

Building the International Virtual Observatory Alliance (IVOA) Programmatic Challenges

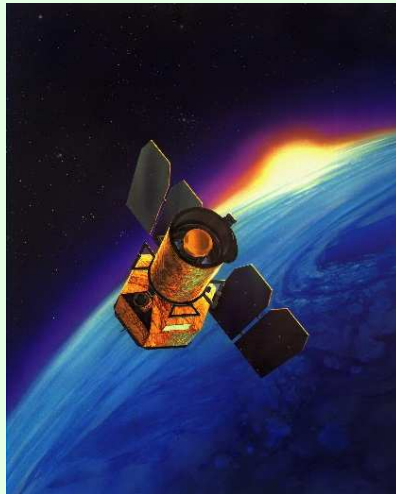
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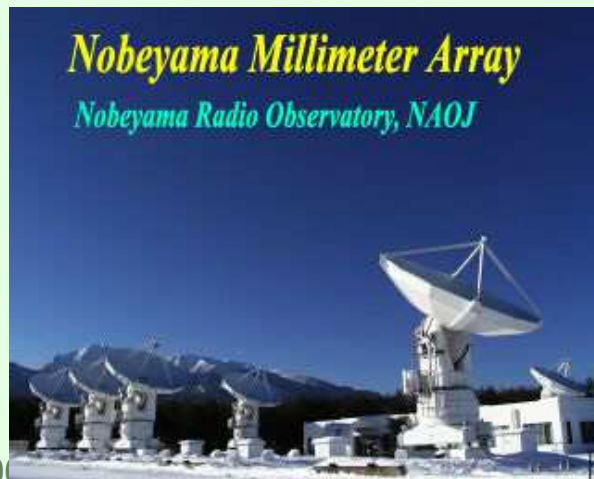
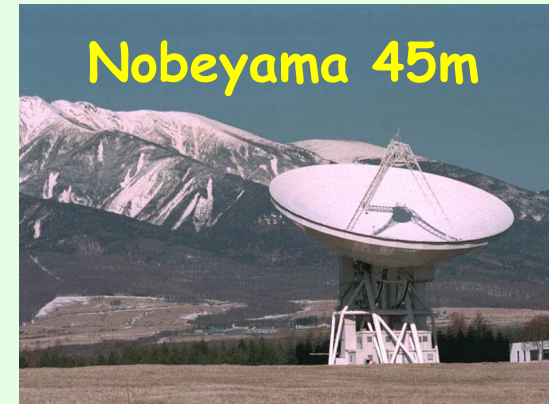
Data Resources in the World

- ESO VLT @ Paranal
- ESO telescopes @ La Silla
- Telescopes in Mauna Kea
Subaru, Keck, JCMT, CSO, SMA,,,
- Telescopes on board satellites
HST, GALEX,,,



Data Resources in NAOJ

- **Subaru** 8.2m Optical-Infrared Telescope
- **Kiso** 105cm Schmidt Camera
- **Okayama** 188cm Optical Telescope
- **Nobeyama 45m** Radio Telescope
- **Nobeyama Millimeter Array**
- **Nobeyama Radioheliograph**
- **VSOP**
- **VERA**
- **ALMA**

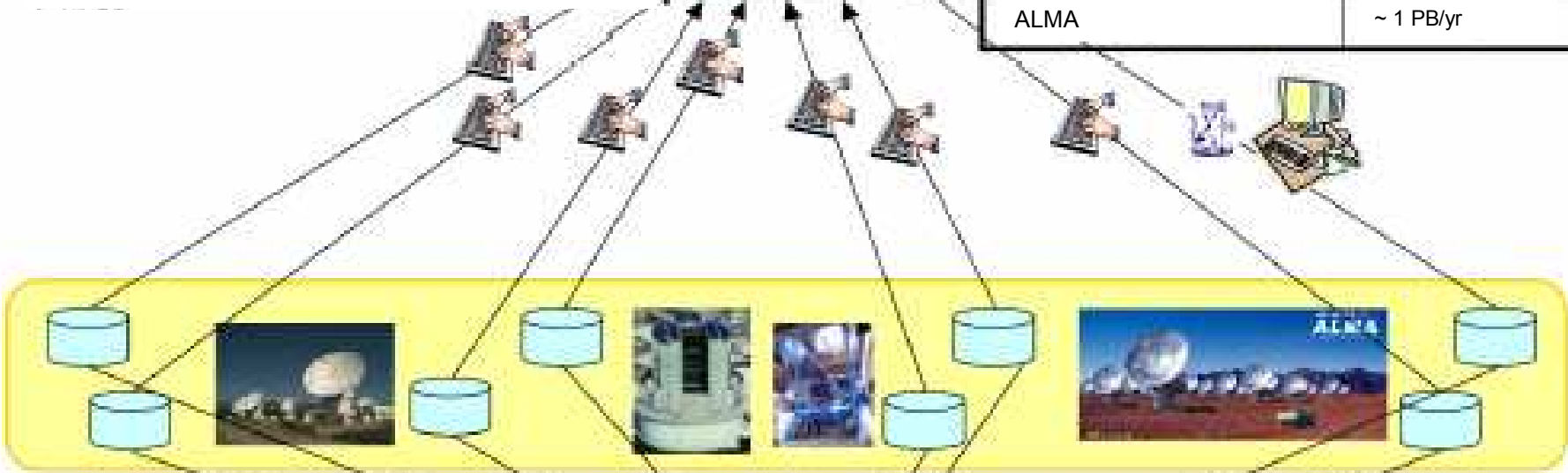


July 18, 2000

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**Too hard to collect and analyze whole data.
Need Cat's help**

	Data Rate
Nobeyam Radio Obs.	~ 1 TB/yr
SUBARU telescope	~ 20 TB/yr
ALMA	~ 1 PB/yr



Accelerate astronomical research, and sufficient time for research itself !!

Even for educational use

Virtual Observatory



Accessible from anywhere at any time

VO- New Research Infrastructure in the 21st Century



A collection of integrated astronomical data archives and software tools that utilize computer networks to create an environment in which research can be conducted.

<http://www.encyclopedia.com/html/v1/virtobserv.asp>

International Endorsements



- IAU XXVth GA Res. (2003 Jul.)
- OECD Rec. ('04 Aug)
 - place archives that may be accessible via internet
 - provide adequate funding as long-term issues

VO Projects in the world



- 16 countries and a region
- International Virtual Observatory Alliance (IVOA)
Standards to interoperate VOs

<http://www.ivoa.net/>



July 18, 2006

COI



Virtual Observatory Architecture

Discover Compute Publish Collaborate

Portals, User Interfaces, Tools

- VOPlot
- DIS
- SkyQuery
- Aladin
- Mirage
- Topcat
- conVOT
- OASIS

interfaces to data

Registry Services Data Services Compute Services

HTTP Services SOAP Services Grid Services

stateless, registered & self-describing & persistent, authenticated

Semantics (UCD)

OAI

ADS

Digital Library
Other registries
XML, DC, METS

SIAP, SSAP

OpenSkyQuery

VOTable

FITS, GIF, ...

visualization

crossmatch

image

data mining

source detection

Virtual Data

Workflow (pipelines)

Authentication & Authorization

BULK ACCESS

Existing Data Centers

My Space storage services

Grid Middleware
SRB, Globus, OGSA
SOAP, GridFTP

Databases, Persistency, Replication

Disks, Tapes, CPUs, Fiber



Standardization in IVOA



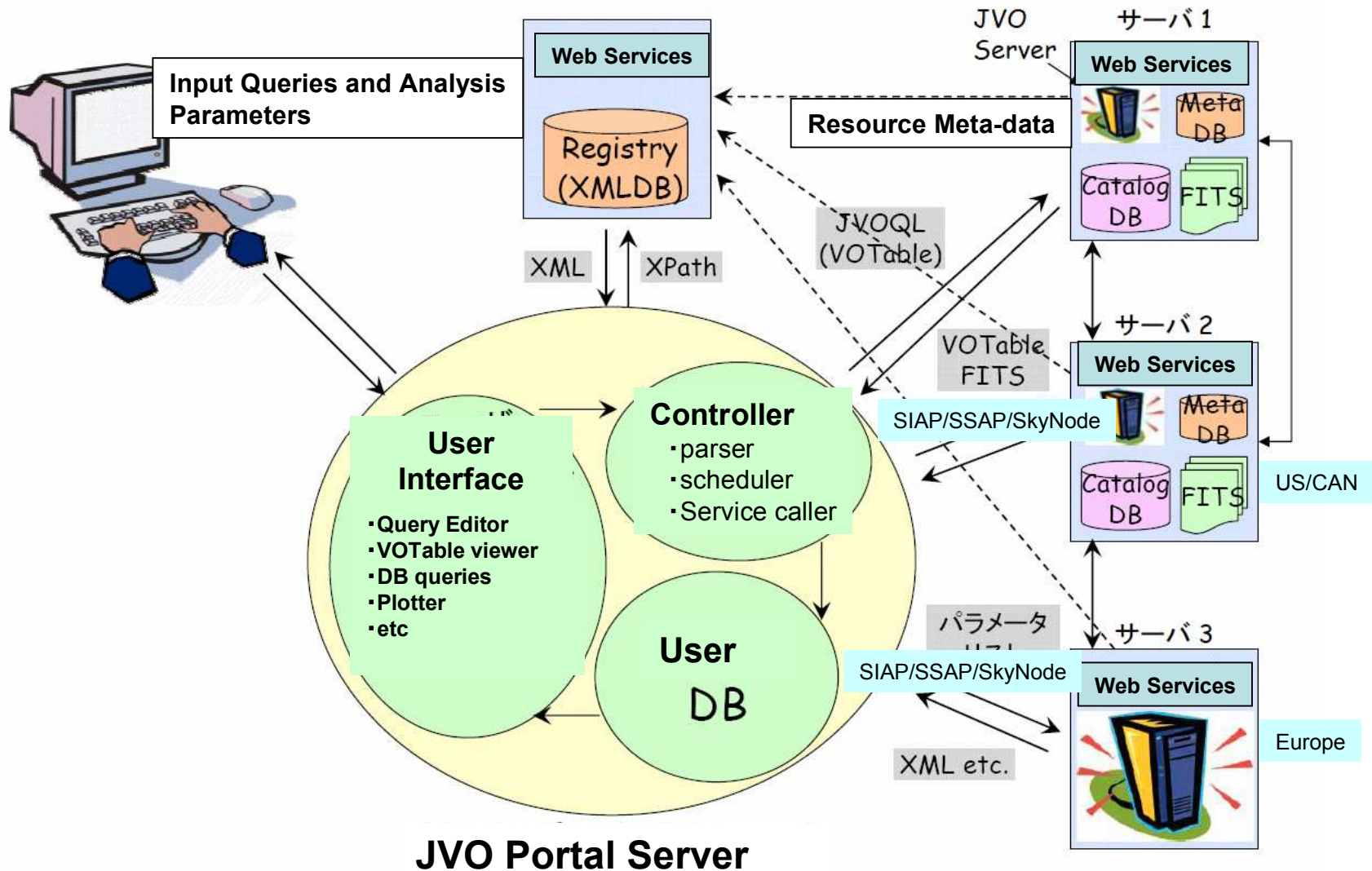
- Query Language to Federated DBs (VOQL)
- Access resource meta-data based on the OAI-PMH
- Access Images, Spectra, Catalogues, etc:
SkyNode, SIAP, SSAP, STC, etc.
- Unified Attribute Names:
UCD (Unified Contents Descriptions)
- **Output format**: VOTable (XML)
- and so on

IVOA Interoperability WS

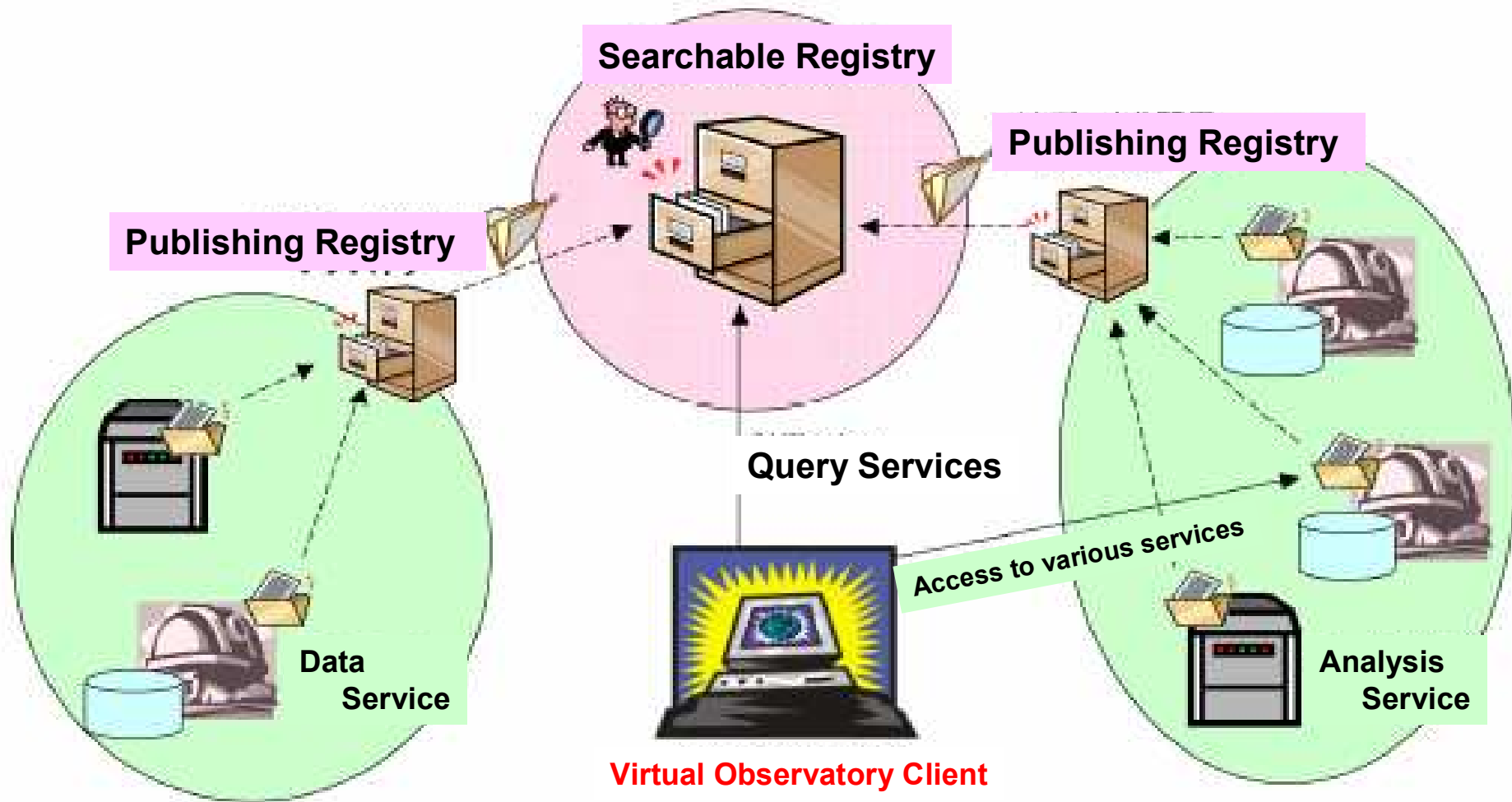


- Twice a year
- Discussions toward standardization
- **Human network as a basis for cyber network**

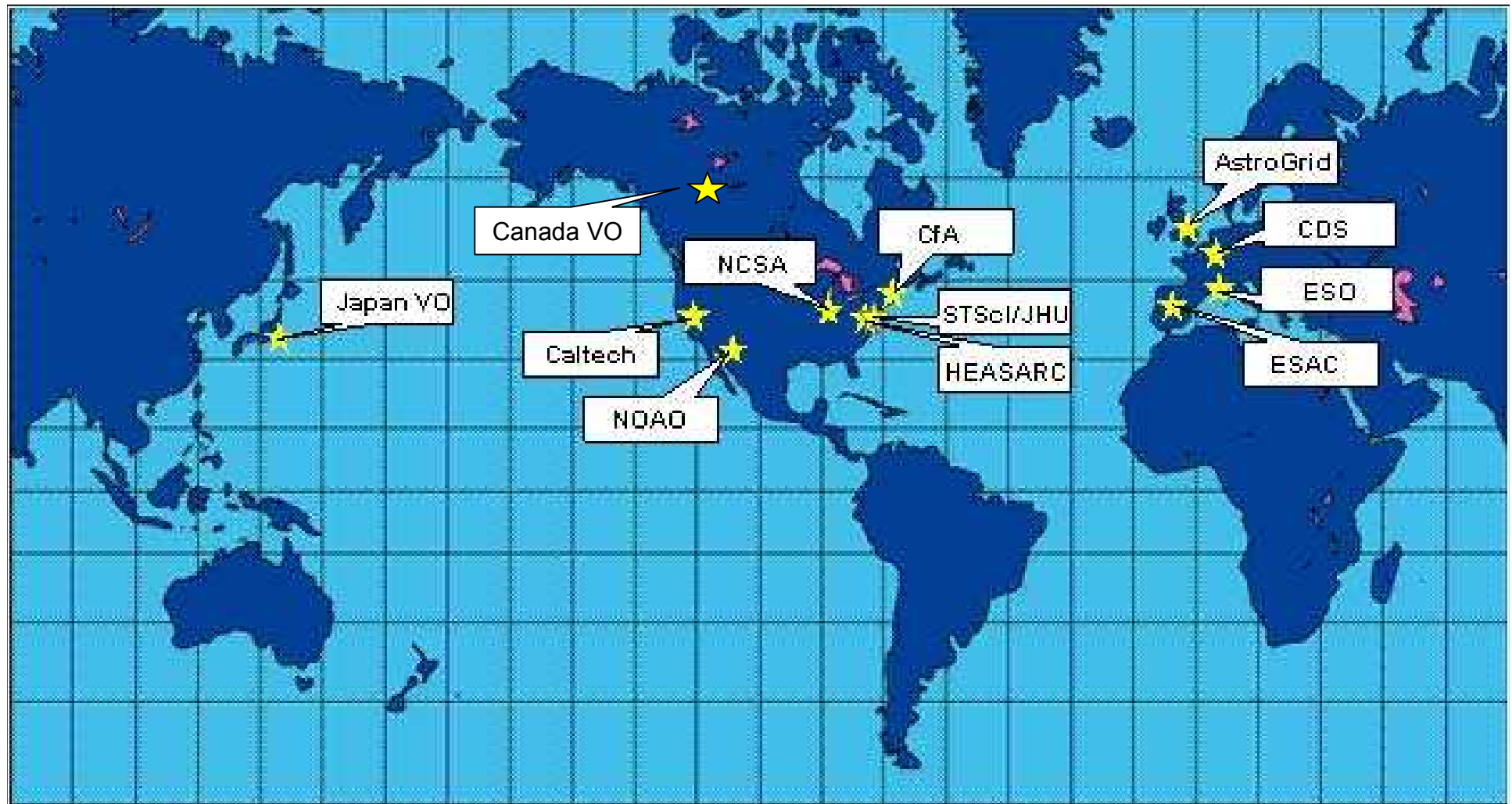
Schematic diagram of VOs



Exchange of Meta Data: OAI-PMH



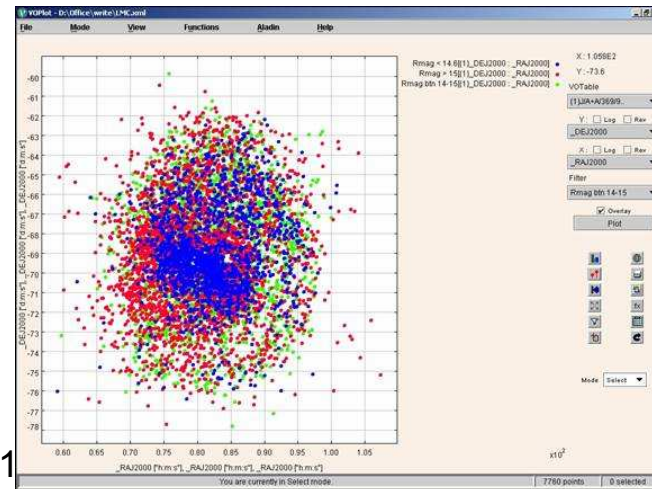
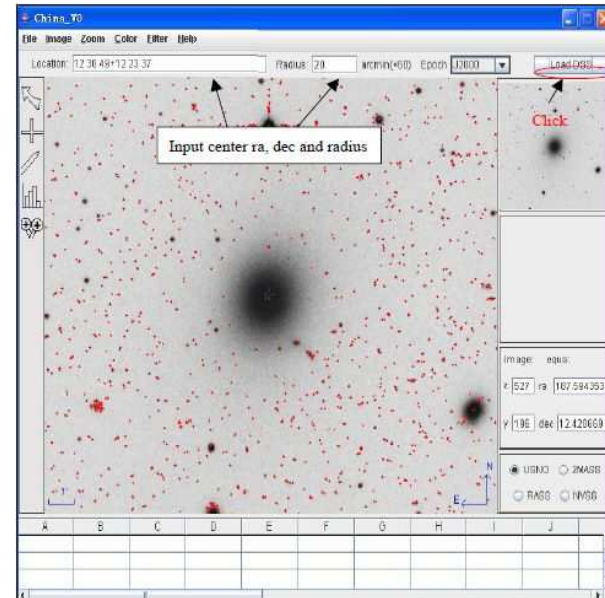
Interconnected VO Data services in the World



Software Tool providers



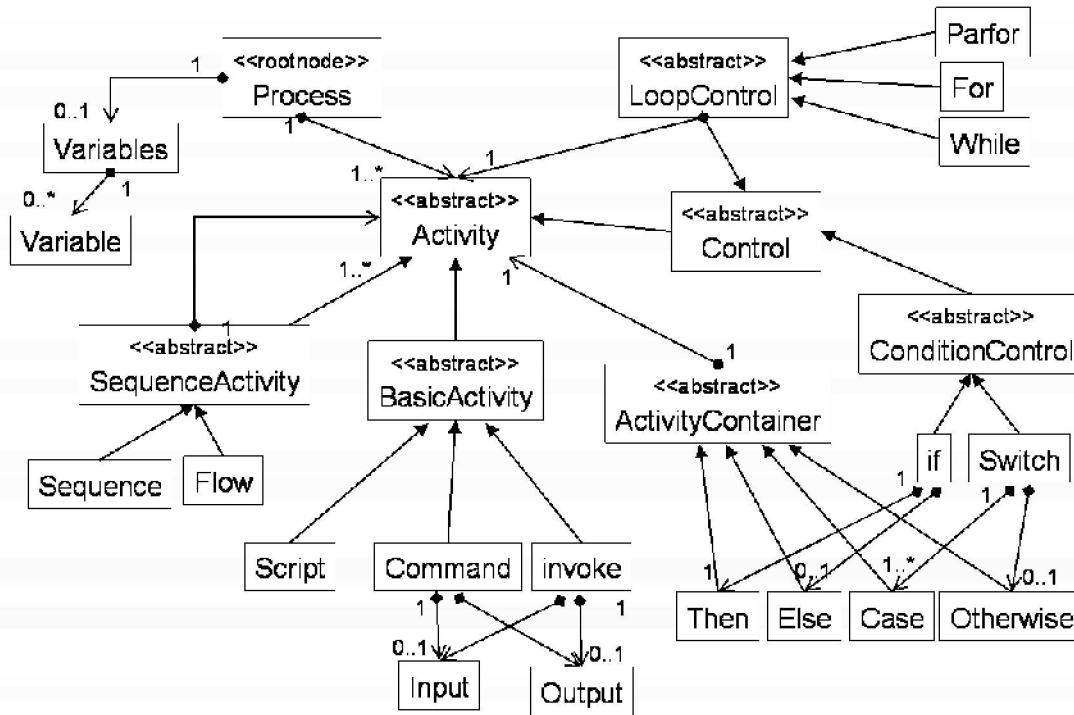
- VO-China
 - VOFilter : VOTable → OpenOffice data
 - VOIMPAT : Image processing and analysis tool
 - ’’
- VO-India
 - VO-Plot: to plot contents in VOTable
 - ’’



Workflow Description Language



Schema Diagram of Workflow Description Language



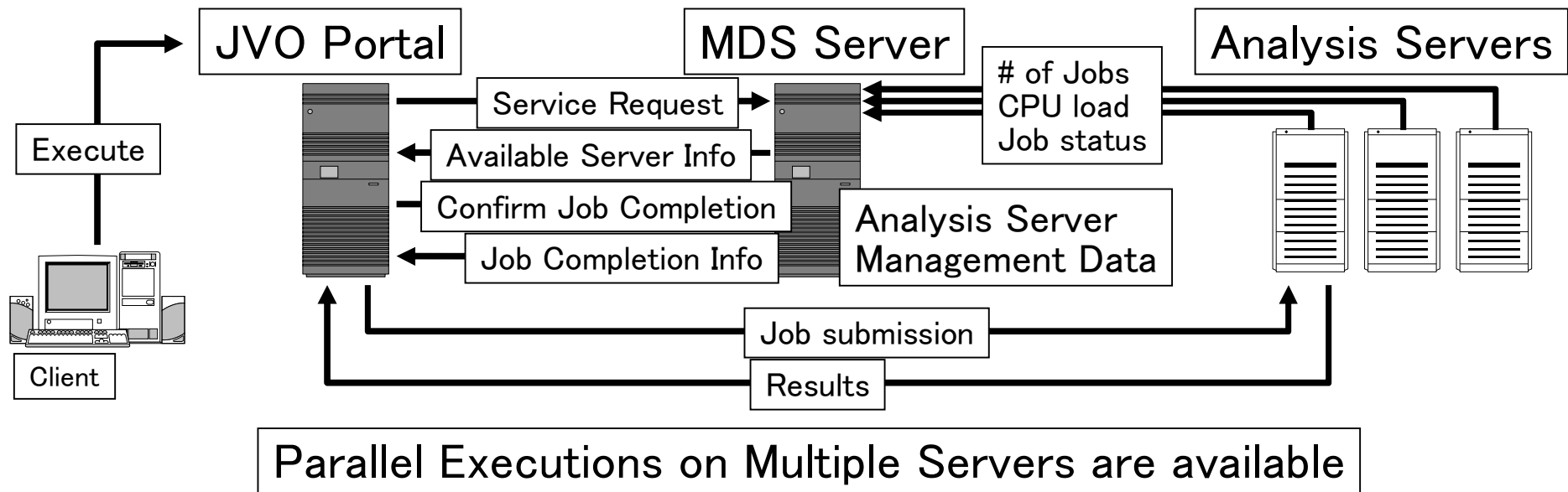
Based on BPEL4WS

- Variable definition
- Controls (Loop, Condition)
- Parallel execution
- Invoke external services
- Invoke built-in Java Classes

Management of Multiple Servers



- Data Analysis services under JVO
 - SExtractor (Image → Catalog)
 - HyperZ (Catalog → photometric redshift)
 - In operation on multiple servers
- Monitor and Discovery Service (MDS) server







Workflow Status

Status | [Registry](#) | [Search](#) | [Workflow](#) | [Result](#) | [Database](#) | [QSO](#) | [DataViewer](#) | [Link](#) | [MemoryMonitor](#) | [Logout](#)

⇒ [All](#) | [Detail](#)

Workflow Name : work_20060123200255167

Activity Name	Host	Elapsed Time (s)	Flag	Status
1_executeQuery	cda.harvard.edu	1.93		success
		0.0		success
2_executeQuery	jvo.nao.ac.jp	2.143		success
		0.0		success
3_executeQuery	pma.iso.wilspa.esa.es	4.632		success
		0.0		success
4_executeQuery	www.cadc-ccda.hia-ihc.nrc-cnrc.gc.ca	0.0		executing
		0.0		waiting
5_executeQuery		0.0		waiting

User ID	User Name	Group	Last Login
ohishi	Masatoshi Ohishi	jvo	Mon Jan 23 19:56:18 JST 2006

Discovery of a Brown Dwarf: SDSS/2MASS



2MASSW J1217-03

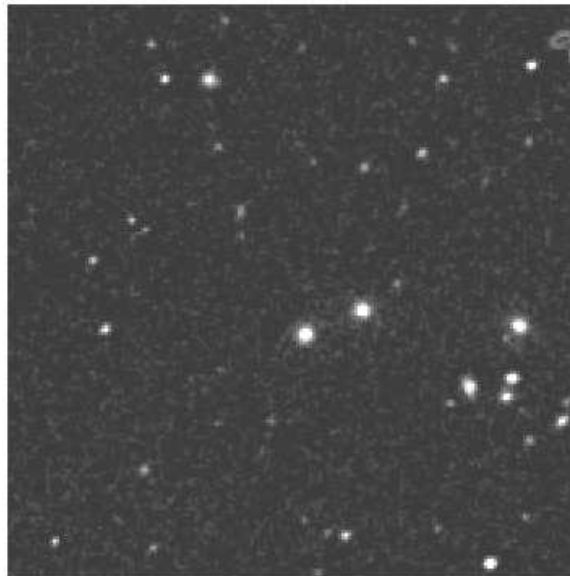
A methane (T-type) dwarf in the constellation Virgo

The near-infrared view



2MASS Composite JHK_s Atlas Image

The optical view



Palomar Digitized Sky Survey

discoveries like
this much easier if
databases jointly
queryable



A.J.Burgasser (Caltech), J.D.Kirkpatrick (IPAC/Caltech), M.E.Brown (Caltech),
I.N.Reid (U.Penn), J.E.Gizis (U.Mass), C.C.Dahn & D.G.Monet (USNO, Flagstaff),
C.A.Beichman (JPL), J.Liebert (Arizona), R.M.Cutri (IPAC/Caltech), M.E.Skrutskie (U.Mass)

The 2MASS Project is a collaboration between the University of Massachusetts and IPAC



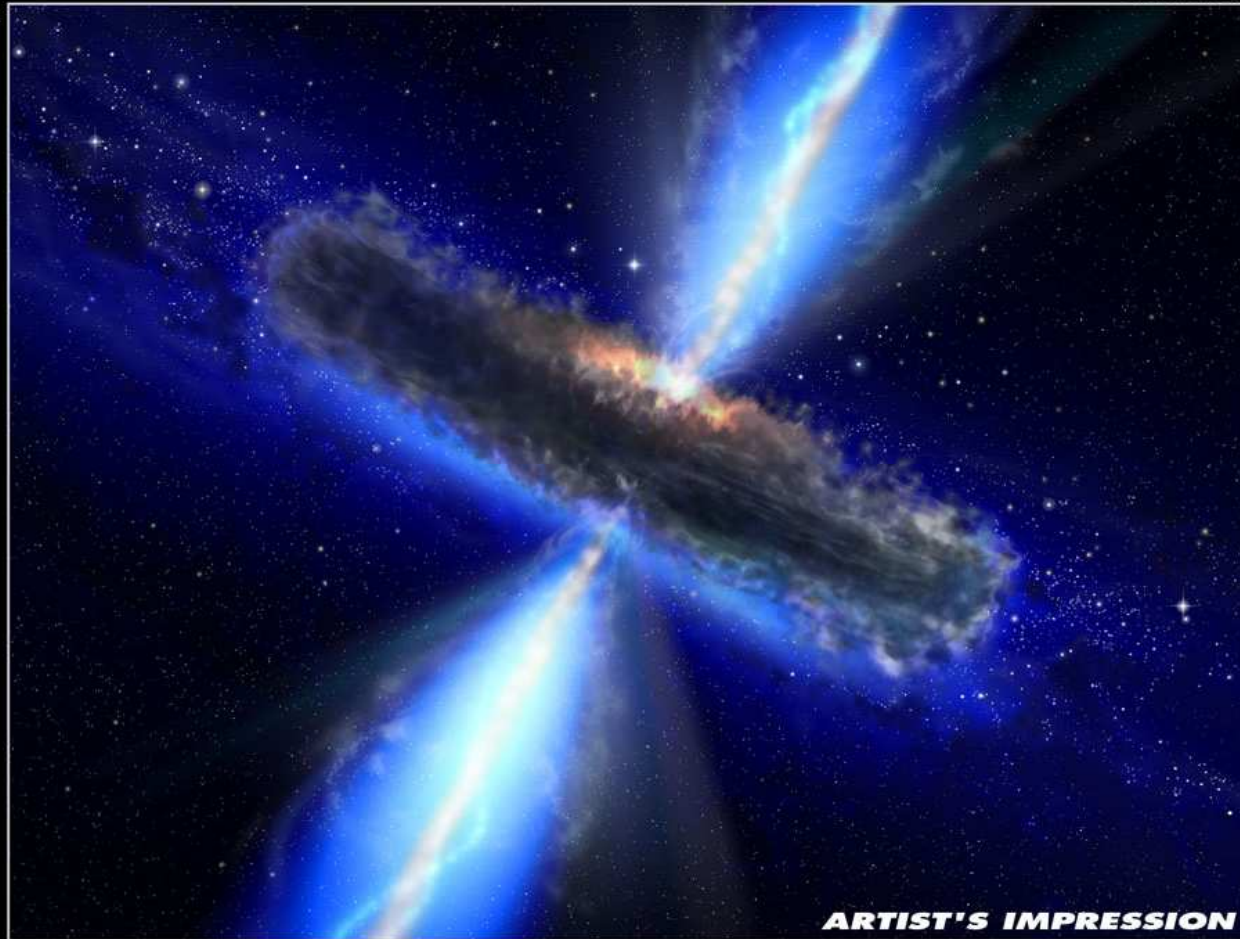
Detection of MANY Type II Quasars

NEWS RELEASE

Virtual observatory discovers missing black holes



HEIC 0409



ARTIST'S IMPRESSION



HUBBLE SPACE TELESCOPE

ESA/NASA, the AVO project and Paolo Padovani



Latest Science outputs



- Aug 2006 – VO Special Session @IAU GA
 - 5 days session
- 200+ participants registered already
 - ~30 science talks out of ~50
 - ~100 posters

New Moves



- Some VO projects move from R&D phase to operations phase
 - UK, Japan, US, EU,,,
- New VO projects
 - Brazil, Chinese Taipei, Blugaria, Tagikistan, Ireland, Czech,,,

Items to be done



- Distributed Storage to store query/analysis results
- Secure access to VOs : single-sign-on
- Other Standardizations
 - Standard application interface
- Advertisement to Data Centers
 - data centers need implement VO interfaces
- VO schools for astronomers

<http://www.ivoa.net/>



July 1

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