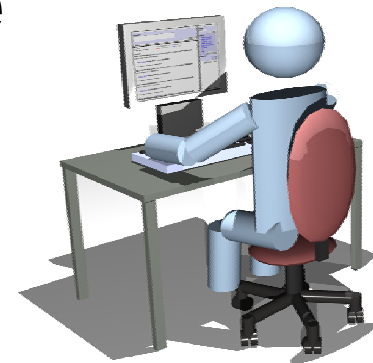


Integration of Earth Observation Data and Domain Knowledge Using Topic Maps



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Rajan Man Bajracharya – ICIMOD

SATOPI project which is being developed by Space Applications Services as a co-funded activity with the European Space Agency (ESA contract number 21520/08/I/OL).



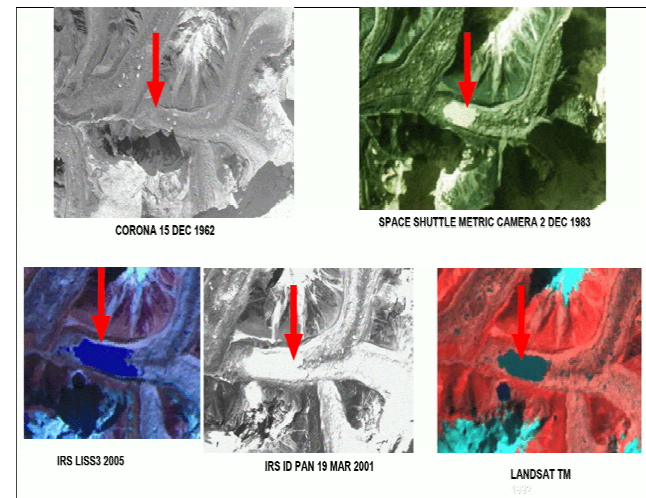
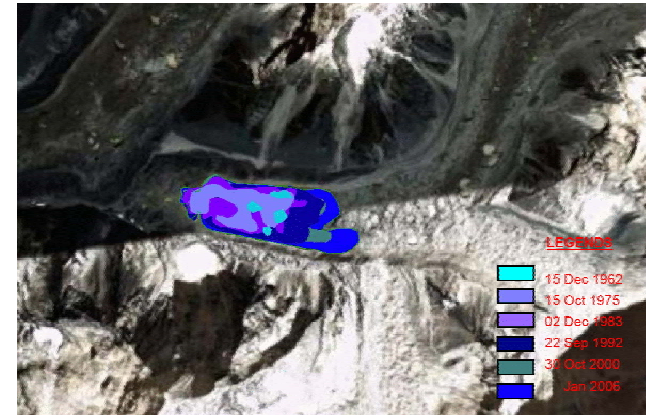
The Use Case – GLOFs in the Himalayas

- Glacial Lake Outburst Flood (GLOF) happen when glaciers melt, and glacier lakes are formed next to them.
- The glacier lakes are usually dammed by a natural dam made partly from ice. These dams are unstable.
- When the water level goes up, the ice in the dams floats causing the dam to break.
- The resulted floods can be very intense. For example, in a GLOF event happened in 1985, the water from Dig Tsho Lake went downhill in a flood that lasted 4-6 hours, and with a flow of 1600 to 2350 cubic meters per second.



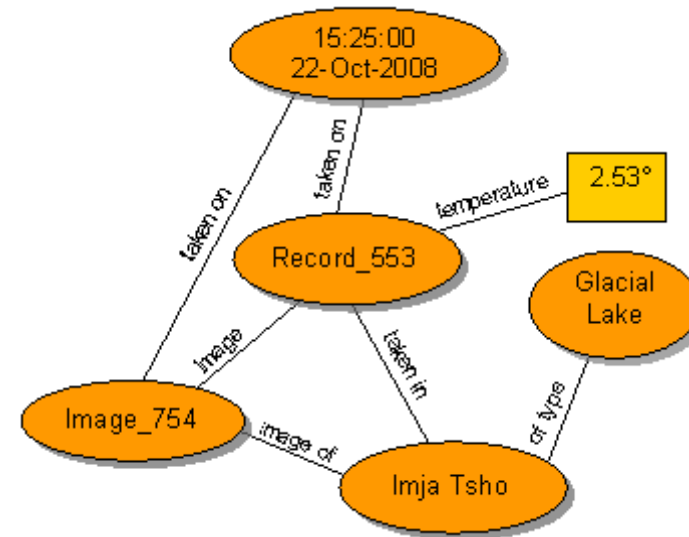
The Need

- The phenomena of GLOF events depend on many factors such as weather, topography and characteristics of the glacier, the glacier lake and its dam.
 - In order to identify precursors for a GLOF event the researcher has to collect data from different resources:
 - Different remote Earth Observation sensors each might have its own interface.
 - Data which is already collected about the glacier lake and similar glacier lakes
 - Weather data
 - etc.
- ➔ The process of accessing and collecting the data slows down the research.

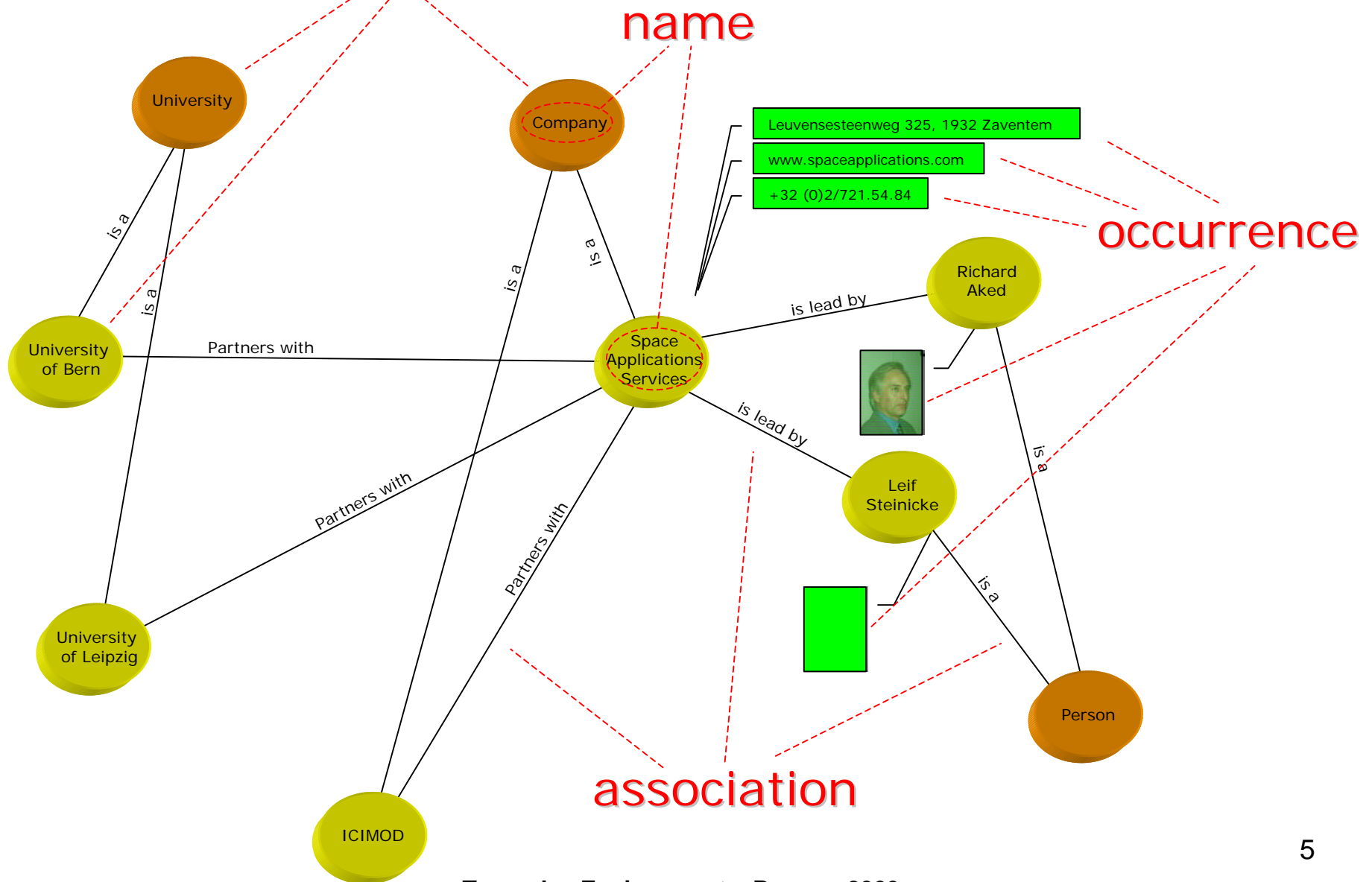


The Technology Used – Topic Maps

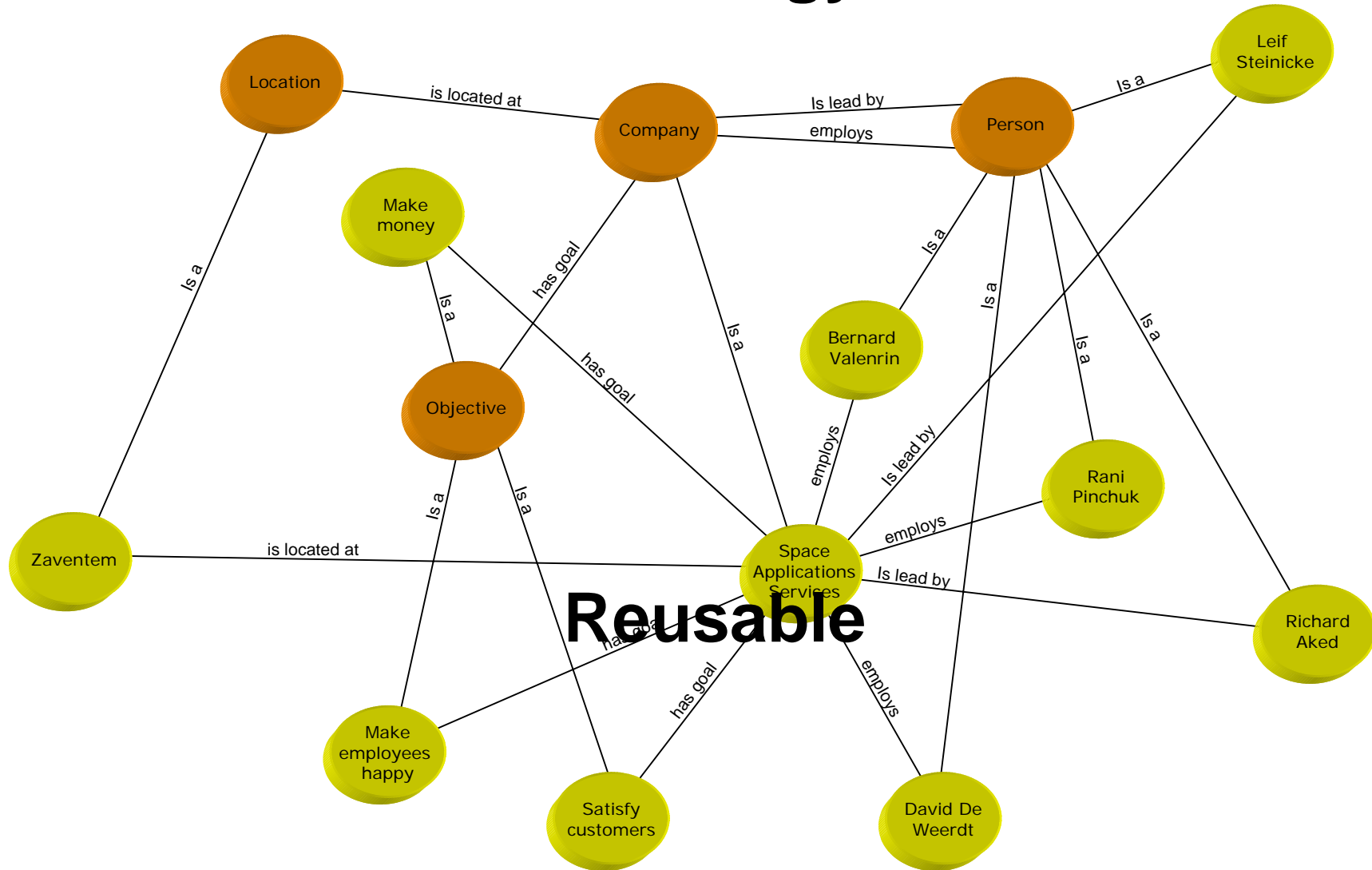
- Topic Maps is an international standard (ISO/IEC 13250: 2003) for knowledge representation and information integration.
- Topic Maps provides the ability to represent knowledge in a natural way – the way we, humans, grasp knowledge.
- Dynamic topic maps (which describe events) can be created.
- Topic Maps standard guides how to merge different topic maps.



Topic Maps



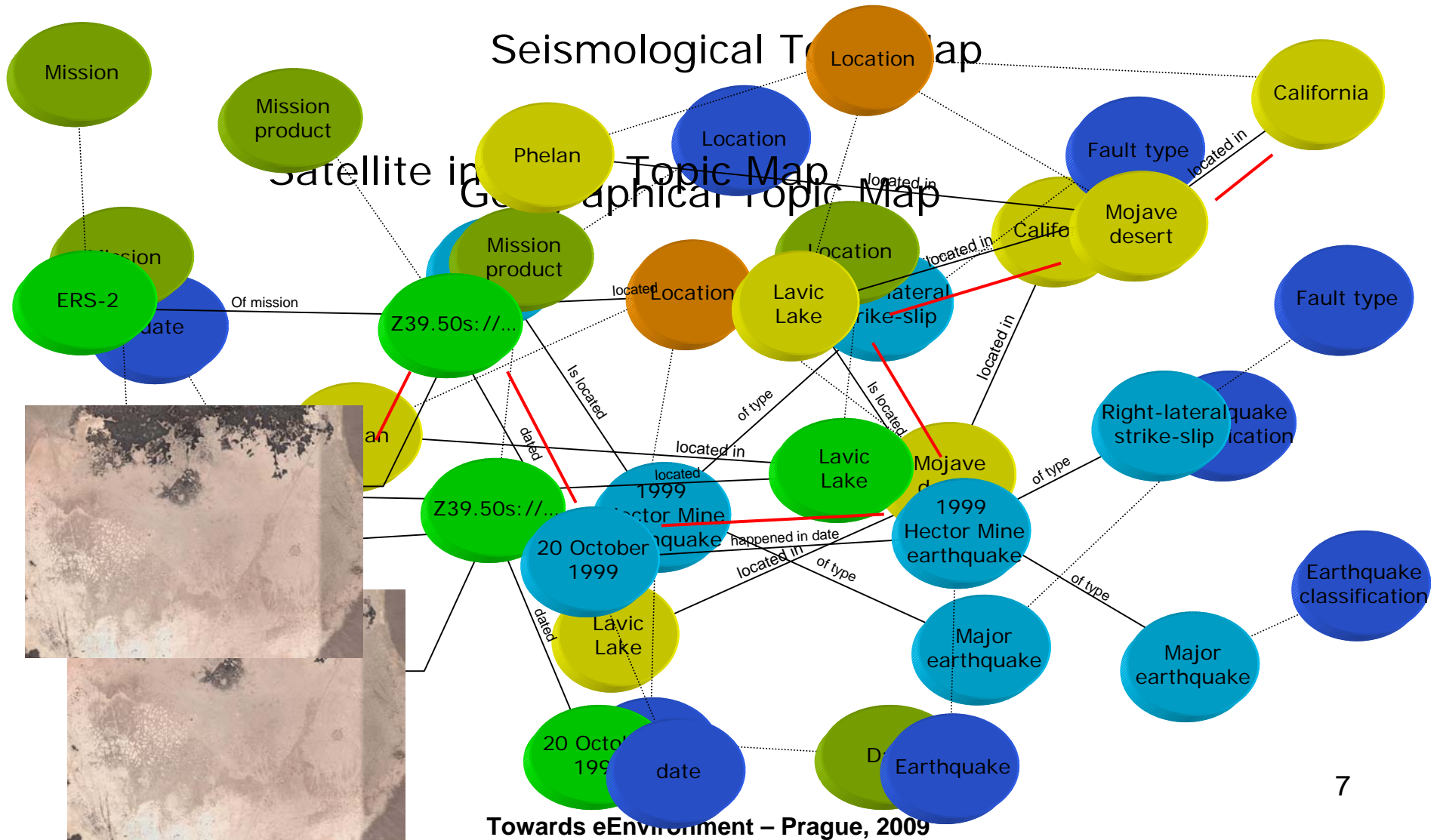
Ontology



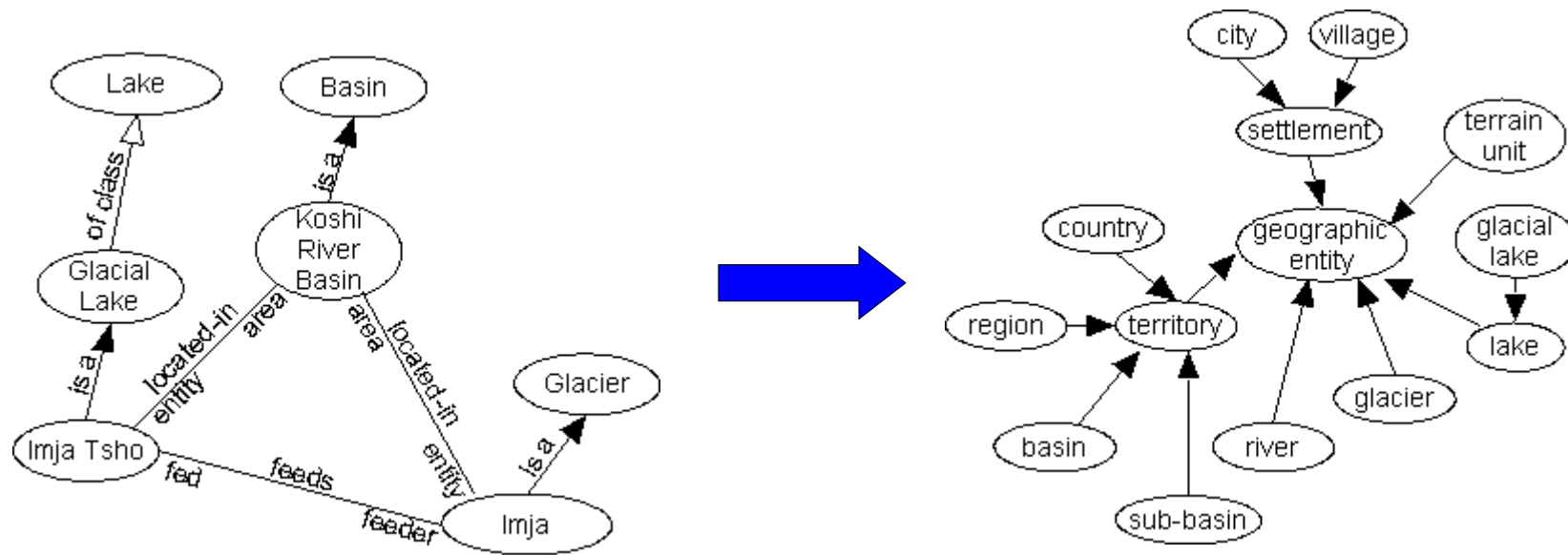
Reusable

Merging

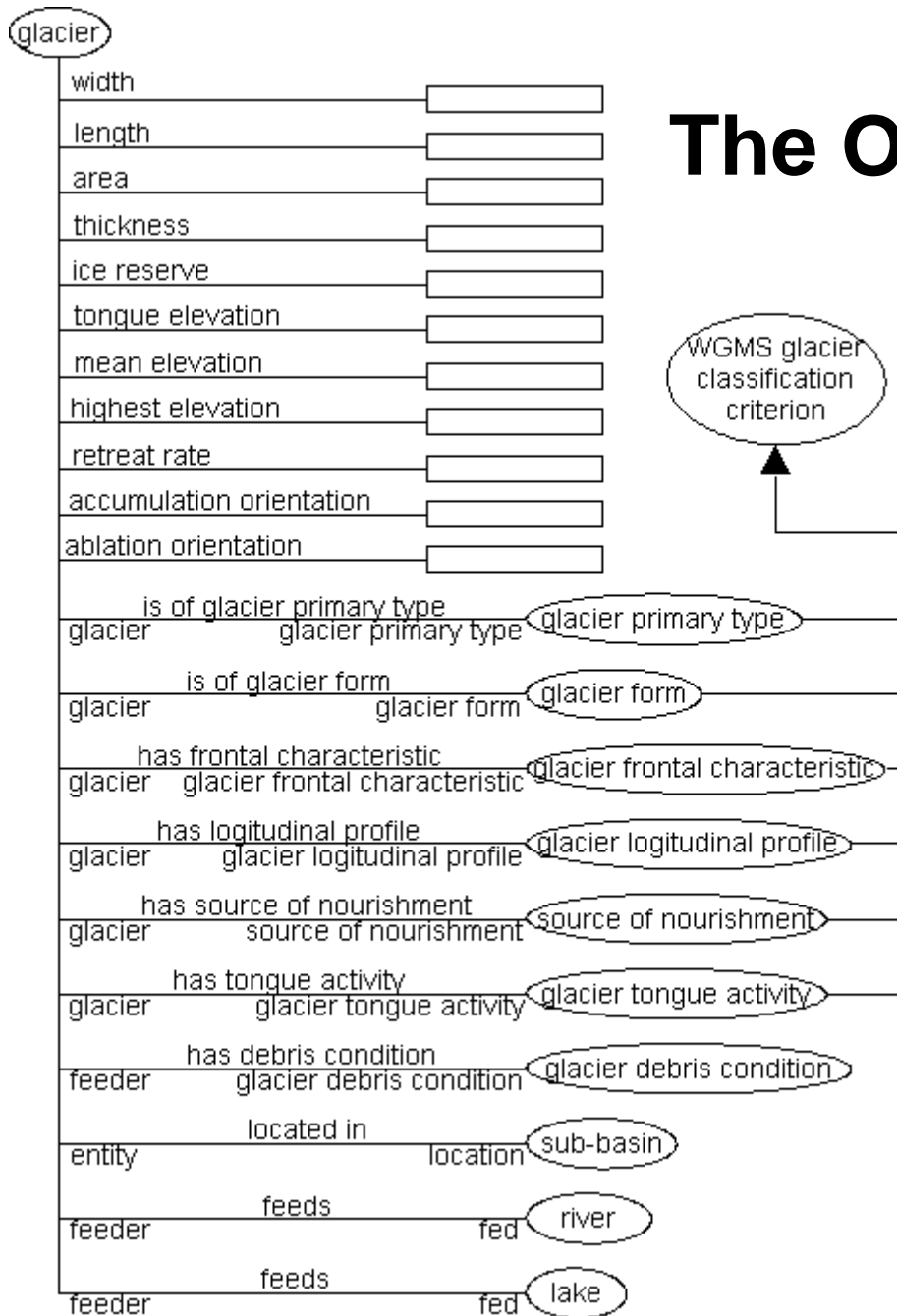
Goal: get satellite images of earthquake sites in California, after 1998



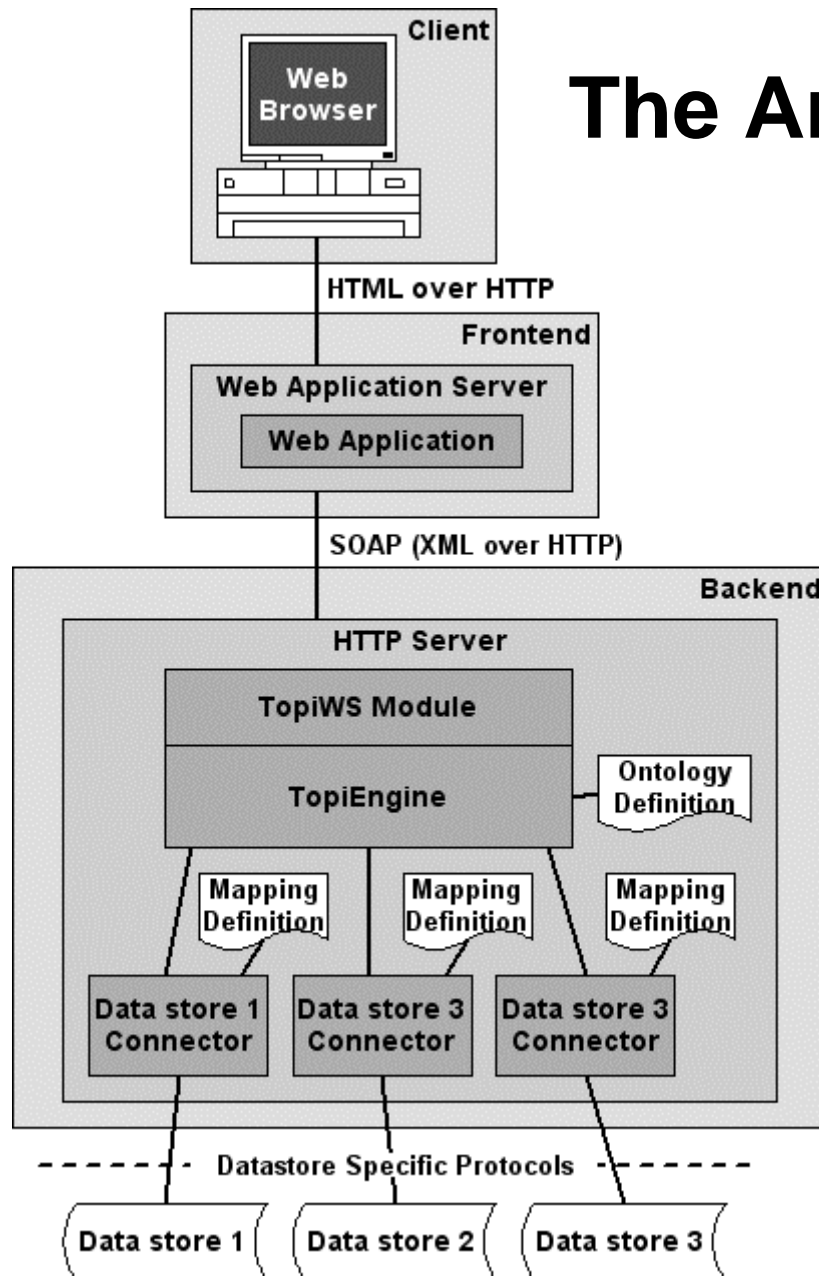
The Ontology (1)



The Ontology (2)



The Architecture



The User Interface

Search for: [Glaciers](#), [Lakes](#), [Territories](#), [Settlements](#), [Events](#), [Missions](#), [Devices](#), [Photographs](#).

Glaciers Search Form

Free search by name or identifier:

Filter by Localization

Country:

Region:

Basin:

Sub-Basin:

Coordinates: Latitude: Longitude:

Filter by Type

Classification Number:

Primary Type:

Form:

Frontal Characteristic:

Longitudinal Profile:

Source of Nourishment:

Tongue Activity:

Debris Condition: Any Debris Free Debris Covered

Filter by Characteristics

Period to consider: From: To:

Max Length: From: To: m

Max Width: From: To: m

Max Thickness: From: To: m

Area: From: To: m²

Highest Elevation: From: To: m

Ice Reserve: From: To: m³

Retreat Rate: From: To: m/yr

Accumulation Orientation:

Ablation Orientation:

Matching Glaciers

Search in progress ...

Glacier Number	Glacier Name
1 Kdu_gr 40	Langmuche
2 Gbu_gr 52	Hindun

Display the [full list](#) in a new window.

Search for: [Glaciers](#), [Lakes](#), [Territories](#), [Settlements](#), [Events](#), [Missions](#), [Devices](#), [Photographs](#).

Glacial Lake: Imja Tsho (Kdh_gl 350)

Display data for the year: 2004

Description

The **Imja Tsho** is a **supraglacial** lake located in [Nepal](#), in the [Dudh Koshi](#) sub-basin. Its parent glaciers are [Imja \(Kdu_gr 160\)](#) and [Lhotse \(Kdu_gr 156\)](#). It is oriented towards **South-West** and the coordinates of its approximate centre are: **27°54.00'** latitude North and **86°55.40'** longitude East.

The lake has a mean length of **410** meters and has an area of **40011** square meters. Its width is not available. Its surface is located at an altitude of **5023** meters above sea level, with an average depth of **XXX** meters. The volume of water stored in the lake is estimated at **YY** million cubic meters. The water itself has a temperature of **ZZ**°C and a degree of mineralisation of **M**.

The **Imja Tsho** lake did not experience any major event in the past. It is a **closed** lake considered as **potentially dangerous**.

The **Imja Tsho** lake is made of several lakes who merged in the year **YYYY**: [lake 1 \(num\)](#), [lake 2 \(num\)](#) and [lake 3 \(num\)](#).

The **Imja Tsho** lake has in the year **YYYY** into several lakes: [lake 1 \(num\)](#), [lake 2 \(num\)](#) and [lake 3 \(num\)](#).

[Picture1 \(PIC123\)](#), 31-Jan-2002

Relations

Imja Tsho is localized in:

- Country: [Nepal](#)
- Region:
- Basin: [Koshi River Basin](#)
- Sub-basin: [Dudh Koshi](#)

Imja Tsho experienced the following events:

- [GLOF in \(year\)](#)
- [GLOF in \(year\)](#)

Imja Tsho is fed by:

- Glacier: [Imja \(Kdu_gr 160\)](#)
- Glacier: [Lhotse \(Kdu_gr 156\)](#)

and feeds:

- Lake: [Lake A \(Kdu_gl 123\)](#)
- River: [River B](#)

Resources

	Name	Reference	Date	Type	Mission	Resolution	Size
Pictures	Picture1	PIC123	31-Jan-2002	JPG		4096x3192	2.3 MB
	Picture2	PIC234	4-Mar-2003	JPG		1024x768	750 kB
	Picture3	PIC345	4-Mar-2003	JPG		4096x4096	3.3 MB
Movies	Movie1	MOV123	31-Jan-2002	QuickTime		640x480	15 min, 65 MB
	Movie2	MOV234	31-Jan-2002	AVI		320x240	3 min, 13 MB
Maps	Map1	SF123		Shapefile			
	Map2	MAP321	7-May-2006	TIFF			

Related Activities - LINDO

Large Scale Distributed Indexation of Multi media Objects (LINDO)

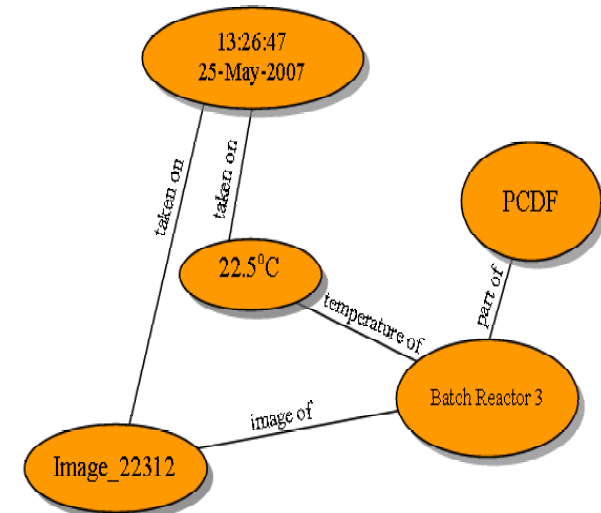
- European project – IWT/ITEA2 project (ITEA2-06011).
- The Belgian part of LINDO targets a **portable domain question answering system over Topic Maps**.
- Has started November 2007.
- A three year research project.
- The results of LINDO will be tested against the topic maps developed in SATOPI.



Related Activities - ULISSE - FP7 IP

Knowledge Integration and Dissemination for Space Science Experimentation

- This project aims at pursuing the exploitation and valorization of scientific data from previous and future space science experiments on the ISS and other space platforms, promoting the involvement of specialized communities and awareness of the general public.
- It will merge and provide access to scientific and technical data of most scientific disciplines, including Life Sciences, Space Medicine and Exobiology, Biotechnology, Material and Fluid Sciences.
- The vision related to Topic Maps in this project is to organize, merge and provide unique access to multi disciplinary data.



Future Work – GLADI

- The project will be build on three conceptual pillars:
 - Innovation related to federation of data from different sources with knowledge, and providing one access point to this data using domain terminology.
 - Innovation related to the collection of data using remote EO data with WSN, and the reduce of cost in deployment and maintenance of WSN.
 - Two use cases, one in the Alps and one in The Himalaya Mountain which take advantage of the semantic backbone and the collected data in order to model, simulate and understand better processes and threats related to GLOFs.
- The development in the project will relay on these three pillars and will be built from the following steps:
 - Identifying 20 dangerous lakes using remote EO.
 - Installing WSN on some of those.
 - Using the data gathered and the facilitated access to it provided by the semantic integration backbone, research will be done in order to identify precursors for an event, and to understand the processes involved.
 - This research will lead to the understanding of which sensors should be deployed in order to identify future events.

Thank you
for your
attention

