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ON THE TERM COORDINATED UNIVERSAL TIME

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The definition and use of the term *Coordinated Universal Time* is more than a technical matter. Practical considerations are as important as technical requirements because using and applying accurate and precise time measurements are critical to many fundamental applications—not just knowing "what time it is." Clarity of the meaning of the term is one of the most important practical requirements. We maintain that if the definition of Coordinated Universal Time is changed to remove the essential connection between that time scale and synodic benchmarks, the term Coordinated Universal Time, abbreviated UTC, cannot be used to refer to the revised time scale that is disconnected from Earth rotation.

INTRODUCTION

In this paper we discuss a current proposal to introduce a new interpretation of the scientific meaning of time; more precisely, we discuss how this new interpretation should be "named" to protect the interests of the scientific and technical community that deal with time measurements.

BACKGROUND OF THE ISSUE

Coordinated Universal Time (UTC) was conceived to accommodate a time scale based on virtually invariant seconds quantified according to frequencies of energy level transitions in stable matter while sustaining the significance of time as a measure of Earth's rotation relative to virtually stationary and well characterized inertial references. The evolution of UTC as a ubiquitous civil and scientific time scale is described well in the now classic text by McCarthy and Seidelmann.[1] The leap second is the best known characteristic of UTC as defined in the ITU-R-460 series of recommendations to date. The rationale for the leap second and the more precise corrections to UTC available in broadcasts available to all in the world is well understood, and the procedures for accommodating leap second insertions are well codified. Nonetheless, many who do not rely on time synchronized with Earth rotation find the insertion cumbersome and disruptive. Those who feel burdened have petitioned the International Telecommunication Union Radiocommunication Sector (ITU-R) to eliminate the leap second from the definition of UTC, most recently in the 2012 World Radiocommunication Conference (WRC-12). A decision was deferred so that member states could be better informed. Preparations for reengagement at WRC-15 are ongoing.

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In several presentations, publications, and scholarly works, Finkleman *et al*. examine the issues in depth and explain the considerations dispassionately and clearly.[2] [3]

STATEMENT OF THE TERMINOLOGICAL PROBLEM

Noted terminological authorities have examined and judged proposed changes to the definition of UTC. Authoritative rulings were distributed at the WRC-12 and submitted through official channels to ITU Study Groups.[4] The normative terminological position is that the changes proposed, particularly deprecating the connection between UTC and Earth rotation, would create polysemy if the term to designate this changed definition were not *also* changed. *Polysemy* can lead to a state of confusion because the same term is used to designate quite different things in the same context. In the case of UTC, if a new term is not introduced to name the new concept, there will be two different interpretations of the concept of time, both designated by UTC: (a) time aligned with Earth rotation embodied with leap seconds and more precise corrections now commonly available and (b) time without any connection to Earth rotation. Proleptic analyses common in astronomy, astrodynamics, religion, and many other fields of endeavor will be confounded. Uncountable reference documents and currently authoritative sources will be ambiguous. Apart from cogent technical objections to deprecating Earth rotation, this lack of terminological clarity alone will have significant practical, societal, and legal consequences. We maintain that a new technical interpretation of the fundamental notion of time must be accompanied by terminological rigor if it is adopted. Whether there should be a change is another matter, well presented in this volume.

HOW TERMINOLOGY AS A DISCIPLINE CAN CONTRIBUTE

Terminology is a branch of linguistics that includes work in lexicography, translation, technical writing, knowledge modeling and content management. As a discipline, terminology is concerned with understanding the nature of concepts in specialized fields of activity and their relationships with the terms that denote them. Terminology draws on normative and highly developed principles and methods embodied in the International Organization for Standardization (ISO) Technical Committee 37 (TC37) and its core of professional terminologists. These professionals make all endeavors more effective with transparent and meaningful terms that serve well in almost all languages.

TC37 standards prevail with the same rigor, consensus, and international confirmation as all ISO standards and practices. But in addition, of the 279 Technical Committees in ISO, TC37 is one of only 11 committees that have attained the special status of being a "horizontal committee". A horizontal committee helps other technical committees achieve standardization in their respective fields. According to ISO, "Consultation with these committees, or their documents, is advisable if you face difficulties in any of the relevant subject areas."[*] With regards to TC37, ISO further states:

> Terminology plays a vital part in all standardization efforts; it (standardization) can only work if everybody understands what is being talked about. Clear, consistent and coherent standards first of all need clear and consistent terminology. ISO/TC 37 develops the principles and methods for developing terminology to facilitate expert communication. If you

[*] International Organization for Standardization. 2007. ISO Committees on Horizontal Subjects. URL: http://www.iso.org/iso/iso_committees_on_horizontal_subjects.pdf

face difficulty with a particular term and need to define it properly, the rules set by TC 37 can help.

A *term* is a linguistic expression that denotes a concept in a *special language* (domain, or subject field). In contrast to words from *general* language, two key properties of terms are their single-meaning relationship (called *monosemy*) with the specialized concept that they designate, and the stability of the relationship between linguistic form and content in texts dealing with this concept (called lexicalization). Monosemy and lexicalization are fundamental tenets and inviolable principles of normative terminology.

Terminologists discriminate terms precisely from vocabulary in general. The characteristics of a term include the following:

- It is consistently associated with the same concept.
- It is consistently used within a particular subject field.
- It has only one meaning within that subject field.

The terms *Coordinated Universal Time* and *UTC* meet all of these criteria; hence, their meaning and use must be governed by normative terminological rigor. Furthermore, given the highly-specialized nature of the field of precise time measurement and the use of measured time across a wide range of applications, these terms are among the most highly "terminological" that one could find in language. In this particular case if any, the application of rigorous terminological principles should not be questioned.

What are the terminological principles that govern the designation and use of a term? Besides being recognized by the same set of semantic features and by its definition, a specialized concept is also recognized by the stability of its association with the term used to designate it. In turn, a term may be recognized as such by virtue of its stable pairing with the same set of semantic features that distinguish the concept from others. This stability is sometimes called "degree of lexicalization" and sometimes "degree of terminologization". The lack of such stability leads to "cognitive fuzziness", as in polysemy and synonymy. Concept-term stability is preserved in the single-concept principle so fundamental for terms in highly specialized scientific and technical fields that depend on absolute clarity.

Retaining the term and abbreviation *Coordinated Universal Time* and *UTC* for a newly introduced concept, a time scale unrelated to Earth rotation, violates these principles and creates terminologically unarguable polysemy. This was judged authoritatively in documents and evidence presented officially to the ITU-R.

EXAMPLE OF A REAL TERMINOLOGY PROBLEM

An example of a real terminology problem may help to demonstrate the importance of applying rigorous terminology management principles to such an important concept as that of time measurement. The term *data type* (sometimes written *datatype*) has been adopted in various technical fields—even very closely related ones—with different meanings. The following is just a small selection of the different definitions that one can find:

(1) a set of distinct values, characterized by properties of those values, and by operations on those values (ISO 11179-1 – Information Technology – Metadata Registries)

(2) a classification identifying one of various types of data, such as real-valued, integer or Boolean, that determines the possible values for that type (Wikipedia, Computer Science)

(3) a classification of individual data points (Statistics)

(4) structural metadata associated with digital data that indicates the digital format or the application used to process the data (M.I.T. Press, Digital Libraries)

(5) a string that specifies the format of data that a printing application sends to a printer in a print job. (Printing)

Even within the field of computer science, there are different interpretations of the meaning of this term depending on the computing language, for instance:

(6) a set of possible values, together with all the operations that know how to deal with those values (Perl programming)

(7) a set of rules describing a specific set of information, including the allowed range and operations and how information is stored (Visual Basic programming)

(8) a 3-tuple, consisting of a) a set of distinct values, called its value space, b) a set of lexical representations, called its lexical space, and c) a set of facets that characterize properties of the value space, individual values or lexical items. (XML)

To further complicate matters, the term *data element type*, which could be perceived as a variant of *data type*, has yet another meaning in computational linguistics: an elementary descriptor used in a linguistic description or annotation scheme (ISO TC37). Yet this concept is also denoted by the term *data category*. To the uninitiated, the term *data category* and *data type* could be misconstrued as synonyms. Even more confusing, the concept of "a range of possible values", corresponding to definitions (1) and (6) above, if not more, is also denoted by yet another term, *value domain* (ISO TC37, ISO TC29, ISO 11179).

This example demonstrates both polysemy (when one term has multiple meanings) and synonymy (when different terms have the same meaning), within a relatively confined subject area or family of related subject areas (computing, information technology, digital libraries, statistics, etc). As a result of this terminological imprecision, one finds that to avoid ambiguity the terms involved are defined in almost every document where they are used. (Or worse, they are not defined at all and the user is left to guess the meaning.) This results in a proliferation of different definitions as noted above, meaning that outside of a given context the term *data type* has no identifiable meaning at all.

PROPOSAL

Over two years ago, ISO TC37 submitted a proposal to the ITU Radiocommunication Assembly aimed at addressing this issue (see appendix). By edict of ISO, the standards developed by ISO TC37 are "normative" (mandatory) across the 279 ISO technical committees, which govern virtually all scientific and technical domains of human activity. This means that terminological rigor is recognized as essential for effective communication in specialized domains, and this is why ISO designated TC37 as a horizontal committee. The following quote (slightly edited) summarizes TC37's recommendation well:

> Rather than changing the meaning of an existing term, (…) a new concept (meaning), or a shift in concept, should be designated by a newly-coined term.

TC37 presented convincing arguments as to why UTC should *not* be used to refer to a newly introduced concept of time, some of which were summarized in the previous sections of this paper. But it also sanctioned a proposal for a new term already submitted to the ITU-R in 2003,

namely, *Temps International (TI)*, or *International Time* in English.[*] As explained in the proposal, this term transparently conveys the desired meaning of an international standard measurement of time while presenting no conflicts with the terms for the various existing time measurement protocols. Furthermore, it resembles the term *International Atomic Time (TAI)*, which is advantageous since the two terms represent almost identical concepts.

SUMMARY

We have described briefly the concepts, principles, and standards of normative and rigorous terminological science. We have further demonstrated that if, alongside the concept long embodied in UTC, a totally different concept divorced from Earth rotation is introduced, the new concept cannot adopt the now ubiquitous *UTC* term. After demonstrating the authoritative status of ISO TC37 in terminology matters, we presented a proposal from ISO TC37 to coin a new term for the new concept, namely *Temps International*. The authors of this paper support this proposal, but we also welcome alternatives.

REFERENCES

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[4] Warburton, K., and Erdmann, H., Statement from ISO Technical Committee 37 to the ITU Radio Assembly, January 7, 2012

[*] http://www.ucolick.org/~sla/leapsecs/torino/closure.pdf