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

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Speaker Background & Todays 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”

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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

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 µs
  - Data Center - ns range
- Sovereign source
  - For regulation 100 µs (EU)

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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

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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

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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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Solution Sets - GNSS

- Challenges
  - Space weather
  - Terrestrial Weather
  - Terrain
  - Operations
  - Bad actors
- Meeting the challenges
  - Newer Constellations
  - “Firewalls”
  - Newer standards (IEEE P1952 – In Progress)
  - Refined ground base antennas and receivers
  - High Performance Grand Masters
  - Independent performance monitoring tools

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Solution Sets – Other Sources

- Terrestrial radio – eLoran
- Timing as a Service (TAAS)
- Landline Timing
- Internal Clocks – Very common in FSS

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

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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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