Re: DAX Web Services

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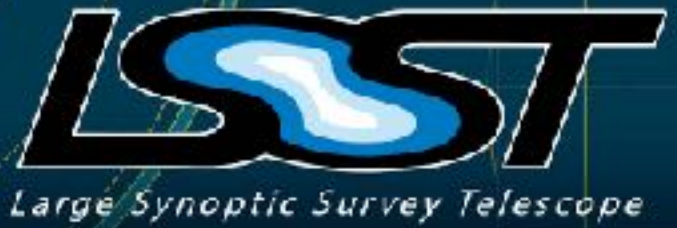
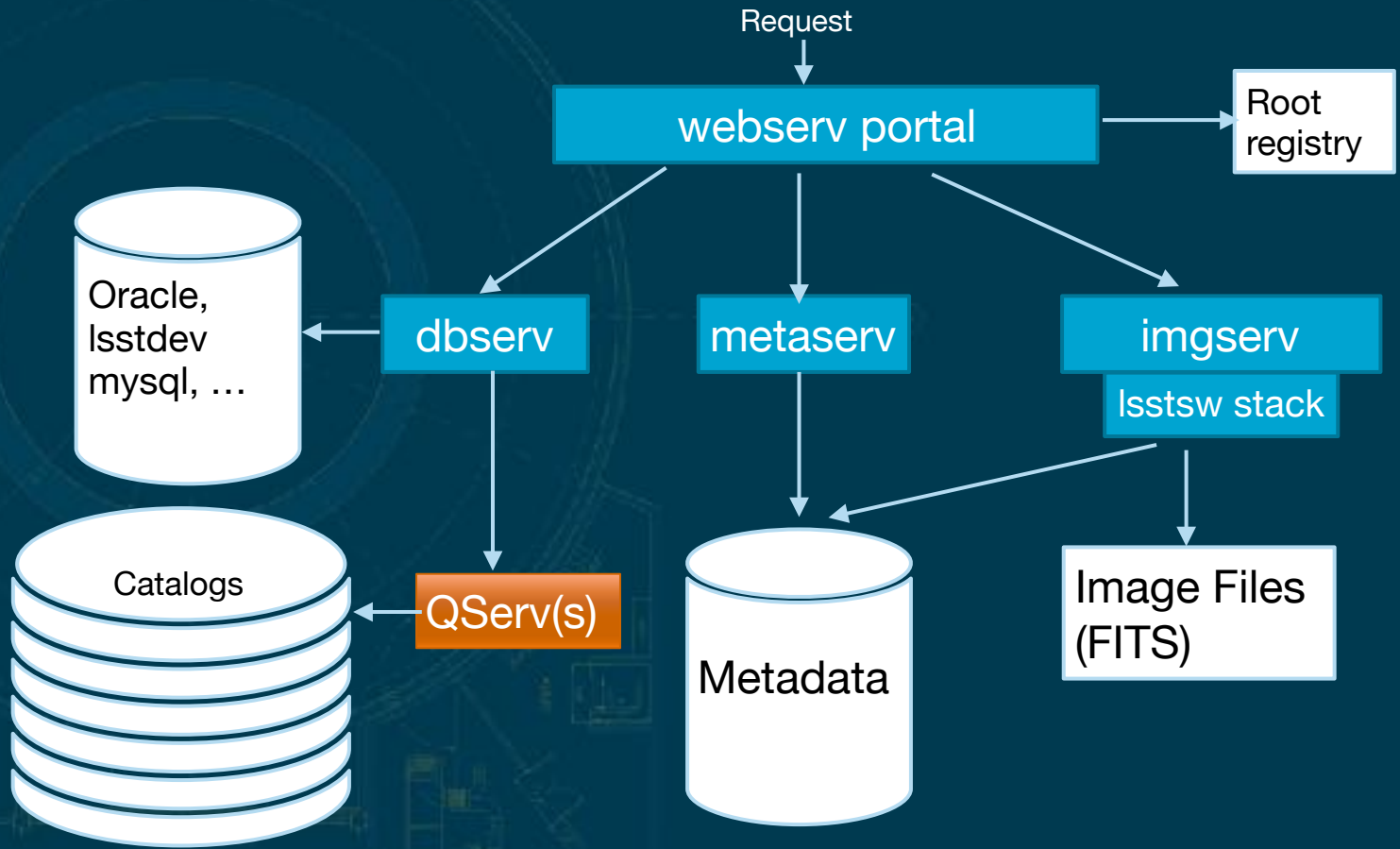


IVOA INTEROP - MAY 2018 - VICTORIA, B.C.

What is DAX Webserv

- DAX -> Data Access
- Collection of Data Access Interfaces for LSST, Implemented as 3 Core Sets of REST APIs
    - dax_webserv (webserv) -> Portal for DAX services, root registry
    - dax_dbserv (dbserv) -> Database Services(TAP)
    - dax_metaserv (metaserv) -> Tools for metadata ingestion and APIs (VO Schemas, RegTAP, ObsCore, simple Metadata API serving JSON)
    - dax_imgserv (imgserv) -> Image Services (SODA-like), image cutouts/ synthesis/generation

Layout of DAX Web Services



DAX Data Transfer Today

Software Development Platforms:

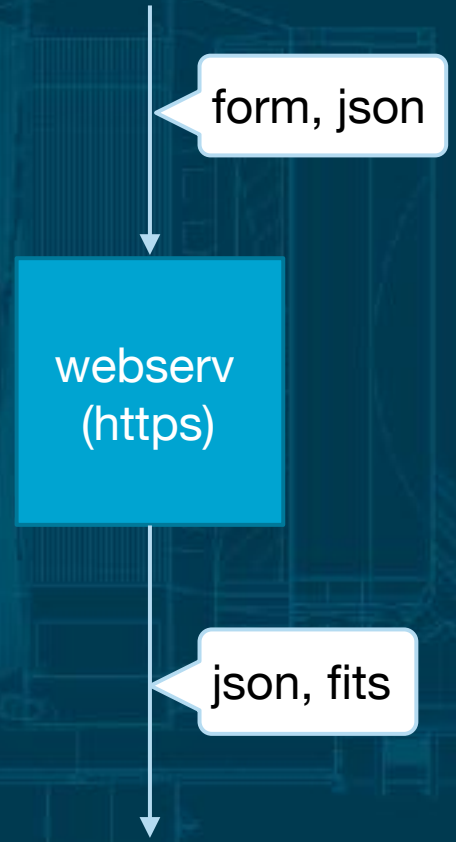
- LSST Software Stack (python, C++)
- SQLAlchemy (python)
- Presto/JDBC (kotlin/java)

RESTful Query Request:

- GET/POST
- JSON (imgserv)

Query Response:

- JSON (metaserv)
- FITS (imgserv)



DAX Roadmap for VO Interfaces

Status: coming out of v0 or pilot implementations

In v1, committed support for VO standards:

- metaserv: RegTAP, ObsTAP
- imgserv: SIA v2, DAL/SODA [ImageDM]
- dbserv: TAP/ADQL, SCS (backward-compatibility/public outreach, TBD)

Approach to Support VO Standards

Data Transport: xml/json/fits over https
Interchange format: VOTable, JSON-Schema
Query Language: Interactive, declarative [ADQL, SQL]
Big Data: async [batch/parallel processing], cluster computing [Docker containers orchestrated by Kubernetes]

JSON Input -> XML Output

```
{
  “$schema”: “http://json-schema.org/draft-04/schema#",
  “id”: “https://github.com/lsst/dax_imgserv/blob/master/python/lsst/dax/imgserv/config/imageREST_v1.schema",
  "ucd": "https://lsst.org/schemas/vo_ucd.schema",
  “namespace”: "lsst.dax.imgserv",
  "ucd": "obs.image",
  "description": "DAX_ImageServ API v1",
  "version": "1",
  “definitions”:
  {
    "orientation": {
    "type": "string",
    "ucd": "pos",
    "enum": [
      “Pixel_Coordinate", “Equatorial_J2000",     “Equatorial_B1950", "Ecliptic_J2000",
      “Ecliptic_B1950",    “Galactic", "Super_Galactic"
    ]
  },
  "ra": {
    "type": "number",
    "unit": “deg",
    "minimum": 0,
    "maximum": 360,
    "ucd": "pos.eq.ra"
  },
  "dec": {
    "type": "number",
    "unit": “deg",
    "minimum": -90,
    "maximum": 90,
    "ucd": "pos.eq.dec"
},
  …
}
```

DAX Schema

```
<?xml version="1.0" encoding="UTF-8"?>
<xs:schema
   xmlns:xs="http://www.w3.org/2001/XMLSchema"
elementFormDefault="qualified"
   xmlns="http://www.ivoa.net/xml/VOTable/v1.3"
   targetNamespace="http://www.ivoa.net/xml/VOTable/v1.3"
>
<xs:annotation><xs:documentation>
    VOTable is meant to serialize tabular documents in the
    context of Virtual Observatory applications. This schema
    corresponds to the VOTable document available from
    http://www.ivoa.net/Documents/latest/VOT.html
</xs:documentation></xs:annotation>

<!-- Here we define some interesting new datatypes:
    - anyTEXT   may have embedded XHTML (conforming HTML)
    - astroYear is an epoch in Besselian or Julian year, e.g. J2000
    - arrayDEF  specifies an array size e.g. 12x23x*
    - dataType  defines the acceptable datatypes
    - ucdType   defines the acceptable UCDs (UCD1+)
    - precType  defines the acceptable precisions
    - yesno     defines just the 2 alternatives
-->

<xs:complexType name="anyTEXT" mixed="true">
  <xs:sequence>
    <xs:any minOccurs="0" maxOccurs="unbounded" processContents="skip"/>
  </xs:sequence>
</xs:complexType>

  …
</xs:schema>
```

VO Schema

DAX Intermediate(Internal) Representation


```
{
  "$comment": [
  "Version: 1.0",
  "Source: https://lsst.org/schemas/imgserv_api_v1.schema",
  "HashOp: hashlib.sha256(str(sorted(api_id)).encode('utf-8')).hexdigest()"
  ],
  "2ca69ed8aa69c9f01469617000a6a30d5df02d3843677330c6b457eef0e5b0d9": {
    "api": "Image.full_nearest",
    "api_id": ["db", "ds", "filter", "center.x", "center.y", "center.unit"]
  },
  "1697b5040cb4fb249ab5152412cc95a3b7f5a9d74dd5ed5666cacb1e420fb539":
    "api": "Image.full_from_data_id",
    "api_id": ["db", "ds", "run", "camcol", "field", "filter"]
  },
 "fd2dd2f42cbf6670533e20932165e4dbe7d9718c9ebcca8a48dc7afff21234d4": {
    "api": "Image.full_from_data_id",
    "api_id": ["db", "ds", "tract", "patch_x", "patch_y", “filter"]
  },
 "124ad4bde6e752bbc6e9d688b2c775adaaa59df6e1e53230b6302f165ccd7629": {
   "api": "Image.full_from_data_id",
   "api_id": ["db", "ds", "tract", "patch", "filter"]
  },
  …
```


DAX Interfaces (json)

VO Interfaces (xml)

DAX Service Validation and Verification

Four-Tier Testing Approach:

1. Unit testing, at module level
2. Requests validated through JSON Schema
3. Suite of Integration tests with results (.fits) checked via SHA checksums
4. External service for VO validation, as in:
   - http://wiki.ivoa.net/twiki/bin/view/IVOA/IvoaValidatorsSummary

DAX is Open Source

LSST on GitHub: https://github.com/lsst

DAX GitHub Projects:

- lsst/dax_webserv [python]
- lsst/dax_dbserv [dbserv_v0, python] -> deprecated
- lsst/albuquery [dbserv_v1, kotlin/java]
- lsst/dax_metaserv [v1, python]
- lsst/dax_imgserv [v1, python]

Thank You!

Acknowledgement to Key DAX Contributors:
- **Brian Van Klaveren (LSST-DM)**
- **John Gates (LSST-DM)**
- **Jacek Becla (LSST-DM Emeritus)**

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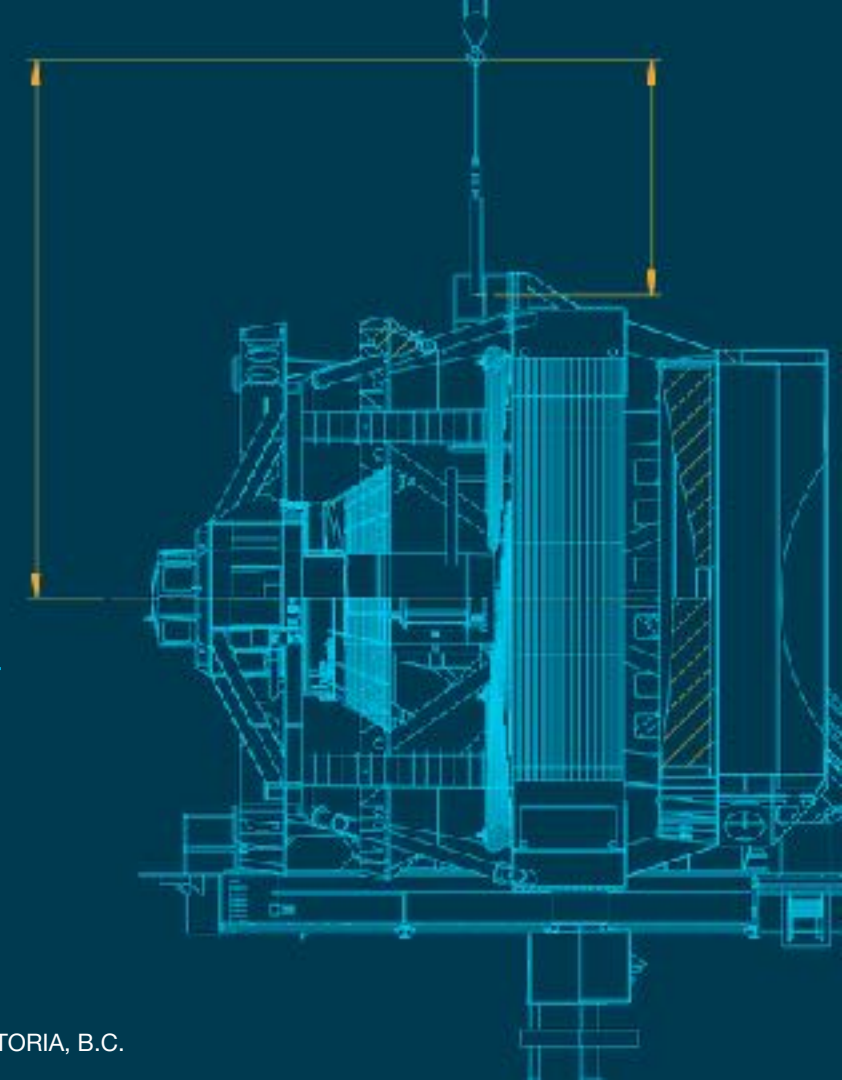

Large Synoptic Survey Telescope