

TIME SYNC COMPLIANCE FOR ELECTRONIC TRADING

ITSF 2017 UPDATE

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0. OUTLINE

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003 -2.761, 1,701

TIME SYNC COMPLIANCE FOR ELECTRONIC TRADING

1. **Regulatory requirements**
What we need to achieve to stay compliant
2. **Ongoing challenges**
What has changed in the last years?
3. **State of affairs**
The NMS CAT Clock Sync Assessment
4. **Traceability?**
Define, achieve, prove, maintain
5. **Reporting and collection of data**
Some field experiences
6. **Conclusions**



1. REGULATORY REQUIREMENTS

WHAT WE NEED TO ACHIEVE TO STAY COMPLIANT

TIME SYNC COMPLIANCE FOR ELECTRONIC TRADING: REGULATORY REQUIREMENTS

WHAT WE NEED TO ACHIEVE TO STAY COMPLIANT 1/3

Regulations:

EU: ESMA MiFID II Regulatory Technical Standard 25:

- Specifies maximum divergence from “UTC”
- 100 μ s for firms with sub-ms gateway-to-gateway latency, otherwise 1 ms
- Effective 3 January 2018, still little known about reporting requirements from local regulators
- Requirement to demonstrate compliant design

US: SEC RULE 613 under the Consolidated Audit Trail / NMS plan:

- Specifies maximum divergence from “Time maintained by NIST” – not UTC, just NIST
- 100 μ s for exchanges (Participants), 50 ms for broker-dealers (Industry Members), 1 s for manual events (OTC)
- Requirement to demonstrate compliant design and report violations once compliance thresholds established
- In effect, reporting due to begin

US : FINRA RULE 4590

- 50 ms to NIST

Other regions:

- Similar requirements likely to follow in Asia

TIME SYNC COMPLIANCE FOR ELECTRONIC TRADING: REGULATORY REQUIREMENTS

WHAT WE NEED TO ACHIEVE TO STAY COMPLIANT 2/3

Requirements in summary:

Achieve, maintain and demonstrate compliance:

- Requirement is specified for Business Clocks. Business clock is the OS clock in a trading server (we think)
- Traceability is only explicitly mentioned in MiFID II
- Strict, metrological traceability is not easy to demonstrate, but in practice we can get “close”
- More than horizontal sync within one network, this aims for *global* sync

Be prepared to report violations:

- This means monitoring every synchronised node and keeping records. Hundreds to thousands per organisation
- There are no percentile brackets, 100% compliance required

Why this is required:

- These regulations are all about fairness, transaction reporting and market forensics
- Markets will function without this (unlike power and telecom), but tracking events becomes increasingly difficult

TIME SYNC COMPLIANCE FOR ELECTRONIC TRADING: REGULATORY REQUIREMENTS

WHAT WE NEED TO ACHIEVE TO STAY COMPLIANT 3/3

What this means for the Finance industry:

Design, deploy and monitor a traceable time sync infrastructure:

- Most high-frequency trading firms and exchanges have already done this in some way
- For banks this often means to touch many “sacred” legacy systems
- Few are in a position to run a forklift upgrade

For many small and medium businesses (and traditional organisations) this means ensuring sync for the first time:

- Steep learning curve
- The challenge of achieving 50 ms for the first time, or even 1 s for the first time, is not to be underestimated



2. ONGOING CHALLENGES

WHAT HAS CHANGED IN THE LAST YEARS

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TIME SYNC COMPLIANCE FOR ELECTRONIC TRADING: ONGOING CHALLENGES

WHAT HAS CHANGED IN THE LAST YEARS? 1/2

Original challenges – technology, mostly solved:

Time provider / GM equipment:

- Suitable equipment: available – link speeds, oscillator options, etc.
- Most built to Telecom requirements: not the case anymore

Network assistance:

- PTP Transparent and Boundary Clocks commonly available in switches
- Vendors understand the requirement, part of nearly all new enterprise ASICs

Server hardware and software:

- Lack of hardware timestamp support: nearly all new equipment supports this
- Software / client support is adequate to maintain good sync
- Legacy systems and applications are still a challenge, but can be made to work

TIME SYNC COMPLIANCE FOR ELECTRONIC TRADING: ONGOING CHALLENGES

WHAT HAS CHANGED IN THE LAST YEARS? 2/2

Original challenges – non-technical, *mostly still remain*:

Education and knowledge gaps:

- There is still confusion around basic terms: precision and accuracy
- Engineers and even regulators still use *time error* and *offset* interchangeably with *drift*
- Very few books available, and none on enterprise time sync

Training:

- Very few training courses available, and mainly focus on Telecom and power
- Little to none specifically tailored for Finance. Needs to cover the whole path from time source to application!

Vendor certification:

- Still no relevant vendor certification tracks
- If not sync vendors, network equipment vendors could do this
- Is the industry not interested in producing experts? That was never a problem with network engineers...

3. STATE OF AFFAIRS

THE NMS CAT CLOCK SYNC ASSESSMENT

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TIME SYNC COMPLIANCE FOR ELECTRONIC TRADING: STATE OF AFFAIRS

THE NMS CAT CLOCK SYNC ASSESSMENT 1/3

NMS CAT Clock Sync assessment (11-23 April 2017):

<http://www.catnmsplan.com/wp-content/uploads/2017/06/Clock-Synchronization-Assessment-Final-5.15.17.pdf>

The study:

- Targeted to broker-dealers only (Industry Members), not exchanges - so this is about the 50 ms requirement
- Exchanges represent a mean view of 36 μ s requirement – earlier studies
- Participant Members only (broker-dealers, not exchanges – exchanges agreed on a mean of 36 μ s)
- 143 responses, 13% small firms, 60% large firms, 27% did not need to report to CAT

Perspective:

- 12 % respondents submit 100+ million reportable events per month, average every 7 ms
- NYSE volume around 5 million trades per day, average every 6 ms given 9-hour trading window
(source: http://www.nyxdata.com/nysedata/asp/factbook/viewer_edition.asp?mode=table&key=3141&category=3)

The questions:

- Current time sync technology used, topmost reference used (“master” clock source)
- Current sync tolerances and improvements to them, how often they are exceeded
- Costs and time to comply with various tolerances

TIME SYNC COMPLIANCE FOR ELECTRONIC TRADING: STATE OF AFFAIRS

THE NMS CAT CLOCK SYNC ASSESSMENT 2/3

NMS CAT Clock Sync assessment (11-23 April 2017):

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Selected answer breakdown:

- **Improving internal standards:** 23% would not change their sync standards if not the regulations
- **Exceeding thresholds:** 46% did not know, 5% multiple per day, but over 30% once or twice per year
- **Cost factors:** hardware/software first, then maintenance, then compliance. 70% said less than \$100k to get 50 ms
- **Time to achieve 50 ms:** 30% less than a month, 9% 6 months+, 11% “other amount”
- **Time to achieve other tolerances** (some hope there, or wishful thinking): 70% say they can reach 100 μ s in 1-2 years
- **How often sync is assessed:** 49% daily, but 6% annually
- **Current practices:** 64% sub-50 ms, 47% 1-50 ms, 8% 500 μ s-1ms, 9% 1-500 μ s, but 13% 50-500 ms and 4% up to 1 s
- **Technologies used to sync business clocks:** 50% multiple, 46% NTP, GPS 22% (how?), and PTP 22%
- **In co-location:** 35% use NTP and 33% use PTP
- **How often clocks are synchronised:** 23% from 1/s to 1/min, 12% once per day (but 47% for small firms!)
- **Master clock reference:** 20% GPS, but 45% stated “NIST Atomic clock”...how?

TIME SYNC COMPLIANCE FOR ELECTRONIC TRADING: STATE OF AFFAIRS

THE NMS CAT CLOCK SYNC ASSESSMENT 3/3

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Fun fact #1 – the *don't know* coefficient:

- “Do not know” constituted approximately 29% of *all* answers. Slightly more than the 27% respondents that do not need to report.

$$\gamma_{dnk} \cong 0.29$$

Fun fact #2 – the winner is:

- 46% respondents use NTP and 45% say their reference is “NIST Atomic Clock”
- By means of deduction: this must translate to NTP from time.nist.gov over the *Internet*
- This is not a PTP vs. NTP debate: poor sync practices associated with traditional use of NTP are the problem

Conclusions:

- Exchanges seem to have time sync under control, but many trading firms still have a long way to go
- If many (most) really still sync over the Internet and most assess daily, how reliable are the error figures?
- Desperate need for education
- Grain of salt needed (“42.7% of all statistics are made up on the spot” – attributed to Steven Wright, number varies)

4. TRACEABILITY?

DEFINE, ACHIEVE, PROVE, MAINTAIN

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TIME SYNC COMPLIANCE FOR ELECTRONIC TRADING: TRACEABILITY?

DEFINE, ACHIEVE, PROVE, MAINTAIN 1/2

Defining and understanding traceability:

- Given the “state of affairs”, do we think people understand the definition and requirement? Educate!
- GPS traceability Gap (USNO -> USAF handoff). We all know it is traceable, even if the chain is missing a link
- Do not cause more drama than needed, users are confused enough as is

Achieving traceability:

- **Is a poor synchronisation system poorly connected to a traceable source still considered traceable?**
- **We need more readily available calibration services from NMIs or approved contractors (man with a clock):**
 - firms need to realise they need this done, periodically, or the regulators need to ask for this
 - if a turnip seller is required by law to have his scales calibrated by an approved institution, why isn't a broker required to calibrate his clocks if he turns millions of dollars?
- **Without official calibration, how meaningful are the numbers reported by trading firms?**

TIME SYNC COMPLIANCE FOR ELECTRONIC TRADING: TRACEABILITY?

DEFINE, ACHIEVE, PROVE, MAINTAIN 2/2

Proving traceability:

- NMI-operated GPS Common View services are available in many countries, with well-defined uncertainty
- Direct terrestrial feeds from UTC sources are becoming available
- If using a direct UTC source is not cost-effective, at least get access to one source and use it for verification
- Protocols (both packet and RF) need to include cryptographically verified authoritative source confirmation
- It is not easy to outsource the full sync path all the way to the software application, but why not outsource most of this?

Maintaining traceability and error threshold:

- **Are users aware of oscillator life time and aging?**
- **Are users aware of the need to track upstream source status? If a PTP BC is in holdover, its slaves still report near-zero offsets. Are users aware if their upmost time source is stable?**
- **How easy is it to put SLAs around commercial time services?**



5. REPORTING AND DATA COLLECTION

SOME FIELD EXPERIENCES

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TIME SYNC COMPLIANCE FOR ELECTRONIC TRADING: REPORTING AND DATA COLLECTION

SOME FIELD EXPERIENCES

Issues:

- Most non-trivial sync networks use a mix of vendors for different PTP components (GM, switch – TC or BC, NIC)
- Not all use PTP
- No SNMP MIBs cover all that is needed
- Dedicated monitoring systems do not cover everything
- Need for a holistic view, need for TimeOps teams

Current solutions:

- Consensus: syslog and log indexing repositories are a popular option, dashboards can be built
- Alarms still mostly via SNMP traps – hugely vendor-dependent

Missing – a common log format:

- Generalised support for any time sources, indicating uncertainty and granularity: GNSS, NTP, PTP, 1PPS
- Needs to cover master clocks / time servers, clients and probe / measurement devices
- Common set of statistics and metrics: offset, path delay, MTIE preserving timestamps of min/max offsets
- Well-defined fault and state events, but not without associated more detailed protocol-specific information

6. CONCLUSIONS AND FUTURE

The background features a blue-toned financial chart. A prominent green line curves upwards from the bottom left towards the top right. In the upper right corner, there are several candlestick-style data points. The chart is overlaid with a light blue grid. At the bottom, there are some faint numerical labels: '01', '02', '03', '04' along a horizontal axis, and '-2.761, 1,701' near the bottom right corner.

TIME SYNC COMPLIANCE FOR ELECTRONIC TRADING: CONCLUSIONS AND FUTURE

Conclusions:

- Technology is there, access to traceable time sources is mostly there, still some work to do on monitoring
- The need for education is there more than ever
- Regulators have a lot to learn, they need more sync experts (an expert with commercial interest is better than an unassociated non-expert)
- Current rules are good first steps, never mind actual numbers, but what it means to enforce and maintain them

Future:

- Trading volumes keep growing steadily, but not dramatically so
- Regulators all indicate that requirements will be reviewed
- If the next step is 10 us, this means very little room for error, every part of the sync path will matter, this is more complex than Telecom
- Time-aware and time-correct computer architectures: will we ever see them?
- Will we ever escape the hardware vs. software time air gap in the OS? Why can we not have a ToD CPU register?

THANK YOU QUESTIONS?

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