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Towards a knowledge exchange infrastructure for Agricultural Research and Technology

The Role of the Agricultural Ontology Service

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Knowledge Exchange and Capacity Building Division

Food and Agriculture Organization of the UN

International Conference on Semantic Web and Digital Libraries

Bangalore, 20-23 February 2007

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World Food Summit 1996

Reducing Hunger and Poverty in the World by 50% in 2015

"The Rome Declaration calls upon us to reduce by half the number of chronically undernourished people on the Earth by the year 2015 … If each of us gives his or her best I believe that we can meet and even exceed the target we have set for ourselves.""The Rome Declaration calls upon us to reduce by half the number of chronically undernourished people on the Earth by the year 2015 … If each of us gives his or her best I believe that we can meet and even exceed the target we have set for ourselves."

Our Division's Goal: Combating Hunger by Facilitation of Knowledge Exchange

"We have the possibility to do it. We have the knowledge. We have the resources. And with the Rome Declaration and the Plan of Action, we've shown that we have the will."

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العربية 中文 english français español

Knowledge Forum

Webcasting from FAO

Knowledge exchange and dialogue to help build a world without hunger

The **Knowledge Forum** provides a direct gateway to the Organization's vast expertise and wealth of knowledge through a series of interactive services. It is also an opportunity to learn from and give a voice to the agricultural community regarding a wide range of issues affecting Food Security and Agricultural Production today. Through the Knowledge Forum, FAO uses knowledge exchange and dialogue to help build a world without hunger.

Ask FAO   **Best Practices**   **Knowledge Networks**

Ask FAO responds to the critical role that direct dialogue plays in fighting hunger. Users can interact directly with technical experts in particular fields of interest, and obtain answers to their questions.

Best Practices provides a series of summaries that introduce some best practices in FAO's areas of expertise. It also provides links to further resources with supporting technical information.

FAO's **Thematic knowledge networks** are virtual communities of professional staff and collaborating centres with common interests and objectives related to sustainable agriculture and food security, built around twelve priority...

Next   Previous   Highlight all   Match case

This Presentation

1. Data, Information, Knowledge and the Semantic Web,
2. An Infrastructure for Agricultural Science and Technology
   a) The openAccess publishing Paradigm
   b) Open Archives: The AGRIS OAI Architecture Proposal
   c) Crop and Weather Data: Meteo Broker
   d) A general model

3. The Agricultural Ontology Service
   a) The AGROVOC Concept Server
   b) AgMes
   c) NeOn
   d) Ontologies under Development

4. The Process and the Vision

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Data, Information, Knowledge and the Semantic Web

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The Stair to Wisdom

Judgement		Wisdom
Inferences		Knowledge
Structure		Information
Codification		Data
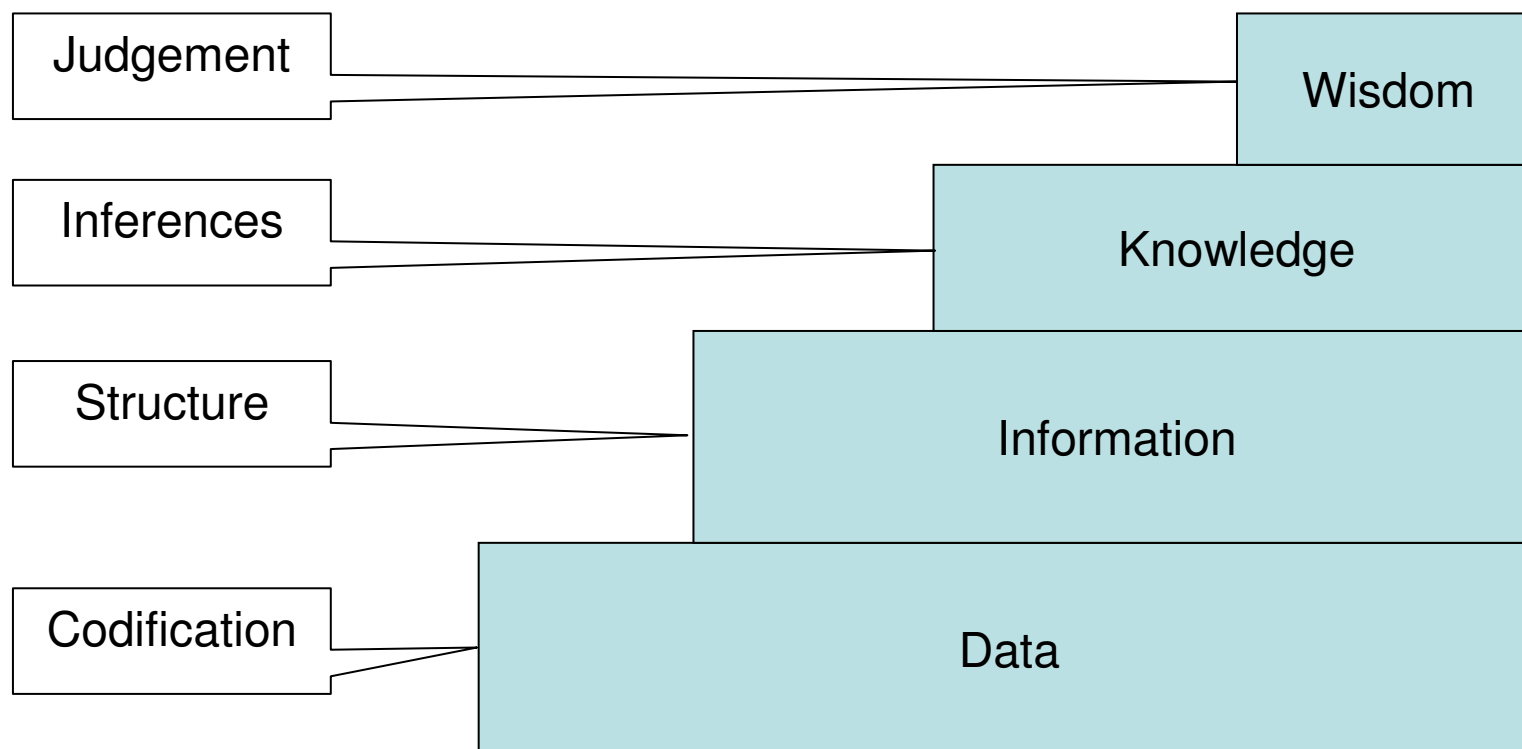
On which Step of the Stair is the Internet?

- In the first 10 years the Internet has been mainly a space for publishing
    - Operations which were done on hardcopy were digitized, but workflows and processes remained the same
    - There is no conceptual difference between a card catalogue and an electronic catalogue as mostly used nowadays
- The virtual connection of resources on the Internet stayed virtual, in reality many distinct silos of Information and Knowledge were created
    - Partly Steps backed, compared to Interoperability protocols in the Library area z39.50) confined to ILMS
    - WebServices no real kickstart (in FAO 1!)
- The only real large scale integration success is Google, everything else is corporate (Amazone, ebay,)

- Worst Situation in Technology and Science

- Tim Berners Lee: The web is like a big relational database without relations

Web 20 tries to introduce this relational expects by human efforts

Social Bookmarking is a way to create relations and networks between cataloguers on the web, Delicous and FlickR are kind of community catalogues

RSS feeds try to get different information silos on the web in connection

- But again silos are created. Single Web2 spots do not communicate with each other, Consistence within such spots is low, scalability not proven

©Berners-Lee

.........the big picture

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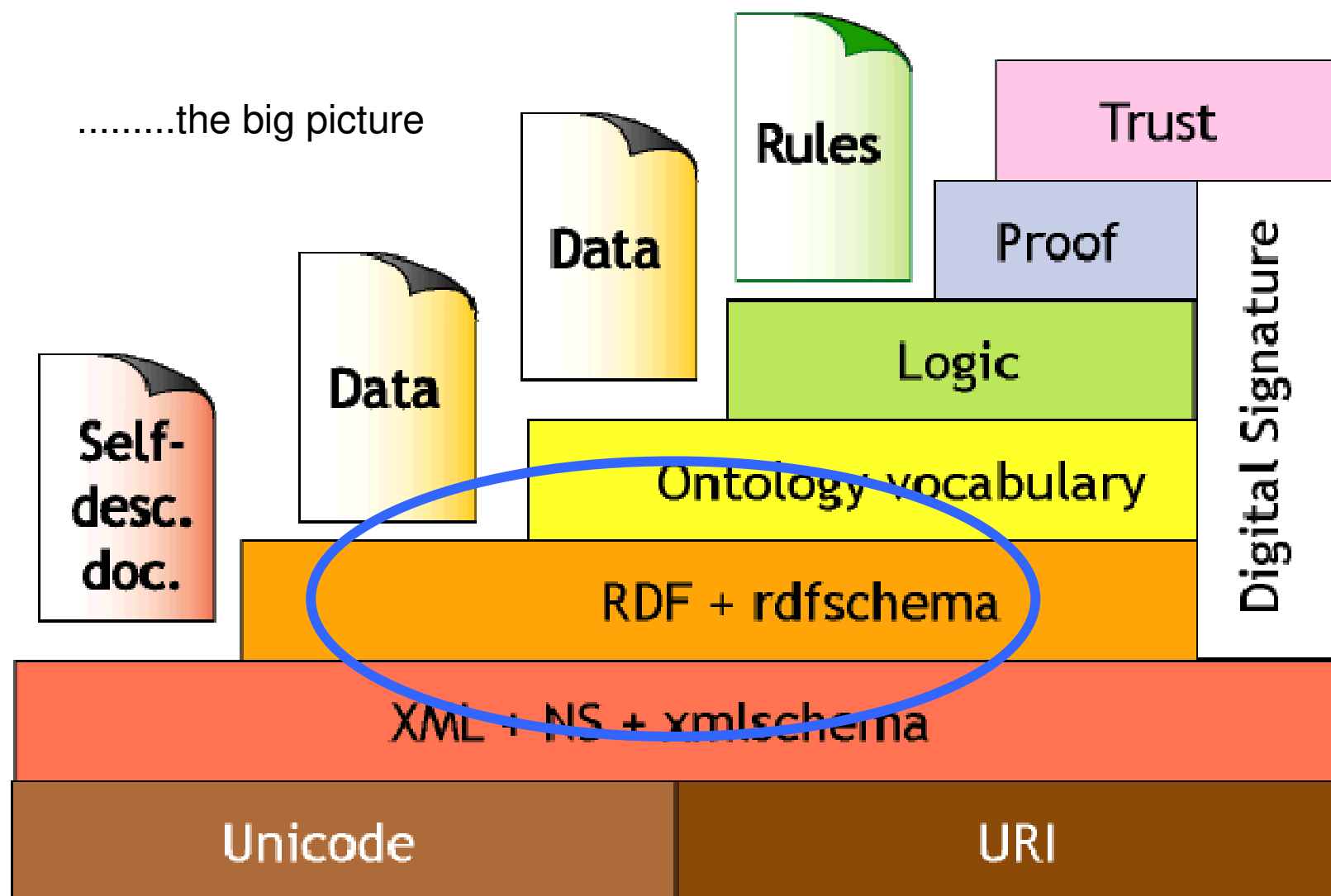
A Knowledge Infrastructure for Agricultural Science and Technology

a) The Open Access Publishing Paradigm

b) Open Archives: The AGRIS OAI Architecture Proposal

c) Crop and Weather Data: Meteo - Broker

d) A general model

OAI: how to get the different repositories to communicat

Uni2

Uni2

FAO

CAAS

NAL

CABI

Uni2

Uni2

Uni 1

Uni2

DLML

ICAR

Uni2

Uni 3
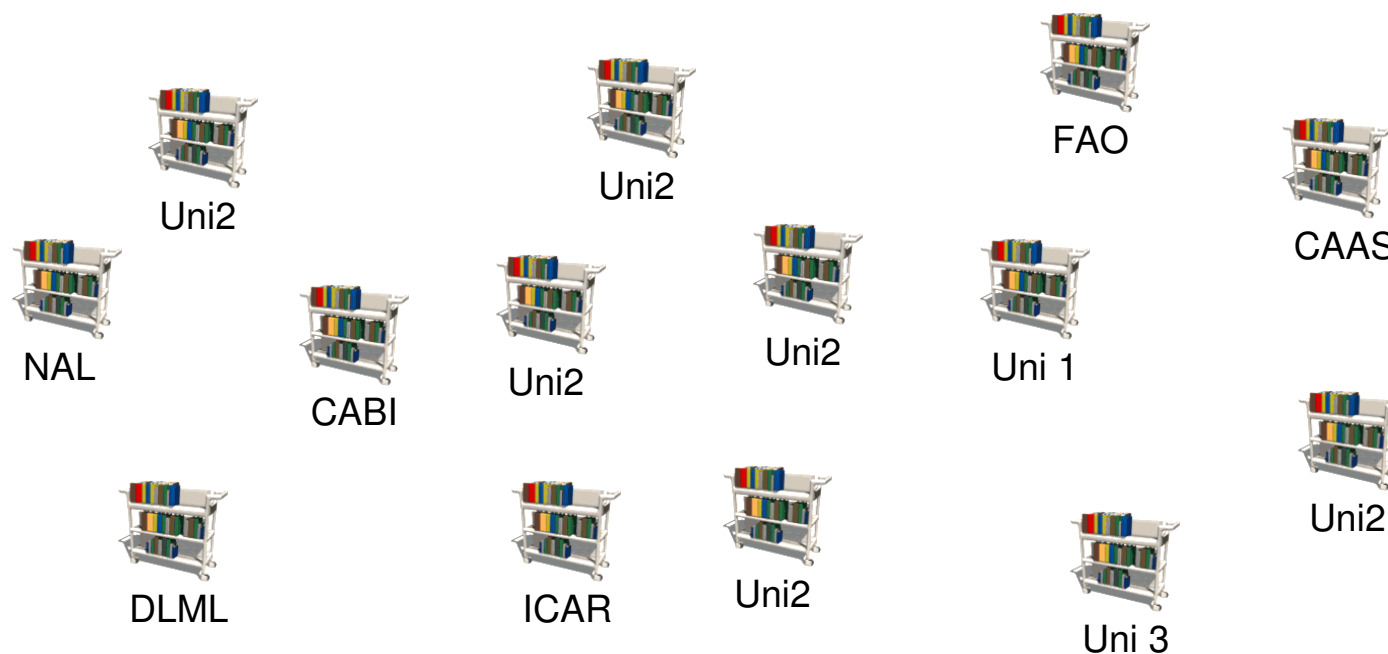
Dublin Core Metadata Exchance Schema (1996)

Open Archive Initiative Metdata Harvesting protocol (OAI MHP)

...our starting point was simple: exchange of bibliographical data between different repositories

© Salokhe
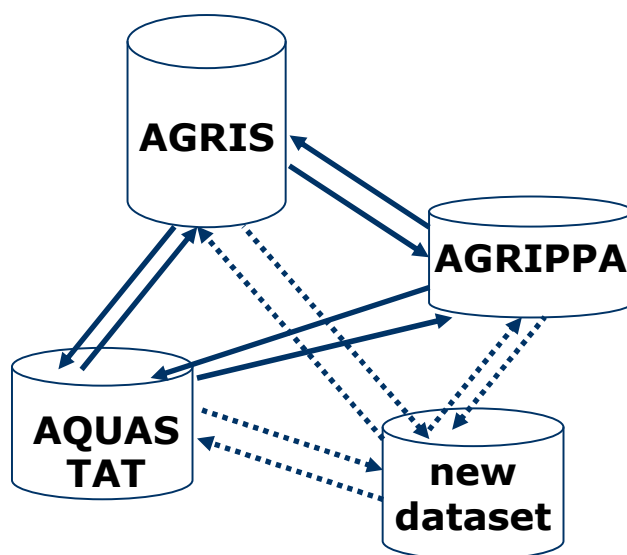
In the above Figure, the addition of a 'new database' means six new mappings (shown using the dotted lines) will have to be created for everyone to share information with each other. Imagine now, if we had one more! Each new addition of database results in other new mappings. This is calculated with the following formula.

$$n\_P\_2 = \frac{n!}{(n - 2)!}$$

Where n = number of databases that want to share information with each other.

Additionally, if there would be a change in any one of the formats, all the other databases that are sharing information would also have to change their own mappings.

AGRIS

AGRIPPA

AQUAS TAT

new dataset

PP

common exchange layer

AQUAS TAT

new database
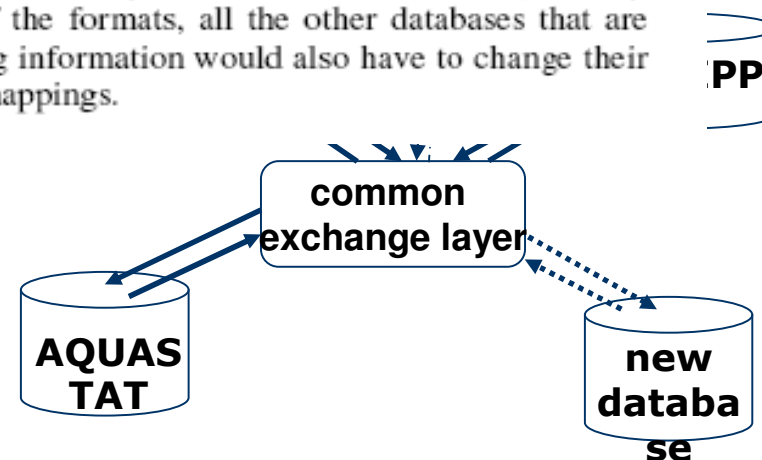
Why not simple DC?

Citation

For example, the citation information using AGRIS AP is displayed as:

<ags:citation>

    <ags:citationTitle>Journal of Agricultural Research and Extension (Thailand)</ags:citationTitle>

    <ags:citationTitle>Warasan Wichai Lae Songsoem Wichakan Kaset</ags:citationTitle>

    <ags:citationIdentifier scheme="ags:ISSN">0125-8850</ags:citationIdentifier>

    <ags:citationNumber>18(2) p.1-12</ags:citationNumber>

    <ags:citationChronology>Apr-Sep 2001</ags:citationChronology>

</ags:citation>

The dumbing down process would result in the information being merged into various fields and presented as:

<dc:relation> Journal of Agricultural Research and Extension (Thailand); Warasan Wichai Lae Songsoem Wichakan Kaset; 18(2) p.1-12; ISSN: 0125-8850; Apr-Sep 2001</dc:relation>

Relation

For example, the relation information using AGRIS AP is displayed as:

<dc:relation>

    <dcterms:isVersionOf>http://www.fao.org/agris/agmes/DC1-FAO1.doc </dcterms:isVersionOf >

    <ags:relationHasTranslation>ftp://ftp.fao.org/fao/W8270c.pdf </ags:relationHasTranslation>

</dc:relation>

The dumbing down process would result in the information being merged into various fields and presented as:

<dc:relation> http://www.fao.org/agris/agmes/DC1-FAO1.doc</dc:relation>

<dc:relation> ftp://ftp.fao.org/fao/W8270c.pdf </dc:relation>

The AGRIS – Application Profile

```
<?xml version="1.0"?>
<rdf:RDF xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#" xmlns:dc="http://purl.org/dc/elements/1.1/"
xmlns:dcterms="http://purl.org/dc/terms/" xmlns:ags="http://www.fao.org/agris/agmes/schemas/1.0/ags#">

    <rdf:Description about="http://www.fao.org/docrep/008/ae909e/ae909e00.htm">
        <dc:title> AGRIS: Guidelines for Description of Information Objects for International Information System on Agricultural
Sciences and Technology </dc:title>

        <ags:creator> FAO, Rome (Italy). Library and Documentation Systems Div. </ags:creator>
        <dc:subject>Metadata Standards; Guidelines; Dublin Core; Document-like Information Objects; Application Profile;
Information Exchange</dc:subject>

        <dc:subject>
            <ags:subjectClassification>
                <value>C30</value>
                <rdfs:label>Documentation and information</rdfs:label>
                <rdfs:isDefinedBy rdf:resource="http://www.fao.org/agris/"/>
            </ags:subjectClassification>
        </dc:subject>
        <dc:subject>
            <ags:subjectClassification>
                <value>Z699.35.M28</value>
                <rdfs:isDefinedBy rdf:resource="http://lcweb.loc.gov/catdir/cpso/lcco/lcco.html"/>
            </ags:subjectClassification>
        </dc:subject>
        <dc:subject>
            <ags:subjectThesaurus>
                <rdfs:label>AGRIS; DATA PROCESSING ; METHODS ; TRAINING ; LIBRARIANSHIP ; STANDARDS; INFORMATION
STORAGE </rdfs:label>

                <rdfs:isDefinedy rdf:resource="http://www.fao.org/agrovoc/"/>
            </ags:subjectThesaurus>
        </dc:subject>
        <dc:subject>
            <ags:subjectThesaurus>
                <rdfs:label>information processing; information systems; information storage; AGRIS </rdfs:label>
```
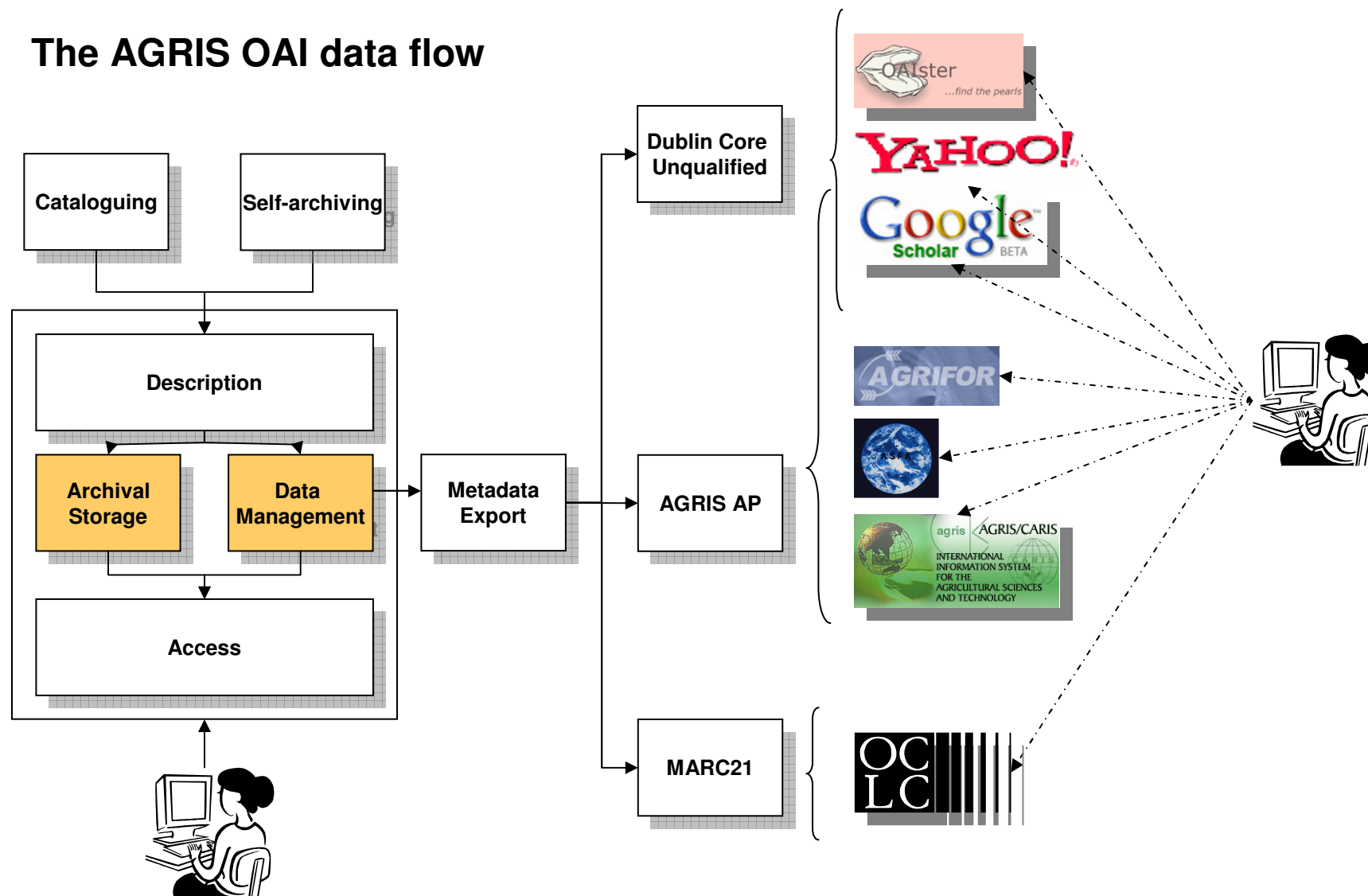
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The AGRIS OAI data flow

Figure 3. The Data Providers : open archives. A data provider can export metadata in different metadata formats (*Figure 3*). The Unqualified Dublin Core is the basic metadata format for OAI Protocol, but the function of DC is basically to facilitate the exchange of metadata at cross-domain level, to enable the communication outside of the specific communities. For AGRIS Community, as other subject networks, it is necessary the use of a richer metadata format. For that AGRIS Iniative will encourage the export in AGRIS AP in order to guarantee a high level in the quality of description of agricultural information resources.

The AGRIS OAI Search Engine

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Data Providers

Service Providers

Lucene Index

Ontology layer

SEARCH

The AGRIS OAI Search Engine

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The AGRIS OAI - Network

Methods

Software

Content Management

AGRIS Website

Knowledge Exchange

Information Management Specialist

Metadata + Full text

Agris Data Providers

External Service Providers

Directories

Researcher Open Access

Standards

Self Archiving

Agris Service Providers

Internet

Users

Figure 2. Agris Network: Content Management. The *Figure 2* shows the main elements in the workflow for AGRIS Network and their connections following the new architecture. Conceptually, the workflow is divided in two principal actions: *content management* and *exposing metadata*.

AGRIS OAI: Implementation Examples

- NARIMS - (Egyptian National Agricultural Information Management System)
- KAINET (Kenya Agricultural Information Network)
- BIBSYS (Norwegian Agricultural University)
- GFIS (Global Forestry Information Services)
- Many AGRIS centres)

.. but far, far away from a critical mass

MeteoBroker: Heterogeneous scientific data

ChizuSOAPClientSample

Help

get | latitude `0` | longitude `-15` | scale `210000000` | whole world ▼ | disp name `false` ▼

Over 22,000 stations of 25 databases
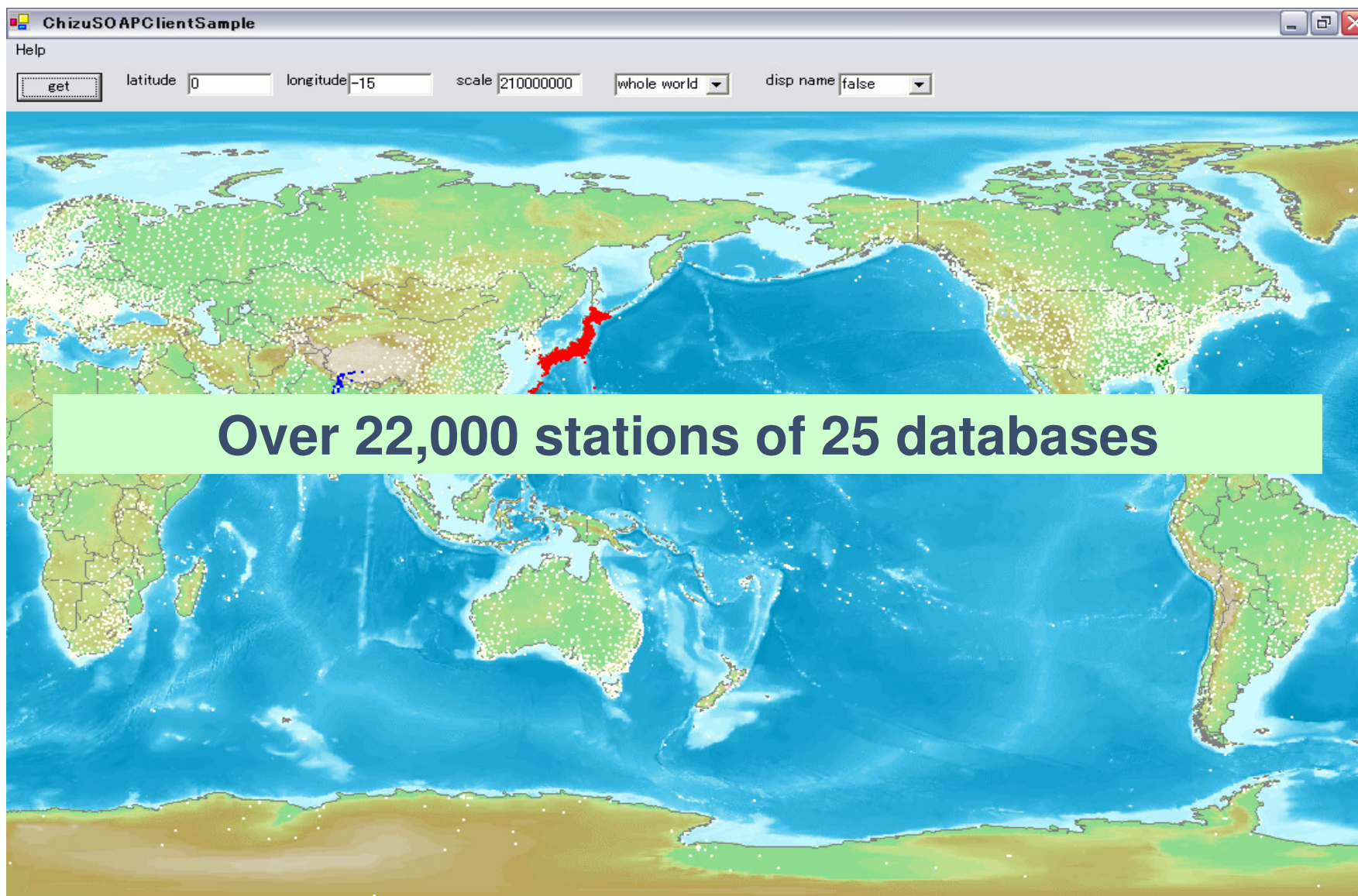
MeteoBroker: Heterogeneous scientific data

- A lot of digital data sets are continuously produced in agricultural experimental stations
  - Using ordinal software such as spread sheet applications
  - But they are likely to be kept in local stations and scientist level
    - The data sets are isolated and hardly integrated among different locations
  - How to ease data publication for merging and sharing for end users
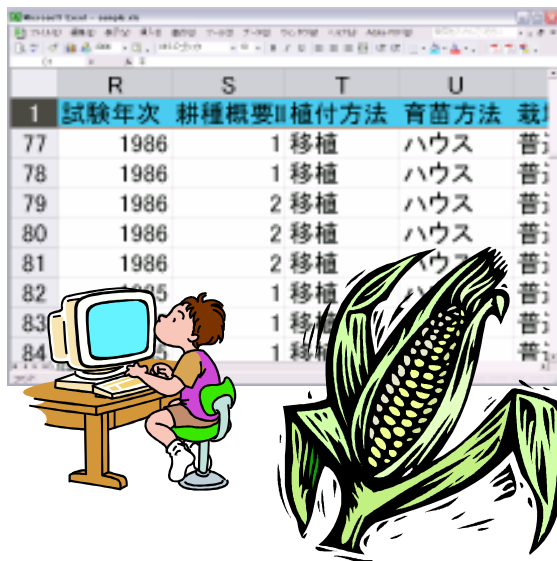
MeteoBroker: semantic Organization of weather data

- Separated crop data are hard to be integrated with different resources, e.g. weather data

- Heterogeneity
  - e.g. Models constructed using local data are only applicable locally

- How to integrate crop data with weather data upon user's request

MeteoBroker: If merging and sharing are possible

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- End users can freely combine separated data sets from different locations and perform analysis on them

- Datamining over the huge amount of data sets becomes real and we can possibly find out unknown facts

- Integration with completely different resources e.g. weather data becomes also possible

- Constructing new model becomes quite easy

- Integrated data help model test and verification.

MeteoBroker: The Infrastructure Grid

Case Base

Farm Manageme Agterm Dictionary

Growth Model1

Meta Database

Weather Data 1

The Internet

Data Broker

Field Data Monitoring

User who needs Decision

Weather Data 2

Growth Model2
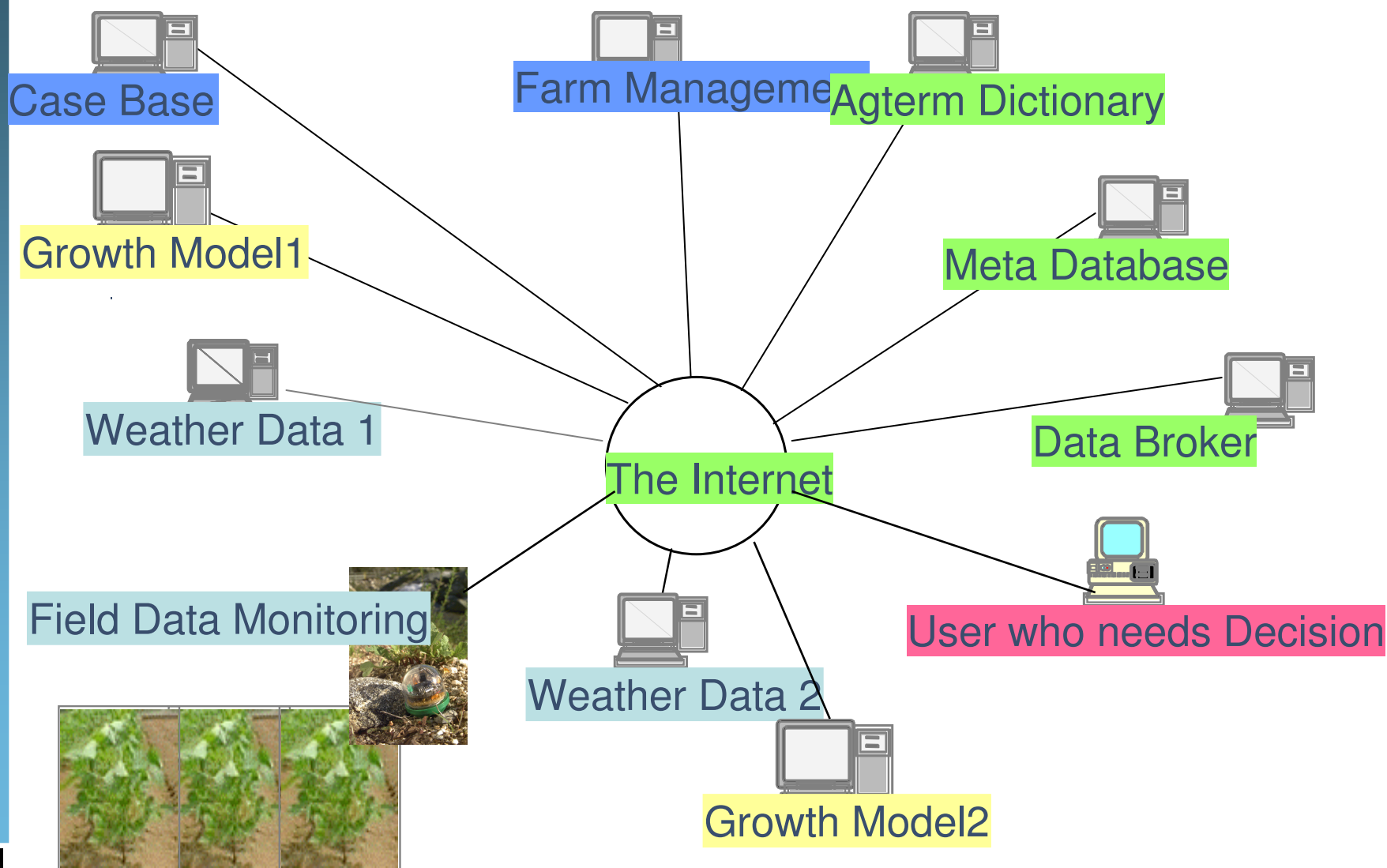
Meteo Broker: the architecture

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- •Decision Support Services
- •Simulation Models

Metadata database

Item Definition OWL

Station metadata RDF

2. Request

3. Request metadata

1. Register

Inference Engine

Intelligent Broker

Dynamic DB Wrapper

Meteorological databases

DB

DB

DB

DB

4. Request data

..a semantic webspace for Agricultural Research and Technology

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Aggregated Database View	Subject specific Portals	News feed services	Group Work Spaces	Decision Support Systems	...	Information System (n)

Common exchange layer   (OWL, RDFS)
(Vocabularies, Ontologies,)

AGRIS Open Archives	Institutional Directories	......	Geo Network	CGIAR Data Sets	Other Data Sets

Data Grid

Data
Providers

Metadata
Layer

Ontology
Layer

Web
Interface

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Getting Interoperability: The Agricultural Ontology Service

a) Agrovoc

b) Exchange Schemata

c) Ontologies

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Coherence in Agricultural Information Systems
■ *Interoperability, Reusability, and Cooperation* ■

| Search |

| Home | Partners | Discussion Lists | العربية | 中文 | English | Français | Español |
| AGROVOC Concept Server | Metadata Schemas | Tools | Publications | News/Events |

Coherence in Agricultural Information Systems

The main objectives of the initiative are:

- to facilitate collaboration, partnership and networking among partners by promoting information exchange and knowledge sharing;
- to harmonize the decentralized efforts currently taking place in the development of methodologies, standards and applications for management of agricultural information systems; consequently, providing a 'one-stop' access to system designers and implementers

Read the complete proposal here.

:: NEWS ::

■ [Document] Reengineering Thesauri for New Applications: the AGROVOC Example

■ [Document] Proceedings of the 5th AOS Workshop Available

Keep updated with RSS ?

:: EVENTS ::

■ Eighth International Open Forum on Metadata Registries: Semantic Interoperability: Where Meaning Meets Metadata

■ The Sixth Agricultural Ontology Workshop in Portugal

Comments? Please write to the webmaster

© FAO, 2005

http://www.fao.org/aims

AGROVOC

food and related domains (e.g. environment).

Search term: weed   [Search in AGROVOC]

⦿ starting with ◯ containing text ◯ exact match

Search results for terms containing: weed

Terms found: 9

Term	ID	Lang	Type
Weed competition	35266	EN	Non-Descriptor with USE relation
Weed control	8345	EN	Descriptor with relations
Weed control equipment	15296	EN	Descriptor with relations
Weed control methods	35983	EN	Non-Descriptor with USE relation
Weed killers	15297	EN	Non-Descriptor with USE relation
Weeders	25843	EN	Non-Descriptor with USE relation
Weeding	8346	EN	Descriptor with relations
Weeding hoes	25844	EN	Non-Descriptor with USE relation
Weeds	8347	EN	Descriptor with relations

Legend for relationships

Search also in other FAO resources:

- **KOS:** [FAOTERM] | **Glossary** | **Biotechnology Glossary**
- **IS:** **WAICENT Information Finder**

Search also in non FAO resources:
UNBIS | **Wordnet** | **Google** | **Wikipedia**

AGROVOC

AGROVOC

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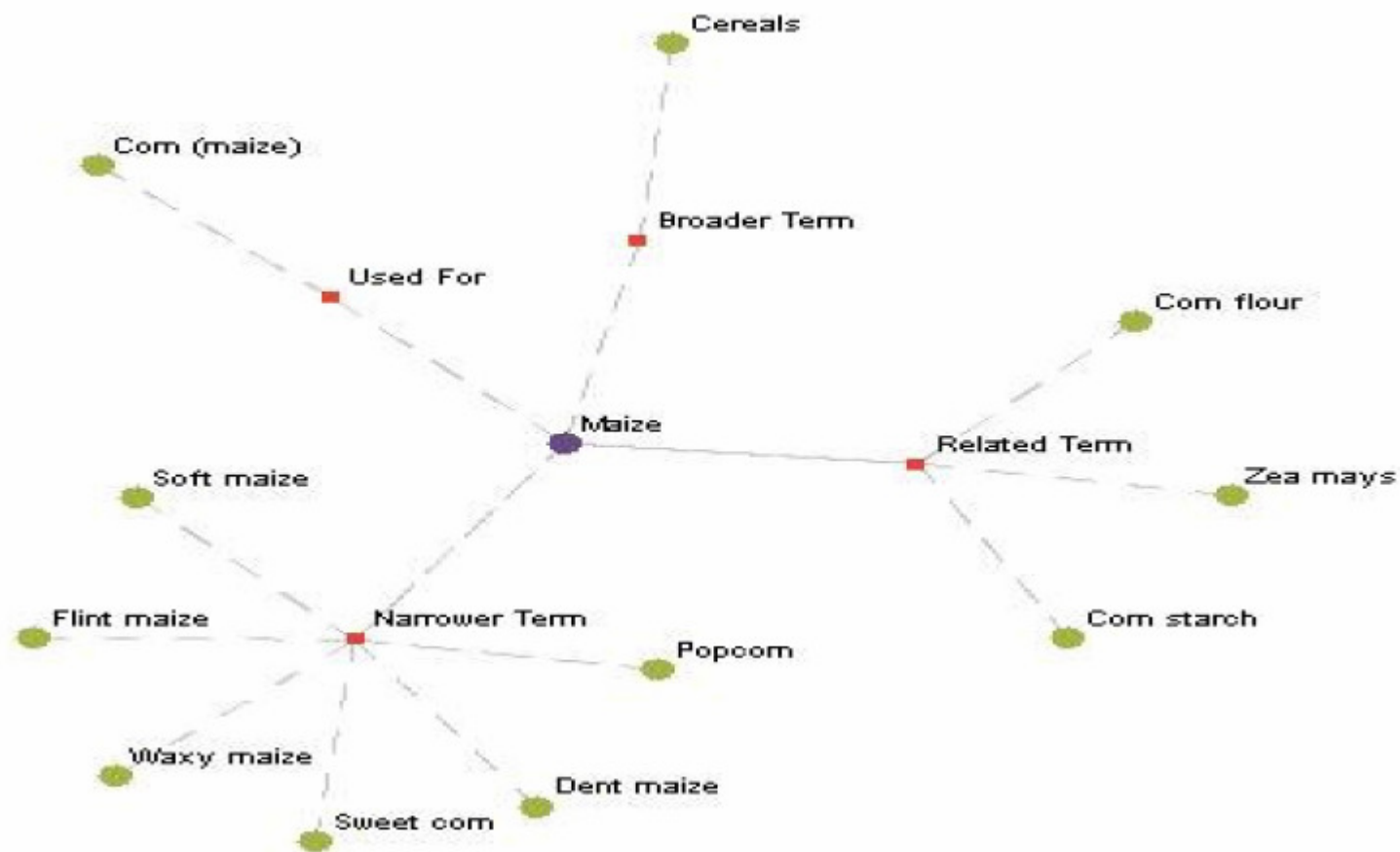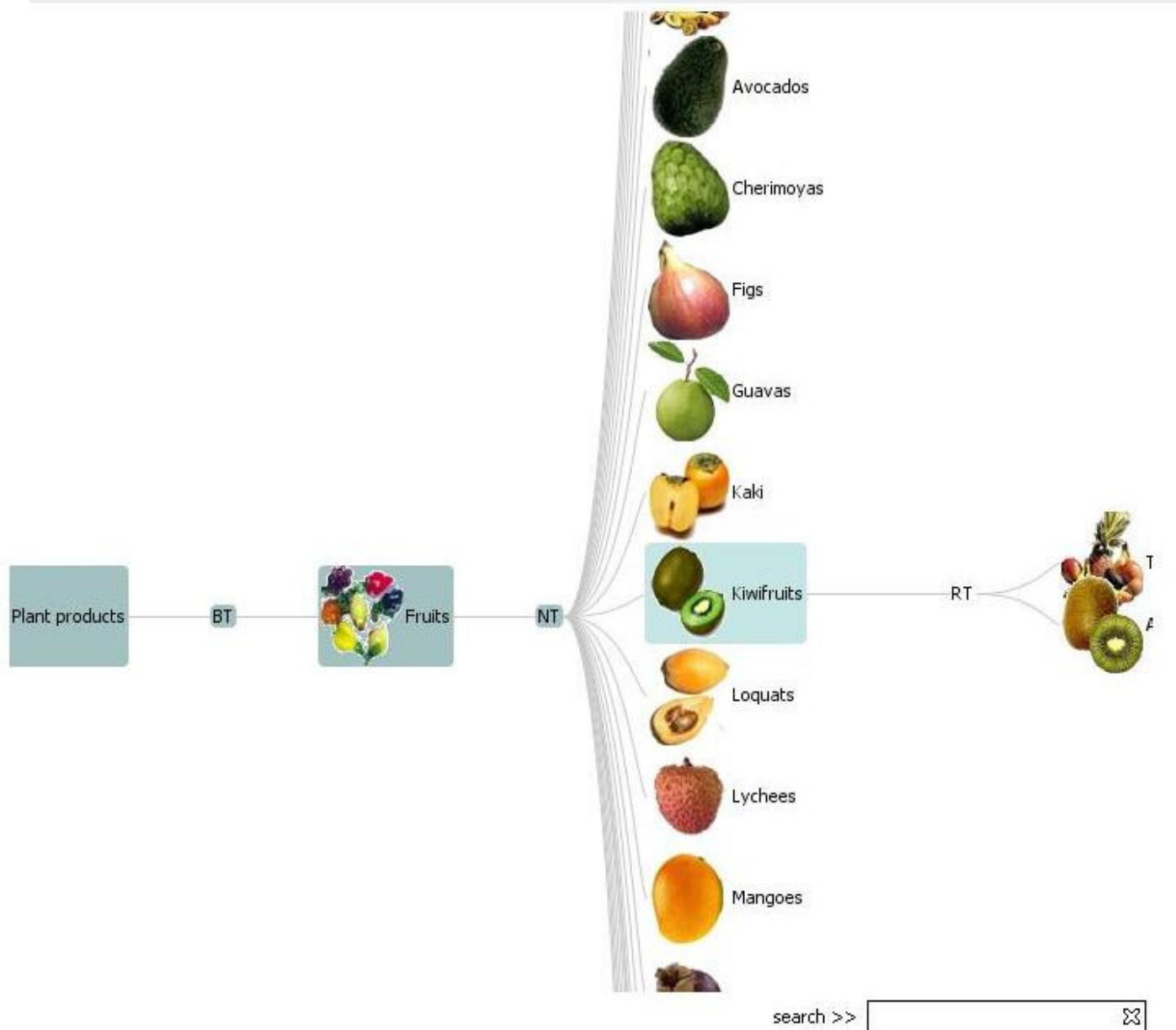
AGROVOC

AGROVOC is available in the following languages:

Web site	Contact
English	FAO
French	FAO
Spanish	FAO
Arabic	FAO
Chinese	FAO	CAAS
Portuguese	FAO	Ministério da Agricultura, Desenvolvimento Rural e das Pescas, Portugal
Czech	FAO	Institute of Agricultural and Food Information
Thai	Thai	FAO	Main Library, Kasetsart University, Thailand
Japanese	Japanese	FAO	AFFRIC , Japan
Lao	Information Management and Strategic Planning Division of the National Agriculture and Forestry Research Institute, Lao PDR ✉
Hungarian (Under construction)	Gödöllo Agribusiness Centre
Slovak (Under construction)	ÚVTIP
Korean (Under construction)	RDA, Korea
Malay (Under construction)	Institute of Multimedia and Software in collaboration with Universiti Putra Malaysia Library, Malaysia - ✉
German (Last release 1999)	FAO	ZADI
Italian (Last release 1992 - Under revision)	FAO	ISMEA
Polish (Currently under translation)	Centralna Biblioteka Rolnicza, Central Agricultural Library (CBR), Warszawa, Poland ✉ Elżbieta Dziuk-Renik

Agrovoc Conceptserver Workbench: Overall design

Concept Hierarchy

- owl:Thing
  - Fibre crops
  - Regrowth
  - Sesquiterpenoids
    - ABA
  - Small Island Developing State
  - Animal
  - Plant fibres
  - Plant growth substances
  - Plants
    - Musaceae
      - Musa
  - Scitamineae

text corpus

ipunt

.doc, .pdf, .xml, etc.

AOS/CS Workbench

concordance
pattern-matching
multilingual

input

Count	Pct	Word
77	4.5214%	the
53	3.1122%	and
46	2.7011%	to
41	2.4075%	of
39	2.2901%	nbsp
32	1.8790%	-
26	1.5267%	for
22	1.2918%	a
20	1.1744%	in
18	1.0570%	on
18	1.0570%	information
16	0.9395%	you

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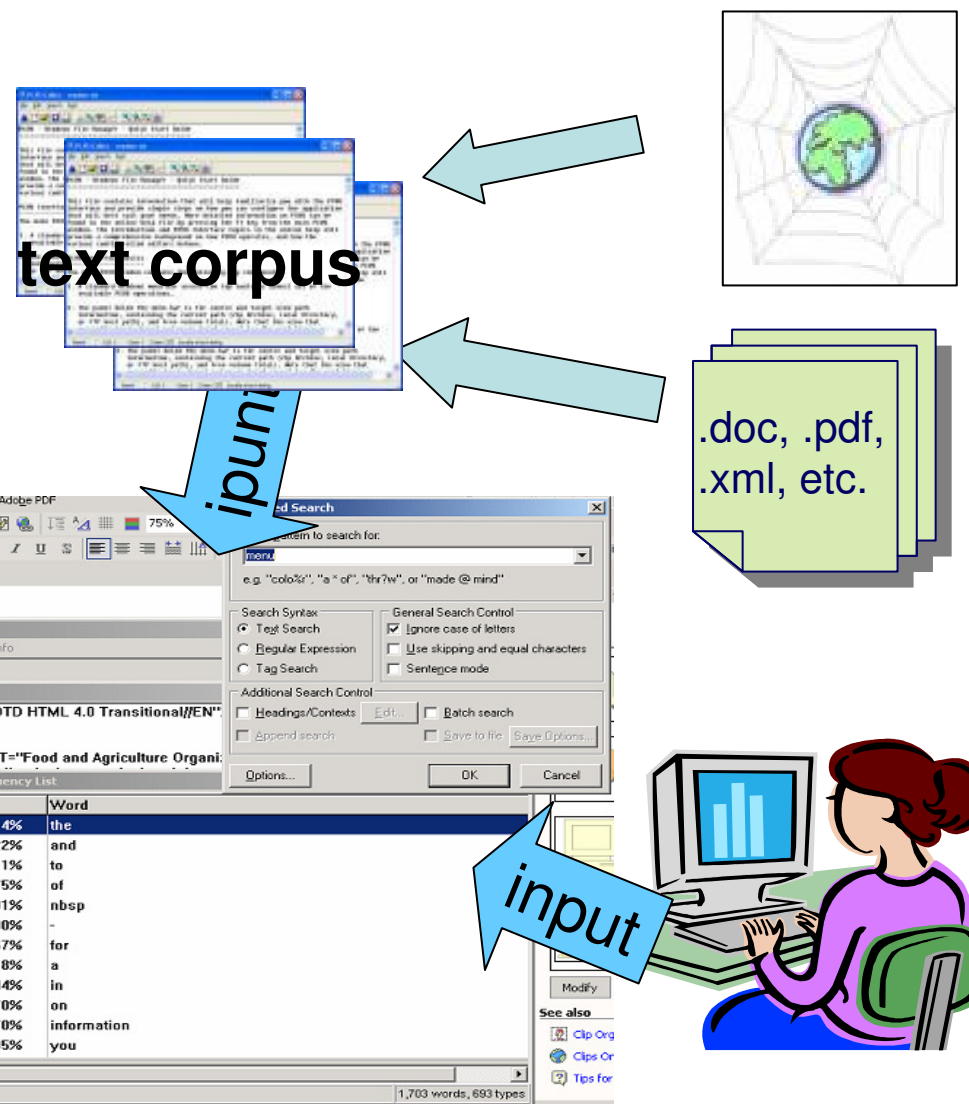
Agrovoc ConceptServer Workbench: Features

- Text processing
- Corpus Creation
- Corpus Analysis
- Manage
  - Concepts, Terms, Relationships
  - Classification Schemes
- Quality Assurance
- Versioning and Deployment

- Other functionalities
  - Search
  - Import / Export
  - Validations
  - Administration
  - Help

Metadata Exchange Schemas

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- AgMES elements
- RDF schemas
- **Metadata schemas**
- Document-like resources
- Events metadata
- Geospatial metadata
- Organization metadata
- Person/Expert metadata
- Biodiversity and Genetic Resources metadata
- Project metadata
- Statistical metadata
- **Application Profiles**
- More about APs
- Namespace vs. AP
- How to create an AP?
- Applied APs in FAO
- **Glossary**
- **Frequently Asked Questions**

The metadata exchange format landscape

The exponential growth of available material on the World Wide Web has created the challenge of how to get meaningful information and knowledge out of it. This is because resource discovery varies depending on the structure, type and content of the resource, and on the interests of the information keepers. Furthermore, the information needs of users are often complex; and this requires that information and knowledge be drawn from distributed archives and systems in different domains. The notion of the semantic web defines this goal, and various initiatives are underway to improve resource discovery and knowledge mining.

Resources

METADATA ELEMENT SET

METADATA ELEMENTS
- title
- singers
- duration
- lyrics
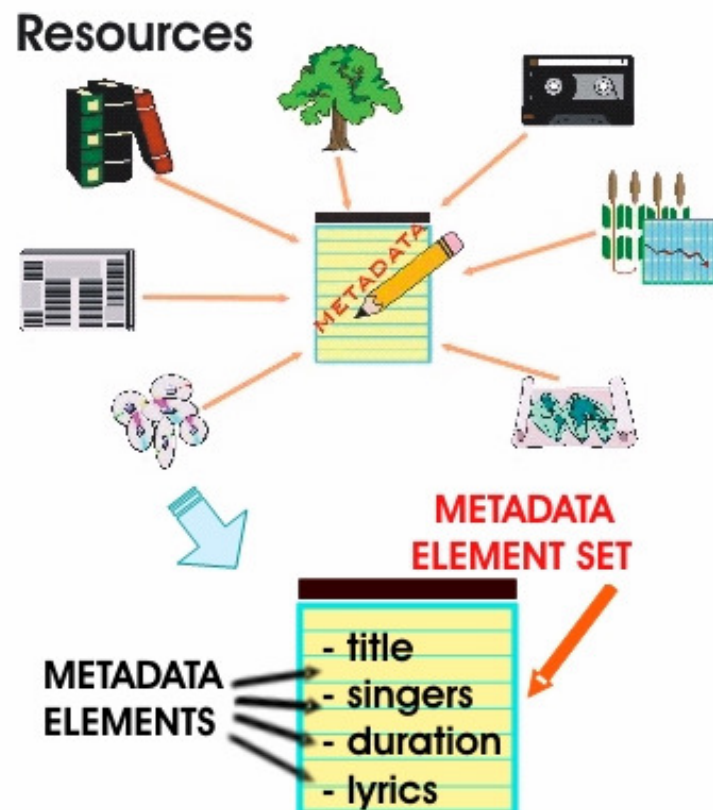
Geo-Political Ontology

- Class Area:
  - Groups:
    - EconomicRegion
    - GeographicalRegion
    - Organization
    - SpecialGroups
  - Territory:
    - Disputed
    - NonSelfGoverning
    - Other
    - SelfGoverning

- isValidFrom (in years)
- isValidUntil (in years)
- isSuccessorOf
- isPredecessorOf
- hasOfficialName (string)
  - sub properties for all languages
- hasShortName (string),
  - subproperties for all languages
- hasCode
  - sub properties for all classifications
- hasBorderWith
- dependsOn (domain: non-self-governing territories, range: self-governing-territories)

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Fishery Ontology (1)
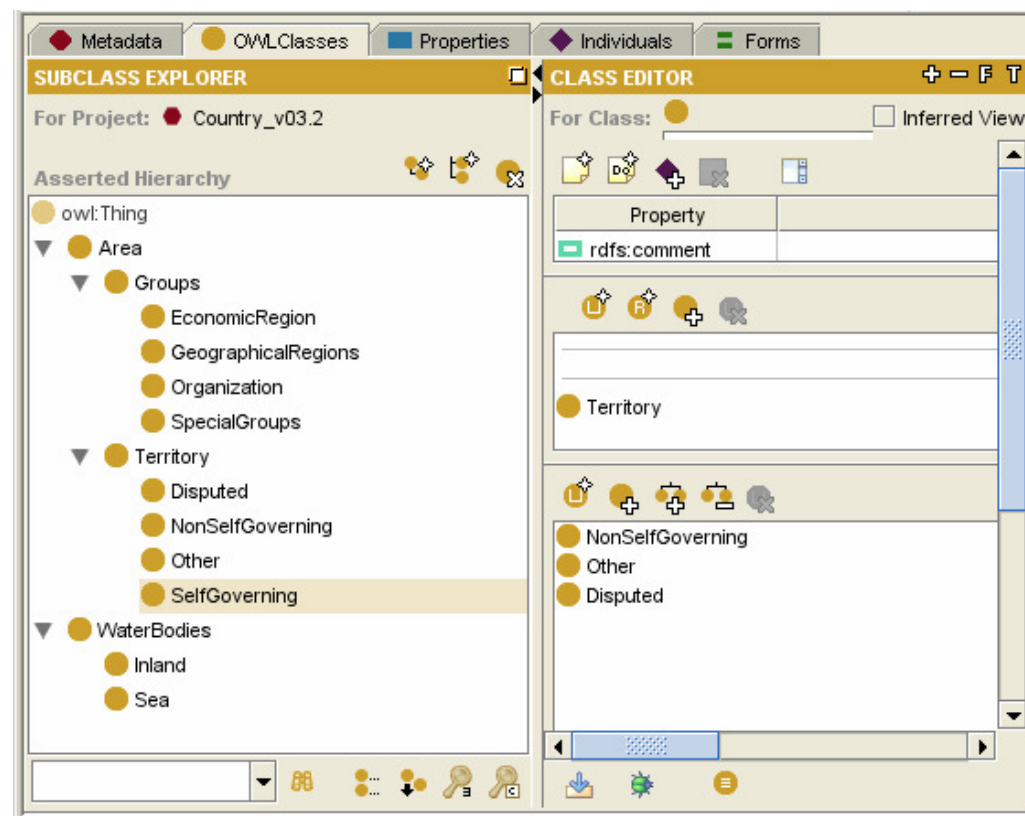
- Ontologies built from existing classifications schemas and thesauri.
  - Biological species: 44,100
    - 11000 species, 4 langs, taxonomic and ISCAAP codes
  - Water bodies: 1,500
    - 300 water division, 5 codes
  - Land areas: 25,000
    - 250 territories, 5 langs, 2 names, 4 codes.
    - economic regions, geographical regions, organizations
  - ASFA thesaurus: 22,000
    - 11000 entries, code
  - AGROVOC thesaurus - Fisheries: 42,000
    - 7000 terms, 6 languages
  - Commodities: 6,000
- Over 150 interesting resources identified in D7.2.1. Around 30 can be really useful and will be detailed.

KOS (thesauri, classification schemes, glossaries)

AGROVOC thesaurus

ASFA thesaurus

RTMS taxonomies

Fisheries glossaries

Integrate, merge, map

Fisheries ontologies

Fishery Ontology (2)

KOS (thesauri, classification schemes, glossaries)

ASFA thesaurus

AGROVOC thesaurus

RTMS taxonomies

Fisheries glossaries

Integrate, merge, map

Fisheries ontologies

Alert System

Use

Feed and maintain validity

Ontology learning/population

Connect to

Use

Use

Knowledge bases (metadata, documents, statistics...)

FIGIS resources

ASFA abstracts

Regional non-FAO resources
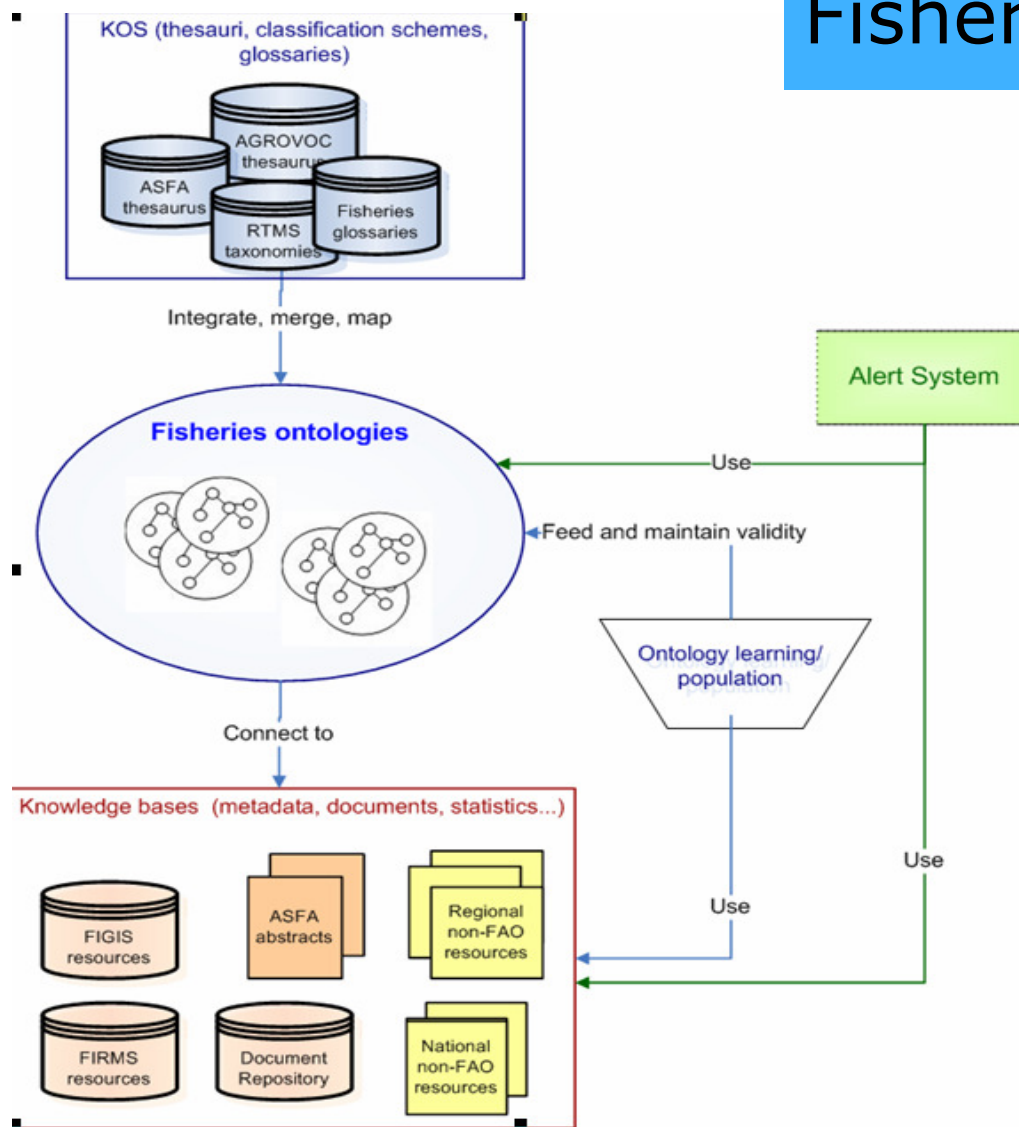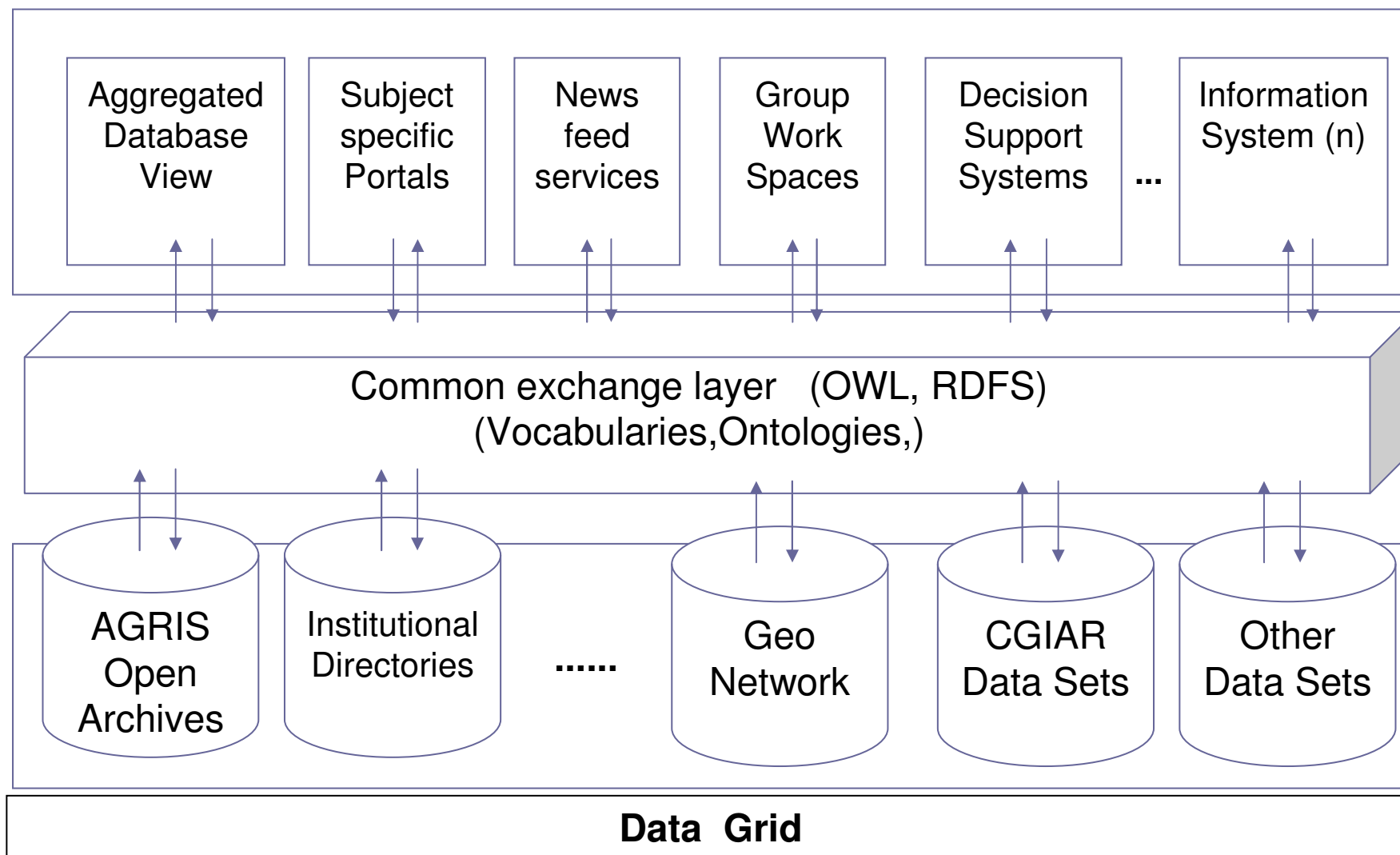
FIRMS resources

Document Repository

National non-FAO resources

Figure 4 – Overview of the ontology-driven FSDAS

..a semantic webspace for Agricultural Research and Technology

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| Aggregated Database View | Subject specific Portals | News feed services | Group Work Spaces | Decision Support Systems | ... | Information System (n) |

Common exchange layer   (OWL, RDFS)
(Vocabularies,Ontologies,)

| AGRIS Open Archives | Institutional Directories | ...... | Geo Network | CGIAR Data Sets | Other Data Sets |

Data Grid

A semantic space in the web:

Network of Data and Service Providers with agreed procedures and standards – and common ontological layers

- ## Data Provider: exposes institutional open archives of data and information
- Development Agencies and NGOs
- Research Institutions
- Industry Information Centres

- ## Service Provider: provides services based on these institutional open archives
- Libraries and other traditional Aggregators
- Thematic or Regional Centres of Excellence
- The data providers themselves

The Implementation

2000
- Brussels meeting and AGstandards (AgMES) initiative

2001
- Launch of the Agricultural Ontology Service

2002
- AOS Workshops

2003
- Release of AgMES NameSpace as first AOS element
- Metadata Elements for Document Like Objects

2004
- AGRIS Application Profile for ARD publications

2005
- Implementation of AGRIS AP in various bibliographical databases
- 4 new language versions of AGROVOC
- Booming downloads of AGROVOC as a de facto Standard
- AIMS website released

2006
- AGRIS repository in AGRIS AP XML published
- AGROVOC OWL Model ready and coding of AGV-concept server started
- Grant from the EU for a system of fishery ontologies in a 4 years project
- Ontologies for geopolitical and organization Information started
- ConceptPaper to transform the AGRIS repository in an Ontology

AOS – a "business model"

A consortium of Information Providers and Consumers providing a clearinghouse for semantic standards in the area of Agriculture, Food Security and Rural Development

- One stop access to agreed standards (Ontologies, Metadataschemas, Vocabularies…)
- Establishment of mechanisms to agree on common standards and procedures
- Collaborative efforts in maintaining standards
- Registration and documentation of common standards (namespaces, application profiles, protocols)
- Organization of seminars and workshops to further develop and promote the use of semantic standards
- Participation in semantic web activities to get funding for specific projects

Conclusions

We are only at the beginning of the Knowledge and Information Age

We have bits and pieces for a Knowledge Exchange Infrastructure in Agricultural Research and Technology- but we have to put them together

Community building and collaboration is necessary to achieve semantic interoperability between different players

Food and Agriculture Organization
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helping to build a world without hunger

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Thank you

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