

# Network Time Synchronization

**Why It is Crucial for Regulatory Compliance in Enterprise Applications**

Satish Kikkeri  
Director of Marketing, Enterprise Programs  
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# Agenda

## Presenter



Satish Kikkeri

Director of Marketing,  
Enterprise Programs

- Overview of timing in Enterprise applications
- What is regulatory compliance
- Why is time synchronization important
- How does Time Accuracy & Synchronization help in Compliance
- Time Source Protocols For Enterprise Applications
- Microsemi Time Servers for the Financial Enterprise Market
- Key Takeaways

# Evolution of Enterprise IT and Need for Time Accuracy

- As Enterprise has evolved value of timing accuracy and sync has increased
  - Enterprise IT Silo's need time accuracy with synchronization & measurable latency
- Standardization & consolidation needs improved timing accuracy for efficiency
  - Single time source to monitor and manage enterprise wide with audit & event logs
- Infrastructure shared services, resource, & application mgmt add challenges
  - Accuracy, reliability, and security as a component of time from a single time source



# What is Regulatory Compliance and Why is Time Synchronization Important?



# Enterprise Application/Operation Areas that Need Accurate Time

- **Log file accuracy, auditing & monitoring**

- Faster systems require better granularity and accuracy in the log time stamps
- NMS report integrity
- Network fault diagnosis and recovery

- **Access security and authentication**

- Issues with security, access rights, non-repudiation
- Login errors when time drift beyond predefined skews (PDC)

- **Transaction processing**

- Time stamping in a fast disparate networks with heavy traffic

- **Scheduled operations**

- Backup, archive, retrieval

- **Real-world time values**

- Email
- Web-based transactions
- Workstations

- **Legal requirements**

- Repudiation
- Data Loss

- **Regulatory compliance requirements**

- Various requirements/industry segment

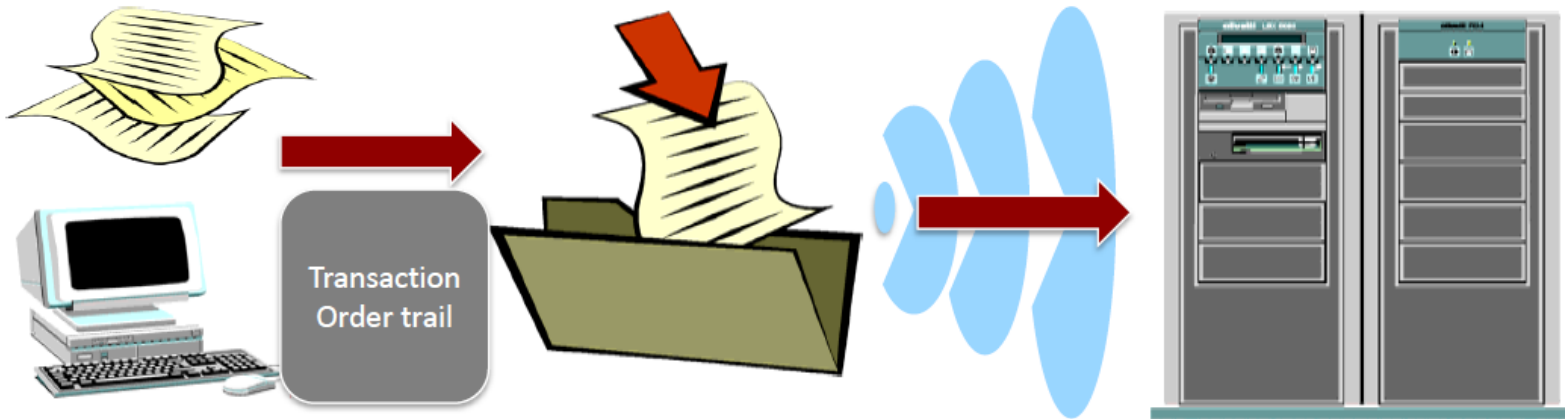
# When is Compliance Required for Financial Applications?

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- The business is regulated (i.e. GLBA, SOX, etc.) or subject to formal industry standards (i.e. PCI, OATS, etc.)
- The financial systems and operations are periodically audited
- The business relies on audit logs to uncover system problems or used to generate an alert to illegal or unauthorized activity OR
- The business shares critical or sensitive information with other organizations

# Network Time Synchronization and Regulatory Compliance

## Typical to a Financial Transactional Network



### Step1:

Financial Institutions in its DCs record order events pertaining to clients & type

### Step2:

Institution creates a folder where all the associated records are assembled

### Step3:

Transmit transactions for appropriate handling and create audit logs...

### Step4:

Generate feedback and analyze data for mandatory compliance requirements



# What is Regulatory Compliance?

- Compliance to guidelines established by different financial governing bodies

Sarbanes-Oxley  
Financial and Accounting Disclosure Information



- Major regulatory compliances

- Sarbanes-Oxley Act of 1999 (SOX)
- Order Audit Trail System - (OATS – under FINRA directive)
- Payment Card Industry- Data Security Standards (PCI-DSS)
- Gramm-Leach-Bliley Acct (GLBA)
- Federal Information Security Management Act (FISMA)
- Markets in Financial Instruments Directive (MiFID – EUs FINRA)





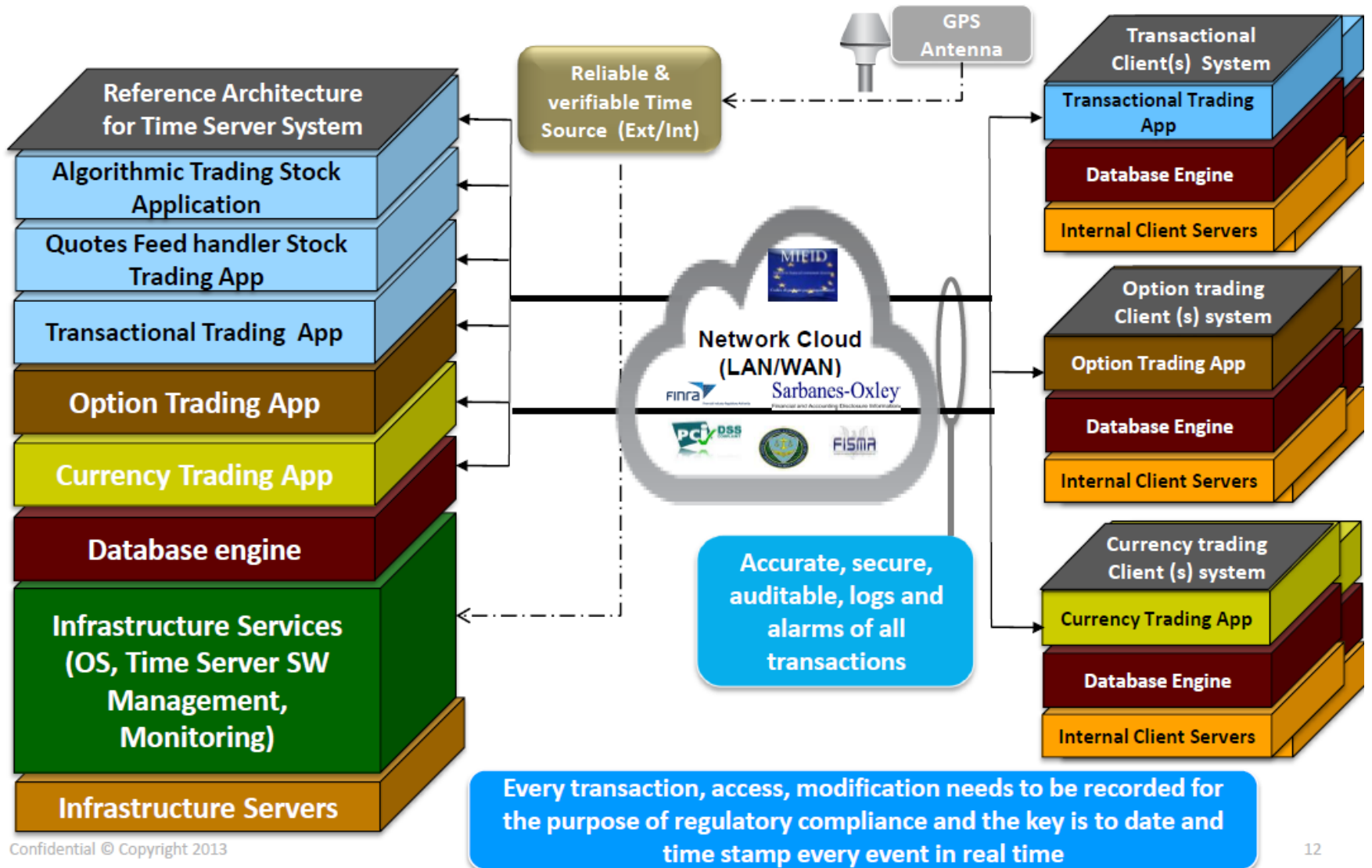
# Why Do Financial Sectors Need Regulatory Compliance?

- Financial sectors are mandated by government to
  - Strict regulatory compliances on electronic communications
  - Protect sensitive and confidential data with accurate time stamping
- At the core of various regulatory compliance is the need for
  - Accuracy of financial reporting based on accurate time & event sync
  - Elimination of fraudulent security trades with time as proof
  - Protection of customer information from modification for auditing
- Doing things on time is very important in distributed computing
  - Synchronize to meet SLAs & service definition

# What are Some of the Compliances (U.S. Financial Regulations)?

Sarbanes-Oxley Compliance (SOX)	
What is it?	Validity of Financial statements with strict internal audit and control
Who does it apply?	All U.S. publicly traded companies
Requirements	Support authentication, <b>time stamping</b> for audits, security policies
Gramm-Leach-Bliley Act (GLBA)	
What is it?	Protect consumer's information at financial institutions from modifications
Who does it apply?	Banks, Security firms, insurance companies and other companies providing financial products and services
Requirements	Provide reports with clear audit trail with user access date and <b>time stamp</b> details
Order Audit Trail System (OATS)	
Who does it apply?	All securities firms doing business in US under FINRA regulation
Requirements	Electronically capturing and reporting of specific data elements related to handling or execution of orders using a synchronized clock
Payment Card Industry – Data Security Standard (PCI-DSS)	
What is it?	Log access attempts to cardholder data environment in real-time with data & <b>time stamp</b>
Applies?	Any business that stores and transacts payments using cardholder data
Requirements	Implement automated audit trails to verify use of identification and authentication methods with real-time date and <b>time stamps</b>

# Reference Network Time Architecture - Where is Accurate Time Source Needed?



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# Key Elements of Network Time Synchronization

- An Accurate Time Source
  - External through GPS /GNSS or reliable single source (Ex: NIST)
- A Robust Time keeping architecture internal to a data center
- Robust and flexible system with software to support compliance
- Efficient network Time management policy
- Secure, reliable, verifiable and auditable policies and control

# How does Time Accuracy and Synchronization Aid in becoming Compliant?



# Essential Elements of Network Time Synchronization

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**Accurate**

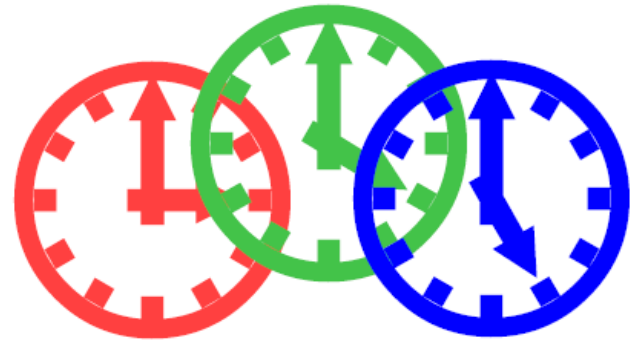
**Reliable**

**Secure**

**Auditable**

# Why are Network Clocks a Problem in Enterprise Applications?

- Every network element has a clock
- Clocks drift due to:
  - Oscillator quality
  - Temperature changes
  - Intentional oscillator frequency dithering to lower overall frequency emissions (reduce harmonics)
  - Power save modes
  - Oscillator aging
- Distributed computing exposes new challenges with clock drifts:
  - Lack of initial time of day synchronization
  - Different clock drift rates between servers, switches, routers lead to performance degradation





# Is There Time Drift Problem Today?

## [VM Linux Guests Time drifting problem with time sensitive application](#)

Virtual Machine time drift

The *drift* is small, but the *application* is very *time* sensitive and can be destructive to the data. ...  
Is your *problem* about the *clock* being too fast, too slow or because it

## [Troubleshooting False Alerts in Hyperic With Time Sync | Javalobby](#)

Platform and Dev Sync issues

[java.dzone.com/articles/troubleshooting-false-alerts](#)

Sep 6, 2012 *Time drift* occurs as the system time becomes separated from the JVM time. ... Troubleshooting *Time Sync Issues* .. Your monitoring tool shows your resource is down, you go check on it, and its fine. Even more aggravating, you go back to your monitoring tool and the resource is magically up again? If it happens once, you are annoyed, if it happens repeatedly – you distrust your monitoring system.

## [Knowledgebase Solution: Time Synchronization Issues](#)

Security and time sync issues

<https://www.pingidentity.com/.../Time-Synchronization-Issues>

Apr 13, 2012 – Resolving *problems* with *time* synchronization between the PingIdentity *application* server and other servers. ... For persistent *issues* when you suspect a *time skew/sync* issue follow these directions ... Cloud Identity Security ...

## [Correcting Windows Clock Drift under High-CPU Conditions ...](#)

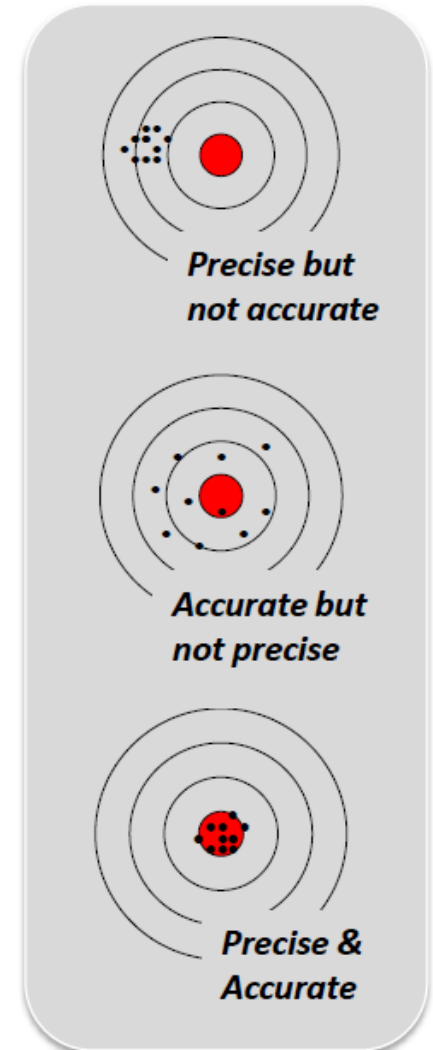
Windows and Hyper-V time sync issues

[support.steadfast.net/.../correcting-windows-clock-drift-under-...Share](#)

Sep 20, 2011 – ... servers, colocation, *cloud* services, virtualization, and managed services. ... Certain CPU-intensive *applications* (trading *applications* in ... Severe enough *clock drift* will cause Windows to re-sync with the

# What is Accuracy and Precision of Time?

- Accuracy is a function of “correctness” relative to an agreed to standard, (UTC for example)
- Hardware clock characteristics for accuracy:
  - 50 ns rms, 150 ns peak to UTC while tracking GPS
  - Single satellite operation to 1  $\mu$ s to UTC
- As network & CPU speeds improve, so does precision, but not necessarily accuracy



# Role of Data Security in Financial Networks

- Security Expectations
  - Provide access - Management & User
  - Authentication with the right set of access credentials
- Secure Server/Client Authentication
  - NTPv4 Autokey for NTP packet integrity and source verification
  - MD5 Security keys for NTP packet integrity and source verification
- Secure user access to provisioning/configuration
  - All ports have independent Access Control Lists
  - Local username and password control
  - SSL/HTTPS/SSH
  - Termination of unwanted services such as Telnet, SSH, etc.
  - RADIUS authentication



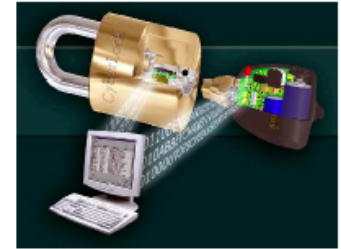
# Role of Time Source Reliability in Financial Networks

- Time Reliability means:
  - Providing time from a reliable source
  - Notification when time synchronization is in question
- Time Reliability should include:
  - Solutions with oscillator upgrades for holdover
  - Time sanity cross-checking to other clocks  
(Peers in NTP)
- Management architecture for reporting reliability
  - SNMP, Customizable alarms, Email alerts



# Role of Audits in Financial Networks

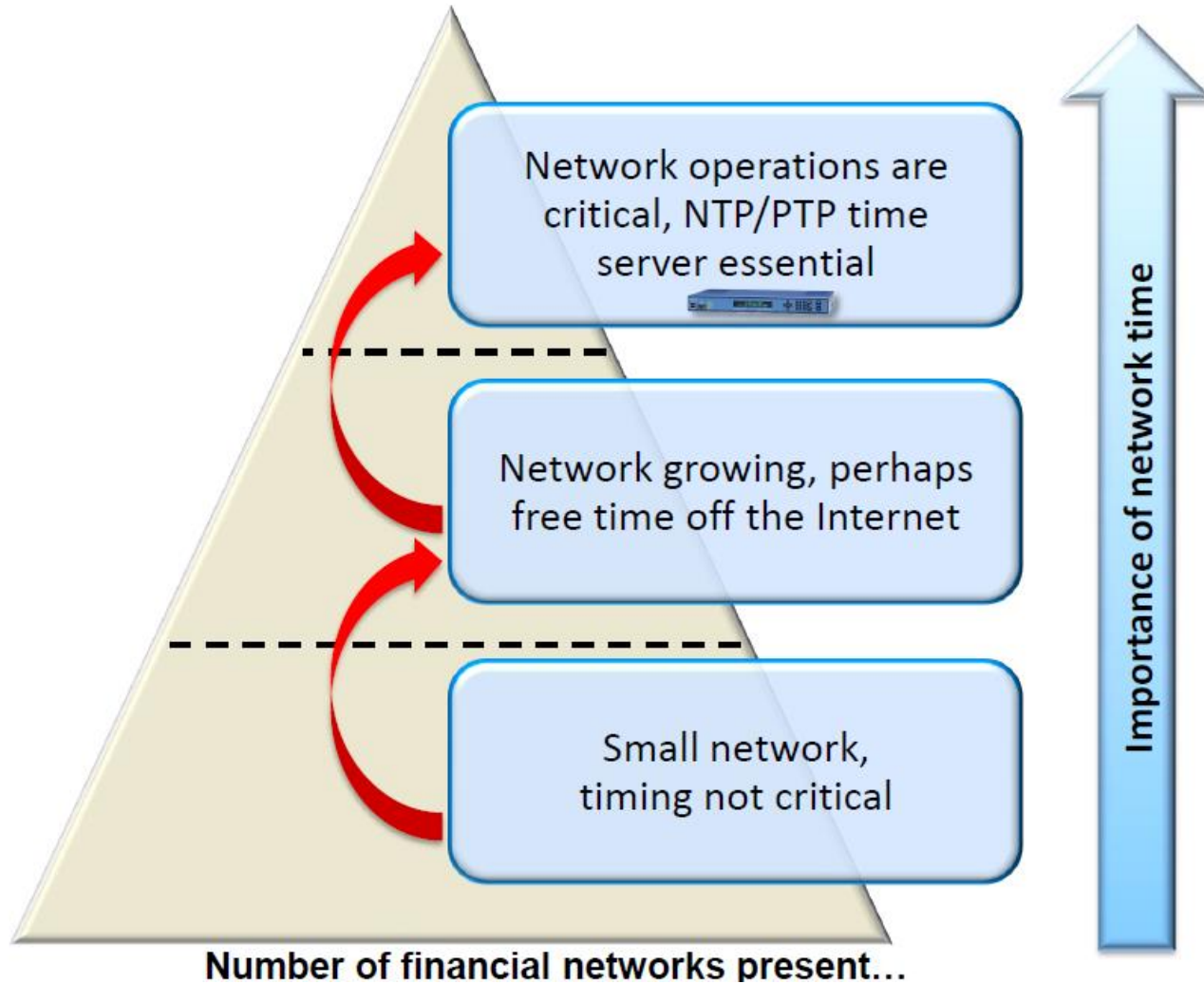
- Audit trails to improve security, reliability and accuracy of time
  - Capabilities to enhance and validate accuracy of network transactions
  - Usable when veracity of transactions are needed
- Provide enterprises with event logs, audit trails when
  - Data validity is impacted due
    - Data loss, modifications, access compromise
  - Protect enterprises from internal and external security threats
- Associate each transaction to real-time date and transaction time stamps
  - Reliable and verifiable single source of time
  - Logs attributable to user access, time of access, type of transaction
- Meet the various stringent regulatory compliances



# Time Source Protocols for Financial Applications



# Network Timing Landscape



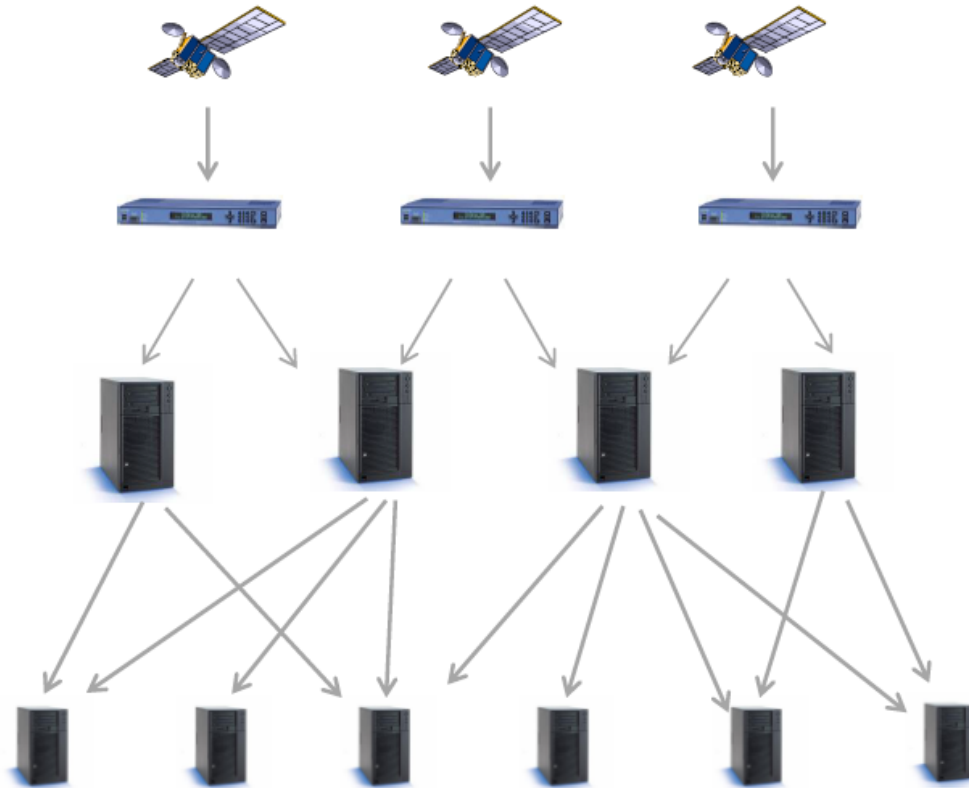


# What is NTP?

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# Typical NTP Stratum Architecture



Stratum 0: GNSS/GPS

Stratum 1: Accurate Master clock to all enterprises, verifiable to a single source

Stratum 2: Enterprise Infrastructure servers, routers, switches connecting various elements in the network propagate time and address compliance

Stratum 3: various network elements and other devices in the transactional network get time for transactional accuracy, sync & auditability

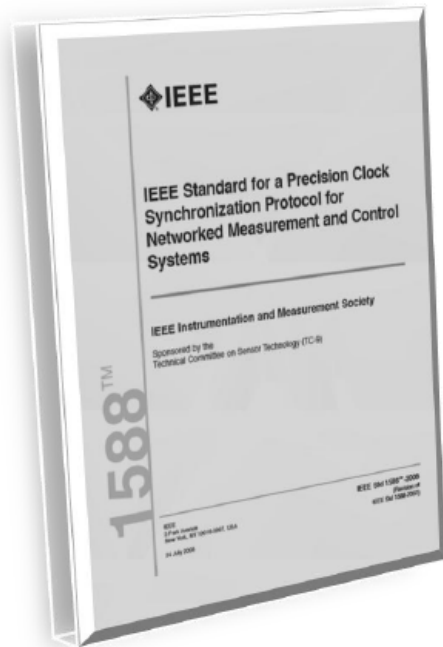
- Each instance the time is transferred the Stratum indexes independent of the intervening network
- Timing packets transferred via Unicast

# What is PTP (1EEE 1588v2)?

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# Precision Time Protocol Standard



- Protocol specification for distributing precise time over packet networks
- Time is carried in “event messages” transmitted back and forth between Grandmaster Clock and a Slave Clock
- Profiles (industry standard “settings”)
  - Default Profile: Multicast both ways
    - Hybrid mode
      - Multicast Master to Slave
      - Unicast Slave to Master
  - Telecom Profile:
    - Unicast with bandwidth reservation on Grandmaster
    - Designed for frequency transfer, not Time of Day

# PTP - Best Master Clock Selection

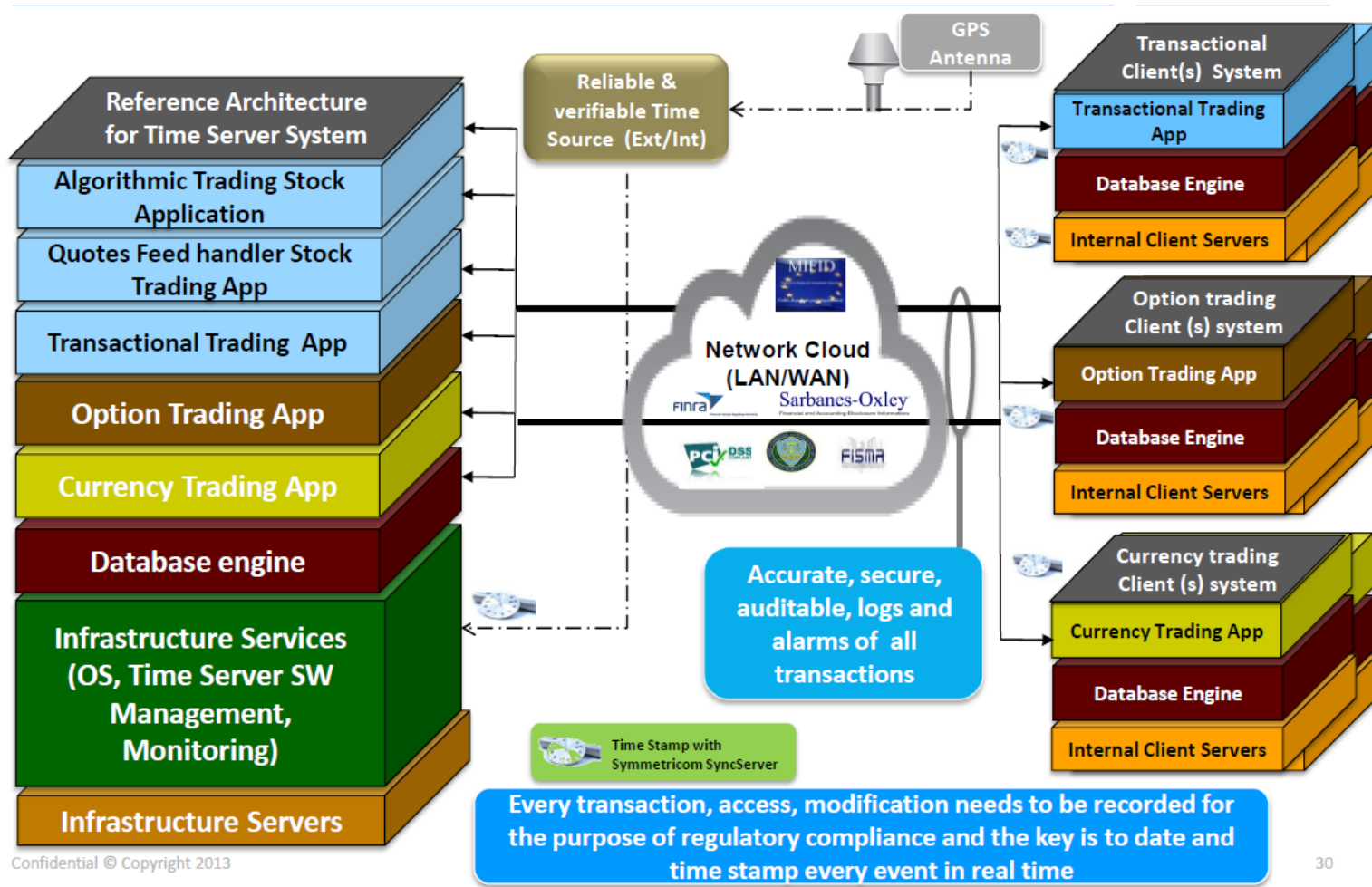
- Multiple PTP Grandmasters can be multicasting on the same network
- Grandmasters decide which is “best”
  - Based on declared properties
  - There is a tie breaker
- One Grandmaster stays active
- Other Grandmaster(s) go passive
- Slaves know of all Grandmasters
- If active Grandmaster drops, next best passive takes over, slaves switch automatically



# NTP vs. PTP Feature Comparison

Feature	NTP	PTP
Peak time transfer error possible (accuracy at slave)	> 0.5 ms	< 100 $\mu$ s to 100's of ns
Error Source	Routers	Switches and O/S stack delay
Spatial extent	LAN/WAN	LAN
Implementation	<ul style="list-style-type: none"> <li>• HW or SW Servers</li> <li>• SW clients</li> <li>• Clients "Pull" time from Server (client/server)</li> </ul>	<ul style="list-style-type: none"> <li>• HW Masters</li> <li>• HW or SW</li> <li>• Master "Pushes" time to Slave (master/slave)</li> </ul>
Protocols	UDP/IP – Unicast (mainly)	UPD/IP - Multicast
Security	MD5 & Autokey	none
Administration	Configured	Self organized
Relative Cost	Less expensive	More expensive

# Reference Network Time Architecture: Why Accurate Time Source is Mandatory



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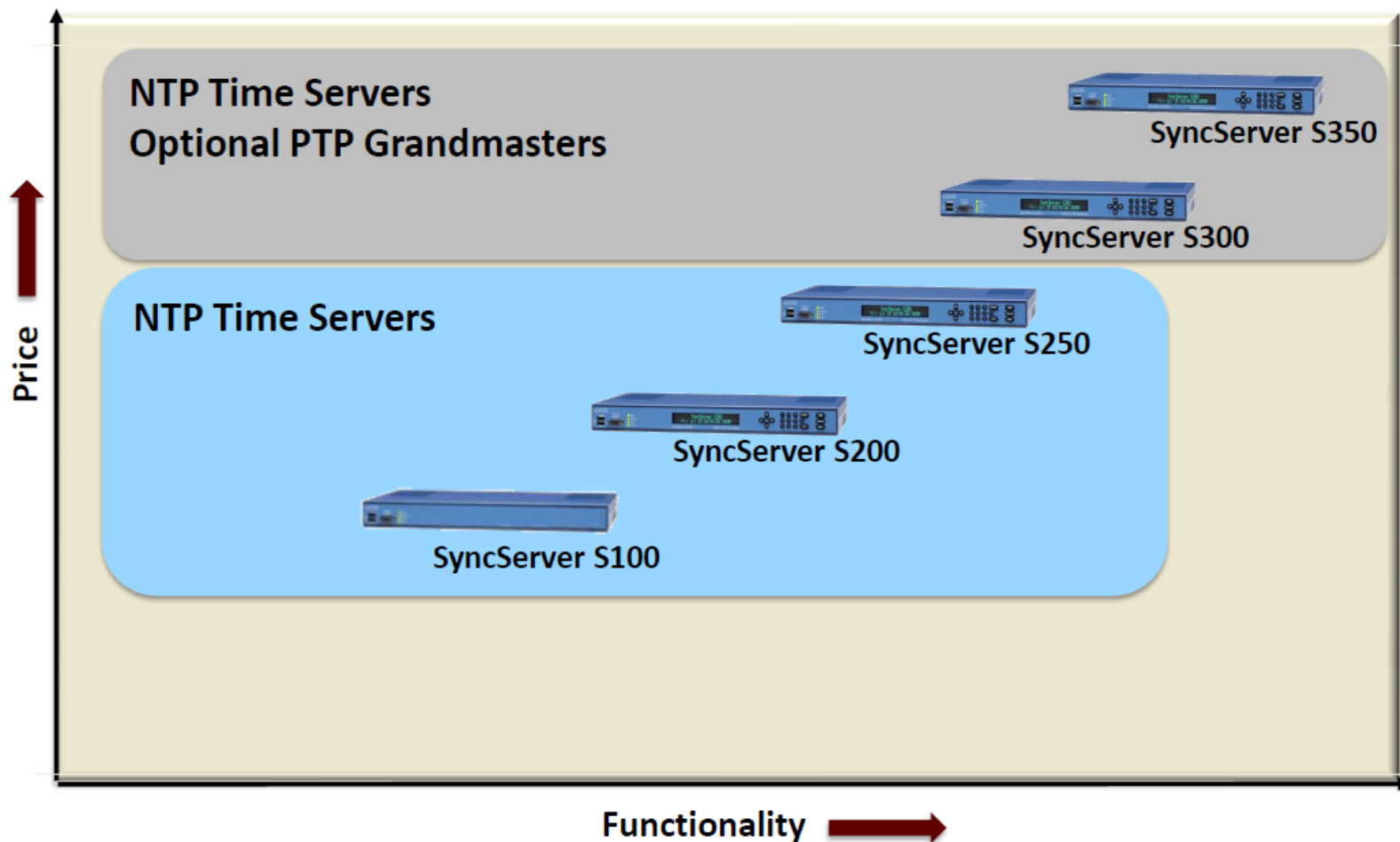


# Time Servers for the Financial Enterprise Market

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# Time Server Portfolio to Help Meet Regulatory Compliance



# Enterprise Time Server: SyncServer S300



## Key Benefits

- Synchronize thousands of client, server & workstation clocks
- Very reliable & secure source of time for your network
- Extremely accurate time source for network sync
- Very easy to install and maintain
- Multiple NTP ports for easy network configuration and adaptation
- Intuitive web interface for easy control & maintenance

## Key Features

- **Accuracy**
    - Stratum 1 operation via GPS satellites
    - Nanosecond time accuracy to UTC
    - IEEE 1588 / PTP Grandmaster option
  - **Reliability**
    - Rubidium and OCXO oscillator upgrades
    - Stratum 2 operation via NTP servers
  - **Security**
    - RADIUS, NTPv4 autokey, MD5 authentication
    - Secure web-based management
    - SSH, SSL, HTTPS, Telnet
  - **Ease of Use**
    - Web Interface
    - SNMP
    - IPv6 and IPv4 compatible
- many more.....

# Key Takeaways

- Reliance on accurate time is critical in Financial applications
  - Accurate time source
  - Robust network time synchronization with authentication & resiliency
- Time accuracy & synchronization are at the core of regulatory compliance
  - All elements must be reliably and individually monitored and identifiable
  - Transactions must be time stamped for validity and retrieval
- Accuracy of financial reporting relies on time and event synchronization
  - Eliminate fraudulent or improper modification of secure transactions
  - Monitoring support for auditable & traceable digital forensics
- Robust Network Timekeeping architecture
  - Accurate, reliable, secure and auditable
  - Improve ROI, reduce risks, while addressing industry and government compliance



**Microsemi Corporate Headquarters**

One Enterprise, Aliso Viejo, CA 92656 USA

Within the USA: +1 (800) 713-4113

Outside the USA: +1 (949) 380-6100

Sales: +1 (949) 380-6136

Fax: +1 (949) 215-4996

email: [sales.support@microsemi.com](mailto:sales.support@microsemi.com)

[www.microsemi.com](http://www.microsemi.com)

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