Fig. 1

Fig. 2

Fig. 3

1. TIMESYS State of Play

(cf. Fig. 1)

Markus Demleitner
msdemlei@ari.uni-heidelberg.de

(cf. Fig. 2)

- What appears to be consensus
- Things people have complained about
- Desiderata

Out now: VOTable 1.4-20190218 – review soon!

Still worth a read for background: "A Proposal for a TIMESYS Element in VOTable" (IVOA Note 2018-12-12).

(cf. Fig. 3)

2. Consensus

- We'll have a TIMESYS element much like COOSYS at least as long as STC2 and DM annotation aren't there.
- TIMESYS metadata includes reference position and time scale.
- There's a way to say "start counting time from here" ("timeorigin").

```
<TIMESYS ID="gaia_frame" refposition="BARYCENTER"
  timeorigin="0" timescale="TCB"/>
 <TABLE name="ts_data">
   <FIELD ID="obs_time" datatype="double" name="obs_time"
     ucd="time.epoch" unit="d" ref="gaia_frame"/>
```

3. MJD vs. timeorigin

STC2 models JD and MJD differently from times given for other timeorigins (extra classes).

In VOTable, no sufficient reason to do this was found.

But: To ward off typos in 2400000.5 (MJD's timeorigin), you can write `timeorigin='MJD-origin'` and for symmetry `timeorigin='JD-origin'`.

This is in current VOTable 1.4. It doesn't quite pass my instance of Occam's razor, but it's probably no disaster either.

4. Reference Direction?

xSYS would be a lot more useful if they referenced `FIELD` and `PARAM`, not the other way round:

```
<TIMESYS time="epoch" timescale="TT"
  refposition="TOPOCENTER"/>
<COOSYS system="ICRS" long="ra" lat="dec"
  epoch_ref="epoch"/>
<FIELD id="epoch" name="epoch".../>
<FIELD id="ra" name="RA".../>
```

Alas, we can't fix `COOSYS` in a quick update, so `TIMESYS` is born broken (i.e., being referenced). We can fix both later if DM is further delayed.

5. Mandatory ref?

People floated that if there's a TIMESYS, it should automatically cover everything time-like in the VOTable; this would let people support TIMESYS without changing FIELDs. Incidentally, fixing the reference direction would fix that problem, too.

But the likelihood this goes bad is really high. Many VOTables include multiple times with different frames (e.g., observation time vs. processing time; observation time vs. mean epoch), and it's much too easy to forget about one of them. Even determining what's time-like is hard (what about exposure time?). There's lots of corner cases (what if there's multiple TIMESYSes?).

Not changed in the last WD yet ("readers SHOULD assume the lexically first TIMESYS element in the VOTable to be pertinent"). Seems there's a consensus we'll fix it in the PR.

6. refposition on COOSYS?

François O. proposed to add `@refposition` to COOSYS, too, now that we have it in TIMESYS.

I'd like to ward off non-TIMESYS changes for VOTable 1.4. But if everyone wants it and promises not to quarrel, I suppose it might just go in.

7. Force Common refposition?

Arnold wanted to require that refposition is identical in COOSYS and TIMESYS.

Given there's usually multiple COOSYS and TIMESYS, even properly specifying this requirement (currently) is hard. Nobody is pursuing it right now. .

8. Vocabulary Issues

To make the whole thing useful, we have to enumerate

- time scales http://ivoa.net/rdf/timescale. *In reasonably good shape*
- reference positions http://ivoa.net/rdf/refposition. *main problem here: TOPOCENTER*
- perhaps reference systems for COOSYS. *Broken draft in SVN*

9. Vocabularies: Timescale

Essentially a sanitised version of STC 1 timescales plus a bit improvement in 2018-12 discussions.

Gets tricky at the seconds level as early as the 1950s; but that's not fixable with a reasonable amount of work.

Current terms: TAI, TT, UT, UTC, GPS, TCG, TCB, TDB, UNKNOWN

See http://ivoa.net/rdf/timescale.

10. Vocabularies: Refposition

Roughly what STC1 had, minus several terms that seemed unlikely to be of use to anyone.

Current terms: TOPOCENTER, GEOCENTER, BARYCENTER, HELIOCENTER, EMBARYCENTER, UNKNOWN.

A useful addition would be to have specialisations of TOPOCENTER (GROUND, LEO, ...). This would allow clients to represent uncertainties with the refposition in error estimates, which TOPOCENTER does not. But someone else would have to push that along.

See http://ivoa.net/rdf/refposition

11. Reference Systems?

Since we're moving to having terms in vocabularies in TIMESYS, should we change COOSYS to use the future STC2 vocabulary, too?

Current systems in schema: eq_FK4, eq_FK5, ICRS, ecl_FK4, ecl_FK5, galactic, supergalactic, xy, barycentric, geo_app

Current draft for STC2: see Volute[1]

STC2 vocabulary is probably nowhere near ready now, and it's an almost unrelated change. Let's not do it.

12. Summing Up

Implement! . . . and think about TOPOCENTER-derived reference positions.

[1] https://volute.g-vo.org/svn/trunk/projects/semantics/vocabularies/refframe/terms.csv