

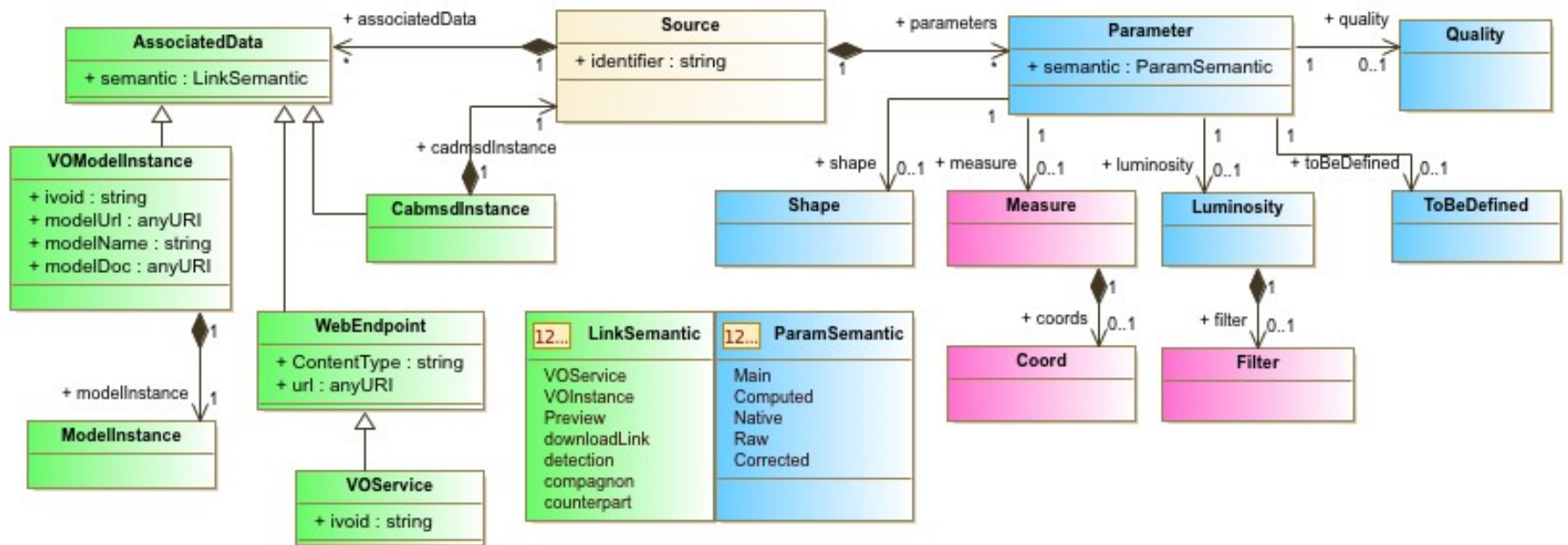


Annotating ZTF data (TimeSeries) with CAB-MSD. DM in TAP

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□ CAB-MDS DataModel (see next talk)





“VODataservice “tableset” data model mapping



- Reuse some possibilities of a well established VO standard
- Create a VODataservice « tableset » (=heart of a TAP schema)
 - table with type =« base_table» describing the native VOTables
 - tables (hereafter « virtual » tables) mapping the model structure.

“VODataservice “tableset” data model mapping



```
vosi:tableset~
  xmlns:vosi="http://www.ivoa.net/xml/VOSITables/v1.0"~
  xmlns:vod="http://www.ivoa.net/xml/VODataService/v1.1"~
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xsi:schemaLocation="http://www.ivoa.net/xml/VODa
<schema>~
  <name>ZPN-native-annotated</name>~
  <description>ZPN native tableset + views for CAB-SDM + meas_set annotation</description>~
  <table type="base_table">~
    <name>ZPN-native-table</name>~
    <description>>ZPN Native table</description>~
    <column>~
      <name>objectid</name>~
      <description>document internal source id</description>~
      <dataType xsi:type="vod:TAPType">INTEGER</dataType>~
      <ucd>meta.id</ucd>~
    </column>~
    <column>~
      <name>oid</name>~
      <description>published source id</description>~
      <dataType xsi:type="vod:TAPType">BIGINT</dataType>~
      <ucd>meta.id</ucd>~
    </column>~
    <column>~
      <name>expid</name>~
      <dataType xsi:type="vod:TAPType">INTEGER</dataType>~
      <ucd>meta.id;obs-exposure</ucd>~
    </column>~
    <column>~
      <name>hjd</name>~
      <dataType xsi:type="vod:TAPType">DOUBLE</dataType>~
      <ucd>time.epoch</ucd>~
```

“VODataService “tableset” data model mapping



```
<table type="view">~
  <name>meas_set:TimeSeries</name>~
  <column>~
    <name>vomodelInstance</name>~
    <utype>cab-sdm:VOModelInstance.ModelInstance</utype>~
  </column>~
  <column>~
    <name>mjd</name>~
    <utype>meas_set:Point;meas:Time;coords:TimeStamp.date</utype>~
  </column>~
  <column>~
    <name>hjd</name>~
    <utype>meas_set:Point;meas:Time;coords:TimeStamp.date</utype>~
  </column>~
  <column>~
    <name>mag</name>~
    <utype>meas_set:Point;cab-sdm:Luminosity.value</utype>~
  </column>~
  <column>~
    <name>magerr</name>~
    <utype>meas_set:Point;cab-sdm:Luminosity.error</utype>~
  </column>~
  <foreignKey>~
    <targetTable>ZTF-native-table</targetTable>~
    <fkColumn>~
      <fromColumn>mjd</fromColumn>~
      <targetColumn>mjd</targetColumn>~
    </fkColumn>~
  </foreignKey>~
  <foreignKey>~
    <targetTable>ZTF-native-table</targetTable>~
    <fkColumn>~
      <fromColumn>hjd</fromColumn>~
      <targetColumn>hjd</targetColumn>~
    </fkColumn>~
  </foreignKey>~
  <foreignKey>~
    <targetTable>ZTF-native-table</targetTable>~
    <fkColumn>~
      <fromColumn>mag</fromColumn>~
      <targetColumn>mag</targetColumn>~
    </fkColumn>~
  </foreignKey>~
  <foreignKey>~
    <targetTable>ZTF-native-table</targetTable>~
    <fkColumn>~
      <fromColumn>magerr</fromColumn>~
      <targetColumn>magerr</targetColumn>~
    </fkColumn>~
  </foreignKey>~
  <foreignKey>~
    <targetTable>TimeFrame</targetTable>~
    <fkColumn>~
      <fromColumn>mjd</fromColumn>~
      <targetColumn>frameid</targetColumn>~
    </fkColumn>~
  </foreignKey>~
  <foreignKey>~
    <targetTable>TimeFrame-HELIO</targetTable>~
    <fkColumn>~
      <fromColumn>hjd</fromColumn>~
      <targetColumn>frameid</targetColumn>~
    </fkColumn>~
  </foreignKey>~
  </foreignKey>~
</table>~
```



“VOData service “tableset” data model mapping



- Rule to define the virtual table applied to the main table :
 - identify the columns associated to cab-msd instance attributes or VOInstance model
 - create virtual tables with virtual columns related to native columns by foreign keys.
 - complete the virtual table with unused model attributes. (will be PARAMS in the serialisation)
 - put vo-dml.id into utype in the simple case
 - in case of 1 to 1 references : replace hierachy by a flat table going to the leave
 - replace any “ivoa type”, ucd, unit attribute in the model by corresponding element inside the « column » element.

□ “FLAT” utypes generation



- **Derive** « flat » utypes from the tableset this way :
- **Look** if the FIELD is referred directly in one of the « view » tables and if yes :
 - → **add** the utype of this « view » column to the utype of the actual column
- **Look** if the « view » table is referred from another « view » table column
 - → **Concatenate** the utype of the referring column before the result table
- **Iterate** the last step until we reach to top view class

□ “FLAT” utypes generation



- `<FIELD name="ra" datatype="double" ucd="pos.eq.ra" unit="deg"/>`
 - utype = « meas:EquatorialPosition.ra »
 - utype = « cab-msd:Source/meas:EquatorialPosition.ra »

- So now we have :
`<FIELD name="ra" datatype="double" ucd="pos.eq.ra" unit="deg" utype = « cab-msd:Source/meas:EquatorialPosition.ra » />`

- In the same way

`<FIELD name="hjd" datatype="double" ucd="time.epoch" unit="d">`

→ utype = « meas_set:Point.meas:Time.coords:TimeStamp.date »

→ utype = « cab-msd:VOModelInstance.modelInstance/meas_set:Point/meas:Time/coords:TimeStamp.date »

→ utype = « cab-msd:Source.VOModelInstance.modelInstance/meas_set:Point/meas:Time/coords:TimeStamp.date »

`<FIELD name="hjd" datatype="double" ucd="time.epoch" unit="d" utype = « cab-msd:Source.VOModelInstance.modelInstance/meas_set:Point/meas:Time/coords:TimeStamp.date » />`

□ “FLAT” utypes generation



```
<TABLE>
<FIELD name="oid" datatype="long" ucd="meta.id" utype="cab-msd:Source.identifier" >
  <DESCRIPTION>Object ID</DESCRIPTION>
</FIELD>
<FIELD name="expid" datatype="int" ucd="meta.id;obs.exposure" utype="cab-msd:Source.Parameter">
  <DESCRIPTION>Exposure ID</DESCRIPTION>
</FIELD>
<FIELD name="hjd" datatype="double" ucd="time.epoch" unit="d" utype = "cab-msd:VOModelInstance.modelInstance/meas_set:Point/meas:Time/coords:TimeStamp.date" ref="hjtime" >
  <DESCRIPTION>Heliocentric Julian date (computed from mjd and the mean ra and dec of the input catalog)</DESCRIPTION>
</FIELD>
<FIELD name="mjd" datatype="double" ucd="time.epoch;obs.exposure" unit="d" utype = "cab-msd:VOModelInstance.modelInstance/meas_set:Point/meas:Time/coords:TimeStamp.date" ref="time" >
  <DESCRIPTION>Modified Julian date</DESCRIPTION>
</FIELD>
<FIELD name="mag" datatype="float" ucd="phot.mag;em.opt" unit="mag" utype = "cab-msd:VOModelInstance.modelInstance/meas_set:Point/cab-msd:Luminosity.value">
  <DESCRIPTION>Magnitude</DESCRIPTION>
</FIELD>
<FIELD name="magerr" datatype="float" ucd="stat.error;phot.mag;em.opt" unit="mag" utype = "cab-msd:VOModelInstance.modelInstance/meas_set:Point/cab-msd:Luminosity.error">
  <DESCRIPTION>Uncertainty in mag measurement. Includes correction to conform to photometric repeatability RMS derived from &quot;non-variable&quot; population.</DESCRIPTION>
</FIELD>
<FIELD name="catflags" datatype="int" ucd="meta.code" utype="cab-msd:Source.Parameter">
  <DESCRIPTION>Catalog flags for source from PSF-fitting catalog</DESCRIPTION>
</FIELD>
<FIELD name="filtercode" datatype="char" arraysize="*" ucd="instr.bandpass" utype="cab-msd:Source.Parameter">
  <DESCRIPTION>Filter code (abbreviated name)</DESCRIPTION>
</FIELD>
<FIELD name="ra" datatype="double" ucd="pos.eq.ra" unit="deg" utype = "cab-msd:Source/meas:EquatorialPosition.ra" ref="ICRS" >
  <DESCRIPTION>Right Ascension of source</DESCRIPTION>
</FIELD>
<FIELD name="dec" datatype="double" ucd="pos.eq.dec" unit="deg" utype = "cab-msd:Source/meas:EquatorialPosition.dec" ref="ICRS" >
  <DESCRIPTION>Declination of source</DESCRIPTION>
</FIELD>
<FIELD name="chi" datatype="float" ucd="stat.parameter" utype="cab-msd:Source.Parameter">
  <DESCRIPTION>Chi-squared of source</DESCRIPTION>
</FIELD>
<FIELD name="sharp" datatype="float" ucd="stat.parameter" utype="cab-msd:Source.Parameter">
  <DESCRIPTION>Sharpness of source</DESCRIPTION>
</FIELD>
<FIELD name="filefracday" datatype="long" ucd="time.epoch;obs.exposure" utype="cab-msd:Source.Parameter">
  <DESCRIPTION>Exposure file timestamp, with decimal representation YYYYMMDDdddd: year, month, day, and fractional day</DESCRIPTION>
</FIELD>
<FIELD name="field" datatype="int" ucd="meta.id;obs.field" utype="cab-msd:Source.Parameter">
  <DESCRIPTION>Field ID</DESCRIPTION>
</FIELD>
<FIELD name="ccdId" datatype="unsignedByte" ucd="meta.id;instr.det" utype="cab-msd:Source.Parameter">
  <DESCRIPTION>CCD number (1..16)</DESCRIPTION>
</FIELD>
```

□ “FLAT” utype



- Pros :
 - no structure to read before the table
 - Simple pointer to the structure in tableset (→ model)
- Cons :
 - strings may be long
 - difficult to distinguish columns with similar utypes
 - « association » of columns can be made by refs :
But refs may have several other meanings and are unique
 - no easy “group of rows” to define instances (= no filter or grouping facility).

□ GROUP serialisation



- **Derive** GROUPs from the tableset this way :
- **Look** if the FIELD is referred directly in one of the « view » tables and if yes :
- → **create** a GROUP with the virtual table utype, create a FIELDref inside and use the column utype of this « view » column for the FIELDref
- **Look** if the « view » table is referred from another « view » table column
- → **create** an upper level GROUP containing the first one.
- **Add** appropriate PARAMS and FIELDref inside.
- **Iterate** the last step until we reach to top view class

GROUP serialisation



```
<TIMESYS ID="time" refposition="BARYCENTER" timeorigin="" timescale="TCB"/>
<TIMESYS ID="htime" refposition="HELIOCENTER" timeorigin="" timescale="TCB"/>
<COOSYS ID="ICRS" system="ICRS" epoch="J2015"/>
<GROUP utype="cab-msd:Source" />
<FIELDref utype="cab-msd:Source.identifier" ref="oid"/>
<GROUP utype="cab-msd:VOModelInstance">
  <PARAM utype="cab-msd:VOModelInstance.vodmlid" value="adhoc://meas_set" />
  <PARAM utype="cab-msd:VOModelInstance.modelName" value="Measures Set" />
  <PARAM utype="cab-msd:VOModelloc" value="http://adhoc.doc.html" />
  <GROUP utype="meas_set:Point">
    <GROUP utype="meas:Time;coords:TimeStamp" ref="htime">
      <FIELDref "meas:Time;coords:TimeStamp.date" ref="hjd"/>
    </GROUP>
    <GROUP utype="meas:Time;coords:TimeStamp" ref="time">
      <FIELDref "meas:Time;coords:TimeStamp.date" ref="mjd"/>
    </GROUP>
    <GROUP utype="cab-msd:Luminosity" >
      <FIELDref "cab-msd:Luminosity.value" ref="mag"/>
      <FIELDref "cab-msd:Luminosity.error" ref="magerr"/>
    </GROUP>
  </GROUP>
  <GROUP utype="meas:EquatorialPosition">
    <FIELDref utype="meas:EquatorialPosition.ra" ref="ra"/>
    <FIELDref utype="meas:EquatorialPosition.dec" ref="dec"/>
  </GROUP>
  <FIELDref utype="Source.Parameter" ref="expid" />
  <FIELDref utype="Source.Parameter" ref="catflags" />
  <FIELDref utype="Source.Parameter" ref="filtercode" />
  <FIELDref utype="Source.Parameter" ref="chi" />
  <FIELDref utype="Source.Parameter" ref="sharp" />
  <FIELDref utype="Source.Parameter" ref="ccdId" />
  <FIELDref utype="Source.Parameter" ref="field" />
</GROUP>
```

□ GROUP serialisation



- Pros :
 - no change to the main table
 - association between column unambiguous
- Cons :
 - structure to parse
 - no easy “group of rows” to define instances (= no filter or grouping facility).

□ VODML-“like” serialisation



- From Tableset to VODML-“like” (Laurent Michel proposal)
 - 1) Transform attributes of the FIELD into an ivoa:Quantity :

```
<INSTANCE dm-role= »utype » dm-type= « ivoa:?Quantity » />
```

```
<VALUE dmrole="ivoa:Quantity.unit" dmtype="ivoa:Unit" value=" ?"/>
```

```
<VALUE dmrole="ivoa:?Quantity.value" dmtype="ivoa:?" ref=" ?"/>
```

```
</INSTANCE>
```

- 2) Transform each column into an INSTANCE level.
 - Dm-role is the utype of the level
 - Dm-type is deduced from lower level Dm-role eg :
 - lower level : dm-role: TimeStamp.date
 - higher level : dm-type : TimeStamp

□ VODML-“like” serialisation



- From Tableset to VODML-Lite
 - 3) Create a COMPOSITION for each table
 - 4) create references when tableset contains reference columns
 - 4) When two tables have the same column content create a single INSTANCE with a FILTER
 - 5) And again up to the top

□ VODML-“like” serialisation



```
<VODML>
  <MODELS>
    <MODEL>
      <NAME>meas</NAME>
      <URL>https://volute.g-vo.org/svn/trunk/projects/dm/STC/Meas/vo-dml/STC_meas-v1.0.vo-dml.xml</URL>
    </MODEL>
    <MODEL>
      <NAME>ivoa</NAME>
      <URL>http://www.ivoa.net/xml/VODML/20180519/IVOA-v1.0.vo-dml.xml</URL>
    </MODEL>
    <MODEL>
      <NAME>coords</NAME>
      <URL>https://volute.g-vo.org/svn/trunk/projects/dm/STC/Coords/vo-dml/STC_coords-v1.0.vo-dml.xml</URL>
    </MODEL>
    <MODEL>
      <NAME>coords</NAME>
      <URL>https://volute.g-vo.org/svn/trunk/projects/dm/nd_point-v1.0.vo-dml.xml</URL>
    </MODEL>
    <MODEL>
      <NAME>coords</NAME>
      <URL>https://volute.g-vo.org/svn/trunk/projects/dm/cab-msd-v1.0.vo-dml.xml</URL>
    </MODEL>
  </MODELS>
  <GLOBALS>
    <!-- Space Frame ICRS -->
    <INSTANCE dmrole="root" dmtpe="coords:SpaceFrame" ID="SpaceFrame_ICRS">
      <VALUE value="ICRS" dmrole="coords:SpaceFrame.spaceRefFrame" dmtpe="ivoa:string"/>
      <INSTANCE dmrole="coords:SpaceFrame.refPosition" dmtpe="coords:StdRefLocation">
        <VALUE value="GEOCENTER" dmrole="coords:StdRefLocation.position" dmtpe="ivoa:string"/>
      </INSTANCE>
    </INSTANCE>
    <!-- Time frame (imported from coords) -->
    <INSTANCE dmrole="" dmtpe="coords:TimeFrame" ID="TimeFrame_TT_HELIO">
      <INSTANCE dmrole="coords:TimeFrame.refPosition" dmtpe="coords:StdRefLocation">
        <VALUE value="HELIOCENTER" dmrole="coords:StdRefLocation.position" dmtpe="ivoa:string" />
      </INSTANCE>
      <VALUE value="TT" dmrole="coords:TimeFrame.timescale" dmtpe="ivoa:string"/>
    </INSTANCE>
    <INSTANCE dmrole="" dmtpe="coords:TimeFrame" ID="TimeFrame_TT_BARY">
      <INSTANCE dmrole="coords:TimeFrame.refPosition" dmtpe="coords:StdRefLocation">
        <VALUE value="BARYCENTER" dmrole="coords:StdRefLocation.position" dmtpe="ivoa:string" />
      </INSTANCE>
      <VALUE value="TT" dmrole="coords:TimeFrame.timescale" dmtpe="ivoa:string"/>
    </INSTANCE>
    <!-- G filter definition: ad-hoc because no model yet -->
    <INSTANCE dmrole="" dmtpe="cab-msd:Filter" ID="Filter_G">
      <VALUE value="G" dmrole="cab-msd:Filter.name" dmtpe="ivoa:string"/>
      <VALUE value="http://svo.url.filter/ztf/g" dmrole="cab-msd:FilterUrl" dmtpe="ivoa:string"/>
    </INSTANCE>
  </GLOBALS>
  <TEMPLATES tableref="xxx">
```


□ VODML-“like” serialisation



```
<VALUE value="http://svo.url.filter/ztf/g" dmrole="cab-msd:FilterUrl" dmtpe="ivoa:string"/>
</INSTANCE>
</GLOBALS>
<TEMPLATES tableref="xxx">
  <!--
    One single CAB-MSD instance in the VOTable (for purpose)
  -->
  <INSTANCE dmrole="root" dmtpe="cab-msd:Source">
    <VALUE dmrole="cab-msd:Source.identifier" dmtpe="ivoa:string" value="686103400034440"/>
    <!--
      Set of measurements (imported from STC2) attached to that instance
    -->
    <COMPOSITION dmrole="cab_msd:Source.parameters">
      <!--
        Position not specified in the VOTable: hard coded in default attributes
      -->
      <INSTANCE dmrole="root" dmtpe="meas:EquatorialPosition">
        <INSTANCE dmrole="meas:Measure.error" dmtpe="meas:Error" >
          <INSTANCE dmrole="meas:Error.ranError" dmtpe="meas:Symmetrical">
            <INSTANCE dmrole="meas:Symmetrical.radius" dmtpe="ivoa:RealQuantity">
              <VALUE dmrole="ivoa:Quantity.unit" dmtpe="ivoa:Unit" value="arcsec"/>
              <VALUE dmrole="ivoa:RealQuantity.value" dmtpe="ivoa:real" value="1"/>
            </INSTANCE>
          </INSTANCE>
        </INSTANCE>
        <INSTANCE dmrole="meas:EquatorialPosition.ra" dmtpe="coords:Longitude">
          <INSTANCE dmrole="coords:Coordinate.frame" ref="SpaceFrame_ICRS"/>
          <INSTANCE dmrole="coords:SpaceCoord.cval" dmtpe="ivoa:RealQuantity" >
            <VALUE dmrole="ivoa:Quantity.unit" dmtpe="ivoa:Unit" value="deg"/>
            <VALUE dmrole="ivoa:RealQuantity.value" dmtpe="ivoa:real" value="298.00252119999999"/>
          </INSTANCE>
        <INSTANCE dmrole="meas:EquatorialPosition.dec" dmtpe="coords:Latitude">
          <INSTANCE dmrole="coords:Coordinate.frame" ref="SpaceFrame_ICRS"/>
          <INSTANCE dmrole="coords:SpaceCoord.cval" dmtpe="ivoa:RealQuantity">
            <VALUE dmrole="ivoa:Quantity.unit" dmtpe="ivoa:Unit" value="deg"/>
            <VALUE dmrole="ivoa:RealQuantity.value" dmtpe="ivoa:real" value="29.871491800000001"/>
          </INSTANCE>
        </INSTANCE>
      </INSTANCE>
    </COMPOSITION>
  </INSTANCE>
</COMPOSITION>
```

VODML-“like” serialisation



```
<COMPOSITION dmrole="cab_msd:associatedData" size="2">
  <!--
  Web URL link for te data origin|
  -->
  <INSTANCE dmrole="cab_msd:associatedData" dtype="cab-msd:WebEndpoint">
    <VALUE dmrole="cab-msd:link.semantic" value="Documentation"/>
    <VALUE dmrole="cab-msd:WebUrl.mime" value="text/html"/>
    <VALUE dmrole="cab-msd:WebUrl.url" value="https://irsa.ipac.caltech.edu/docs/program_interface/ztf_lightcurve_api.html"/>
  </INSTANCE>
  <!--
  Associated data links of type VO instance (instances of the LightCurve model)
  The model of those instances is given with the instance mapping
  -->
  <INSTANCE dmrole="cab_msd:associatedData" dtype="cab-msd:VOModelInstance">
    <VALUE dmrole="cab-msd:link.semantic" value="LightCurve"/>
    <VALUE dmrole="cab-msd:msd:VOModelInstance.name" value="nd_point"/>
    <VALUE dmrole="cab-msd:msd:VOModelInstance.lvoid" value="ivoa://cab-msd/interop2019/nd_point"/>
    <INSTANCE dmrole="cab-msd:VOModelInstance.ModelInstance">
      <!--
      ARRAY: One instance of cab-msd:VOInstance per DATATABLE row
      -->
      <ARRAY dmrole="meas_set:TimeSeries">
        <!--
        set of measurements defined by the LightCurve model (time-stamp + mag)
        -->
        <INSTANCE dmrole="meas_set:point" dtype="meas_set:Point">
          <FILTER key="oid" value="686103400034440" />
          <!--
          Time Stamp : HJD not defined in STC, let's suppose that CAB-MSD supports it
          -->
          <INSTANCE dmrole="meas:Time" dtype="meas:Measure">
            <INSTANCE dmrole="meas:Time.coord" dtype="coords:TimeStamp">
              <INSTANCE dmrole="coords:TimeStamp.date" dtype="ivoa:RealQuantity">
                <VALUE dmrole="ivoa:Quantity.unit" dtype="ivoa:Unit" value="d"/>
                <!-- fields have no ID: let's take their names as identifiers -->
                <VALUE dmrole="ivoa:RealQuantity.value" dtype="ivoa:real" ref="mjd" />
              </INSTANCE>
              <INSTANCE dmrole="coords:Coordinate.frame" ref="TimeFrame_TT_BARY"/>
            </INSTANCE>
            <INSTANCE dmrole="meas:Measure.error" dtype="meas:Error" >
              <INSTANCE dmrole="meas:Error.ranError" dtype="meas:Symmetrical">
                <INSTANCE dmrole="meas:Symmetrical.radius" dtype="ivoa:RealQuantity">
                  <VALUE dmrole="ivoa:Quantity.unit" dtype="ivoa:Unit" value="sec"/>
                  <VALUE dmrole="ivoa:RealQuantity.value" dtype="ivoa:real" value="1"/>
                </INSTANCE>
              </INSTANCE>
            </INSTANCE>
          </INSTANCE>
          <!--
          Mag : the band is given by the filter
          -->
          <INSTANCE dmrole="cab-msd:Luminosity" dtype="cab-msd:Mag">
            <INSTANCE dmrole="cab-msd:Mag.coord">
              <VALUE dmrole="nd_point:mag.value" dtype="ivoa:real" ref="mag" />
              <INSTANCE dmrole="nd_point:Mag.frame" ref="Filter_G"/>
            </INSTANCE>
            <COMPOSITION dmrole="meas:Measure.Error" size="1">
              <VALUE dmrole="meas:Measure.Error.randerror" ref="magerr"/>
            </COMPOSITION>
          </INSTANCE>
        </ARRAY>
      </INSTANCE>
    </COMPOSITION>
  </INSTANCE>
</COMPOSITION>
</TEMPLATES>
</VODML>
```

□ VODML-“like” serialisation



- Pro :
 - Full model structure available :
 - distinction composition/instance
 - dm-types and dm-roles
 - Possibility of addressing rows in the table :
 - allow references to lines in existing tables
 - No change in native VOTABLE
- Cons :
 - Lot of levels (less human readable)
 - The inverse process doesn't reproduce easily the “native VODML-Lite” transcription of vo-dml-xml.

□ Conclusions



- Flat utypes and groups are easy to generate from the tableset
- VO-dml-like generation from the tableset maybe sometime difficult but is richer in modern content
- The fact that tableset can be derived from VO-DML-Like makes it compatible with TAP. → virtual Tableset proposal maybe part of the TAP schema