Lessons Learned during the Development and Operation of Virtual Observatory

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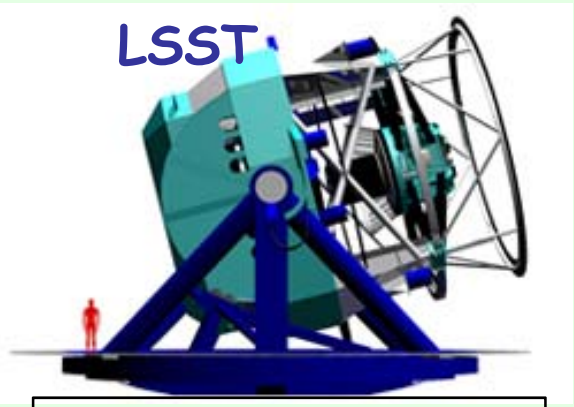
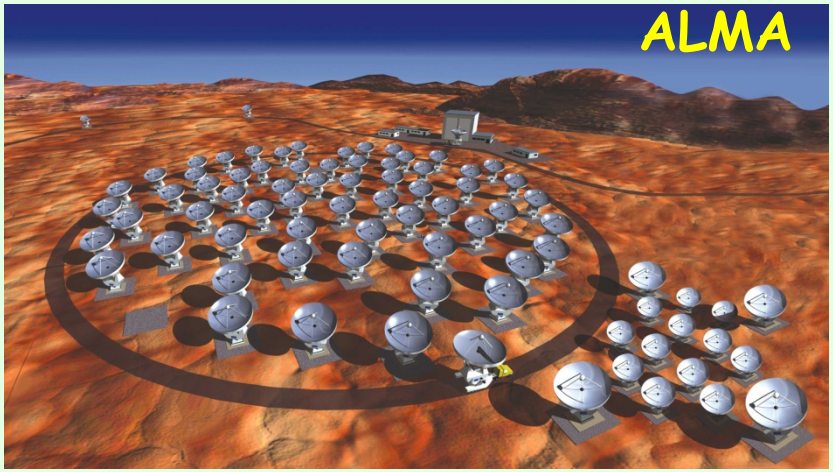
Planned Data Resources

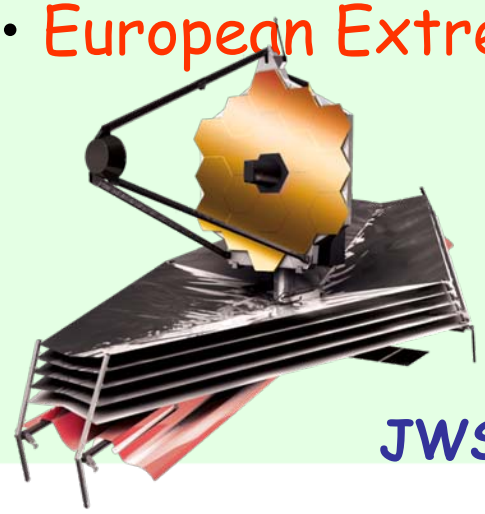
- ALMA
- JWST
- LSST
- LOFAR
- SKA
- Thirty MetreTelescope
- Giant Magellan Telescope
- European Extremely Large Telescope



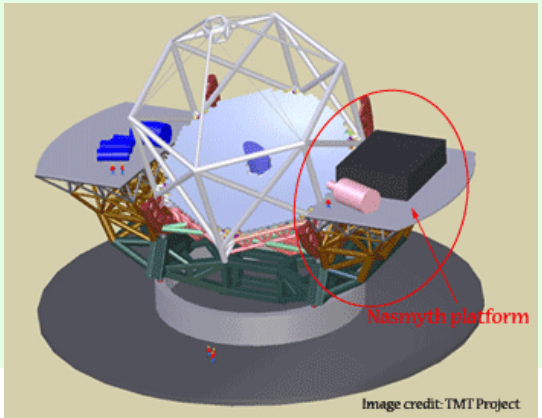
30 PB/yr x 6 yr ~ 200 PB



~ a few PB/yr



JWST



TMT

Flow of Observational Research

- Issues, Planning
- Observation
- Data Reduction
  - Calib., Select, Combine
    , , ,
- Data Analysis
  - Physical Parameters
  - Thinking
  - Solution
- Publish

Data

↓

Information

↓

Knowledge

↓

Understanding

↓

Wisdom

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

VO Projects in the world

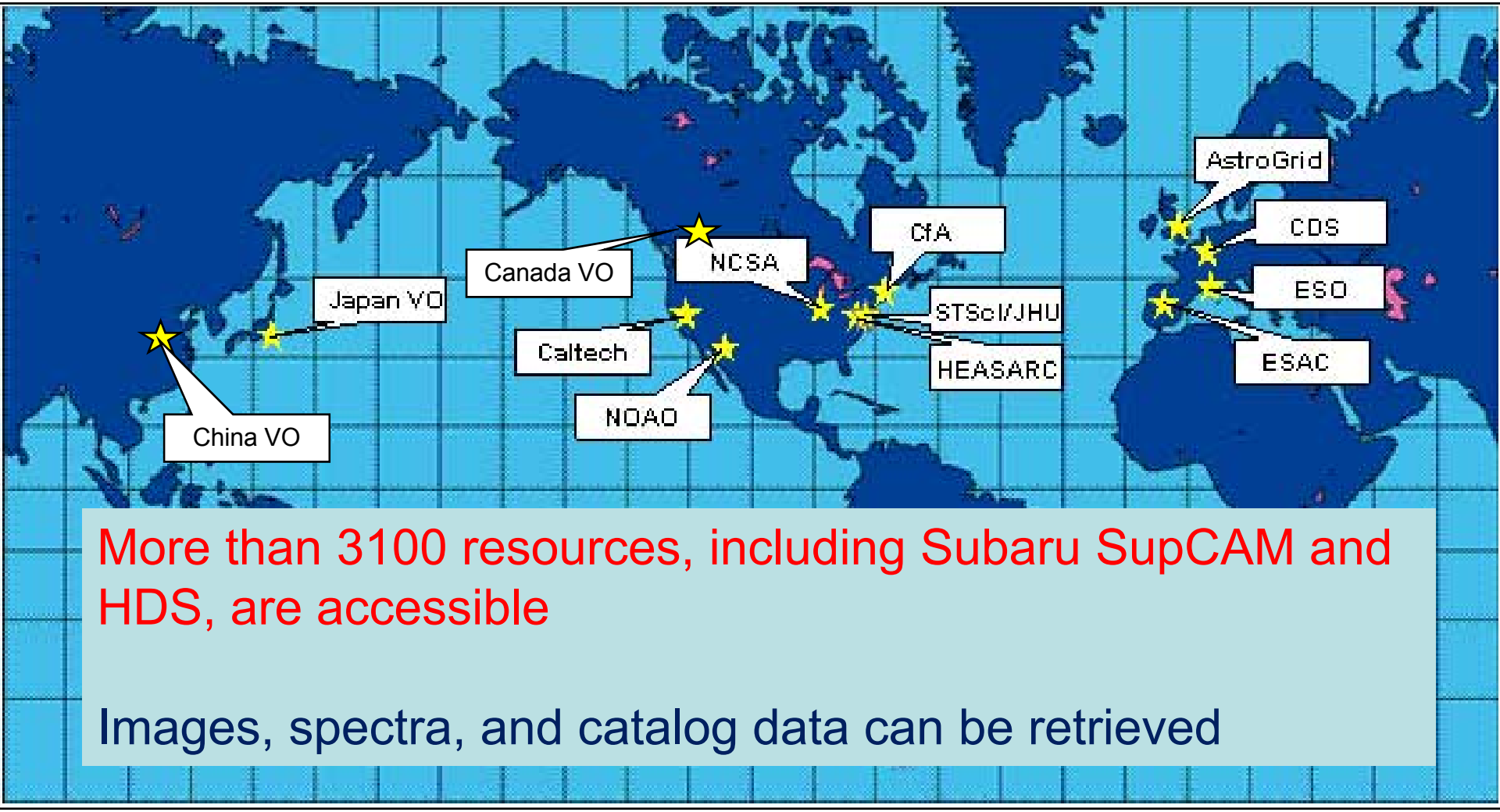
- 17 countries and a region (EU)
- International Virtual Observatory Alliance (IVOA) Standards to interoperate VOs

- Meta data,
  data models,
  data accesses,
  output format,
  etc.

Standardization in IVOA

- Meta-data
  - Contents & access protocol
- Access Images, Spectra, Catalogues
  - TAP, SIAP, SSAP, STC, etc.
- Query Language to Federated DBs (ADQL)
- Unified Attribute Names
  - UCD (Unified Contents Descriptions)
- Output format : VOTable (in XML)
  - FITS

Astronomical Virtual Observatories
~ DataGrid ~



More than 3100 resources, including Subaru SupCAM and HDS, are accessible

Images, spectra, and catalog data can be retrieved

Looking Ahead

Universe on Your Desktop

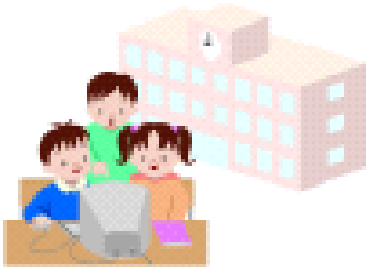
大量のデータをどう処理したらよいか悩む天文学者。猫の手も借りたい状況。

	データ生成率
野辺山宇宙電波望遠鏡	
すばる望遠鏡	

VO の…効率的に研究を進める天文学者、研究のアイデアも豊富に浮かぶ。

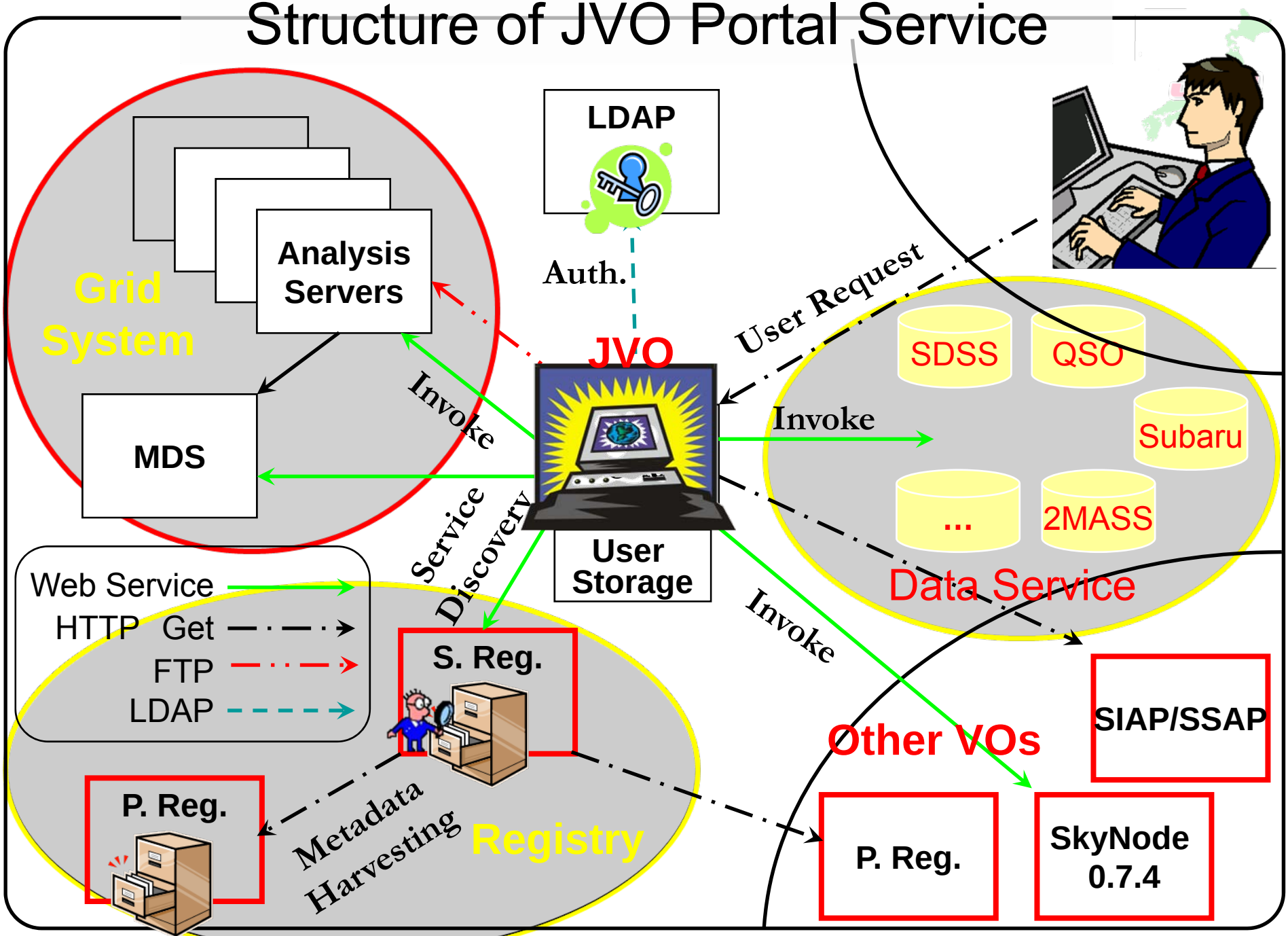
バーチャル天文台

教育の教材としても利用できる。



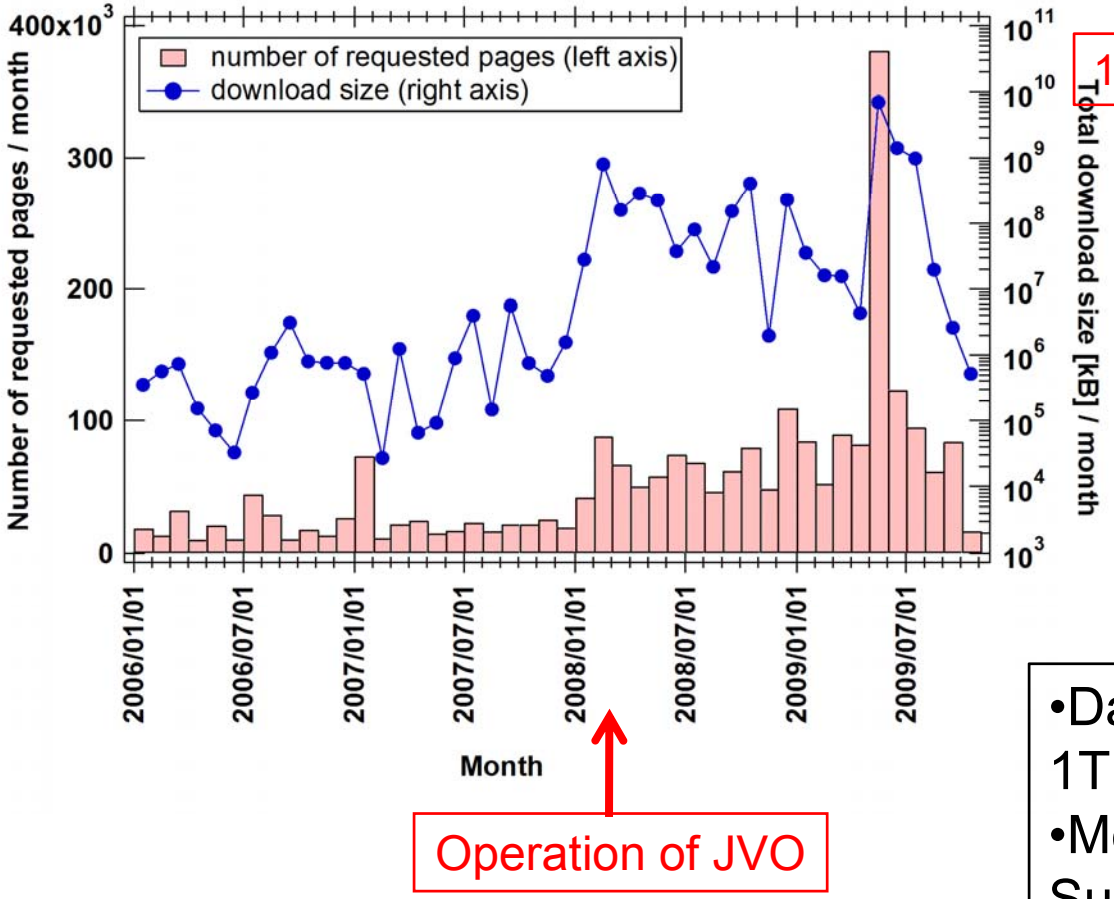
いつでもどこでも天文データにアクセスできる。

Structure of JVO Portal Service

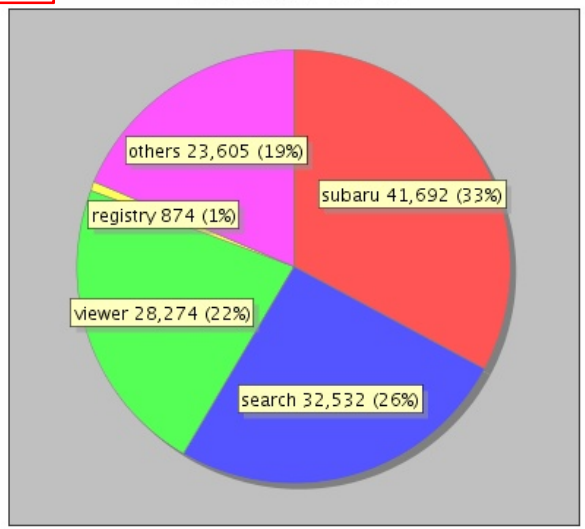


http://jvo.nao.ac.jp/portal/

Access Statistics to JVO Portal (as of 2009 Sep)



1TB



- Data request of more than 1TBytes/Month from the world
- Most access to Subaru SupCAM data

VO-enabled Papers

SAO/NASA Astrophysics Data System (ADS)

Query Results from the Astronomy Database

Selected and retrieved 172 abstracts.

#	Bibcode Authors	
1	2009MNRAS.tmp.1016M Mollá, M.; García-Vargas, M. L.; Bressan, A.	PopStar I: evolutionary synthesis model description
2	2009MNRAS.396..223D D'Abrusco, R.; Longo, G.; Walton, N. A.	
3	2009AJ....137.5012C Caballero, J. A.; López-Santiago, J.; de Castro, E.; Comide, M.	
4	2009GeoJI.177..463B Beggan, C. D.; Whaler, K. A.; MacMillan, S.	1.000 05/2009 A E F R U Biased residuals of core flow models from satellite-derived `virtual observatories'

~170 Refereed Papers that have "Virtual Observatory" in its abstract

More than 1300 papers mentioning "Virtual Observatory"

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Wisdom

More Science-Driven

- Demonstrate scientific merit
  - Publish “product papers” by yourselves
- Select most commonly used functionalities

- Quality Index
  - Toward quality assurance, jointly with observatories

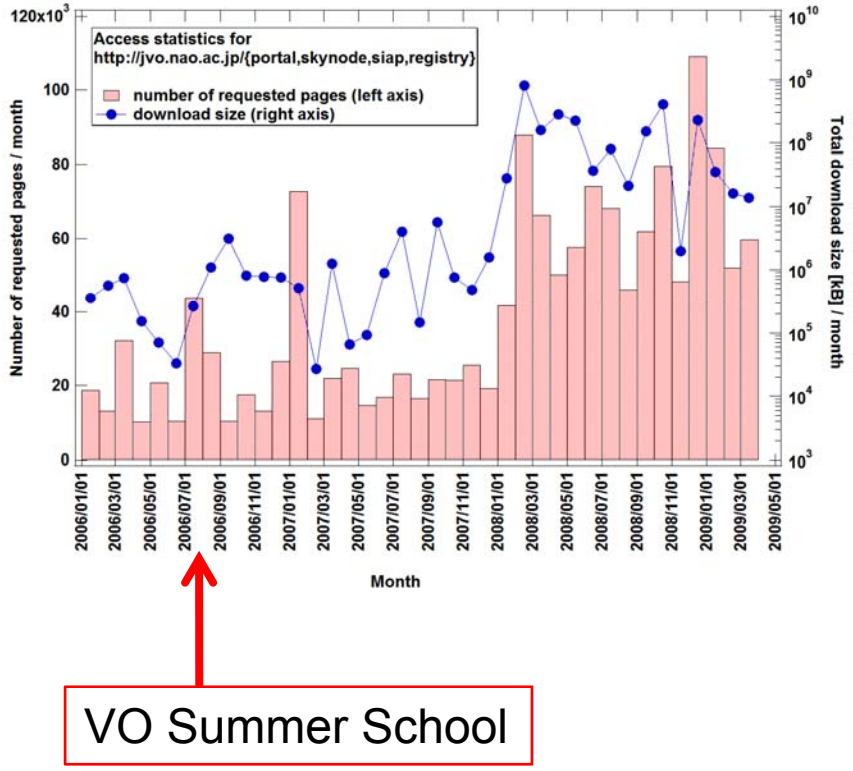
- Young researchers
  - Researchers are VERY conservative !
  - Young researchers tend to show interest to new ones

Users View Point

- Easiness to use
  - self-explanatory
  - Basic functionalities are sufficient
  - Others could be done by a local machine
- Market research
  - Science use cases
  - tutorials
- Novice vs Expert
  - GUI vs CUI
  - Almost no astronomers know SQL

Importance of Tutorials

- A must toward more dissemination and more publications
  - pure users
  - feedback
  - potential tutors



Establishing Standards

- Standards are quite effective
  - Access protocols, data format, etc.
  - Interoperability → wider dissemination and application
  - Endorsement by the IAU (VO WG)

- Painful process
  - Philosophy, idea, aim, intention, view,,,
  - Compromise, patience
  - Establishment of relationship：respect to each other
  - Coffee/tea breaks and lunch/dinner talks are crucial

Technology

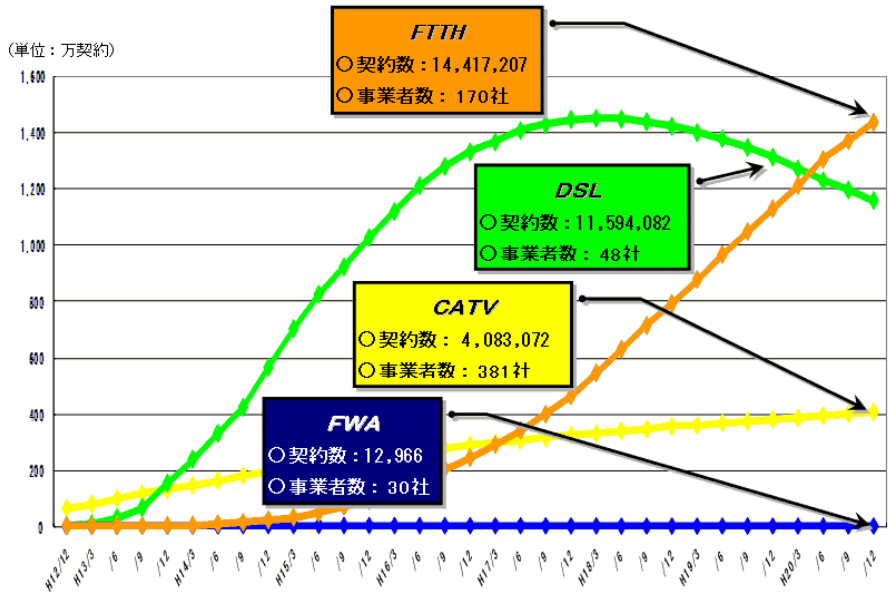
- Not too early, not too late
- Stability, robustness
  - “doable or not” is the issue
- Sustainability, support
- Popularity
  - help desk around you
- Platform independency
  - for easy dissemination

For Data providers

- Give credit to them
  - Hard and invisible to prepare science-ready data
- Easy implementation
  - tool kit
- Validation tool prior to publication of data
  - Ensure reliability of the data product

For Tax-Payers

- Effective tool for outreach activity
- Educational use
  - Dedicated user interface, w/ teachers
- More access by non-astronomers
- Funding agencies



http://www.soumu.go.jp/menu_news/s-news/090318_1.html

Summary

- VO data services are available through many VO projects – Data Grid
- More data analysis tools need to be integrated into the VO world → knowledge (and papers)
- More science-driven, easy-to-use design of the VO tools would be required
- Quality assurance/ quality index toward more reliable would be crucial in the data-incentive era

Supported by

- JSPS
  "Core to Core Program" (2004~2008)

- MEXT Grant-in-Aid
  "Information Explosion" (2001~)

- National Institute for Informatics
  "CSI Program" (2006~)

- NAOJ