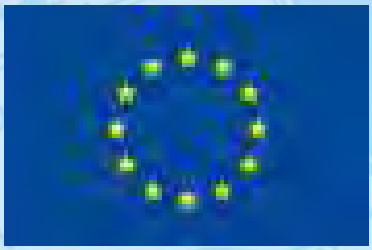


GISt activiteiten voor het GeoValley project

Projectnummer: GBP / Geo Valley 21F.005

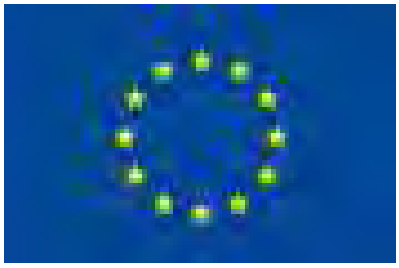
Theo Tijssen & Wilko Quak

GISt Report No. 63

TU Delft Delft University of Technology

Challenge the future

GIS TECHNOLOGY



GISt activiteiten voor het GeoValley[1] project

Projectnummer: GBP / Geo Valley 21F.005

Theo Tijssen & Wilko Quak

GISt Report No. 63

[1] Dit project is medegefinancierd met steun van het Europees Fonds voor Regionale Ontwikkeling van de Europese Commissie.

Samenvatting

Dit rapport bevat een beknopt verslag van in activiteiten van Theo Tijssen en Wilko Quak in het kader van het GeoValley project. Het rapport bevat een flink aantal bijlagen waarin de geproduceerde resultaten integraal zijn opgenomen (presentaties, artikelen, analyses, etc.)

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Inhoud

1 Achtergrond 1

2 Overzicht bijlagen 3

1 Achtergrond

In de jaren 2009-2011 heeft de sectie GISt van het OTB geparticipeerd in het door de EU mede gefinancierde project Geo Valley. Geo Valley is een investeringsplan opgesteld door de Stichting Geomatics Business Park, in samenwerking met organisaties afkomstig uit alle provincies van Landsdeel West. De activiteiten van de sectie vonden plaats binnen de onderzoek- en ontwikkelingsactiviteit (O&O) 'Geomatica Technologie en Infrastructuur' binnen deelproject I (O&O). Binnen het thema "Geomatica Technologie en Infrastructuur (T&I)" wordt nieuwe kennis ontwikkeld over een (e-) netwerk infrastructuur dat de bedrijven in het Geomatics Business Park ondersteunt in het verkrijgen, gebruiken, verwerken en verspreiden van geo-informatie. De verwachting is dat dit onderzoek bestaande diensten aanmerkelijk kan verbeteren en efficiënter maken. Daarbij zal een aanpak worden gekozen die optimaal aansluit bij de nationale en internationale ontwikkelingen op het gebied van geo-informatie voorzieningen in combinatie met netwerktechnologie.

Met name Theo Tijssen en Wilko Quak zijn bij de uitvoering van die project betrokken geweest vanuit de sectie GISt. In de bijlages van dit document geven wij een overzicht van de bijdrages van de sectie GISt aan dit project.

2 Overzicht bijlagen

A. Wilko Quak. Presentatie op intern overleg: 'Running services on top of a DBMS' (2009-12-14)
B. Wilko Quak, Theo Tijssen. Lunch presentatie op OTB-TUDelft. (2010-02-04)
C. Wilko Quak. Geo Valley Update event op het Geonatics Businuess Park (2010-03-18)
D. Wilko Quak. Proposed structure for embedding 3D-Coverages in INSPIRE UML Diagrams (2011-07-15)
E. Wilko Quak. Unfinished Paper: Toward integrated support for coverages in INSPIRE (2012-03-22)

Bijlage A

Wilko Quak. Presentatie op intern overleg: 'Running services on top of a DBMS' (2009-12-14)

Running Services on top of a DBMS

Wilko Quak, GIS Technologie, OTB
25-10-2012

TUDelft

Overview

- DBMS
- Services
- How to merge them
- Do we go parallel?

DBMS

- Can manage lots of data data
- Has a bunch of pre-defined operations on the data
- Can do user authentication

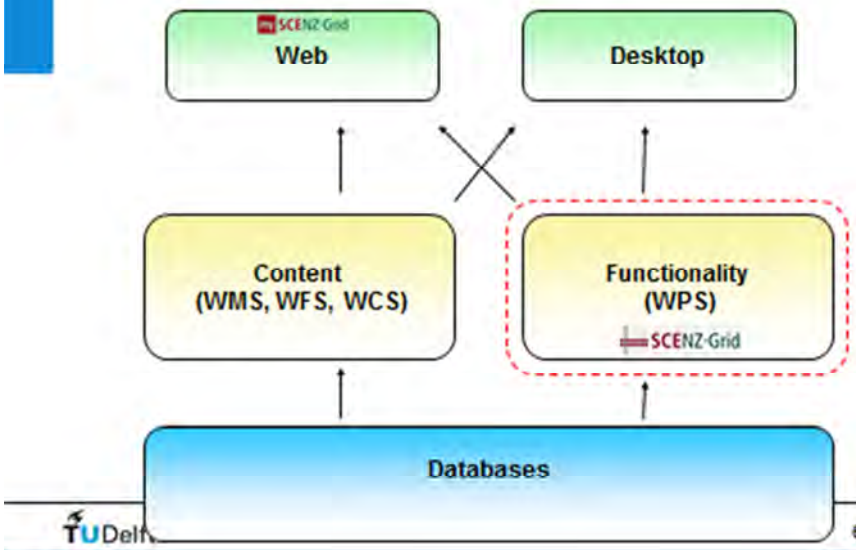
Spatial DBMS operations

ST_Area . . . . . ST_Buffer . . . . . ST_OrderingEquals . . .
ST_Azimuth . . . . . ST_BuildArea . . . . . ST_Overlaps . . . . .
ST_Centroid . . . . . ST_Collect . . . . . ST_Perimeter . . . . .
ST_Contains . . . . . ST_ConvexHull . . . . . ST_Perimeter2D . . .
ST_ContainsProperly . . . ST_CurveToLine . . . . . ST_Perimeter3D . . .
ST_Covers . . . . . ST_Difference . . . . . ST_PointOnSurface .
ST_CoveredBy . . . . . ST_Dump . . . . . ST_Relate . . . . . .
ST_Crosses . . . . . ST_DumpRings . . . . . ST_Touches . . . . . .
ST_LineCrossingDirection ST_Intersection . . . . . ST_Within . . . . . .
ST_Disjoint . . . . . ST_LineToCurve . . . . . ntatie 4
ST_Distance ST_MemUnion

Services

- Map Services
  - WMS for raster data
  - WFS for vector data
  - WCS for coverage data
- Web Processing Services is more soa oriented
  - *GetCapabilities* returns service-level metadata
  - *DescribeProcess* returns a description of a process including its inputs and outputs
  - *Execute* returns the output(s) of a process

SCENZ-Grid



DBMS and SOA

- Functionality on DBMS and WPS are standardized on a different level:
  - DBMS defines exact semantics of operations
  - WPS defies how to get the names and parameters of operations.

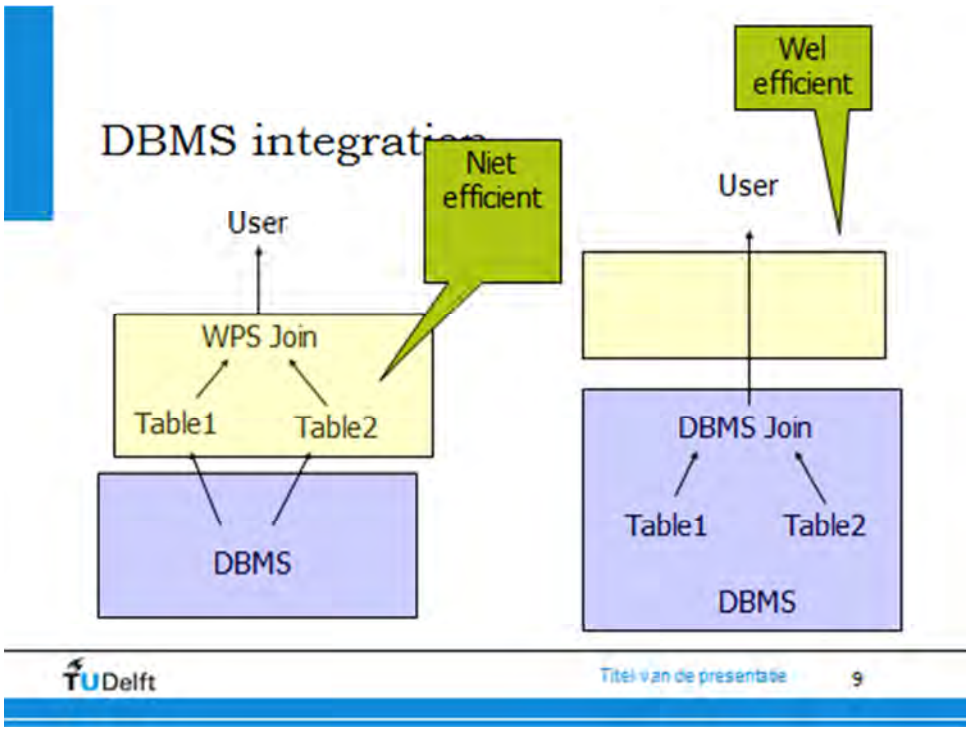
We need to solve this mismatch.

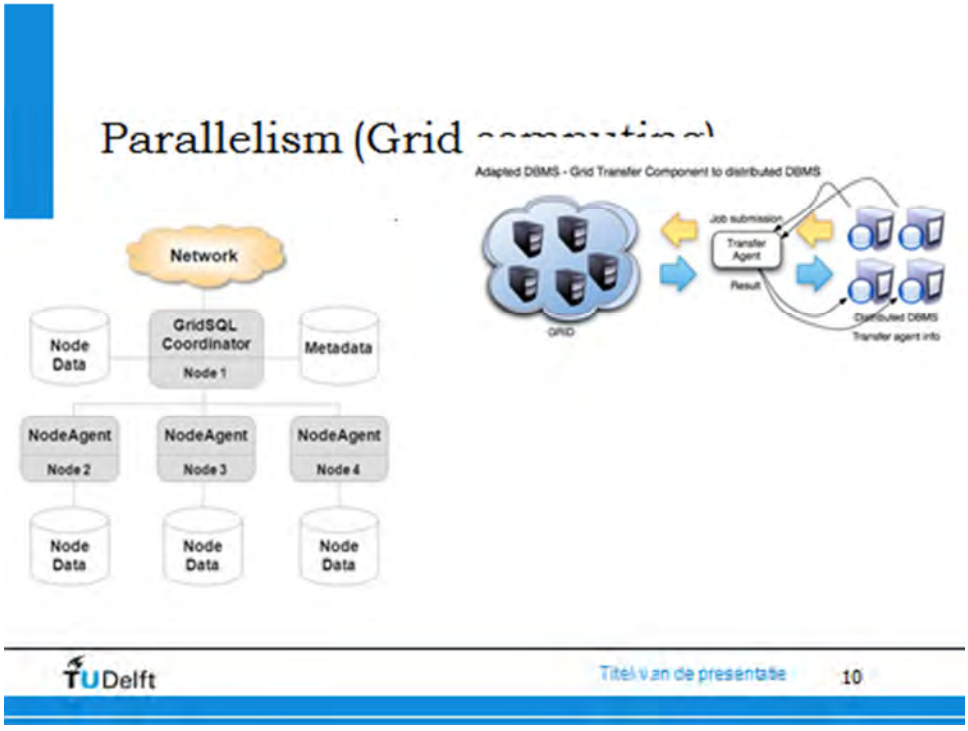
Linking services and databases

- Provide all DBMS operations as WPS services.
- Build a working system

Research Question: How to integrated DBSM and Servies

Open Question: Do we need parallelism


DBMS integratie
Niet efficient
User
WPS Join
Table1
Table2
DBMS
Wel efficient
User
DBMS Join
Table1
Table2
DBMS
TUDelft
Titel van de presentatie
9


Parallelism (Grid
Network
Node Data
GridSQL Coordinator
Node 1
Metadata
NodeAgent
Node 2
NodeAgent
Node 3
NodeAgent
Node 4
Node Data
Node Data
Node Data
Adapted DBMS - Grid Transfer Component to distributed DBMS
Job submission
Transfer Agent
Result
GRID
TUDelft
Titel van de presentatie
10

Bijlage B

Wilko Quak, Theo Tijssen. Lunch presentatie op OTB-TUDelft. (2010-02-04)

GeoValley

Project, status, planning

Wilko Quak, Theo Tijssen -- OTB

25-10-2012

TU Delft

Overview

- Project Overview
  - Geovalley
  - Activity overview
  - Our Activity: Geomatics Technology & Infrastructure
- What has been done
- What will we do?

GeoValley – Project Overview

GeoValley – Activity overview

- 1.1 Eco-engineering in water-management of marine and estuary systems
- 1.2 Air Quality and Traffic
- 1.3 Monitoring spatial quality in rural- and urban area management
- 2 Geomatica technology en infrastructure
- 3 Knowledge Transfer

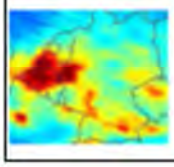
Application Oriented Activities

Activiteit titel: Eco-engineering in waterbeheer van mariene en estuariene systemen **Act. Nr:** 1.1

Act. verantwoordelijke : Alkyon (Belinda Kater)
Totale investeringen : € 1.550.000,= (ex. BTW)

Start Act. : 1 september 2008
Eind Act. : 1 juni 2012
Partners : **Alkyon,** IMARES, SOVON, UvA, NLR, Argoss, Infram

Activiteit titel: Luchtkwaliteit & Verkeer **Act. nummer:** 1.2



Act. verantwoordelijke : ARGOSS (Hein Zelle)
Totale investeringen : € 875.000,= (ex. BTW)

Start Act. : 1 sept. 2008
Eind Act. : 1 sept. 2011
Partners : **ARGOSS,** TNO B&O (KNMI), NLR

Activiteit Titel: Monitoring ruimtelijke kwaliteit in natuur- en stedelijk gebiedsbeheer **Act. 1.3**

Act. verantwoordelijke : Infram (Franklin Thijs)
Totale investeringen : € 900.000,= (ex. BTW)

Start : 01-01-2009
Einde : 31-01-2011
Partners : Infram, Argeops, VB Ecoflight, NLR, TU-Twente/ITC

Knowlege Transfer

Activiteit titel: KennisTransfer **Act. Nummer:** 3

Geomatics Business Park

Act. verantwoordelijke : Stichting Geomatics Business Park
Totale investeringen : **€ 1.701.800,=** (incl. BTW)

Start Act. : 1 juli 2007
Eind Act. : 1 september 2012

Our contribution

Activiteit titel: Geomatica technologie en infrastructuur **Act. Nummer:** 2

Act. verantwoordelijke : NLR (Rob van Swol)
Totale investeringen

Start : 01-01-2009
Einde : 31-01-2011
Partners : NLR, TU Delft (Onderzoeksinstituut OTB), TNO (Bouw en Ondergrond)

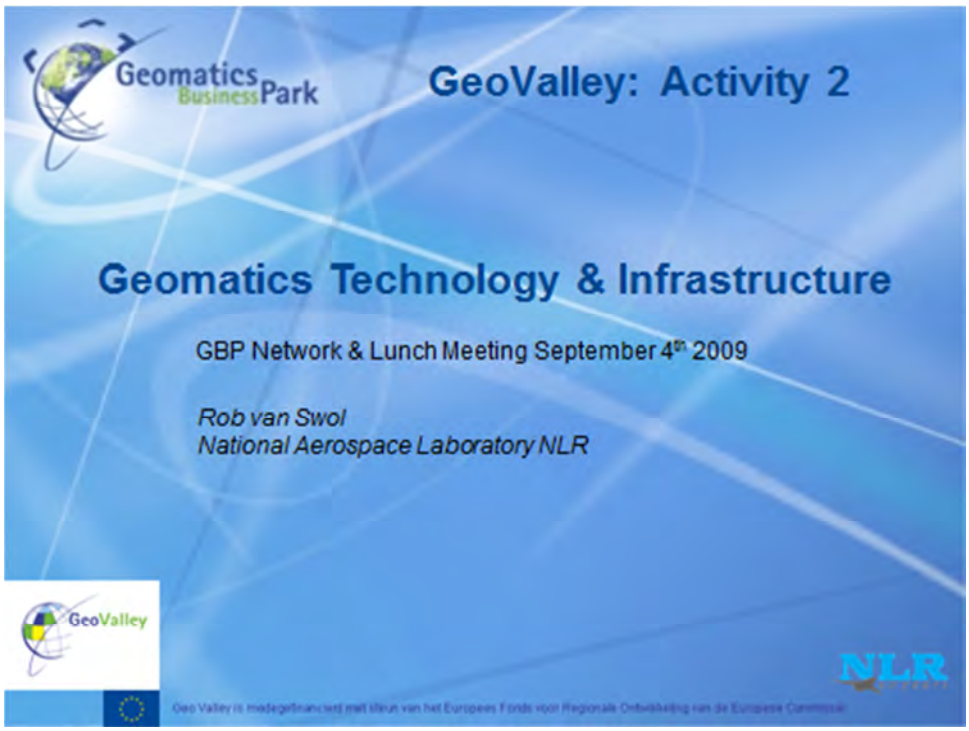
2009: 82 days
2010: 78 days
2011: 52 days

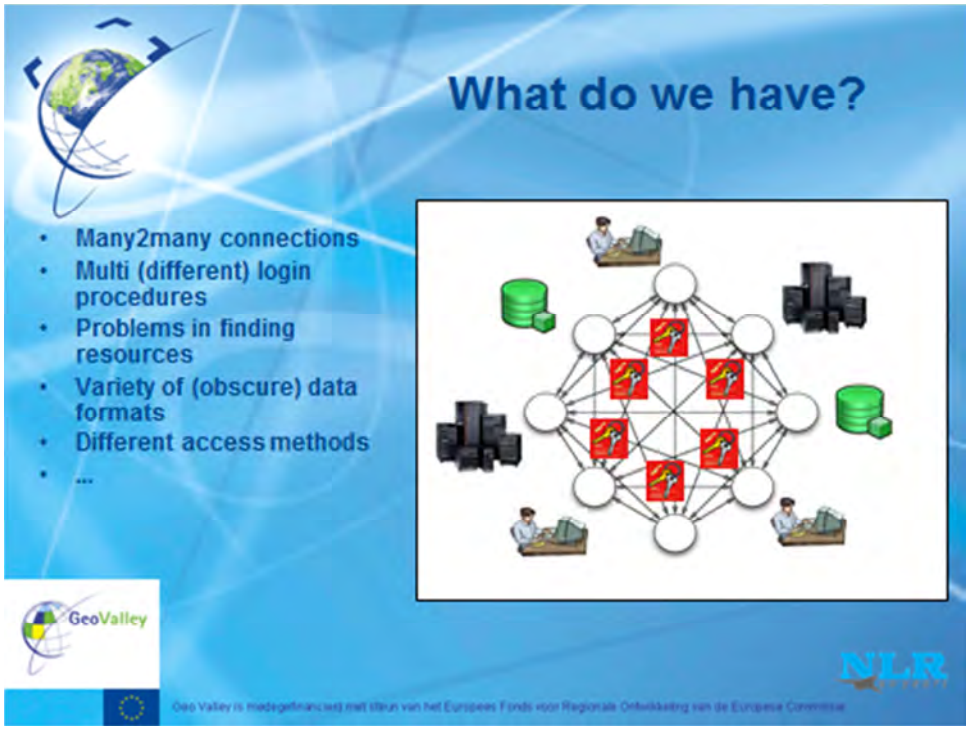
Work Packages:

2.1 : Geo-service infrastructuur

2.1.1: Inventarisatie: web- en GIS technologie (TUDelft)
2.1.2: Inventarisatie: gebruiksaspecten (NLR)
2.1.3: Validatie – Gap Analysis (TUDelft)
2.1.4: Validatie - testbed (TUDelft)
2.1.5: Architectuurontwerp (TUDelft)
2.1.6: Implementatie en testen (NLR)

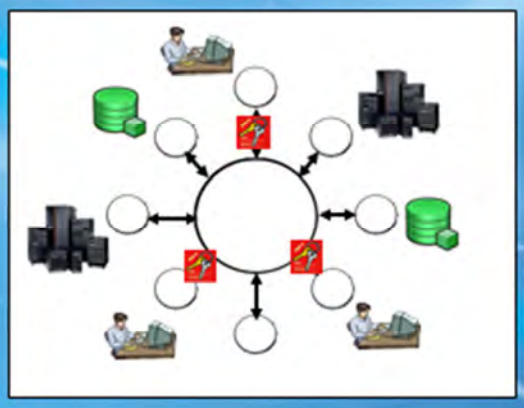
Here we are responsible


Geomatics Business Park
GeoValley: Activity 2
Geomatics Technology & Infrastructure
GBP Network & Lunch Meeting September 4th 2009
Rob van Swol
National Aerospace Laboratory NLR
GeoValley
NLR


What do we have?
Many2many connections
Multi (different) login procedures
Problems in finding resources
Variety of (obscure) data formats
Different access methods
...
GeoValley
NLR

What do we want?

- Federated environment
- One login
- One catalogue; easy to find resources
- Well described data formats
- Transparent access
- Harmonized data access
- ...



GeoValley

Geo Valley is medegefinancierd met steun van het Europees Fonds voor Regionale Ontwikkeling van de Europese Commissie

NLR

What do we need?

- Technology standards
  - Network (SOAP), ...
- Data access standards
  - OGC: WFS, WMS, WCS, CSW..
- Metadata standards
  - ISO 19115/19139, ...
- Technology developments
  - BPEL services flow, ...
- Regulations
  - INSPIRE

GeoValley

Geo Valley is medegefinancierd met steun van het Europees Fonds voor Regionale Ontwikkeling van de Europese Commissie

NLR


What do we get?
Geo-information applications build on:
• sustainable distributed network platform
• providing access to
– expert knowledge
– tools
– geospatial data
– Earth observation data
• seamless interface to European SDI, National SDI
ITtoolbox
GeoValley
NLR


Who are we?
• National Aerospace Laboratory, NLR
• TNO (Built Environment and Geosciences)
• Delft University of Technology
• Steering Group
– Alkyon
– BMT ARGOSS
– Infram
NLR 90 years
TNO
TU Delft
Delft University of Technology
GeoValley
NLR

What did we do / are we doing....

- Write overview of GI standards for Earth Observation (Wilko)
- Research storage of raster data in RDBMS (Theo)

What are we going to do...

- Integrate raster & vector in DBMS and Services
- Efficient service chaining using DBMS

DBMS and SOA

- Functionality of DBMS and WPS are standardized on a different level:
  - DBMS defines exact semantics of operations
  - WPS defines how to get the names and parameters of operations

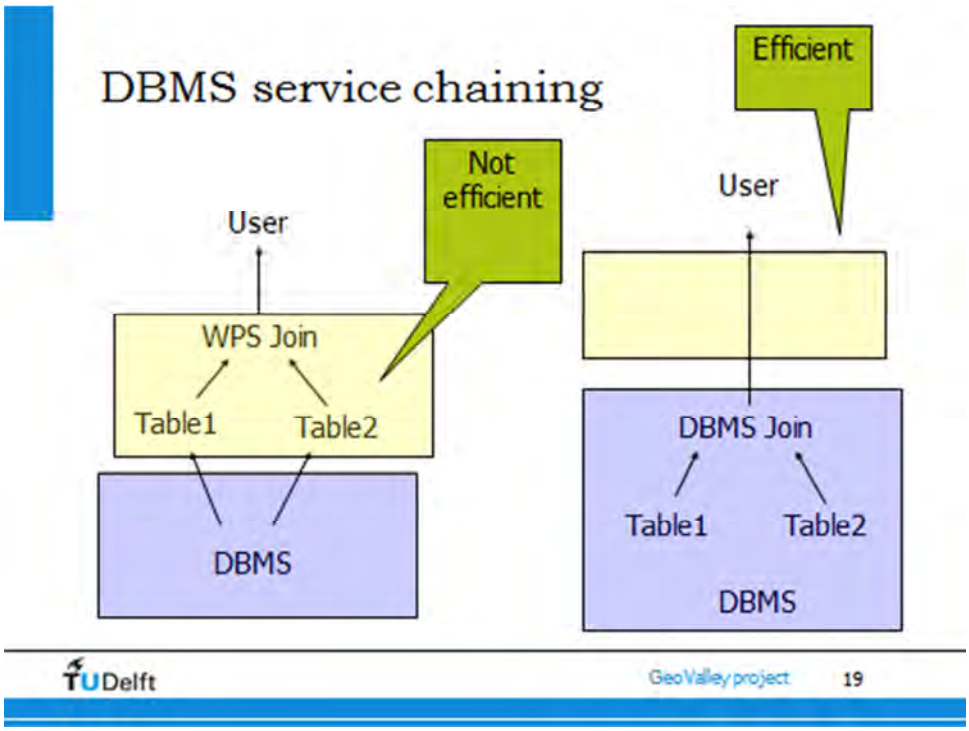
We need to solve this mismatch.

DBMS and service chaining

- Provide all DBMS operations as WPS services.
- Build a working system

Research Question: How to integrate DBSM and Services?

Open Question: Do we need parallelism?



Raster data support in RDBMS

Many initiatives for storing raster data in DBMS, e.g.:

- PostgreSQL/PostGIS
  - PgRaster (proposal)
  - PostGIS WKT Raster (partial Beta 0)
- Oracle
  - GeoImage (initial implementation)
  - GeoRaster (current production version)

PgRaster will be a PostGIS implementation of GeoRaster,
PostGIS WKT Raster uses a different approach.

Testing raster data support

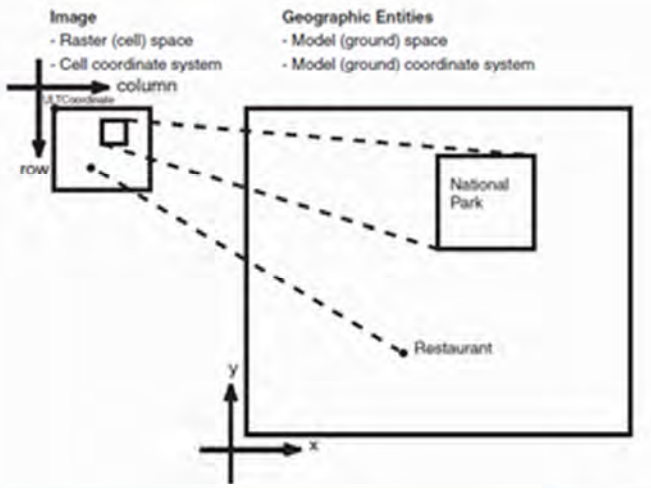
- Functionality
  - Data type(s)
  - Geo-referencing
  - Multi-resolution / level of detail (pyramids)
  - Input / output formats
  - Available operations
  - APIs
  - Client tools
- Performance
  - Physical storage options, blocking (tiles), compression, interleaving
  - Data loading
  - Indexing
  - Data retrieval, queries (rectangles, polygons)

GeoRaster datatypes: sdo_georaster (metadata) and sdo_raster (cell values)

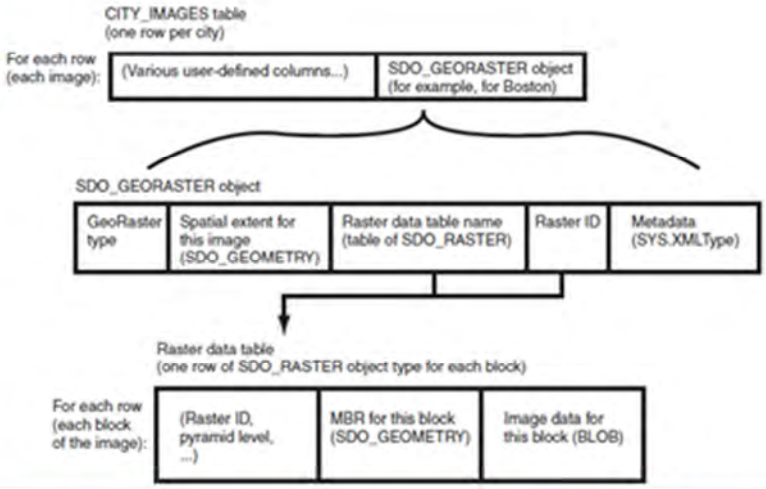
```
CREATE TYPE sdo_georaster AS OBJECT (
    rasterType              NUMBER,
    spatialExtent           SDO_GEOMETRY,
    rasterDataTable         VARCHAR2(32),
    rasterID        NUMBER,
    metadata        XMLType);

CREATE TYPE sdo_raster AS OBJECT (
    rasterID        NUMBER,
    pyramidLevel            NUMBER,
    bandBlockNumber         NUMBER,
    rowBlockNumber          NUMBER,
    columnBlockNumber NUMBER,
    blockMBR        SDO_GEOMETRY,
    rasterBlock             BLOB);
```

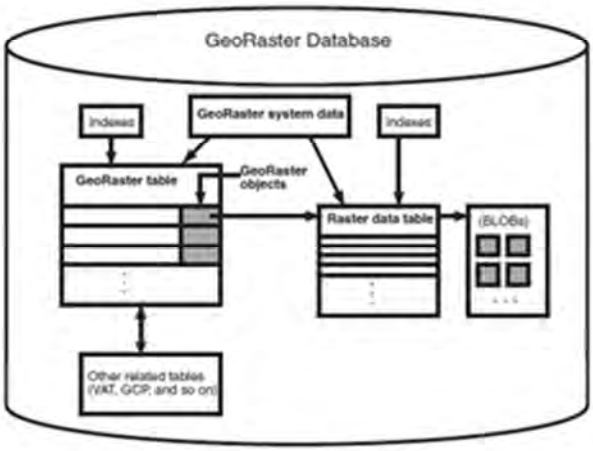
GeoRaster coordinate spaces



GeoRaster physical storage



Raster data in an Oracle database



PostGIS WKT Raster approach

- Similar to PostGIS vector geometry
  - 1 table = 1 raster coverage (possibly non-rectangular)
  - 1 row = 1 tile or raster object
- Only 1 new datatype: RASTER
  - is self-contained (includes metadata and data)
- High level of vector – raster integration
  - many spatial operations can be applied to vector and raster
  - lossless vector – raster conversion
- In-DB and Out-DB storage

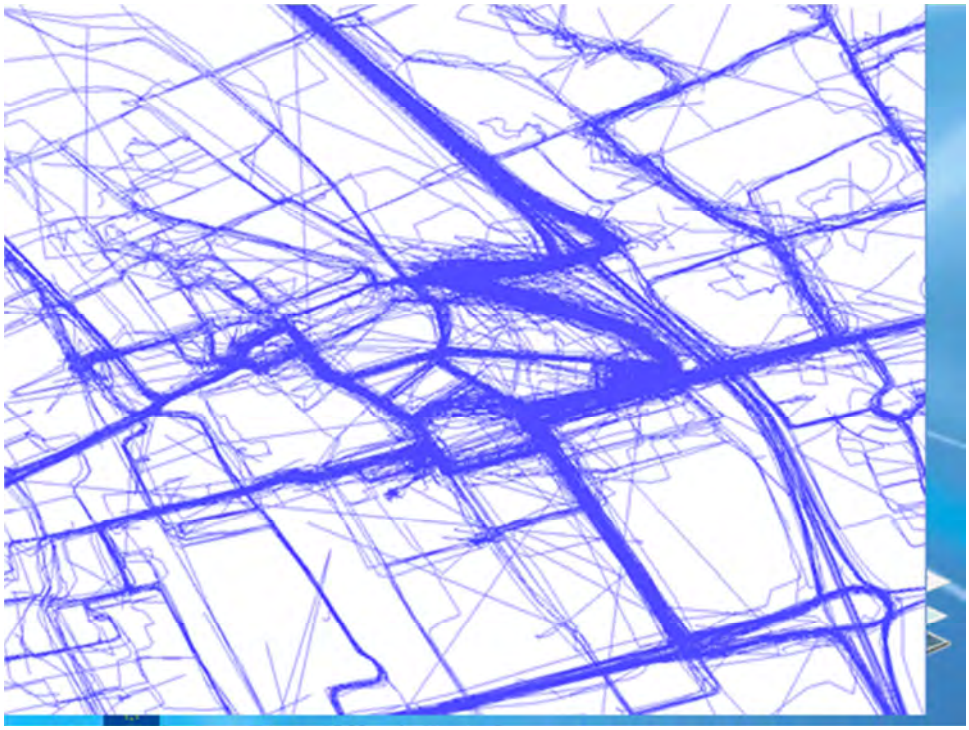
Bijlage C

Wilko Quak. Geo Valley Update event op het Geonatics Businuess Parkt (2010-03-18)


Geomatics BusinessPark
Geo Valley: Activiteit 2
Geomatica Technologie & Infrastructuur
NLR 90 years
TUDelft
Delft University of Technology
TNO
GeoValley

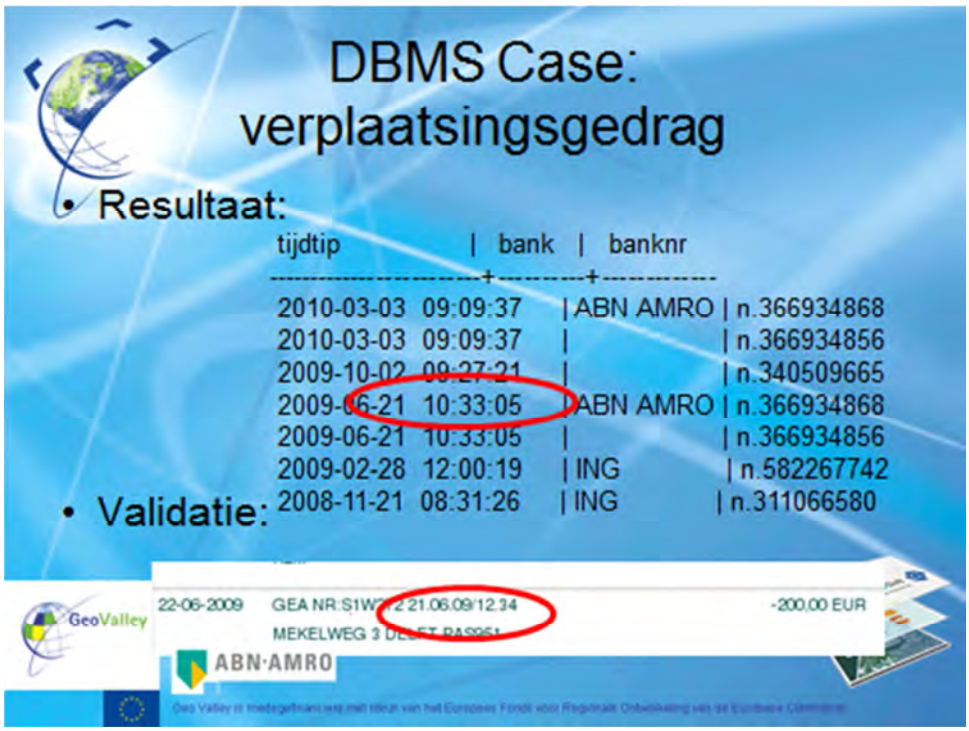

Introductie
"GDSC in de Wolken"
Remco Dost (NLR)
"De DBMS als basis van een service architectuur"
Wilko Quak (TUDelft)
GeoValley


DBMS
• Hoe ziet het dagelijks leven van een Geo-Database Management Systeeem (DBMS) gebruiker eruit…
• Voorbeeld verplaatsingsgedrag:
– In een onderzoek naar verplaatsingsgedrag van mensen keken we naar het gebruik van PIN automaten.
– Hoe heb ik dat met een DBMS opgelost…
GeoValley




ING
ABN AMRO
ING
ING
ING
ING
ING


DBMS case:
verplaatsingsgedrag
• Kan ik achterhalen wanneer ik pin?
• Antwoord GeoDBMS gebruiker in SQL:
select sum(endtime-starttime),atm.id,tp.filename
from trackpoints tp,osm_node_amenities atm
where ST_Dwithin(tp.location,atm.geometry,0.0005)
and atm.amenitytype = 'atm'
group by atm.id,tp.filename
having sum(endtime-starttime) > '00:02:00'
• Resultaat: …
GeoValley


DBMS Case:
verplaatsingsgedrag
• Resultaat:
tijdtip | bank | banknr
2010-03-03 09:09:37 | ABN AMRO | n.366934868
2010-03-03 09:09:37 | | n.366934856
2009-10-02 09:27:21 | | n.340509665
2009-06-21 10:33:05 | ABN AMRO | n.366934868
2009-06-21 10:33:05 | | n.366934856
2009-02-28 12:00:19 | ING | n.582267742
2008-11-21 08:31:26 | ING | n.311066580
• Validatie:
22-06-2009
-200,00 EUR
GeoValley
ABN·AMRO

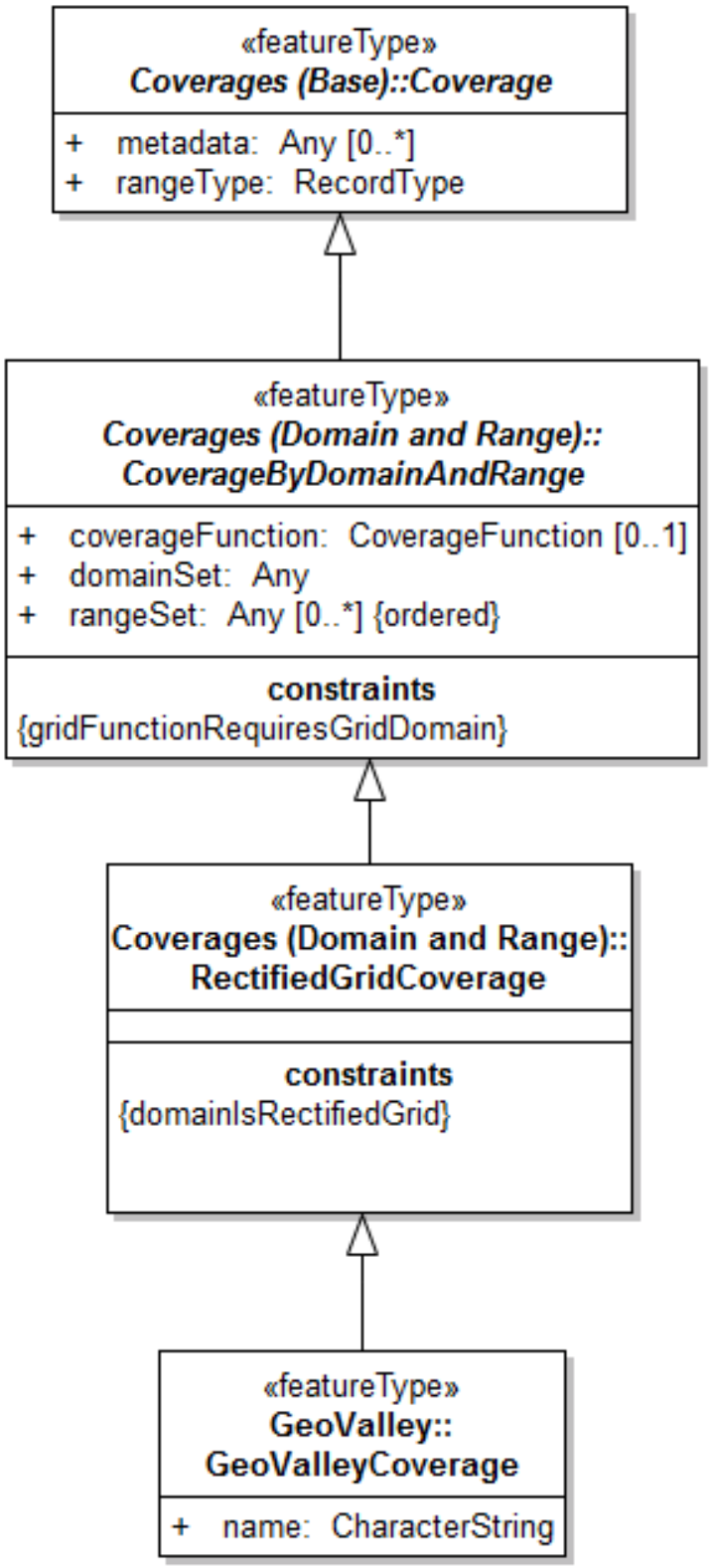

Nu in Aardobservatie…
• Kan ik achterhalen hoeveel zonuren ik heb gehad?
14:00 (13:00 UTC)
Dat lukte niet in een halfuurtje


DBMS case:
lessen
• Wanneer gegevens in dezelfde DBMS zitten is koppelen erg makkelijk (half uur werk)
• Vector gegevens (=GIS) veel makkelijker dan raster (=Aardobservatie)
• Data naar DBMS halen was veel werk (liever laat ik die bij de bron).
GeoValley


Wat kan ik bijdragen aan Geovalley?
• Database functionaliteit aanbieden als service.
• Aardobservatie functionaliteit toevoegen aan DBMS.
GeoValley

Bijlage D

Wilko Quak. Proposed structure for embedding 3D-Coverages in INSPIRE UML Diagrams (2011-07-15)


«featureType»
Coverages (Base)::Coverage
+ metadata: Any [0..*]
+ rangeType: RecordType
«featureType»
Coverages (Domain and Range)::
CoverageByDomainAndRange
+ coverageFunction: CoverageFunction [0..1]
+ domainSet: Any
+ rangeSet: Any [0..*] {ordered}
constraints
{gridFunctionRequiresGridDomain}
«featureType»
Coverages (Domain and Range)::
RectifiedGridCoverage
constraints
{domainIsRectifiedGrid}
«featureType»
GeoValley::
GeoValleyCoverage
+ name: CharacterString

Bijlage E

Wilko Quak. Unfinished Paper: Toward integrated support for coverages in INSPIRE (2012-03-22)

This paper is unfinished because the paper comments on a draft version of a standard in the INSPIRE project that has been withdrawn, possibly because of the findings done in this paper that were communicated with the INSPIRE developers before the paper was finished.

Toward integrated support for coverages in INSPIRE

Wilko Quak

Delft University of Technology (c.w.quak@tudelft.nl)

Abstract

In the INSPIRE project the modelling of coverages has been a debated issue. Initially support for coverages in the Generic Conceptual Model was minimal, because the first themes did not need support for coverages. Only during the development of the Annex II and III specifications support for coverages was gradually included. During the Cross Thematic Working Group meeting in Somma Lombardo (May 2011) it was decided that whenever the data of a theme has the characteristics of a coverage it should be modelled as a coverage. This decision came together with a change proposal for the Generic Conceptual Model that was published simultaneously. During the public consultation of the INSPIRE annex II and III draft specifications a consultation for the proposal for the Generic Conceptual Model was also included. Based on the results of this consultation it was concluded that the use of coverages in INSPIRE modelling should be minimized and only coverages of very specific types should be used. In this paper we describe the process of the coverage development and discuss what steps need to be taken for a broader support for coverages in INSPIRE.
Keywords: coverages, generic conceptual model, data specification

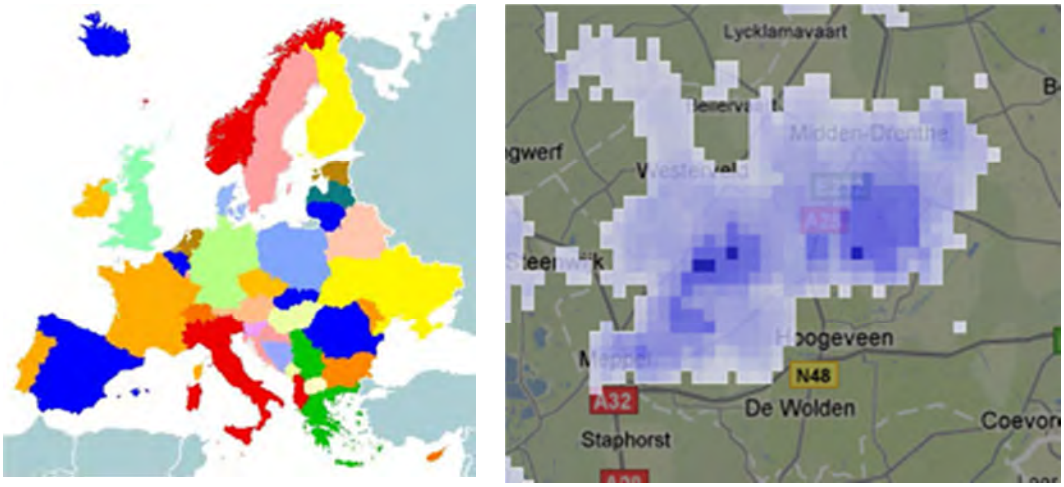
1 CONCEPTS OF COVERAGES

Conceptually coverages in ISO are defined in ISO 19123 (2005) as:

> *feature that acts as a function to return values from its range for any direct position within its spatial, temporal or spatiotemporal domain*

Dependent on whether the function that defines the coverage is continuous or not, the coverage can be classified as a continuous or discrete coverage. An example of a discrete coverage is given in Figure 1 (left) where the mapping function maps from direction positions to a member state of the EU. In Figure 1 (right) a continuous coverage is depicted where a rain map is shown.

Figure 1: Discrete (left) and Continuous coverage (right)



Although conceptually these two data sets can both be modelled as coverages, implementation is often different. The map of the member states is usually implemented as a collection of (mutually exclusive and collectively exhaustive) polygons whereas the rain-map could be either represented as a raster data set or as a collection of point observations from which a specific value for each position within the coverage can be calculated via interpolation. When users interact with a coverage dataset

This diversity of implementations for one generic concept is one of the issues that needs to be resolved in INSPIRE.

2 COVERAGES IN THE INSPIRE GENERIC CONCEPTUAL MODEL

For each theme in INSPIRE a data product specification is made that describes the relevant classes their attributes relationships etc. These specifications will be modelled based on the Generic Conceptual Model (D2.5). [todo: In this paper we use a first draft of Version 3.4].

In the GCM there are two ways of representing of topologies.

It should be noted that although the topology representations are described in the Generic Conceptual Model the representations are closer to an implementation model because they describe how the

3 ISSUES WITH COVERAGES

In this section I try to trace back the things that went wrong in the in the modelling of the INSPIRE themes using coverages to the concept of coverage as described in ISO 19123. This leads to two conceptual issues that need to be resolved. First: can a coverage behave as a feature collection and second: a better distinction between the concept of coverage and its implementation is needed. These two issues will be elaborated in section 3.1 and 3.2, also a way towards a solution is provided.

3.1 Feature attribute value vs the feature itself

A coverage defines a mapping from a direct position to a collection of feature attribute values. However the distinction between a feature attribute value and the feature itself is not completely clear. However from the ISO19123 it appears that the intension is that a coverage is not a Feature Collection but a collection of values and on a value no operations with side effects are possible. This means queries can be done, but the original objects can never be edited.

As a consequence modelling a Feature Collection where the features are mutually exclusive and collectively exhaustive (as the collection of the member states of Europe) as coverage will not work because the resulting structure will not behave as a Feature Collection anymore. This property of a coverage stems from the fact that coverages are often implemented and grid cells lack identity.

Conceptually it is possible to model a coverage so that it behaves as a Feature Collection (already now it is stated in ISO 19123 that a collection of feature can be derived from a coverage), however how this will impact on the services that provide coverages needs further research. Eventually it would mean integration of a Web Feature Server and Web Coverage Server but whether this is desirable from an implementation point of view is debatable.

3.2 Concept or Implementation

ISO 19123 defines the concept of coverage and at the same time it describe how a coverage may be implemented. This mixture of concept and implementation leads to questions that need to be answered. For example in clause 5.1.4 of the specification it is described that a discrete coverage could be used to implement an associated continuous coverage. In INSPIRE there is a separation between the conceptual model and the implementation model; usually the models are the same but it is possible to specify an implementation model that is different from the conceptual model. In this way a coverage that is conceptually continuous can be implemented as a discrete multipoint coverage. When a continuous coverage is implemented as a discrete coverage there is no place to store the attributes for the originating continuous coverage (such as interpolationType) therefore the resulting implementation is incomplete. The most straightforward way of solving this issue is extending the discrete coverage model with optional attributes that implement the originating continuous coverge.

4 CONCLUSIONS AND THE WAY FORWARD

The path that INSPIRE has taken for the use of coverages in the data (i.e. only use them when their use widely accepted in the specific theme) is sensible as current support for generic coverage in the specification and implementation part has shown to be too immature. By moving forward with coverages in INSPIRE in themes that already work with coverage outside INSPIRE is a good way of building experience with coverages in the inspire context.

Harmonization between the INSPIRE themes for coverages is still needed. Since the adaptations for the Generic Conceptual Model were written in parallel with the data specifications the text in the Generic Conceptual Model could not be used as a harmonizing guideline.

Themes that currently do not use coverage types but where their data effectively behaves like a coverage might want to migrate in the future to a specification where coverages is used. Before this a happens the standardization of coverages needs to be taken a step further. The main issues that need to be resolved are:

- All levels of the standards (from abstract specification, to implementation in a server need to be harmonized.
- Many of the issues in the current standard stem from the unclear distinction between the implementation of coverages and the abstract concept of coverages. Only by fully separating concept (a function that returns a value) from implementation (as raster or as collection of polygons) an interoperable standard can be achieved.
- [TODO] State that coverage as feature collection is a good idea conceptually.

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