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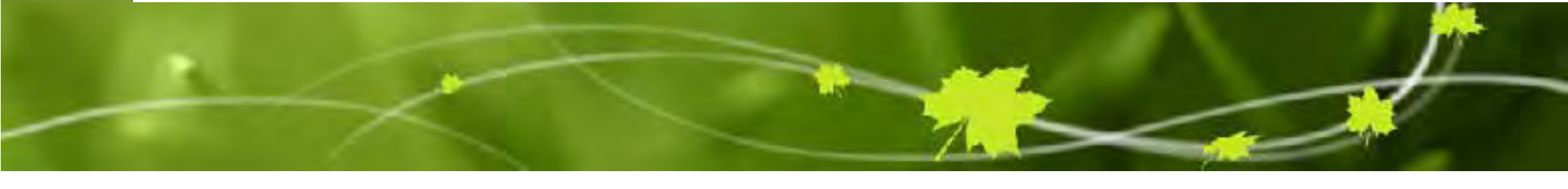
GIS and Open Standards

**Making a Great Lake Superior
Duluth, Minnesota, USA**

Tom Kralidis

National Information Strategies

29 October 2007



Sections

- Spatial Data Infrastructure (SDI)
- Open Standards
- Example: CGDI
- Open Standards and Open Source
- Live Demos / Applications



Infrastructure

- Many pieces working independent of make, model
- Open interface
 - Can communicate with other objects
- Transparent / Invisible
- Cooperative
- Distributed linkages



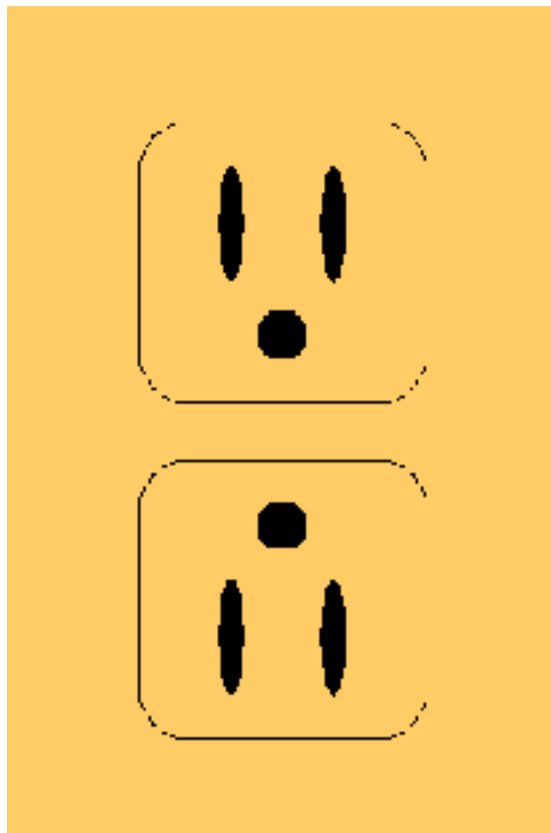
The Distributed Approach

- Distributed Spatial Data infrastructure
- Cost / Feasibility
- One Source
- Up-to-date Data
- Data Management Issues
- Less:
 - Local storage space
 - redundant data
- Communication via *Interfaces*



Interface Example

Electrical Interface



- Provides electrical services
- Accepts plug
- Turns on toaster
- Toaster provides content such as food

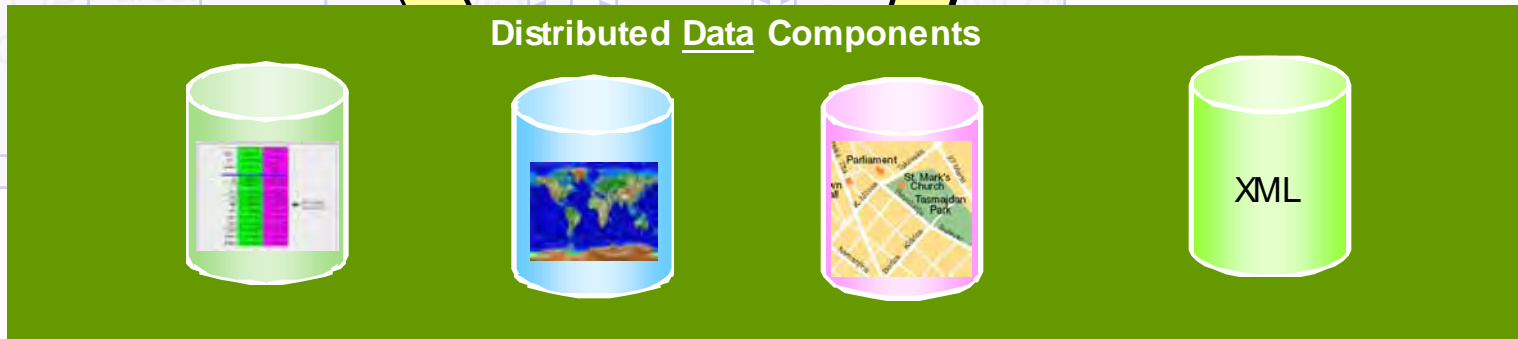
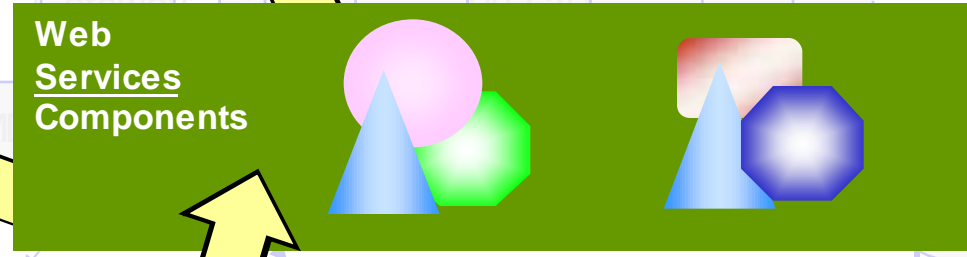
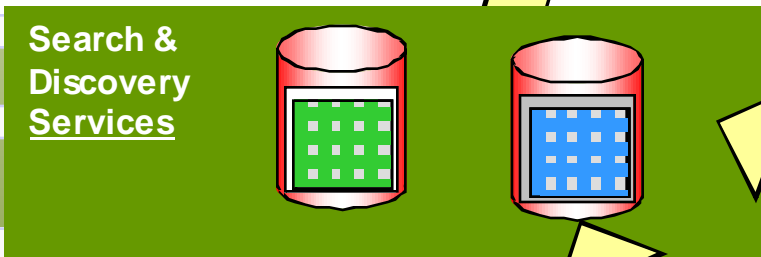
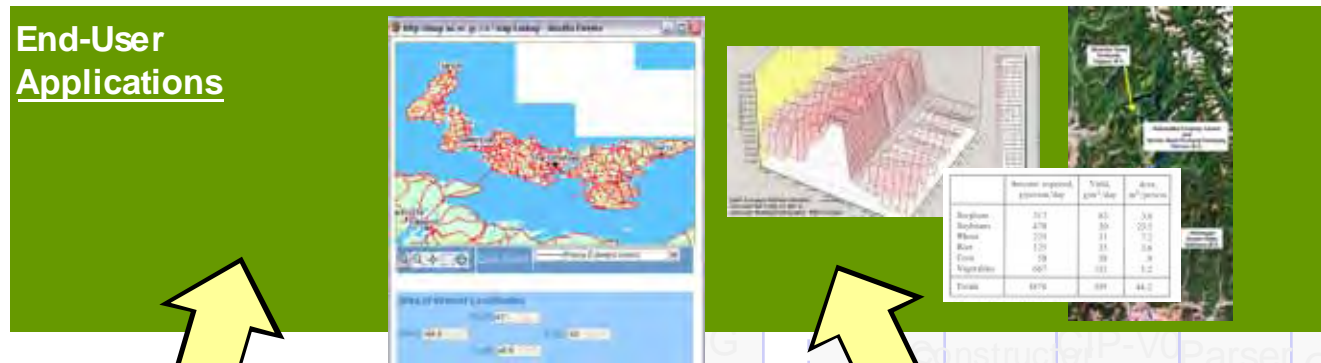
Web Services as Interfaces

- Independent of
 - Operating Systems
 - Programming Languages
 - Organizations
- How?
 - Open / non-proprietary data / messaging standards
 - eXtensible Markup Language (XML)



Services Oriented Architecture

3-Tier framework



Open Geospatial Consortium (OGC)

- est. 1994
- Interoperability
- Data / Information Exchange Between computing systems
- Government / Industry / Academia
- Iterative Specification Development Process
- “Making Location Count”

- Evolution
 - Desktop → Enterprise → Web Services
- Dynamic Online Mapping



OGC Current Activities of Interest

- Sensor Web Enablement
- Digital Rights Management
- Web Geo Processing / Geospatial Linking
- REST
- Mass Media

Web Map Service (WMS)

- Provides images of map data defined by a geographic / spatial component
- Provides point based query functionality
- Interoperable means of map compositing
- Interoperable, 'just-in-time' approach to map delivery
- Map compositing from multi-servers



Web Mapping: Phase I

The screenshot shows a Netscape browser window displaying the GéoGratis website. The main content area features a large, diamond-shaped Landsat 7 Ortho image of a river delta. To the left of the image is a sidebar with navigation links: [Landsat](#), [RADARSAT](#), [Atlas Vectors](#), [CGIS \(Canadian Geographic Information Systems\)](#), [GeoBase Data \(COD Framework Layers\)](#), [Earth Observation Data](#), and [Vector/Taxular Data](#). Below these links are sections for [DOWNLOAD DIRECTORY](#) and an **Abstract** describing the orthoimage data set. The abstract text reads: "The orthoimage data set is in creation. The imagery has been not available, the most accurate better in the South and 50 m accuracy is evaluated for use from sources as mentioned in centroids. In some cases the used. The control points are used. Sectors are located in the sur".

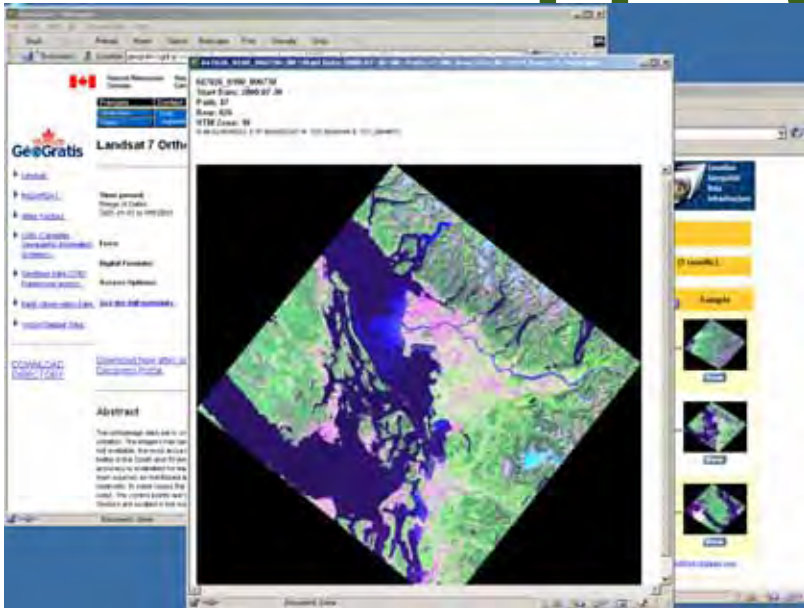
Metadata for the image is displayed in the top right corner of the browser window:
047026_0100_000730
 Start Date: 2000-07-30
 Path: 47
 Row: 026
 UTM Zone: 10
N 49.024338523 5 47 900002297 W -124.3838044 E -121 2994872

On the right side of the browser window, there is a sidebar with a search results section showing "(3 results)" and three thumbnail images, each with a "View" button. Below this is a link for "Unfiltered Images.wml".

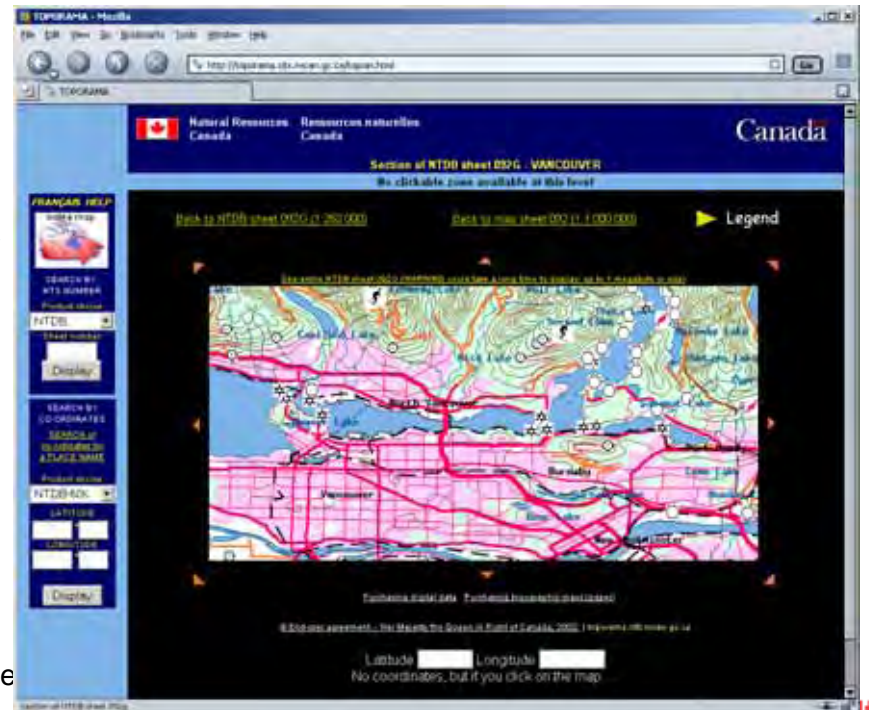
At the bottom left of the browser window, there is a text label: "Section of NTDB sheet 092g".



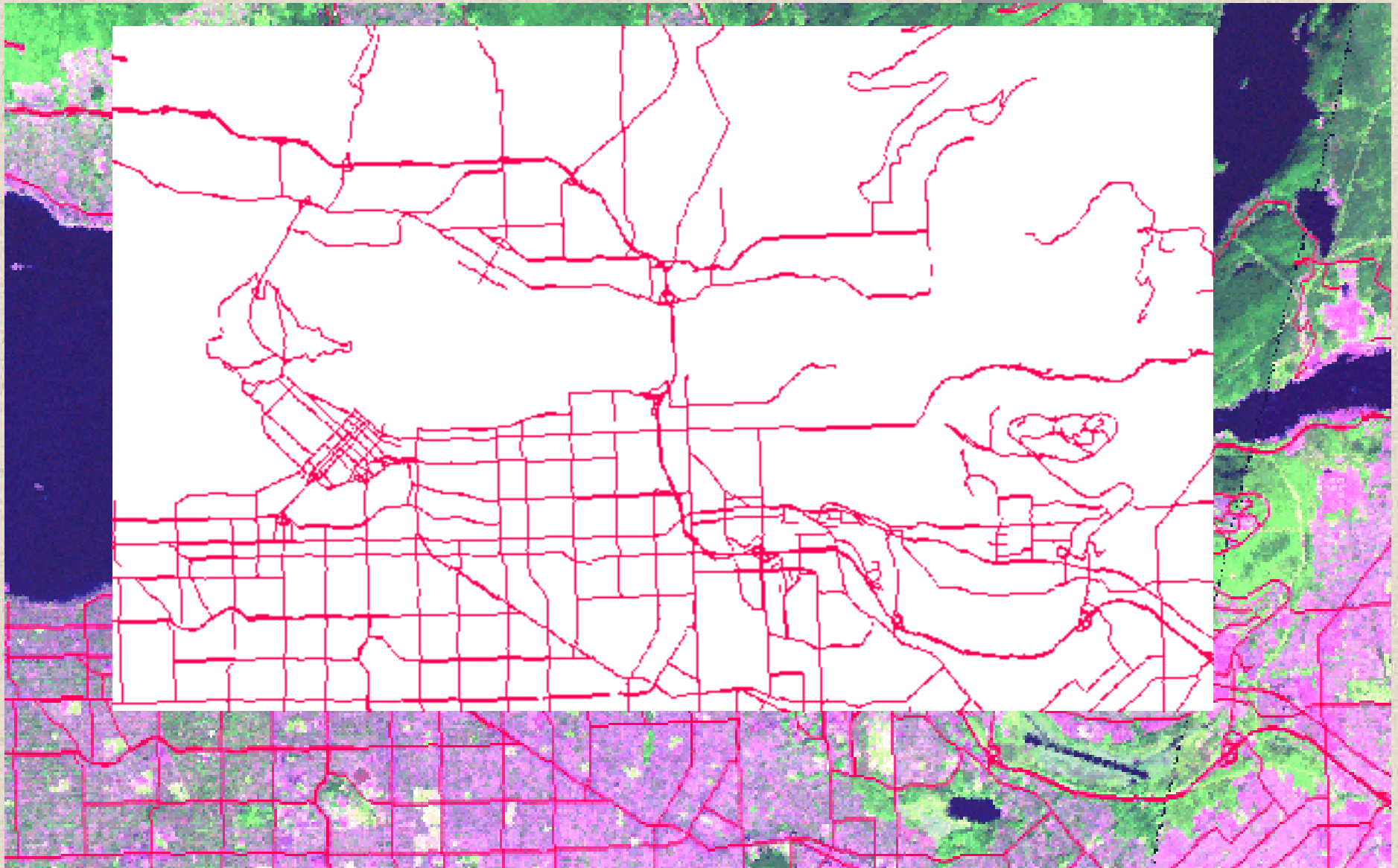
Web Mapping: Phase I



- ~~• Interoperability~~
- ~~• Common Standards~~
- ~~• Services~~



Web Mapping with WMS



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Web Feature Service (WFS)

- Feature level access to spatial data
 - Finer grained access and query
- Spatial and non-spatial query capability
 - Attribute and / or geometry
- Returns GML
 - Can further transform with XSLT to SVG, style with SLD, etc.
- Transactional capability
 - INSERT, UPDATE, DELETE, LOCK, ...
- Security considerations



Web Coverage Server (WCS)

- Returns data as a function of a function
- Supported data types (HDF, NTIF, GeoTIFF)
- Appropriate for imagery and gridded data



Geography Markup Language (GML)

- XML grammar for geospatial information
- Basic application framework for handling geospatial information
- Enables complex features & feature associations between data
- Can be processed by many XML tools in various development environments
- Leverages eXtensible Markup Language (XML)
 - Self Describing
 - Structured
 - Human Readable
 - Portable, non-proprietary
 - Interoperable



Geography Markup Language (GML)

```
<?xml version="1.0" encoding="ISO-8859-1" standalone="no"?>
<WatershedLookupResultSet version="1.0.0" xmlns="http://www.ec.gc.ca/watershed" xmlns:gml="http://www.opengis.net/gml"
  <gml:description>This is the Environment Canada Watershed Lookup Service</gml:description>
  <gml:name>EC:WatershedLookup</gml:name>
  <gml:boundedBy>
    <gml:Box srsName="http://www.opengis.net/gml/srs/epsg.xml#4326">
      <gml:coordinates>-70.4289188653549,43.3918418884274,-59.6925621032715,49.1731086779867<,
    </gml:Box>
  </gml:boundedBy>
  <watershedBoundary>
    <gml:surfaceProperty>
      <gml:Polygon srsName="http://www.opengis.net/gml/srs/epsg.xml#4326">
        <gml:exterior>
          <gml:LinearRing srsName="http://www.opengis.net/gml/srs/epsg.xml#4326">
            <gml:coordinates>
              -70.4289188653549,43.3918418884274 -70.4289188653549,49.1731086779867 -59.6925621032715,49.1731086779867 -59.
              -70.4289188653549,43.3918418884274
            </gml:coordinates>
          </gml:LinearRing>
        </gml:exterior>
      </gml:Polygon>
    </gml:surfaceProperty>
  </watershedBoundary>
</WatershedLookupResultSet>
```



Styled Layer Descriptor (SLD)

- Custom Symbolization of map data
- Styling
- Addresses lack of symbolization within current and past OGC services
- Cartographic design of GeoData
- Augments OpenGIS specifications
 - Can custom style WMS content
 - Can custom style WFS content



Styled Layer Descriptor (SLD)

```
<?xml version="1.0" encoding="utf-8" standalone="no"?>
<StyledLayerDescriptor version="1.0.0"
  xmlns="http://www.opengis.net/sld"
  xmlns:ogc="http://www.opengis.net/ogc"
  xmlns:xlink="http://www.w3.org/1999/xlink"
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xsi:schemaLocation="http://www.opengis.net/sld http://schemas.opengis.net/sld/1.0.0/Styled
  <!-- Request URL : http://cgdi-dev.geoconnections.org/prototypes/owsview/scripts/makeSLD.cgi?layername=POL
  <!-- Saved to URL: http://cgdi-dev.geoconnections.org/prototypes/owsview/cache/109577932720650sld_1_0_0.xml
  <Name>owsview_generated_sld</Name>
  <Title>SLD for layer Political Boundaries</Title>
  <Abstract>This is a generated SLD, automatically generated by owsview Viewer Client Generator (http://cgdi
  <NamedLayer>
    <Name>POLBNDL_BND_1M:Foundation</Name>
    <UserStyle>
      <Name>sld_01</Name>
      <Title>sld_01</Title>
      <IsDefault>1</IsDefault>
      <FeatureTypeStyle>
        <Rule>
          <LineSymbolizer>
            <Stroke>
              <CssParameter name="stroke">#00CC33</CssParameter>
              <CssParameter name="stroke-width">4</CssParameter>
            </Stroke>
          </LineSymbolizer>
        </Rule>
      </FeatureTypeStyle>
    </UserStyle>
  </NamedLayer>
</StyledLayerDescriptor>
```

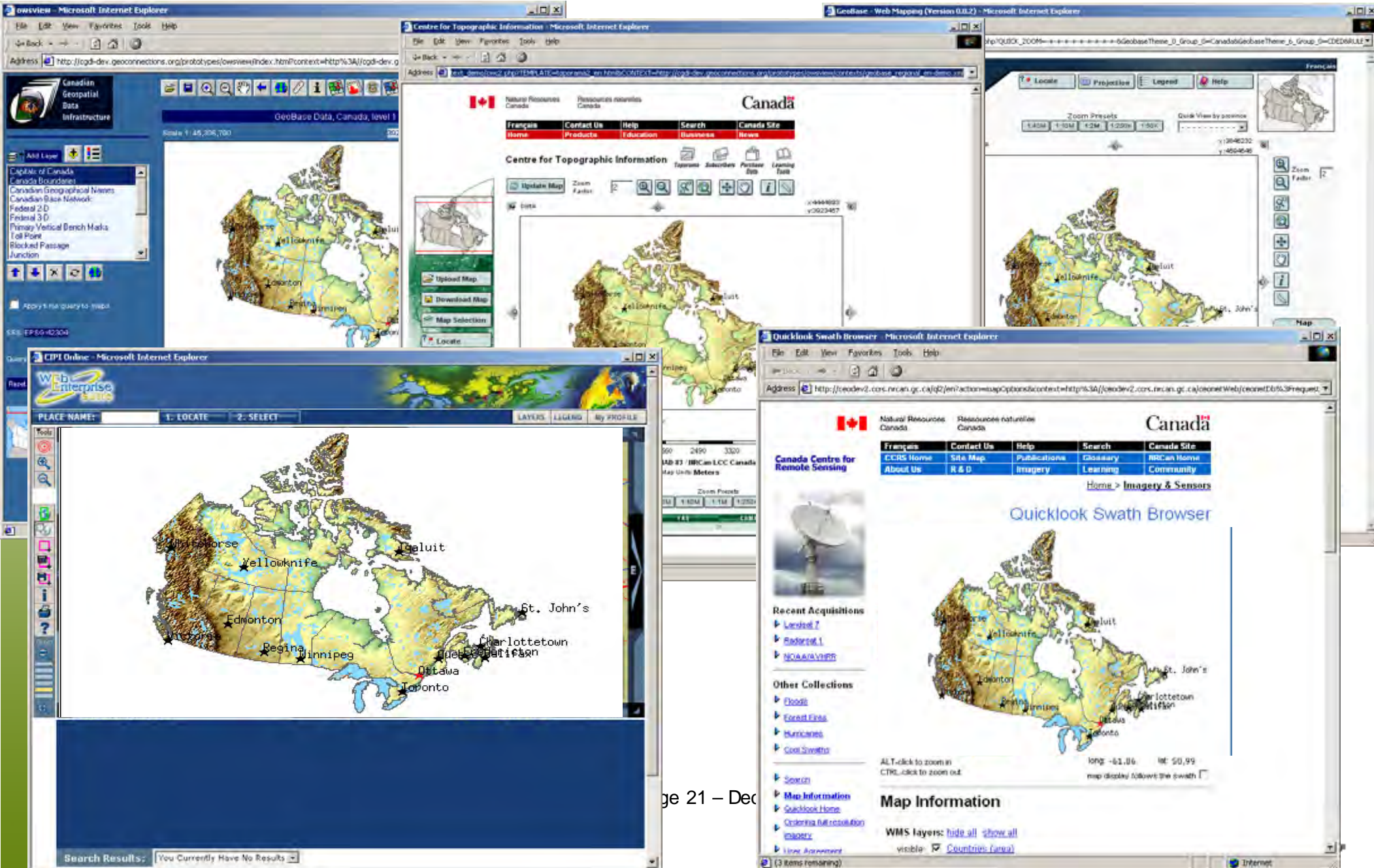


Web Map Context Documents (WMC)

- ‘bookmarkable’ XML encoding of state of a web mapping application
- Analogous to ‘project’ files in most popular GIS software packages
- Enables sharing of application scenarios, demonstrative presentations, etc.



WMC – Same data; multiple applications



SensorWeb Enablement

- Vast amount of information is observed phenomenon and / or instrument based, such as:
 - Water Quality
 - Water Quantity
 - Air Pollution
 - Climate Monitoring

- Requirement to:
 - Describe Instruments (Characteristics, Properties)
 - Report Observations / Measurements
 - Dissemination / Interoperability



OGC SensorWeb Enablement

- “OGC SWE”
- Enable real time integration of heterogeneous sensor webs
- Can apply to:
 - flood gauges
 - air pollution monitors
 - stress gauges on bridges
 - Webcams
 - Robots
 - Space and airborne earth imaging devices
 - <http://www.opengis.org/functional/?page=swe>

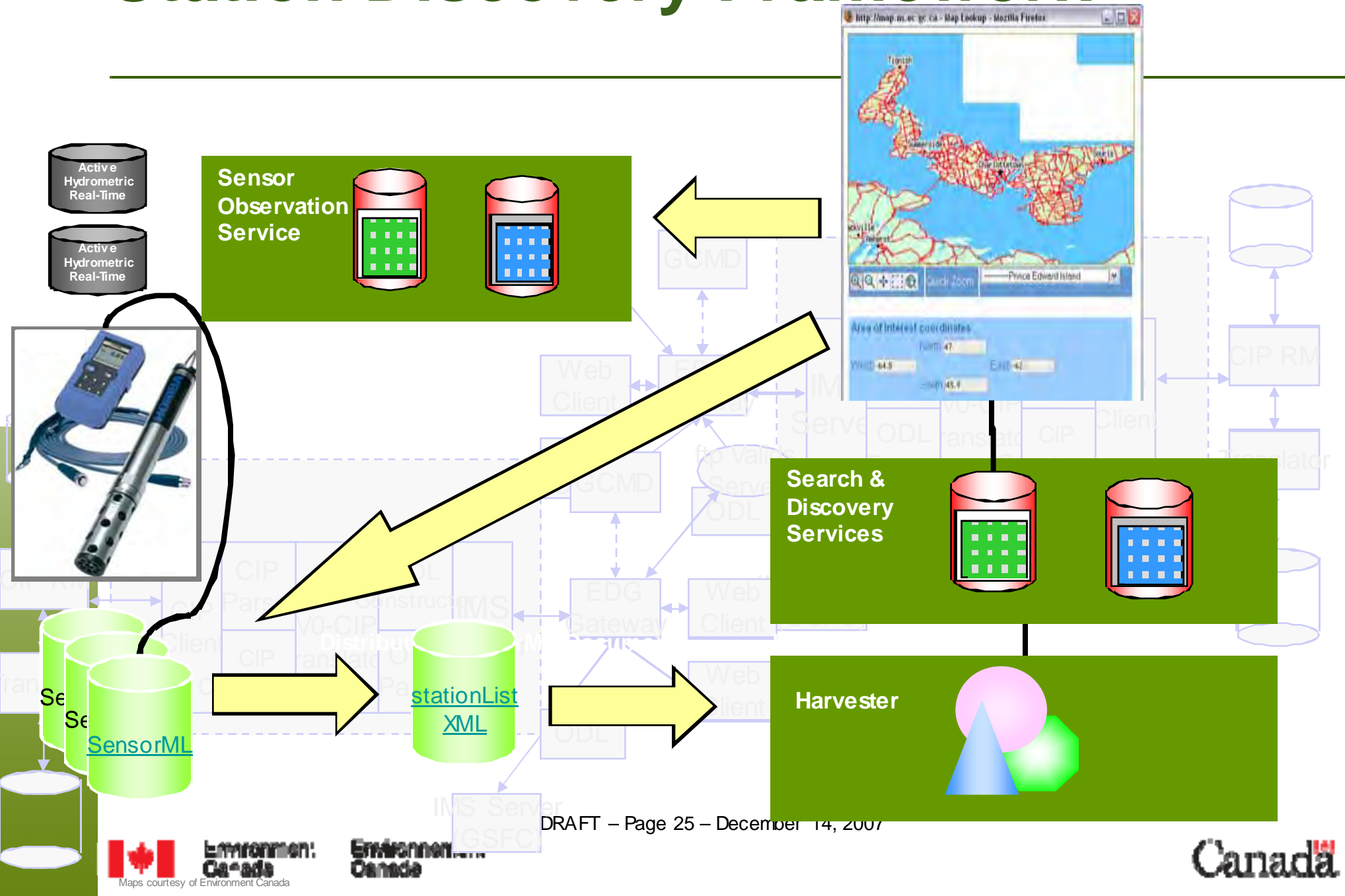


SensorWeb Enablement

- Thread sets:
 - SensorML
 - Observations and Measurements
 - Sensor Observation Service
 - Sensor Alert Service
 - Sensor Planning Service



Station Discovery Framework



Web Processing Service (WPS)

- Generic specification which allows for spatial processing instructions to be messaged and processed online
- Format conversion
- Intersection
- Buffering
- Any spatial algorithm

- Opens spatial processing interoperability over the Web



Example: CGDI / GeoConnections

1999 - 2005

“A Canadian geospatial information infrastructure that is accessible to all communities, pervasive throughout our country, ubiquitous for its users, and self-sustaining, to support the protection and betterment of Canada's health, social, cultural, economic and natural resource heritage and future”

- Putting Canada's Geographic Information on the Internet

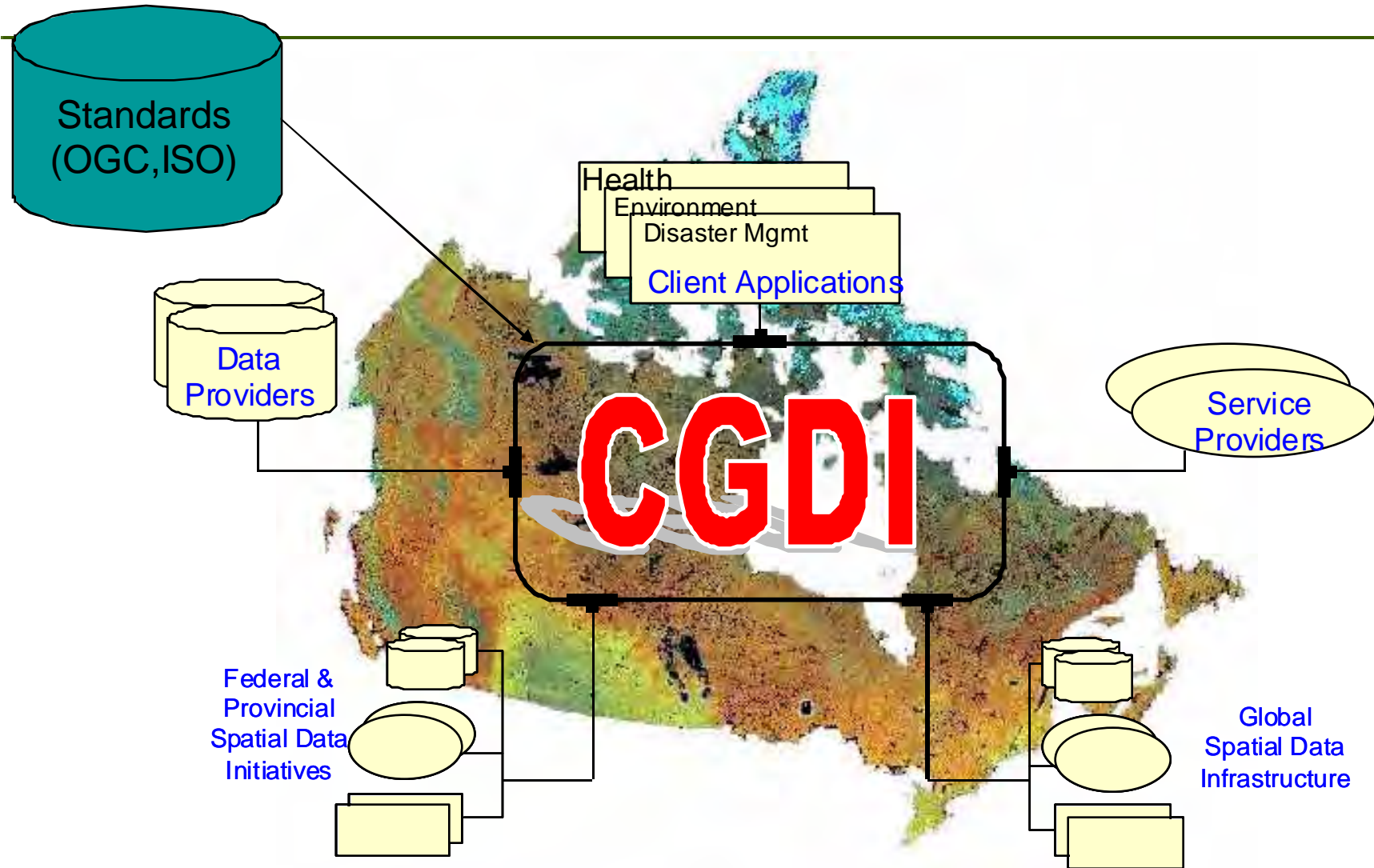
2005-2010

To expand the CGDI, providing on demand access to geographic information, related services and applications in support of sound decision making

- User-Driven



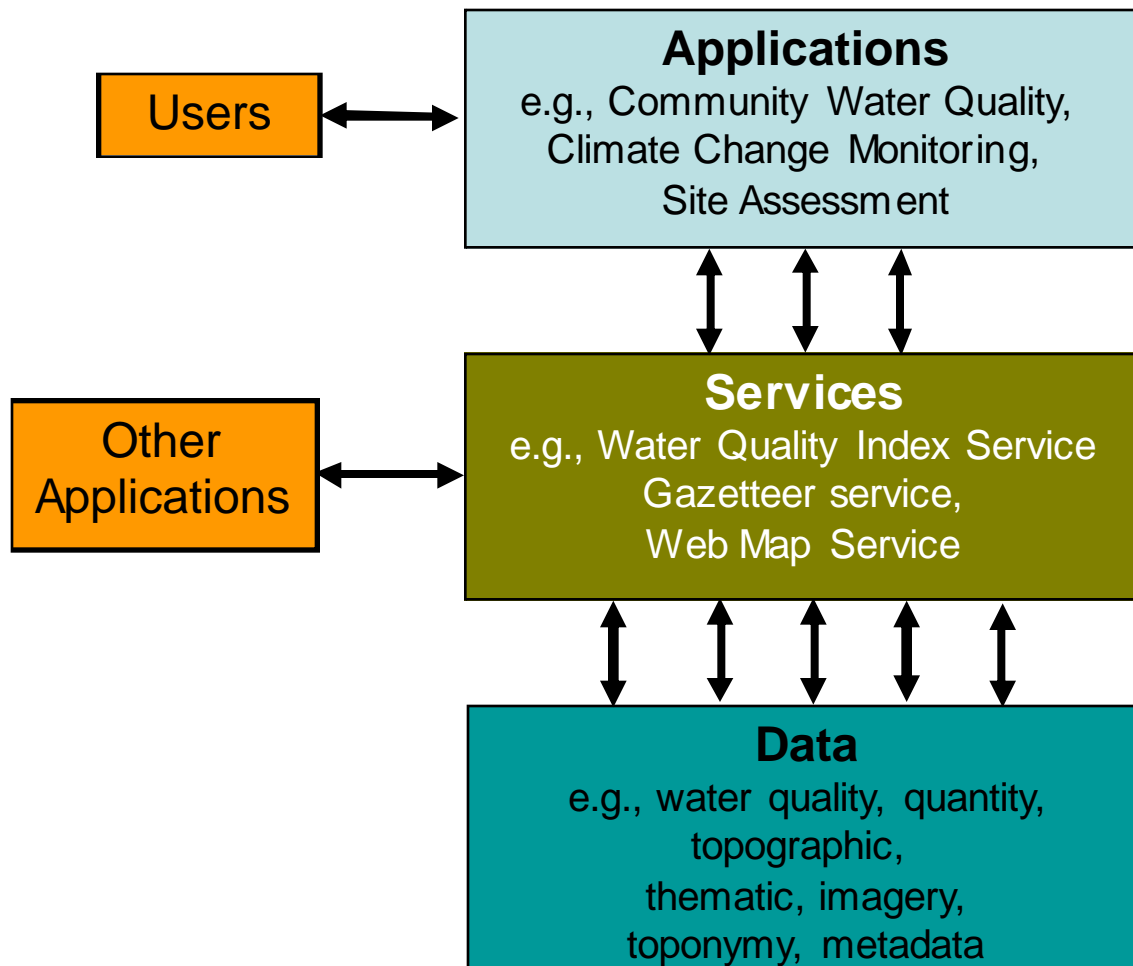
CGDI View From 50000 ft.



OGC / CGDI

- OGC series of standards will be used to provide a guideline for building geospatial information systems using IT standards and infrastructure
- Web / Feature Level Mapping, Service Architecture, Data / Service Discovery, Visualization, Access

Web Services Architecture Approach



For Example...

A community website which calculates water quality for a given community

uses
Gazetteer service,
Water Quality Index Service
Web Map Service

based on
Geographical Names,
Road network features
Base maps

CGDI Endorsed Specifications

- Web Mapping State
 - OpenGIS Web Map Context Documents (WMC)
- Visualization
 - OpenGIS Web Map Service (WMS)
- Data Access
 - OpenGIS Web Feature Service (WFS)
- Data Encoding
 - OpenGIS Geography Markup Language (GML)
- Data Presentation
 - OpenGIS Styled Layer Descriptor (SLD)
- Data Query
 - OpenGIS Filter Encoding (FES)
- Metadata
 - ISO Metadata Standard (TC 211 DIS 19115)
- Catalog / Access
 - GeoData Discovery, Catalog Service (OGC spec based on z39.50 profile)



Standards Relationships

- ISO: Abstract, Models, References
- W3C: Web
- OGC: Leverages ISO, W3C, etc.
- Defacto: community, in principle



OpenGIS -> Open Geospatial

- September 2004
- Reasons
- Benefits
 - Not all data is in GIS format, but may have location-ish properties
 - The Geospatial Web has arrived!
 - Google, Virtual Earth, Yahoo!

What about Google, Yahoo, Microsoft

- Useful, Easy and Valuable APIs and approaches!
- Implementation specific
- OGC has a Mass Market Working Group to attempt to address such market issues



Conclusion

- Questions
- Comments

Thanks!



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