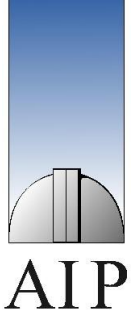
Integraion und Steuerung von verteilten Sensorsystemen



Grid-Package for a Robotic Telescope Network (RTN)

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Overview

- Introduction / motivation
- Grid architecture
- The *OpenTel* package
- User interfaces
- Summary

Why grid technology for a telescopes network?

A grid provides technology to use and manage a RTN

- direct access to telescope, storage and compute resources
- virtual organization (VO) management
  - manage the access of collaborations to telescopes
- resource management
  - integration and monitoring of telescopes, storage, computers
- job management
  - scheduling or canceling of observations, data analysis
- data management
  - immediate access to the data
- metadata management
  - information about what is going on in the network

Grid architecture: Grid Middleware

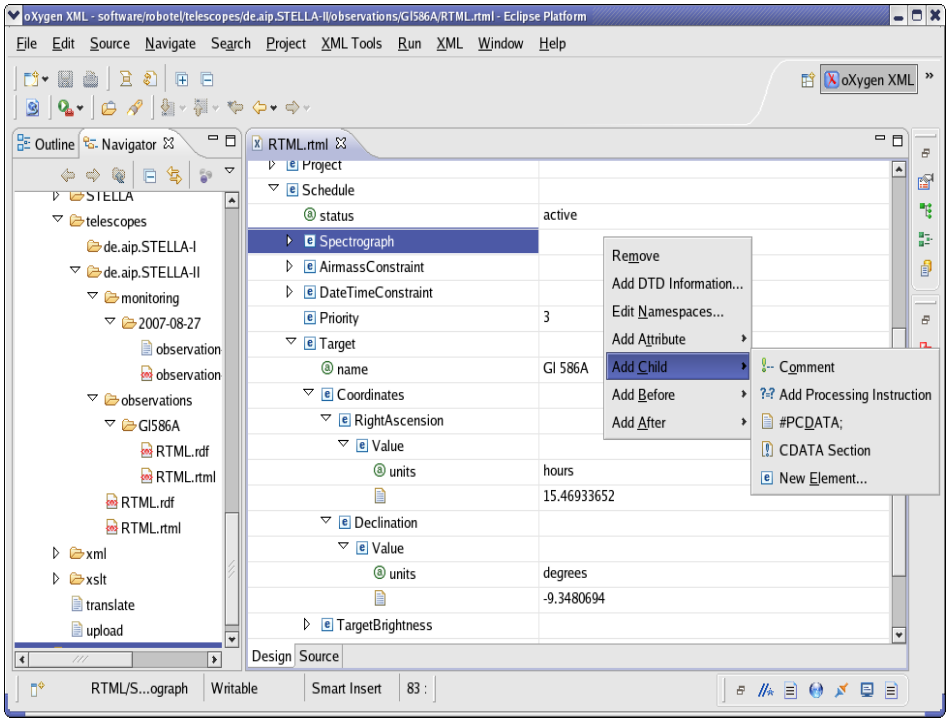
Globus toolkit

- Job management:
  - WS GRAM (Grid Resource and Allocation Manager) with web service interface through endpoint reference (EPR)
  - An elementary set of grid commands for the job management, interactive access to resources and file transfer (globusrun-ws -submit / -status / -cancel, gsissh, gsiftp)
  - Resource monitoring
- Virtual Organization (VO) management
  + VOMRS (component from AIP)

Grid architecture: Protocol

Remote Telescope Markup Language (RTML)

- XML dialect defined by the Heterogeneous Telescope Network
  http://monet.uni-sw.gwdg.de/XMLSchema/RTML/schemas/RTML-nightly.xsd
- describes essential metadata, e.g.
  - telescope setup and status
  - observation schedules
  - observation history
  - source catalogs
  - weather information
- Usage with XML editor

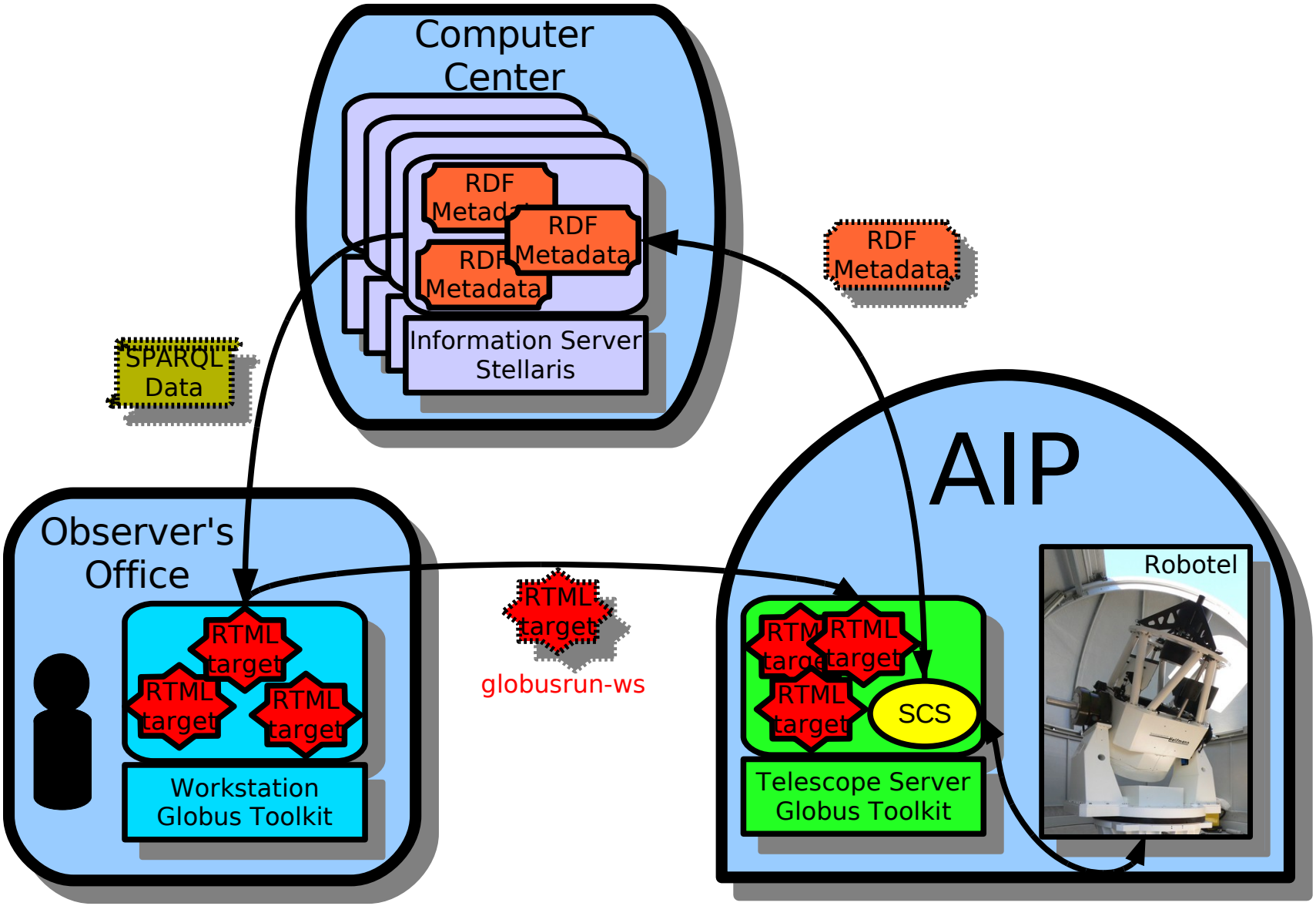


Grid architecture: Information Service

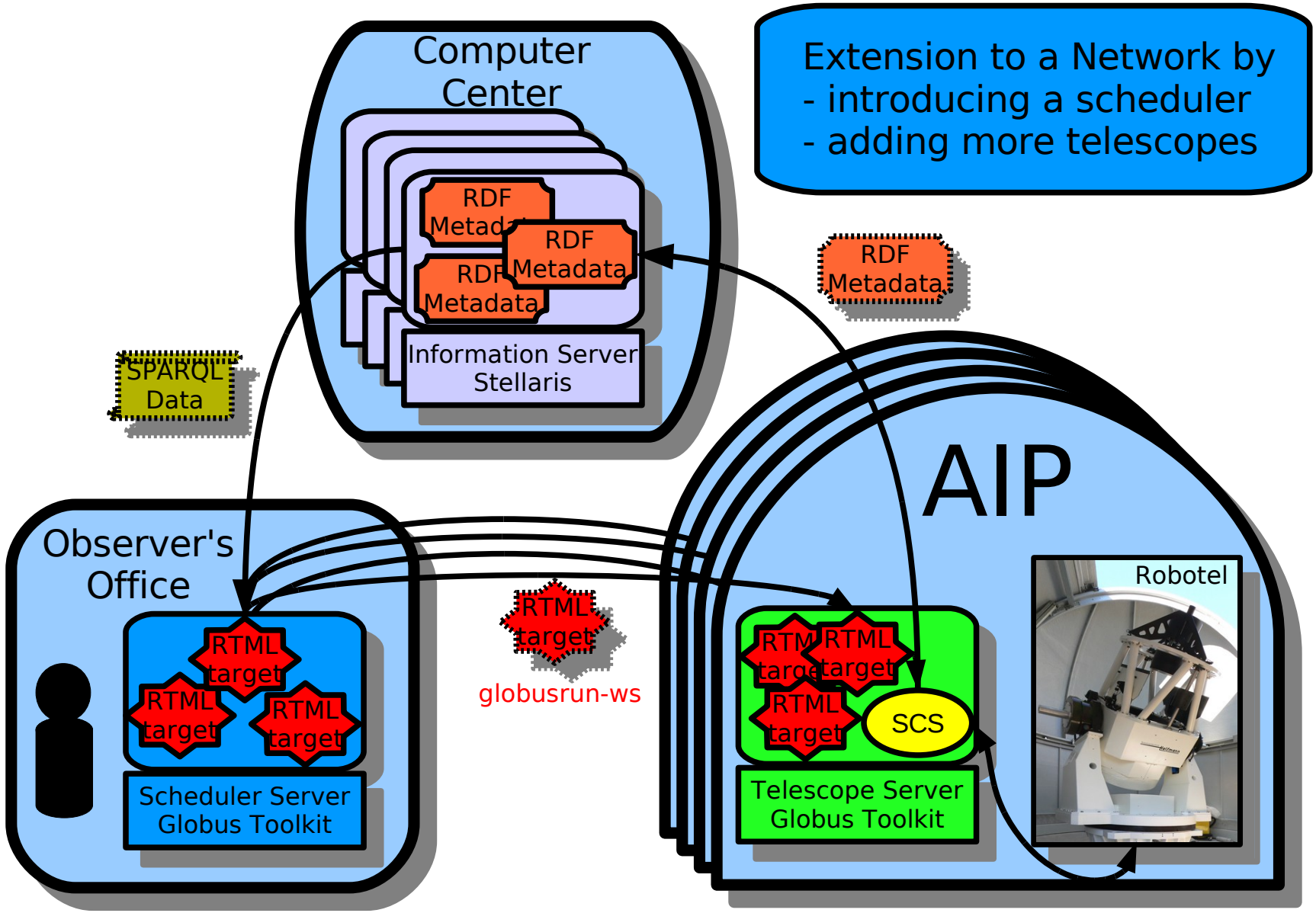
Stellaris

- development of AstroGrid-D by the ZIB (M. Högqvist)
- available at http://www.gac-grid.org/ (Apache License)
- is used by AstroGrid-D for
  - grid resource monitoring (e.g. compute resources, telescopes)
  - job monitoring
- tested and runs stable
- metadata is exchanged and stored in RDF

Grid Architecture: Workflow



Grid Architecture: Workflow



The Grid Package

OpenTel

Developed by AstroGrid-D at the AIP (F. Breitling)
http://www.gac-grid.org/project-products/Software/RoboticTelescopes/OTPackage.html

- Broker
- Network Scheduler
- OT-Utilities for the operation
- Templates
  - RTML for telescopes and observations
  - SPARQL for information access
- Documentation
- Subcomponents

OpenTel: Resource Broker

- Find appropriate telescopes
- Based on Cwm (read coom) a general-purpose data processor for the semantic web (like sed/awk for text)
- Uses RDF files (n3) as input

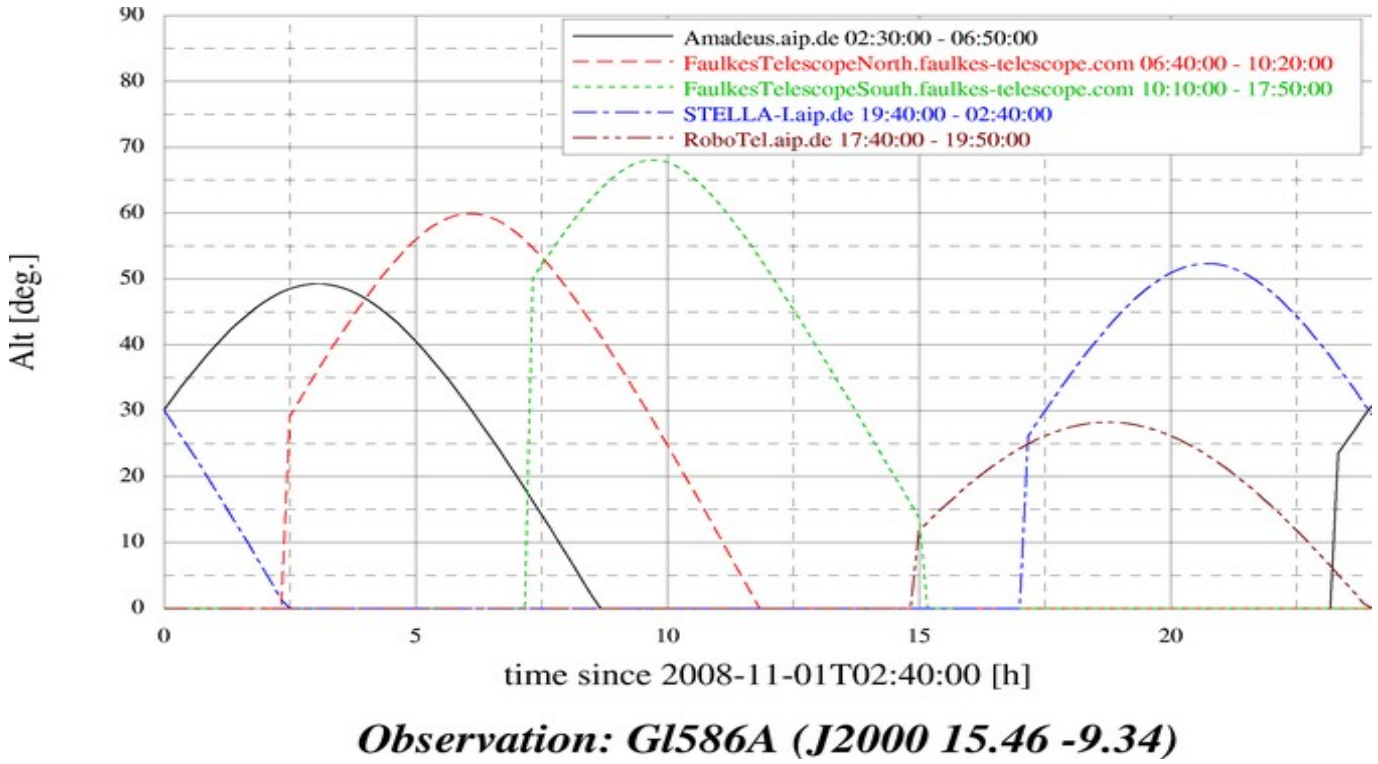
```
@prefix : <http://is.astrogrid-d.org/2008/02/14/opentel#>.
@prefix OTR: <http://is.astrogrid-d.org/2008/02/14/opentelrequest#>.
:req1 a OTR:REQ;
  OTR:MinLatitude 0;
  OTR:MaxLatitude 60;
  OTR:MinLongitude -120;
  OTR:MaxLongitude 12;
  OTR:MinAltitude 1200;
  OTR:MaxAltitude 3500.
```

- Example

```
photon:~/ot-examples$ ot-broker /opt/OpenTel/broker/examples/req.n3

Amadeus.aip.de
MONET.Uni-Goettingen.de
STELLA-I.aip.de
STELLA-II.aip.de
Wolfgang.aip.de
```

OpenTel: Network Scheduler



Observation: Gl586A (J2000 15.46 -9.34)

```
photon:~$ TARGET=Gl586A
photon:~$ START=2008-11-01T02:40:00
photon:~$ ot-scheduler -s $START TELLIST.txt $TARGET.rtml
Created `Gl586A.sch'
Amadeus.aip.de                                  2008-11-01T02:30:00   2008-11-01T06:50:00
FaulkesTelescopeNorth.faulkes-telescope.com     2008-11-01T06:40:00   2008-11-01T10:20:00
FaulkesTelescopeSouth.faulkes-telescope.com     2008-11-01T10:10:00   2008-11-01T17:50:00
RoboTel.aip.de                                  2008-11-01T17:40:00   2008-11-01T19:50:00
STELLA-I.aip.de                                 2008-11-01T19:40:00   2008-11-02T02:40:00
```

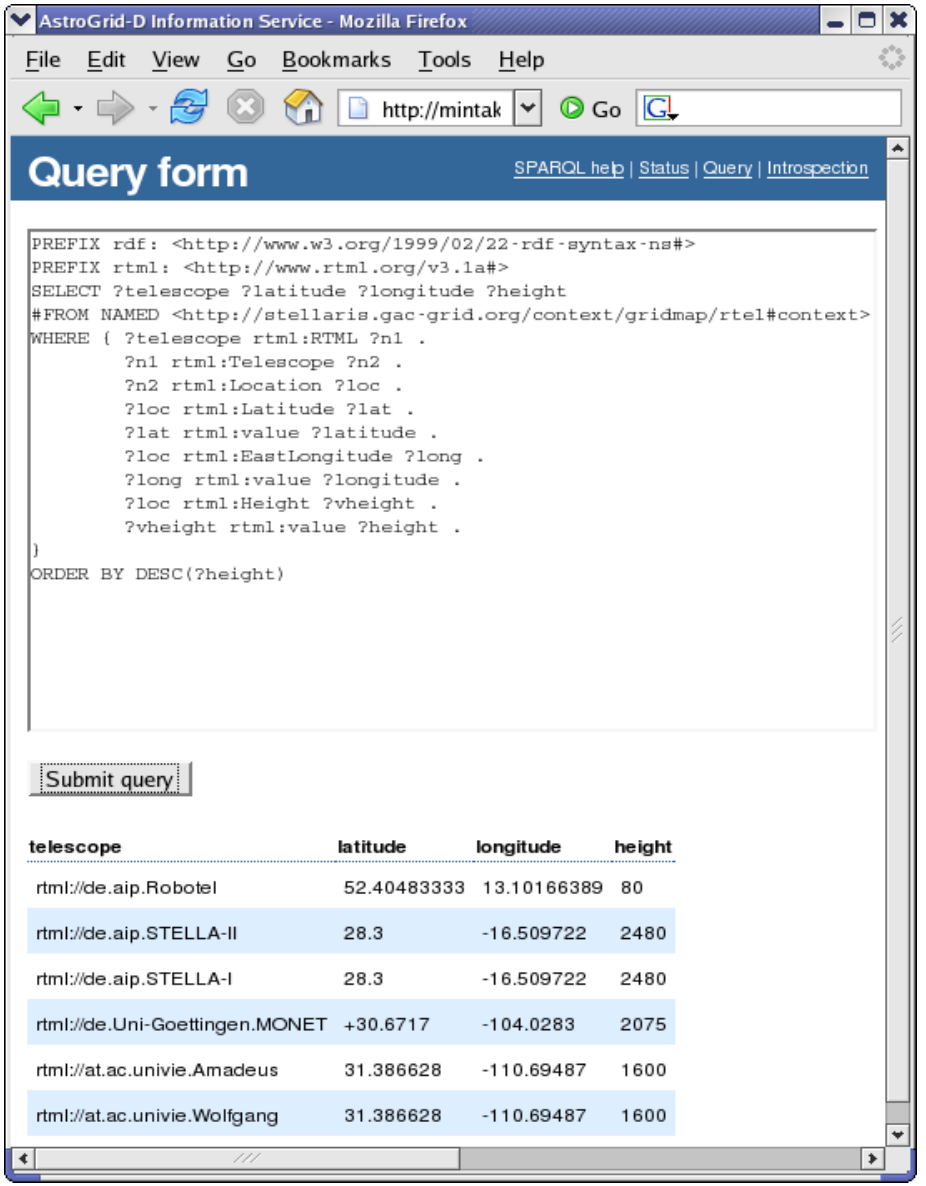
OpenTel: Metadata converter

XML2RDF.xsl

- a universal XML to RDF transformation via XSLT (Extensible Stylesheet Language Transformation)
- RDF is a new data model for embedding information in a schematic document structure to make it more machine readable
- Stellaris & broker need data in Resource Description Format (RDF)
- can transform arbitrary XML files into RDF/XML format (e.g. RTML)
- Simple usage via command line
  - Xsltproc, cURL for uploading to Stellaris
- *http://www.gac-grid.org/project-products/Software/XML2RDF.html*
- *Breitling, F., 2009, Astronomical Notes, Volume 330 Issue 7, 755 http://arxiv.org/abs/0906.2291*

User Interface: Stellaris query form

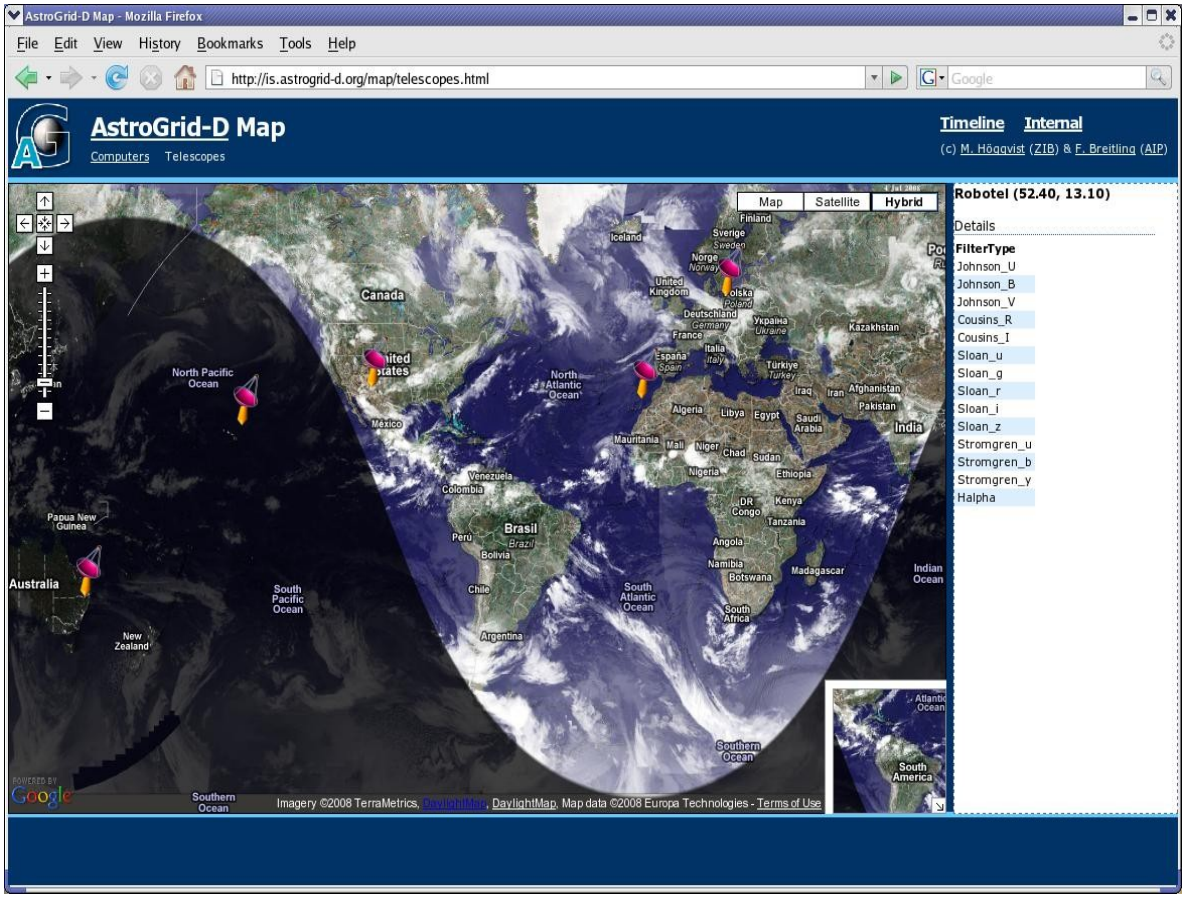
- web interface to Stellaris, e.g. to
  - telescope location and altitude
  - Weather conditions
  - Observation schedule
  - Data
  - Compute resources
- uses SPARQL Query Language for RDF
- simple syntax for selected and sorted retrieval of information
- Example on left:
  list of telescope sorted by altitude



User Interface: Telescope Map

Graphical (web browser) interface

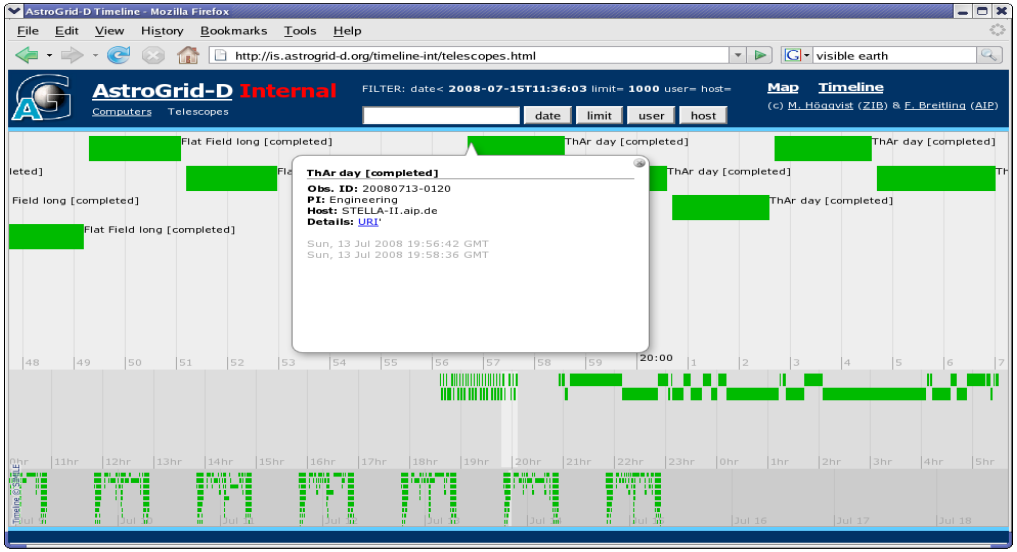
- to display telescope info
- Based on Google Maps and SPARQL
- Developed at ZIB (M. Höggqvist) & AIP (F. Breitling)
- http://www.gac-grid.org/

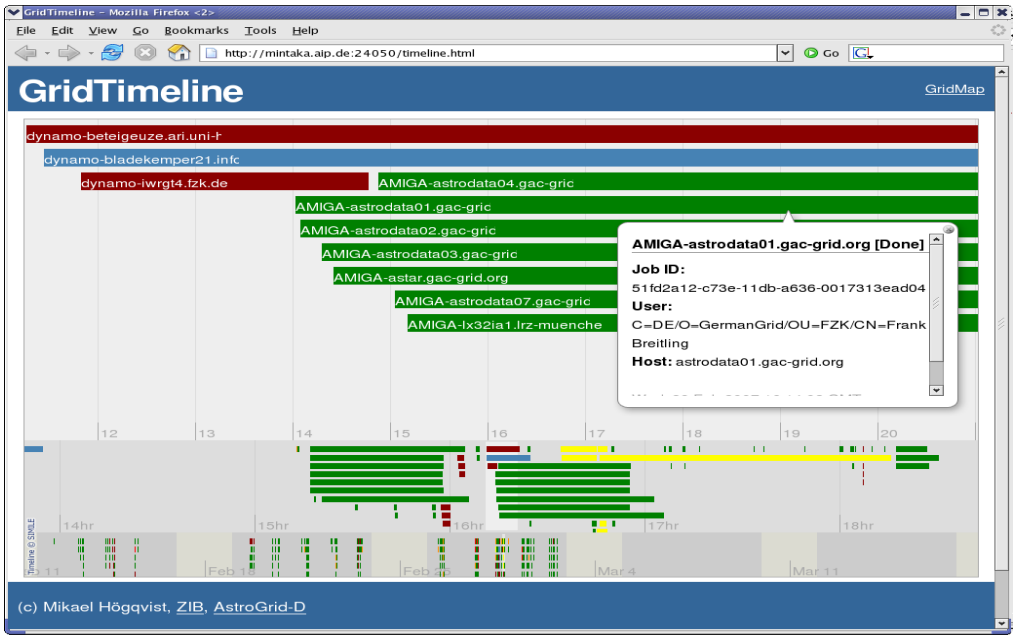


User Interface: Telescope Timeline

Web browser user interface

- Developed in AstroGrid-D by ZIB (M. Höggvist) & AIP (F. Breitling)
- currently used to display job-state metadata
- Based on „Simile“ Timeline
  - like Google Maps for time-based information
  - a DHTML-based AJAXy widget for visualizing time-based events.
  - http://simile.mit.edu/timeline/
- http://www.gac-grid.org/





Summary

- The Grid architecture for operating a RTN has been developed
- Five RTs of the AIP are available for network operation
- The information service Stellaris is working
- Metadata protocols (RTML, RDF, etc.) are implemented
- User interfaces for monitoring are available
- OT-Package for operating the network has been developed
- A network scheduler is available

Thanks for your attention!

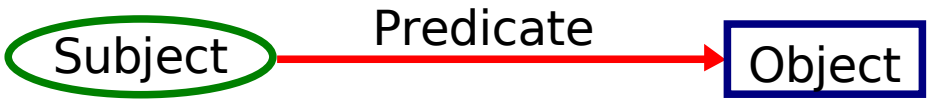
OpenTel - http://www.gac-grid.org/project-products/Software/RoboticTelescopes.html

Frank Breitling - http://www.aip.de/People/fbreitling/

Grid Architecture: RDF

RDF (Resource Description Framework)

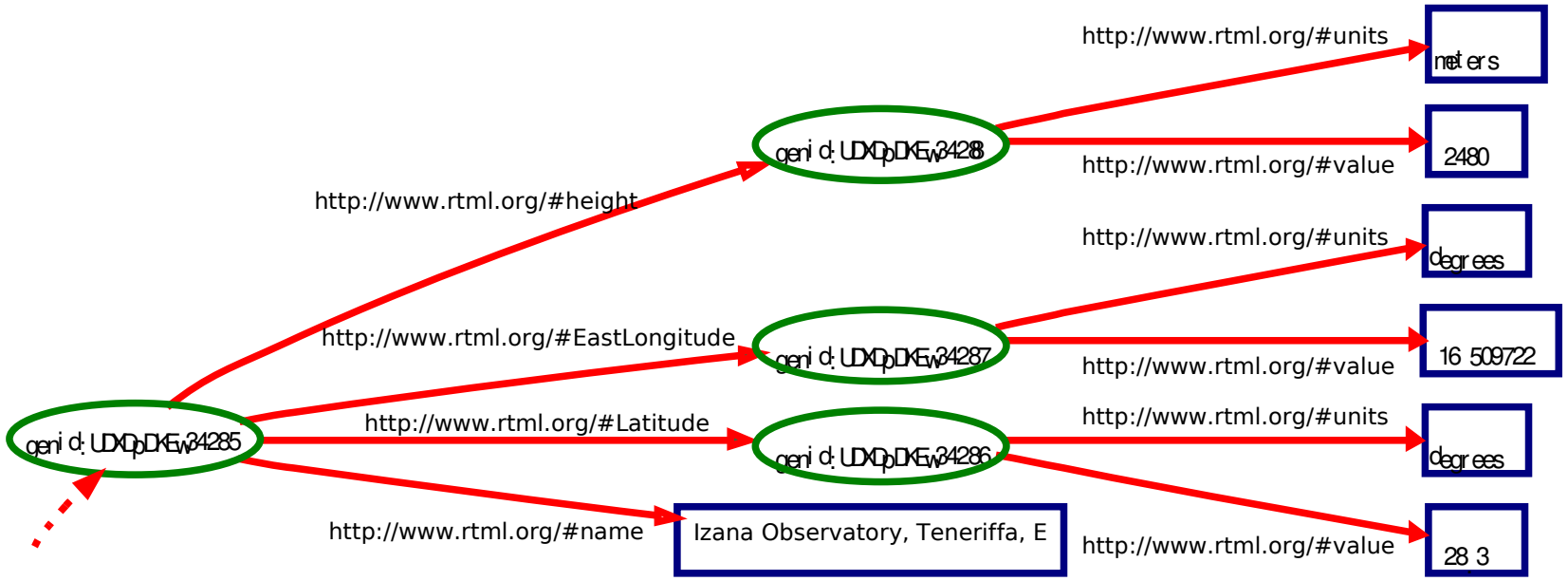
- standard for storing information
- is based on graph theory
- it presents information in triples
- as



- different formats exist
  - RDF/XML (W3C recommendation)
  - Notation 3 (N3) (W3C specification)
- is a development of the semantic web
- the SPARQL query language exists for retrieval of RDF information

Grid Architecture: RDF graph

- example of a partial RDF graph
- represents the location information of Stella-I (static metadata)



Obtained with W3C RDF Validation Service (http://www.w3.org/RDF/Validator/)