

Architectural Patterns in Open GIS Web Services

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Open GIS Consortium

..... *Spatial connectivity*

for a changing world.

[www. opengis.org](http://www.opengis.org)

[www. isotc211.org](http://www.isotc211.org)

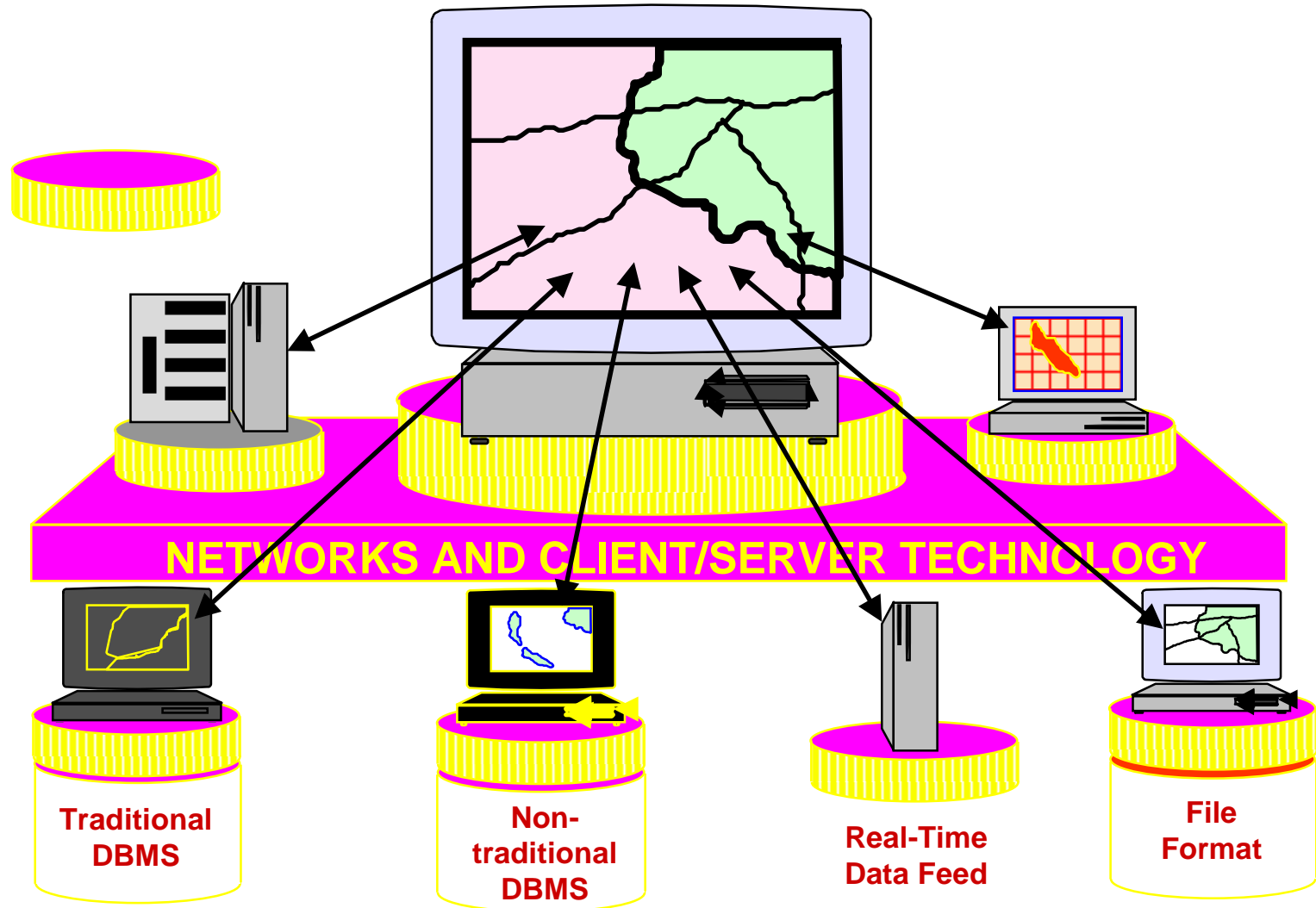
- **Problem: Interoperability of GIS – through standards**
- **Open GIS: OGC and ISO/TC211 standards**
- **Architectural patterns: ISO/OGC Service Architecture**
- **OGC Web Services architecture**
- **Pattern – Service binding template**
- **OGC, ISO/TC211 and OMG MDA**
- **Conclusion**

Architectural Patterns in Open GIS Web Services

OGC (Open Geodata Consortium) and ISO/TC211 is involved in the creation of standards and recommendations for geospatial information and services.

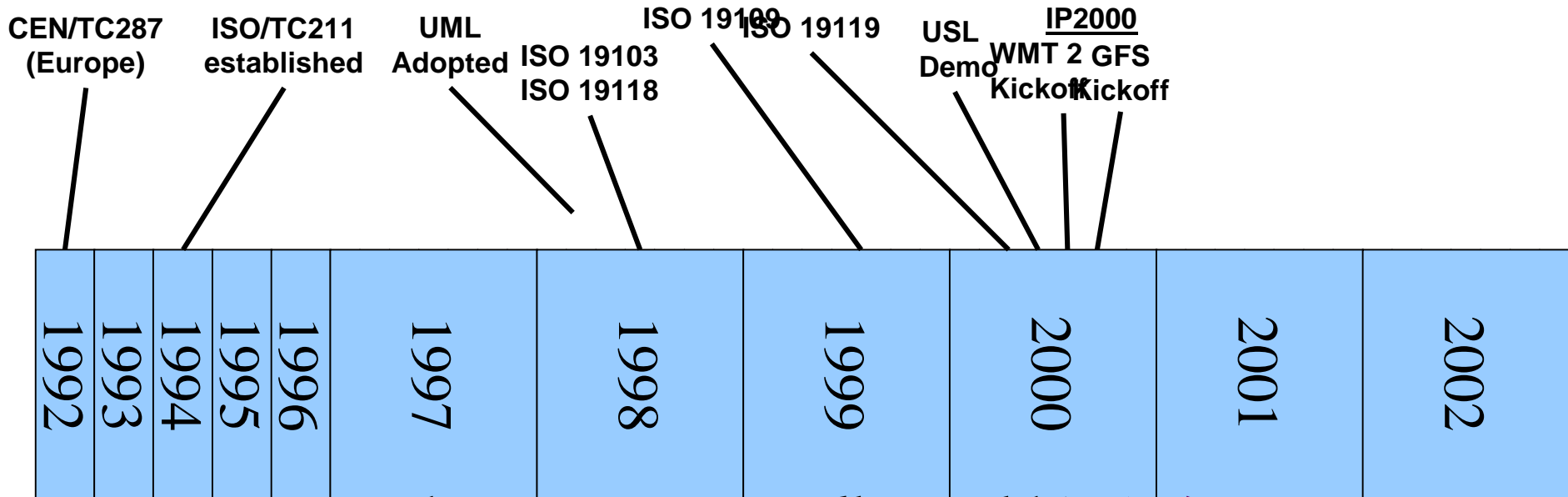
OGC Web Services provide a vendor-neutral, interoperable framework for web-based discovery, access, integration, analysis, exploitation and visualization of multiple online geodata sources, sensor-derived information, and geoprocessing capabilities. The current UDDI and ebXML registry models provide a basis for business and service descriptions in the OWS registry model. The strong information- and content-oriented focus of GIS web services has led to a further development of architectural patterns for flexible information search and retrieval for general content-oriented web services, based on a dynamic binding template. The relationship to the OMG MDA approach and the ISO 19119 service specification standard of ISO/TC211 will be discussed.

Problem Goal: Transparent Access to Heterogeneous Geodata and Geoprocessing Services



ISO/TC211 & OGC "Roadmap"

ISO/TC211 Stds



OGC Specifications



2001/2002 Initiatives

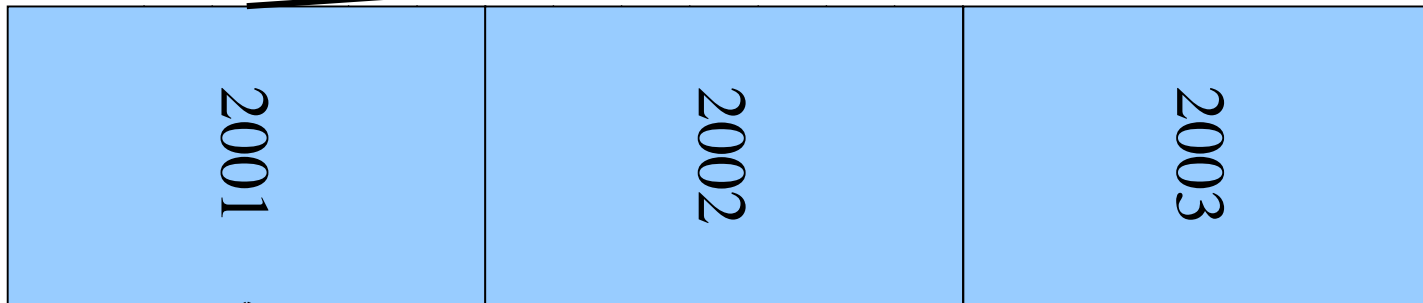
IP2001

Decision Support
4D
Info Community Enable
Location Services
Military Pilot Project
WMT-3 — GFS-2

2001 Business

IETF Response
The Open Group
MAGIC Agenda
E-Government
Digital Earth

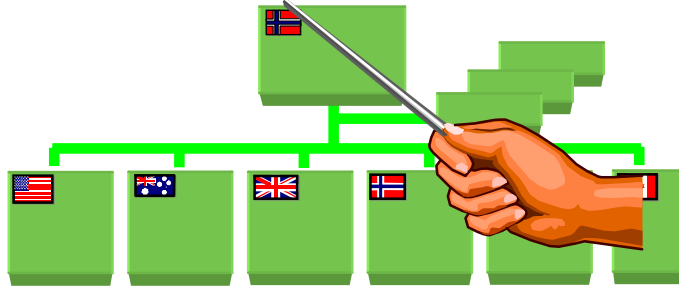
LIF Agenda
W3C Coordination
SEDRIS Agenda
OpenGIS.net
European Programs



GFS
Gazetteer
WFS, WCS
GeoLink, LOF
Geoparse, Geocode
GML XML Schema
Thesaurus
Type Dictionary

WMS-2
Legend,
Style Sheet &
S.S.Catalog
SLD, Symbol Library
GML Extensions:
IML, Coverage,
Basic Service Model
Filter

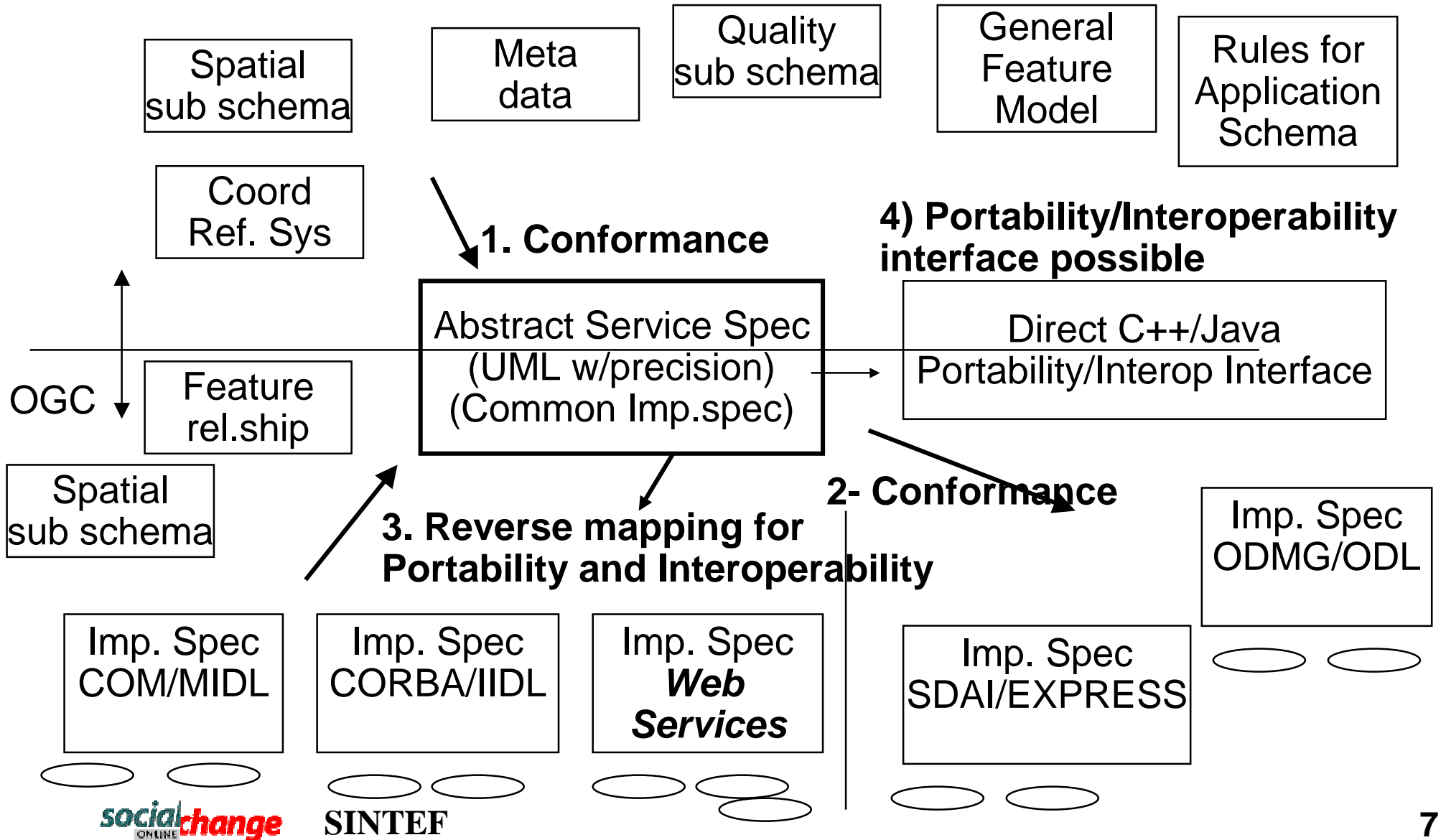
ISO/TC211 Overview

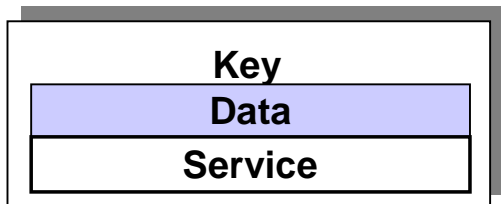
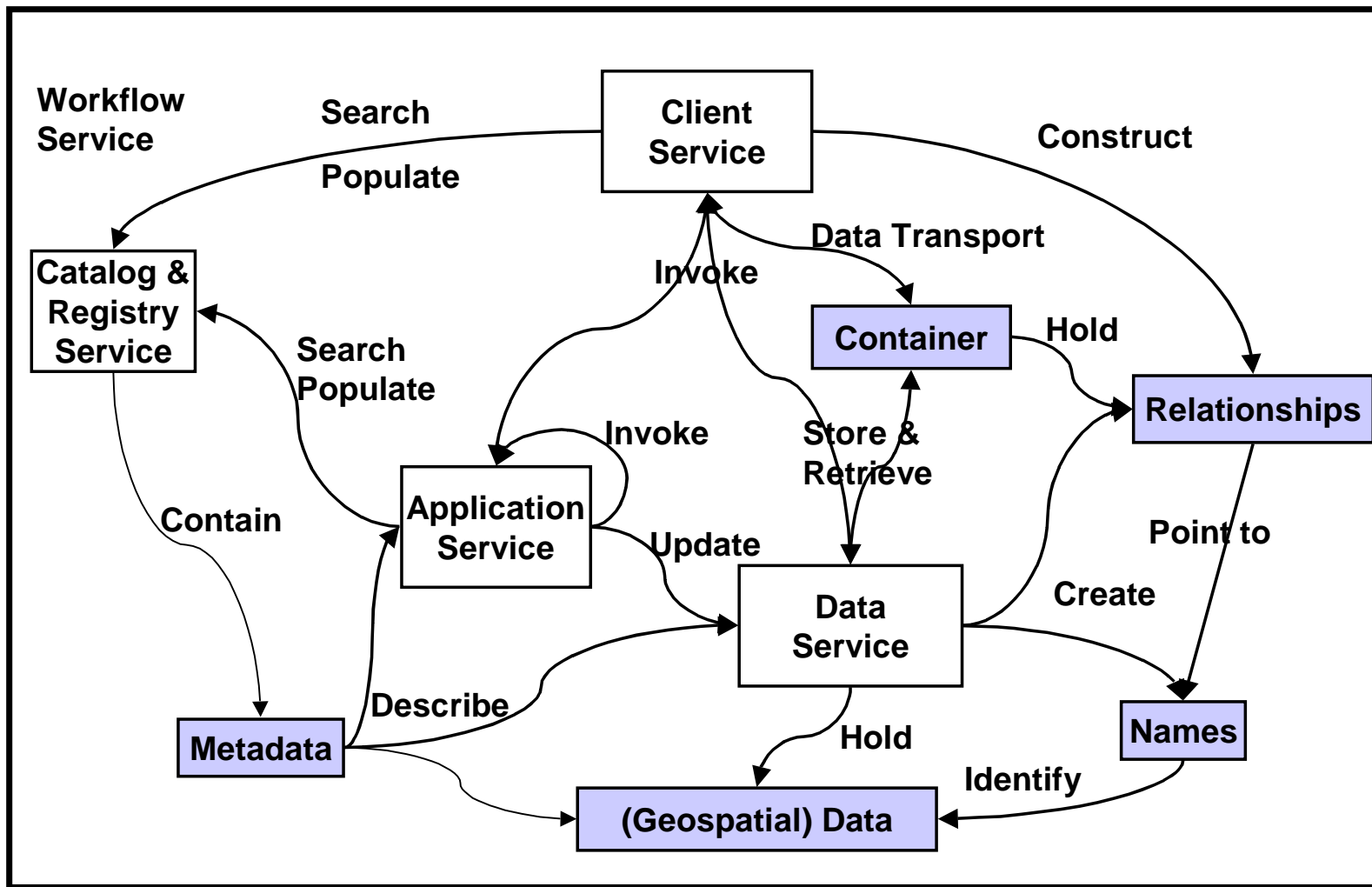


- ISO 19101 - Reference model
- ISO 19102 - Overview
- ISO 19103 - Conceptual schema language
- ISO 19104 - Terminology
- ISO 19105 - Conformance and testing
- ISO 19106 - Profiles
- ISO 19107 - Spatial schema
- ISO 19108 - Temporal schema
- ISO 19109 - Rules for application schema
- ISO 19110 - Feature cataloguing methodology
- ISO 19111 - Spatial referencing by coordinates
- ISO 19112 - Spatial referencing by geographic identifiers
- ISO 19113 - Quality principles
- ISO 19114 - Quality evaluation procedures
- ISO 19115 - Metadata
- ISO 19116 - Positioning services
- ISO 19117 - Metadata

- ISO 19118 - Encoding
- ISO 19119 - Services
- ISO/TR 19120 - Functional standards + new rev
- ISO/TR 19121 Imagery and gridded data
- ISO/TR 19122 - Qualifications and certification of personnel
- ISO 19123 - Schema for coverage geometry and functions
- ISO 19124 - Imagery and gridded data components
- ISO 19125 - Simple feature access – Part 1-3
- ISO 19126 - Profile - FACC Data Dictionary
- ISO 19127 - Geodetic codes and parameters
- ISO 19128 - Web Map Server Interface
- ISO 19129 - Imagery, gridded and coverage data framework
- ISO 19130 - Sensor and data model for imagery and gridded data
- ISO 19131 - Data product specification
- ISO 19132 - Location based services possible standards
- ISO 19133 - Location based services tracking and navigation
- ISO 19134 - Multimodal location based services for routing and navigation
- ISO 19135 - Procedures for registration of geographic information items

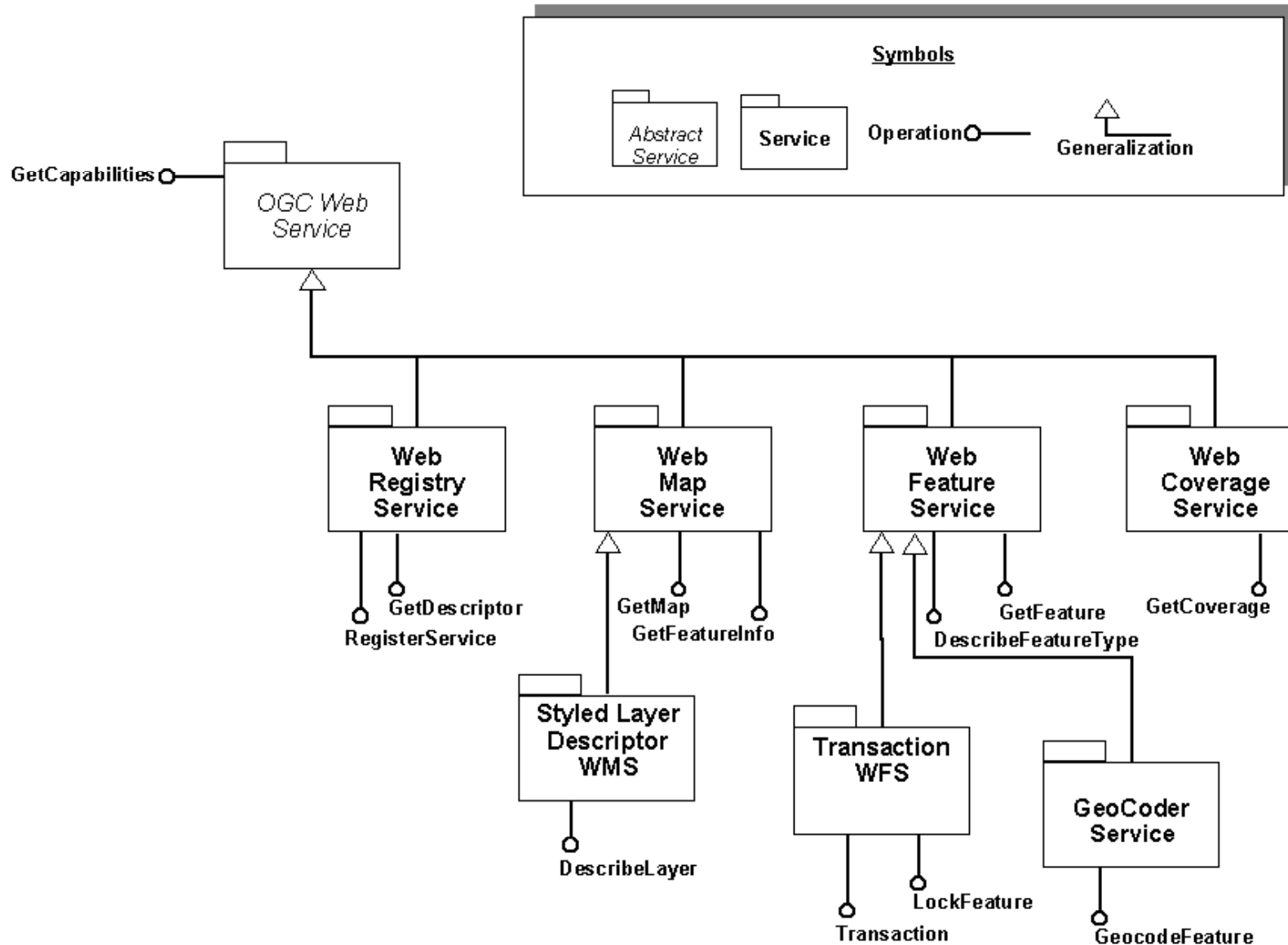
ISO/TC211 and OpenGIS

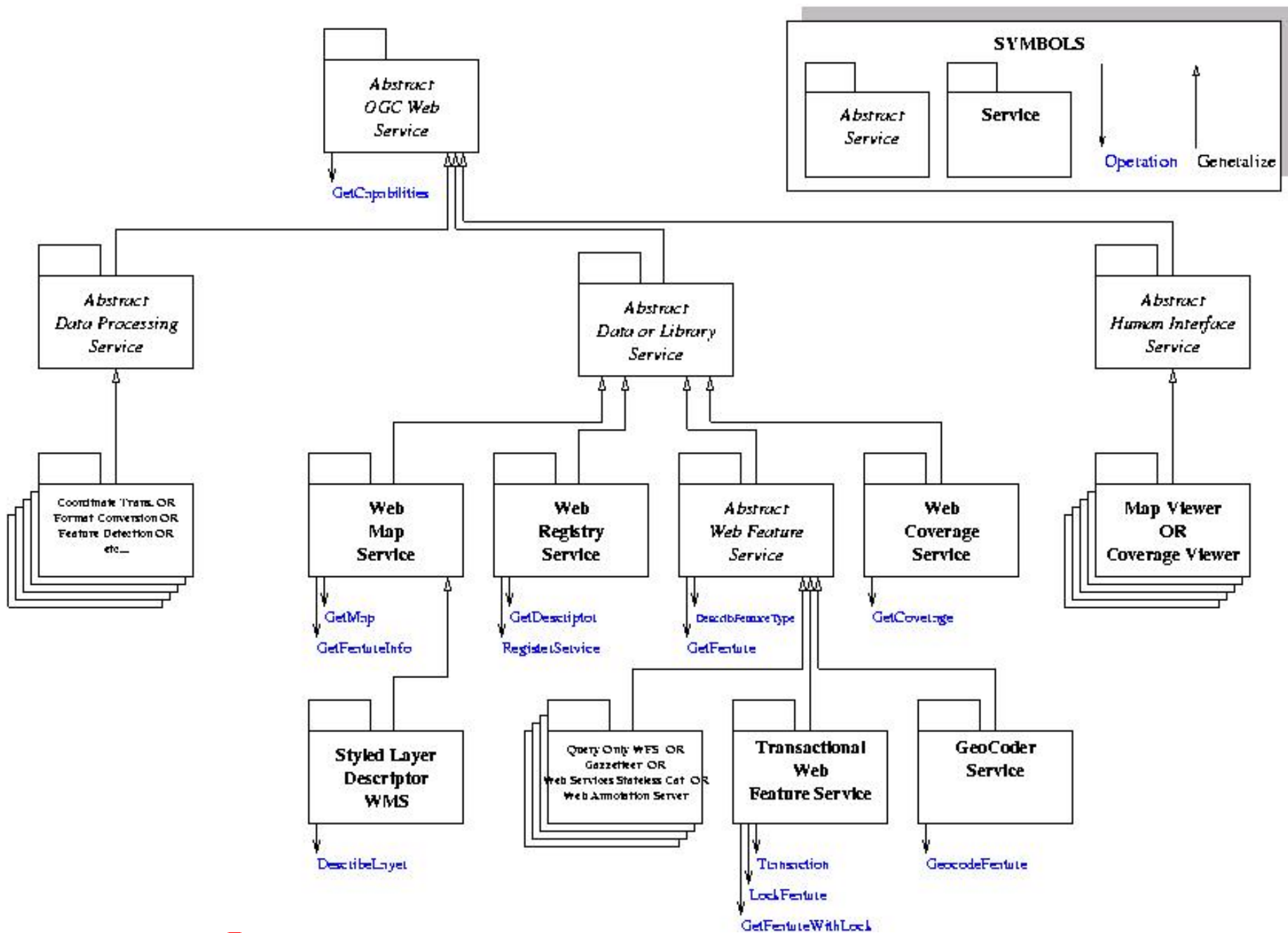




Pattern for Service Architecture

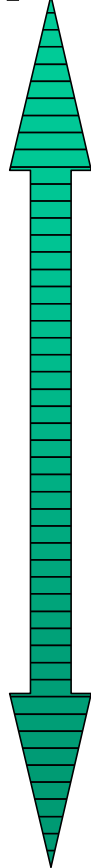
OpenGIS Web Services Architecture



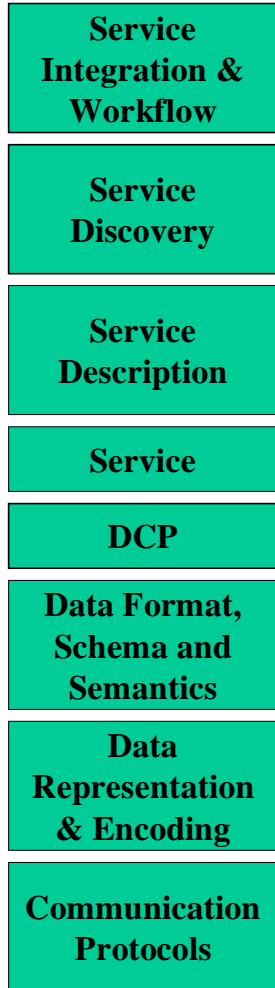


Interoperability Layers

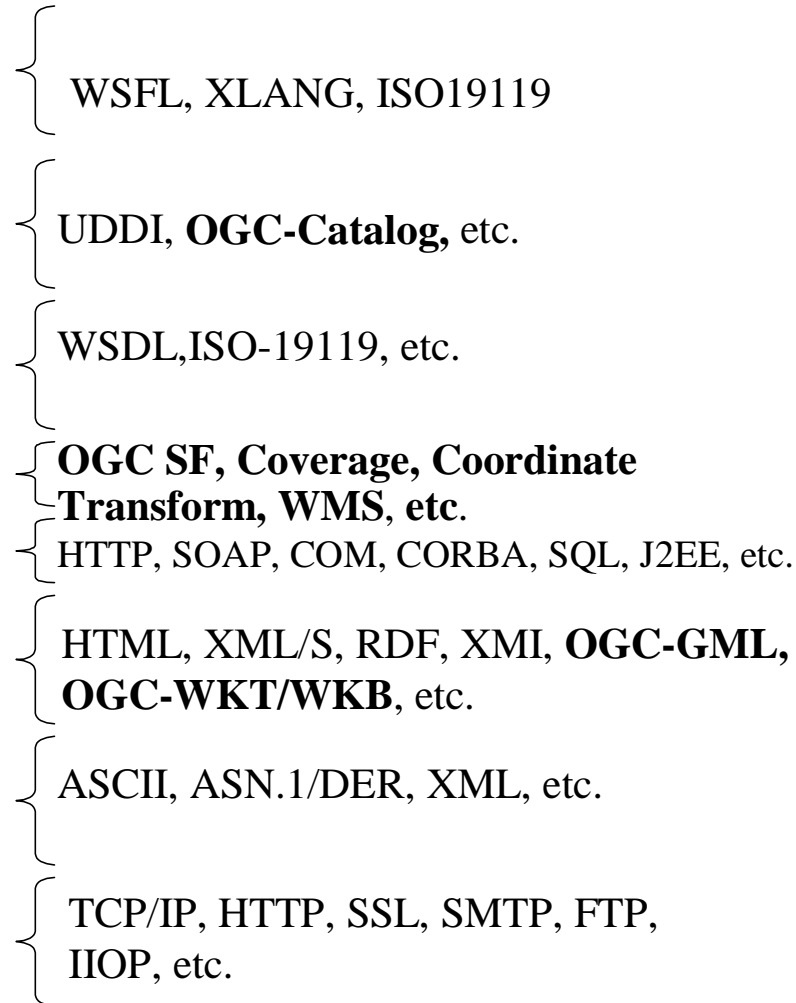
Interoperability



Connectivity



Interoperability Standards



Binding Patterns for OpenGIS Web Services

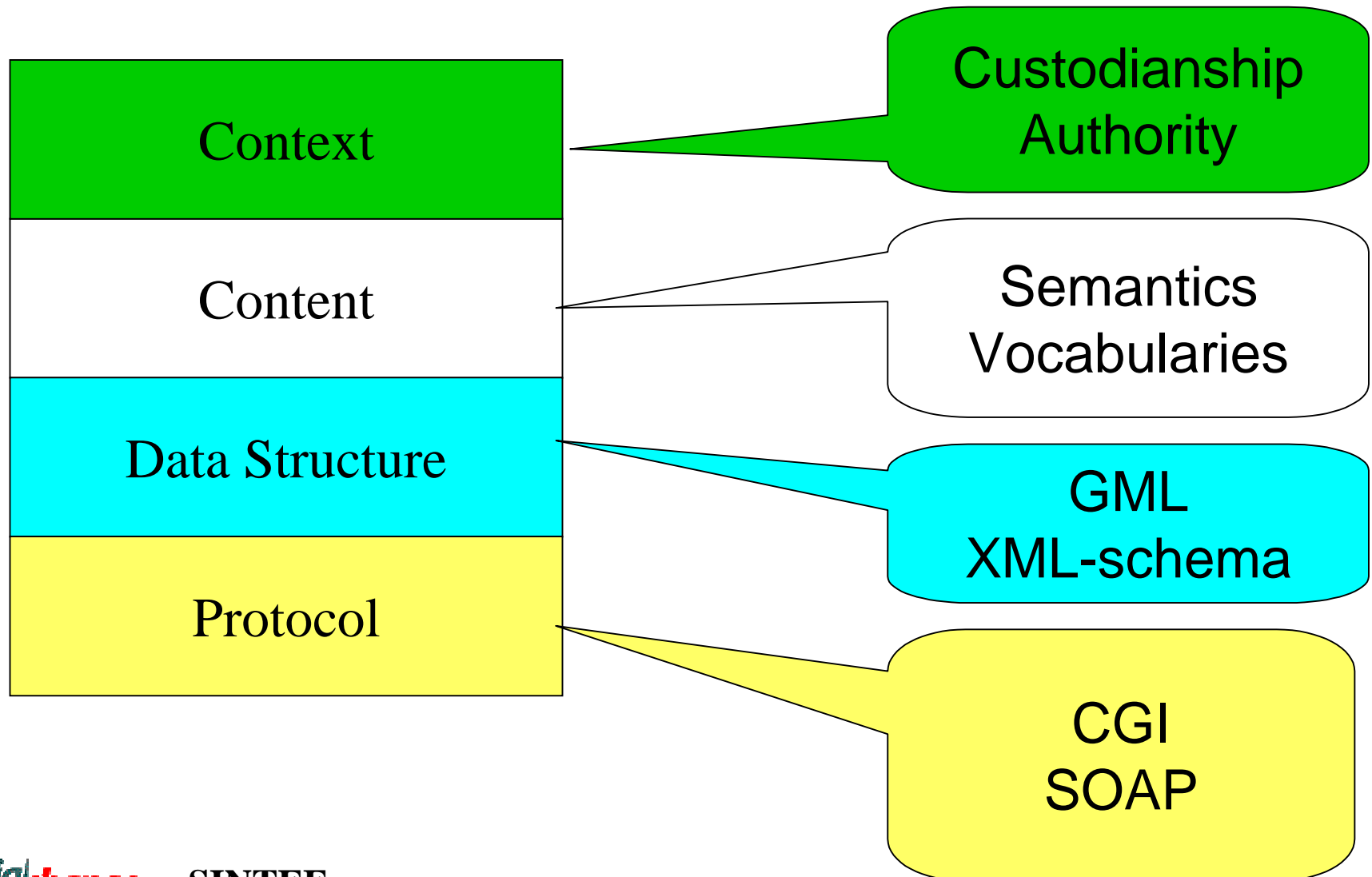
A Special Case?

- **Much content has a geographic facet.**
- ***Most* structured data is geographically organized.**
- **Geographic data can be terabytes and time dependent – exploitation is often an matter of choosing the right bit.**
- **A natural fit for demand access services.**
- **Content centric....**
- **BindingTemplate: A generalised content-aware recipe for invoking services**

Content Centricity

- **Semantics of service primarily a function of the content – not the access protocol**
- **Well known interfaces to exploit application-centric content**
- **Unlike “stock ticker” – application-centric interfaces to well known content**
- **OpenGIS defines standards for interoperability**

Interoperability...



Motivation

- **Need a consistent way to describe geographical content for service instances.**
- **Use Cases need to support persistent early binding – “e.g. show me what the traffic is like today, (using service X I discovered yesterday).”**
- **Need a consistent way to “chain” services.**
- **WSDL “binding” section inadequate – “types” only provide structural information.**

Synopsis

- **Operations invoked by parameterized messages**
- **Valid parameter values are constrained by service instances**
- **Service invocation requires all mandatory “unbound” parameters to be bound**
- **Service chaining requires bindings to be described throughout the chain**

Binding Templates

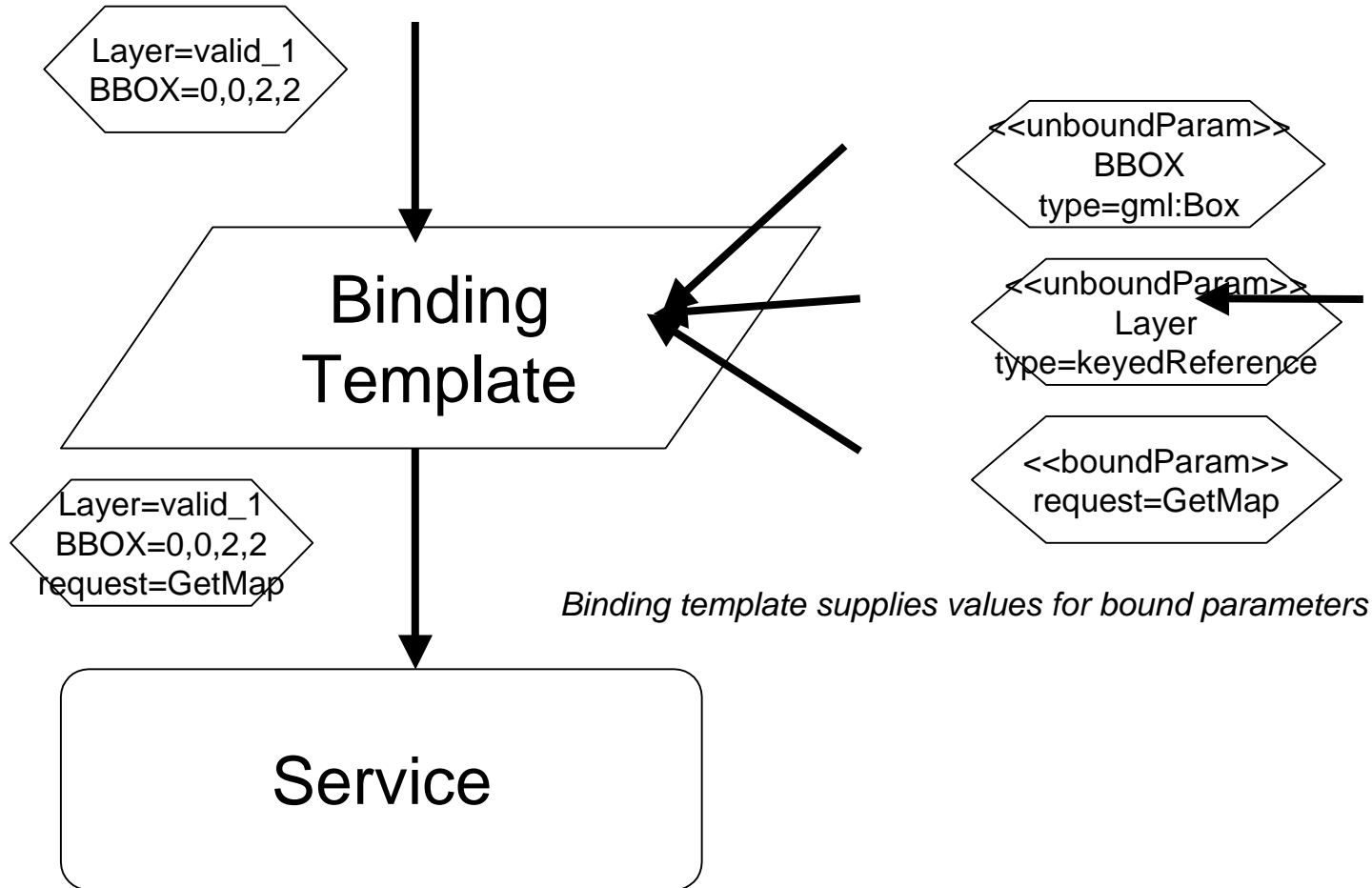
- **A recipe for invoking services**
- **Generalisation of a common pattern appearing in OpenGIS Use Cases**
- **Reference objects from registries that define semantics of service**
- **binding templates may reference each other, creating the service chain to be invoked and allowing mix of early and late binding**

Mechanisms

- **Syntax for persisting an invocation recipe**
- **Derived from Registry Entry (ebRIM model)**
- **Can be passed as a complex parameter to a service further down the chain**
- **(e.g. tell a Web Map Server how to query a Web Feature Server and how to portray the results)**

Invoking a service

Client supplies values for unbound parameters



Early vs. Late Binding

Most invocations can be either early or late bound to particular messages

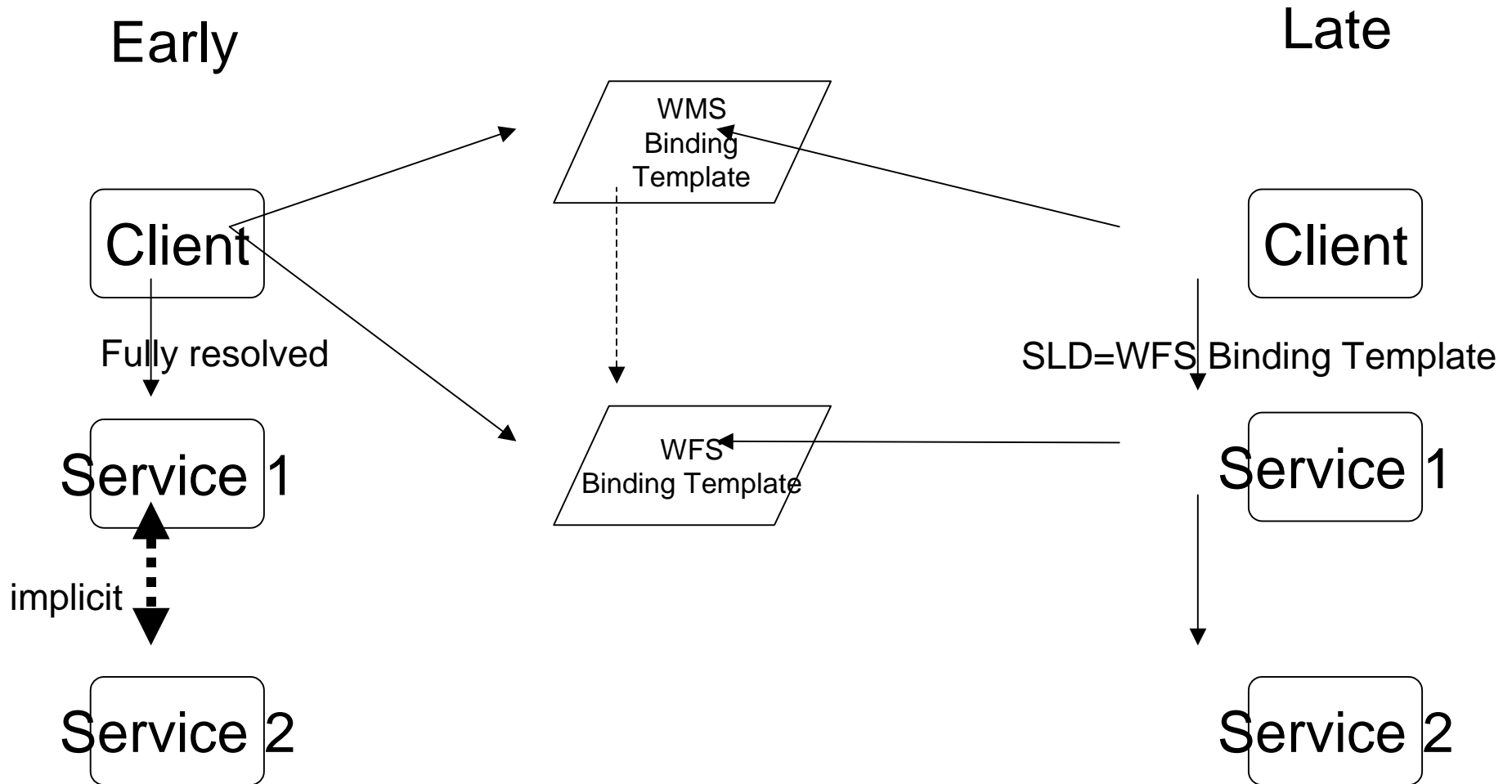
Early binding

- E.g. get the most recent weather report

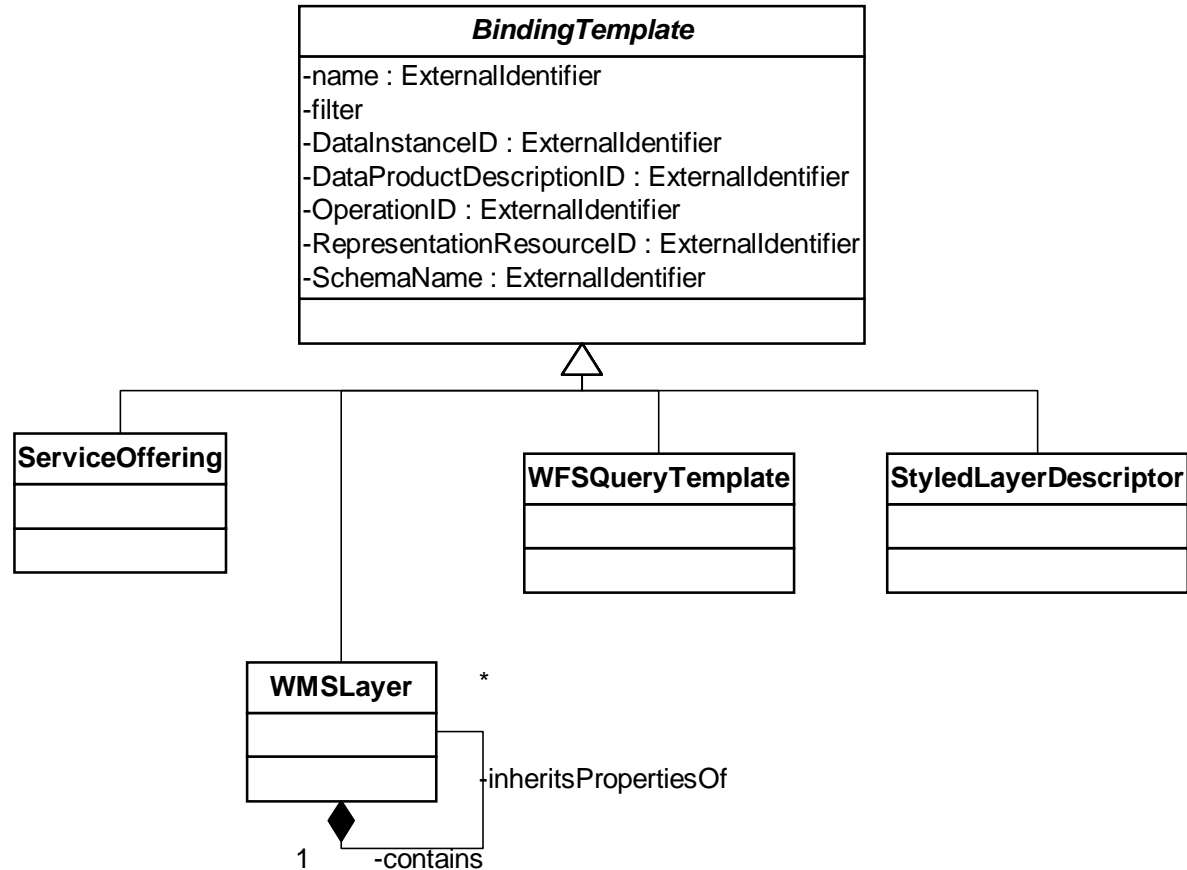
Late binding

- zoom to the area of flooding

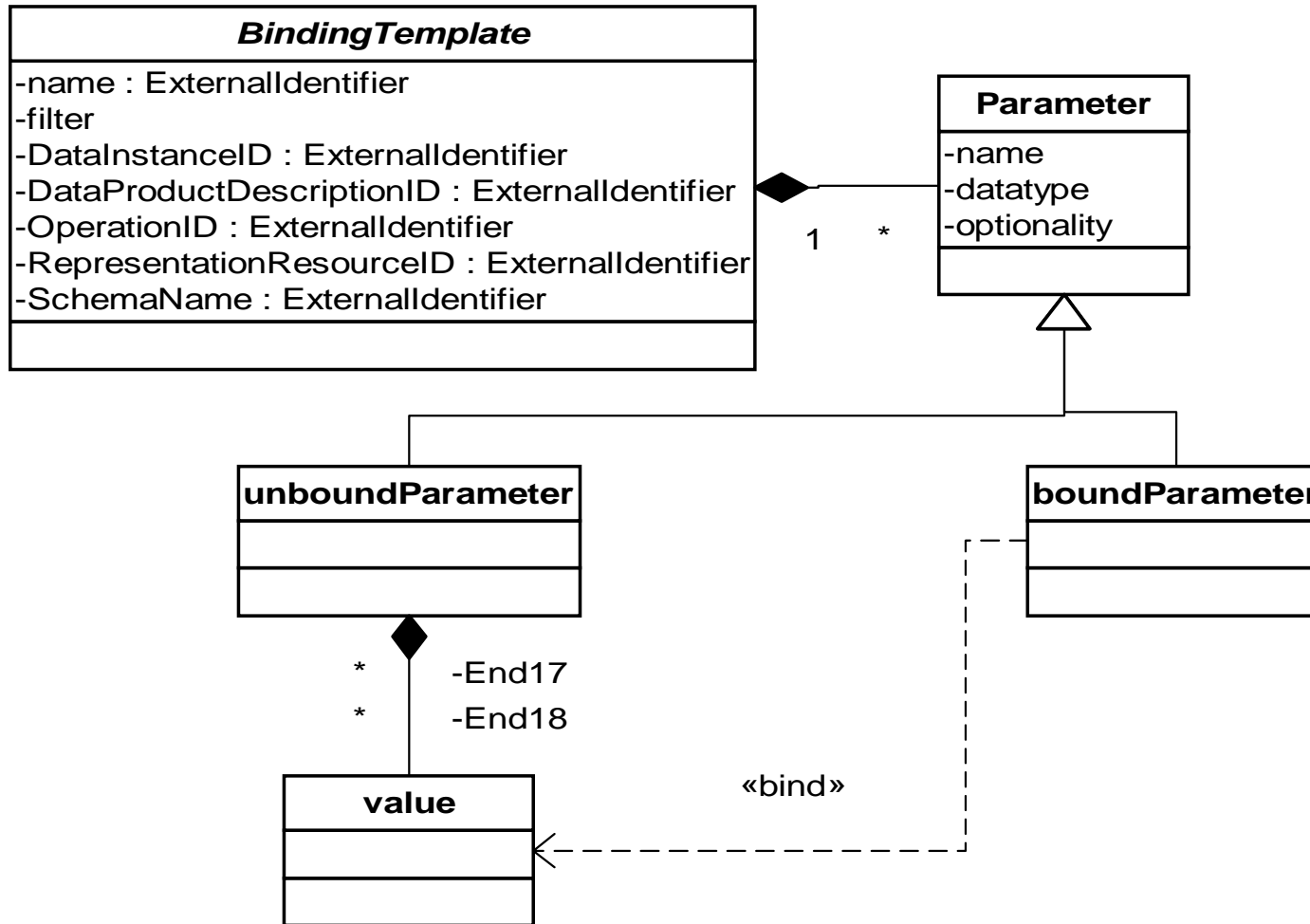
Web Map Server Example



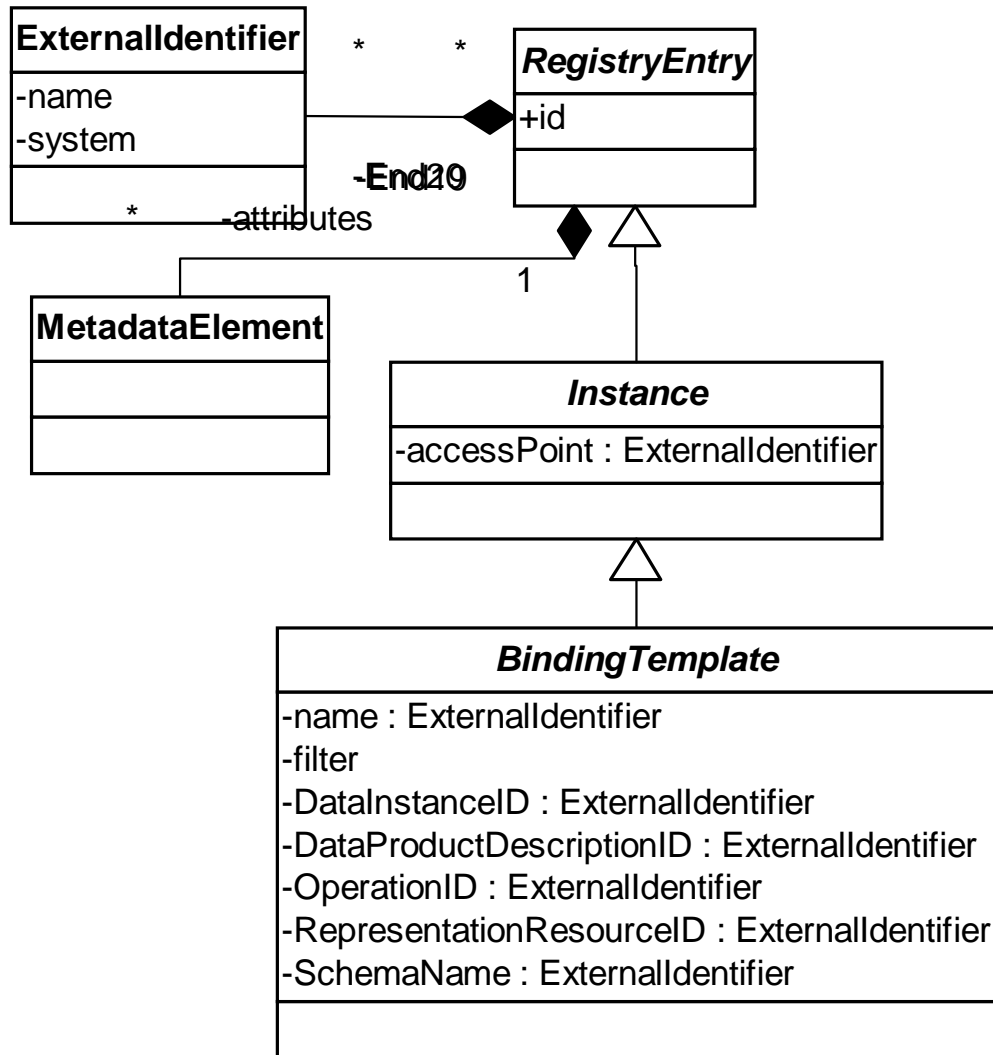
Instances of BindingTemplates



Parameter Model



BindingTemplate



Note:

- Can be retrieved from a registry
- Has name, attributes to support persistence
- Contents (attributes TBD by further modelling)
- TBD - modelling relationships to other BindingTemplates

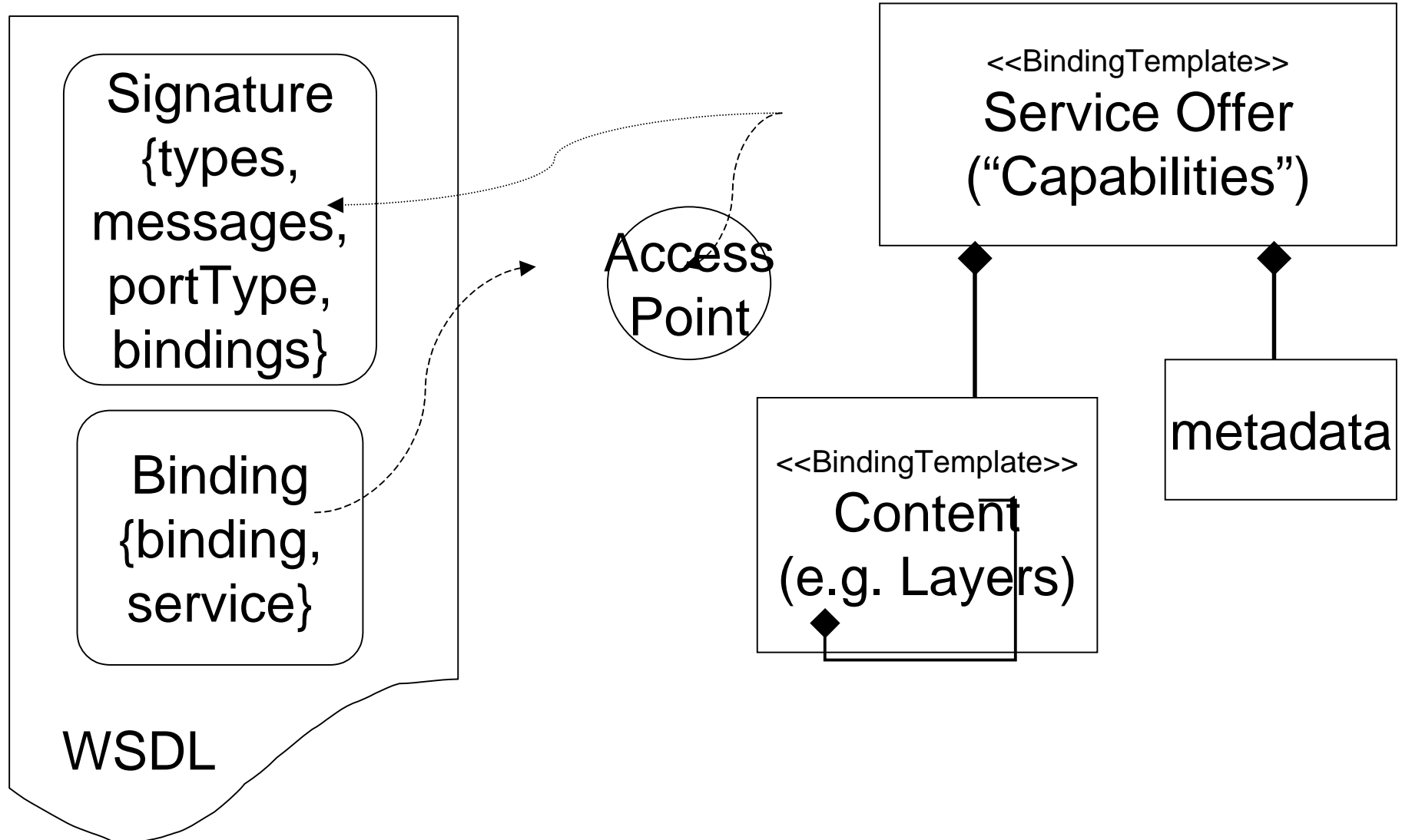
Benefits

- **Common pattern across all interface specifications**
- **Common rules for resolving bindings and invoking services established**
- **Ability to deploy content access services in a meaningful way (well known types and content domain mechanisms available)**
- **Ability to store service invocation patterns in registries**

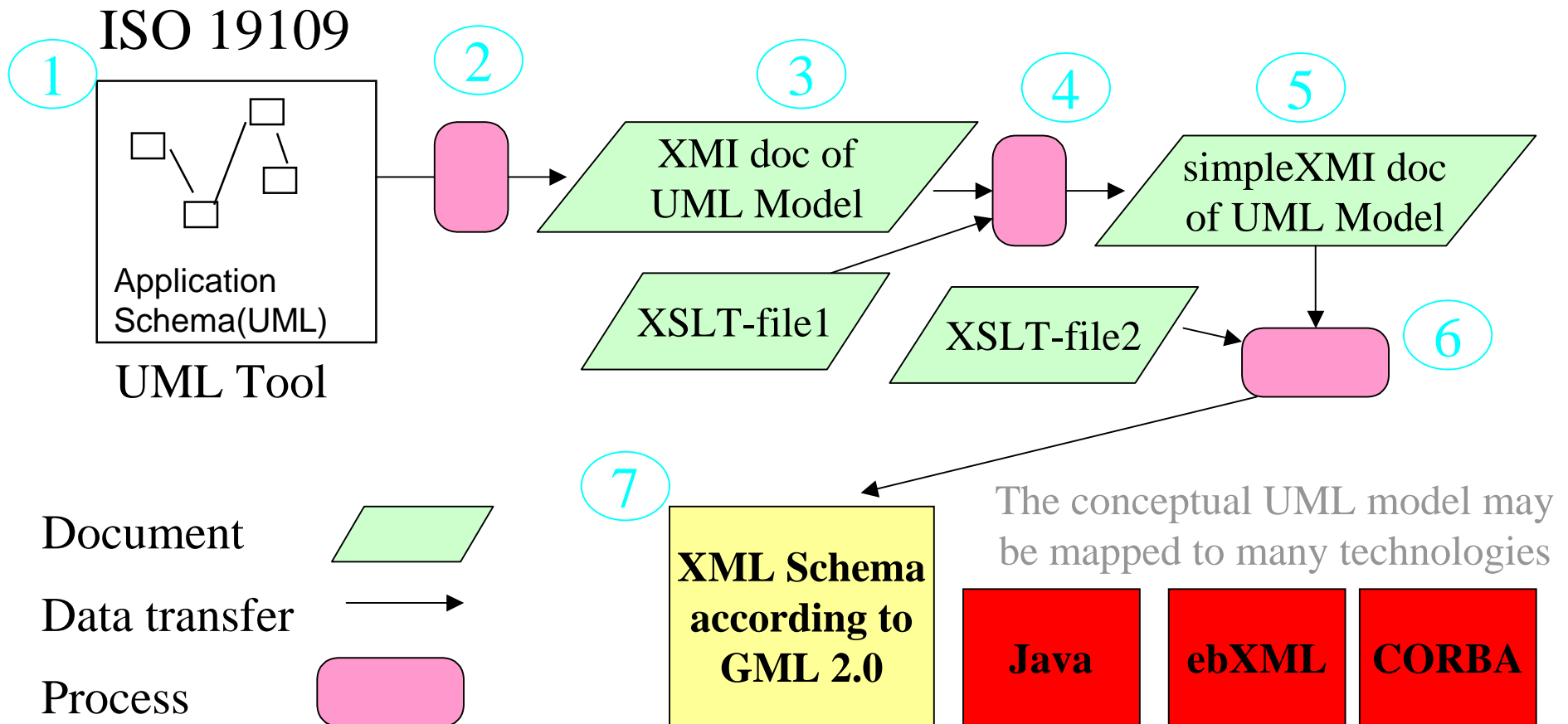
Why not just WSDL?

- **WSDL provides some of what we need**
- **Granularity does not match early/late binding behaviour**
- **Data Types not expressive enough**
- **Enumerations not powerful enough for real world content (29000 species of flora in NSW Australia!)**
- **OpenGIS interface specifications mainly provide semantic definitions of parameters – these are not per-service!**

WSDL ++



GeNorway project - XSLT-based code generation from UML to GML for data exchange



\GML2.0 spec. city application schema example

```
<complexType name="RiverType">
  <complexContent>
    <extension base="gml:AbstractFeatureType">
      <sequence>
        <element ref="gml:centerLineOf"/>
      </sequence>
    </extension>
  </complexContent></complexType>
<complexType name="RoadType">
  <complexContent>
    <extension base="gml:AbstractFeatureType">
      <sequence>
        <element name="linearGeometry" type="gml:LineStringPropertyType"/>
        <element name="classification" type="string"/>
        <element name="number" type="string"/>
      </sequence>
    </extension>
  </complexContent> </complexType>
```

simpleXMI - reducing the complexity of XMI

```
<class name="Road" superClass="CityFeature" abstract="false">  
  <attribute name="classification" type="CharacterString"/>  
  <attribute name="number" type="CharacterString"/>  
  <attribute name="linearGeometry" type="GM_Curve"/>  
</class>  
<class name="River" superClass="CityFeature" abstract="false">  
  <attribute name="centerLineOf" type="GM_Curve"/>  
</class>  
<class name="CityModel" abstract="false">  
  <attribute name="dateCreated" type="Date"/>  
  <relationship name="cityMember" otherClass="CityFeature"  
    cardinality="0..*" collectionType="set"  
    aggregationType="composite"/>  
</class>
```

Example and ISO 19118 encoding

```
<complexType name="Road">
  <sequence>
    <element name="classification"
type="CharacterString"/>
    <element name="number" type="CharacterString"/>
    <element name="linearGeometry"
type="GM_Curve"/>
  </sequence>
  <attributeGroup ref="IM_ObjectIdentification"/>
</complexType>
```

Conclusion

- **The OGC (and ISO 19119) Service architecture patterns and the service binding template could be reused by other "information-intensive" domains**

To support ISO/TC211 and OGC and other similar domain standardisation Organisations, OMG should as soon as possible produce the following:

- **Well defined rules and tools for creating platform-independent service and information models**
- **Well defined rules and tools for mappings to platform-specific models for the most important platforms: Web services/XML, CORBA, J2EE/EJB, SQL, ...**
- **A version of XMI (2.0?) that can produce human readable (HUTN) XML – similar to the GML and ISO 19118 schema specifications currently being made**
- **A tool-independent model diagram interchange format that can be used to support interoperability between multiple UML tools (the diagram interchange RFP!)**