TAP and the Data Models

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Abstract. The purpose of the “TAP and the Data Models” Bird of Feathers session was to discuss the relevance of enabling TAP services to deal with IVOA standardized data models and to refine the functionalities required to implement such a capability.

1. Introduction

TAP (Dowler et al. 2019) is one of the big achievements of the VO. This protocol gives any relational database a high level of interoperability thanks to 3 IVOA standards: 1) the TAP_SCHEMA that describes tables and the way to join them, 2) ADQL (Osuna et al. 2008), a subset of SQL, with some astronomy-specific features and 3) UWS (Harrison & Rixon 2016), a REST API to handle service requests.

These features provide a common way to discover the content of TAP services and to query them. This works very well with relational data and we propose to investigate the possibility for TAP services to map searched data on data models. Indeed several data models have been developed by IVOA in order to tackle the complexity of the relationships between astronomical data features. Among those we can quote Photometry Data Model (Salgado et al. 2013), Coordinates (Rots et al. 2021), Measurements (Cresitel-DDittmar & Rots 2021) or MANGO (Michel et al. 2020) that is well suited to describe astronomical source properties and relations to some data sets representing these sources. TAP services are able to host complex data bound with joins but the standard still misses important features to serve real model instances: 1) Clients must be able to discover whether model views are available for a given resource 2) TAP services must be able to host extra meta-data necessary to build model instances on the fly 3) TAP services must support serialization formats suitable for complex data.

The purpose of the BoF¹ is to discuss the relevance of enabling TAP services to deal with Data Models and to sketch up the functionalities required to implement such

¹https://www.youtube.com/watch?v=HSWTgy7bfM
a capability. Possible strategies are described elsewhere in this conference proceedings (Bonnarel et al. 2021)

2. Browsing data built upon any relational schema

Some TAP services are already able to serve data that are built upon complex relational schemes. We can mention TAP Simbad (Oberto et al. 2015) built upon an internal relational schema or all services based on CAOM (Dowler 2019) which is a model published out of the VO standard process. Another popular case is the relational registry based on a relational schema published as a VO standard (Demleitner et al. 2014)

In the case of services based on relational schemata, table data are connected together by joins that are discoverable in the TAP_SCHEMA.

Although there is no standard way to link such schemes to a model vision as VODML (Lemson et al. 2018) can provide, the services mentioned above are relevant use-cases to prospect different methods to deal with modeled data in a TAP context.

This capability is being exercised in the frame of the TAP-Complex project 2 which aims at providing TAPHandle (Michel et al. 2014) with some advanced model ability. This Javascript proof of concept is based on a middle-ware API that explores the TAP_SCHEMA to map all joins related to the searched table. The rows of that table are displayed in a usual way, but when the user clicks on one of them, the names of the joined tables are listed below and joined data can be fetched by clicking on those table labels. The mapping of the table joins done at connection time makes the access to joined data very easy. Users can set constraints on any table and query strings are automatically generated with all relevant join statements. Query results are re-normalized internally.

3. Legacy data annotation

A step toward a better DM integration in TAP consists in enabling services to annotate legacy data either by data recombination and grouping or by providing complete model views. This requires the server to operate a post-processing inserting into VOTables annotations that bind data columns with model leaves.

This can be done by using GROUPs and UTyPes as shown by J.Silverman (Caltech). The Caltech/IPAC-IRSA TAP service caches information about interesting combinations of database-table columns at start-up. At run-time, the service adds a GROUP element to VOTable-format responses for any such group of columns all of which are contained in the expanded SELECT clause of the user query. Judith’s presentation showed how this functionality is supported. An open question is to know how users can discover that e.g. the exposed source table is linked with a detection table. Without a datamodel mapping, TAP provides no way to say "service is exposing sources with their different detections".

The IVOA is working on a more generic solution based on a mapping syntax (Michel et al. 2021) that allows to map data on any model compliant with the VODML meta-model. These annotations are built as leading XML blocks in VOTables. Such

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2https://github.com/lmichel/TAP-complex-data
blocks denote the model structure and contains references to the appropriate table FIELDS. Model-aware clients can build model instances just by reading the annotation block and by resolving the FIELD references to get the model leaf values. In a TAP context, the server must be able to automatically generate such annotations. For this, it must check that the selected columns match with the model definitions and thus can be mapped on that model. To operate the mapping, the server needs further information such as coordinate frames and data profile resources giving the binding between table columns and model leaves. A prototype (Louys et al. 2021) implementing this feature has been demonstrated.

4. Object Relational Mapping (ORM) Strategy

TAP services can also be used to host model instances. In this case, we must not map data on a model anymore but we have to do a real object relational mapping. However, proposing a common ORM schema is not on the VO roadmap. The work around strategy is to propose one specific standard per model. This has been done first for ObsTAP (Tody et al. 2011) which flattens the ObsCore model on one table. This is also the case for ProvTAP which proposes a relational view for Provenance (Servillat et al. 2020) data. A prototype (ProvHiPS) tracing the provenance of HST HiPS tiles has been demonstrated. As the model mapping is defined by a standard, there is no need to add extra information to the TAP service. Both TAP_SCHEMA content and meta-data defined in that standard provide all pieces of information needed to construct model instances from query results. There are however 2 major issues: 1) Provenance instances cannot be serialized in one single table; in order to solve this issue resulting VOTable documents must either contain multiple tables or provide a flattened view of the model itself (namely last step provenance) 2) The client must be able to tell the server it is searching Provenance instances.

5. Conclusions and Perspective

This session and the following discussions highlighted that TAP services can already serve hierarchical data and that serving legacy data with annotations or even Provenance instances is within our reach. On server side, we need to add model profiles and other extra meta-data to the TAP_SCHEMA to allow the addition of model annotations into the query responses. This post processing could also add other tables with associated data (e.g. sources with their detections). Such a feature wouldn’t break existing TAP clients. The ADQL queries would remain unchanged and legacy clients could simply skip annotations.

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3https://github.com/Lmichel/TAP-annoter
4https://wiki.ivoa.net/internal/IVOA/ObservationProvenanceDataModel ProvTAP.pdf
5https://wiki.ivoa.net/internal/IVOA/TapandTheDMs/Etherpad_notes.txt
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