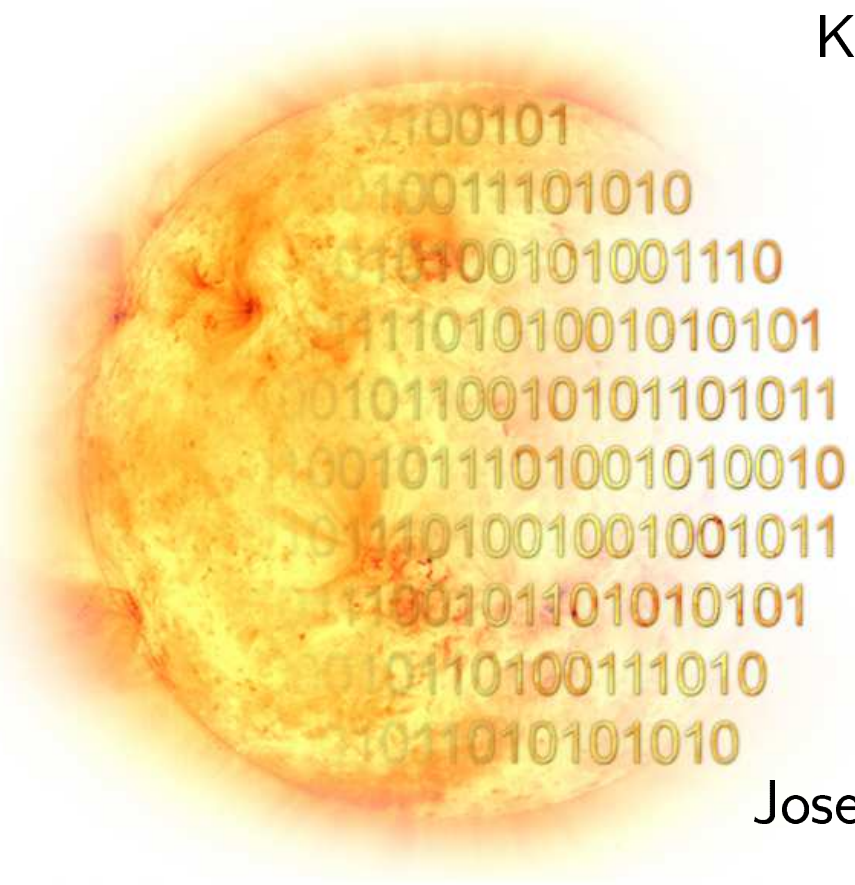
Data Integration Using SOAP in the VSO



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VSO Overview

Perspectives

- From a user
  - Search all participating data sources with a common interface
- From a data provider
  - Register data services with VSO
  - Utilize existing internal query and export facilities

Challenges

- Distributed locations
- Heterogeneous data services
  - DBs or file systems
  - Search capabilities
- Integration
  - Transparency
  - Metadata as “glue”
- Extensibility
  - Add future data providers
  - Session logging

XML (eXtensible Markup Language)

- A mechanism to identify structure in a document
  - "keyword=value" + structure
  - user defined *arbitrary* tags, no semantics
  - text-based and platform-independent
- Applications
  - format for data exchange — widely accepted
  - format for data storage — ???, native XML databases exist
  - mid-ground — relational DB that provides XML view
    - XML query
    - Mapping between XML view and relational DB
- And tons more X-concepts: XML schema, XLink, XPointer, XPath, XSL, XSLT, XQuery, DOM& SAX, XHTML, ...

Resource Registry

- Dataset description — "What"
  - Observable
  - Time coverage
  - Operation status
  - Contact
  - etc
- Interface description — "How"
  - Searchable
  - Retrievable
  - Format
  - etc

A sample entry:

```
<DataProvider>
  <Name>SOI</Name>
  <Organization>Stanford University</Organization>
  <Facility>Instrument</Facility>
  <Contact>R. Bogart</Contact>
  <Dataset Name="MDI">
    <Dopplergram>
      <Polarization>Linear</Polarization>
    </Dopplergram>
    ...
    <TimeCoverage>
      <Start>1996-01-01</Start>
      <End>2003-02-01</End>
    </TimeCoverage>
    <URL>http://soi.stanford.edu</URL>
    <OperationStatus>On-line</OperationStatus>
    <Distribution>HTTP</Distribution>
  </Dataset>
</DataProvider>
```

Web Services

- Characteristics
  - Service available over the network
  - Standardized XML messaging
  - Independent of platform and programming language
- Application-centric replacing human-centric (POST/GET)
- Automation of the Web: service description, service registry
- Protocol stack

Discovery	UDDI
Description	WSDL
XML messaging	XML-RPC,SOAP
Transport	HTTP,SMTP,FTP

SOAP

- Simple Object Access Protocol
- Characteristics
  - RPC (Remote Procedure Call) mechanism
  - HTTP as transport
  - Client-server messaging encoded in XML documents.
    - Independent of platform and programming language
- Implementation available for Java, Perl, Python, etc.
- Three major parts
  - Data encapsulation specs: XML envelope
  - Data encoding rules: agreed-upon data types
  - RPC conventions: one- or two-way messaging

Perl SOAP::Lite Module

- Written by Paul Kulchenko
- Interfaces

Client

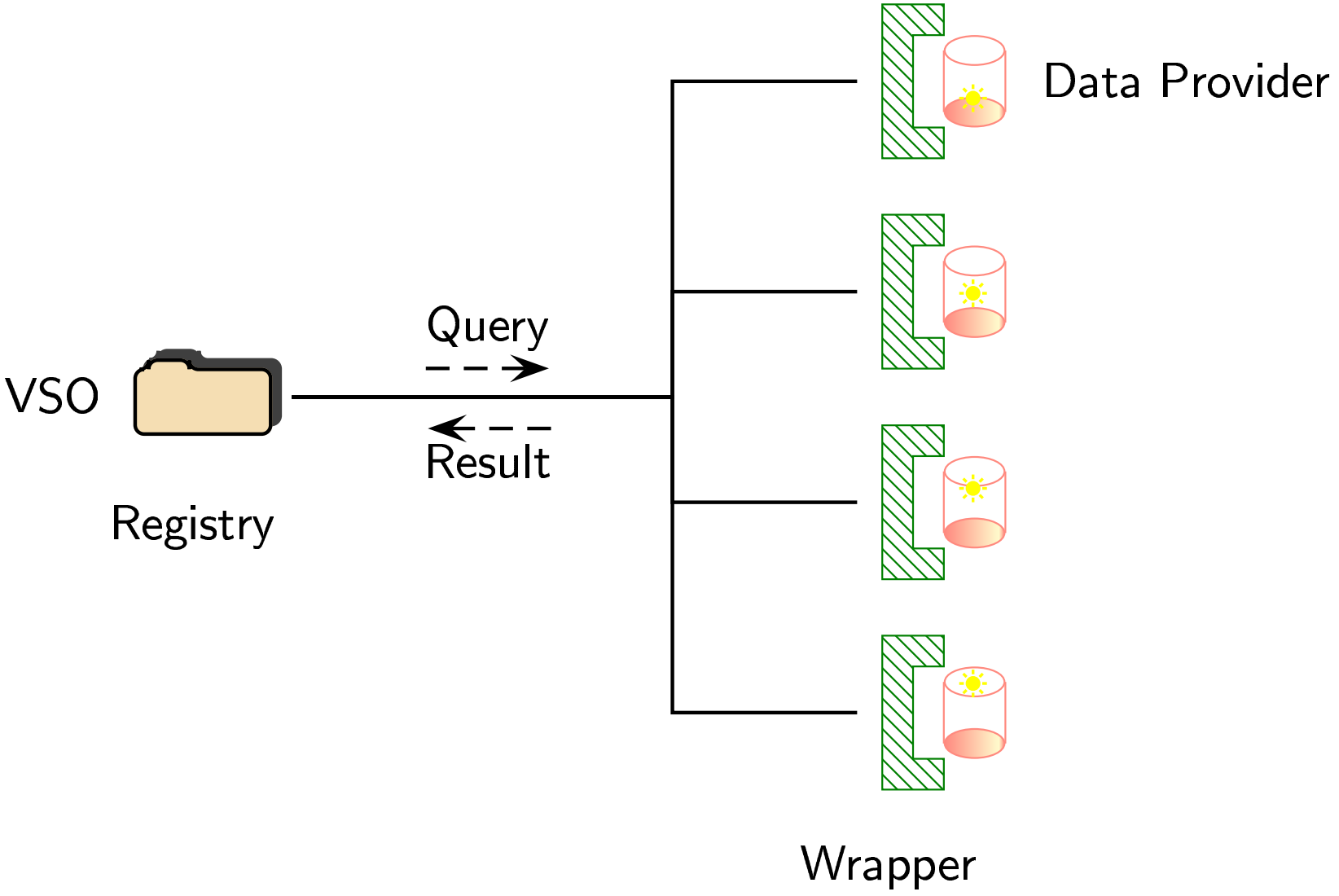
```
use SOAP::Lite;
$soap = SOAP::Lite
-> uri('http://vso.stanford.edu/MDI')
-> proxy('http://vso.stanford.edu/mdi.cgi');

$result = $soap->Query();
```

Server

```
use SOAP::Transport::HTTP;
SOAP::Transport::HTTP::CGI
-> dispatch_to('MDI')
-> handle;
package MDI;
sub Query { ... }
```

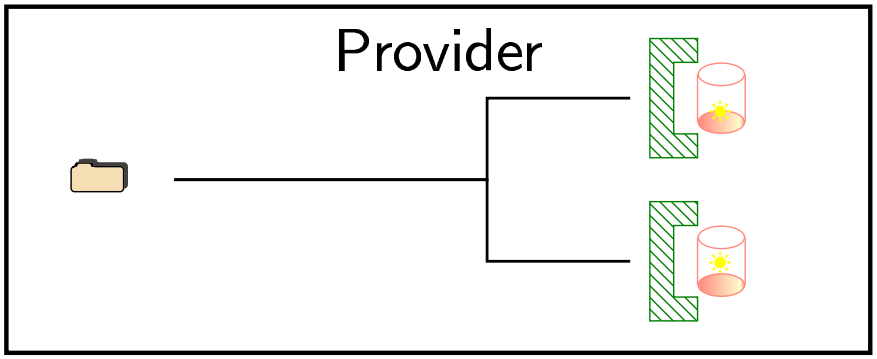
- Error handling mechanism
  - Timeout
  - Reason of failure: standard and custom-defined

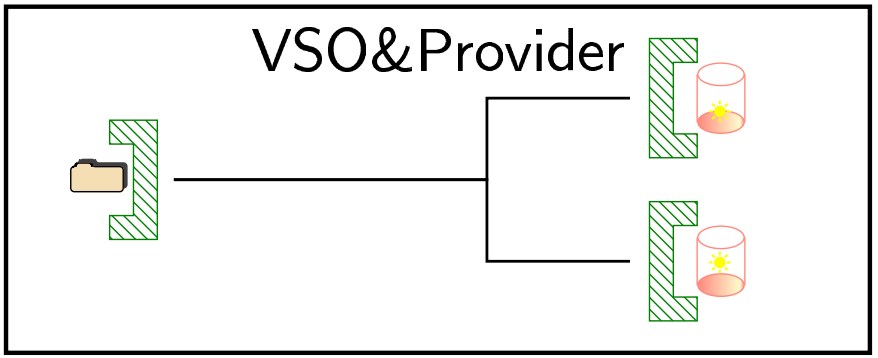
Functional Framework

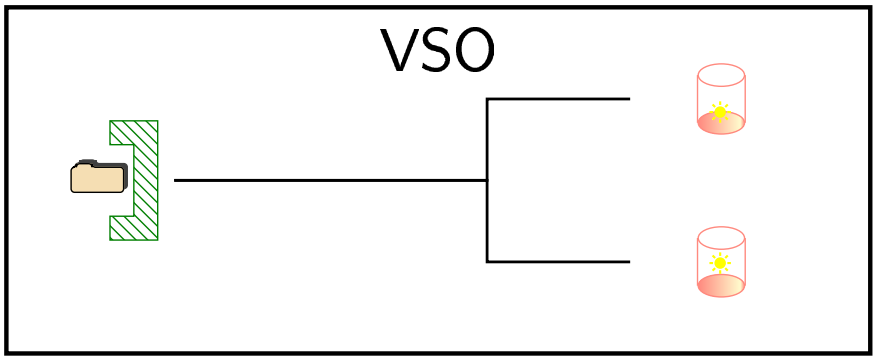


Wrapper

- Functionalities
  - Data Model Mapping
  - Query Construction
- Implementation points

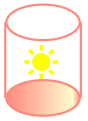






Data Provider Issues

- Diversity
  - Bookkeeping mechanisms
    - Databases
      - ✔ PostgreSQL
      - ✔ Oracle
      - ✔ MySQL
    - File systems
  - Existing search/export capability
- Work load concern
  - Limit maximum number of results
- Cost of data delivery
- Duplicated datasets



Time Interval Search: Registry

- Sample entries

Data provider	Time coverage
Stanford University	
National Solar Observatory	
Solar Data Analysis Center	
Montana State University	

- For a given a time interval, resource registry tells VSO which provider might have the matching datasets.
- It is these providers that VSO queries.

Time Interval Search: Wrapper

Search for all datasets for October 30, 2001

```
WHERE  UNIX_TIMESTAMP(obstart) >=
       UNIX_TIMESTAMP("2001.10.30 00:00:00")
AND    UNIX_TIMESTAMP(obsend)  <=
       UNIX_TIMESTAMP("2001.10.30 23:59:00")

where  date_obs >= 10-Oct-2001 00:00:00
and    date_end <= 10-Oct-2001 23:59:00

WHERE  '2001.10.30' <= Date_Obs
AND                    Date_Obs <= '2001.10.30'
AND    '00:00:00'   <= Time_Obs_Start
AND                    Time_Obs_End <= '23:59:00'

WHERE series_num >= 77376
AND   series_num <= 77399
```

Reference

- Official VSO webpage http://virtualsolar.org
- Time Search http://vso.stanford.edu/ti.html
- Perl::Lite http://soaplite.com
- E. Cerami, Web service essentials, O'Reilly, 2001