

URSI Commission J Working Group questionnaire concerning leap seconds in UTC

Appendix I. Questionnaire

It is being proposed to change the definition of Coordinated Universal Time (UTC) regarding the insertion of leap seconds, possibly even eliminating their use. Leap seconds are introduced so as to keep UTC synchronized (within 0.9 s) to the time scale determined from the Earth's rotation.

Should no new leap seconds be inserted, solar time will diverge from atomic time at the rate of about 2 seconds every 3 years, and after about a century $|UT1-UTC|$ would exceed 1 minute. Although no fundamental problems are anticipated, it is very likely that Y2K-like problems may result in software that assumes $UT1=UTC$, or $|UT1-UTC| < \text{some value}$, or whose input/output records use a field size that can only accommodate $|UT1-UTC|$ values up to one second.

To gather information, an URSI Commission J Working Group was formed, consisting of Don Backer, Wim. N. Brouw, Barry Clark, Irwin Shapiro, Ir. E. Van Lil, with Demetrios Matsakis being the chair.

We would like to ask you to consult with the members of your institute who currently deal with UT1-UTC, and give us a considered response to the following two questions:

A. If the appropriate international bodies decide to eliminate the insertion of new leap seconds, would you foresee any practical problems for your institution/instrument/observations?

no ____

* yes ____

* possibly ____

(* please explain any known or possible problems)

B. Would you be in favor of such a proposal?

yes ____

no ____

indifferent ____

have better idea ____

(feel free to comment)

C. Is there anyone else you would recommend we contact?

(feel free to forward this email directly)

I would appreciate your assistance, and a response by January 15 to dnm@orion.usno.navy.mil.

I am attaching a list of institutions and persons contacted, except for 931 institutions whose emails were obtained from the AAS. I would like to apologize to anyone contacted twice, but also appreciate it if you would forward this email to anyone we have missed. Also, if you are an URSI Commission J national chair, we would appreciate your forwarding this email to your complete membership and in particular to the directors of observatories.

Sincerely,

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Appendix II. Distribution List

Efforts were made to conduct an international survey, and responses were received from Europe, Japan, China, Australia, Canada, Russia, Saudi Arabia, Brazil, and other countries. The majority of the responses, however, were from the U.S. Commercial interests, such as satellite companies, were highly undersampled. The questionnaire asked people to forward it to others, and we know the following were contacted:

1. 128 prominent scientists, who were mostly URSI Commission J members and official representatives of institutions associated with URSI.
2. 27 URSI Commission J national chairs.
3. 931 Institutions extracted from a database kept by the American Astronomical Society, including many from outside the United States. Several hundred of those email addresses proved invalid.
4. All on the USNO Series 7 mailing list.
5. All on the "Gazette" mailing list of the International Earth Rotation Service (IERS). This would be expected to include most scientific groups that are directly involved with UT1.
6. One responder who worked in SETI indicated he had forwarded it to SETI circles.
7. The Internet Engineering Task Force's mail exploder.
8. One responder, who was against any change, indicated he had forwarded the questionnaire extensively around Jet Propulsion Labs (JPL).

Appendix III.
**"Standard Reply" to queries concerning the
questionnaire**

Thank you for your response, which will be tabulated. Unix-technology willing, we also plan to send a copy of our report all responders.

Many people have asked me why there is a move to rethink the leap seconds, with solutions such as (but not limited to) adding no new leap seconds. I unfortunately edited out some of the reasons from early drafts of the questionnaire, because I was afraid that people would not read a long email. Since then, I have developed the following "standard reply":

1.) Many high-tech navigation systems, particularly those using spread-spectrum techniques, can't handle leap seconds very well. GLONASS, the Russian equivalent to GPS, goes off-line for leap second adjustments. Also, problems can occur in interfacing between systems that handle leap seconds differently. There is also the practical problem of inserting a second every year and half - people often do it the wrong way. The response one person sent me is below, and it concerns Network Time Protocol (NTP), which uses the internet to transfer time.

If leap seconds went away, the NTP community would worship the ground you walk on. Leap secs introduce a manual discontinuity in the NTP time scale. It takes a while to propagate leap secs through the hierarchy. Leap seconds are a tremendous headache in the NTP world because they cannot be predicted. One must set a flag to indicate that one is coming. I think it is a very true statement that all GPS users would vote against continuing leap seconds, not just NTP users. Many telecommunications circuits use GPS or atomic clocks to keep cellular phones in operation, and leap seconds are a nuisance to them as well.

2.) I also received many comments about the effects on society when UT1 diverges. Note that we are talking about a minute in the next century. Society routinely handles a one-hour switch with every daily savings time, and a half-hour offset if they live at the edge of a time zone. By the time leap seconds add up to an hour, the world will be very different. If we have settled the solar system, a whole new scheme will probably have evolved. Even if we have not changed our system, society has enough slop in its timekeeping that people will slowly shift without even knowing it. More people will start showing up to work at 9:00 AM, and less at 8:30 AM, etc.

3) The "Innovations" section in November's GPS World is on this subject, and discusses other possibilities aside from "no new leap seconds". These are inserting larger discontinuities less frequently, inserting integer leap seconds at predefined times, simply using TAI, and redefining the length of the second.

4) It should be pointed out that UT1-UTC is readily available on the web. The USNO, as a subbureau of the International Rotation Service, makes this information available via a weekly mailing and from a web page at <http://www.maia.usno.navy.mil>, and other organizations also provide this service.

5) My final comment is not to worry about any "surprise" decisions - before/if the international bodies all decide to do this, it will be fully debated and publicized. My role, here, is simply to gather information.