



A Virtual Data Product Toolkit Based on Geospatial Web Service Orchestration

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Agenda

- **Introduction**
- **Life cycle of virtual data product**
- **OGC Catalog Service for Web (CSW)**
- **Model designer**
- **Virtual data service**
- **BPELPower – service chain engine**
- **Conclusion**



Introduction

- **Virtual Data Product**
 - Much geospatial scientific data is not obtained directly from measurements but rather derived from other data by the application of **computational procedures**.
 - *Landslide susceptibility (slope, aspect, NDVI...)*
- **Geospatial Model**
 - Abstract computational procedure
 - Behavior-based high level geospatial knowledge.



Introduction

- **Web Service**

- “A Web service is a software system designed to support interoperable machine-to-machine interaction over a network.”

(<http://www.w3.org/TR/ws-arch/>)

- **Web Service Orchestration**

- Assembling individual Web Services into a service chain (representing a more complicated geospatial model and process flow) to achieve desired results

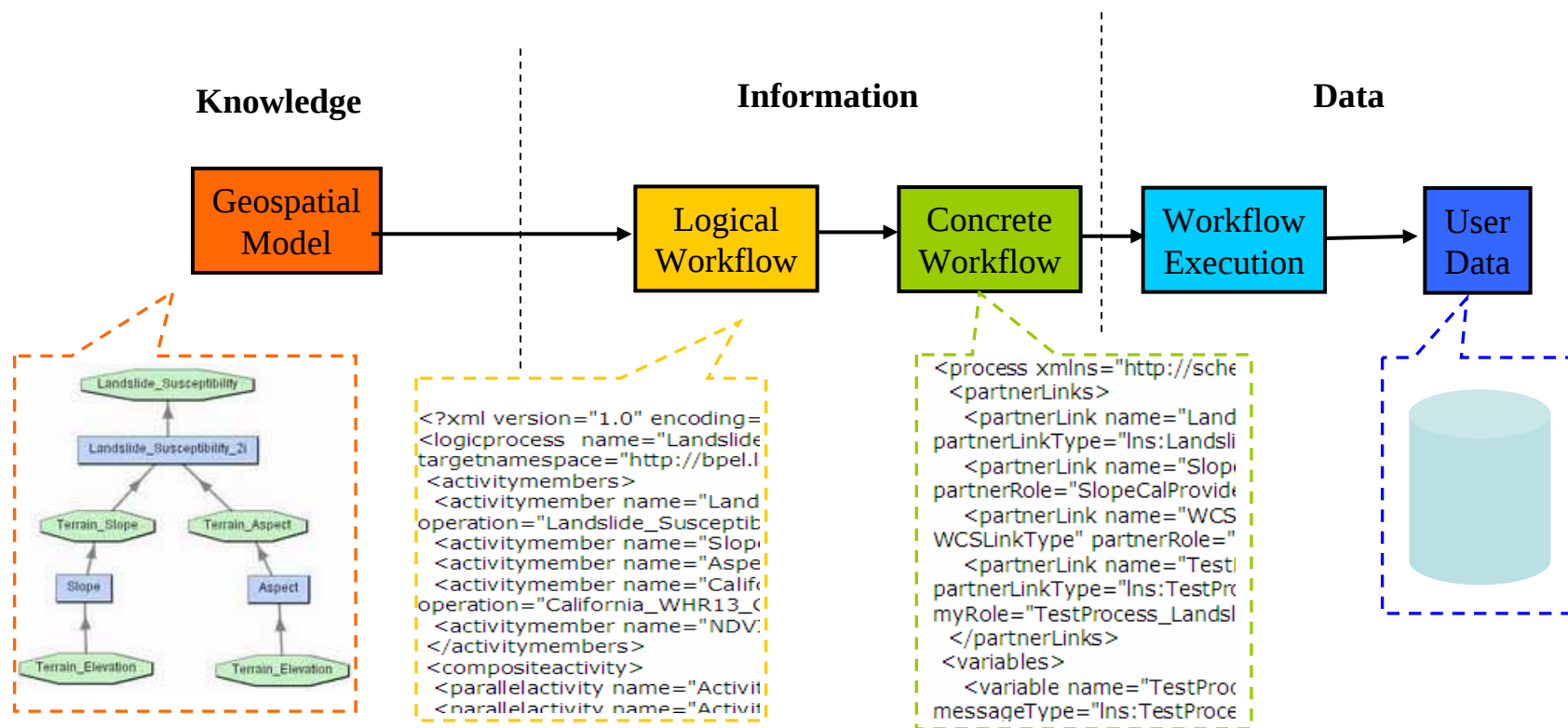


Introduction

- **Toolkit**
 - With geospatial knowledge
 - *Design*
 - *Discovery*
 - *Retrieve*
 - *Chain*
 - *Orchestrate*
 - *Visualization*



Life Cycle of Virtual Data Products





OGC Catalog Service for Web (CSW)

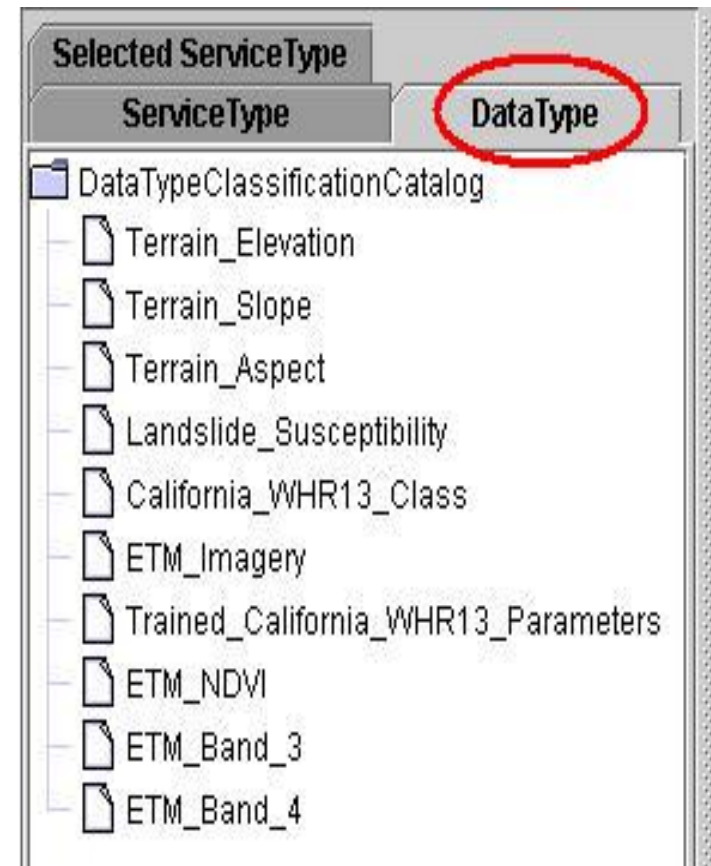
- **Directory Role**
 - Providers advertise the availability of their resources, and consumers can then query the metadata to discover and run-time access them.
- **EB/RIM Information Model**
 - Specifies formally how domain objects are organized, constrained and interpreted based on domain conceptual structure.
- **Standard Interfaces**
 - GetCapabilities, describeType, getRecord...
- **<http://geobrain.laits.gmu.edu/csw/discovery/>**



Model Designer

- **Data Type**

- Data type is a class of data having the same scientific meaning.
- The data type hierarchical list is chosen according to the scientific terminology of discipline domain.
- Each data registered in the catalogue is associated with some data types.

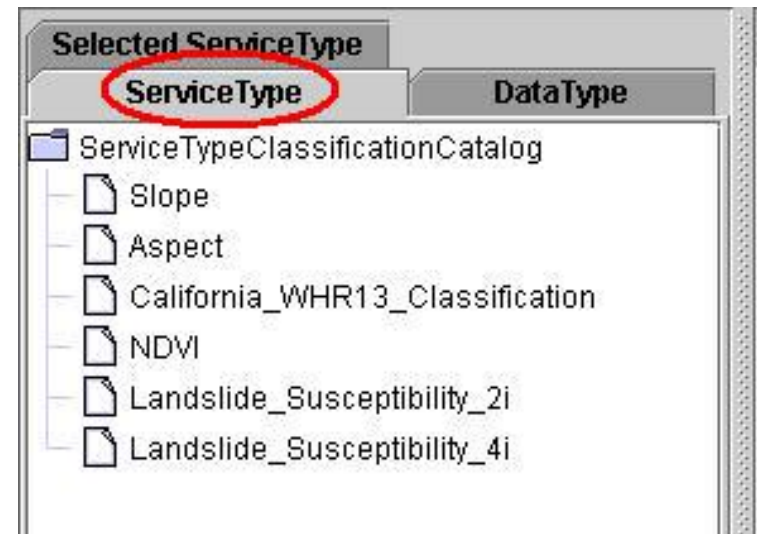
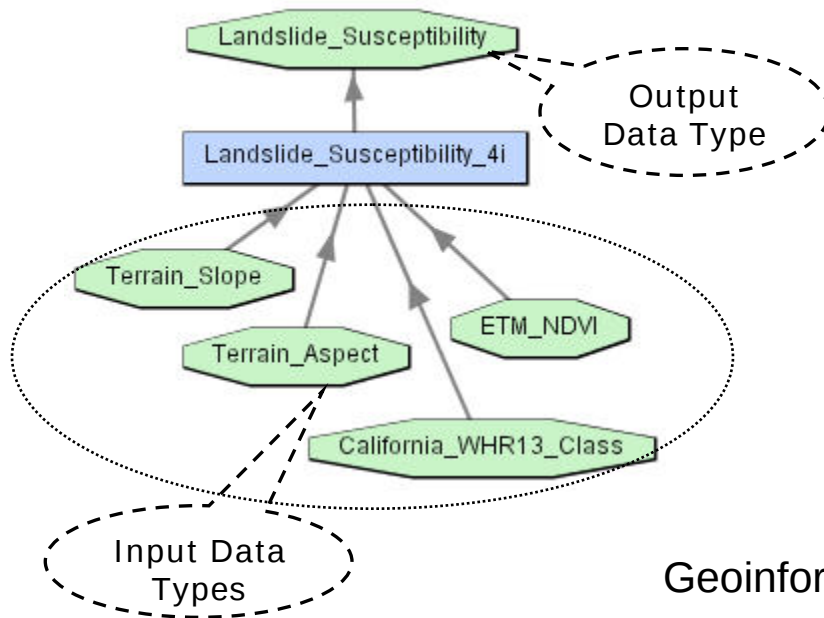




Model Designer

- **Service Type**

- Service type is a class of services having the same input data types and output data type.
- Each service registered in the catalogue is associated with a service type.





Model Designer

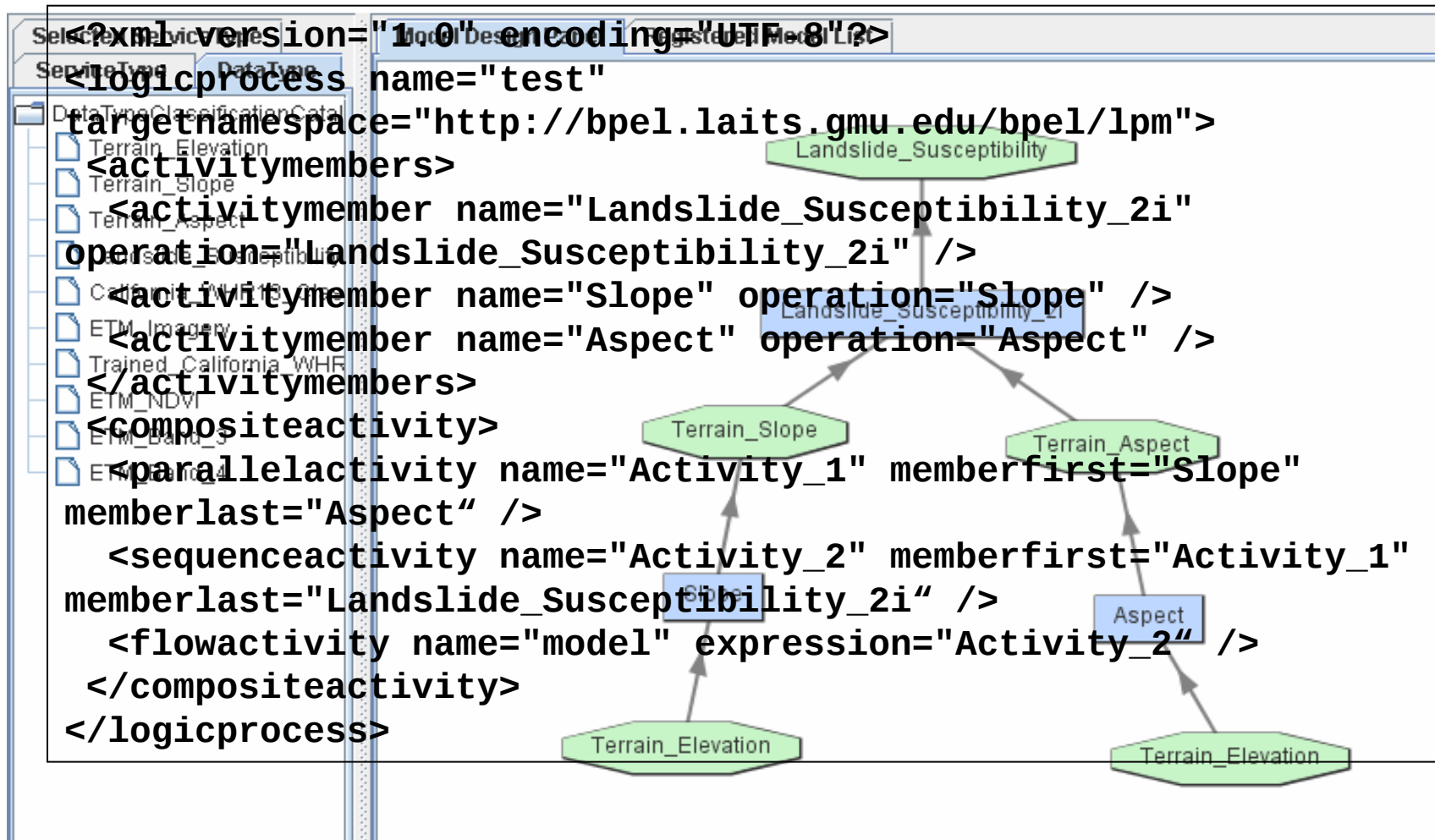
- **Example**

- Select “Landslide_Susceptibility” data type.
- Find a service type whose output type is “Landslide_Susceptibility”. This is be done automatically by designer. Only the satisfied service types are listed and selectable.
- Select “Landslide_Susceptibility _2i” service type whose input data types are “Terrain_Slope” and “Terrain_Aspect”. If there are more than one satisfied services, the designer allows user to view their metadata to assist selection.
- Find service types whose output data types are “Terrain_Slope” and “Terrain_Aspect” as step 2. Select “Slope” and “Aspect” service type whose input data type is “Terrain_Elevation”.



Model Designer

- <http://laits.gmu.edu/vdp/>





Virtual Data Service

- **Instantiation**

- Input: logical workflow
- Output: BPEL process
- Service discovery
 - *Find a service instance for each service type in logical workflow*
- Data service add-in
 - *Find the most appropriate existing data (at the bottom of geospatial model) and add the relevant data services automatically, such as Web Coverage Service, Web Coordinate Transformation Service.*

- **BPEL4WS (Business Process Execution Language for Web Service)**

- A language for the formal specification of business processes and business interaction protocols. By doing so, it extends the Web Services interaction model and enables it to support business transactions.



Virtual Data Service

- **Standard interfaces**

- OGC Web Coverage Service

- *getCoverage*

<http://laits.gmu.edu:8099/AWCSPortal/AWCSPortal?service=AWCSPortal&request=getCoverage&version=1.0.0&coverage=VIRTUAL:landslide2i&crs=EPSG:4326&bbox=-122.2656,37.5993,-122.0013,37.8778&format=HDF-EOS&width=100&height=100&resx=1000&resy=1000&axisname=NewAxis&axisvalue=Decarl&submit=submit>



BPELPower – Service Chain Engine

- **Based on the mainstream standards**
 - BPEL, WSDL, WSIF, Xalan, Xerces, UDDI, AXIS, SOAP, JNDI, J2EE (servlets/EJBs/JSPs), Jetspeed (Portlets) and JMX. It runs on top of popular application servers, such as Tomcat, J2EE, JBoss, Weblogic and WebSphere.
- **“Deploy it”.**
 - WSDL-based web services and BEPLE-based web services chain can be deployed in BPELPower, where their validations are checked.
- **“Try it”.**
 - WSDL-based web services and BEPLE-based web services chain can be executed in BPELPower dynamically. Different invocations (e.g., HTTP POST/GET, SOAP document/rpc, etc.) are well supported.
- **See detail at <http://geobrain.laits.gmu.edu:8098/bpel>.**



BPELPower – Service Chain Engine

BPEL Process Manager - BPELPower - Mozilla Firefox

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[📄](#) Web Model Designer [📄](#) Web Services Orchestration: ... **BPEL Process Manager - B...**

BPELPower **BPEL Process Manager**

[WSDL Services](#) [BPEL Processes](#) [Instances](#) [LBPL Activities](#)

Deployed WSDL Services

Service Name	Service Name
CurrencyExchangeService	EMBLNucleotideSequenceWebService
GMU-NGA-WCS	GMU-WICS
Grass General CommandsService	Grass Imagery CommandsService
Grass Raster3D CommandsService	Grass Raster CommandsService
Grass Raster InOut CommandsService	Grass Vector CommandsService
Grass Vector InOut CommandsService	GridSlopeAspectService
GridSlopeService	GridWCSService Laits
GridWCSService No	GridWCSService

[+ Deploy New Services](#) [+ Undeploy Services](#)

Logged to domain: **default** BPELPower v2.0.



Conclusion

- **Life cycle of virtual geospatial product**
 - Design (knowledge) → instantiation (information)
→ execution (data)
- **Interoperability**
 - Web Services
 - *Catalog service, Virtual data service, BPELPower...*
- **Expansibility**
 - Web Service chain
 - *Easily add new services to represent more complex product.*