XML for MPC Ephemerides and Other Time Series

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In Defense of STC

- As a prominent Eventer said yesterday: The Standard is in the document, not in the schema
  - XML Schema is a poor modeling language anyway
- The purpose of the use of STC in WhereWhen is not to allow VOEvents to be written in a million different ways, but to ensure that they will be understood by the rest of the world, in perpetuity

In Defence of STC

- One cannot, and should not, assume that one knows what other researchers – contemporaneous and future – are interested in
  - If that were the case, the Harvard plate collection should have been junked in its entirety a long time ago
- Almost all of that information can be boiler plate and can be ignored if so desired

More on STC

- VO aims at serving the entire astronomical community
  - We need to be explicit and provide complete metadata in a way that allows others to understand us; we don't necessarily need to understand others – only documents that comply with VOEvent standard
  - Even then, if you have no interest in solar data, you are free to say you can't handle data expressed in solar coordinate systems

However, …

- It would be nice if associated data, such as images, were described by corresponding metadata, too;
  I mean ObservationLocation
- SEAP appears to invent its own standard for specifying spatial Regions; it would be nice if it were consistent with TAP/ADQL

Time Series Data

- Putting time series data into a table with full metadata description
- A light-weight schema that combines an STC element with a simple table

Putting STC Data in a Table

```
<xs:schema xmlns="stcTab.xsd" xmlns:stc=… targetNamespace="stcTab.xsd">
  <xs:import namespace="http://www.ivoa.net/xml/STC/stc-v1.30.xsd"/>
  <xs:element name="STCTable" type="stcTableType"/>
  <xs:complexType name="stcTableType">
    <xs:sequence>
      <xs:element ref="stc:STCmetadata"/>
      <xs:element name="Table" type="tableType"/>
    </xs:sequence>
  </xs:complexType>
  <xs:complexType name="tableType">
    <xs:sequence>
      <xs:element name="Documentation" type="docType" minOccurs="0"
        maxOccurs="unbounded"/>
      <xs:element name="Header" type="headerType"/>
      <xs:element name="TR" type="rowType" maxOccurs="unbounded"/>
    </xs:sequence>
  </xs:complexType>
```

STC Table Schema

```
<xs:complexType name="headerType">
  <xs:sequence>
    <xs:element name="TH" type="columnType" maxOccurs="unbounded"/>
  </xs:sequence>
</xs:complexType>
<xs:complexType name="columnType">
  <xs:simpleContent>
    <xs:extension base="xs:string">
      <xs:attribute name="id" type="xs:ID"/>
    </xs:extension>
  </xs:simpleContent>
</xs:complexType>
<xs:complexType name="rowType">
  <xs:choice maxOccurs="unbounded">
    <xs:element name="TD" type="xs:double"/>
    <xs:element name="TDI" type="xs:int"/>
    <xs:element name="TDT" type="xs:dateTime"/>
    <xs:element name="TDS" type="xs:string"/>
    <xs:element name="TDU" type="xs:anyURI"/>
    <xs:element name="TDA" type="stc:astroCoordAreaType"/>
  </xs:choice>
</xs:complexType>
</xs:schema>
```

Simple Time Series Example

- Construct a simple STC element and a simple table
- Let the coordinate values refer to columns in the table through ID-IDREF linking
  - Coordinate system
  - Coordinate specification
  - Table body
  - Style sheet

A Coordinate System

```
<stc:CatalogEntryLocation>
  <!--  Specify TT, ICRS frame, referenced to the barycenter  -->
  <stc:AstroCoordSystem id="TT-ICRS">
    <stc:TimeFrame>
      <stc:TimeScale>TT</stc:TimeScale>
      <stc:BARYCENTER/>
    </stc:TimeFrame>
    <stc:SpaceFrame>
      <stc:ICRS/>
      <stc:BARYCENTER/>
    </stc:SpaceFrame>
  </stc:AstroCoordSystem>
```

Specify the Coordinates

```
<stc:AstroCoords coord_system_id="TT-ICRS">
  <stc:Time>
    <stc:TimeInstant>
      <stc:ISOTime xsi:nil="true“idref="Time"/>
    </stc:TimeInstant>
  </stc:Time>
  <stc:Position2D unit="deg">
    <stc:Value2>
      <stc:C1 xsi:nil="true" idref="RA"/>
      <stc:C2 xsi:nil="true" idref="Dec"/>
    </stc:Value2>
  </stc:Position2D>
</stc:AstroCoords>
</stc:CatalogEntryLocation>
```

The Data

```
<Table>
  <Header>
    <TH id="Time">Time</TH>
    <TH id="RA">RA</TH>
    <TH id="Dec">Dec</TH>
  </Header>
  <TR><TDT>2009-04-28T22:30:00</TDT><TD>123.4</TD><TD>56.7</TD></TR>
  <TR><TDT>2009-04-28T22:40:00</TDT><TD>133.4</TD><TD>46.7</TD></TR>
  <TR><TDT>2009-04-28T22:50:00</TDT><TD>143.4</TD><TD>36.7</TD></TR>
  <TR><TDT>2009-04-28T23:00:00</TDT><TD>153.4</TD><TD>26.7</TD></TR>
  <TR><TDT>2009-04-28T23:10:00</TDT><TD>163.4</TD><TD>16.7</TD></TR>
</Table>
</STCTable>
```

Render with a Style Sheet

file:///C:/Documents%20and%20Settings/ar

STC-based Time Series

Time	RA	Dec
2009-04-28T22:30:00	123.4	56.7
2009-04-28T22:40:00	133.4	46.7
2009-04-28T22:50:00	143.4	36.7
2009-04-28T23:00:00	153.4	26.7
2009-04-28T23:10:00	163.4	16.7

MPC Ephemerides

- Complex files:
  - 4 different coordinate systems
    - Geodetic
    - Ecliptic
    - Equatorial
    - Alt-Az
  - 5 different sets of coordinates
    - Including orbital elements
    - Not counting elongations, phases, magnitudes

MPC Ephemeris

Designation: P/2008 Y2
Alternate designation:
Last observed:
Discoverer:
Discovery site:
Discovery date:
Perturbed ephemeris: Based on MPC 65057

Orbital elements

Epoch: MJD 55000.0
a: 3.588981
q: 1.6383734154810001
e: 0.543499
Node: 330.8934
Arg of Peri: 162.3346
M: 0.0
P: 6.80
n: 0.14494504167169947
Time of peri: 2009-01-22T09:28:39 (TT)

Ephemeris

For telescope site 802, Longitude: 288.87164, Latitude: 42.38146, Altitude: 30.0

Date and Time (UTC)	R.A	Dec	Delta (AU)	Distance (AU)	Elongation	Phase	mi	SkyMotionRA	SkyMotionDec	ObjAzi	ObjAlt	SolarAlt	LunarPhase	LunarDist	LunarAlt
2009-03-18T00:00:00	+9.8563	9.175	0.792	1.724	149.3	17.2	17.9	1.63	-19.55	298	+40	-13	0.57	112	-63
2009-03-19T00:00:00	+9.8580	9.044	0.799	1.727	148.4	17.6	17.9	2.87	-19.53	299	+40	-13	0.48	124	-70
2009-03-20T00:00:00	+9.8603	8.912	0.806	1.730	147.4	18.1	17.9	4.10	-19.51	300	+41	-13	0.38	136	-72