Planes will crash!
Things that leap seconds didn't, and did, cause

Steve Allen
UCO/Lick Observatory
Only the first item of the two documents (abolition of offset) found nearly unanimous consent while for the others discussions are still open. According to the authoritative intervention of D. H. Sadler and G. M. Winkler, who examined thoroughly the serious dissensions between those concerned with standard frequencies and those who request a time system connected with the Earth’s rotation (astronomers, geodesists, navigators etc.) and in particular the world-wide collision avoidance system for aircraft (CAS), which cannot admit stepping time adjustments, serious objections can be made as regards the proposals of the two documents; also because said Commissions ignore the needs of a great minority who cannot prescind from the definition of above mentioned U.T.C. and in particular cannot accept differences greater than ± 0.1. It is stated as a necessity that activities concerning time service should be completely independent of the activities of frequency standards laboratories.
The President urged Commission 31 to consider the scope of its activities. The Commissions of URSI, CCDS, and the IAU are, in many cases, attended by the same people, but the discussions are held in very different climates. Commission 31 should ensure that its views are made known to the Directing Board of the BIH.

The Chairman of CCIR IWP VII/I, H. M. Smith, explained that problems arose from the need for two time systems: UT based on the rotation of the Earth and a uniform atomic time scale based on the second. The control of radio time signals is the responsibility of the CCIR, and at Boulder, 1968, a Working Party had been set up to look into the problem of improving the system for radio time signals which would better suit the needs of users of both UT and AT. The Working Party had proposed that the signals should be emitted without offset, but that there should be steps of 1 second to keep the signals in general agreement with UT and that this system should commence on 1.1.72. The Working Party sought the views of Commission 31 on details of implementation.

In reporting informally on the draft recommendations, J. Terrien stressed that the CCDS had still to report to the CIPM. He added that although the IAU had no power to change the recommendations he would note any views expressed by Commission 31 and report them at the October meeting of the CIPM.
The President reported that unfortunately the IAU had received no official communication from the CCIR of the recommendations and resolutions made at New Delhi. D. H. Sadler expressed amazement since a CCIR resolution stated specifically that the IAU should be informed. After further discussion H. M. Smith said that although the Commission could not comment on documents which had not been received he would like views on the six points he had raised in an earlier meeting.

The President proposed that the discussion on reaction to the CCIR’s recommendations be dropped and that the Commission proceed to hold a free discussion giving their own views and this was agreed. The President then read out a draft of the resolution on time signal emissions which had been prepared by the Organizing Committee. After clarification of a few points the meeting adjourned.

Third Session

The President reopened discussion on the draft Resolution by remarking on the need to reach an acceptable compromise. The following points were made:
I now come to measurements and standards of time. BIPM, as you know, does no experimental work on the measurement of time or frequency. Nevertheless my staff and I consider that we must keep abreast of every aspect of this subject. That is why I am a member of Commission 31 (Time) of the International Astronomical Union, am always invited to the General Assembly of the International Radio Scientific Union, and am well acquainted with whatever is discussed by the International Radio Consultative Committee of the International Telecommunications Union. I have several times visited laboratories where atomic frequency standards, of the caesium beam or hydrogen maser type, have been built. And I believe this activity has been profitable, for in the last few years regrettable misunderstandings, especially between astronomers and physicists, have crept into discussions on time and frequency. Naturally all those competent to do so have tried to remove such misunderstandings, and I have done my good share.
2. Consideration of Study Group 7 documents (Docs. 7/1000 to 7/1042)

Docs. 7/1000 to 7/1002

2.1 The Chairman of Study Group 7, introducing his Report (Doc. 7/1001), stressed the most important aspects of the Study Group’s work during the last Study Period. In particular, he drew attention to the recommended adoption of Coordinated Universal Time (UTC) as the basis for civil time, the results achieved in respect of time and frequency generators, and problems encountered in respect of mutual interference in the bands allocated for the time and frequency services.

Coordinated Universal Time (UTC)

UTC was introduced by Recommendation 460 in 1972 for the purpose of time-signal emissions of standard-frequency and time-signal transmitters. In 1975 the General Conference of Weights and Measures recommended UTC as the basis of civil time. Some countries have already introduced new time laws in which legal time is no longer based on mean solar time of the Greenwich meridian, Universal Time (UT), but on UTC. Though UT and UTC differ by less than 1 s, for precise time measurements, their qualities differ considerably. Though UTC is defined and at many places immediately available with an uncertainty of less than 1 μs. In contrast, UT is uncertain by several ms. The scale unit of UTC is the SI second which is the legal time unit in many countries, since only UTC time signals and corresponding standard frequencies are distributed, the UTC time scale is the general reference for civil time as well as for all international services. Greenwich Mean Time (GMT), though not precisely defined, corresponds nearly to UT. In the new Recommendation 535, it is recommended that the term GMT in the Radio Regulations be replaced by UTC. It is also recommended that UTC should be used in all official documents of the International Telecommunication Union. According to Recommendation 736 the designation UTC is to be used in all languages.

Review of the work

In contrast to earlier Study Periods, no contributions concerning the definition and designation of time scales and relevant problems have been submitted. This shows that the fundamental problems on time and frequency are sufficiently solved.

Some of the important work was done in the three Interim Working Parties.

Interim Working Party 7/1/ has successfully accomplished its work on the implementation of the UTC system.

Interim Working Party 7/2 has prepared a glossary containing more than sixty terms and definitions used in the standard frequency and time signal service.

Interim Working Party 7/3 has presented a final Report on the proposed reduction of mutual interference between standard frequency and time signal emissions in bands 6 and 7.

On the basis of the results achieved, Study Group 7 decided to abolish the three Working Parties; the remaining work could be accomplished by the Study Group itself.
What is a leap second like?
2005 leap second

http://www.boatingsf.com/ships-on-SF-bay/central-san-francisco-bay
2005 leap second
Automated Identification System (AIS)
Media Alert

Saab TransponderTech AB

Date: December 5th, 2005
From: ACR Electronics, Inc.
Re: Re-synchronization of AIS systems due to Leap Second Phenomenon
Contact: John Bell/PRCoordinator ACR Electronics, Inc.
Email: prseitz@bellsouth.net
Tel: 954-970-3394

Timing problem in the R3 and R4 Transponder
A problem with the UTC time has recently occurred in our R3 and R4 transponder products. This causes a functional problem in our transponders which will remain until the end of 2005. The problem can be removed with a software upgrade that is available through our Service Network.

1.1 Background
UTC time is used as the time base in the AIS system. A leap second will be introduced in UTC time at midnight, 31st December 2005. Announcement on the upcoming change in UTC has been broadcast in the GPS system since early July this year.

According the Time and Frequency Division at the U.S. National Institution of Standards and Technology an extra second will be added to 2005 to make up for the slowing down of the Earth’s rotation.

The once common “leap second” is the first in seven years and reflects the unpredictable nature of the planet’s behavior. For the first time since 1998, the International Earth Rotation and Reference Systems Service in Paris will sneak in an extra second at the end of the year to get time back in synch with the atomic clock, which is unwavering in its measurement of time on earth.

ACR Electronics, a global manufacturer of two Automatic Identification Systems (AIS) brands-- The GlobalWatch™ and GlobalWatch™-- is alerting customers that the additional second will affect the performance of their on-board AIS systems, unless a manual re-synchronization takes place between January 1 and January 2. The “leap second” will affect all AIS systems and manufacturers such as ACR are proactively notifying users around the world.

The Coordinated Universal Time (UTC) kept by the atomic clock is used as the time-base for all AIS systems. Unless re-synchronized the GPS-signal received by the transponder could fail to identify targets on the AIS display.

ACR, in addition to emails to dealers and unit owners, has posted a detailed technical bulletin on its website at www.acrelectronics.com offering two simple options for manual re-synchronization.

Also, something at Google ...
2008 leap second
Linux kernel deadlock  https://lkml.org/lkml/2009/1/5/562

On Fri, Jan 2, 2009 at 4:21 PM, Chris Adams <cmadams@hiwaay.net> wrote:
> Once upon a time, Linas Vepstas <linasvepstas@gmail.com> said:
> >> Below follows a summary of the reported crashes. I'm ignoring the
> >> zillions of "mine didn't crash" reports, or the "you're a paranoid
> >> conspiracy theorist, its random chance" reports.
> >>
> > I have reproduced this and got a stack trace (this is with Fedora 8 and
> > kernel kernel-2.6.26.6-49.fc8.x86_64):
> >
> [snip]
> > Basically (to my untrained eye), the leap second code is called from the
> > timer interrupt handler, which holds xtime_lock. The leap second code
> > does a printk to notify about the leap second. The printk code tries to
> > wake up klogd (I assume to prioritize kernel messages), and (under some
> > conditions), the scheduler attempts to get the current time, which tries
> > to get xtime_lock => deadlock.

This analysis looks correct to me.

Grrrr. This has bit us a few times since the "no printk while holding
the xtime lock" restriction was added.
Thomas: Do you think this warrents adding a check to the printk path
to make sure the xtime lock isn't held? This way we can at least get a
warning when someone accidentally adds a printk or calls a function
that does while holding the xtime_lock.

thanks
-john

Meanwhile, at Google ...
Google “leap smear”

Google is among the few agencies on the planet capable of defining and distributing its own global time scale.

The leap smear is a “lie”

Cloud applications are generally not real-time systems.
2012 leap second
derecho occurred 1 day before leap second

June 29, 2012 Midwest to East Coast Derecho
Radar Imagery Composite Summary 18-04 UTC
~600 miles in 10 hours / Average Speed ~60 mph

Over 500 preliminary thunderstorm wind reports indicated by *
Peak wind gusts 80-100mph. Millions w/o power.
2012 leap second

Some Linux systems without a kernel patch from March crashed all day before the leap if they ran NTP.
https://lkml.org/lkml/2012/3/15/616

Heavily loaded systems were more likely to crash.
http://blog.fastmail.fm/2012/07/03/a-story-of-leaping-seconds/

Some Linux systems running old unpatched kernels (re)experienced the 2008 deadlock bug.

Large amounts of speculation and misinformation
Leap second did not crash Pirate Bay
Nor fark
http://www.fark.com/comments/blog284

Some Linux systems running fully patched kernels experienced the 2012 livelock bug.
Qantas reservation system Amadeus and many other sites, not all reported in the media.
2012 leap second

Linux kernel livelock   https://lkml.org/lkml/2012/7/1/19

Date   Sun, 1 Jul 2012 01:16:13 -0700
Subject Re: Leap second insertion causes futex to repeatedly timeout
From    john stultz <>

On Sat, Jun 30, 2012 at 5:57 PM, Jan Engelhardt <jengelh@inai.de> wrote:
> This year's leap second insertion has had the strange effect on at least
> Linux versions 3.4.4 (my end) and 3.5-rc4 (Simon's box, Cc) that certain
> processes use up all CPU power, because of futexes repeatedly timing
> out. This seems to only affect certain processes.
> Simon observes - http://s85.org/cwXfmLyt - that
> Firefox/Thunderbird/Chrome/Java are affected.
> As for me, it affects VirtualBox, mysqld and ksoftirqd. The processes
> continue to run and respond. Most weird: I can stop-start mysqld and the
> issue persists. (I would have expected it to go away because the leap
> second event would then be in the past that mysqld does not know about
> anymore.)
>
> Is this a kernel issue? glibc?

Some of the reports that the issue is resolved by calling:

```
$ date -s "\date"
```

suggests that it might be due to clock_wasset() not being called
after the leap second was added, causing some hrtimer confusion.

Thomas: does that sound about right?

I've got an initial patch to add the clock_wasset() calls where
needed, but so far have not been able to reproduce the issue (tried
firefox and some simpler futex tests). I'll keep trying and hopefully
have something to send out tomorrow.

Again, my apologies for the trouble.

-John
2012-07-31, 2012-08-31 and 2012-12-31
NTP LI (leap indicator) bits
roughly 10% to 20% of servers always wrong

http://www.maths.tcd.ie/~dwmalone/time/leap2012/#ntpleapflag
2012-11-19 Giant Leap

tick.usno.navy.mil and tock.usno.navy.mil
NTP servers reported year as 2000

Nov 19 14:22:16.062 MST: %SYS-6-CLOCKUPDATE:
    System clock has been updated
    from 14:22:16 MST Mon Nov 19 2012
    to 14:22:16 MST Sun Nov 19 2000,
    configured from NTP by 192.5.41.40.

http://mailman.nanog.org/pipermail/nanog/2012-November/053414.html
https://puck.nether.net/pipermail/outages/2012-November/thread.html
See threads “NTP Issues Today” and “Possible NTP attacks?”

Posts reported sites having to reboot all systems.
What the computer is saying

I'm sorry, Dave.
I'm afraid I can't do that.

I think you know what the problem is just as well as I do.
Skip Newhall
Leap Second Party

- Masterclock TCD 26 (IRIG-B from Spectracom)
- Spectracom Netclock/2 Model 8128 (WWVB)
- Symmetricom XLI (GPS)
- ESE Display 270U/9 (IRIG-B from XLI)
- ESE Model/85 (GPS)
- Symmetricom Syncserver S350 (GPS)
- Symmetricom Syncserver S250 (GPS)
Leap Second Party

23:59:60

00:00:00
2013, DevOps Reactions
Say it with pictures. Describe your feelings about your everyday sysadmin interactions.
http://devopsreactions.tumblr.com/post/38053375865/

“When I realized the leap second problem”