Plant biology open data interoperability in the big data era

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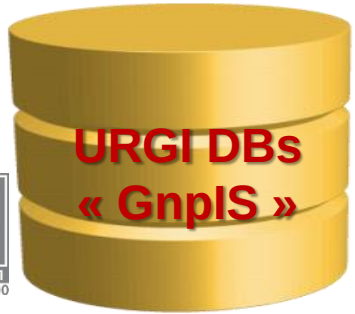
A bioinformatic unit for crops and pathogens



Phenotypes

- GxE
- QTL maps
- GWAS, GS

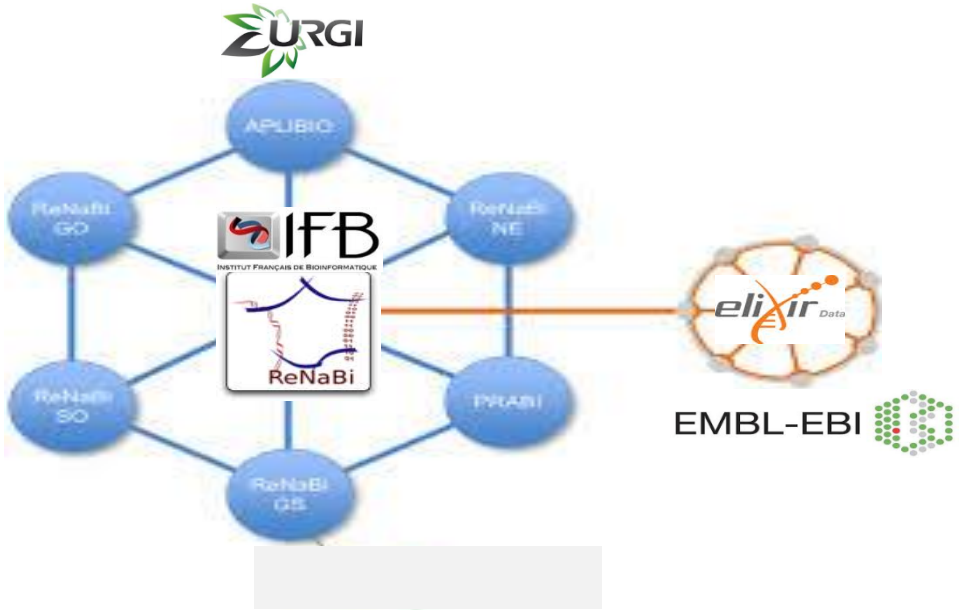
Genetics

- Genetic maps
- Genetic markers
- Genetic resources

Genome

- Annotation
- Transcriptome
- SNP / Structural variant

URGI is a node of the french network of bio-informatics facilities (IFB-ReNaBi)



Challenges

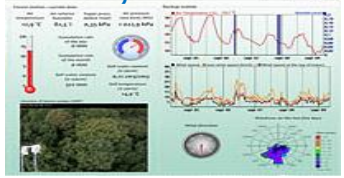
Necessity to connect data stored into different information systems

- Because the volumes are becoming too big for one information system (Ex: NGS)
- Because it is impossible to store all data in a single data model (Ex: phenotyping)
- Because data relevant for a scientific question may be stored in different databases dedicated to other purposes

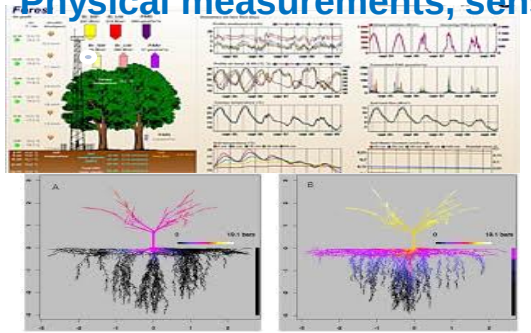
Necessity to organize and query heterogeneous data collected in different laboratories/context

Different data structures <-> different initial question
Potentially different experimental protocoles

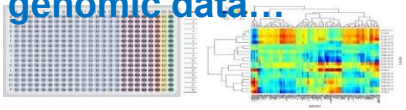
Climate, environment



Physical measurements, sensors…



Metabolites, proteins, genomic data…



Post-harvest

Bibliography, human sciences…

Development of guidelines, ontologies and standards by the **community of data producers/researchers**

Consequences on information systems

Towards distributed systems

Work in progress

Towards distributed information systems

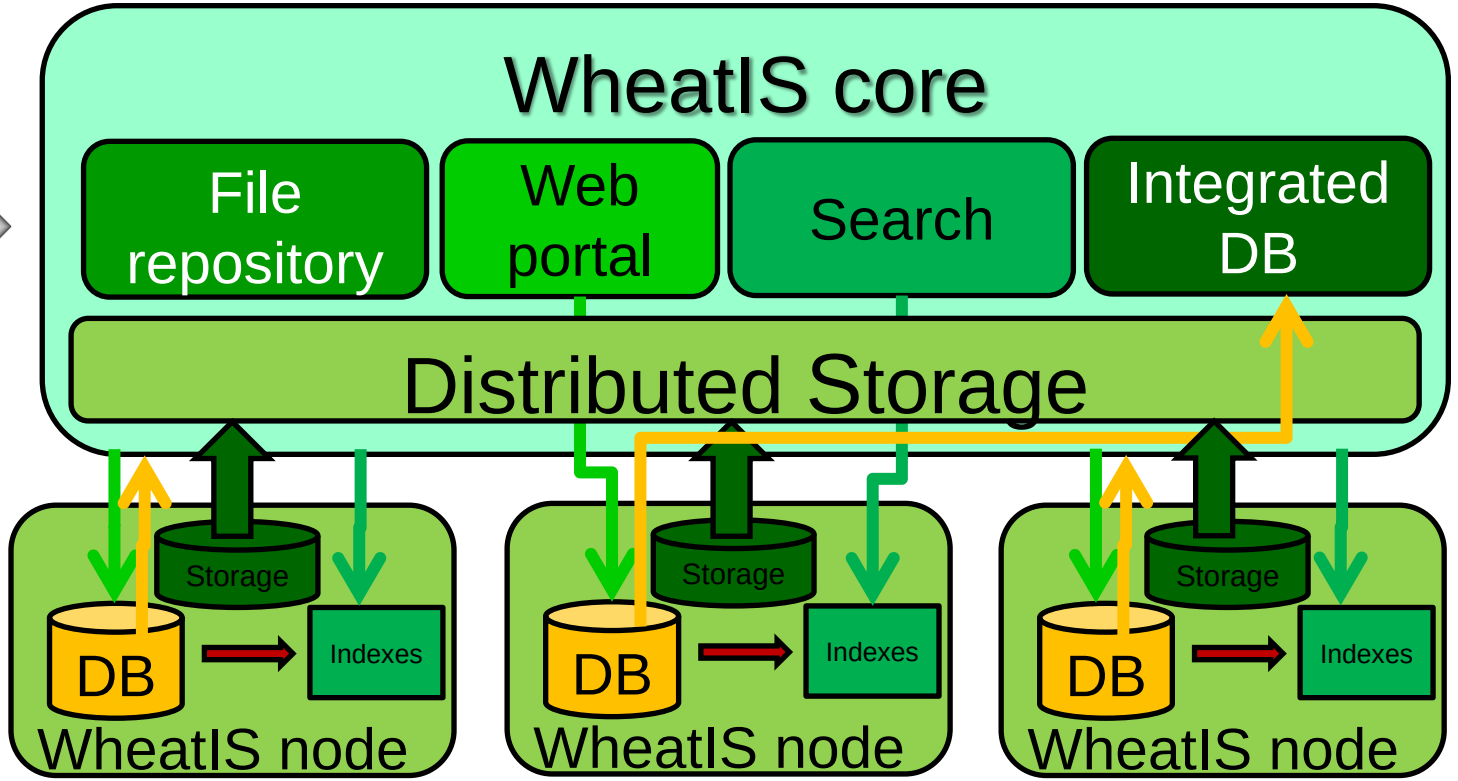
WheatIS: the information system of the International Wheat Initiative (coord. H. Lucas): (chair: H. Quesneville)

Google-like query tool allowing to retrieve information in the databases of the transnational **TransPLANT** infrastructure (coord P. Kersey, EBI)

Information system for French Plant Phenotyping Network (**Phenome**, coord F. Tardieu)

Building a portal for the french crop **germplasm collections** (ARCAD-FEDER, J-L Pham coord)

WheatIS architecture



Definition of standards

Survey of existing standards: **(1) data, (2) ontologies, (3) meta-data**

"**Cookbook**": how to produce easily shareable, reusable and interoperable "wheat data"

Identification of **end-users** categories and **WheatIS nodes**

Challenge : adoption of the recommendations by the community

- simple ontologies
- good balance between genericity and necessary specifity
- alignment with other international initiatives
- tools to help users

Ontologies / Thesaurus

References Ontologies

PATO
- Area
- …

Plant Ontology
- Leaf
- …

Unit Ontology
- cm2
- …

Plant Ontology PO Consortium

Applied Ontologies

Crop Ontology

Wheat

Leaf Area
- Unit : cm2
- Method

Yield
- Unit : t/ha
- Method

Rust
- Scale
- Method
- Stage

Vitis

Budbreak date

Young Shoot: aperture of tip
- OIV:001
- Scale:1-3-5
- UPOV:3

Generation Challenge Programme — CULTIVATING PLANT DIVERSITY FOR THE RESOURCE POOR

Bioversity International

Thesaurus

BreedWheat
- Leaf Area
  - **BreedWheat Method**
- Yield

Breed Wheat

Phenome
- Leaf Area
- Budbreak date

PHENOME Réseau Français Phénomique végétale FPPN

AnaEE Analysis and Experimentation on Ecosystems France

Full text queries of distributed databases

GnpIS

EnsemblPlants

EMBL-EBI

MetaCrop

IPK

CR-EST

IPK

GEBIS

IPK

HELMHOLTZ GEMEINSCHAFT

PLANTS DB

PolapgenDB

IGR

Lucene indexes

Apache Solr

Lucene

elasticsearch.

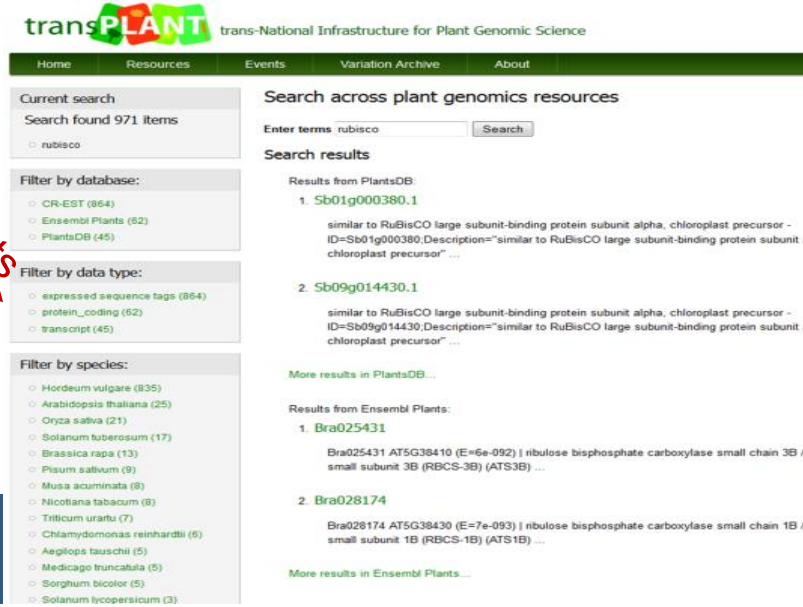
Google like query

Google like list of results

http://www.transplantdb.eu/

User web interface

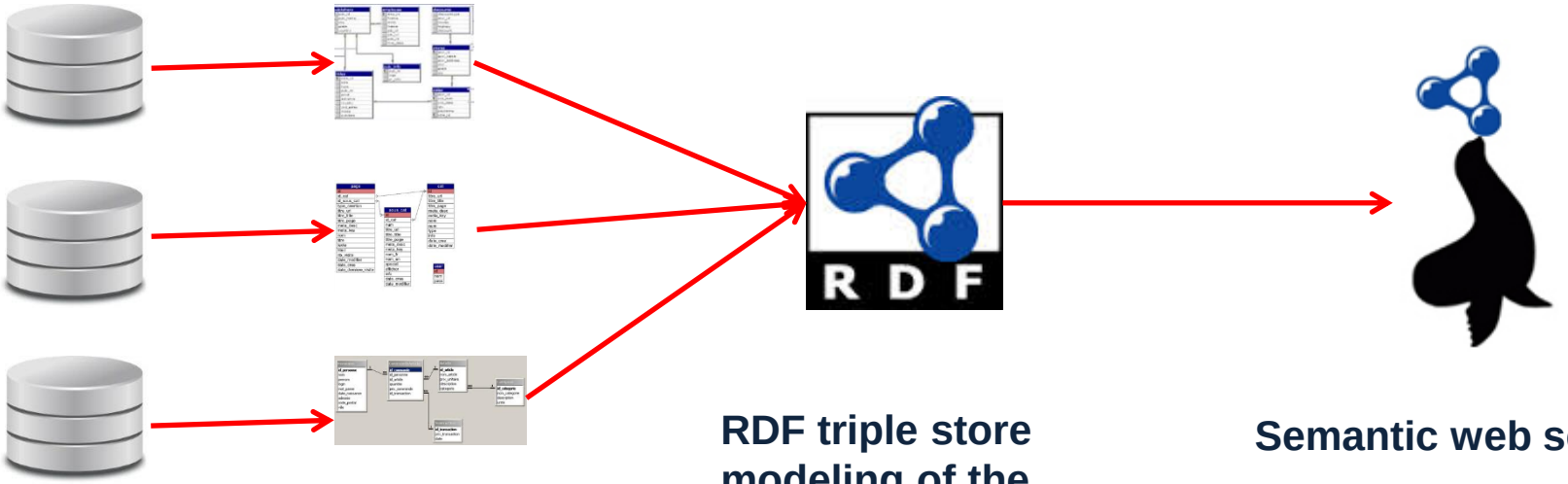
EMBL-EBI



Wheat Initiative

Perspectives

Develop a web semantic interoperability between the plant databases of the French Elixir node



Ontology based annotation of database schemes

RDF triple store modeling of the databases schemes integrated with existing ontologies

Semantic web services

Summary

Challenge: the query of high volumes of heterogeneous and distributed data

⇒ Federation of information systems

- ❖ At the national and european level
- ❖ through noSQL technologies (SolR, ElasticSearch…)
- ❖ Web semantic layer

Aknowledgements

URGI team

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WheatIS timeline