

A Historical View of the Need and Current Use of Precision Timing in the Financial Services Sector (FSS)

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Speaker Background & Today's Discussion

- Andrew F. Bach (Andy) Independent FinTech Consultant
- 40+ Years in the Financial Technology Sector;
 - NYSE Euronext
 - Juniper
 - Public Sector
- Goals of today's discussion.
 - Introduction to the history and creation of the Financial Sector
 - The Financial Sector relentless need for Precision timing

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History of the FSS

The First Trade,
First Investment Stock,
Need for an Exchange,
Quest for Information

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The First Trade

- Independent Cargo sailing ships
- Dutch East India Company (Circa 1600)
- Share the risk – share the reward

First Investment Grade Stock

- Invest 100K Gilder?
 - Invest in one ship or in several
 - About 60% don't sink
 - About 80% of the survivors make money
 - Net only about 48% are profitable but highly profitable >250% Gross
- Share risk among 10 investors
- Invest in 10% of the ship for 10% of the profit or loss.
- Invest in 10 ships – Buy a 10% share of the voyage
 - Yields 25K or 25% net profit on investment “Shares”

FIRST INVESTMENT GRADE FUTURE

- Created in USA about 1800's
- Farmer needs to plant BUT needs \$\$ for seed.
- Sells harvest BEFORE planting to buy seeds
 - Creates a futures contract with General store, Distributor, Broker
 - Farmer uses proceeds to buy, plant, and harvest Crops
 - Sale price and quantity are fixed **before** seeds are bought
- Harvest is shipped after 90 days to the futures holder
 - If a poor harvest
 - Farmer must buy someone's crops to make up the difference
 - Crops at delivered at price agreed to 90 days earlier not current market price
- High risk deal for both the farmer and the dealer

Need for an Exchange Venue

- Ship voyage and investment horizon is at least 2 years
- Recover funds before 2 – 3 years
- Need to trade shares
 - Started in coffee houses in Amsterdam
 - Formal Exchange created in 1604

The Quest for Information

- Did the ship sink?
 - Sell shares before everyone knows
- Is the ship heavily laden?
 - If yes – go long (Buy shares)
- When will the ship arrive?
 - Arriving soon – Lock in profits



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The Need for Speed

Driving Forces,
Information Transportation

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Need for speed - Driving Forces

- The smart (Profitable) investor is the knowledgeable investor.
- Knowledge is profit power especially if no other investor knows the information
- The sooner I know it, the smarter I am, the greater is the profit.
- **BUT** – Investor cannot trade ahead of the market.....

Need For Speed - Information Transport

- Runners
- Carrier pigeons
- Signal Fires
- Semaphores (1750's)
- Telegraph (1860's)
- Telephone (1880's)
- Ethernet (Market Data Patents 2002)
- Free space optics
- Quantum Entanglement, Moonbeams & Pixie Dust

The Need for Time in the FSS

Speed, Time, Accuracy, and
Precision



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Speed, Time, Accuracy, and Precision

- The FSS version
 - Demanding but limited use cases
- Position independent
 - Except GNSS integrity check
- Limited reference dependence
 - Internal reference fine for most use cases
 - External reference for Regulation only

Need For Time - Speed

- Faster is better
 - Fast information arrival = greater profits
- Approaching sub nanosecond speeds routine operations
 - Time stamping at the ns level is common

Need for Time - Timing

- Benchmark all Events:
 - Network Performance
 - Application Performance
 - External Venue Performance
 - Transmission Delays
 - Information Events

Need For Speed - Accuracy

- Alignment to what?
- Internal Source
 - Global <1 ms
 - Regional < 10 μ s
 - Data Center - ns range
- Sovereign source
 - For regulation 100 μ s (EU)

Need For Timing - Precision

- Nanoseconds matter across a data center
- Picoseconds matter within a processing cluster
- Microseconds matter across the globe

Timing Drivers & Requirements

Operations, Performance,
Regulation



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Timing Drivers & Requirements - Operations

- Internal instrumentation
 - Sniffers
 - Routers
 - NIC's
- External events
 - News Events
 - Market Data
 - Social Media
- Application instrumentation
 - Processing time
 - Jitter
- Global timing reference
 - Synchronized transaction positions

Timing Drivers & Requirements - Performance

- Application/Algos
 - Cash Management
 - Security
 - High speed trading
 - Crypto
- Database
 - Synchronize globally dispersed data bases
- Network
 - Time the timing network
 - Timestamp the transaction

Timing Drivers & Requirements - Regulation

- Why do regulators care?
 - Keeping the honest folks honest.
 - Catching insider trading.
 - Maintaining fair and orderly markets.
- Alignment to sovereign
 - Legal – Align to NIST
 - Implied – use source traceable to TIA member
- Holdover
 - The longer the better >1 month
 - Correction can be applied in post processing



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Solution Sets – Meeting the Challenge

GNSS, Other Sources, Objectives,
Scalability, Security

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Challenges

- Space & terrestrial weather
- Terrain
- Operations
- Bad actors
- Cyber
- Networking/distribution

Meeting the challenges - Space Based

- Newer Constellations and other space-based solutions
- RF & Cyber security
- Newer standards (IEEE P1952 – In Progress)
- Refined ground base antennas and receivers

Meeting the challenges - Ground Based

- Terrestrial radio – eLoran
- Timing as a Service (TAAS)
- Landline Timing
- Internal Clocks – Very common in FSS
- PTP/WR becoming de facto industry protocol
- High Performance Grand Masters
- Independent performance monitoring tools

Solution Set – Objectives

- Alignment to external authoritative source <1 ms
(Internal Goal)
- Precision in the ns range
- Highly resilient and stable
- Holdover expected but not mandated

Solution Set – Scalability

- High fanout - Capacity for 100,000's of PTP clients per site
 - 10K+ servers
 - Multi containers
 - Interstitial processing nodes – Network (routers, switches, etc)
 - Instrumentation – Sniffers, NIC's, etc.
 - Ultra high PTP client support
- High Density, Low footprint timing/servers
- Expandability
 - Modular expandability required

Solution Set – Security

- Need for Security:
 - Why rob banks – “Because that’s where the money is”
 - Willie Sutton (1901 – 1980) – Famous American bank robber.
 - Disrupt Financial services
 - Impede a nation-states continued viability
- Security, including segmented architecture
 - Using HW instead of SW forces containment
 - Multi HW CPUs
 - Improves resilience to DOS attacks
 - Segregation of Command & Control from timing distribution

Closing Thoughts

Summary Comments
Question?

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