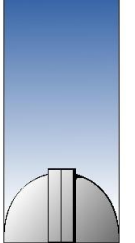




Integraion und Steuerung von verteilten Sensorsystemen



AIP

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

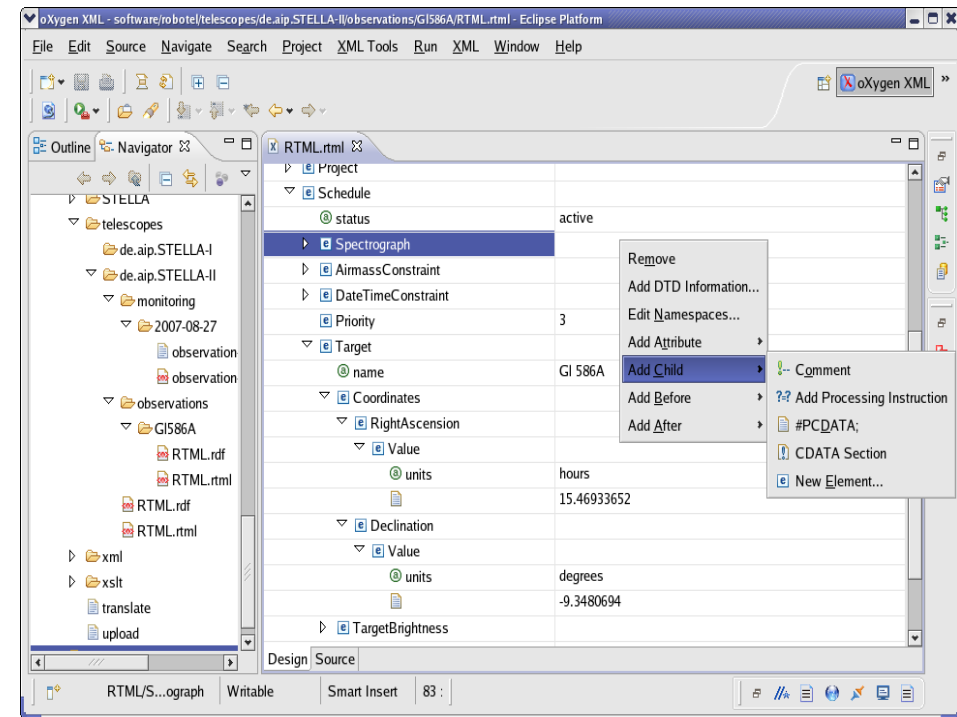


- Job management:
 - WS GRAM (Grid Resource and Allocation Manager) with web service interface through endpoint reference (EPR)
 - An elementary set of grid commands for the job management, interactive access to resources and file transfer (globusrun-ws -submit / -status / -cancel, gsissh, gsiftp)
 -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



Remote Telescope Markup Language (RTML)

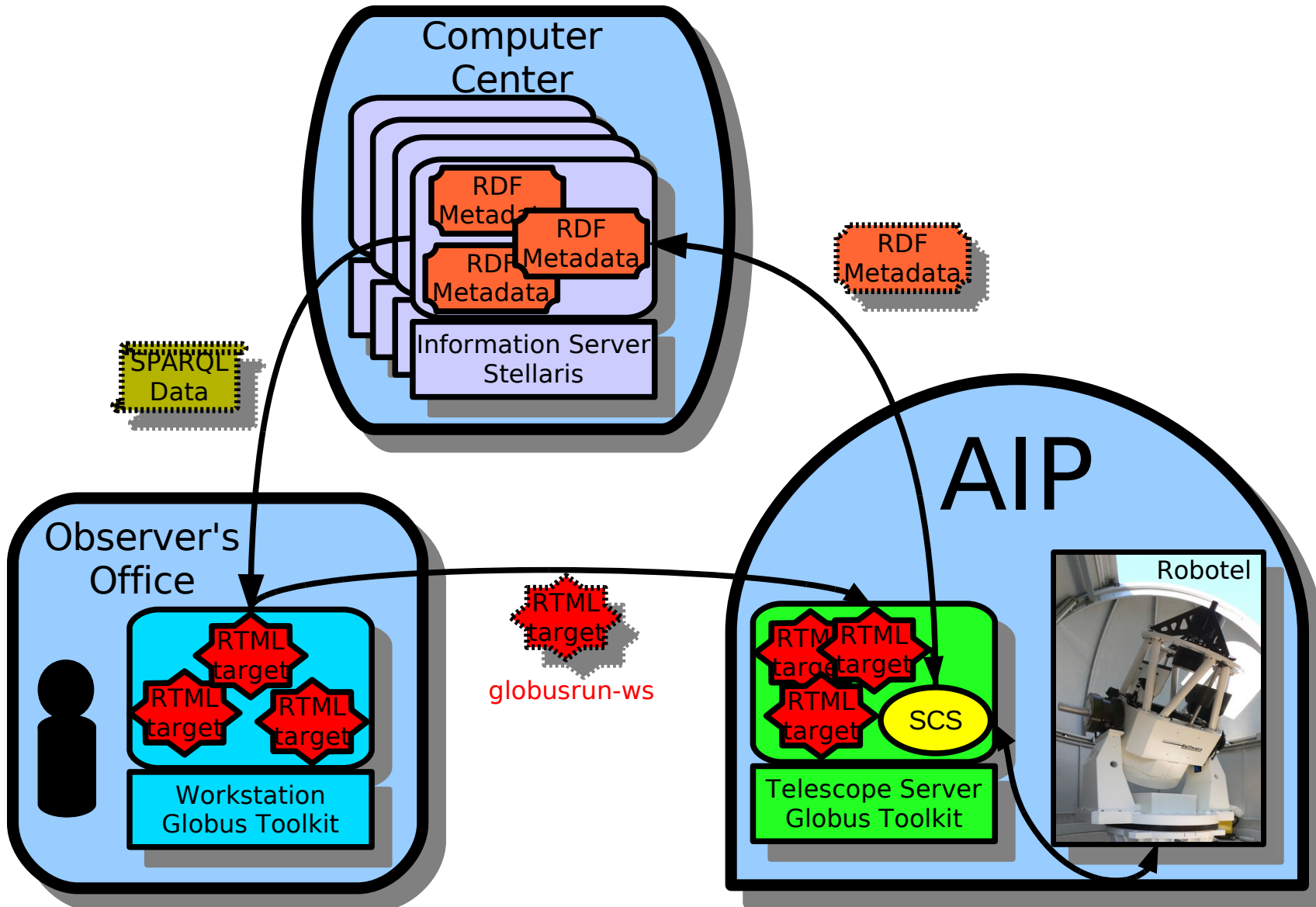
- XML dialect defined by the Heterogeneous Telescope Network
<http://monet.uni-sw.gwdg.de/XMLSchema/RTML/schemas/RTML-nightly.xsd>
- describes essential metadata, e.g.
 - telescope setup and status
 - observation schedules
 - observation history
 - source catalogs
 - weather information
- Usage with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



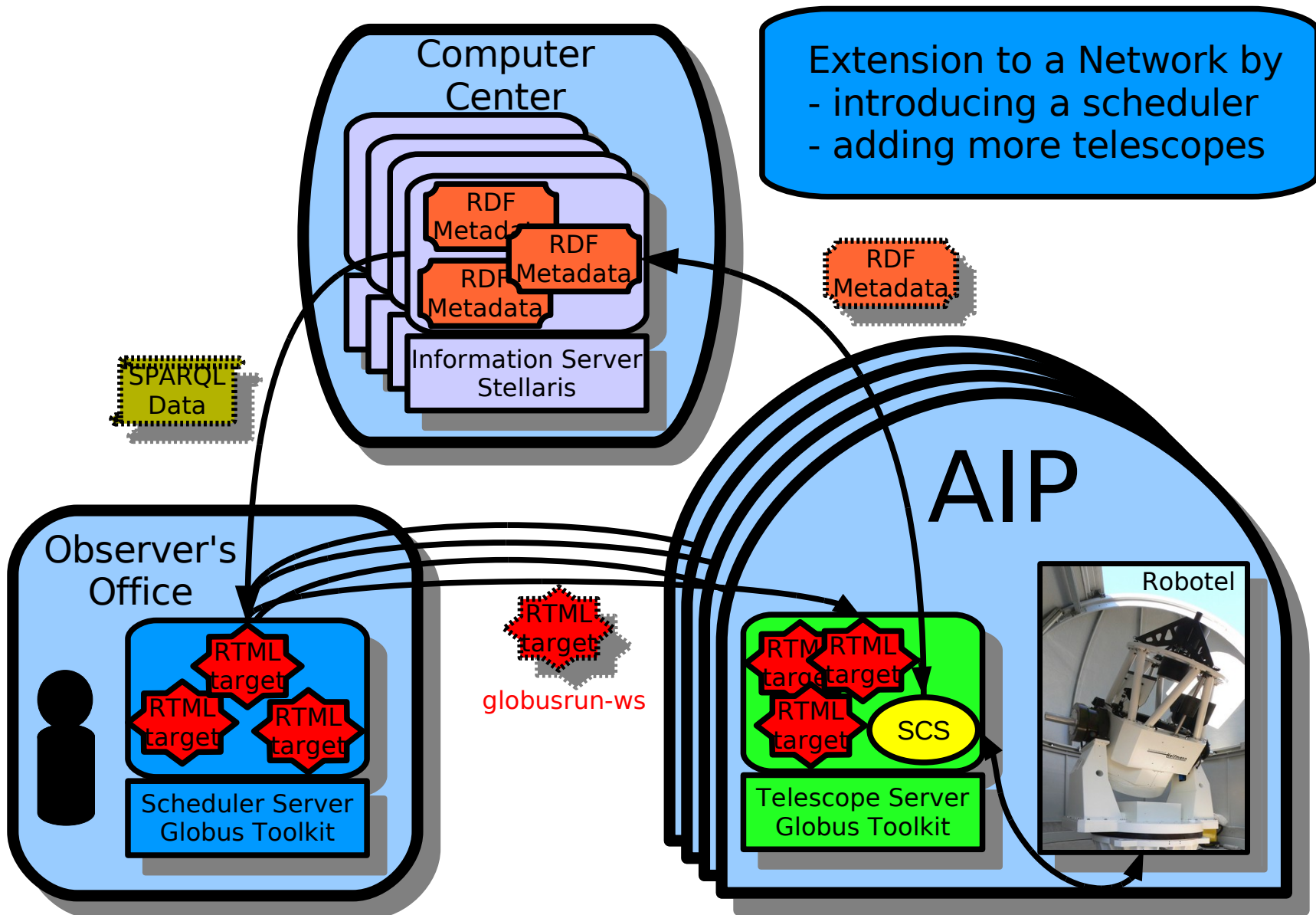


Stellaris

- development of AstroGrid-D by the ZIB (M. Höggqvist)
- 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





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.
```

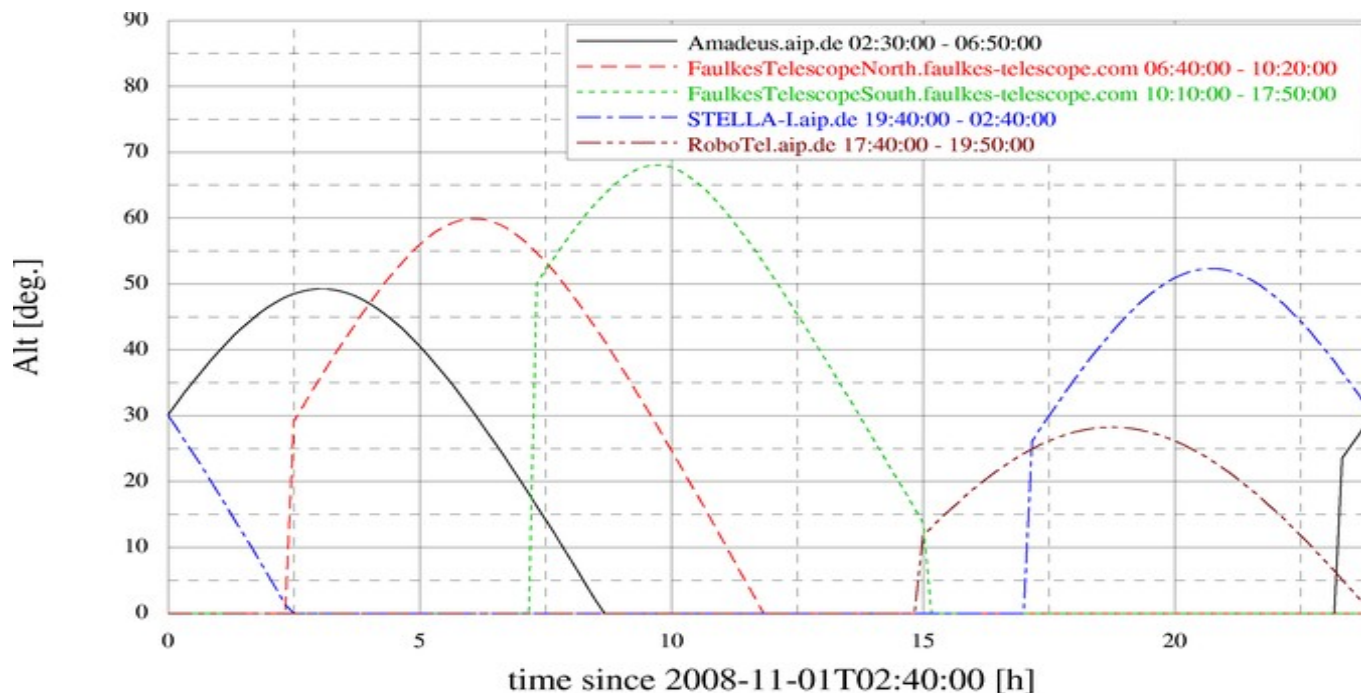
- Example

```
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: G1586A (J2000 15.46 -9.34)

```

photon:~$ TARGET=G1586A
photon:~$ START=2008-11-01T02:40:00
photon:~$ ot-scheduler -s $START TELLIST.txt $TARGET.rtml
Created `G1586A.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

```
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
PREFIX rtml: <http://www.rtml.org/v3.1a#>
SELECT ?telescope ?latitude ?longitude ?height
#FROM NAMED <http://stellaris.gac-grid.org/context/gridmap/rtel#context>
WHERE ( ?telescope rtml:RTML ?n1 .
        ?n1 rtml:Telescope ?n2 .
        ?n2 rtml:Location ?loc .
        ?loc rtml:Latitude ?lat .
        ?lat rtml:value ?latitude .
        ?loc rtml:EastLongitude ?long .
        ?long rtml:value ?longitude .
        ?loc rtml:Height ?vheight .
        ?vheight rtml:value ?height .
      )
ORDER BY DESC(?height)
```

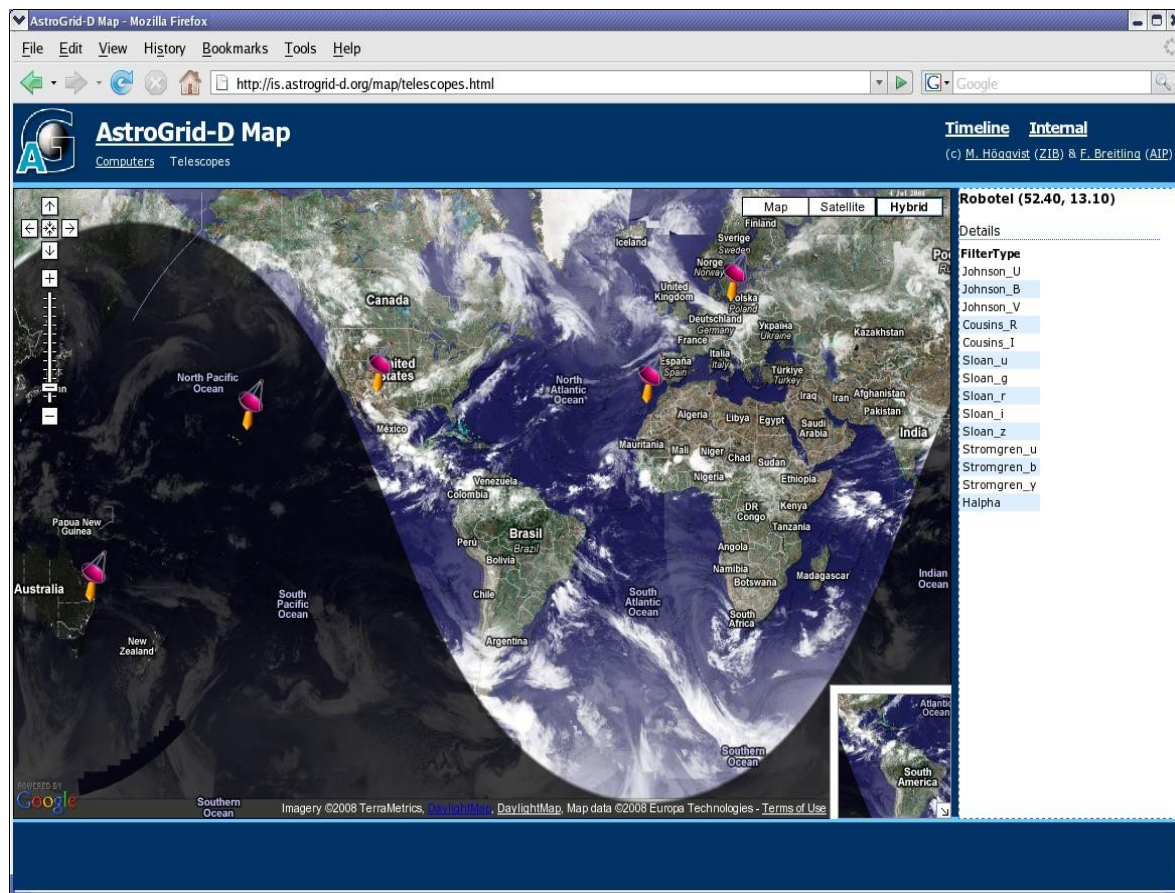
telescope	latitude	longitude	height
rtml://de.aip.Robotel	52.40483333	13.10166389	80
rtml://de.aip.STELLA-II	28.3	-16.509722	2480
rtml://de.aip.STELLA-I	28.3	-16.509722	2480
rtml://de.Uni-Goettingen.MONET	+30.6717	-104.0283	2075
rtml://at.ac.univie.Amadeus	31.386628	-110.69487	1600
rtml://at.ac.univie.Wolfgang	31.386628	-110.69487	1600



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/>

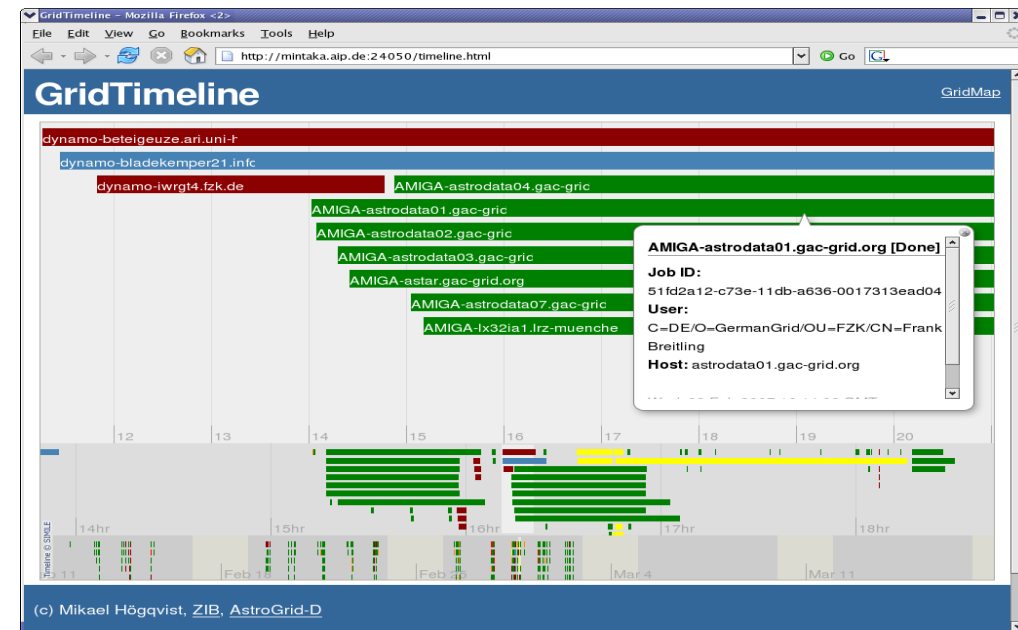
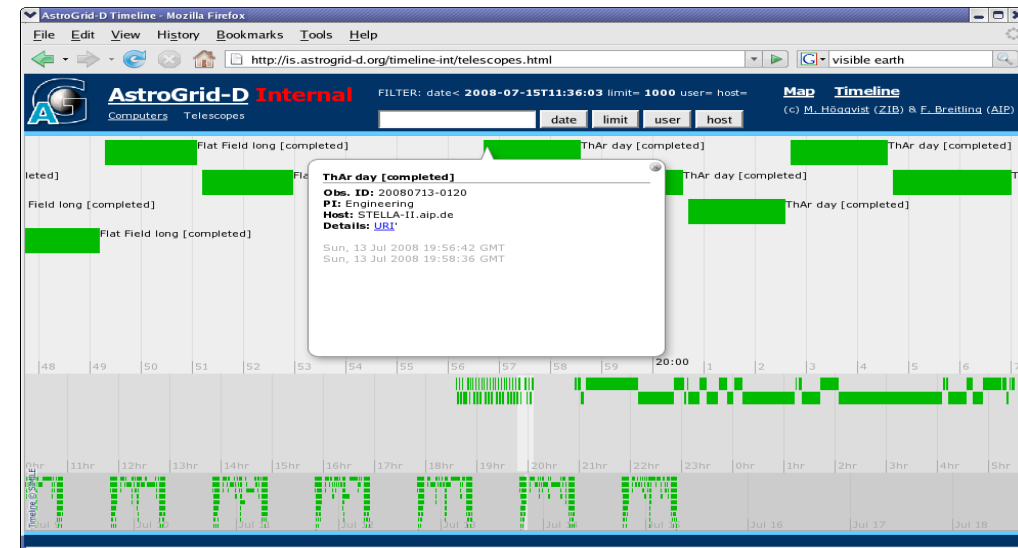




User Interface: Telescope Timeline

Web browser user interface

- Developed in AstroGrid-D by ZIB (M. Höggqvist) & 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/>

RDF (Resource Description Framework)

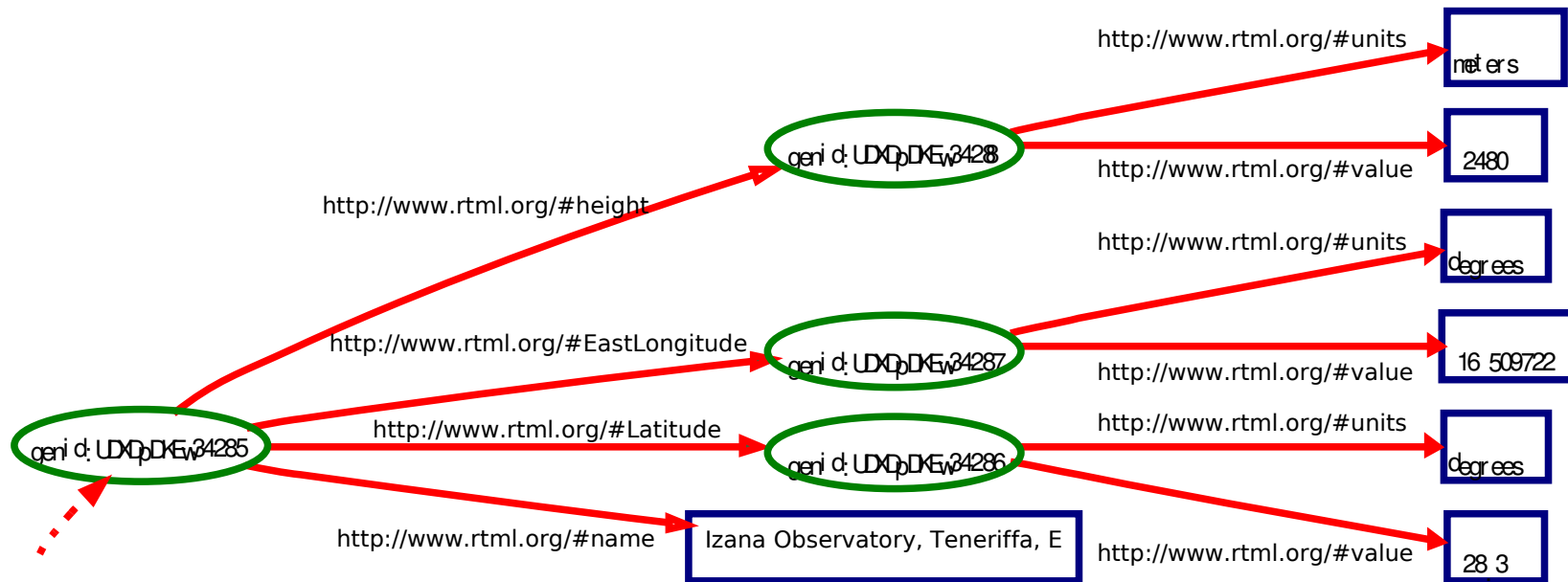
- standard for storing information
- is based on graph theory
- it presents information in triples

• 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

- 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/>)