

## Leap Seconds and Server Time Protocol (STP) What should I do?

There is plenty of documentation in the Server Time Protocol Planning Guide and Server Time Protocol Implementation Guide regarding Leap Seconds. This white paper will not attempt to rehash the fine-spun detail that is already written there.

Also, this paper will not try to explain why leap seconds exist. There is plenty of information about that on-line. See [http://en.wikipedia.org/wiki/Leap\\_second](http://en.wikipedia.org/wiki/Leap_second) for a reasonable description of leap seconds.

Leap seconds are typically inserted into the international time keeping standard either at the end of June or the end of December, if at all. Leap second adjustments occur at the same time worldwide. Therefore, it must be understood when UTC 23:59:59 will occur in your particular time zone, because this is when a scheduled leap second offset adjustment will be applied.

### Should I care?

IBM often gets the question about what to do regarding leap seconds in the mainframe environment. As usual, the answer “depends”. You need to decide what category you fit into.

1. My server needs to be accurate, the very instant a new leap second occurs. Not many mainframe servers or distributed servers fit into this category. Usually, if you fit into this category, you already know it.
2. My server needs to be accurate, within one second or so. I can live with it, as long as accurate time is gradually corrected (steered) by accessing an external time source (ETS). This is more typical for most mainframe users.

### Category 1

If you fit into category 1, there are steps that need to be taken. Leap seconds must be managed.

Prior to initializing time via Server Time Protocol (STP), you need to determine the number of accumulated leap seconds which have occurred since 1972 and initialize Coordinated Server Time (CST) accordingly. The URL given above or any number of timekeeping websites can help with this.

You must stay abreast of any new leap seconds that are announced throughout the year and into the future.

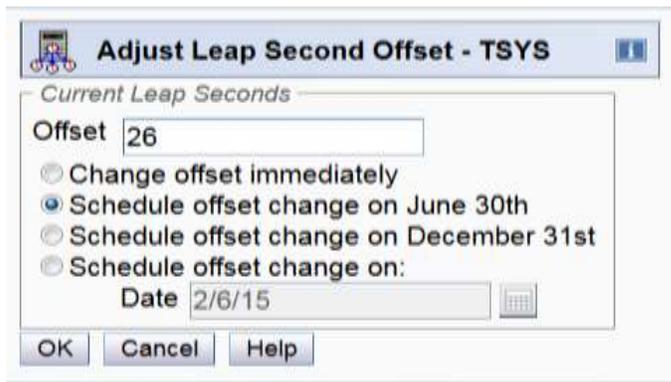
Lastly, through the Hardware Management Console, manually schedule STP to insert the new leap seconds when they are announced and due to occur.

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In this example, assume that leap seconds were included when Coordinated Server Time was initiated. The accumulated number of leap seconds entered will be shown in the Adjust Leap Second Offset panel, allowing you to schedule the upcoming leap second.

When a new leap second must be added, you increase the number of leap seconds already entered by one. In this example, there were 25 leap seconds when CST was initialized. This is the current number of leap seconds if you've kept current. The number of leap seconds increased by one on June 30, 2015. So, you should have entered 26 here, and specify "Schedule offset to change on June 30<sup>th</sup>".

There is no scheduled leap second planned for December 2015.



**Note:** If you have already initialized time with leap seconds specified, it is very important to stay current with them. If you find you've missed a leap second or two over the years, you should NOT schedule more than one additional leap second at a time. Doing so can be catastrophic to z/OS or a z/OS Sysplex.

Making a positive leap second change causes z/OS to spin and become non-dispatch-able for the duration of the delta between the current leap second offset and the new leap second offset. This is to avoid duplicate UTC time stamps. However, a large positive change in leap seconds (an eternity to z/OS) can cause a system outage, as z/OS must spin for that amount of time to avoid duplicate UTC time stamps.

### Category 2

If you fit into category 2, it is much less complicated.

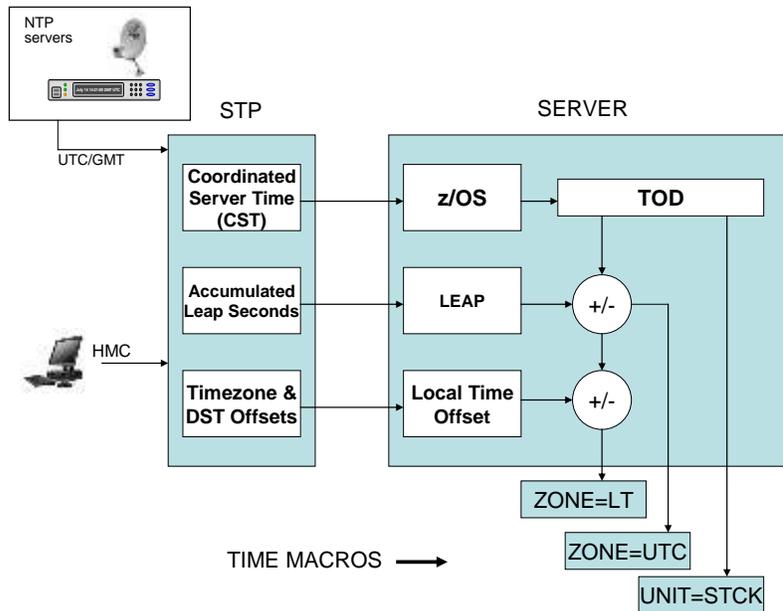
Assuming you have defined an external time source for Server Time Protocol to use, STP will sense that the time provided by the ETS has changed by one second the next time the external time source is accessed. As usual, STP will begin to slowly steer the mainframe time to the new value. It takes approximately 7 hours for STP to steer out a one second delta.

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### How it works with z/OS

How the z/OS system image and applications use these values depends on options specified in the TIME macro. These values are transmitted from the Current Time Server (CTS) to all the servers in the Coordinated Timing Network (CTN).

| Option                     | Time macro with ZONE=LT | Time macro with ZONE=UTC | Time macro with STCK |
|----------------------------|-------------------------|--------------------------|----------------------|
| Include TOD in result      | Yes                     | Yes                      | Yes                  |
| Include leap second offset | Yes                     | Yes                      | No                   |
| Include time zone offset   | Yes                     | No                       | No                   |



Without leap seconds specified, z/OS time will differ from the ETS time when the leap second occurs. STP will begin steering to the correct time provided by the external time source at a rate of approximately 1 second per 7 hours.

| STCK (CST) | Leap Seconds | UTC      | NTP/ETS Time | Note: The leap second occurs at UTC time, not local time. |
|------------|--------------|----------|--------------|---|
| 23:59:58   | 0            | 23:59:58 | 23:59:58     |   |
| 23:59:59   | 0            | 23:59:59 | 23:59:59     |   |
| 00:00:00   | 0            | 23:59:60 | 00:00:00     | Leap second inserted                                      |
| 00:00:01   | 0            | 00:00:00 | 00:00:00     |   |
| 00:00:02   | 0            | 00:00:01 | 00:00:01     | Steering required, which takes 7 hours per second.        |

## Leap Seconds and Server Time Protocol (STP) What should I do?

With leap seconds specified, z/OS time will stay in synch with the ETS time when the leap second occurs.

| STCK (CST) | Leap Seconds | UTC      | NTP/ETS Time | Note: The leap second occurs at UTC time, not local time. |
|------------|--------------|----------|--------------|---|
| 00:00:23   | 25           | 23:59:58 | 23:59:58     |   |
| 00:00:24   | 25           | 23:59:59 | 23:59:59     |   |
| 00:00:25   | 25           | 23:59:60 | 00:00:00     | Leap second inserted. z/OS spins for 1 second.            |
| 00:00:26   | 26           | 00:00:00 | 00:00:00     |   |
| 00:00:27   | 26           | 00:00:01 | 00:00:01     | Steering NOT required to correct z/OS time.               |

STP accepts local time provided by the user, the UTC time from an external time source (ETS), or a delta value, and calculates the value of the Coordinated Server Time using the leap seconds and time zone offset values specified.

$$\text{STCK} = \text{UTC} + \text{LS}$$

There are two ways for an application program to obtain system time.

1. The STCK instruction:

This returns the raw Time of Date (TOD) value. The application needs to convert it to UTC by subtracting the total leap second offset, or to LOCAL time by adding the local time of day offset and subtracting the leap second offset.

2. The Time Macro:

The application can issue the TIME macro with the appropriate parameter - STCK or, ZONE=LT, ZONE=UTC.

**STP Website for documentation, presentations, education:**

<http://www.ibm.com/systems/z/advantages/ps0/stp.html>