DISCUSSION CONCLUDING AAS 11-677

Neil deGrasse Tyson wondered if there was some value in letting errors happen in order to discover them more efficiently. Arnold Rots replied that if civil time is decoupled from Earth rotation, small errors are likely to gradually increase with time, such that by the time they are noticed, years or decades of recorded data might need to be corrected or reprocessed. David Terrett added that the concern here was that, unlike Y2K issues, there really is no catastrophic failure to give warning that a problem is occurring. Mark Storz clarified that some software should be expected to crash. As an example, Ken Seidelmann noted one organization did not make necessary corrections to predicted ephemerides caused by a change of standards caused by the 1925 redefinition of GMT in almanacs.

Steve Malys suggested that there are two very different categories of operations. Interruptions to science missions or research activities have limited impact and these programs are likely to be managed flexibly. In contrast, military missions cannot easily tolerate operational downtime and are therefore managed very rigidly. As an example, so many things are now dependent on an operational system like GPS; the ramifications of GPS going offline for even an hour are hard to image and such capability cannot be allowed to suffer failure. Therefore, in these cases it takes much more testing and analysis to ensure that problems will not happen from changes to timekeeping standards. Terrett suggested that the US DoD has more resources than, say, astronomers, to address such issues. Malys agreed but clarified that building and maintenance of DoD systems tends to be spread out amongst contractors outside the DoD itself, the management of which creates an institutionalized environment, such that the potential for flexibility and collaboration is greater amongst research astronomers compared to military operations.

Ken Seidelmann asked about the verification of software owned by individuals in need of correction. Rob Seaman agreed that this is not a minor issue, but that situation was obviously beyond his immediate influence.

Dennis McCarthy asked what Seaman would like to see from the IERS in terms of improving infrastructure for UT1 dissemination. Terrett offered that topic was the subject of his upcoming paper. Seaman noted that the modern paradigm for astronomical infrastructure is the Virtual Observatory, an internet-based service-oriented architecture with very clear standards for usage in principle. Therefore, a clear protocol and a robust infrastructure must exist to transport the messaging. The infrastructure should consider that telescopes are operated untended and without reliable network connectivity due to their remoteness, so there may be a need for something more sophisticated than synchronizing time through the USNO web site. Terrett disagreed, suggesting that the simplest possible approach should be preferred. McCarthy noted that IERS representatives were in the room and this meeting was the ideal opportunity to inform the IERS regarding user requirements. Seaman noted that the issue of UT1 dissemination is a good issue to address independent of any leap second issues.

Terrett said that he was only familiar with his own applications and accuracy requirements and was unsure of the timing requirements of other communities, and that his proposal may not meet all needs. Rots wondered if encoding of GPS signals might be an option for time broadcasts in the

future. Terrett said that mostly observatories simply need to accurately synchronize their clock to UT1. Rots was not convinced that UT1 was all that an observatory would want from a time service. Seaman admitted that a service at the complexity and robustness of NTP might suffice; there might be two different kinds of time transmitted although that creates its own complications. Terrett clarified that he was interested in a service that broadcasts a correction to civil time rather than Earth-rotation time itself. Seaman said that if the correction is slowly changing (as DUT1 precise to 0.1 seconds is now), then there is no need for a continuous broadcast correction service unless higher precision is needed. The point of Seaman's paper was that there are many cases that are not necessarily attempting to "point something at something else." Terrett said his main concern was a means of providing precise real-time Earth orientation.

McCarthy said that at some point the IERS had casually discussed maintaining a time signal steered to UT1 and making that signal accessible to users who needed a precise realization of UT1 in real time. The drawback to such a service is that some may use the service without understanding what it provides. Seaman noted that if leap seconds cease, then symmetry is broken between UTC and UT1 and there will be a need to keep track of and distribute these scales separately regardless.

George Kaplan asked for clarity regarding the FITS standard for time; Allen replied that FITS refers to data formats that have been in use in astronomy for a couple of decades now, and the time standard refers to World Coordinate System Paper V, which is basically a specification of how to write metadata, such that a machine should be able interpret the scale being used.[1] Rots noted that the reason for mentioning FITS was that this standard should be able to cover whatever happens regarding the future of UTC.

REFERENCES

[1] Rots, A.H., P.S. Bunclark, M.R. Calabretta, S.L. Allen, R.N. Manchester (2009), "Representations of Time Coordinates in FITS" Astronomy & Astrophysics Manuscript No. WCSPaperV0.73, September 28, 2009. (URL http://hea-www.cfa.harvard.edu/~arots/TimeWCS/WCSPaperV0.73.pdf)