Leap Second Event Preparedness
FIA Market Technology Division

May 14, 2015

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Today's Webinar

- The webinar will be recorded.

- The presentation will be available on the FIA website within the next 24 hours.

- The presentation will run for about 25 minutes.

- There will be a 20 minute period after the presentation to answer questions.

- Please post questions during the webinar to the organizer using the chat facility.

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A leap second[1] is the addition of an extra second at the end of a day to realign the Coordinated Universal Time (UTC) standard with mean solar time. UTC - based on International Atomic Time (TAI) - is the accepted standard for international time synchronization, taking the place of Greenwich Mean Time in 1960. The last leap second occurred on Saturday June 30th 2012.

On **Tuesday June 30th 2015**, an additional second will be added to the UTC day to account for variability of the earth's rotation. Theoretically, clocks will change from 23:59:59 to 23:59:60 to 00:00:00 UTC.

This will be the first time that it has occurred during active trading hours in an environment where electronic and automated trading relies on sub-second precision for communication, execution, clearing, surveillance and audit trails.   During the 2012 Leap Second Event several systems – including airline systems and internet servers - encountered issues based on differences in preparedness and implementation.

The Leap Second Event will coincide with several global financial markets opening for trading or already in the process of trading, including Asia-Pacific equity and futures markets in Japan, Korea, Singapore and Australia, as well as overnight US futures markets and late trading on some US equity markets.

[1] Introducing a leap second periodically corrects for irregularities in the Earth's rate of rotation. This concept was originally introduced in 1972. The decision to introduce a leap second is taken by the International Earth Rotation and Reference Systems Service (IERS), formally the Bureau International de l'Heure. Leap seconds are only introduced on either June 30th or December 31st.

Around the Globe – Trading and Clearing

There is concern within the financial industry that similar issues could lead to disruption to trading operations across exchanges, clearing houses, brokers, investors and key service providers.

The CFTC has requested that US futures exchanges provide details on how they plan to approach the leap second event by May 15th 2015.   Several US exchanges will postpone their open on June 30th.

Several exchanges in Asia have also announced details regarding how their systems will adjust their clocks before or after the leap second, and will retain normal trading hours.

The different approaches taken will have an impact on all market participants.

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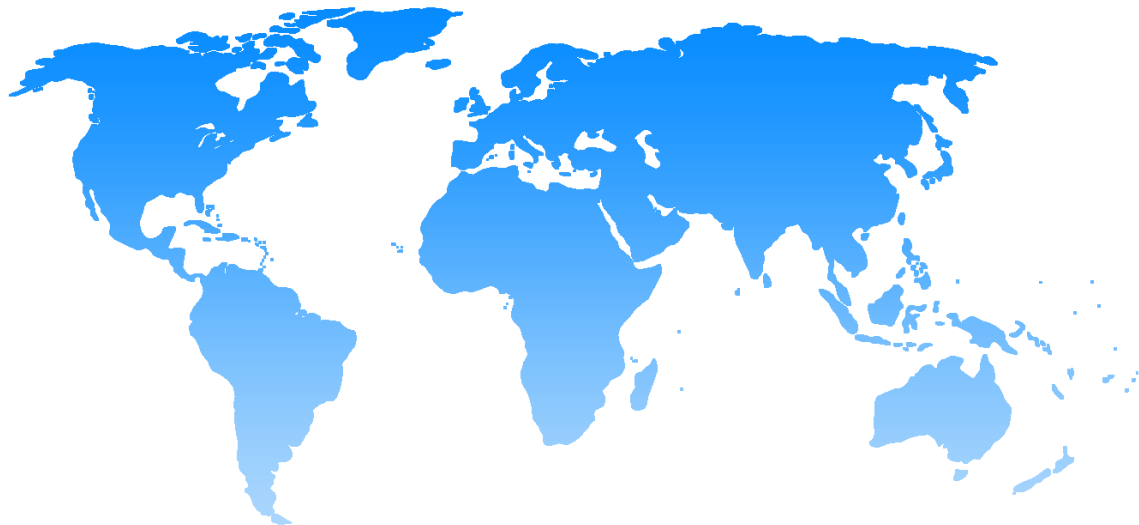
Around the Globe – Markets Open or Closed

Americas:

- **BM&F, Eris and TMX**: Not open

- **CFE:** *to be announced*

- **CME and ICE**: Delayed opening until after the Leap Second Event

- **NYSE Arca**: Evening trading closes early to avoid the Leap Second Event

Europe, Middle East and Africa:

Markets are not open during the Leap Second Event

Asia-Pacific:

- **Australian**, **New Zealand**, **Japanese**, **Singapore** and **Korean** markets will be trading as usual around the Leap Second Event

- **Indian, Hong Kong** and **Taiwan** markets are not open during the Leap Second Event

23:59:59 UTC is equivalent to the following times around the globe:

New York	19:59:59 EDT (UTC-4)
Chicago	18:59:59 CDT (UTC-5)
London	00:59:59 BST (UTC+1)
Frankfurt	01:59:59 CEST, (UTC+2)
Singapore	07:59:59 SGT (UTC+8)
Tokyo	08:59:59 JST (UTC+9)
Sydney	09:59:59 AEST, UTC+10)

No Impact

Possible Impact

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What is NTP and How Does it Work?

- **Network Time Protocol** (**NTP**) is a networking protocol for clock synchronization between computer systems over variable-latency data networks

- NTP has been in operation since the 1980s and is one of the oldest Internet protocols in current use

- NTP is intended to synchronize all participating computers to within milliseconds of Coordinated Universal Time (UTC).

- NTP uses a hierarchical, semi-layered system of time sources. Each level of this hierarchy is termed a "stratum". Each stratum is less precise than its source

- Where a system's time is inaccurate, NTP will update its time to match the time source. Multiple options are available based on the selected NTP solution, operating system and configuration. Typical options include a Snap method and Drift method

- **Precision Time Protocol (PTP)** is a relatively new protocol that was developed to improve the time synchronization accuracy to the nanosecond level.

- The current implementation is PTPv2. The next version is likely to include an improved mechanism for handling leap seconds and other time synchronization events.

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Leap Second Dilution

Time synchronization protocols such as PTPv2 avoid the timestamp 23:59:60 and *dilute* the additional second created by the Leap Second Event before or afterwards, leading to a slightly non-linear approach to timestamps.

Scenario 1 – Dilution after the Event:

➢ Asia Pacific exchanges such as ASX, ASX24, SGX, TFX and KRX will rely on their time synchronization protocols to dilute the leap second *after* the event.

➢ These markets will either open or remain open for continuous trading during the Leap Second Event. Their system clocks will transition from 23:59:59 UTC to 00:00:00 UTC *one second earlier* than midnight TAI.

➢ The clocks will then add milliseconds over different periods of time after the Leap Second Event on July 1st Asian time to synchronize with TAI.

➢ SGX intend to dilute the leap second between 03:00 and 05:00 SGT on July 2nd.

Scenario 2 – Dilution before the Event:

➢ JPX uses a time synchronization protocol that dilutes the leap second *before* the event. Their system clocks will add milliseconds over a period of 2 hours prior to midnight UTC and their 00:00:00 UTC timestamp will coincide precisely with midnight TAI.

Key:

1 Linear progression of UTC with insertion of leap second (23:59:60)

2 Leap Second Adjustment *AFTER* the event (ASX24, KRX, TFX)

3 Leap Second Adjustment *BEFORE* the event (JPX)

Note that lengthened seconds are exaggerated for the purpose of illustration

Time is Relative ...

Different clocks will handle the Leap Second differently ...

For a few hours before and after the Leap Second Event, time will become relative to what your system clock does in comparison with other system clocks ...

Depending on how your system clock adjusts for the leap second, your systems will always be slightly out-of-sync with one of the exchanges in the Asia-Pacific region until all systems are resynchronized with International Atomic Time.

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Technical Readiness

- Individual Firm preparedness is an important factor to industry stability

- This event is not specific to the exchanges

- Many potential issues may arise

- Each firm should understand their environment

  ➤ **NTP**

  » *What is your time source*

  » *How does your time source respond to the incremental second*

  » *What options have been configured within your environment*

  ➤ **Systems**

  » *Are your systems patched to current levels*

  » *Check with systems vendors communicated leap second vulnerabilities*

  » *2012 issues surrounding unpatched RedHat Linux*

- What hardware and software vendors are saying

  ➤ Check with vendor sites for available patches

  ➤ Microsoft and RedHat have established recommendations for Leap Second

  ➤ FIA members are validating systems and vendor communication and sharing with the Market Technology Division Working Group

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Recommendations

- Understand your environment and how NTP/PTP is setup

- Investigate updates available for your installed systems

- Hardware and software vendors are reporting Leap Second Event readiness with many reporting vulnerabilities in older versions

- Patch your systems

- Leap second occurs every few years, some issues may be unique to an environment or configuration

- Monitor on June 30th

- Share any new information with the Market Technology Division Working Group and we will share with the industry

Summary

- Exchanges continue to announce their plans for June 30th

- Where Exchanges are open, multiple approaches have been selected to adjust for the additional second

- Understanding how your environment is expected to handle the additional leap second is the first step

- Preparedness and proactive management of vulnerabilities is advised

- Efforts are underway to escalate industry concerns on leap seconds and identify future solutions

- The Leap Second Event is an example of external factors that can and will impact the industry

- The ability to accept and adjust to external factors such as the Leap Second Event is important to industry stability and success

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Further Information

- The next FIA Market Technology Division Working Group meeting for Leap Second Preparedness will be held on Tuesday May 19th at 11am US/Eastern time.

- **For further information please contact:**

  - ➢ **Brian Adams,** *Executive Vice President & Chief Information Officer*, Rosenthal Collins Group; *Vice President*, FIA Market Technology Division (badams@rcgdirect.com)

  - ➢ **Greg Wood,** *Director*, Deutsche Bank Securities; *President*, FIA Market Technology Division (greg.wood@db.com)

  - ➢ **Mary Freeman**, *Director of Programming and Events*, FIA (mfreeman@fia.org)

Links

- [What is a Leap Second?](#)

- [Managing Leap Seconds with NTP](#)

- [2012 Issues with the Leap Second](#)

- [Resolving Leap Second Issues in Red Hat Linux](#)

- [Resolving Leap Second issues is Suse Linux](#)

- [Cisco solutions, Leap Second preparedness](#)

  - [Cisco UCS Bug and Leap Seconds](#)

  - [Cisco Nexus 3000 and 3500 Issue](#)

  - [Cisco Nexus 7000 Issue](#)

- [Juniper support for Leap Second](#)

- [Microsoft Windows handling of Leap Second](#)

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Published Exchange and Regulatory Links

- [ICE System Notification](#)

- [CME Clearing Advisory](#) / [CME Globex Notice](#)

- [ASX Management of the International Leap Second](#)

- [ASIC Market Supervision Notice](#)

- *Please note that information regarding how other exchanges (notably KRX, JPX, SGX, TFX) plan to handle the Leap Second Event have been published as member notices or communicated directly to FIA*

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