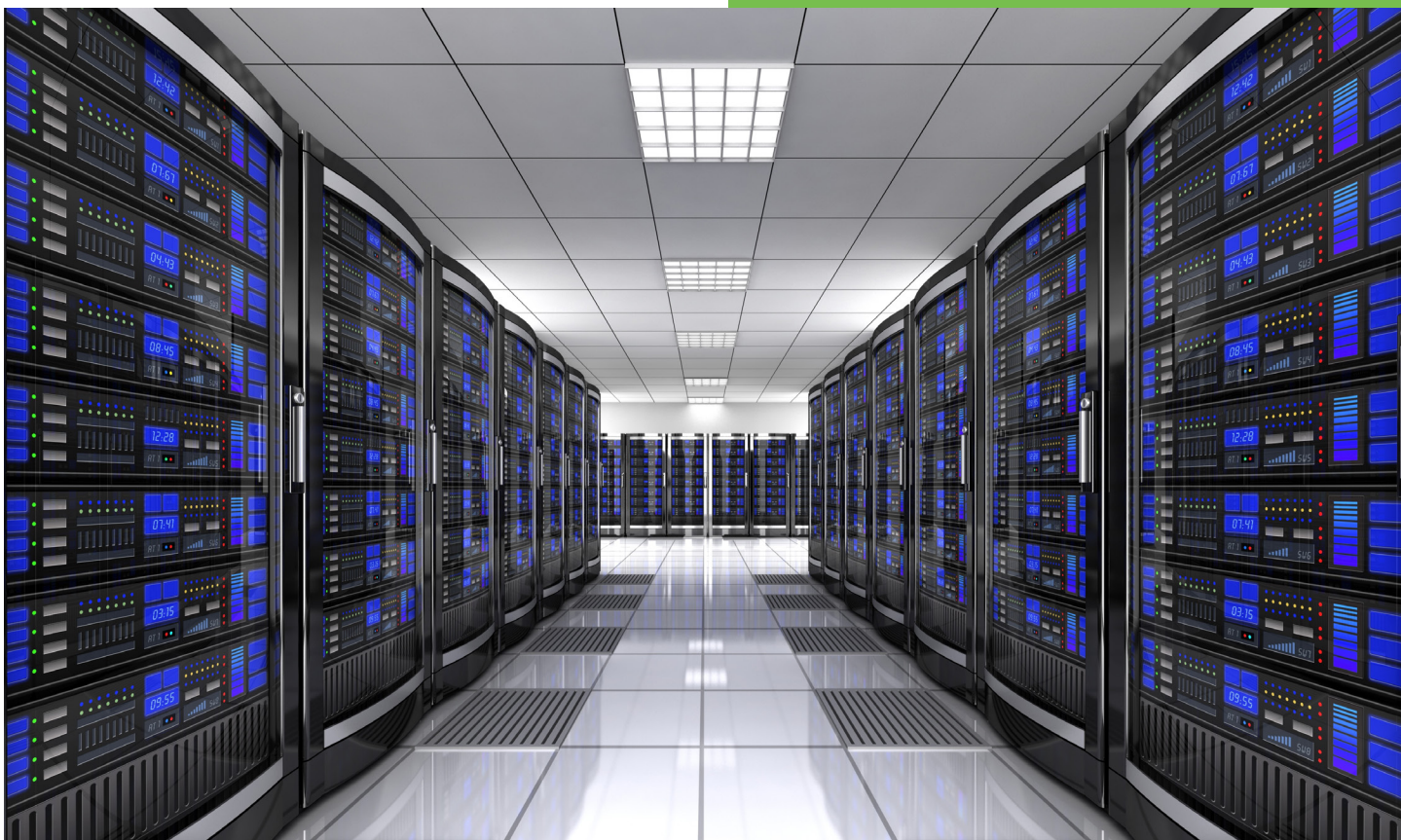
- Order execution issues and data inaccuracies
- Regulatory compliance challenges
- Disruptions in algorithmic and high-frequency trading
- Operational risks and loss of investor confidence



Regulatory Requirements

The need for precise timing is underscored by international regulations, such as the MiFID II/ ESMA Synchronization requirements implemented in Europe by January 2018. These regulations set clear benchmarks for time accuracy:

Trading Activity	Required Accuracy to UTC	Granularity
High Frequency Trading (HFT)	100 μs	1 μs
Non-Human Intervention Trading	1 ms	-



High-Frequency Trading Needs and Components

To maintain a competitive edge, HFT operations require:

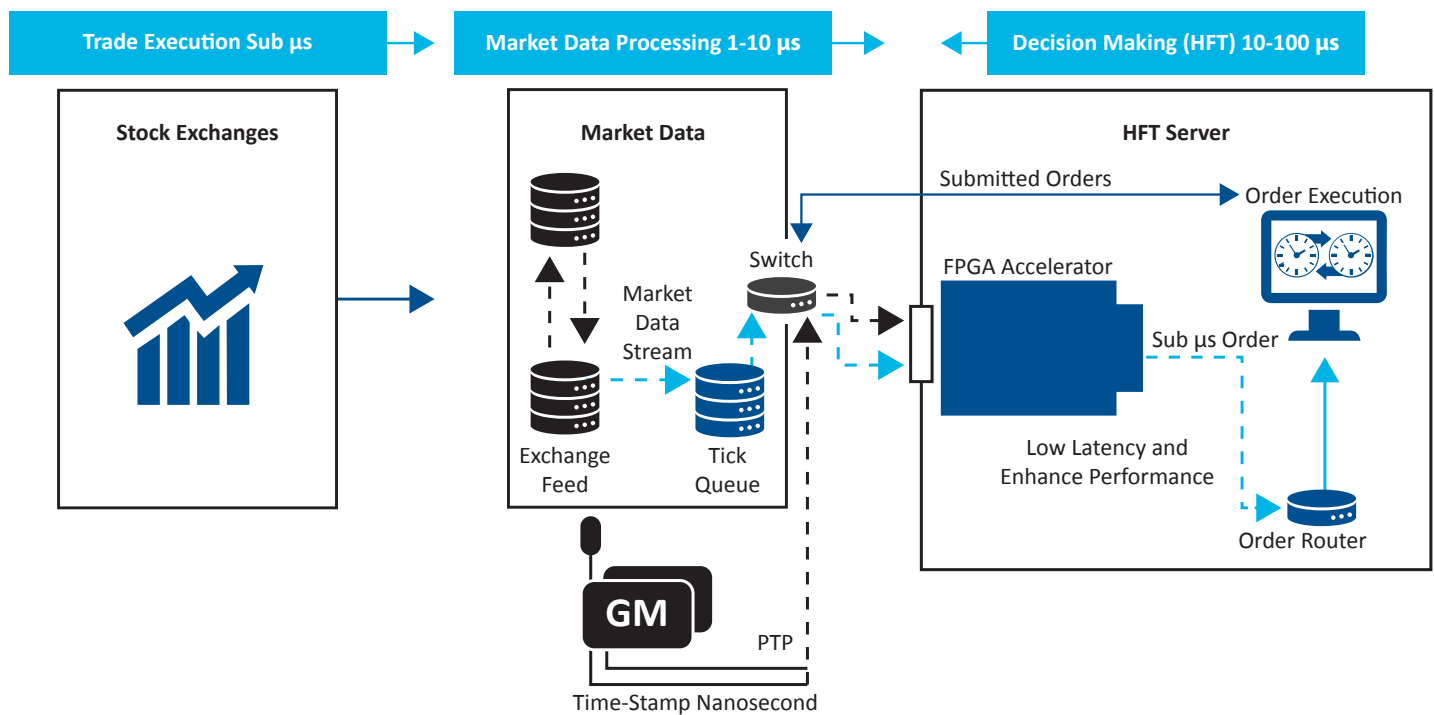
Real-time data feeds: Essential to avoid microsecond delays that impact profitability

High-speed computers: Specialized hardware designed for rapid processing

Co-location: Placing trading computers as close as possible to the exchange servers to drastically reduce time delays

Computer algorithms: The core intelligence driving HFT decisions and execution inside modern FPGAs

High-Frequency Trading Speed Breakdown



Stock Exchanges and Market Data

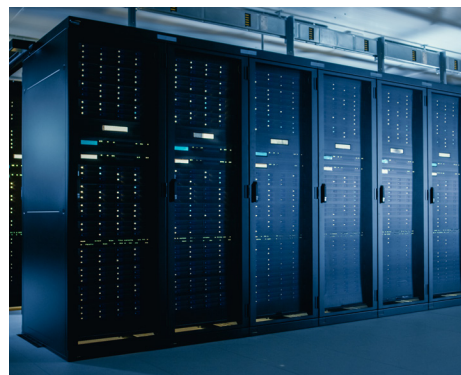
HFT Servers are capable of executing **thousands of orders per second**. High-speed low-latency systems need accurate and precise time for:

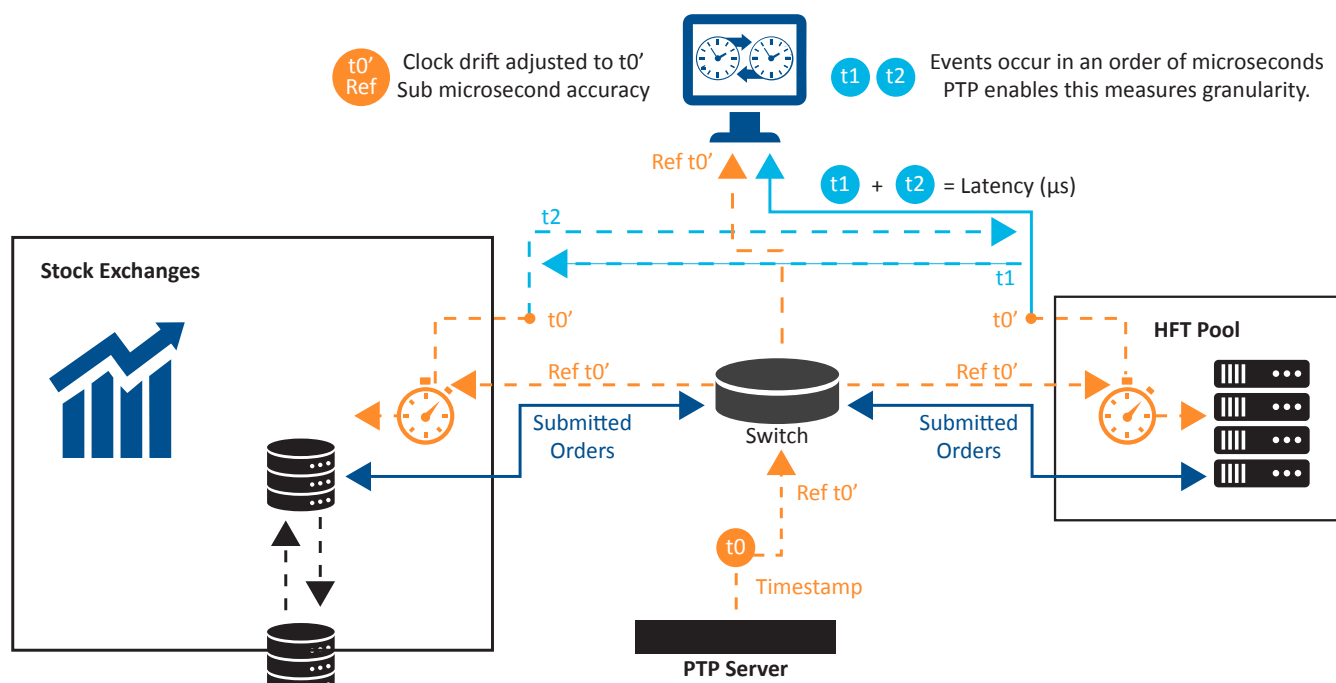
- Time tagging market data
- Precise time between trading servers
- Ultra-low latency switches require high accuracy timing for real-time data delivery
- Network latency measurements and monitoring
- Data analysis

HFT Servers

Built under powerful computers, dedicated Network Interface Cards (NICs) with special FPGAs and complex statistical algorithms:

- Need sub-microsecond accuracy at the software layer of the servers
- Need to read the time a million times per second or more





The Impact of Precise Time Protocol

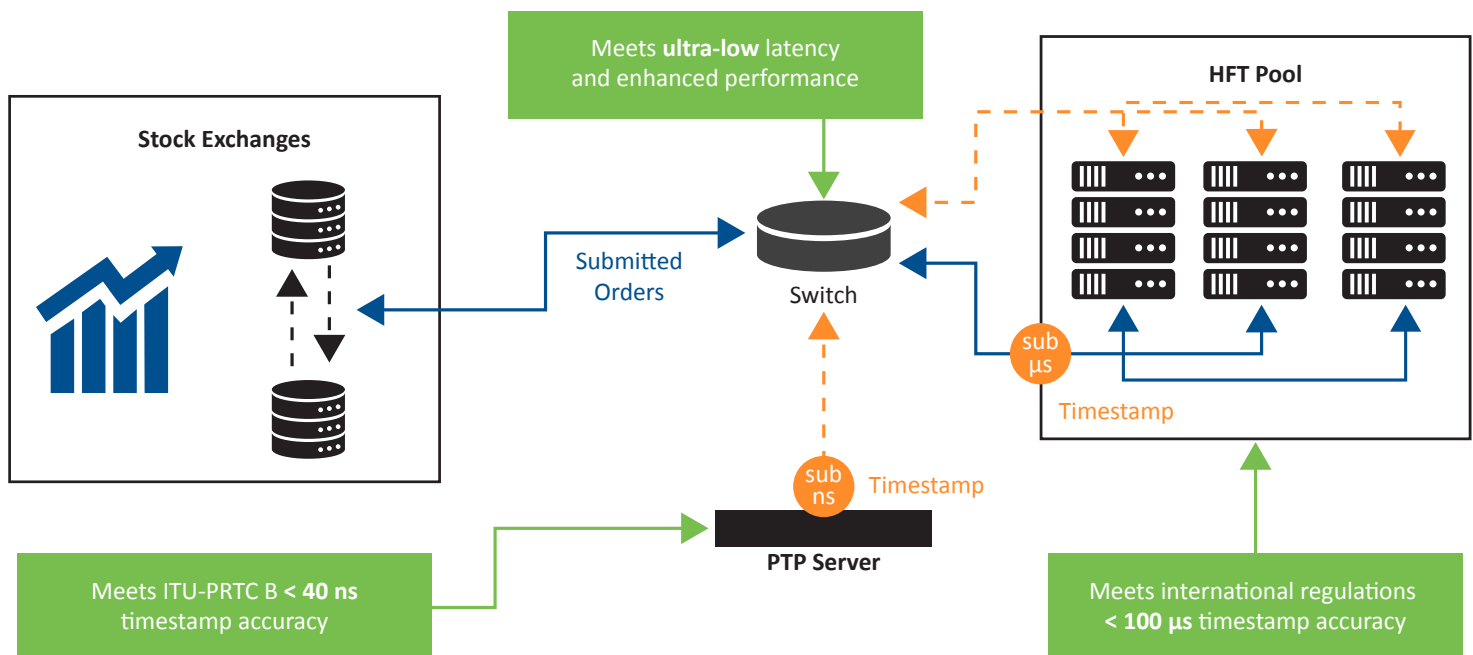
Precise Time Protocol (PTP) is specifically designed for achieving high-precision time synchronization in distributed systems. It is suitable for applications requiring extreme accuracy, such as algorithmic trading and HFT, as it allows for sub-microsecond accuracy.

PTP functions by exchanging timing messages between devices to calculate clock offsets and dynamically adjust for clock drift.

A PTP server will create a common clock-based reference for all elements of the trading ecosystem. Delivering sub-nanosecond accuracy, allows all other equipment to perform sub-microsecond accuracy. It also enables latency testing to reach this accuracy level granularity.

Latency testing plays a crucial role in assessing how well systems perform under competitive and regulatory demands. It ensures that hardware, software and network optimizations lead to measurable improvements in system performance.

The implementation of PTP ensures that stock market infrastructure is not only compliant with stringent international regulations, but is also equipped to support the demands of modern HFT. Modern Primary Reference Time Clocks (PRTCs) comply with Telecommunication Union Telecommunication Standardization Sector ITU-T G.8272 class B standards. They are designed to minimize power consumption, contribute to achieving sub-nanosecond accuracy and serve as reliable references for latency testing.



Solution



TimeProvider® 4500

- High-speed network interfaces up to 25 Gbps
- Ready for High Accuracy Time Transfer (HA-TT) ITU-T G.8171.1 and 2
- High capacity for PTP and NTP today and additional capacity in future releases
- Flexible full redundancy capability 1:1 anytime with additional same clock
- Modern oscillator construction based on CPT (laser interrogation which consume less power and operate over temperature oscillations)
- Native PRTC-B with single band receiver, ITU-T G.8272 class B (<40 ns to UTC)

Microchip Technology Inc. | 2355 W. Chandler Blvd. | Chandler AZ, 85224-6199 | microchip.com