IBM Z

Enterprise Computing and Time Synchronization Update

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Abstract

The latest generation of IBM Z Systems family of mainframes is used by over 90% of the worlds 100 largest global banks as the computing platform they run their businesses on. The IBM Z also is heavily used in other financial, insurance, and retail companies worldwide to the point where it is often said that the world's economy runs on IBM mainframes. This session will discuss the time synchronization regulatory changes that led to IBM studying the IEEE 1588 Precision Time Protocol (PTP), and what IBM is doing with PTP and these enterprise computing platforms that are central to the world's financial systems. We will also discuss some of the ideas IBM has on highly resilient time synchronization networks to improve availability and security of this mission critical cyber infrastructure.

Agenda

- Intro
- Latest financial industry time synchronization regulations
- IBM Z time synchronization today
- IBM Z and PTP
- IBM Z time synchronization direction
- Thoughts on resiliency

Time Synch Recent Regulatory Changes: Background

- Widespread proliferation and usage of electronic trading platforms with their automation
- Advent of High Frequency Trading (HFT)
- Increased the need for tighter synchronization and traceability to a common reference time scale
- All systems playing a role subject to the new rules

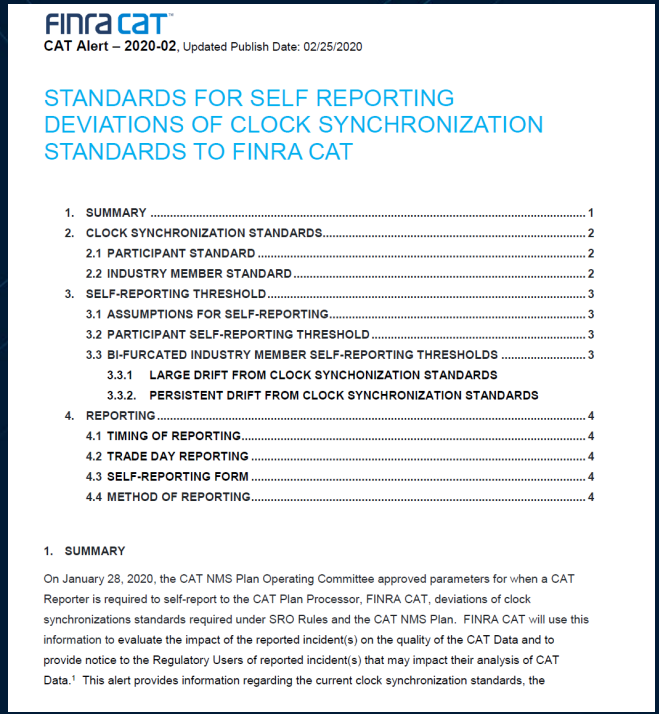
Government Regulations-US (FINRA)

- **Effective 2018 , requires synchronization of equipment to within 50ms of NIST(UTC)**
  - Also requires audit log capability to prove compliance
- Consolidated Audit Trail (CAT)
  - Requires sending of complete documentation on all orders to a central repository by 8am Eastern Time the day following a trade.
  - Requires time stamps at **ms resolution** at five places in the audit trail

FINRA CAT February 2020 Update

- IBM made aware by clients that this is starting to be enforced this summer

Standard: The Industry Member would need to self-report a deviation if a system creating and recording CAT Reportable Events drifts out of compliance with the established standards **10 times in one rolling 24-hour period** at any time when the system is recording a timestamp on data that is reportable to the CAT on a given device or server. (The 10 times standard also applies to systems that process Manual Order events.)



FINRA CAT

CAT Alert – 2020-02, Updated Publish Date: 02/25/2020

STANDARDS FOR SELF REPORTING DEVIATIONS OF CLOCK SYNCHRONIZATION STANDARDS TO FINRA CAT

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1. SUMMARY

On January 28, 2020, the CAT NMS Plan Operating Committee approved parameters for when a CAT Reporter is required to self-report to the CAT Plan Processor, FINRA CAT, deviations of clock synchronizations standards required under SRO Rules and the CAT NMS Plan. FINRA CAT will use this information to evaluate the impact of the reported incident(s) on the quality of the CAT Data and to provide notice to the Regulatory Users of reported incident(s) that may impact their analysis of CAT Data.[1] This alert provides information regarding the current clock synchronization standards, the

Government Regulations-EU (ESMA and MiFID II)

- MiFID II requirements went into effect in January 2018
- MiFID II applies to any organization dealing in European financial instruments
- MiFID II clock synchronization requirements are more stringent that the latest U.S. requirements previously discussed
- Business clocks that provide the timestamp for any reportable event should be coordinated to UTC, using either a link to one of the laboratories maintaining a UTC(*k*) realization of UTC, or the time signals disseminated by GPS or other satellite system.
- Level of accuracy number typically cited: 100 microseconds divergence from UTC
  - 1 microsecond or better timestamp granularity

Server Time Protocol (STP) : 2006-today

- Designed to provide the capability for multiple servers to maintain time synchronization with each other and form a Coordinated Timing Network (CTN)
  - CTN: a collection of servers that are time synchronized to a time value called Coordinated Server Time (CST)
  - Single view of time with an external time reference
- Message based time synchronization protocol
  - Similar to Network Time Protocol (NTP)
  - Timekeeping information transmitted over specialized connections (coupling links)
  - Supports a multi-site timing network of up to 200 km over fiber optic cabling
- Two external time source options (prior to May 2020)
  - NTP server (100ms accuracy)
  - NTP server with Pulse Per Second (PPS) (10 us accuracy)
- STP will maintain all of the systems in the Coordinated Time Network (CTN) so that their timestamps stay within less than **10 μs of each other**

Emergence of Precision Time Protocol (PTP)

A higher precision protocol….

- Transmission times measured with hardware assistance
- All switches and devices participate
- Capable of synchronization into the sub-microsecond range
- Currently used primarily in telecom and utility industry, moving into finance

IBM Z is moving forward and integrating PTP into IBM's Server Time Protocol (STP) environment

- Improved synchronization between mainframes
- Better synchronization to UTC
- Better synchronization to non IBM Z equipment
- Provide greater resilience of the STP CTN

Recent IBM Z 15 Announcements

- 12 Sept 2019 IBM Announcement letter
  - New IBM mainframe announced
  - Formally announced our statement of direction for IEEE 1588 Precision Time Protocol (PTP)
  - The regulatory changes previously discussed were the primary driver
- 14 April 2020 IBM Announcement letter
  - Support for PTP announced
  - General availability (GA) 15 May 2020
  - The initial implementation will be for PTP connectivity via the IBM Z HMC/SE Hardware Management Console/Support Element
  - At that time there will be no change to the use of STP CTNs for time coordination, other than the potential to use a PTP-based external time source.

Statement of General Direction for PTP

- Future implementation is planned to include full connectivity of an external PTP time source directly to the IBM Z central processing complex (CPC).
  - Reintroduces the concept of a mixed CTN
  - Support for traditional STP
  - Support for native PTP implementations
- Beyond this, the goal is to enhance the role of IBM Z machines in a PTP environment that addresses the many governmental regulations and security concerns that our clients are facing.

Thoughts on Improving Time Synchronization Network Resiliency

- Discussions on resiliency are about the triad of high availability, redundancy, and security
- The Global Positioning System is not about position, its about time
  - Need to have a backup plan
  - What are you going to do?
- Network security vulnerabilities due to network design, poor habits, or protocol vulnerabilities
  - NTP has well publicized/well documented security issues
    - New NTS for NTP Draft RFC in the IETF
- Dedicated network for time synchronization?

Thoughts on Improving Time Synchronization Network Resiliency

- Time synchronization information is not a secret-it does not need to be encrypted
  - However, some end users require all networks to be encrypted
- Robust authentication must be used
- PTP standard's security annex should not be considered "optional"
- Accuracy is important, but not the be all end all
- Standards need to incorporate resiliency (security). The argument that its incorporation hurts performance may be valid, but not valid enough to exclude

If you don't have enough resiliency, and something bad happens, is anyone going to care about what kind of performance you had

Summary

- Background on the modern IBM mainframe and use cases
- Discussed the recent financial industry regulatory changes that drove IBM to support PTP on the IBM Z (mainframe)
- Discussed IBM Z time synch, and Server Time Protocol (STP)
- Discussed IBM Z PTP announcement and statement of direction
- Discussed some thoughts on time synch network resiliency

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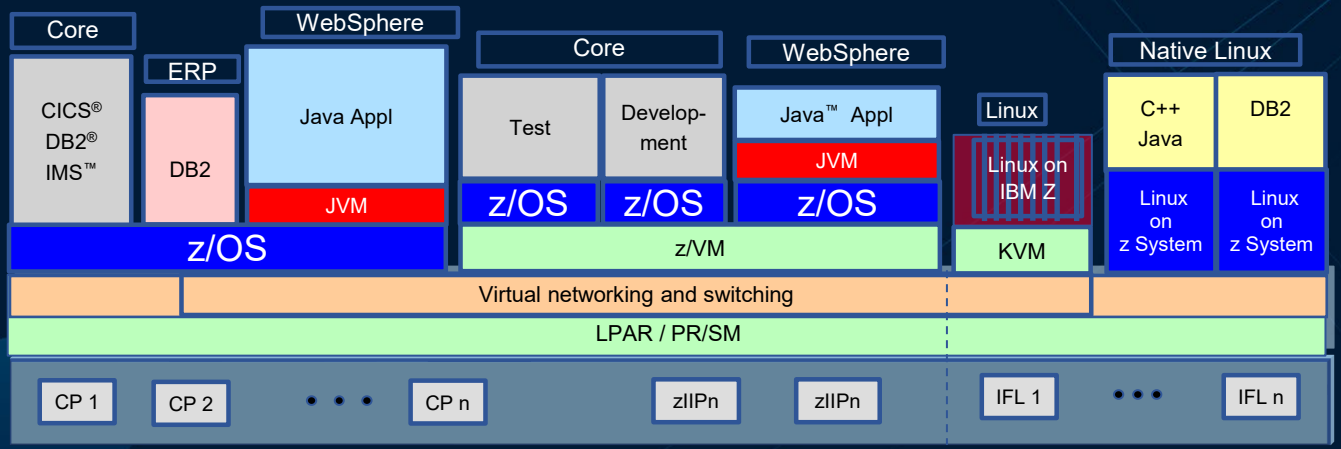
Additional background material

IBM Z: What is a mainframe?

An integrated, highly scalable computer system that allows many different pieces of work to be handled at the same time, sharing the same information as needed with protection, handling very large amounts of information for many users with security, without users experiencing any failures in service



- Large scale, robust consolidation platform
- Built-in virtualization
- 100's to 1000's of virtual servers on z/VM
- Intelligent and autonomic management of diverse workloads and system resources

World's leading businesses run on the mainframe

IBM z

92
of the top 100 worldwide banks

10
out of 10 of the world's largest insurers

23
of the top 25 US retailers

23
out of 25 of the world's largest airlines

Mainframes process
30 billion business transactions per day

Mainframes enable
$6 trillion in card payments annually

80 percent of the world's corporate data resides or originates on mainframes

91 percent of CIOs said new customer-facing apps are accessing the mainframe

IBM Z and Time Synchronization

IBM Z

- It is up to the customer to ensure that Z receives an accurate time. We recommend GPS.
- Z uses excellent oscillator hardware, sensitive to 1.7 seconds/week, and self-correcting
- Use the IBM Server Time Protocol, which relies on external time sources, to provide TOD
- STP will maintain all of the systems in the Coordinated Time Network (CTN) so that their timestamps stay within less than **10 μs** of each other
- IBM focus is on ensuring systems within the CTN are kept close together in order to maintain the data integrity of the Z/OS Sysplexes.
- Once an oscillator history has been established, STP sets a fine steering value for that oscillator, and will detect if the external time source steers away from it. The system will perform a call home to report a possible oscillator failure.
- Leap-Second handled by suspending all processing during the leap second, for instant update and to protect apps that can't handle it.