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Bundesamt für Landestopografie
Office fédéral de topographie
Ufficio federale di topografia
Uffizi federal da topografia

Elements of a Service Oriented Architecture (SOA) based on OGC and W3C Standards

Hans Ulrich Wiedmer, Swiss Federal Office of Topography
COGIS: Coordination, geoinformation and services

FOSS4G 2006, Lausanne

Outline

- Organisation: COGIS: Coordination, Geoinformation and Services
- What is Service Oriented Architecture (SOA)?
- ZapThink's SOA Roadmap
- Elements of a SOA (walking along the Roadmap …)
  - Web Service Implementations
  - Identity and Access Management (IAM)
  - Governance Framework
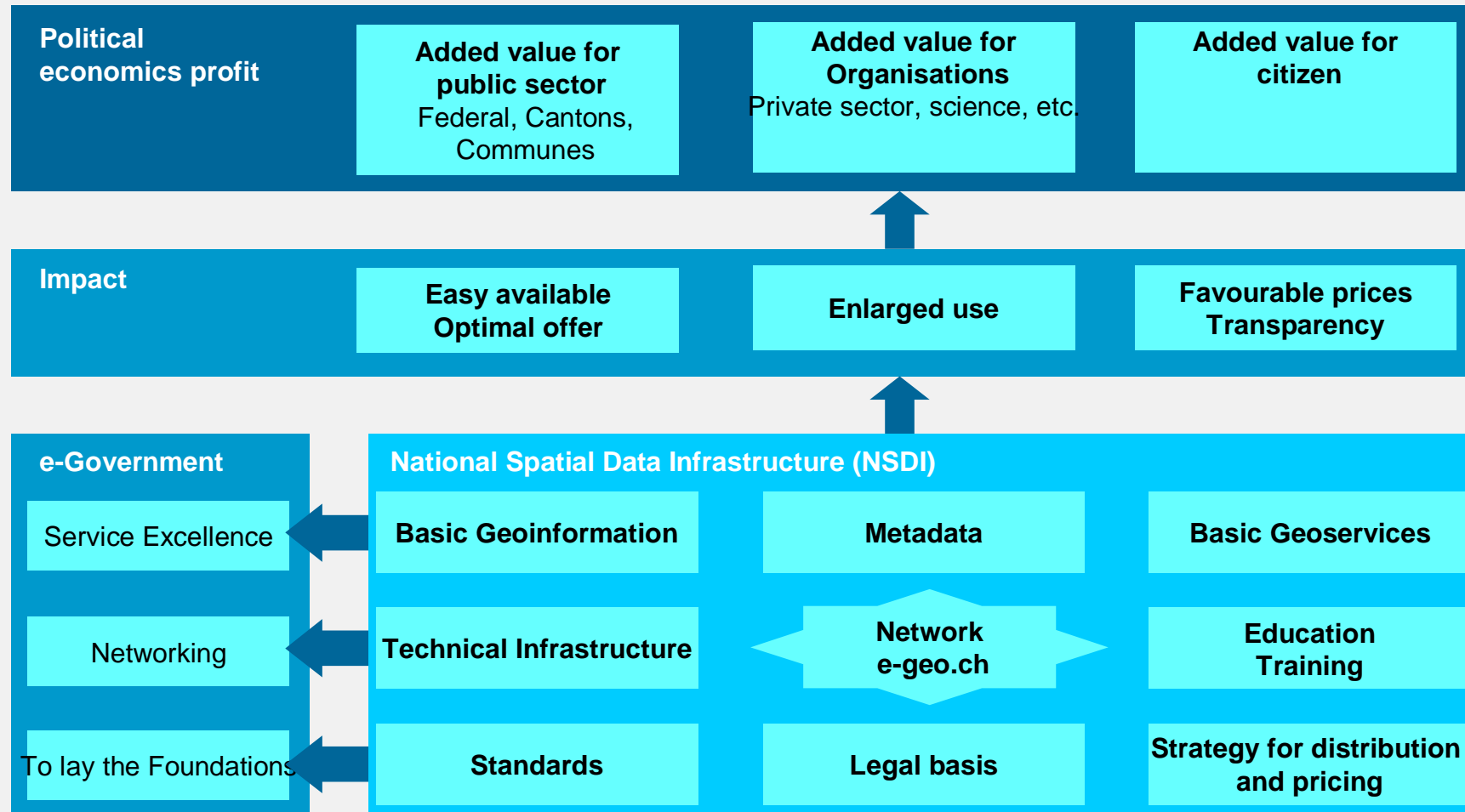 - Metadata Management
  - MDA, Semantic Integration
- Conclusion

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+ + +

Mission of COGIS:
Coordination, geoinformation and services

- movement towards a better promotion of geoinformation, its methods and tools
- agreement on a common strategy for geoinformation and GIS
- coordination of acquisition, diffusion and pricing policies related to geographical data
- the promotion in the use of tools and standards for modelling and geographical data exchange
- the promotion of services for disseminating geoinformation

<div style="border:2px solid red;">

The federal strategy for geoinformation

passed by the federal council in June 2001

main goal: Swiss National Spatial Data Infrastructure

</div>

Political economics profit, Impact and the National Spatial Data Infrastructure (NSDI)

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→ Hear Jean-Philippe Amstein at Friday, 14:20, on "Implementation of the Swiss National Geodata Infrastructure" (MAX 350)

Political economics profit	**Added value for public sector** Federal, Cantons, Communes	**Added value for Organisations** Private sector, science, etc.	**Added value for citizen**

Impact	**Easy available Optimal offer**	**Enlarged use**	**Favourable prices Transparency**

e-Government

Service Excellence	←	**Basic Geoinformation**	**Metadata**	**Basic Geoservices**

National Spatial Data Infrastructure (NSDI)

Networking	←	**Technical Infrastructure**	**Network e-geo.ch**	**Education Training**

To lay the Foundations	←	**Standards**	**Legal basis**	**Strategy for distribution and pricing**

Federal Spatial Data Infrastructure

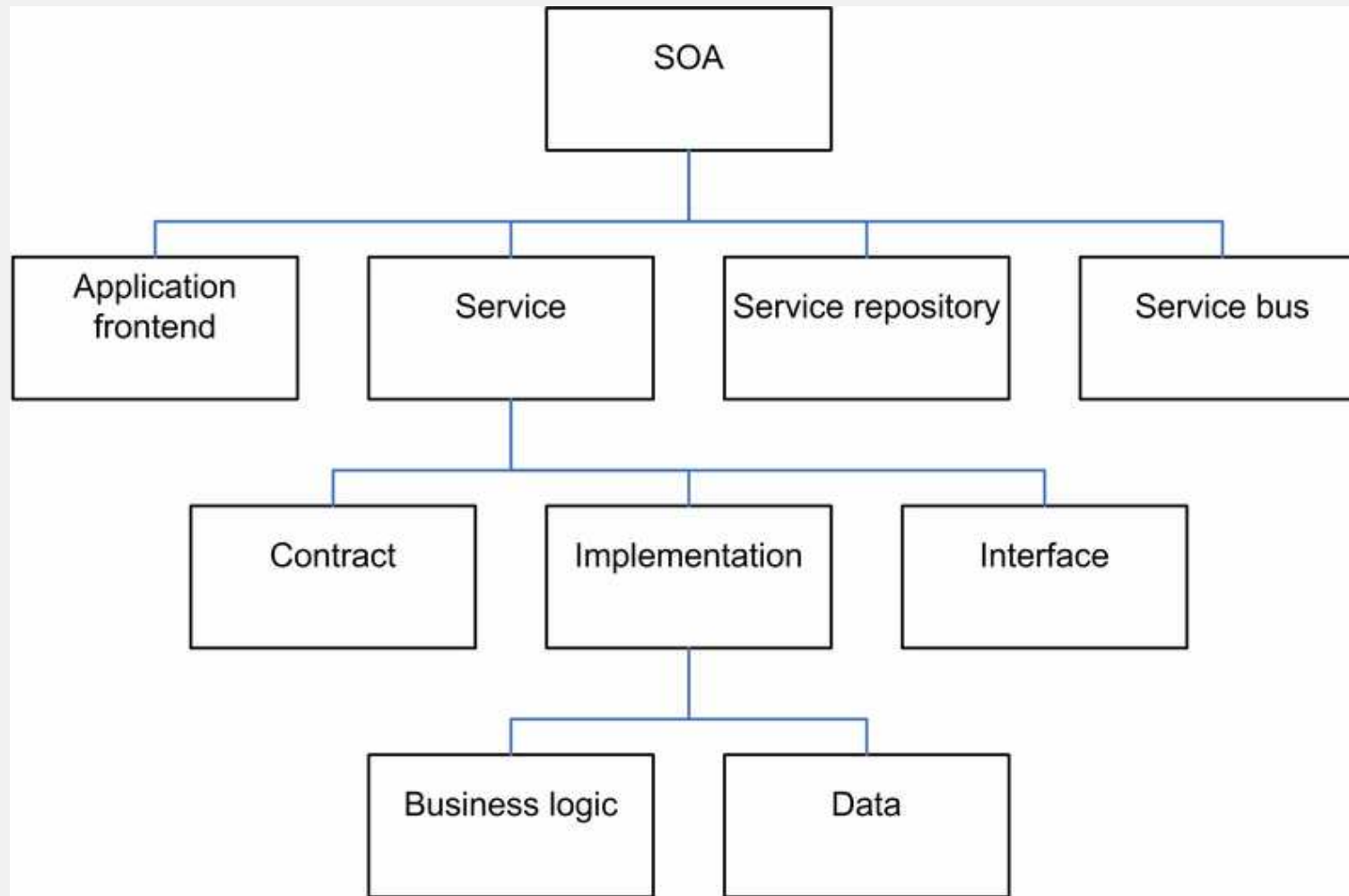- Federal geographical data
- Networked services
- Federal SDI as
  part of the NSDI
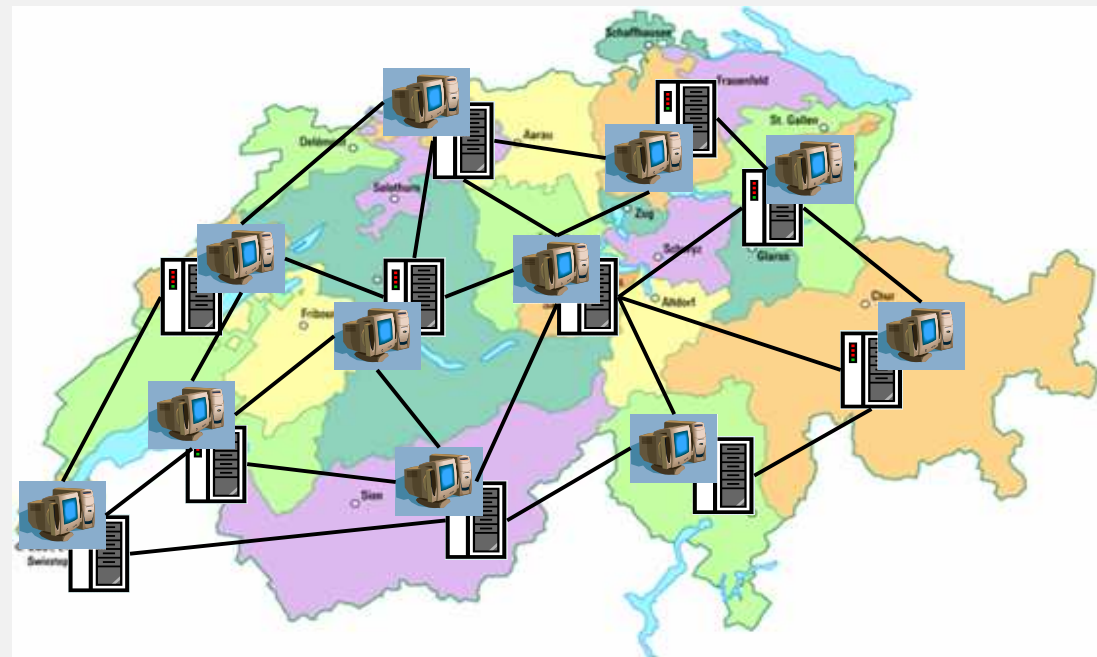
What is Service Oriented Architecture (SOA)?

- **perspective of software architecture**

- defines the **use of loosely coupled software services** to support the requirements of the business processes and software users.

- resources on a network are made available as independent services

- services can be accessed without knowledge of their underlying platform implementation
  [http://en.wikipedia.org/wiki/Service-oriented_architecture]

- Definition from OASIS:
  Service Oriented Architecture is a paradigm for organizing and utilizing distributed capabilities that may be under the control of different ownership domains. It provides a uniform means to offer, discover, interact with and use capabilities to produce desired effects consistent with measurable preconditions and expectations.

Elements of a SOA (acc. to Krafzig et al)
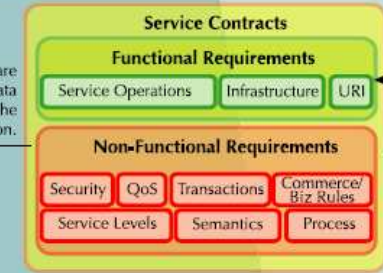
zapthink's Service-Oriented Architecture Roadmap™

The first step toward SOA
for many organizations is
to use Web Services for
point-to-point integration,
typically with legacy sytems.

Service
Consumer — bind — Service
Provider

Web Services Security

Network (Packet) Level	Application Level
TCP/IP packet inspection perimeter-based	XML-based Content aware Application control

Closed Systems	Open Systems
Proprietary, closed APIs Tight coupling Single administrator Localized users	Open, accessable APIs Loose coupling Multiple administrators Distributed users

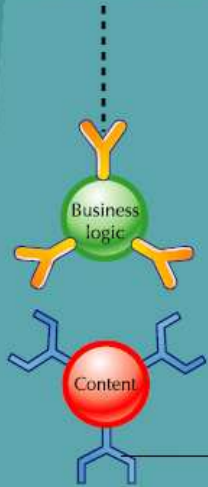| Fragmented Control	Managed Security
Islands of security Maintained as separate units	Whole network policies Tiered administration

Governance allows
management to plan
an orderly SOA by
communicating policies to
employees, providing tools
for enforcing those policies,
increasing visibility into
policy compliance, and
mitigating any problems
that result.

Service contracts are
the critical metadata
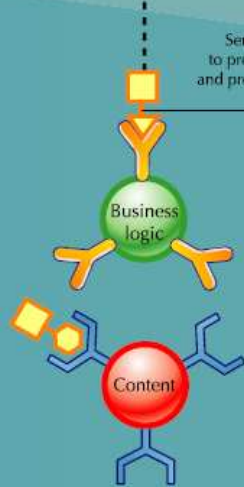that underlie the
Services abstraction.

Service Contracts

Functional Requirements

Service Operations	Infrastructure	URI

Non-Functional Requirements

Security	QoS	Transactions	Commerce/ Biz Rules
Service Levels	Semantics		Process

Create a Governance Framework

Implementation
Timeline

Heterogeneous Systems with Proprietary Interfaces

Wrap Legacy Systems in Services Interfaces

Secure Service Interfaces

Manage Services

Includes business
process management,
transaction management,
business activity
monitoring, and
billing and metering.

Includes
provisioning,
version control,
Web Service
dependencies,
& deprecation.

Service adapters bind
to proprietary interfaces
and provide standardized
interfaces.

Companies who are
already implementing
Single Sign-On (SSO)
can "kill two birds with
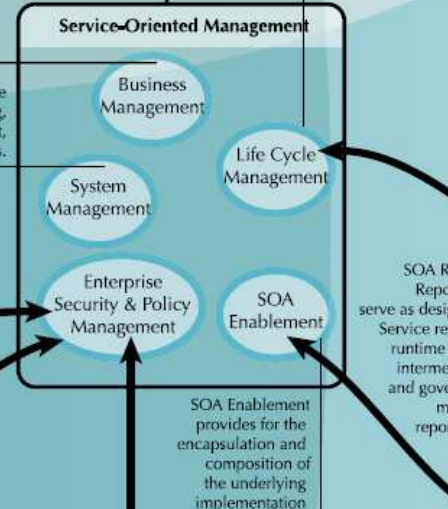one stone" by leveraging
those efforts for SOA.

Includes Web Service
monitoring, alerting,
exception management,
and root cause analysis.

Service-Oriented Management

Business
Management

Business
logic

Business
logic

System
Management

Life Cycle
Management

Identity and Access Management

Content

Content

LDAP

Identity and
Access
Management

Enterprise
Security & Policy
Management

SOA
Enablement

Digital
Certificates

Identity
Management
Specifications

Governance & Policy

SOA R...
Repo...
serve as desig...
Service re...
runtime
interme...
and gove...
m...
repo...

SOA Enablement
provides for the
encapsulation and
composition of
the underlying
implementation

Service Contracts

Functional Requirements

Service Operations | Infrastructure | URI

Non-Functional Requirements

Security | QoS | Transactions | Commerce/Biz Rules

Service Levels | Semantics | Process

WSDL Contract Specs
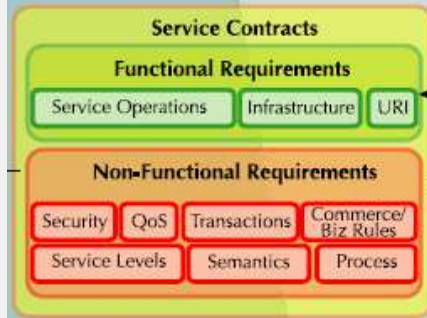
The SOA Metamodel represents all the design time and runtime models that represent SOA.

Building reusable, composable Services enables an SOA to change to meet unpredictable requirements both inside and outside the company.

Service-oriented composite applications consist of Service-oriented processes.

Implement the SOA Metamodel

Contract-First Development

Service-Oriented Process

Sema Integra

Manage Services

Contract-first development is a key best practice for creating the Services in the Service Model.
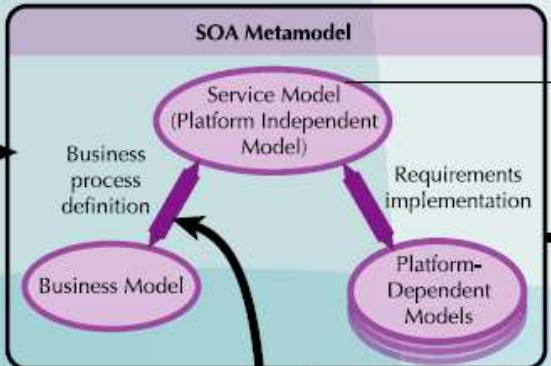
...business ...management, ...on management, ...activity ...g, and ...d metering.

Includes provisioning, version control, Web Service dependencies, & deprecation.

SOA Metamodel

Service Model (Platform Independent Model)

Business process definition

Requirements implementation

Business Model

Platform-Dependent Models

The Service Model represents business Services in production as well as requirements for new Services.

Semantic I

Taxon

Service-Oriented Management

Business Management

System Management

Enterprise Security & Policy Management

SOA Enablement

Life Cycle Management

Service-Oriented Metadata Management is critical for implementing policy and governance solutions in SOA implementations.

Metadata Managment

UDDI ebXML

MDA Agile Methodologies TOGAF

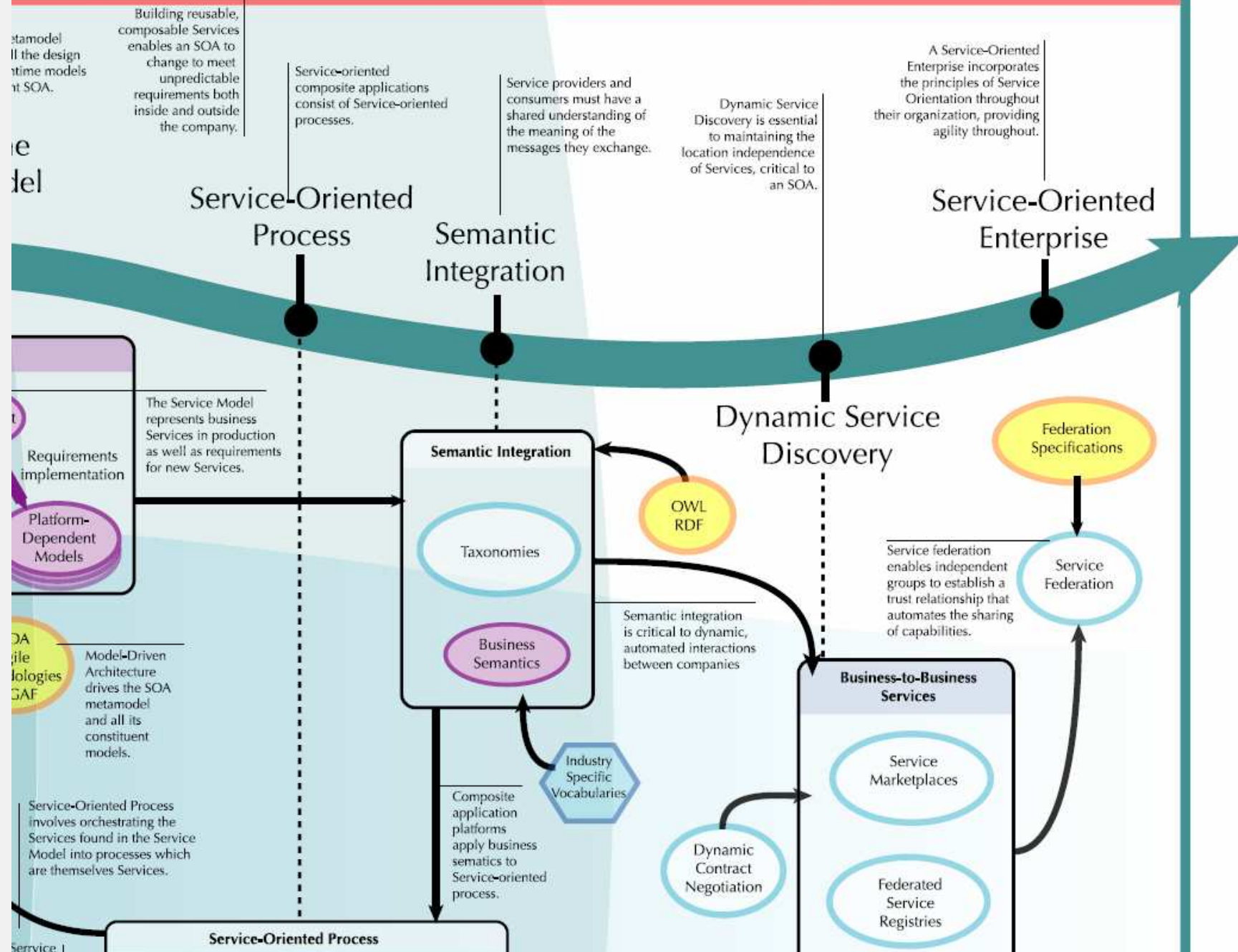Model-Driven Architecture drives the SOA metamodel and all its constituent models.

Bus Sem

SOA Registry/ Repositories serve as design-time Service registries, runtime Service intermediaries, and governance metadata repositories.
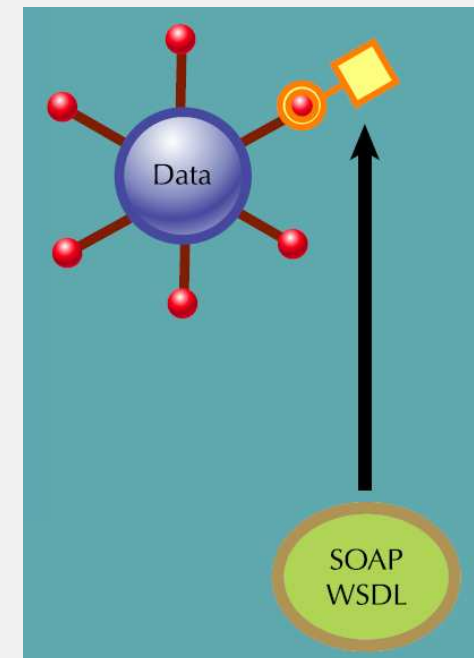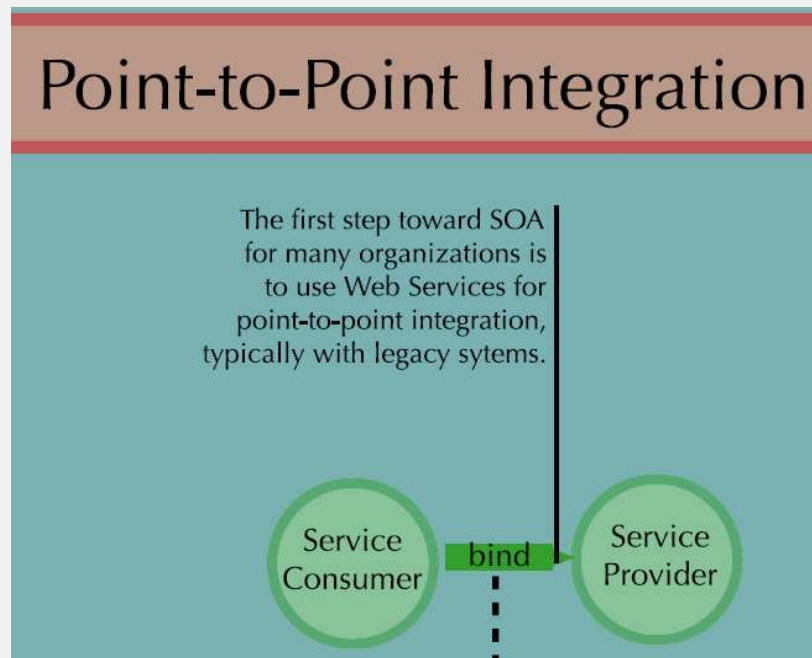
Registry/ Repository

Asset Management

Service-Oriented Process involves orchestrating the Services found in the Service Model into processes which are themselves Services.

Composi applicati platform apply bu sematics Service-process.

SOA Enablement provides for the encapsulation and

Service-Oriented Process

The use of Service

Composable, Reusable Services

Enterprise SOA

Building reusable, composable Services enables an SOA to change to meet unpredictable requirements both inside and outside the company.

Service-oriented composite applications consist of Service-oriented processes.

Service providers and consumers must have a shared understanding of the meaning of the messages they exchange.

Dynamic Service Discovery is essential to maintaining the location independence of Services, critical to an SOA.

A Service-Oriented Enterprise incorporates the principles of Service Orientation throughout their organization, providing agility throughout.

etamodel ll the design ntime models t SOA.

e del

Service-Oriented Process

Semantic Integration

Dynamic Service Discovery

Service-Oriented Enterprise

The Service Model represents business Services in production as well as requirements for new Services.

Requirements implementation

Platform-Dependent Models

Semantic Integration

Taxonomies

OWL RDF

Federation Specifications

Service federation enables independent groups to establish a trust relationship that automates the sharing of capabilities.

Service Federation

Business Semantics

Semantic integration is critical to dynamic, automated interactions between companies

OA gile lologies GAF

Model-Driven Architecture drives the SOA metamodel and all its constituent models.

Business-to-Business Services

Industry Specific Vocabularies

Service Marketplaces

Service-Oriented Process involves orchestrating the Services found in the Service Model into processes which are themselves Services.

Composite application platforms apply business semantics to Service-oriented process.

Dynamic Contract Negotiation

Federated Service Registries

Service-Oriented Process

Service

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Service Implementations

- Service interfaces wrap geodata
- Usage of these services primarily in in house projects
- „tight coupling" of know how between provider and consumer

National Spatial Data Infrastructure (NSDI)

Basic Geoinformation	Metadata	Basic Geoservices
Technical Infrastructure	Network e-geo.ch	Education Training
Standards	Legal basis	Strategy for distribution and pricing

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Networked services spring from exploitable geographical data

The geodata portal: an element of the Federal Spatial Data Infrastructure

The Geodata Portal of swisstopo / KOGIS
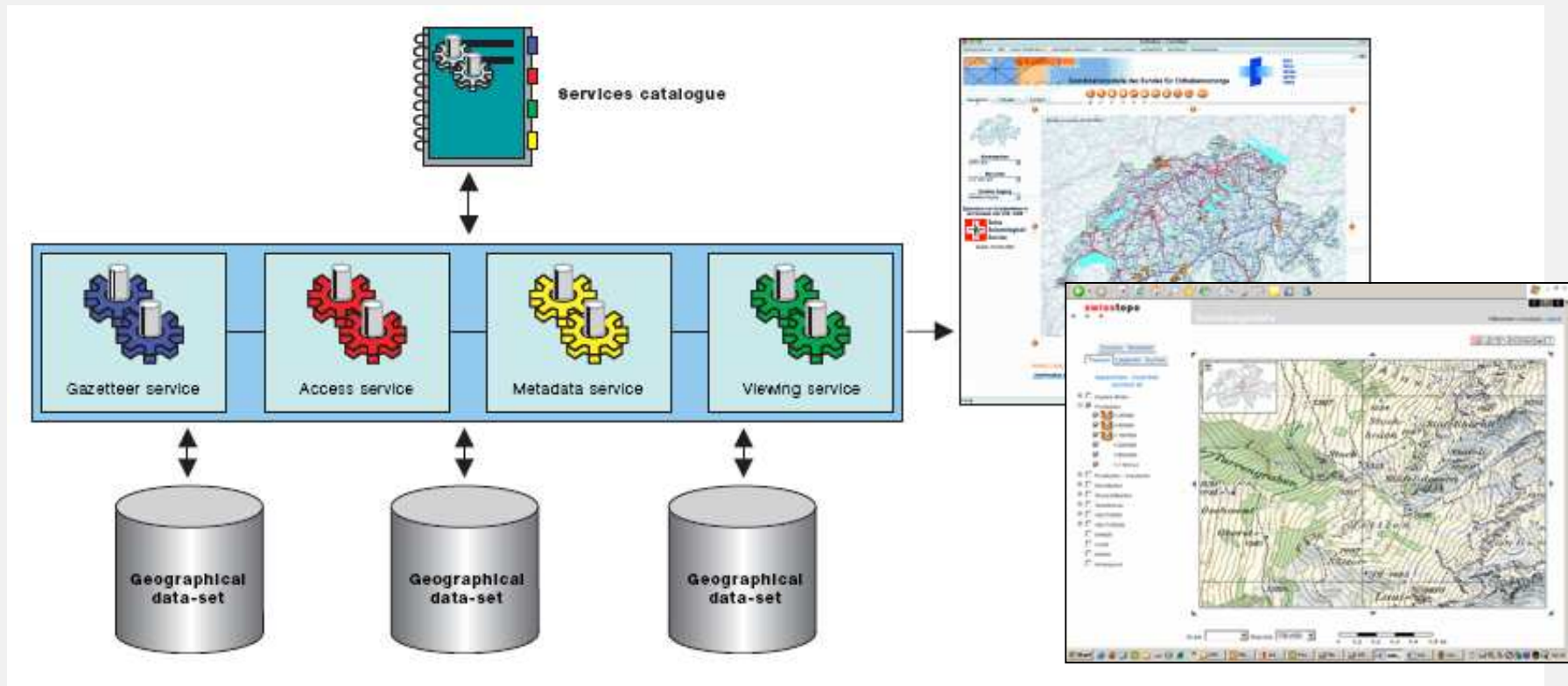
Geodata portal with services

Applications (combination of services)

Types of services

Gazetteer service

Access service

Metadata service

Viewing service
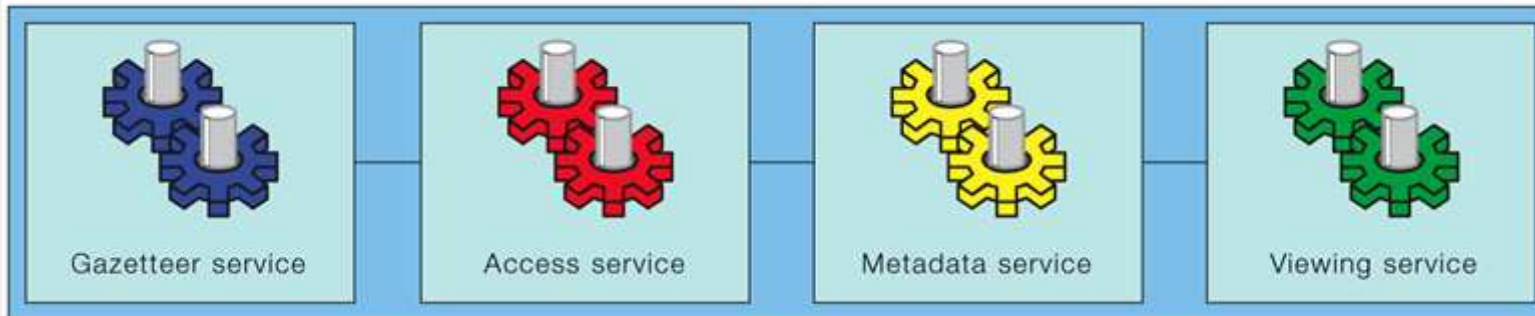
Chaining of services

gov. address register **ZIP Code** **pixel map PK25**

Suchdienst   Suchdienst   Visualisierungs-
dienst
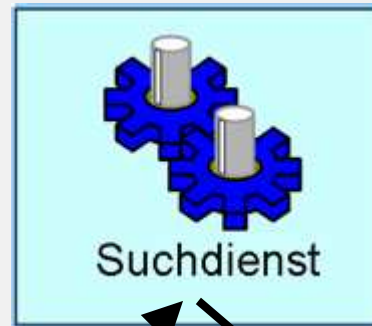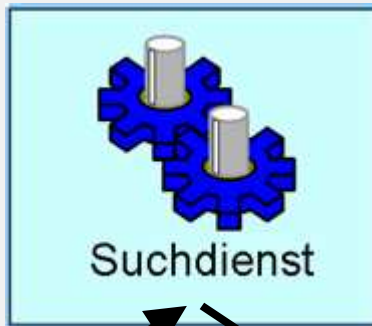
Commune, street   X, Y   ZIP, town   Map

Köniz,   *600977,*   *3084 Wabern*
Seftigenstr.   *197417*
284

Technologies for geographical web services

- SOAP (Simple Object Access Protocol)
  for search services (see following slides)

- OGC WMS (Web Map Service) for visualization services:

- http://some.server.ch/wms?
      version=1.1.1&
      request=GetMap&
      Layers=pk50,vec200_building,vec200_road&
      format=png&
      bbox=643000,176500,651000,184500&
      width=800&height=800

Example: business process of the Federal Office of Communications OFCOM Management of antenna locations

- request for new antenna: neighbour cantons are involved too

- **problem**: how to find these cantons
- **solution**: SOAP-Service (implemented using the open source database PostGIS)

swisstopo logo in top right

swisstopo
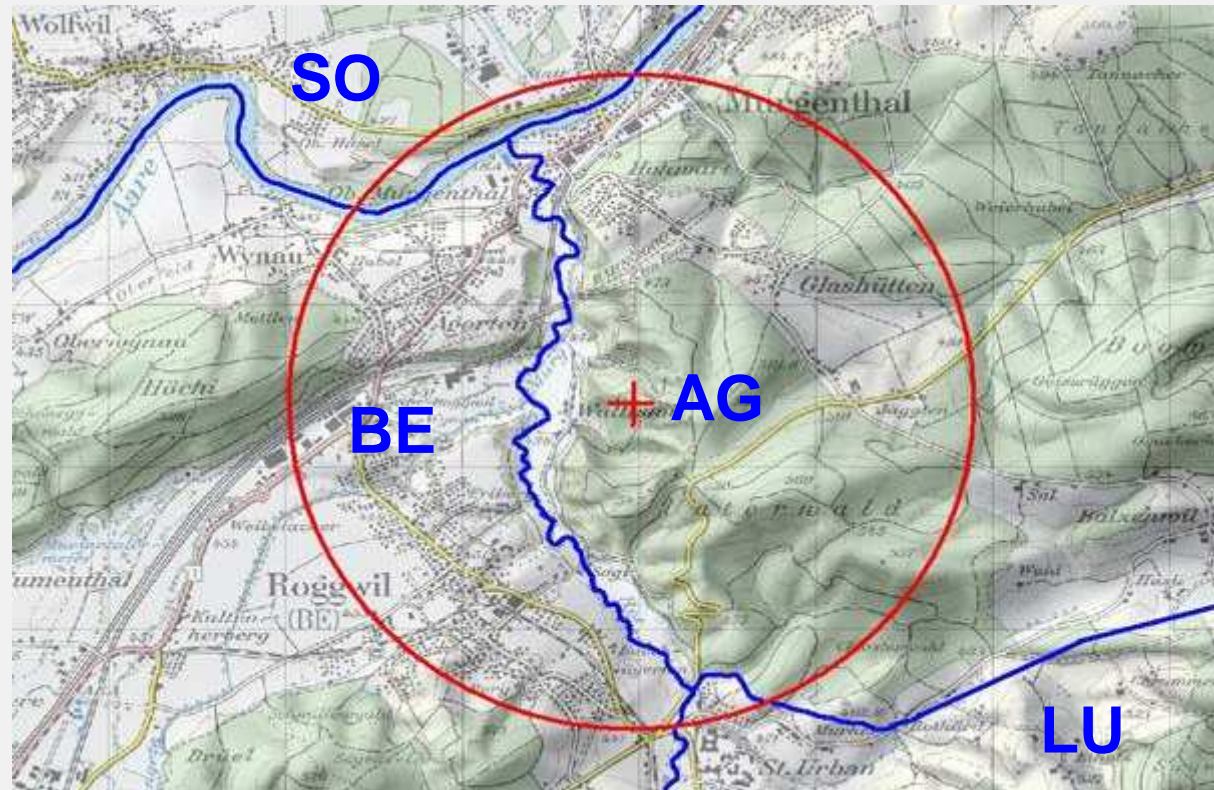
What is SOAP?
(Simple Object Access Protocol)

Request:

(simplified)

```
<getCantonsInCircle>
  <x>629980</x>
  <y>233350</y>
  <radius>2000</radius>
</getCantonsInCircle>
```

Question: in which canton lies the point 629980 / 233350? Which cantons are in the neighbourhood?

Response:

(simplified)

```
<getCantonsInCircleResponse>
  <canton>AG</canton>
  <cantonCrossed>
    <item>BE</item>
    <item>SO</item>
    <item>LU</item>
  </cantonCrossed>
</getCantonsInCircleResponse>
```

*Answer:
The point lies in AG with SO, BE, LU in the neighbourhood*

Web Service Implementation
on PostGIS basis: few code required

```php
// get the canton below the coords (x,y)
$result = pg_query("SELECT ak FROM bfs.kanton " .
        "WHERE contains(the_geom, GeometryFromText('POINT($x $y)', -1));");
$cantonBelow = pg_fetch_row($result);
if ($cantonBelow)
  $cantonBelow = $cantonBelow[0];

// get the cantons that are inside (even partially)
// the circle except the previous one.
$result_2 = pg_query("SELECT ak FROM bfs.kanton " .
        "WHERE ak <> '$cantonBelow' AND " .
        "distance(the_geom, GeometryFromText('POINT($x $y)', -1)) < $radius;");
```

- PostGIS SQL statement:
  ```sql
  SELECT ak FROM bfs.kanton WHERE contains(the_geom,
  GeometryFromText('POINT($x $y)', -1));
  ```

- (yet another PostGIS case study … ➔ cf. talk of Paul Ramsey)

What is WSDL?
(Web Service Description Language)

- **Description of result (simplified) :**

```
- <complexType name="getGeoDataBySn25Response">
  - <all>
      <element name="msg" type="xsd:string" />
      <element name="data" type="types:SNData" />
    </all>
  </complexType>
- <complexType name="SNData">
  - <all>
      <element name="id" type="xsd:int" />
      <element name="name" type="xsd:strin
      <element name="gemname" type="xsd:s
      <element name="kanton" type="xsd:string
      <element name="x" type="xsd:double" />
      <element name="y" type="xsd:double" />
    </all>
  </complexType>
```

*The answer contains the fields id, name etc. and the **fields x, y of type double for the coordinates***

Portals and tools for portal development
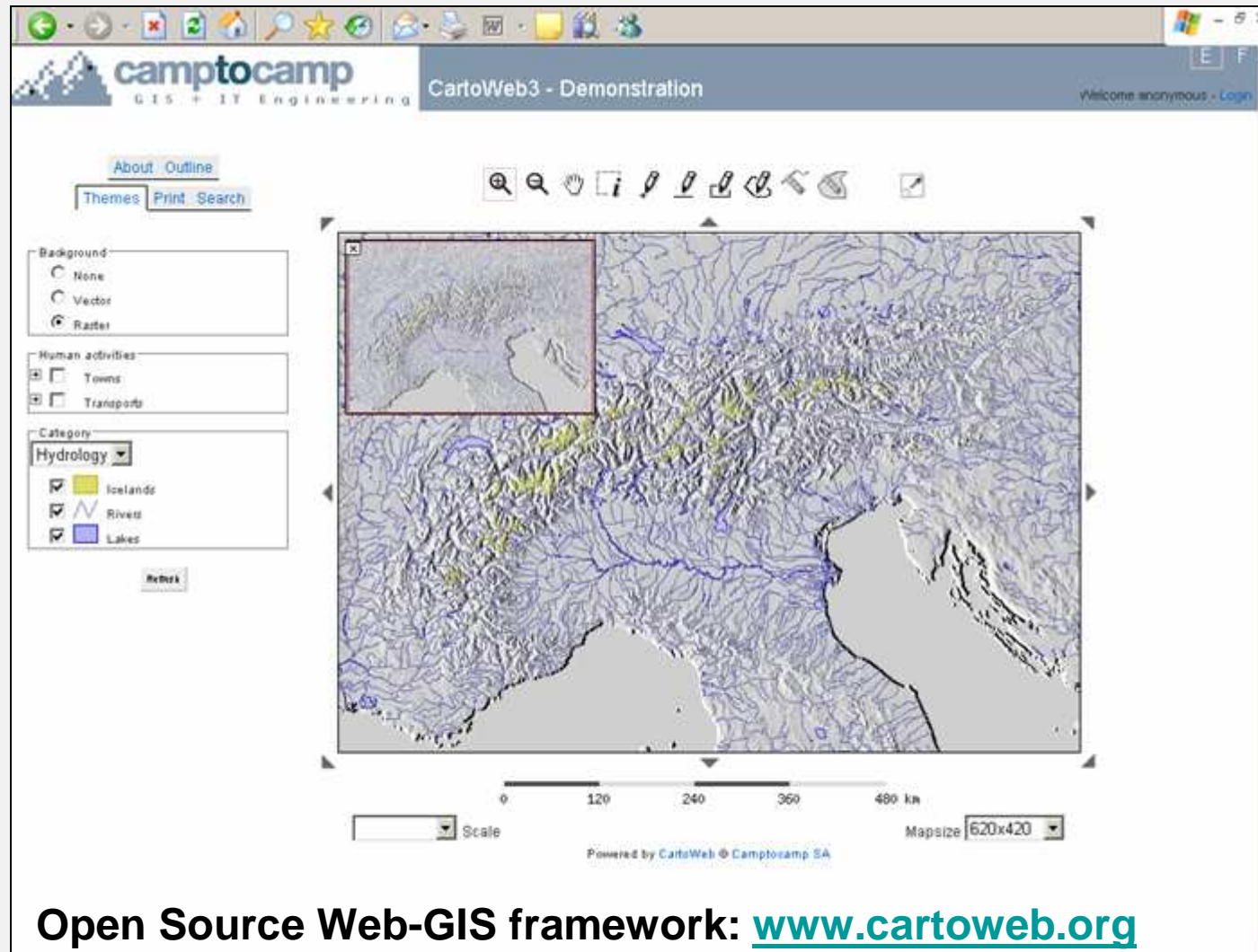
Open Source Web-GIS framework: www.cartoweb.org

Federal Office of Communications OFCOM
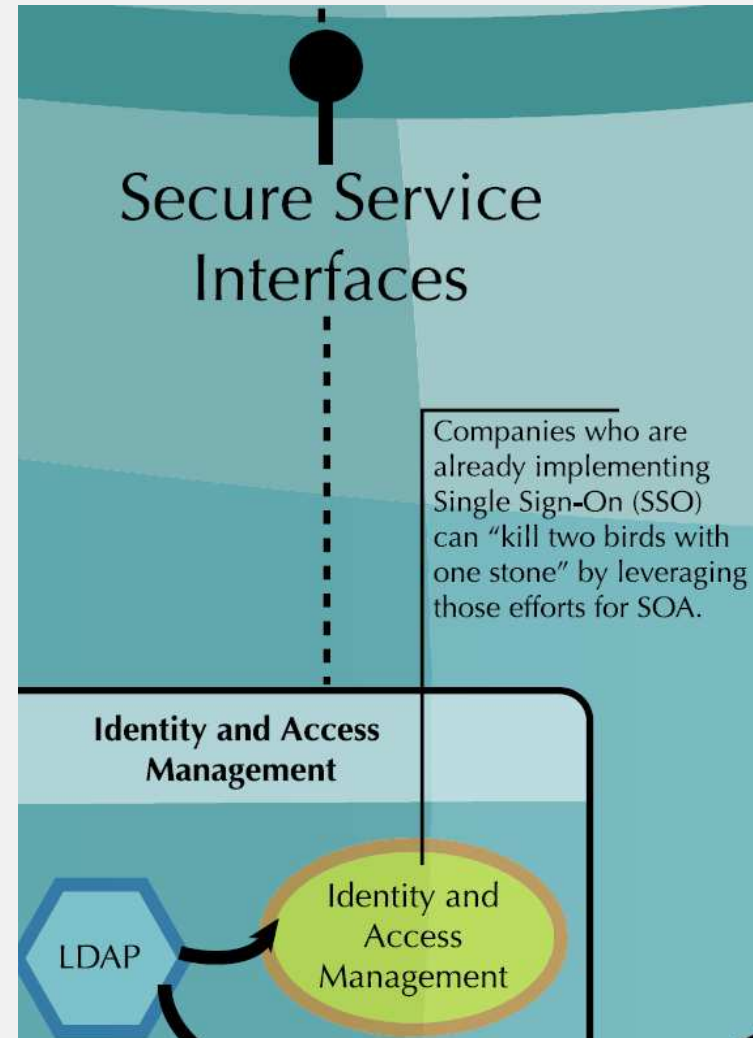## cataster of existing antennas (www.funksender.ch)

Swiss Federal Roads Authority (FEDRO)
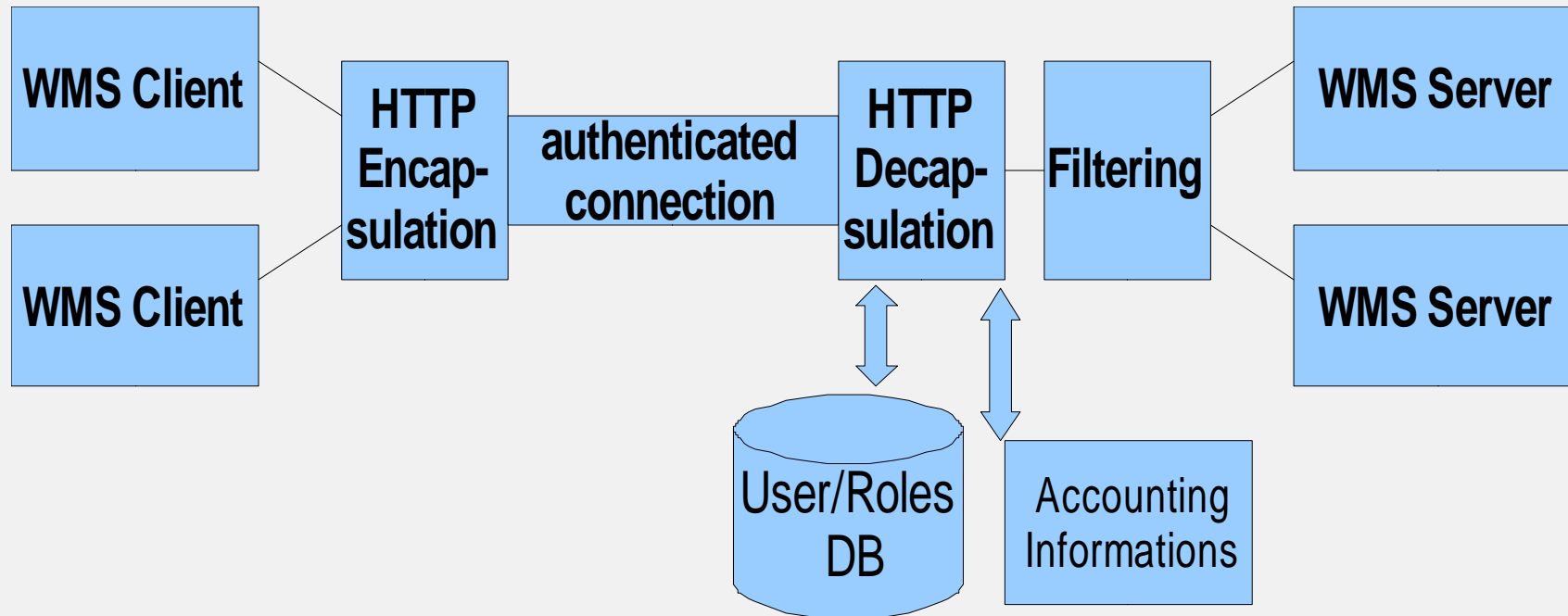# Consolidation of slow motion traffic routes
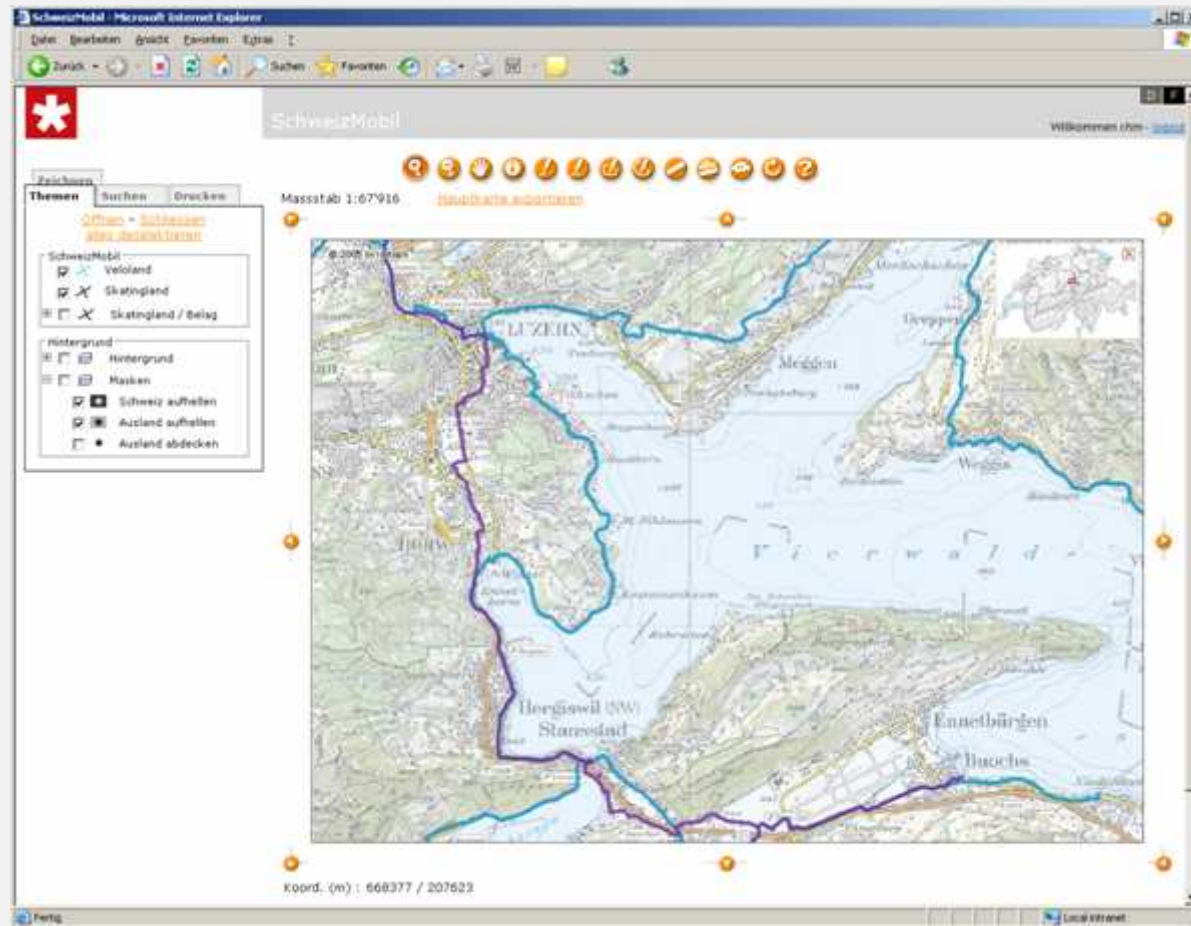
Identity and Access Management

- Protection of services:
  see next slides or camptocamp
  presentation: "Secure WMS
  Implementation"
- User management:
  - today: simply databases,
    not coordinated
  - tomorrow: LDAP, Single
    Sign On

Secure WMS Implementation: Architecture

- Simple access restrictions per role / user (layer, BBOX)

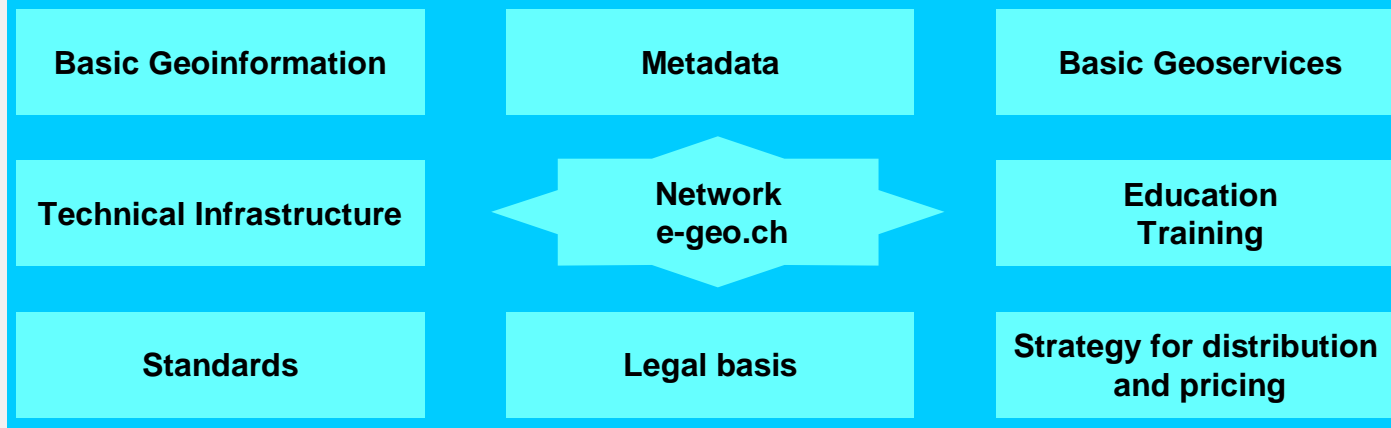# Secure WMS Implementation: Summary

- Baseline:
  - No OGC standard for security yet
  - Must keep interoperability with existing clients
- Conclusion
  - Market needs are faster than OGC
  - This architecture provides a simple transitional solution
- Source of these slides and more info:
  ➔ talk of Sylvain Pasche, camptocamp SA:
  "Secure WMS Implementation"

metadata management for geographical data and services

- operational since Q1/2005:
  www.geocat.ch
  swiss metadata catalogue

- basis: swiss profile of
  ISO 19115

- currently under investigation:
  extension for service metadata
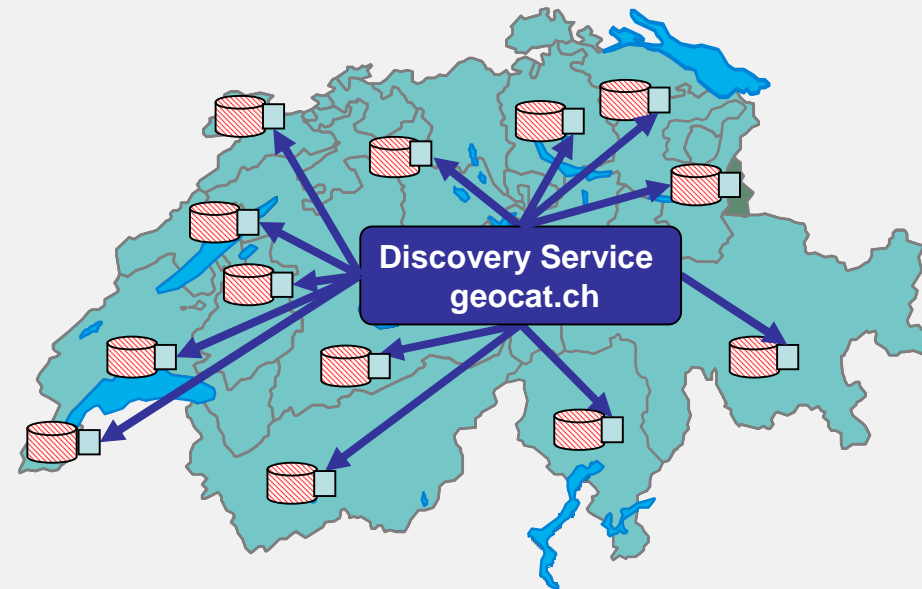 (with ISO 19119 under
  consideration, among others)

Service-Oriented Metadata Management is critical for implementing policy and governance solutions in SOA implementations.

Metadata Managment

SOA Registry/Repositories serve as design-time Service registries, runtime Service intermediaries, and governance metadata repositories.

Registry/Repository

Asset Management

National Spatial Data Infrastructure (NSDI)

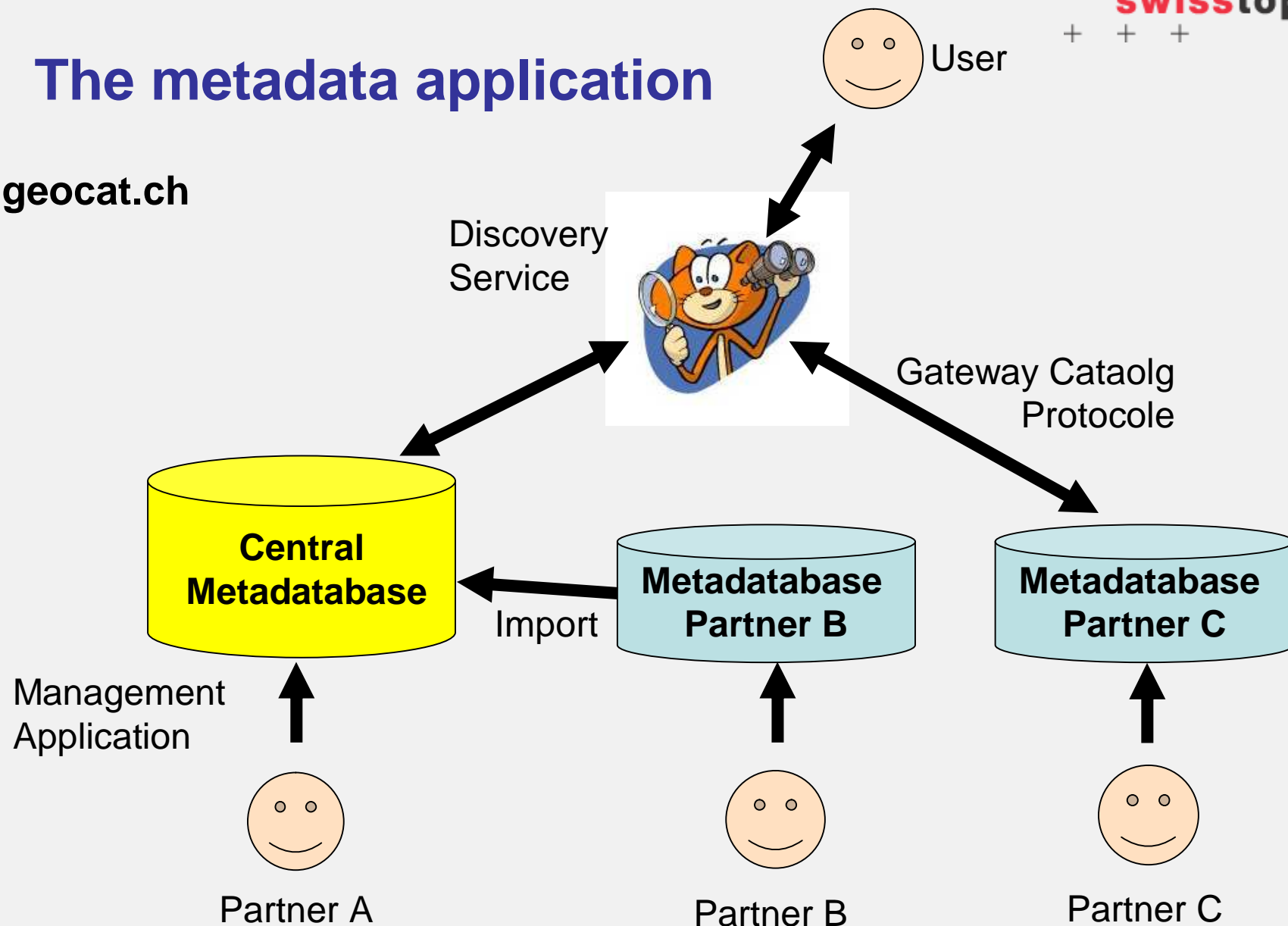| Basic Geoinformation	Metadata	Basic Geoservices
Technical Infrastructure	Network e-geo.ch	Education Training
Standards	Legal basis	Strategy for distribution and pricing

- The geocat.ch project set up a metadata catalogue for GI
- search for metadata on the Internet
- add, edit, manage metadata
- framework of distributed metadata and applications in a federated and heterogeneous infrastructure.
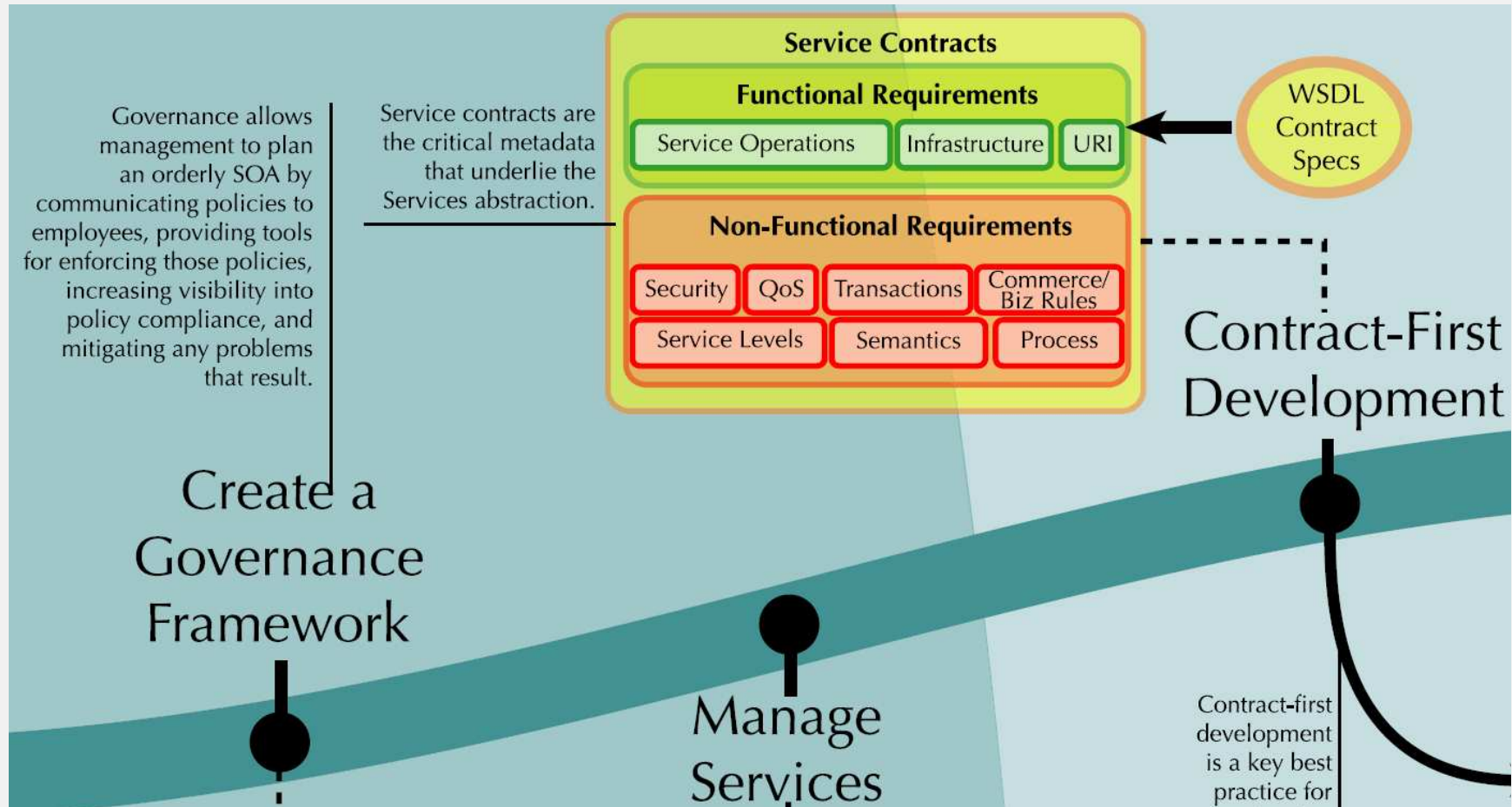
Discovery Service geocat.ch

The metadata application

geocat.ch

swisstopo

User

Discovery Service

Gateway Cataolg Protocole

Central Metadatabase

Metadatabase Partner B

Metadatabase Partner C

Import

Management Application

Partner A

Partner B

Partner C

Eurogeographics: www.euromapfinder.net
➔ find geographical data in Europe

governance framework

Governance allows management to plan an orderly SOA by communicating policies to employees, providing tools for enforcing those policies, increasing visibility into policy compliance, and mitigating any problems that result.

Service contracts are the critical metadata that underlie the Services abstraction.

Service Contracts

Functional Requirements

Service Operations | Infrastructure | URI

Non-Functional Requirements

Security | QoS | Transactions | Commerce/Biz Rules

Service Levels | Semantics | Process

WSDL Contract Specs

Create a Governance Framework

Manage Services

Contract-First Development

Contract-first development is a key best practice for

two parts of a governance framework

- **organisational framework and pricing for a service network**
  - price models for pixel data services defined
  - service contracts: to be defined, first discussions

  - http://www.swisstopo.ch/pub/down/about/publi/studieVerrechnun gsmodelleOeffentlich_en.pdf (german)
  - http://www.swisstopo.ch/pub/down/about/publi/studieVerrechnun gsmodelleOeffentlich_fr.pdf (french)
  - http://www.swisstopo.ch/pub/down/about/publi/studieVerrechnun gsmodelleOeffentlich_de.pdf (english)

- **swiss application profile for geoservices – see next slides**

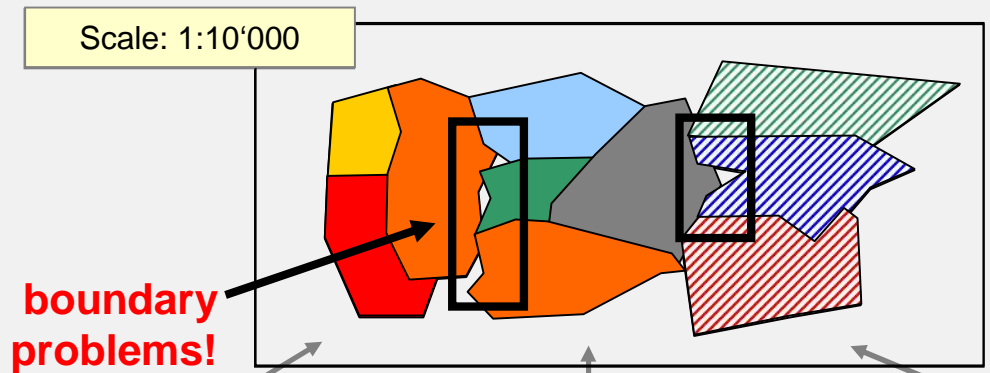# standards for web-based geographical services ➔ need for profiles

- **general goal:** facilitate interoperability within the National Spatial Data Infrastructure (NSDI)

- OpenGIS Consortium (OGC), ISO and W3C standards / specifications provide an important foundation (but … see talk "How good does open source talk OpenGIS?" by Tom Kralidis etc al)

- **Geographical services application profile project**: guarantee that each service on offer can be used within the framework of the NSDI and can in turn make use of other web services of the NSDI

- prepared in 2005 in collaboration with universities, cantons, organisations and the private sector

- currently: commentaries after public review are processed in working group

- plan: adopted as an eCH standard in Q1/2007
  (see www.ech.ch, eGovernment Standards)
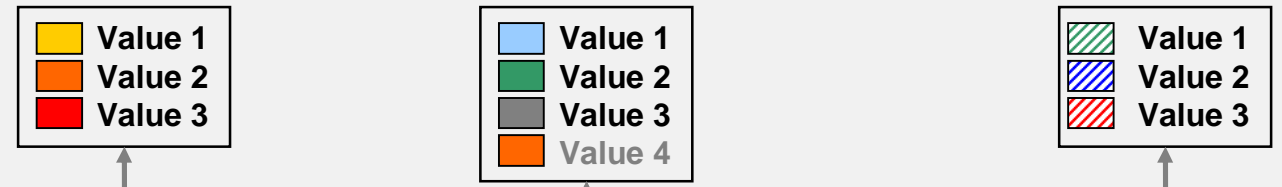
goal levels for connecting services

1. **Visualisation** (using services) of data from different providers – symbolisation as chosen by the service provider

2. **Visualisation** of data from different providers – *uniform symbolisation* (maybe chosen by the service consumer, e.g. using SLD)

3. **Info requests** (query features) – format and attributes as chosen by the service provider

4. **Info requests**, *results in uniform format according to a harmonized data model*

5. **Data delivery** *– according to a common, harmonized data model*
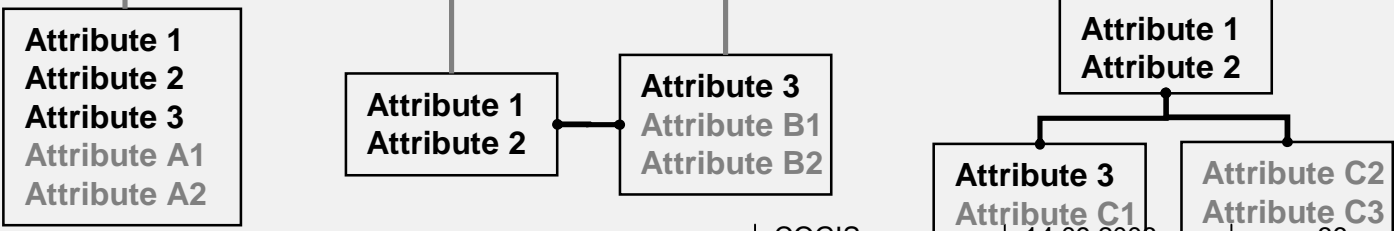
„quick and dirty" solution – goal level 1

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Scale: 1:10'000

presen-
tation

boundary problems!

presen-
tation
model

	Value 1
	Value 2
	Value 3

	Value 1
	Value 2
	Value 3
	Value 4

	Value 1
	Value 2
	Value 3

data
model

Attribute 1
Attribute 2
Attribute 3
Attribute A1
Attribute A2

Attribute 1
Attribute 2

Attribute 3
Attribute B1
Attribute B2

Attribute 1
Attribute 2

Attribute 3
Attribute C1

Attribute C2
Attribute C3
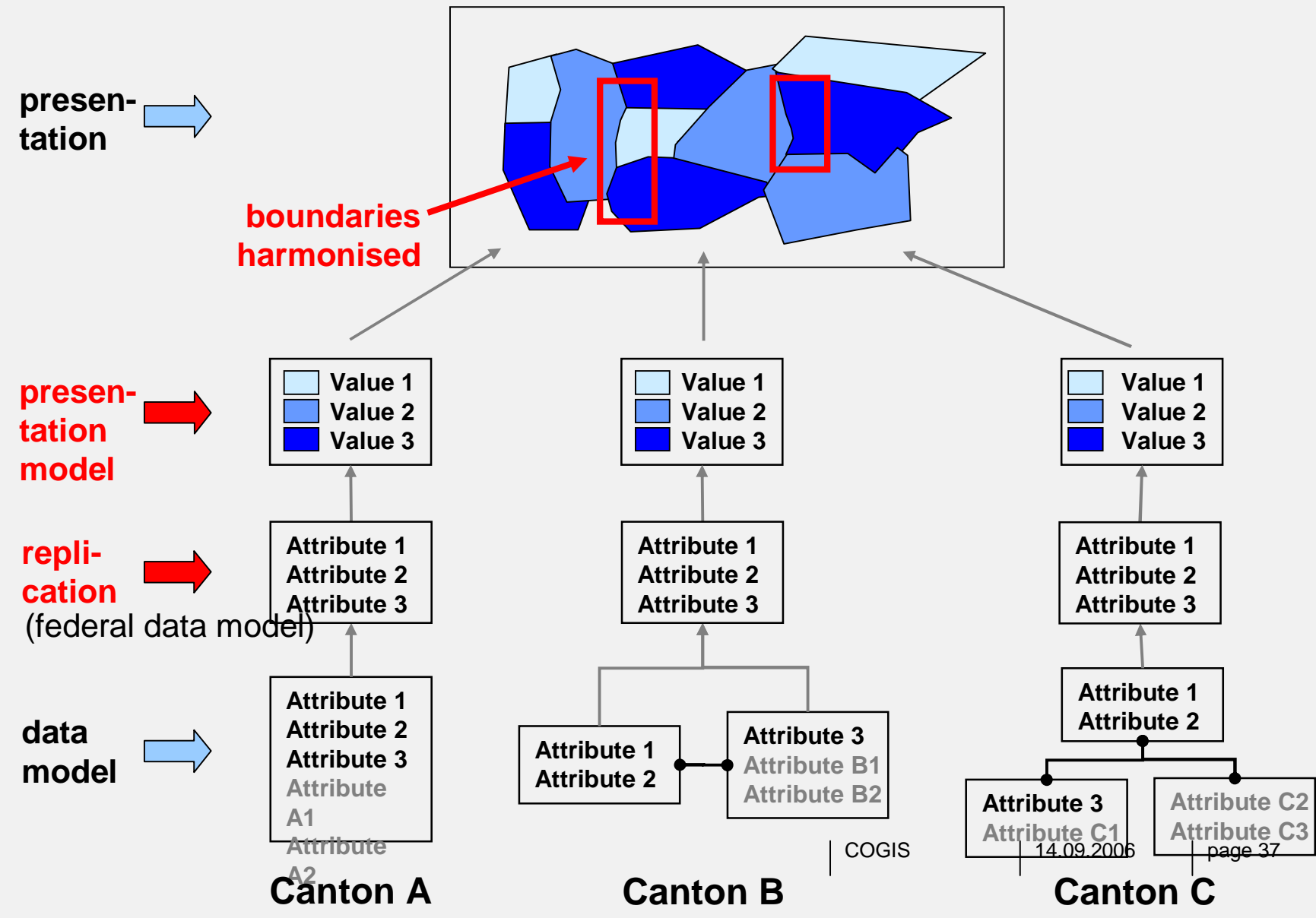
Canton A   Canton B   Canton C

COGIS   14.09.2006   page 36

Source: KKGEO, Lucien Imhof (VD), Patrick Belser (LU)

final solution – levels 2, 3, 4

presen-tation →

boundaries harmonised

presen-tation model →

repli-cation →
(federal data model)

data model →

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Source: KKGEO, Lucien Imhof (VD), Patrick Belser (LU)

| Value 1 |
| Value 2 |
| Value 3 |

| Value 1 |
| Value 2 |
| Value 3 |

| Value 1 |
| Value 2 |
| Value 3 |

Attribute 1
Attribute 2
Attribute 3

Attribute 1
Attribute 2
Attribute 3

Attribute 1
Attribute 2
Attribute 3

Attribute 1
Attribute 2
Attribute 3
Attribute A1
Attribute A2

Attribute 1
Attribute 2

Attribute 3
Attribute B1
Attribute B2

Attribute 1
Attribute 2

Attribute 3
Attribute C1

Attribute C2
Attribute C3

Canton A

Canton B

Canton C

COGIS   14.09.2006   page 37

„the food chain" of geoinformation


```
modelling  >  data capture  >  distribution  >  publication  >
```
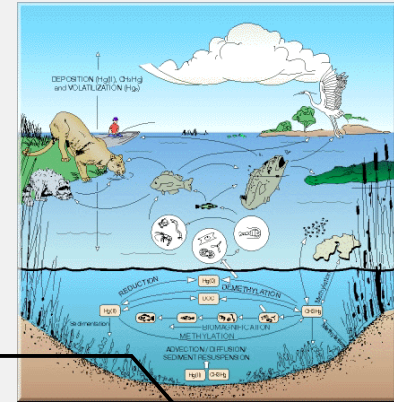
- typical problems: fish eat mercury, people eat fish … ➔ problems are propagated – awareness needed
- actions for publication stage:
  - *application profile for geowebservices*
  - *establish catalogue of services*
- actions for other stages:
  - *harmonisation of data and presentation models*
  - *ensure the modelling of basic geodata of national interest (and their presentation …)*

steps towards semantic integration (goal levels 2 – 5)

- MDA: model driven architecture:
  use a neutral language for definining data
  and presentation models

- Usage of UML (graphical) and INTERLIS
  (textual) languages

- www.interlis.ch

- various open source tools available
  (Compiler, UML Editor, semantic checker,
  support in OGR/GDAL, FME plugin …)

Conclusion

swiss**topo**

+ + +
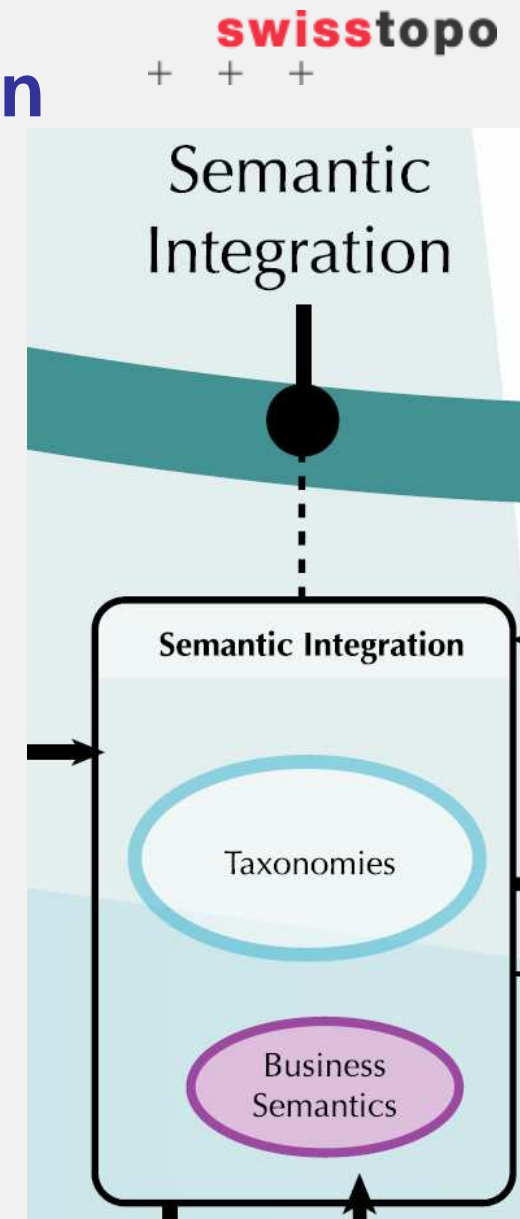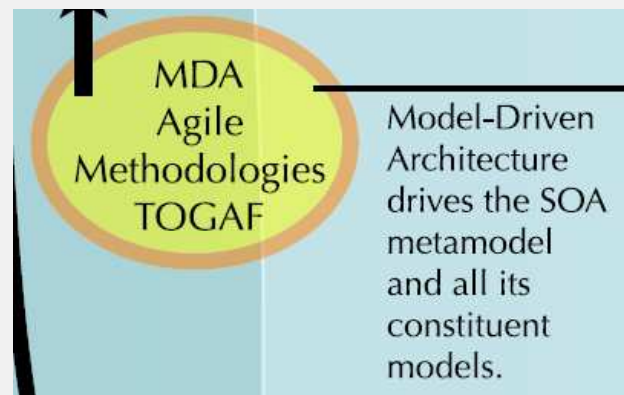
- The SOA Roadmap and the realization of the Federal Spatial Data Infrastructure … where are we?
  - some pieces already realized
  - others planned

- SOA?
  - Service Orientation … yes
  - Architecture … ? much work remains to be done

- … we are on the way
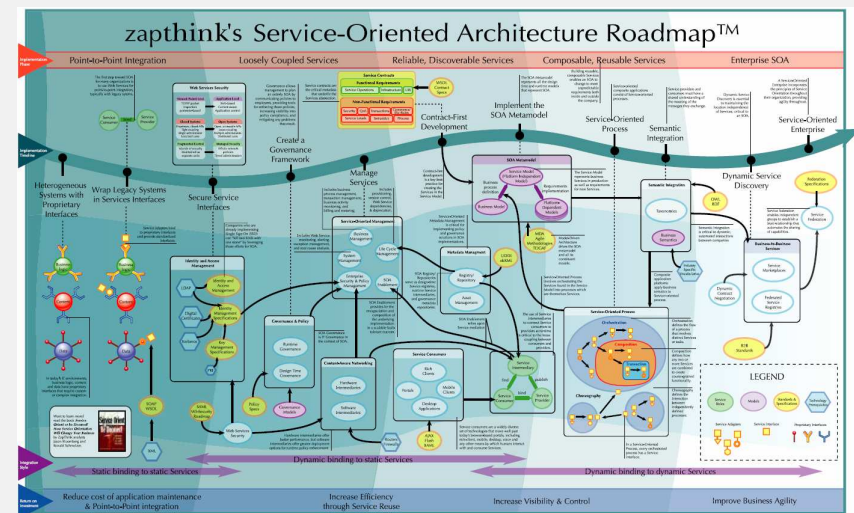
questions and discussion, further informations

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