Project for the Strengthening of
Spatial Data Infrastructures in Member States and Territories of the Association of
Caribbean States

WORKSHOP ON:

GEOSPATIAL DATA INFRASTRUCTURES

SESSION 2:
TECHNOLOGICAL CONSIDERATIONS IN IMPLEMENTING AN SDI

Instructor

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Description & Objectives

- The basic technologies behind SDI

- The Open Standards that facilitates the interoperability

- The experience of Mexico in Web Mapping & SDI

Materials

Interoperability Concepts

- Share information between system and applications.

- Interoperability is the ability of a system or a product to work with other systems or products without special effort on the part of the customer.

- 3 levels
  - Technical
  - Syntactic
  - Semantic

Interoperability Concepts

- The beginning
  - Service Oriented Architecture
    - Is an architecture that represents software functionality as discoverable Services on the network
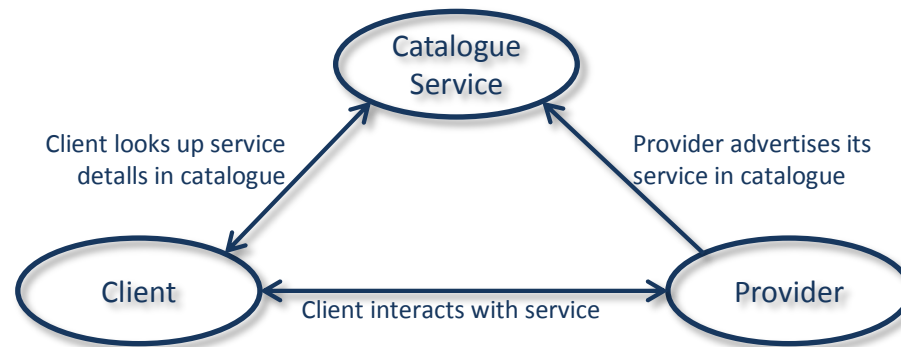
XML

Extensible Markup Language (XML) is a markup language that defines a set of rules for encoding documents in a format that is both human-readable and machine-readable. It is defined by the W3C's XML 1.0 Specification and by several other related specifications, all of which are free open standards.

- Shall be usable over the Internet
- Shall support a wide variety of applications and languages
- Easy to use by programs
- Shall be human – readable and clear
- Shall be formal and concise
- Easy to create

```
<?xml version="1.0"?>
<quiz>
 <qanda seq="1">
  <question>
   Who was the forty-second
   president of the U.S.A.?
  </question>
  <answer>
   William Jefferson Clinton
  </answer>
 </qanda>
 <!-- Note: We need to add
  more questions later.-->
</quiz>
```

XML

XML

```
1   <?xml version="1.0" encoding="ISO-8859-1"?>
2   <!-- xml Example -->
3 - <note>
4       <to>Tove</to>
5       <from>Jani</from>
6       <heading>Reminder</heading>
7       <body type="reminder">Don't forget me this weekend!</body>
8   </note>
```

**Prolog
document type declaration
Comment**

Root element

Element: Block of content

Element content

XML

```
- <exampleOfACDATA>
    - <![CDATA[

            Since this is a CDATA section
            I can use all sorts of reserved characters
            like > < " and &
            or write things like
            <foo></bar>
            but my document is still well formed!

    ]]>
</exampleOfACDATA>
```

XML Example

```
1      <?xml version="1.0"?>
2    - <root xmlns:f="http://www.w3schools.com/furniture"
3      xmlns:h="http://www.w3.org/TR/html4/">                    ← Namespace
4        - <h:table>
5            - <h:tr>
6                    <h:td>Apples</h:td>
7                    <h:td>Bananas</h:td>
8              </h:tr>
9          </h:table>
10       - <f:table>
11             <f:name>African Coffee Table</f:name>
12             <f:width>80</f:width>
13             <f:length>120</f:length>
14         </f:table>
15     </root>
```

GML

- Geography Markup Language (GML) is an **XML application** that provides a **specialized vocabulary** for working with **geographic data**.

- The main purpose of GML is to provide a standard means for **representing** information about **geospatial Features—their properties, interrelationships**, and so on. Features describe real world entities and are the fundamental objects used in GML.

- Features can be concrete and tangible, such as roads and buildings, or abstract and conceptual, such as political boundaries and distributions of quantities over geographical areas (coverages).

GML Encodes Feature Geometry and Properties

To encode the geometry of a feature like a building we simply write:

```
<Feature  fid="142" featureType="school" >
  <Description>Balmoral Middle School</Description>
  <Property Name="NumFloors" type="Integer" value="3"/>
  <Property Name="NumStudents" type="Integer" value="987"/>
    <Polygon  name="extent" srsName="epsg:27354">
      <LineString  name="extent" srsName="epsg:27354">
        <CData>
          491888.999999459,5458045.99963358 491904.999999458,5458044.99963358
          491908.999999462,5458064.99963358 491924.999999461,5458064.99963358
          491925.999999462,5458079.99963359 491977.999999466,5458120.9996336
          491953.999999466,5458017.99963357
        </CData>
      </LineString>
    </Polygon>
</Feature>
```

GML Encodes Feature Geometry and Properties

```xml
▼<ms:msGeometry>
  ▼<gml:MultiPolygon srsName="EPSG:4326">
    ▼<gml:polygonMember>
      ▼<gml:Polygon>
        ▼<gml:outerBoundaryIs>
          ▼<gml:LinearRing>
            ▼<gml:coordinates>
                -0.318987,47.003018 -0.768746,47.358268 -0.574463,47.684285
                -0.347374,47.854602 -0.006740,47.925567 0.135191,47.726864
                0.149384,47.599127 0.419052,47.670092 0.532597,47.428810
                0.305508,47.443003 0.475824,47.144948 0.064225,47.201721
                -0.318987,47.003018
            </gml:coordinates>
          </gml:LinearRing>
        </gml:outerBoundaryIs>
        ▼<gml:innerBoundaryIs>
          ▼<gml:LinearRing>
            ▼<gml:coordinates>
                -0.035126,47.485582 -0.035126,47.485582 -0.049319,47.641706
                -0.233829,47.655899 -0.375760,47.457196 -0.276408,47.286879
                -0.035126,47.485582
            </gml:coordinates>
          </gml:LinearRing>
        </gml:innerBoundaryIs>
      </gml:Polygon>
    </gml:polygonMember>
  </gml:MultiPolygon>
</ms:msGeometry>
```

Link

Unified Modeling Language - UML

- UML is a standard language for specifying, visualizing, constructing, and documenting the artifacts of software systems.

- UML was created by Object Management Group (OMG) and UML 1.0 specification draft was proposed to the OMG in January 1997.

UML

- ***Goals of UML:***

  There are a number of goals for developing UML but the most important is to define some general purpose **modeling language** which all modelers can use and also it needs to be made simple to understand and use.

  UML diagrams are not only made for developers **but also for business users, common people and anybody** interested to **understand a system**. The system can be a software or non software.

UML

There are two broad categories of diagrams and then are again divided into sub-categories: **Structural Diagrams** and **Behavioral Diagrams.**
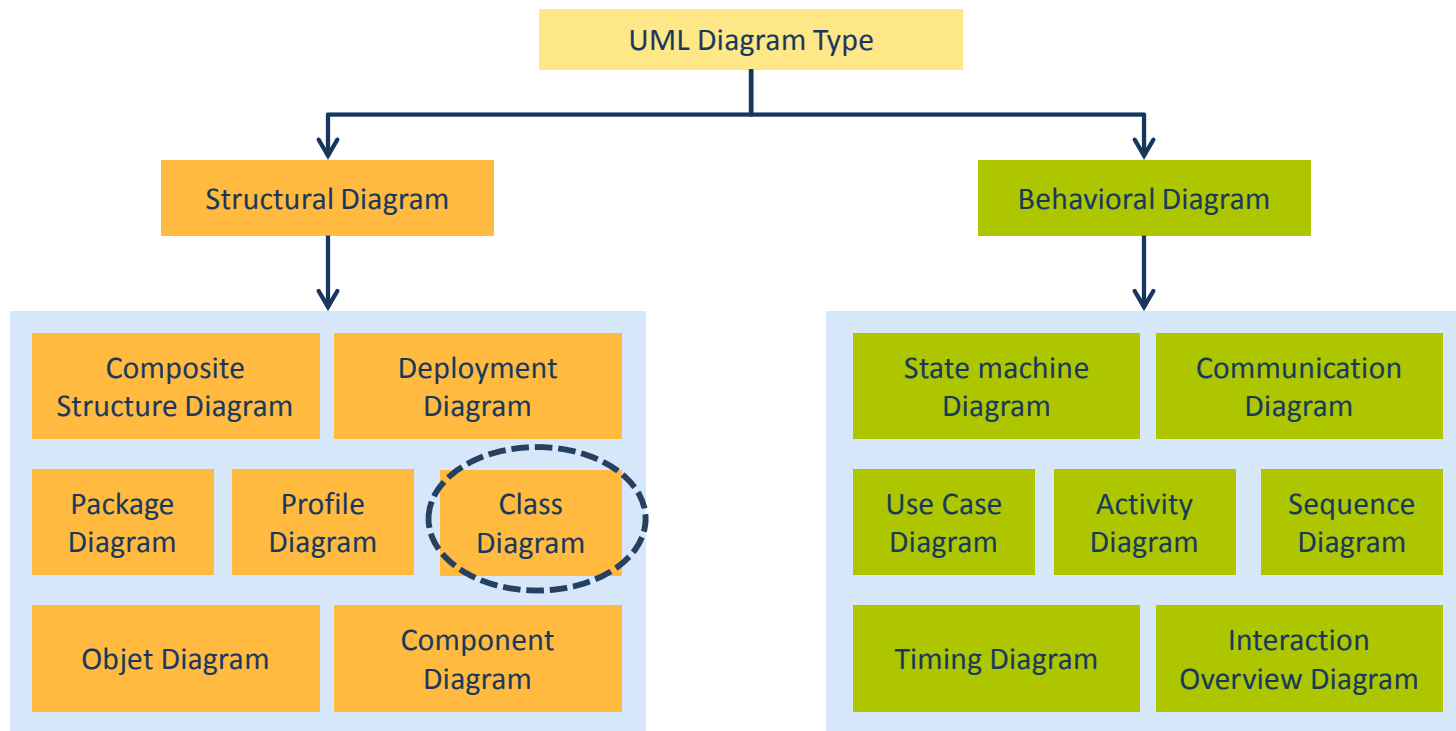
UML

•*Structural Diagrams*:

The *structural diagrams* represent the static aspect of the system. These static aspects represent those parts of a diagram which forms the main structure and therefore stable.

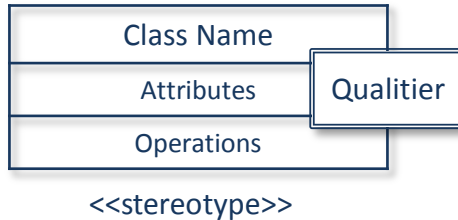These static parts are represents by classes, interfaces, objects, components and nodes.

UML

- ***Class Diagram*:**

  Class diagrams are arguably **the most used UML diagram type**. It is the main **building block of any object oriented solution**. It shows the classes in a system, attributes and operations of each class and the relationship between each class.
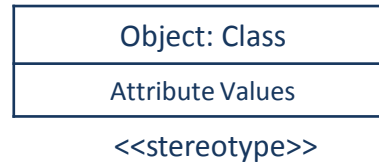
  In most modeling tools, a class has three parts, **name** at the top, **attributes** in the middle and **operations** or **methods** at the bottom. In large systems with many related classes, classes are grouped together to create class diagrams. Different relationships between classes are shown by different types of arrows.
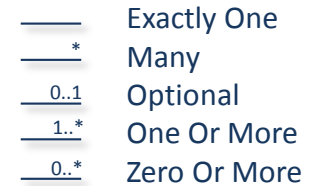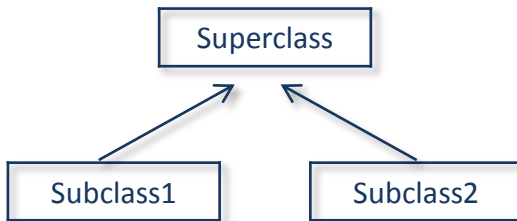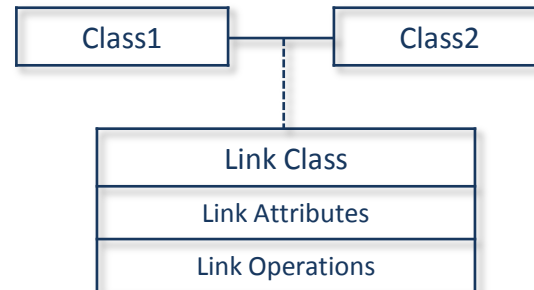
Class Diagram Notation

Class

Class Name
Attributes
Operations

Qualitier

<<stereotype>>

Object

Object: Class
Attribute Values

<<stereotype>>

Component

<<stereotype>>

Multiplicity of Associations

———	Exactly One
*	Many
0..1	Optional
1..*	One Or More
0..*	Zero Or More

Generalization

Superclass

Subclass1		Subclass2

Association Class

Class1		Class2

Link Class
Link Attributes
Link Operations

Class Utility

Dependency

Instantiation

Aggregation

Has By Value

Has By Reference

Directed Association

Class Diagram Notation

Class Name

School

name: String
address: String
phone: Number

Class

Atribute

Departament

name: String

Instructor

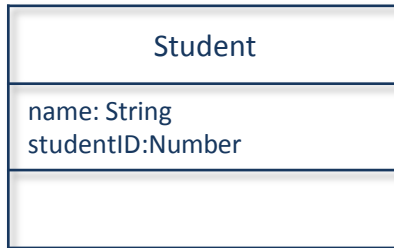name: String

Course

name: String
courseID: Number

Student

name: String
studentID:Number

Class Diagram Notation

Class Name

Aggregation

Has
1..*

Departament

name: String

addInstructor()
removeInstructor()
getInstructor()
getAllInstructor()

Class

Atribute

Operations

1..* AssignedTo 1..*

Instructor

name: String

0..* chairperson 0..1

1..*

1..*

Teaches
*

1..*

School

name: String
address: String
phone: Number

addStudent(Student)
removeStudent ()
getStudents()
addDepartament()
removeDepartment()
getDepartment()
getAllDepartments ()

1..*

Association

Member   *

Course

name: String
courseID: Number

Multiplicity

*

Student

name: String
studentID:Number

*   Attends

OGC Web Standards Services

Service Oriented Architecture Enabling a Geospatial Web:

- Web Map Service (WMS)
- Web Map Tiled Service(WMTS)
- Web Feature Service (WFS)
- WEB Coverage Service (WCS)
- Web Processing Service (WPS)

The Geospatial web is about the complete integration and use of location at all levels of the internet and the web.

WMS

- A Web Map Service (WMS) defines an interface that allows a client to get maps of geospatial data and gain detailed information on specific features shown on the map. A "map" is defined here as a visual representation of geospatial data, not the geospatial data itself.

- A Web Map Service can:
  - Tell a client what **maps it can produce** and which of those can be queried further.
  - **Produce a map** – as a picture, as a series of graphical elements, or as a packaged set of geographic feature data;
  - Answer basic **queries** about the content of a map; and

Implementation Specification Description

There are two types of WMS:

- **Basic WMS**, which provides map layers in pre-defined styles. Using a basic WMS, a client can only choose a style from a pre-defined list of styles to portray a particular map layer. A basic WMS may have direct access to the data store; and

- **Enabled WMS**, With a SLD-enabled WMS, a client has access to the SLD, the SE provides a symbol/style library, and the client can instruct the WMS on the styles to be used and the features to be rendered for a particular map, to create **custom-styled maps**.

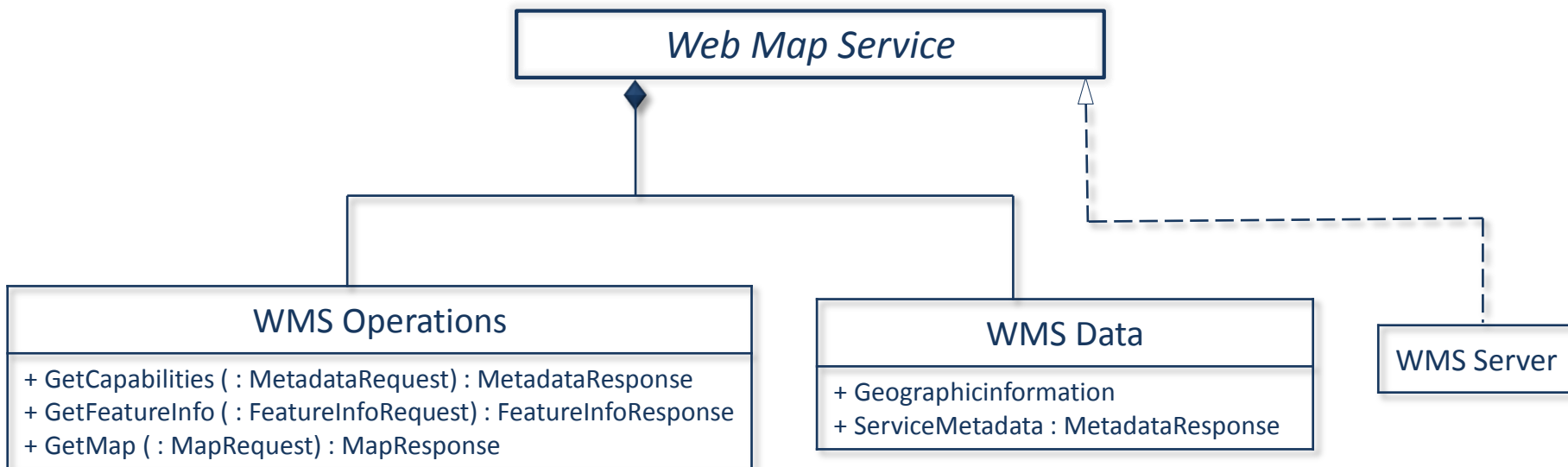Both types of WMS can return geospatial data in either of two map formats:

- "**Picture**" format:GIF (Graphics Interchange Format), PNG (Portable Network Graphics), and JPEG (Joint Photographics Expert Group);

- "**Graphic element**" format: SVG (Scalable Vector Graphics) or WebCGM (Web Computer Graphics Metafile).

IT Basic Architecture
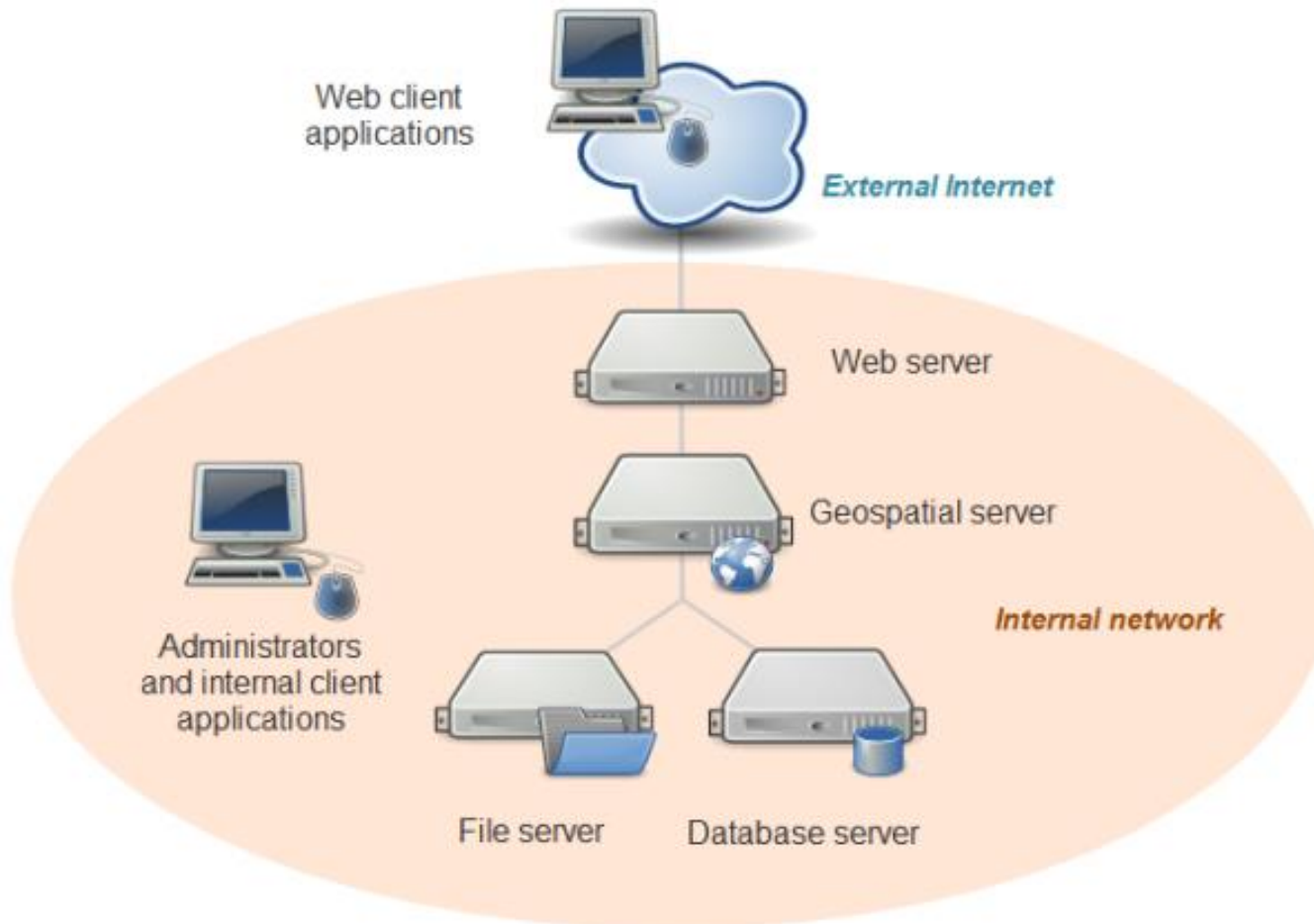
WMS interface

Implementation Specification

A WMS interface consists of the following mandatory and optional operations:

Mandatory:
- GetCapabilities
- GetMap

Optional:
- GetFeatureInfo

Optional for SLD-enabled WMS:
- DescribeLayer
- GetLegendGraphic
- GetStyles
- PutStyles

GetCapabilities

- **GetCapabilities** returns an XML document describing the service and the data collections from which clients may request maps.

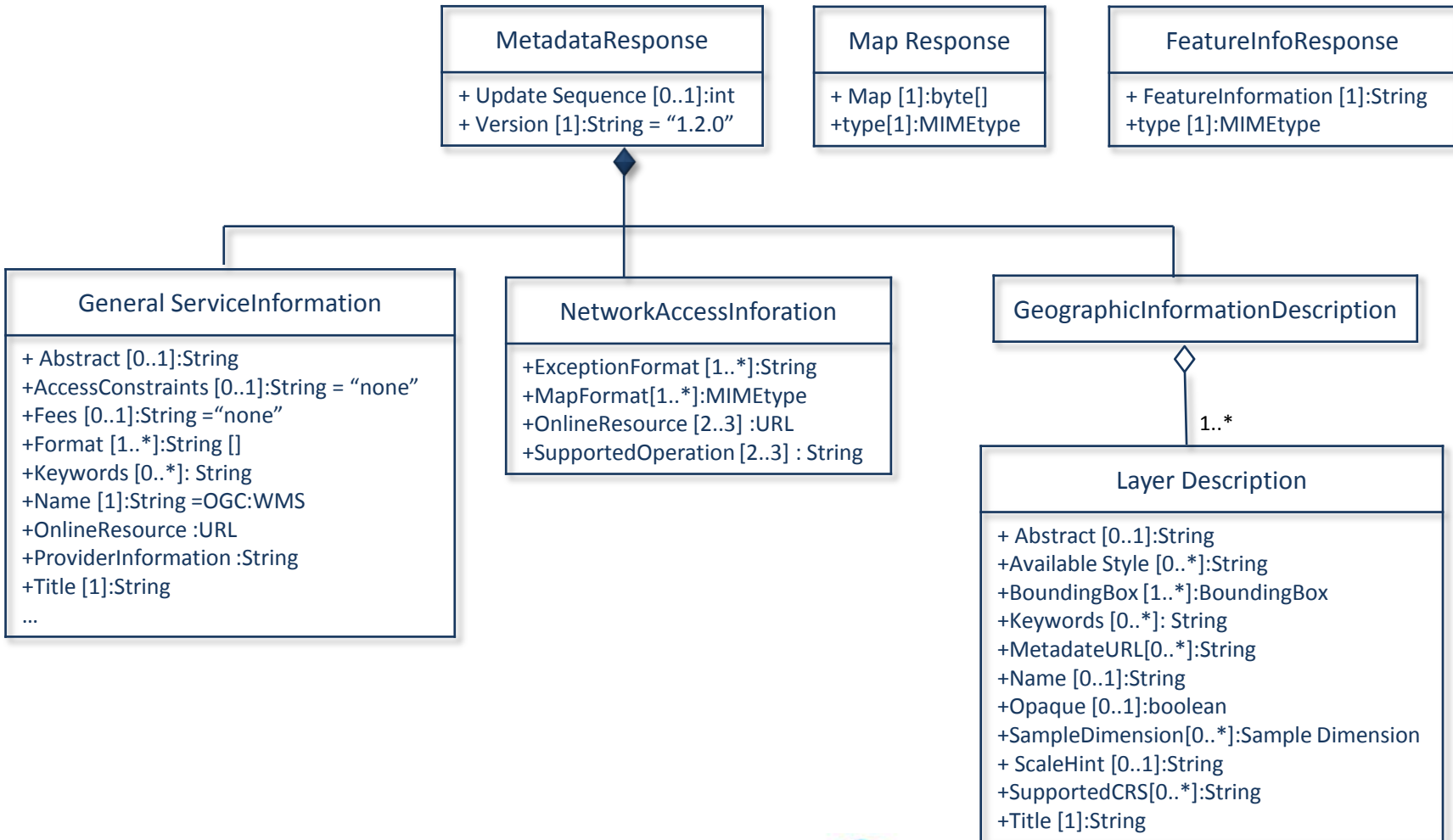   - Can be used on standard HTTP connection
    - Has 3 key pair values (KPV)

    http://gaia.inegi.org.mx/NLB/mdm5.wms?
        Service=WMS&
        Version=1.1.1&
        Request=GetCapabilities

Response Class Diagram

MetadataResponse

+ Update Sequence [0..1]:int
+ Version [1]:String = "1.2.0"

Map Response

+ Map [1]:byte[]
+type[1]:MIMEtype

FeatureInfoResponse

+ FeatureInformation [1]:String
+type [1]:MIMEtype

General ServiceInformation

+ Abstract [0..1]:String
+AccessConstraints [0..1]:String = "none"
+Fees [0..1]:String ="none"
+Format [1..*]:String []
+Keywords [0..*]: String
+Name [1]:String =OGC:WMS
+OnlineResource :URL
+ProviderInformation :String
+Title [1]:String
…

NetworkAccessInforation

+ExceptionFormat [1..*]:String
+MapFormat[1..*]:MIMEtype
+OnlineResource [2..3] :URL
+SupportedOperation [2..3] : String

GeographicInformationDescription

1..*

Layer Description

+ Abstract [0..1]:String
+Available Style [0..*]:String
+BoundingBox [1..*]:BoundingBox
+Keywords [0..*]: String
+MetadateURL[0..*]:String
+Name [0..1]:String
+Opaque [0..1]:boolean
+SampleDimension[0..*]:Sample Dimension
+ ScaleHint [0..1]:String
+SupportedCRS[0..*]:String
+Title [1]:String

GetCapabilities (1)

```xml
<?xml version="1.0" encoding="ISO-8859-1"?>
<!DOCTYPE WMT_MS_Capabilities SYSTEM "http://schemas.opengis.net/wms/1.1.1/WMS_MS_Capabilities.dtd">
<!-- end of DOCTYPE declaration -->
- <WMT_MS_Capabilities version="1.1.1">
        <!-- MapServer version 5.6.5 OUTPUT=GIF OUTPUT=PNG OUTPUT=JPEG OUTPUT=WBMP OUTPUT=PDF OUTPUT=SVG SUPPORTS=PROJ SUPPORTS=AGG SUPPORTS=CAIRO
        SUPPORTS=FREETYPE SUPPORTS=ICONV SUPPORTS=FRIBIDI SUPPORTS=WMS_SERVER SUPPORTS=WMS_CLIENT SUPPORTS=WFS_SERVER SUPPORTS=WFS_CLIENT
        SUPPORTS=WCS_SERVER SUPPORTS=SOS_SERVER SUPPORTS=FASTCGI SUPPORTS=THREADS SUPPORTS=GEOS SUPPORTS=RGBA_PNG INPUT=JPEG INPUT=POSTGIS INPUT=OGR
        INPUT=GDAL INPUT=SHAPEFILE -->
  - <Service>
        <Name>OGC:WMS</Name>
        <Title>Acervo de informacion geografica INEGI (Mapa Digital de Mexico)</Title>
      - <KeywordList>
            <Keyword>WMS</Keyword>
            <Keyword>OGC</Keyword>
            <Keyword>MapServer</Keyword>
            <Keyword>GeoNetwork</Keyword>
        </KeywordList>
        <OnlineResource xlink:href="http://www.inegi.org.mx/" xmlns:xlink="http://www.w3.org/1999/xlink"/>
      - <ContactInformation>
          - <ContactPersonPrimary>
                  <!-- WARNING: Mandatory metadata '..._contactperson' was missing in this context. -->
              <ContactOrganization>INEGI</ContactOrganization>
            </ContactPersonPrimary>
            <ContactPosition>Jefe de Dpto</ContactPosition>
          - <ContactAddress>
                <AddressType>postal</AddressType>
                <Address>Heroe de Nacozari 2301</Address>
                <City>Aguascalientes</City>
                <StateOrProvince>Aguascalientes</StateOrProvince>
                <PostCode>20276</PostCode>
                <Country>Maxico</Country>
            </ContactAddress>
            <ContactVoiceTelephone>+52 4499105300</ContactVoiceTelephone>
            <ContactFacsimileTelephone>+52 4499105328</ContactFacsimileTelephone>
            <ContactElectronicMailAddress>atencion.usuarios@inegi.org.mx </ContactElectronicMailAddress>
        </ContactInformation>
        <Fees>none</Fees>
        <AccessConstraints>none</AccessConstraints>
    </Service>
```

Link

GetCapabilities

```
    </ContactInformation>
    <Fees>none</Fees>
    <AccessConstraints>none</AccessConstraints>
  </Service>
- <Capability>
  - <Request>
    - <GetCapabilities>
        <Format>application/vnd.ogc.wms_xml</Format>
      - <DCPType>
        - <HTTP>
          - <Get>
              <OnlineResource xlink:href="http://gaia.inegi.org.mx/NLB/mdm5.wms?" xmlns:xlink="http://www.w3.org/1999/xlink"/>
            </Get>
          - <Post>
              <OnlineResource xlink:href="http://gaia.inegi.org.mx/NLB/mdm5.wms?" xmlns:xlink="http://www.w3.org/1999/xlink"/>
            </Post>
          </HTTP>
        </DCPType>
      </GetCapabilities>
    - <GetMap>
        <Format>image/png</Format>
        <Format>image/gif</Format>
        <Format>image/png; mode=24bit</Format>
        <Format>image/jpeg</Format>
        <Format>image/vnd.wap.wbmp</Format>
        <Format>image/tiff</Format>
        <Format>image/svg+xml</Format>
      - <DCPType>
        - <HTTP>
          - <Get>
              <OnlineResource xlink:href="http://gaia.inegi.org.mx/NLB/mdm5.wms?" xmlns:xlink="http://www.w3.org/1999/xlink"/>
            </Get>
          - <Post>
              <OnlineResource xlink:href="http://gaia.inegi.org.mx/NLB/mdm5.wms?" xmlns:xlink="http://www.w3.org/1999/xlink"/>
            </Post>
          </HTTP>
        </DCPType>
      </GetMap>
```

GetCapabilities

```
    </HTTP>
  </DCPType>
 </GetMap>
- <GetFeatureInfo>
    <Format>text/plain</Format>
    <Format>text/html</Format>
    <Format>application/vnd.ogc.gml</Format>
  - <DCPType>
    - <HTTP>
      - <Get>
          <OnlineResource xlink:href="http://gaia.inegi.org.mx/NLB/mdm5.wms?" xmlns:xlink="http://www.w3.org/1999/xlink"/>
        </Get>
      - <Post>
          <OnlineResource xlink:href="http://gaia.inegi.org.mx/NLB/mdm5.wms?" xmlns:xlink="http://www.w3.org/1999/xlink"/>
        </Post>
      </HTTP>
    </DCPType>
 </GetFeatureInfo>
- <DescribeLayer>
    <Format>text/xml</Format>
  - <DCPType>
    - <HTTP>
      - <Get>
          <OnlineResource xlink:href="http://gaia.inegi.org.mx/NLB/mdm5.wms?" xmlns:xlink="http://www.w3.org/1999/xlink"/>
        </Get>
      - <Post>
          <OnlineResource xlink:href="http://gaia.inegi.org.mx/NLB/mdm5.wms?" xmlns:xlink="http://www.w3.org/1999/xlink"/>
        </Post>
      </HTTP>
    </DCPType>
 </DescribeLayer>
```

GetCapabilities

```
            </Post>
          </HTTP>
        </DCPType>
      </GetStyles>
    </Request>
-   <Exception>
      <Format>application/vnd.ogc.se_xml</Format>
      <Format>application/vnd.ogc.se_inimage</Format>
      <Format>application/vnd.ogc.se_blank</Format>
    </Exception>
    <VendorSpecificCapabilities/>
    <UserDefinedSymbolization RemoteWFS="0" UserStyle="1" UserLayer="0" SupportSLD="1"/>
-   <Layer>
      <Name>Servicio_WMS_INEGI</Name>
      <Title>Acervo de informacion geografica INEGI (Mapa Digital de Mexico)</Title>
      <Abstract>Servicio_WMS_INEGI</Abstract>
-     <KeywordList>
        <Keyword>WMS</Keyword>
        <Keyword>OGC</Keyword>
        <Keyword>MapServer</Keyword>
        <Keyword>GeoNetwork</Keyword>
      </KeywordList>
      <SRS>EPSG:4326</SRS>
      <LatLonBoundingBox maxy="37.8468" maxx="-85.1237" miny="9.404" minx="-119.993"/>
      <BoundingBox maxy="37.8468" maxx="-85.1237" miny="9.404" minx="-119.993" SRS="EPSG:4326"/>
-     <Attribution>
        <Title>INEGI</Title>
        <OnlineResource xlink:href="http://www.inegi.org.mx/" xmlns:xlink="http://www.w3.org/1999/xlink"/>
-       <LogoURL height="20" width="20">
          <Format>image/jpg</Format>
          <OnlineResource xlink:href="http://mapserver.inegi.org.mx/images/logoINEGI.JPG" xmlns:xlink="http://www.w3.org/1999/xlink" xlink:type="simple"/>
        </LogoURL>
      </Attribution>
-     <Layer cascaded="1" opaque="0" queryable="0">
        <Name>b50</Name>
        <Title>Ortofotos</Title>
        <SRS>EPSG:4326</SRS>
        <LatLonBoundingBox maxy="33.2086" maxx="-85.2516" miny="14.1254" minx="-118.844"/>
        <BoundingBox maxy="33.2086" maxx="-85.2516" miny="14.1254" minx="-118.844" SRS="EPSG:4326"/>
        <ScaleHint max="4989028.48429637" min="0.0249451424214819"/>
      </Layer>
```

GetCapabilities

```xml
            </Layer>
        </Layer>
    - <Layer>
        <Name>MGE</Name>
        <Title>MGE</Title>
        <Abstract>MGE</Abstract>
      - <Layer cascaded="0" opaque="0" queryable="0">
            <Name>c100</Name>
            <Title>Limite Estatal</Title>
            <Abstract/>
          - <KeywordList>
                <Keyword/>
            </KeywordList>
            <SRS>EPSG:4326</SRS>
            <LatLonBoundingBox maxy="37.8468" maxx="-85.1237" miny="9.404" minx="-119.993"/>
            <BoundingBox maxy="37.8468" maxx="-85.1237" miny="9.404" minx="-119.993" SRS="EPSG:4326"/>
          - <Attribution>
                <Title>INEGI</Title>
                <OnlineResource xlink:href="http://www.inegi.org.mx/" xmlns:xlink="http://www.w3.org/1999/xlink"/>
              - <LogoURL height="20" width="20">
                    <Format>image/jpg</Format>
                    <OnlineResource xlink:href="http://mapserver.inegi.org.mx/images/logoINEGI.JPG" xmlns:xlink="http://www.w3.org/1999/xlink"
                        xlink:type="simple"/>
                </LogoURL>
            </Attribution>
          - <DataURL>
                <Format>text/html</Format>
                <OnlineResource xlink:href="http://mapserver.inegi.org.mx/geografia/espanol/normatividad/metadatos/gateway.cfm?id="
                    xmlns:xlink="http://www.w3.org/1999/xlink" xlink:type="simple"/>
            </DataURL>
          - <Style>
                <Name>default</Name>
                <Title>default</Title>
              - <LegendURL height="21" width="111">
                    <Format>image/png</Format>
                    <OnlineResource xlink:href="http://gaia.inegi.org.mx/NLB/mdm5.wms?
                        version=1.1.1&service=WMS&request=GetLegendGraphic&layer=c100&format=image/png&STYLE=default"
                        xmlns:xlink="http://www.w3.org/1999/xlink" xlink:type="simple"/>
                </LegendURL>
            </Style>
        </Layer>
```

GetCapabilities

```xml
            <OnlineResource xlink:href="http://gaia.inegi.org.mx/NLB/mdm5.wms?
                version=1.1.1&service=WMS&request=GetLegendGraphic&layer=c115&format=image/png&STYLE=default"
                xmlns:xlink="http://www.w3.org/1999/xlink" xlink:type="simple"/>
        </LegendURL>
    </Style>
    <ScaleHint max="49.8902848429637" min="0"/>
 </Layer>
- <Layer cascaded="0" opaque="0" queryable="1">
      <Name>c109</Name>
      <Title>AGEB urbana</Title>
      <Abstract/>
   - <KeywordList>
        <Keyword/>
     </KeywordList>
      <SRS>EPSG:4326</SRS>
      <LatLonBoundingBox maxy="37.8468" maxx="-85.1237" miny="9.404" minx="-119.993"/>
      <BoundingBox maxy="37.8468" maxx="-85.1237" miny="9.404" minx="-119.993" SRS="EPSG:4326"/>
   - <Attribution>
        <Title>INEGI</Title>
        <OnlineResource xlink:href="http://www.inegi.org.mx/" xmlns:xlink="http://www.w3.org/1999/xlink"/>
       - <LogoURL height="20" width="20">
          <Format>image/jpg</Format>
          <OnlineResource xlink:href="http://mapserver.inegi.org.mx/images/logoINEGI.JPG" xmlns:xlink="http://www.w3.org/1999/xlink"
              xlink:type="simple"/>
        </LogoURL>
     </Attribution>
   - <DataURL>
        <Format>text/html</Format>
        <OnlineResource xlink:href="http://mapserver.inegi.org.mx/geografia/espanol/normatividad/metadatos/gateway.cfm?id="
          xmlns:xlink="http://www.w3.org/1999/xlink" xlink:type="simple"/>
     </DataURL>
   - <Style>
        <Name>default</Name>
        <Title>default</Title>
       - <LegendURL height="20" width="109">
          <Format>image/png</Format>
          <OnlineResource xlink:href="http://gaia.inegi.org.mx/NLB/mdm5.wms?
              version=1.1.1&service=WMS&request=GetLegendGraphic&layer=c109&format=image/png&STYLE=default"
              xmlns:xlink="http://www.w3.org/1999/xlink" xlink:type="simple"/>
        </LegendURL>
     </Style>
      <ScaleHint max="64.8573702958528" min="0"/>
 </Layer>
```

GetCapabilities (2)

```xml
<WMS_Capabilities version="1.3.0" xsi:schemaLocation="http://www.opengis.net/wms http://schemas.opengis.net/wms/1.3.0/capabilities_1_3_0.xsd">
    <Service>
        <Name>WMS</Name>
        <Title>Spatial Server WMS Service</Title>
        <Abstract>The Spatial Server WMS Service!</Abstract>
        <KeywordList>
            <Keyword>mapinfo</Keyword>
            <Keyword>geographic</Keyword>
            <Keyword>wms</Keyword>
        </KeywordList>
        <OnlineResource ns2:type="simple" ns2:href="http://localhost:8080/rest/Spatial/WMS?"/>
        <ContactInformation>
            <ContactPersonPrimary/>
            <ContactAddress/>
        </ContactInformation>
        <Fees>NONE</Fees>
        <AccessConstraints>NONE</AccessConstraints>
    </Service>
    <Capability>
        <Request>
            <GetCapabilities>
                <Format>application/vnd.ogc.wms_xml</Format>
                <Format>text/xml</Format>
                <DCPType>
                    <HTTP>
                        <Get>
                            <OnlineResource ns2:type="simple" ns2:href="http://localhost:8080/rest/Spatial/WMS?"/>
                        </Get>
                    </HTTP>
                </DCPType>
            </GetCapabilities>
```

Link

GetCapabilities (3)

http://mrdata.usgs.gov/services/nmra?
    request=getcapabilities&
    service=WMS&
    version=1.1.1&

```
<!-- end of DOCTYPE declaration -->
▼<WMT_MS_Capabilities version="1.1.1">
  ▼<!--
      MapServer version 6.4.0 OUTPUT=GIF OUTPUT=PNG OUTPUT=JPEG OUTPUT=KML SUPPORTS=PROJ SUPPORTS=GD SUPPORTS=AGG SUPPORTS=FREETYPE SUPPORTS=CAIRO SUP
    -->
  ▼<Service>
      <Name>OGC:WMS</Name>
      <Title>US_Active_Mines</Title>
      <OnlineResource xmlns:xlink="http://www.w3.org/1999/xlink" xlink:href="http://mrdata.usgs.gov/"/>
    ▼<ContactInformation>
      ▼<ContactPersonPrimary>
          <ContactPerson>Peter N. Schweitzer</ContactPerson>
          <ContactOrganization>U.S. Geological Survey Mineral Resources Program</ContactOrganization>
        </ContactPersonPrimary>
        <ContactPosition>Geologist</ContactPosition>
      ▼<ContactAddress>
          <AddressType>mailing address</AddressType>
          <Address>Mail Stop 954 USGS National Center</Address>
          <City>Reston</City>
          <StateOrProvince>VA</StateOrProvince>
          <PostCode>20192</PostCode>
          <Country>USA</Country>
        </ContactAddress>
        <ContactVoiceTelephone>703-648-6533</ContactVoiceTelephone>
        <ContactFacsimileTelephone>703-648-6252</ContactFacsimileTelephone>
```

[Link](#)

GetMap Request (Mandatory)

Basic KPV

- **VERSION** means the requested version. The use of version and version negotiation are common to all OGC® web services, and are thoroughly discussed in the OGC® WebService Common Implementation Specification.

- **REQUEST**: "GetMap".

- **LAYERS**: provide a comma-separated list of layers to be returned. The layers will be rendered in the manner of "the leftmost, the bottommost".

- **SRS**: namespace identifier to specify Spatial Reference System.

- **FORMAT**: the format to be used to return the map.

- **BBOX**: minx, miny, maxx, maxy – to specify the coordinates of bounding box corners in the

- **WIDTH, HEIGHT**: numbers to specify the size of the map in pixels. These parameters are only used for maps returned in picture formats. If the WIDTH /HEIGHT ratio is different from the ratio specified by the BBOX, the server must re-render the map to fit in the WIDTH and HEIGHT picture frame. If a layer is declared to have fixed width and height, the server will only accept the declared numbers, and will issue a Service Exception for any other numbers.

GetMap Request

http://www2.demis.nl/wms/wms.ashx?

WMS=WorldMap&

VERSION=1.1.1&

REQUEST=GetMap&

SRS=EPSG:4326&

BBOX=-77.7549969635477,19.7080046138376,-75.8373745578412,20.8198703403107&

WIDTH=720&

HEIGHT=445&

FORMAT=Image/jpeg&

BGCOLOR=0xccfaff&

EXCEPTIONS=INIMAGE&

LAYERS=Countries,Builtup%20areas,Coastlines,Waterbodies,Inundated,Rivers,Streams,Railroads,Highways,Roads,Trails,Borders,Cities,Settlements,Spot%20elevations,Airports,Ocean%20features&

TRANSPARENT=TRUE

Link

@ www.demis.nl

GetFeatureInfo

KVP

- **VERSION**: the requested version. For the use of version and the version negotiation, please refer to the OGC® Web Service Common Implementation Specification.

- **REQUEST**: "GetFeatureInfo".

- **QUERY_LAYERS**: a comma-separated list of map layers from which feature information is to be retrieved. It must contain at least one layer name.

- **X , Y**: a point of interest on the map. The point is within the borders of the WIDTH and HEIGHT parameters of the embedded GetMap request. The origin is set to (0,0) at the upper left corner.

- **INFO _FORMAT**: the format to be used when returning the feature information.

- **BBOX**: minx, miny, maxx, maxy – to specify the coordinates of bounding box corners in the

GetFeatureInfo Request

http://www2.demis.nl/wms/wms.ashx?

WMS=WorldMap&

VERSION=1.1.1&

REQUEST=GetFeatureInfo&

QUERY_LAYERS=Countries&

INFO_FORMAT=text%2Fhtml&

WIDTH=720&

HEIGHT=445&

SRS=EPSG:4326&

BBOX=-77.7549969635477,19.7080046138376,-75.8373745578412,20.8198703403107&

x=-77.777044721&

y=21.4283013049
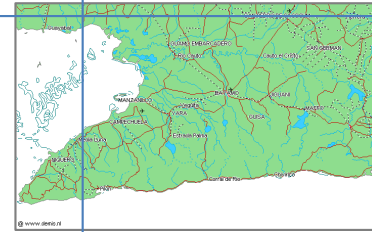
[Link](#)

Layer	ID	Description	Value
Countries	CU	Cuba	

Web Map Tiled Service (WMTS)

The WMTS Implementation Standard provides a standard-based solution to serve digital maps using **pre-defined image tiles**.

The WMTS standard complements the existing Web Map Service (WMS) standard. The WMS standard focuses on flexibility in the client request, enabling clients to obtain exactly the final image they want.

Coarse resolution Highest scale denominator

Detailed resolution Lowest scale denominator
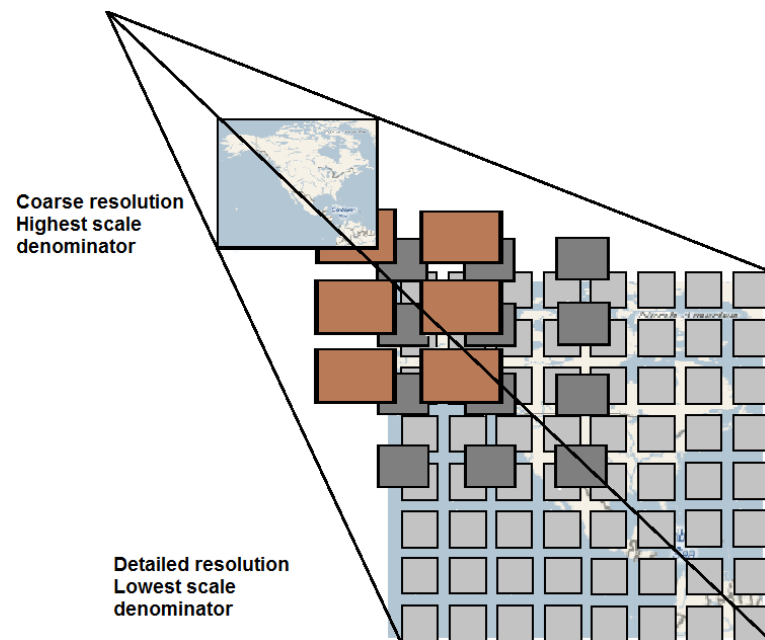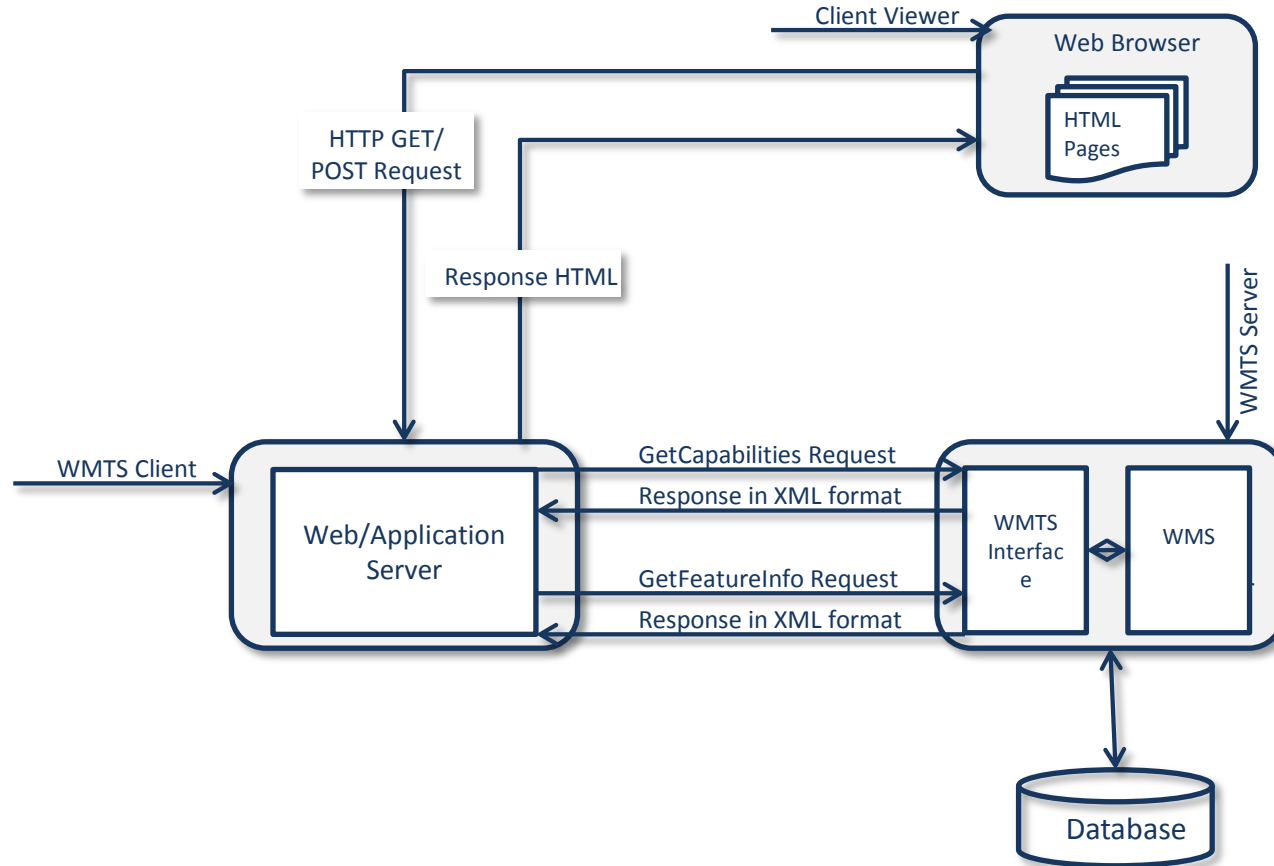
Architecture WMTS

Web Map Tiled Service(WMTS)

- WMTS defines the operations:
  - *GetCapabilities,*
  - *GetTile* and
  - optional *GetFeatureInfo*

  WMTS also **defines** the request mechanisms and **endpoint publishing strategy** to enable a resource-oriented architectural style based on web-based URL endpoints, allowing clients to **simply request theServiceMetadata, Tile, and FeatureInfo resources as documents**.

GetCapabilities Request

http://gaiamapas.inegi.org.mx/mdmCache/service/wmts?
    REQUEST=getcapabilities

This XML file does not appear to have any style information associated with it. The document tree is shown below.

```xml
<Capabilities xmlns="http://www.opengis.net/wmts/1.0" xmlns:ows="http://www.opengis.net/ows/1.1" xmlns:xlink="http://www.w3.org/1999/xlink"
 xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xmlns:gml="http://www.opengis.net/gml" xsi:schemaLocation="http://www.opengis.net/wmts/1.0
 http://schemas.opengis.net/wmts/1.0/wmtsGetCapabilities_response.xsd" version="1.0.0">
  <ows:ServiceIdentification>
    <ows:Title>Mapa Digital de Mexico</ows:Title>
    <ows:Abstract>Servicio de mapas base de MDM</ows:Abstract>
    <ows:Keywords>
      <ows:Keyword>WFS</ows:Keyword>
      <ows:Keyword>WMS</ows:Keyword>
      <ows:Keyword>WMTS</ows:Keyword>
      <ows:Keyword>GEOWEBCACHE</ows:Keyword>
    </ows:Keywords>
    <ows:ServiceType>OGC WMTS</ows:ServiceType>
    <ows:ServiceTypeVersion>1.0.0</ows:ServiceTypeVersion>
    <ows:Fees>NONE</ows:Fees>
    <ows:AccessConstraints>NONE</ows:AccessConstraints>
  </ows:ServiceIdentification>
  <ows:ServiceProvider>
    <ows:ProviderName>INEGI</ows:ProviderName>
    <ows:ProviderSite xlink:href="http://www.inegi.org.mx/"/>
    <ows:ServiceContact>
      <ows:IndividualName>Aaron Villar</ows:IndividualName>
      <ows:PositionName>Geospatial Expert</ows:PositionName>
      <ows:ContactInfo>
        <ows:Phone>
          <ows:Voice>+52 449 9105300</ows:Voice>
          <ows:Facsimile>+52 449 9105300</ows:Facsimile>
        </ows:Phone>
```

Link

GetCapabilities Request

```xml
▼<ows:OperationsMetadata>
  ▼<ows:Operation name="GetCapabilities">
    ▼<ows:DCP>
      ▼<ows:HTTP>
        ▼<ows:Get xlink:href="http://gaiamapas.inegi.org.mx/mdmCache/service/wmts?">
          ▼<ows:Constraint name="GetEncoding">
            ▼<ows:AllowedValues>
                <ows:Value>KVP</ows:Value>
              </ows:AllowedValues>
            </ows:Constraint>
          </ows:Get>
        </ows:HTTP>
      </ows:DCP>
    </ows:Operation>
  ▼<ows:Operation name="GetTile">
    ▼<ows:DCP>
      ▼<ows:HTTP>
        ▼<ows:Get xlink:href="http://gaiamapas.inegi.org.mx/mdmCache/service/wmts?">
          ▼<ows:Constraint name="GetEncoding">
            ▼<ows:AllowedValues>
                <ows:Value>KVP</ows:Value>
              </ows:AllowedValues>
            </ows:Constraint>
          </ows:Get>
        </ows:HTTP>
      </ows:DCP>
    </ows:Operation>
  ▼<ows:Operation name="GetFeatureInfo">
    ▼<ows:DCP>
      ▼<ows:HTTP>
        ▼<ows:Get xlink:href="http://gaiamapas.inegi.org.mx/mdmCache/service/wmts?">
          ▼<ows:Constraint name="GetEncoding">
            ▼<ows:AllowedValues>
                <ows:Value>KVP</ows:Value>
              </ows:AllowedValues>
```

GetCapabilities Request

```xml
▼<Contents>
  ▼<Layer>
      <ows:Title>Acervo de Informacion Geografica MDMv6_beta</ows:Title>
      <ows:Abstract>Acervo de Informacion Geografica MDMv6_beta</ows:Abstract>
      <ows:Identifier>MapaBaseTopograficov6_beta</ows:Identifier>
    ▼<Style isDefault="true">
        <ows:Identifier>_null</ows:Identifier>
      </Style>
      <Format>image/jpeg</Format>
    ▼<TileMatrixSetLink>
        <TileMatrixSet>EPSG:900913</TileMatrixSet>
      ▼<TileMatrixSetLimits>
        ▼<TileMatrixLimits>
            <TileMatrix>EPSG:900913:0</TileMatrix>
            <MinTileRow>1</MinTileRow>
            <MaxTileRow>1</MaxTileRow>
            <MinTileCol>0</MinTileCol>
            <MaxTileCol>0</MaxTileCol>
          </TileMatrixLimits>
        ▼<TileMatrixLimits>
            <TileMatrix>EPSG:900913:1</TileMatrix>
            <MinTileRow>1</MinTileRow>
            <MaxTileRow>1</MaxTileRow>
            <MinTileCol>0</MinTileCol>
            <MaxTileCol>0</MaxTileCol>
          </TileMatrixLimits>
        ▼<TileMatrixLimits>
            <TileMatrix>EPSG:900913:2</TileMatrix>
            <MinTileRow>2</MinTileRow>
            <MaxTileRow>2</MaxTileRow>
            <MinTileCol>0</MinTileCol>
            <MaxTileCol>1</MaxTileCol>
          </TileMatrixLimits>
```

GetCapabilities Request

```xml
▼<Layer>
  <ows:Title>Acervo de Informacion Geografica MDMv60</ows:Title>
  <ows:Abstract>Acervo de Informacion Geografica MDMv60</ows:Abstract>
  <ows:Identifier>MapaBaseHipsografico</ows:Identifier>
  ▼<Style isDefault="true">
    <ows:Identifier>_null</ows:Identifier>
  </Style>
  <Format>image/jpeg</Format>
  ▼<TileMatrixSetLink>
    <TileMatrixSet>EPSG:900913</TileMatrixSet>
    ▼<TileMatrixSetLimits>
      ▼<TileMatrixLimits>
        <TileMatrix>EPSG:900913:0</TileMatrix>
        <MinTileRow>1</MinTileRow>
        <MaxTileRow>1</MaxTileRow>
        <MinTileCol>0</MinTileCol>
        <MaxTileCol>0</MaxTileCol>
      </TileMatrixLimits>
      ▼<TileMatrixLimits>
        <TileMatrix>EPSG:900913:1</TileMatrix>
        <MinTileRow>1</MinTileRow>
        <MaxTileRow>1</MaxTileRow>
        <MinTileCol>0</MinTileCol>
        <MaxTileCol>0</MaxTileCol>
      </TileMatrixLimits>
      ▼<TileMatrixLimits>
        <TileMatrix>EPSG:900913:2</TileMatrix>
        <MinTileRow>2</MinTileRow>
        <MaxTileRow>2</MaxTileRow>
        <MinTileCol>0</MinTileCol>
        <MaxTileCol>1</MaxTileCol>
      </TileMatrixLimits>
      ▼<TileMatrixLimits>
        <TileMatrix>EPSG:900913:3</TileMatrix>
        <MinTileRow>4</MinTileRow>
        <MaxTileRow>4</MaxTileRow>
        <MinTileCol>1</MinTileCol>
        <MaxTileCol>2</MaxTileCol>
      </TileMatrixLimits>
```

GetCapabilities Request

```xml
▼<Layer>
   <ows:Title>Acervo de Informacion Geografica MDMv60</ows:Title>
   <ows:Abstract>Acervo de Informacion Geografica MDMv60</ows:Abstract>
   <ows:Identifier>MapaBaseOrtofoto</ows:Identifier>
  ▼<Style isDefault="true">
   <ows:Identifier>_null</ows:Identifier>
   </Style>
   <Format>image/jpeg</Format>
  ▼<TileMatrixSetLink>
     <TileMatrixSet>EPSG:900913</TileMatrixSet>
    ▼<TileMatrixSetLimits>
      ▼<TileMatrixLimits>
         <TileMatrix>EPSG:900913:0</TileMatrix>
         <MinTileRow>1</MinTileRow>
         <MaxTileRow>1</MaxTileRow>
         <MinTileCol>0</MinTileCol>
         <MaxTileCol>0</MaxTileCol>
       </TileMatrixLimits>
      ▼<TileMatrixLimits>
         <TileMatrix>EPSG:900913:1</TileMatrix>
         <MinTileRow>1</MinTileRow>
         <MaxTileRow>1</MaxTileRow>
         <MinTileCol>0</MinTileCol>
         <MaxTileCol>0</MaxTileCol>
       </TileMatrixLimits>
      ▼<TileMatrixLimits>
         <TileMatrix>EPSG:900913:2</TileMatrix>
         <MinTileRow>2</MinTileRow>
         <MaxTileRow>2</MaxTileRow>
         <MinTileCol>0</MinTileCol>
         <MaxTileCol>1</MaxTileCol>
       </TileMatrixLimits>
      ▼<TileMatrixLimits>
         <TileMatrix>EPSG:900913:3</TileMatrix>
         <MinTileRow>4</MinTileRow>
         <MaxTileRow>4</MaxTileRow>
         <MinTileCol>1</MinTileCol>
         <MaxTileCol>2</MaxTileCol>
       </TileMatrixLimits>
```

GetCapabilities Request

```xml
▼<TileMatrix>
   <ows:Identifier>GlobalCRS84Pixel:14</ows:Identifier>
   <ScaleDenominator>33130.80083133143</ScaleDenominator>
   <TopLeftCorner>90.0 -180.0</TopLeftCorner>
   <TileWidth>256</TileWidth>
   <TileHeight>256</TileHeight>
   <MatrixWidth>16875</MatrixWidth>
   <MatrixHeight>8438</MatrixHeight>
 </TileMatrix>
▼<TileMatrix>
   <ows:Identifier>GlobalCRS84Pixel:15</ows:Identifier>
   <ScaleDenominator>11043.600277110474</ScaleDenominator>
   <TopLeftCorner>90.0 -180.0</TopLeftCorner>
   <TileWidth>256</TileWidth>
   <TileHeight>256</TileHeight>
   <MatrixWidth>50625</MatrixWidth>
   <MatrixHeight>25313</MatrixHeight>
 </TileMatrix>
▼<TileMatrix>
   <ows:Identifier>GlobalCRS84Pixel:16</ows:Identifier>
   <ScaleDenominator>3313.080083133142</ScaleDenominator>
   <TopLeftCorner>90.0 -180.0</TopLeftCorner>
   <TileWidth>256</TileWidth>
   <TileHeight>256</TileHeight>
   <MatrixWidth>168750</MatrixWidth>
   <MatrixHeight>84375</MatrixHeight>
 </TileMatrix>
▼<TileMatrix>
   <ows:Identifier>GlobalCRS84Pixel:17</ows:Identifier>
   <ScaleDenominator>1104.3600277110472</ScaleDenominator>
   <TopLeftCorner>90.0 -180.0</TopLeftCorner>
   <TileWidth>256</TileWidth>
   <TileHeight>256</TileHeight>
   <MatrixWidth>506250</MatrixWidth>
   <MatrixHeight>253125</MatrixHeight>
```

WMTS Examples

- http://basemap.nationalmap.gov/arcgis/rest/services/USGSImageryOnly/MapServer?f=jsapi

- http://basemap.nationalmap.gov/arcgis/rest/services/USGSImageryOnly/MapServer/tile/14/6311/3500

Web Feature Services (WFS)

A *Web Feature Service (WFS)* allows a client to perform **data manipulation operations** on one or more geographic features.

Data manipulation operations include the ability to:

- **Get or Query features** based on spatial and non-spatial constraints,
- **Create** a new feature,
- **Modify** a feature, or
- **Delete** a feature.

A WFS is primarily a feature access service that also includes elements of a feature type **service, a coordinate conversion/transformation** service and a geographic format conversion service.

WFS IT Architecture

Client

Web Feature Service Clients

WFS Request &Response   *(SOAP/XML)*

*Middle Tier
(application server)*

WFS Server APL

Feature Cache

JDBC

Database

Spatial DB with WFS metadata &data

*Admin API
(PL/SQL)*
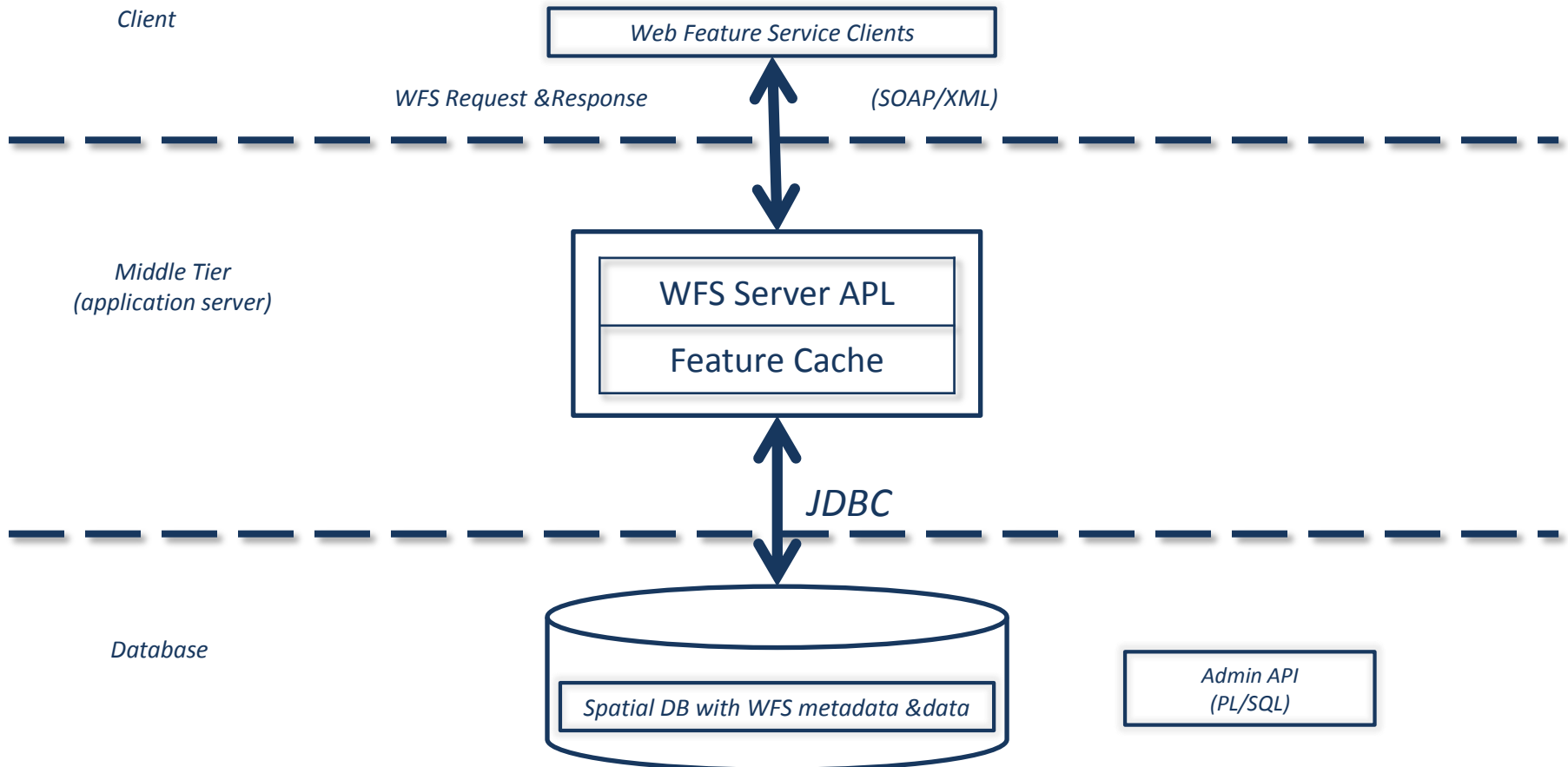
Request Composition

Requests submitted to a WFS may be submitted either via

HTTP GET

- a request that includes all request parameters within the URL submitted to the service. Request parameters are included in the URL as "key=value" pairs (KVPs)

HTTP POST

- a request where the URL consists of only the Host and path, with all other request parameters included in the body of the POST document submitted to the service. The request parameters supplied to the server are encoded as XML within the POST document.

SOAP

- a request submitted as an encapsulated message within a SOAP transaction.

Servers implementing WFS may support either the HTTP GET, POST, or SOAP request model

Conceptually FeatureType = Layer

WFS Operations

WFS Conformance Levels

WFS 2.0.0 Request and their corresponding WFS Compliance Levels

Operation (request=)	Version		Version 2.0.0 Conformance Class			
	1.1.0	2.0.0	Simple	Basic	Transactional	Locking
Get Capabilities	X	X	X	X	X	X
Describe Feature Type	X	X	X	X	X	X
List Stored Queries		X	X	X	X	X
Describe stored Queries		X	X	X	X	X
Get Feature	X	X	X	X	X	X
Stored Query		X	X	X	X	X
Get Property Value		X		X	X	X
Transaction	X	X			X	X
Get Featured With Lock	X	X				X
Lock Feature	X	X				X
Get GML Object	X					

WFS Standard Response Parameters
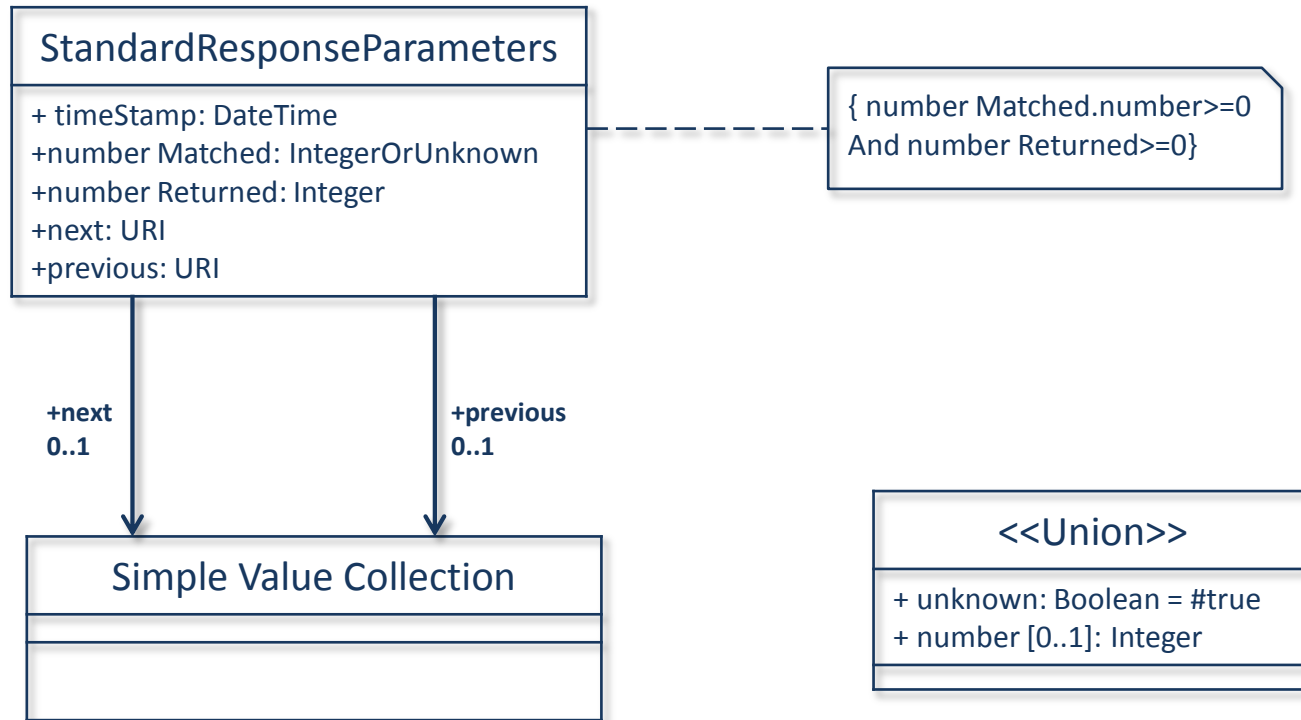
Base Request Parameters For All HTTP GET KVP Requests

URL Component	Operation	O/M[a]	Description
Service	All operations.	M	See 7.6.2.4.
Version [b] (All operations)	All operations except GetCapabilities.	M	See 7.6.2.5.

[a]   O=Optional, M = Mandatory

[b]   Version is mandatory from all operations except the GetCapabilities operation.

Table 7

KVP For DescribeFeatureType Request

URL Component	O/M[a]	Description
Common Keywords (REQUEST = DescribeFeatureType)		See Table 7 (Only keywords from all operations or the Describe Feature Type operation).
TYPENAME	0	A comma separated list of feature types to describe, if no value is specified, the complete application schema offered by the server shall be described.
OUTPUTFORMAT	0	Shall support the value "application/gml+xml; version =3.2" indicating that a GML (see ISO19136:2007) application schema shall be generated. A server may support other values to which this International Standard does not assign any meaning.

[a] O=Optional, M = Mandatory

KVP For GetFeature Request

URL Component	Description
Common Keywords (REQUEST = GetFeature)	See Table 7 for additional parameters that may be used in a KVP-encoded Get Feature request.
Standard Presentation Parameters	See Table 5.
Standard Resolve Parameters	See Table 6.
Adhoc Query Keywords (Mutually exclusive with Stored Query Keywords)	See Table 8.
Stored Query Keywords (Mutually exclusive with Adhoc Query Keywords)	See Table 10.

KVP For GetFeature Request

URL Component	Operation	O/M[a]	Default	Description
STARTINDEX	GetPropertyValue, GetFeature, GetFeatureWithLock	O	1	See 7.6.3.4.
COUNT	GetPropertyValue, GetFeature, GetFeatureWithLock	O	1	See 7.6.3.5.
OUTPUTFORMAT	GetFeruteType, GetPropertyValue, GetFeature, GetFeatureWithLock	O	application/gml+xml; Version =3.2	See 7.6.3.7.
RESULTTYPE	GetPropertyValue, GetFeature, GetFeatureWithLock	O	results	See 7.6.3.6.

[a] O=Optional, M = Mandatory

KVP for GetFeature Request – Adhoc Query Parameters

URL Component	O/Mª	Description
TYPENAMES	Mᵇ	See 7.9.2.4.1.
ALIASES	O	See 7.9.2.4.3.
SRSNAME	O	See 7.9.2.4.4.
Projection clause	O	See Table 9.
FILTER	O	See ISO 19143:2010, 6.3.3.
FILTER_LANGUAGE	O	See ISO 19143:2010, 6.3.3.
RESOURSED	O	See ISO 19143:2010, 6.3.3.
BBOX	O	See OGC 06-121r3-
SORTBY	O	See ISO 19143:2010, Clause 8 The SORBY parameter is used to specify a list of property names whose values should be used to order (upon presentation) the set of feature instances that satisfy the query. The value of the SORTBY parameter shall have the form "*PropertyName [ASC|DESC], Property Name [AASC|DESC],]*" where the letteres ASC are used to indicate an ascending sort and the letters DESC are used to indicate a descending sort, if nether ASC nor DESC are specified, the default sort order shall be ascending., an example value might be: "*SORTBY= Field1 DESC, Fiel2 DESC, DIELS3*". In this case the results are sorted by Field 1 descending, Field2 descending and Field3 ascending.

ᵃ   O=Optional, M = Mandatory
ᵇ   The TYIPENAMES parameter is mandatory in all case except when the RESOURCEID parameter is specified (see 7.9.2.4.1).

GetCapabilities Request

- Sample request to NM RGIS (NM State Boundary)

  http://gstore.unm.edu/apps/rgis/datasets/107046/services/ogc/wfs?

  VERSION=1.0.0&

  SERVICE=WFS&

  REQUEST=GetCapabilities

This XML file does not appear to have any style information associated with it. The document tree is shown below.

```xml
<WFS_Capabilities xmlns="http://www.opengis.net/wfs" xmlns:ogc="http://www.opengis.net/ogc" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
version="1.0.0" updateSequence="0" xsi:schemaLocation="http://www.opengis.net/wfs http://schemas.opengis.net/wfs/1.0.0/WFS-capabilities.xsd">
  <!--
    MapServer version 6.0.3 OUTPUT=GIF OUTPUT=PNG OUTPUT=JPEG OUTPUT=KML SUPPORTS=PROJ SUPPORTS=AGG SUPPORTS=FREETYPE SUPPORTS=ICONV SUPPORTS=WMS_S
  -->
  <Service>
    <Name>MapServer WFS</Name>
    <Title>tl_2010_35_state10</Title>
    <Abstract>
      WFS Service for RGIS dataset State Boundary - 2010 (6ca5428a-a78c-4c82-8120-da70dc92f2cc)
    </Abstract>
    <Keywords>RGIS New Mexico</Keywords>
    <OnlineResource>
      http://gstore.unm.edu/apps/rgis/datasets/6ca5428a-a78c-4c82-8120-da70dc92f2cc/services/ogc/wms
    </OnlineResource>
    <Fees>None</Fees>
    <AccessConstraints>none</AccessConstraints>
  </Service>
  <Capability>
    <Request>
      <GetCapabilities>
        <DCPType>
          <HTTP>
            <Get onlineResource="http://gstore.unm.edu/apps/rgis/datasets/6ca5428a-a78c-4c82-8120-da70dc92f2cc/services/ogc/wfs?"/>
          </HTTP>
        </DCPType>
        <DCPType>
```

Link

DescribeFeatureType Request

- Sample WFS DescribeFeatureType request to NM RGIS (State Boundary) Service

  http://gstore.unm.edu/apps/rgis/datasets/107046/services/ogc/wfs?

  VERSION=1.0.0&

  SERVICE=WFS&

  REQUEST=DescribeFeatureType

This XML file does not appear to have any style information associated with it. The document tree is shown below.

```
▼<schema xmlns:ms="http://mapserver.gis.umn.edu/mapserver" xmlns:ogc="http://www.opengis.net/ogc" xmlns:xsd="http://www.w3.org/2001/XMLSchema"
 xmlns="http://www.w3.org/2001/XMLSchema" xmlns:gml="http://www.opengis.net/gml" targetNamespace="http://mapserver.gis.umn.edu/mapserver"
 elementFormDefault="qualified" version="0.1">
  <import namespace="http://www.opengis.net/gml" schemaLocation="http://schemas.opengis.net/gml/2.1.2/feature.xsd"/>
  <element name="tl_2010_35_state10" type="ms:tl_2010_35_state10Type" substitutionGroup="gml:_Feature"/>
 ▼<complexType name="tl_2010_35_state10Type">
  ▼<complexContent>
   ▼<extension base="gml:AbstractFeatureType">
    ▼<sequence>
      <element name="msGeometry" type="gml:GeometryPropertyType" minOccurs="0" maxOccurs="1"/>
      <element name="NAME10" type="string"/>
      <element name="AWATER10" type="string"/>
      <element name="DIVISION10" type="string"/>
      <element name="REGION10" type="string"/>
      <element name="STUSPS10" type="string"/>
      <element name="ALAND10" type="string"/>
      <element name="INTPTLAT10" type="string"/>
      <element name="STATENS10" type="string"/>
      <element name="LSAD10" type="string"/>
      <element name="FUNCSTAT10" type="string"/>
      <element name="observed" type="string"/>
      <element name="STATEFP10" type="string"/>
      <element name="MTFCC10" type="string"/>
      <element name="GEOID10" type="string"/>
      <element name="id" type="string"/>
```

Link

GetFeature Request

- Sample GetFeature Request - NM RGIS WFS

    http://gstore.unm.edu/apps/rgis/datasets/107046/services/ogc/wfs?

    VERSION=1.0.0&

    SERVICE=WFS&

    REQUEST=GetFeature&

    TYPENAME=tl_2010_35_state10

This XML file does not appear to have any style information associated with it. The document tree is shown below.

```
▼<wfs:FeatureCollection xmlns:ms="http://mapserver.gis.umn.edu/mapserver" xmlns:wfs="http://www.opengis.net/wfs"
 xmlns:gml="http://www.opengis.net/gml" xmlns:ogc="http://www.opengis.net/ogc" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
 xsi:schemaLocation="http://www.opengis.net/wfs http://schemas.opengis.net/wfs/1.0.0/WFS-basic.xsd http://mapserver.gis.umn.edu/mapserver
 http://gstore.unm.edu/apps/rgis/datasets/6ca5428a-a78c-4c82-8120-da70dc92f2cc/services/ogc/wfs?
 SERVICE=WFS&VERSION=1.0.0&REQUEST=DescribeFeatureType&TYPENAME=tl_2010_35_state10&OUTPUTFORMAT=XMLSCHEMA">
 ▼<gml:boundedBy>
  ▼<gml:Box srsName="EPSG:4269">
    <gml:coordinates>-109.050173,31.332170 -103.001960,37.000290</gml:coordinates>
   </gml:Box>
 </gml:boundedBy>
 ▼<!--
    WARNING: FeatureId item 'FID' not found in typename 'tl_2010_35_state10'.
  -->
 ▼<gml:featureMember>
  ▼<ms:tl_2010_35_state10>
   ▼<gml:boundedBy>
    ▼<gml:Box srsName="EPSG:4269">
      <gml:coordinates>-109.050173,31.332170 -103.001960,37.000290</gml:coordinates>
     </gml:Box>
    </gml:boundedBy>
   ▼<ms:msGeometry>
    ▼<gml:Polygon srsName="EPSG:4269">
     ▼<gml:outerBoundaryIs>
      ▼<gml:LinearRing>
       ▼<gml:coordinates>
         -109.046156,34.579290 -109.046160,34.580840 -109.046160,34.580990 -109.046221,34.602030 -109.046218,34.602144 -109.046218,34.602260
         -109.046196,34.603100 -109.046193,34.603233 -109.046160,34.604180 -109.046164,34.604340 -109.046160,34.604508 -109.046137,34.607670
         -109.046137,34.608250 -109.046136,34.609060 -109.046136,34.609250 -109.046136,34.609840 -109.046136,34.609880 -109.046136,34.610080
         -109.046135,34.610670 -109.046135,34.611100 -109.046133,34.611380 -109.046133,34.611386 -109.046134,34.611560 -109.046141,34.612530
```

[Link](#)

Web Coverage Service (WCS)

- "The Web Coverage Service (WCS) supports electronic retrieval of **geospatial data as "coverages**"

- A WCS provides access to potentially detailed and rich sets of geospatial information, in forms that are useful for **client-side rendering**, multi-valued **coverages**, and input into scientific models and other clients.

- The WCS may be compared to the OGC Web Map Service (WMS) and the Web Feature Service (WFS); like them it allows clients to choose portions of a server's information holdings based on spatial constraints and other criteria.

Web Coverage Service (WCS)

WCS can perform the following operations:

Operation	Description
GetCapabilities	Retrieves a list of the server's data, as well as valid WCS operations and parameters
DescribeCoverage	Retrieves an XML document that fully describes the request coverages.
GetCoverage	Returns a coverage in a well known format. Like a WMS GetMap request, but with several extensions to support the retrieval of coverages.

Request Composition

Requests submitted to a WCS may be submitted either via the following protocols, as defined in the three extensions developed thus far for the core WCS standard.

HTTP GET

- a request that includes all request parameters within the URL submitted to the service. Request parameters are included in the URL as "key=value" pairs (KVPs)

HTTP POST

- a request where the URL consists of only the Host and path, with all other request parameters included in the body of the POST document submitted to the service. The request parameters supplied to the server are encoded as XML within the POST document.

XML/SOAP

- a request-response model between the client that conforms with the W3C SOAP web services protocol

KVP Base for WCS Requests

Name	Mandatory/Optional	Definition	Data Type
service	M	Identifier of the OGC service	String, fixed to "WCS"
request	M	Request type name	String, set to operation name
version	M (exception for GetCapabilities)	Request protocol version	String

GetCapabilities Request

- Sample WCS GetCapabilities request for the NSIDC Atlas of the Cryosphere

  http://nsidc.org/cgi-bin/atlas_north?

  service=WCS&

  request=GetCapabilities

This XML file does not appear to have any style information associated with it. The document tree is shown below.

```xml
▼<Capabilities xmlns="http://www.opengis.net/wcs/1.1" xmlns:ows="http://www.opengis.net/ows" xmlns:xlink="http://www.w3.org/1999/xlink"
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xmlns:ogc="http://www.opengis.net/ogc" version="1.1.1">
  ▼<ows:ServiceIdentification>
    <ows:Title>Atlas of the Cryosphere: Northern Hemisphere</ows:Title>
  ▼<ows:Abstract>
      The National Snow and Ice Data Center (NSIDC) Atlas of the Cryosphere is a map server that provides data and information pertinent to the
      frozen regions of Earth, including monthly climatologies of sea ice extent and concentration, snow cover extent, and snow water equivalent, in
      addition to glacier outlines, permafrost extent and classification, ice sheet elevation and accumulation, and more. In order to support polar
      projections, the Atlas is divided into two separate map servers: one for the Northern Hemisphere and one for the Southern Hemisphere. In
      addition to providing map images and source data through Open Geospatial Consortium, Inc. (OGC) protocols (WMS, WFS, and WCS), a dynamic web
      interface for exploring these data is also available at http://nsidc.org/data/atlas. If you have questions, comments or suggestions, please
      contact NSIDC User Services at +1.303.492.6199 or nsidc@nsidc.org. The development of this map server application was supported by NASA's
      Earth Observing System (EOS) Program under contract NAS5-03099 and was developed using MapServer, an Open Source development environment for
      building spatially-enabled internet applications. To cite the Atlas of the Cryosphere: Maurer, J. 2007. Atlas of the Cryosphere. Boulder,
      Colorado USA: National Snow and Ice Data Center. Digital media. Available at http://nsidc.org/data/atlas/.
    </ows:Abstract>
  ▼<ows:Keywords>
      <ows:Keyword>Arctic</ows:Keyword>
      <ows:Keyword>Cryosphere</ows:Keyword>
      <ows:Keyword>Earth Science</ows:Keyword>
      <ows:Keyword>Ice Extent</ows:Keyword>
      <ows:Keyword>Ice Sheets</ows:Keyword>
      <ows:Keyword>Northern Hemisphere</ows:Keyword>
      <ows:Keyword>Oceans</ows:Keyword>
      <ows:Keyword>Polar</ows:Keyword>
      <ows:Keyword>Sea Ice</ows:Keyword>
      <ows:Keyword>Sea Ice Concentration</ows:Keyword>
      <ows:Keyword>Snow/Ice</ows:Keyword>
      <ows:Keyword>Snow Cover</ows:Keyword>
```

Link

GetCapabilities Request

```xml
▼<ows:ServiceProvider>
   <ows:ProviderName>National Snow and Ice Data Center</ows:ProviderName>
   <ows:ProviderSite xlink:type="simple" xlink:href="http://nsidc.org"/>
 ▼<ows:ServiceContact>
    <ows:IndividualName>NSIDC User Services</ows:IndividualName>
    <ows:PositionName>User Services</ows:PositionName>
  ▼<ows:ContactInfo>
    ▼<ows:Phone>
       <ows:Voice>+1 303.492.6199</ows:Voice>
       <ows:Facsimile>+1 303.492.2468</ows:Facsimile>
     </ows:Phone>
    ▼<ows:Address>
       <ows:DeliveryPoint>CIRES, 449 UCB, University of Colorado</ows:DeliveryPoint>
       <ows:City>Boulder</ows:City>
       <ows:AdministrativeArea>CO</ows:AdministrativeArea>
       <ows:PostalCode>80309-0449</ows:PostalCode>
       <ows:Country>USA</ows:Country>
       <ows:ElectronicMailAddress>nsidc@nsidc.org</ows:ElectronicMailAddress>
     </ows:Address>
     <ows:OnlineResource xlink:type="simple" xlink:href="http://nsidc.org"/>
    ▼<ows:HoursOfService>
       Our hours of operation are 9:00 A.M. to 5:00 P.M., U.S. Mountain Time, Monday through Friday. We are closed on most major United States
       holidays.
     </ows:HoursOfService>
     <ows:ContactInstructions>None.</ows:ContactInstructions>
   </ows:ContactInfo>
   <ows:Role>resourceProvider</ows:Role>
  </ows:ServiceContact>
 </ows:ServiceProvider>
▼<ows:OperationsMetadata>
 ▼<ows:Operation name="GetCapabilities">
   ▼<ows:DCP>
    ▼<ows:HTTP>
       <ows:Get xlink:type="simple" xlink:href="http://nsidc.org/cgi-bin/atlas_north?"/>
     </ows:HTTP>
   </ows:DCP>
```

GetCapabilities Request

```xml
▼<ows:Operation name="DescribeCoverage">
  ▼<ows:DCP>
    ▼<ows:HTTP>
        <ows:Get xlink:type="simple" xlink:href="http://nsidc.org/cgi-bin/atlas_north?"/>
      </ows:HTTP>
    </ows:DCP>
  ▼<ows:Parameter name="service">
      <ows:Value>WCS</ows:Value>
    </ows:Parameter>
  ▼<ows:Parameter name="version">
      <ows:Value>1.1.1</ows:Value>
    </ows:Parameter>
  ▼<ows:Parameter name="identifiers">
      <ows:Value>sea_ice_concentration_01</ows:Value>
      <ows:Value>sea_ice_concentration_02</ows:Value>
      <ows:Value>sea_ice_concentration_03</ows:Value>
      <ows:Value>sea_ice_concentration_04</ows:Value>
      <ows:Value>sea_ice_concentration_05</ows:Value>
      <ows:Value>sea_ice_concentration_06</ows:Value>
      <ows:Value>sea_ice_concentration_07</ows:Value>
      <ows:Value>sea_ice_concentration_08</ows:Value>
      <ows:Value>sea_ice_concentration_09</ows:Value>
      <ows:Value>sea_ice_concentration_10</ows:Value>
      <ows:Value>sea_ice_concentration_11</ows:Value>
      <ows:Value>sea_ice_concentration_12</ows:Value>
      <ows:Value>seasonal_snow_classification</ows:Value>
      <ows:Value>snow_extent_01</ows:Value>
      <ows:Value>snow_extent_02</ows:Value>
      <ows:Value>snow_extent_03</ows:Value>
      <ows:Value>snow_extent_04</ows:Value>
      <ows:Value>snow_extent_05</ows:Value>
      <ows:Value>snow_extent_06</ows:Value>
      <ows:Value>snow_extent_07</ows:Value>
      <ows:Value>snow_extent_08</ows:Value>
      <ows:Value>snow_extent_09</ows:Value>
      <ows:Value>snow_extent_10</ows:Value>
      <ows:Value>snow_extent_11</ows:Value>
      <ows:Value>snow_extent_12</ows:Value>
      <ows:Value>snow_water_equivalent_01</ows:Value>
      <ows:Value>snow_water_equivalent_02</ows:Value>
      <ows:Value>snow_water_equivalent_03</ows:Value>
      <ows:Value>snow_water_equivalent_04</ows:Value>
      <ows:Value>snow_water_equivalent_05</ows:Value>
      <ows:Value>snow_water_equivalent_06</ows:Value>
      <ows:Value>snow_water_equivalent_07</ows:Value>
      <ows:Value>snow_water_equivalent_08</ows:Value>
      <ows:Value>snow_water_equivalent_09</ows:Value>
      <ows:Value>snow_water_equivalent_10</ows:Value>
      <ows:Value>snow_water_equivalent_11</ows:Value>
```

GetCapabilities Request

GetCapabilities Request

```
▼<ows:Parameter name="InterpolationType">
   <ows:Value>NEAREST_NEIGHBOUR</ows:Value>
   <ows:Value>BILINEAR</ows:Value>
  </ows:Parameter>
▼<ows:Parameter name="format">
   <ows:Value>image/png</ows:Value>
   <ows:Value>image/tiff</ows:Value>
   <ows:Value>image/gif</ows:Value>
   <ows:Value>image/png; mode=24bit</ows:Value>
   <ows:Value>image/jpeg</ows:Value>
   <ows:Value>image/vnd.wap.wbmp</ows:Value>
  </ows:Parameter>
▼<ows:Parameter name="store">
   <ows:Value>false</ows:Value>
  </ows:Parameter>
▼<ows:Parameter name="GridBaseCRS">
   <ows:Value>urn:ogc:def:crs:epsg::4326</ows:Value>
  </ows:Parameter>
 </ows:Operation>
</ows:OperationsMetadata>
▼<Contents>
 ▼<CoverageSummary>
  ▼<ows:Title>
   Stroeve, J. and W. Meier. 1999, updated 2008. Sea Ice Trends and Climatologies from SMMR and SSM/I. Boulder, Colorado USA: National Snow and
   Ice Data Center. Digital media. Available at http://nsidc.org/data/smmr_ssmi_ancillary/monthly_means.html. Accessed 27 June 2008. Compiled
   from: Cavalieri, D., C. Parkinson, P. Gloersen, and H. J. Zwally. 1996. Sea ice concentrations from Nimbus-7 SMMR and DMSP SSM/I passive
   microwave data. Boulder, Colorado USA: National Snow and Ice Data Center. Digital media. Available at http://nsidc.org/data/nsidc-0051.html.
   Background: Monthly climatologies of sea ice concentration represent mean ice concentration percentages for each month over the entire time
   period 1979-2007, which is generated from passive microwave brightness temperature data derived from Nimbus-7 Scanning Multichannel
   Microwave Radiometer (SMMR) and Defense Meteorological Satellite Program (DMSP) -F8, -F11 and -F13 Special Sensor Microwave/Imager (SSM/I)
   radiances at a grid cell size of 25 x 25 km using the NASA Team algorithm developed by the Oceans and Ice Branch, Laboratory for
   Hydrospheric Processes at NASA Goddard Space Flight Center (GSFC). A threshold of 15 percent concentration has been applied to the monthly
   climatologies.
   </ows:Title>
```

GetCapabilities Request

```xml
▼<ows:Keywords>
    <ows:Keyword>Arctic</ows:Keyword>
    <ows:Keyword>Arctic Ocean</ows:Keyword>
    <ows:Keyword>Cryosphere</ows:Keyword>
    <ows:Keyword>Earth Science</ows:Keyword>
    <ows:Keyword>Northern Hemisphere</ows:Keyword>
    <ows:Keyword>Oceans</ows:Keyword>
    <ows:Keyword>Polar</ows:Keyword>
    <ows:Keyword>Sea Ice</ows:Keyword>
    <ows:Keyword>Sea Ice Concentration</ows:Keyword>
  </ows:Keywords>
▼<ows:BoundingBox crs="urn:ogc:def:crs:OGC::imageCRS" dimensions="2">
    <ows:LowerCorner>0 0</ows:LowerCorner>
    <ows:UpperCorner>316 332</ows:UpperCorner>
  </ows:BoundingBox>
▼<ows:BoundingBox crs="urn:ogc:def:crs:EPSG::32661" dimensions="2">
    <ows:LowerCorner>-3961770.085 -3961769.906</ows:LowerCorner>
    <ows:UpperCorner>3961769.894 4362961.971</ows:UpperCorner>
  </ows:BoundingBox>
▼<ows:WGS84BoundingBox dimensions="2">
    <ows:LowerCorner>-179.999998745864 34.9037152643753</ows:LowerCorner>
    <ows:UpperCorner>178.959571606408 53.7717181062498</ows:UpperCorner>
  </ows:WGS84BoundingBox>
  <SupportedFormat>image/tiff</SupportedFormat>
  <SupportedCRS>urn:ogc:def:crs:EPSG::32661</SupportedCRS>
  <SupportedCRS>urn:ogc:def:crs:EPSG::4326</SupportedCRS>
  <SupportedCRS>urn:ogc:def:crs:EPSG::3408</SupportedCRS>
  <SupportedCRS>urn:ogc:def:crs:EPSG::3410</SupportedCRS>
  <SupportedCRS>urn:ogc:def:crs:EPSG::3411</SupportedCRS>
  <SupportedCRS>urn:ogc:def:crs:EPSG::3413</SupportedCRS>
  <SupportedCRS>urn:ogc:def:crs:EPSG::3571</SupportedCRS>
  <SupportedCRS>urn:ogc:def:crs:EPSG::3572</SupportedCRS>
  <SupportedCRS>urn:ogc:def:crs:EPSG::3573</SupportedCRS>
  <SupportedCRS>urn:ogc:def:crs:EPSG::3574</SupportedCRS>
  <SupportedCRS>urn:ogc:def:crs:EPSG::3575</SupportedCRS>
  <SupportedCRS>urn:ogc:def:crs:EPSG::3576</SupportedCRS>
```

GetCapabilities Request

```
▼<CoverageSummary>
  ▼<ows:Title>
      Stroeve, J. and W. Meier. 1999, updated 2008. Sea Ice Trends and Climatologies from SMMR and SSM/I. Boulder, Colorado USA: National Snow and
      Ice Data Center. Digital media. Available at http://nsidc.org/data/smmr_ssmi_ancillary/monthly_means.html. Accessed 27 June 2008. Compiled
      from: Cavalieri, D., C. Parkinson, P. Gloersen, and H. J. Zwally. 1996. Sea ice concentrations from Nimbus-7 SMMR and DMSP SSM/I passive
      microwave data. Boulder, Colorado USA: National Snow and Ice Data Center. Digital media. Available at http://nsidc.org/data/nsidc-0051.html.
      Background: Monthly climatologies of sea ice concentration represent mean ice concentration percentages for each month over the entire time
      period 1979-2007, which is generated from passive microwave brightness temperature data derived from Nimbus-7 Scanning Multichannel
      Microwave Radiometer (SMMR) and Defense Meteorological Satellite Program (DMSP) -F8, -F11 and -F13 Special Sensor Microwave/Imager (SSM/I)
      radiances at a grid cell size of 25 x 25 km using the NASA Team algorithm developed by the Oceans and Ice Branch, Laboratory for
      Hydrospheric Processes at NASA Goddard Space Flight Center (GSFC). A threshold of 15 percent concentration has been applied to the monthly
      climatologies.
  </ows:Title>
  ▼<ows:Abstract>
      Stroeve, J. and W. Meier. 1999, updated 2008. Sea Ice Trends and Climatologies from SMMR and SSM/I. Boulder, Colorado USA: National Snow and
      Ice Data Center. Digital media. Available at http://nsidc.org/data/smmr_ssmi_ancillary/monthly_means.html. Accessed 27 June 2008. Compiled
      from: Cavalieri, D., C. Parkinson, P. Gloersen, and H. J. Zwally. 1996. Sea ice concentrations from Nimbus-7 SMMR and DMSP SSM/I passive
      microwave data. Boulder, Colorado USA: National Snow and Ice Data Center. Digital media. Available at http://nsidc.org/data/nsidc-0051.html.
      Background: Monthly climatologies of sea ice concentration represent mean ice concentration percentages for each month over the entire time
      period 1979-2007, which is generated from passive microwave brightness temperature data derived from Nimbus-7 Scanning Multichannel
      Microwave Radiometer (SMMR) and Defense Meteorological Satellite Program (DMSP) -F8, -F11 and -F13 Special Sensor Microwave/Imager (SSM/I)
      radiances at a grid cell size of 25 x 25 km using the NASA Team algorithm developed by the Oceans and Ice Branch, Laboratory for
      Hydrospheric Processes at NASA Goddard Space Flight Center (GSFC). A threshold of 15 percent concentration has been applied to the monthly
      climatologies.
  </ows:Abstract>
  <Identifier>sea_ice_concentration_02</Identifier>
  ▼<ows:Keywords>
      <ows:Keyword>Arctic</ows:Keyword>
      <ows:Keyword>Arctic Ocean</ows:Keyword>
      <ows:Keyword>Cryosphere</ows:Keyword>
      <ows:Keyword>Earth Science</ows:Keyword>
      <ows:Keyword>Northern Hemisphere</ows:Keyword>
      <ows:Keyword>Oceans</ows:Keyword>
      <ows:Keyword>Polar</ows:Keyword>
      <ows:Keyword>Sea Ice</ows:Keyword>
      <ows:Keyword>Sea Ice Concentration</ows:Keyword>
  </ows:Keywords>
  ▼<ows:BoundingBox crs="urn:ogc:def:crs:OGC::imageCRS" dimensions="2">
      <ows:LowerCorner>0 0</ows:LowerCorner>
      <ows:UpperCorner>316 332</ows:UpperCorner>
  </ows:BoundingBox>
```

GetCapabilities Request

```xml
▼<ows:WGS84BoundingBox dimensions="2">
    <ows:LowerCorner>-179.999998745864 34.9037152643753</ows:LowerCorner>
    <ows:UpperCorner>178.959571606408 53.7717181062498</ows:UpperCorner>
  </ows:WGS84BoundingBox>
  <SupportedFormat>image/tiff</SupportedFormat>
  <SupportedCRS>urn:ogc:def:crs:EPSG::32661</SupportedCRS>
  <SupportedCRS>urn:ogc:def:crs:EPSG::4326</SupportedCRS>
  <SupportedCRS>urn:ogc:def:crs:EPSG::3408</SupportedCRS>
  <SupportedCRS>urn:ogc:def:crs:EPSG::3410</SupportedCRS>
  <SupportedCRS>urn:ogc:def:crs:EPSG::3411</SupportedCRS>
  <SupportedCRS>urn:ogc:def:crs:EPSG::3413</SupportedCRS>
  <SupportedCRS>urn:ogc:def:crs:EPSG::3571</SupportedCRS>
  <SupportedCRS>urn:ogc:def:crs:EPSG::3572</SupportedCRS>
  <SupportedCRS>urn:ogc:def:crs:EPSG::3573</SupportedCRS>
  <SupportedCRS>urn:ogc:def:crs:EPSG::3574</SupportedCRS>
  <SupportedCRS>urn:ogc:def:crs:EPSG::3575</SupportedCRS>
  <SupportedCRS>urn:ogc:def:crs:EPSG::3576</SupportedCRS>
  <SupportedCRS>urn:ogc:def:crs:EPSG::3973</SupportedCRS>
  <SupportedCRS>urn:ogc:def:crs:EPSG::3975</SupportedCRS>
  <SupportedCRS>urn:ogc:def:crs:EPSG::32624</SupportedCRS>
  <SupportedCRS>urn:ogc:def:crs:EPSG::3857</SupportedCRS>
  <SupportedCRS>urn:ogc:def:crs:EPSG::900913</SupportedCRS>
</CoverageSummary>
▼<CoverageSummary>
  ▼<ows:Title>
    Stroeve, J. and W. Meier. 1999, updated 2008. Sea Ice Trends and Climatologies from SMMR and SSM/I. Boulder, Colorado USA: National Snow and
    Ice Data Center. Digital media. Available at http://nsidc.org/data/smmr_ssmi_ancillary/monthly_means.html. Accessed 27 June 2008. Compiled
    from: Cavalieri, D., C. Parkinson, P. Gloersen, and H. J. Zwally. 1996. Sea ice concentrations from Nimbus-7 SMMR and DMSP SSM/I passive
    microwave data. Boulder, Colorado USA: National Snow and Ice Data Center. Digital media. Available at http://nsidc.org/data/nsidc-0051.html.
    Background: Monthly climatologies of sea ice concentration represent mean ice concentration percentages for each month over the entire time
    period 1979-2007, which is generated from passive microwave brightness temperature data derived from Nimbus-7 Scanning Multichannel
    Microwave Radiometer (SMMR) and Defense Meteorological Satellite Program (DMSP) -F8, -F11 and -F13 Special Sensor Microwave/Imager (SSM/I)
    radiances at a grid cell size of 25 x 25 km using the NASA Team algorithm developed by the Oceans and Ice Branch, Laboratory for
    Hydrospheric Processes at NASA Goddard Space Flight Center (GSFC). A threshold of 15 percent concentration has been applied to the monthly
    climatologies.
  </ows:Title>
```

GetCapabilities Request

```xml
▼<ows:Abstract>
    Bamber, J.L., R.L. Layberry, S.P. Gogenini. 2001. A new ice thickness and bed data set for the Greenland ice sheet 1: Measurement, data
    reduction, and errors. Journal of Geophysical Research. 106(D24): 33773-33780. Data provided by the National Snow and Ice Data Center DAAC,
    University of Colorado, Boulder, CO, USA. Available at http://nsidc.org/data/nsidc-0092.html. 25 October 2006. Bamber, J.L., R.L. Layberry,
    S.P. Gogenini. 2001. A new ice thickness and bed data set for the Greenland ice sheet 2: Relationship between dynamics and basal topography.
    Journal of Geophysical Research. 106(D24): 33781-33788. Data provided by the National Snow and Ice Data Center DAAC, University of Colorado,
    Boulder, CO, USA. Available at http://nsidc.org/data/nsidc-0092.html. 25 October 2006. Background: Digital Elevation Model (DEM) data are a
    combination of European Remote-Sensing (ERS-1) and Geosat satellite radar altimetry data, Airborne Topographic Mapper (ATM) data, and
    photogrammetric digital height data.
</ows:Abstract>
 <Identifier>greenland_elevation</Identifier>
▼<ows:Keywords>
    <ows:Keyword>Cryosphere</ows:Keyword>
    <ows:Keyword>Earth Science</ows:Keyword>
    <ows:Keyword>Greenland</ows:Keyword>
    <ows:Keyword>Ice Sheets</ows:Keyword>
    <ows:Keyword>Ice Sheet Elevation</ows:Keyword>
    <ows:Keyword>Polar</ows:Keyword>
 </ows:Keywords>
▼<ows:BoundingBox crs="urn:ogc:def:crs:OGC::imageCRS" dimensions="2">
    <ows:LowerCorner>0 0</ows:LowerCorner>
    <ows:UpperCorner>599 638</ows:UpperCorner>
 </ows:BoundingBox>
▼<ows:BoundingBox crs="urn:ogc:def:crs:EPSG::32661" dimensions="2">
    <ows:LowerCorner>-825267.555 -1151631.237</ows:LowerCorner>
    <ows:UpperCorner>2173789.735 2041572.863</ows:UpperCorner>
 </ows:BoundingBox>
▼<ows:WGS84BoundingBox dimensions="2">
    <ows:LowerCorner>-179.12303011456 63.0415709487752</ows:LowerCorner>
    <ows:UpperCorner>179.982766500967 82.4151433839318</ows:UpperCorner>
 </ows:WGS84BoundingBox>
 <SupportedFormat>image/tiff</SupportedFormat>
 <SupportedCRS>urn:ogc:def:crs:EPSG::32661</SupportedCRS>
 <SupportedCRS>urn:ogc:def:crs:EPSG::4326</SupportedCRS>
 <SupportedCRS>urn:ogc:def:crs:EPSG::3408</SupportedCRS>
 <SupportedCRS>urn:ogc:def:crs:EPSG::3410</SupportedCRS>
 <SupportedCRS>urn:ogc:def:crs:EPSG::3411</SupportedCRS>
 <SupportedCRS>urn:ogc:def:crs:EPSG::3413</SupportedCRS>
 <SupportedCRS>urn:ogc:def:crs:EPSG::3571</SupportedCRS>
 <SupportedCRS>urn:ogc:def:crs:EPSG::3572</SupportedCRS>
 <SupportedCRS>urn:ogc:def:crs:EPSG::3573</SupportedCRS>
 <SupportedCRS>urn:ogc:def:crs:EPSG::3574</SupportedCRS>
 <SupportedCRS>urn:ogc:def:crs:EPSG::3575</SupportedCRS>
```

KVP for DescribeCoverage Request

Name	Definition	Data Type	Multiplicity
service	Identifier of the OGC service	String, fixed to "WCS"	One (mandatory)
version	Request protocol version	String	One (mandatory)
request	Request type name	String, fixed to "DescribeCoverage"	One (mandatory)
coverageId	List of coverage identifiers to be described	Comma-separated NCName list	One (mandatory)

DescribeCoverage Request

http://nsidc.org/cgi-bin/atlas_north?
    service=WCS&
    request=DescribeCoverage&
    VERSION=1.1.1&
    COVERAGE=snow_extent_01

This XML file does not appear to have any style information associated with it. The document tree is shown below.

```
▼<CoverageDescriptions xmlns="http://www.opengis.net/wcs/1.1" xmlns:ows="http://www.opengis.net/ows" xmlns:xlink="http://www.w3.org/1999/xlink"
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xmlns:ogc="http://www.opengis.net/ogc" version="1.1.1">
  ▼<CoverageDescription>
    ▼<ows:Title>
        Armstrong, R. L., and M. J. Brodzik. 2005. Northern Hemisphere EASE-Grid weekly snow cover and sea ice extent version 3. Boulder, CO, USA:
        National Snow and Ice Data Center. Digital media. Available at http://nsidc.org/data/nsidc-0046.html. 02 August 2006. Background: Snow cover
        extent is based on the digital NOAA-NESDIS Weekly Northern Hemisphere Snow Charts, revised by D. Robinson (Rutgers University)
        (http://climate.rutgers.edu/snowcover/) and regridded to the EASE-Grid. The original NOAA-NESDIS weekly snow charts are derived from the
        manual interpretation of AVHRR, GOES, and other visible-band satellite data.
      </ows:Title>
    ▼<ows:Abstract>
        Armstrong, R. L., and M. J. Brodzik. 2005. Northern Hemisphere EASE-Grid weekly snow cover and sea ice extent version 3. Boulder, CO, USA:
        National Snow and Ice Data Center. Digital media. Available at http://nsidc.org/data/nsidc-0046.html. 02 August 2006. Background: Snow cover
        extent is based on the digital NOAA-NESDIS Weekly Northern Hemisphere Snow Charts, revised by D. Robinson (Rutgers University)
        (http://climate.rutgers.edu/snowcover/) and regridded to the EASE-Grid. The original NOAA-NESDIS weekly snow charts are derived from the
        manual interpretation of AVHRR, GOES, and other visible-band satellite data.
      </ows:Abstract>
      <Identifier>snow_extent_01</Identifier>
    ▼<ows:Keywords>
        <ows:Keyword>Arctic</ows:Keyword>
        <ows:Keyword>Cryosphere</ows:Keyword>
        <ows:Keyword>Earth Science</ows:Keyword>
        <ows:Keyword>Northern Hemisphere</ows:Keyword>
```

Link

KVP for GetCoverage Request

Name	Definition	Data Type	Multiplicity
service	Identifier of the OGC service	String, fixed to "WCS"	One (mandatory)
version	Request protocol version	String	One (mandatory)
request	Request type name	String, fixed to "DescribeCoverage"	One (mandatory)
coverageId	Identifier of coverage to be inspected	NCName	One (mandatory)
subset	boundaries of coverage subset	subsetSpec as defined in Requierement 7	Zero or more (optional)

GetCoverage Request

- Sample WCS GetCoverage request for the NSIDC Atlas of the Cryosphere

  http://nsidc.org/cgi-bin/atlas_north?

  service=WCS&

  request=GetCoverage&

  VERSION=1.1.1&

  COVERAGE=snow_extent_01&

  CRS=urn:ogc:def:crs:EPSG::4326&

  BBOX=-179.855268310333,-89.3181405304869,178.996024534873,89.5930272089838&

  FORMAT=image/tiff&

  WIDTH=1000& HEIGHT=1000

Link

Web Processing Service (**WPS**)

- A Web Processing Service (WPS) provides access to **calculations or models** which operate **on spatially referenced data**.

- A WPS can be configured **to offer** any sort of Geographic Information System (GIS) **functionality to clients across a network**.

- The WPS standard provides a mechanism to identify the spatially-referenced data required by the **calculation**, to **initiate** the calculation, and to **manage** the **output** from the calculation so that it can be accessed by the client.

WPS

- A WPS may offer calculations as simple as **subtracting one** set of spatially referenced numbers from another

- Or as complicated as a global climate change model.

- The data required by the WPS can be delivered across a network or available at the server, and can use data identification and exchange standards that include *Geography Markup Language (**GML**)*, a *Table Joining Service (**TJS**) or Catalogue Services for the Web (**CSW**)*.

WPS Model Interface
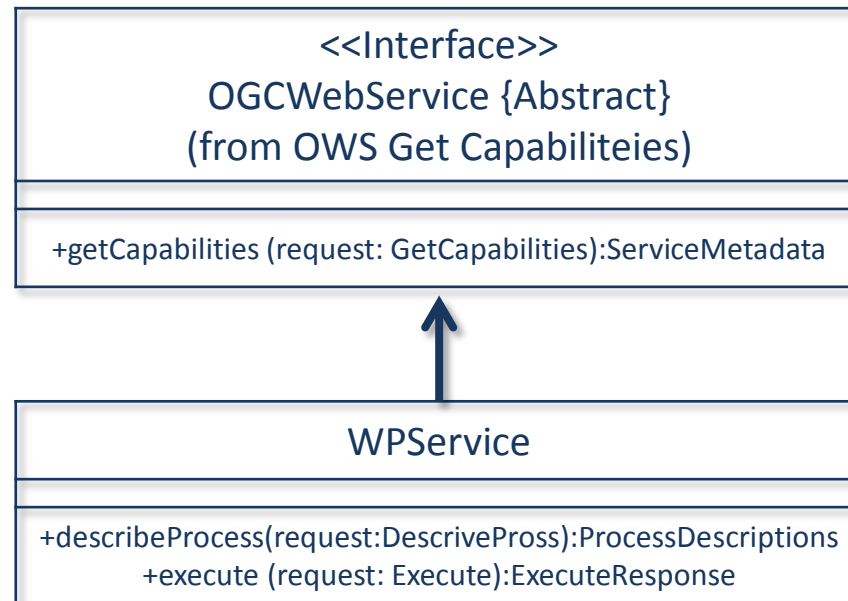
WPS Conceptual Model
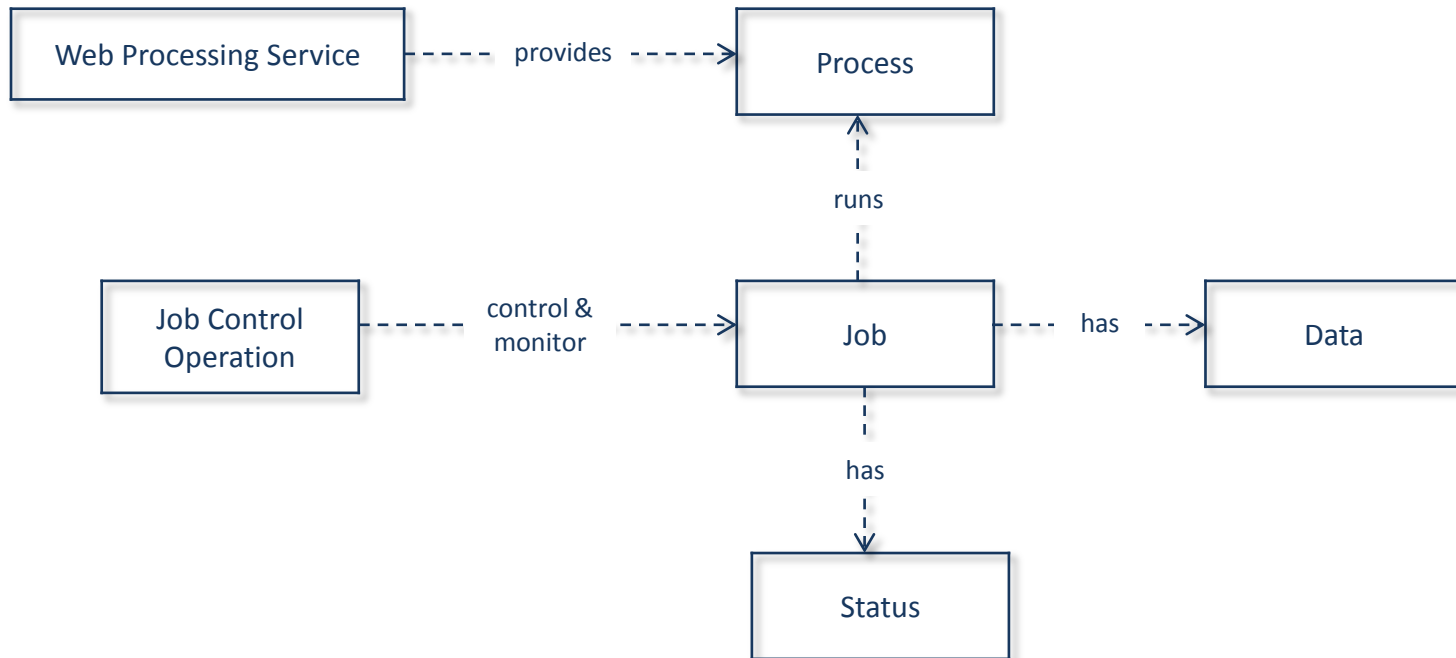
WPS Operations

The WPS standard includes three mandatory operations that can be requested by a client and performed by a WPS server.

These operations can be accessed using HTTP GET and HTTP POST. They are:

- *GetCapabilities*– allows a client to request and receive service metadata (or capabilities) documents that describe the abilities of the specific server implementation and to list the processes it can execute.

- *DescribeProcess*– allows a client to request **and receive detailed information about the processes** that can be run on the service instance, including the **inputs required**, their **allowable formats**, and the **outputs** that can be produced. It provides a means for a client to determine what **the mandatory, optional, and default parameters** are for a particular process, as well as the format of the data inputs and outputs.

- *Execute*– allows a client to run a specified process implemented by the WPS, using **input parameter** values specified by the client. These input values must be identified, as defined in the Process Description, and these values may be **references to datasets accessible via the Internet**.

GetCapabilities Request (1)

http://wps1.lutraconsulting.co.uk/wps.py?

Service=WPS&

Request=GetCapabilities

This XML file does not appear to have any style information associated with it. The document tree is shown below.

```
▼<wps:Capabilities xmlns:xlink="http://www.w3.org/1999/xlink" xmlns:wps="http://www.opengis.net/wps/1.0.0"
 xmlns:ows="http://www.opengis.net/ows/1.1" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" service="WPS" version="1.0.0" xml:lang="en-CA"
 xsi:schemaLocation="http://www.opengis.net/wps/1.0.0 http://schemas.opengis.net/wps/1.0.0/wpsGetCapabilities_response.xsd" updateSequence="1">
 ▼<ows:ServiceIdentification>
    <ows:Title>Lutra Consulting PyWPS Server</ows:Title>
  ▼<ows:Abstract>
     See http://pywps.wald.intevation.org and http://www.opengeospatial.org/standards/wps
    </ows:Abstract>
  ▼<ows:Keywords>
     <ows:Keyword>GRASS</ows:Keyword>
     <ows:Keyword>GIS</ows:Keyword>
     <ows:Keyword>WPS</ows:Keyword>
    </ows:Keywords>
    <ows:ServiceType>WPS</ows:ServiceType>
    <ows:ServiceTypeVersion>1.0.0</ows:ServiceTypeVersion>
    <ows:Fees>None</ows:Fees>
    <ows:AccessConstraints>none</ows:AccessConstraints>
  </ows:ServiceIdentification>
 ▼<ows:ServiceProvider>
    <ows:ProviderName>Lutra Consulting</ows:ProviderName>
    <ows:ProviderSite xlink:href="http://www.lutraconsulting.co.uk"/>
  ▼<ows:ServiceContact>
   ▼<ows:ContactInfo>
     ▼<ows:Address>
        <ows:Country>UK</ows:Country>
        <ows:ElectronicMailAddress>info@lutraconsulting.co.uk</ows:ElectronicMailAddress>
      </ows:Address>
      <ows:OnlineResource xlink:href="http://www.lutraconsulting.co.uk"/>
      <ows:HoursOfService>0:00-24:00</ows:HoursOfService>
      <ows:ContactInstructions>none</ows:ContactInstructions>
     </ows:ContactInfo>
    </ows:ServiceContact>
   </ows:ServiceProvider>
```

Link

GetCapabilities Request (2)

http://cida.usgs.gov/gdp/process/WebProcessingService?

Service=WPS&

Request=GetCapabilities

This XML file does not appear to have any style information associated with it. The document tree is shown below.

```
▼<wps:Capabilities xmlns:xlink="http://www.w3.org/1999/xlink" xmlns:wps="http://www.opengis.net/wps/1.0.0"
  xmlns:ows="http://www.opengis.net/ows/1.1" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" service="WPS" version="1.0.0" xml:lang="en-US"
  xsi:schemaLocation="http://www.opengis.net/wps/1.0.0 http://schemas.opengis.net/wps/1.0.0/wpsGetCapabilities_response.xsd" updateSequence="1">
  ▼<ows:ServiceIdentification>
      <ows:Title>Geo Data Portal WPS Processing</ows:Title>
      <ows:Abstract>Geo Data Portal WPS Processing</ows:Abstract>
    ▼<ows:Keywords>
        <ows:Keyword>WPS</ows:Keyword>
        <ows:Keyword>AAFC</ows:Keyword>
        <ows:Keyword>geospatial</ows:Keyword>
        <ows:Keyword>geoprocessing</ows:Keyword>
      </ows:Keywords>
      <ows:ServiceType>WPS</ows:ServiceType>
      <ows:ServiceTypeVersion>1.0.0</ows:ServiceTypeVersion>
      <ows:ServiceTypeVersion>0.4.0</ows:ServiceTypeVersion>
      <ows:Fees>NONE</ows:Fees>
      <ows:AccessConstraints>NONE</ows:AccessConstraints>
    </ows:ServiceIdentification>
  ▼<ows:ServiceProvider>
      <ows:ProviderName>CIDA</ows:ProviderName>
      <ows:ProviderSite xlink:href="http://cida.usgs.gov/"/>
    ▼<ows:ServiceContact>
        <ows:IndividualName>Tom Kunicki</ows:IndividualName>
        <ows:PositionName>Technical Lead</ows:PositionName>
      ▼<ows:ContactInfo>
        ▼<ows:Phone>
            <ows:Voice>608-821-3851</ows:Voice>
            <ows:Facsimile/>
          </ows:Phone>
```

Link

DescribeProcess Request (1)

wps1.lutraconsulting.co.uk/wps.py?

    Service=WPS&

    Version=1.0.0&

    Request=DescribeProcess&

    Identifier=simple_grass

```xml
▼<wps:ProcessDescriptions xmlns:wps="http://www.opengis.net/wps/1.0.0" xmlns:ows="http://www.opengis.net/ows/1.1"
  xmlns:xlink="http://www.w3.org/1999/xlink" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xsi:schemaLocation="http://www.opengis.net/wps/1.0.0 http://schemas.opengis.net/wps/1.0.0/wpsDescribeProcess_response.xsd" service="WPS"
  version="1.0.0" xml:lang="en-CA">
  ▼<ProcessDescription wps:processVersion="0.1" storeSupported="true" statusSupported="true">
    <ows:Identifier>simple_grass</ows:Identifier>
    <ows:Title>Grass Proof of Concept</ows:Title>
    <ows:Abstract>Pete's simple grass sandpit</ows:Abstract>
  ▼<DataInputs>
    ▼<Input minOccurs="1" maxOccurs="1">
      <ows:Identifier>drain_x</ows:Identifier>
      <ows:Title>Drain point x</ows:Title>
    ▼<LiteralData>
        <ows:DataType ows:reference="http://www.w3.org/TR/xmlschema-2/#integer">integer</ows:DataType>
        <ows:AnyValue/>
      </LiteralData>
    </Input>
    ▼<Input minOccurs="1" maxOccurs="1">
      <ows:Identifier>drain_y</ows:Identifier>
      <ows:Title>Drain point y</ows:Title>
    ▼<LiteralData>
        <ows:DataType ows:reference="http://www.w3.org/TR/xmlschema-2/#integer">integer</ows:DataType>
        <ows:AnyValue/>
      </LiteralData>
    </Input>
```

[Link](#)

DescribeProcess Request (2)

DescribeProcess Operation

http://cida.usgs.gov/gdp/process/WebProcessingService?

Service=WPS&

Version=1.0.0&

Request=DescribeProcess&

Identifier=gov.usgs.cida.gdp.wps.algorithm.FeatureCategoricalGridCoverageAlgorithm

This XML file does not appear to have any style information associated with it. The document tree is shown below.

```
▼<wps:ProcessDescriptions xmlns:wps="http://www.opengis.net/wps/1.0.0" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xmlns:ows="http://www.opengis.net/ows/1.1" xsi:schemaLocation="http://www.opengis.net/wps/1.0.0
  http://schemas.opengis.net/wps/1.0.0/wpsDescribeProcess_response.xsd" xml:lang="en-US" service="WPS" version="1.0.0">
  ▼<ProcessDescription statusSupported="true" storeSupported="true" wps:processVersion="1.0.0">
    ▼<ows:Identifier>
      gov.usgs.cida.gdp.wps.algorithm.FeatureCategoricalGridCoverageAlgorithm
      </ows:Identifier>
      <ows:Title>Categorical Coverage Fraction</ows:Title>
    ▼<ows:Abstract>
      This processing service is used with categorical gridded data to assess the percent coverage of each category for a set of features. This
      service does not process gridded time series. Using the feature dataset bounding-box, a subset of the gridded dataset is requested from the
      remote gridded data server. The location of each grid-cell center is then projected to the feature dataset coordinate reference system. For
      each grid-cell in the subsetted grid, the grid-cell center is tested for inclusion in each feature in the feature dataset. If the grid-cell
      center is in a given feature, the count for that cell's category is incremented for that feature. After all the grid-cell centers are
      processed the coverage fraction for each category is calculated for each feature.
      </ows:Abstract>
    ▼<DataInputs>
      ▼<Input minOccurs="1" maxOccurs="1">
        <ows:Identifier>DATASET_URI</ows:Identifier>
        <ows:Title>Dataset URI</ows:Title>
        ▼<ows:Abstract>
          The base data web service URI for the dataset of interest.
          </ows:Abstract>
        ▼<LiteralData>
          <ows:DataType ows:reference="xs:anyURI"/>
          <ows:AnyValue/>
          </LiteralData>
        </Input>
```

[Link](#)

GeoPortal

Geoportal

ESRI (2004) defines a GIS portal as "a single point of access to spatial information, regardless of the location, format, or structure of the data source".

OGC (2004) defines a geoportal as "a human interface to a collection of online geospatial information resources, including data sets and services".

Maguire and Longley (2005) define a geoportal as "a World Wide Web gateway that organize content and services such as directories, search tools, community information, support resources, data and applications".

Tait (2005) defines a geoportal as "a Web site considered to be an entry point to geographic content on the Web or, more simply, a Web site where geographic content can be discovered".

Geoportal

A geoportal is a gateway to Web-based geospatial resources, enabling users to
- discover,
- view and
- access geospatial information
- and services made available by their providing organizations.

Likewise, data providers can use the geoportal to make their geospatial resources discoverable, and accessible to others

Geoportal

- **Portal Services** – Provide the single point access to the geospatial information on the portal. In addition, these services provide the management and administration of the portal.

- **Catalog Services** – Used to locate geospatial services and information wherever it is located and provide information on the services and information if finds to the user.

- **Portrayal Services** – Used to process the geospatial information and prepare it for presentation to the user.

- **Data Services** – Used to provide geospatial content and data processing.

Geoportal

Provides access to data and metadata

Components:
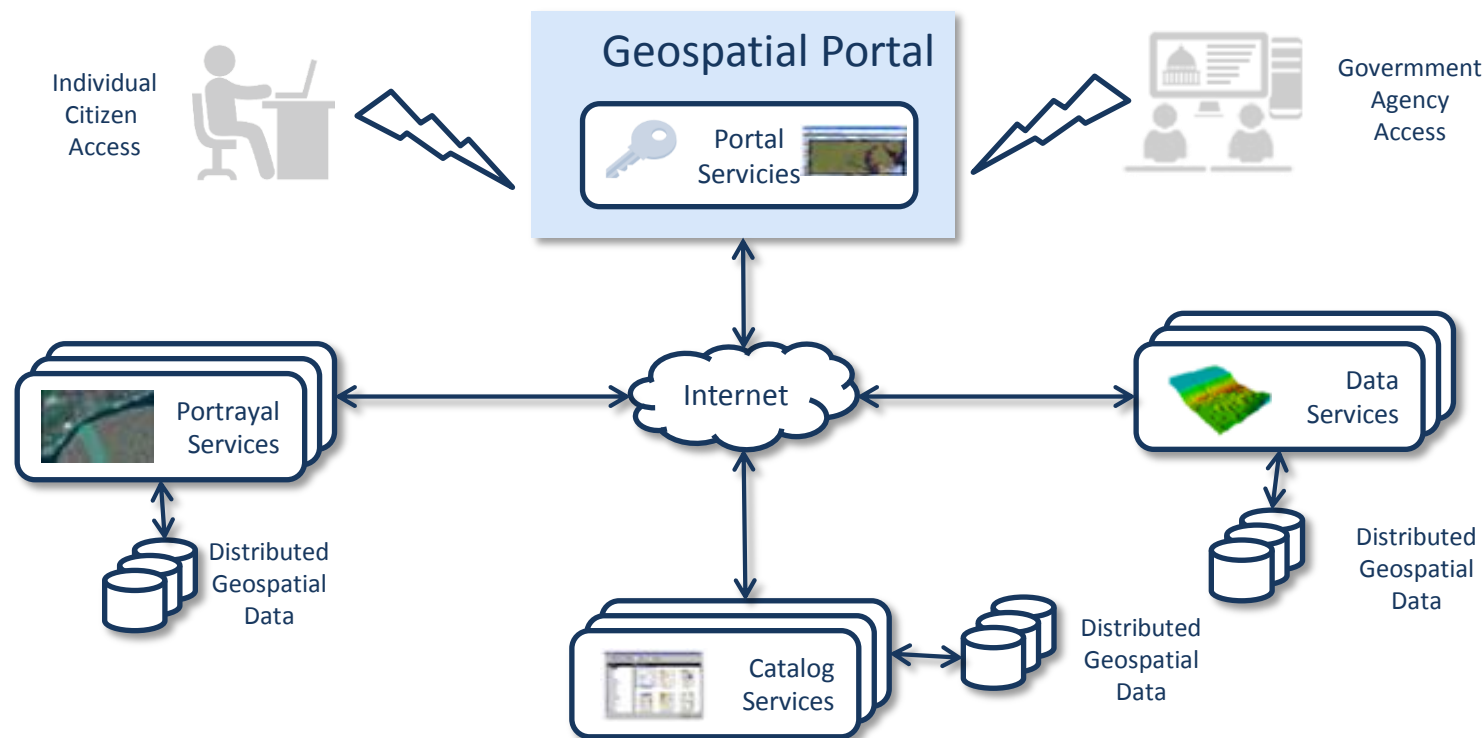
Geoportals Associated With SDI

- They create and maintain indexes or catalogs of metadata that describe the nature and the location of resources in an SDI.

- Resource owners (or service providers) register their services at the portal and supply metadata descriptions.

- The portal arranges metadata records from service providers into a consistent, searchable catalog and makes this catalog available to users.

- Through the catalog, users can search for services coming from any of the registered service providers.

Geoportals Associated With SDI

- Application portals provide more structured interfaces that include specific tools and applications relevant to user's domain interests.

- Application portals provide Web mapping tools to allow users to view and work with the data they find

Examples

- Chile
  - http://www.geoportal.cl/geoportal/

- INSPIRE
  - http://inspire-geoportal.ec.europa.eu/
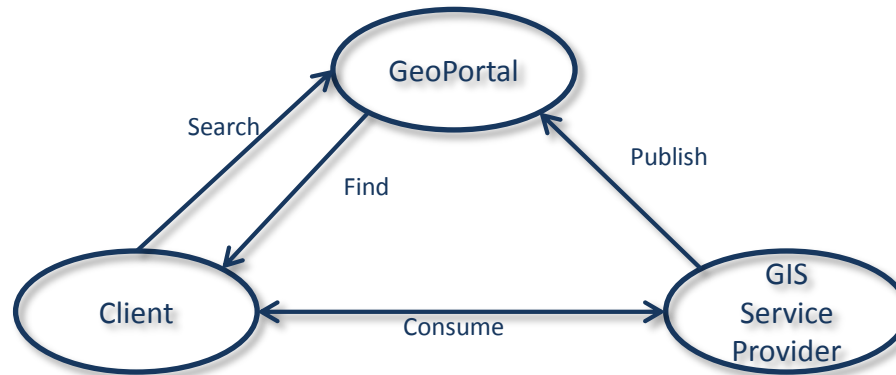
- España
  - http://www.idee.es/

Implementing Geoservices

- Considerations
  - IT
    - Key technology
    - Architectural design
  - Information
  - Service type

Best Practices

- Open source / commercial

- Prefer Enterprise GeoDatabase vs flat files

- Always use spatial indexes

- Three tier approach
  - Separate
    - *Back end*: Database server
    - *Front end*: Application server
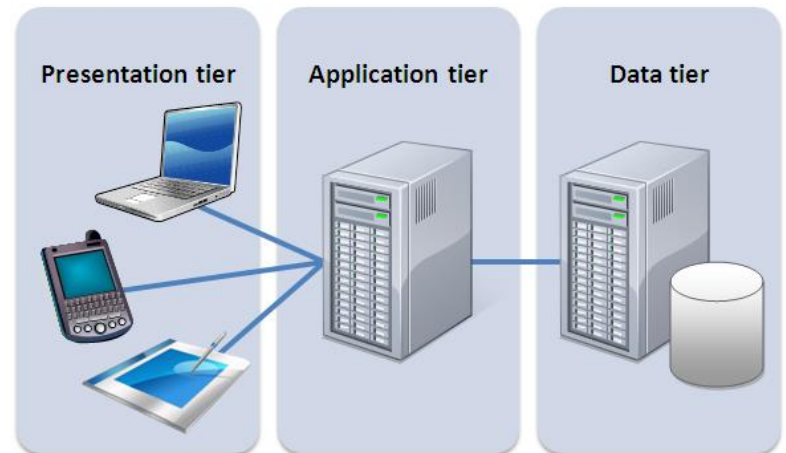
Try to generalize features
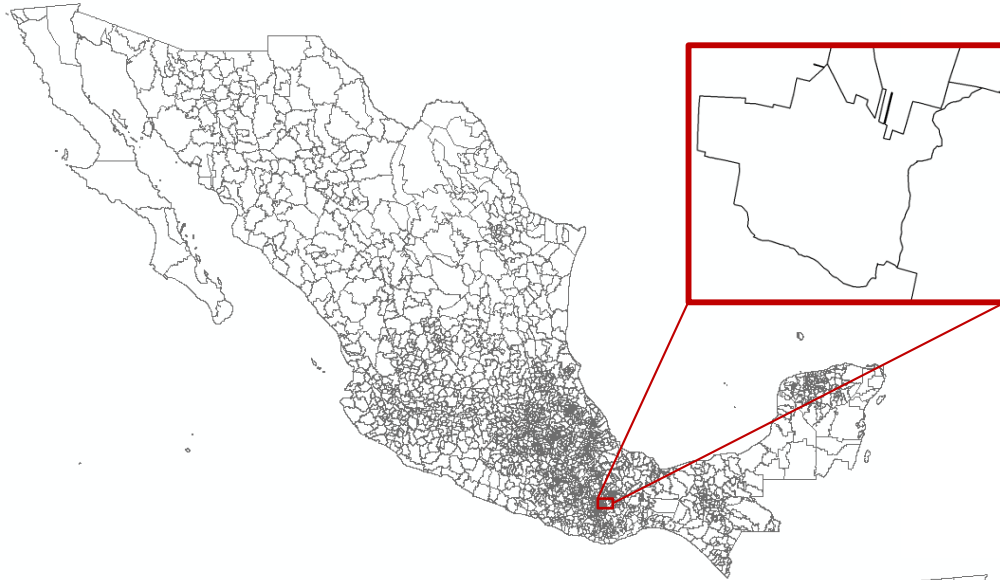
Hi-res feature
Size: 51 MB

Low-res
size: 10 Mb
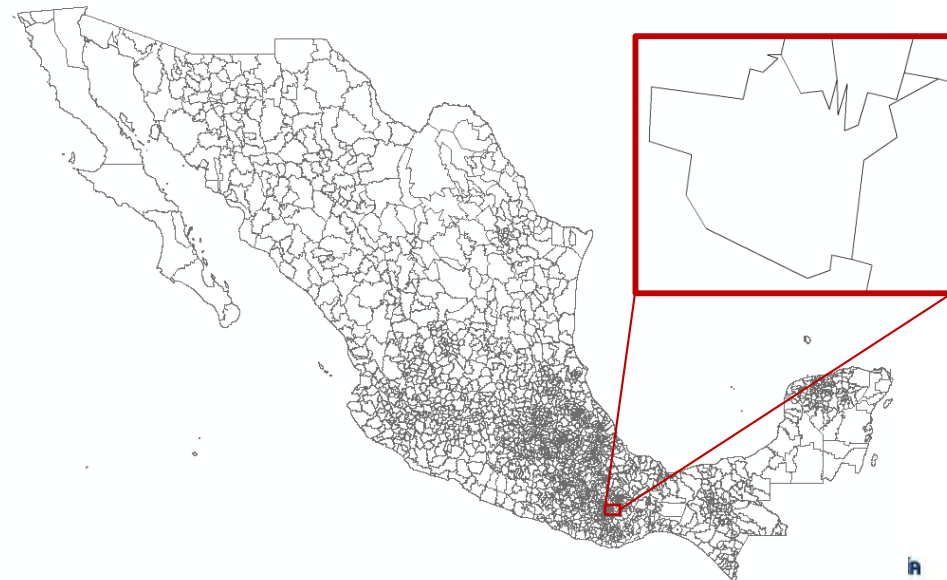
Select by attributes
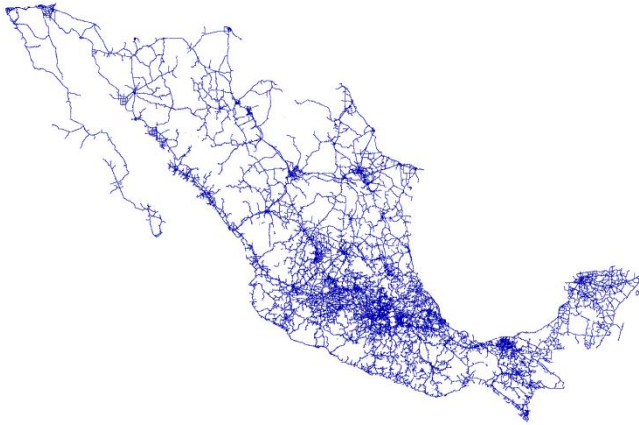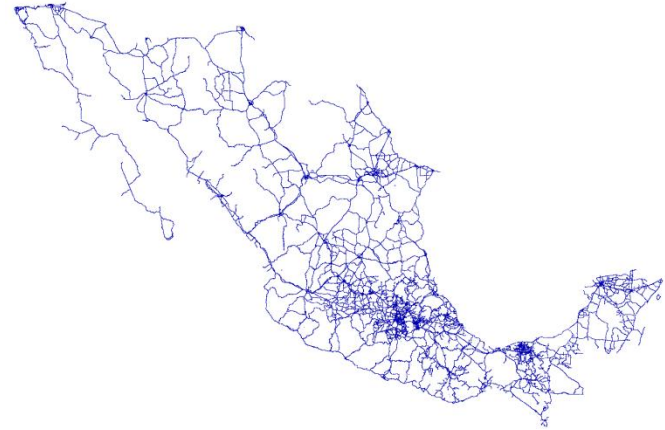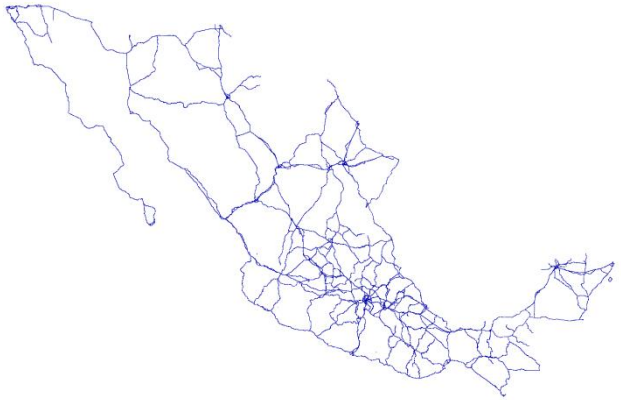
Best Practices

- Identify the main purpose of the map
  - Browse
  - Turn on/off layers
  - Scale free
  - Speed
  - Disk space requirement

Best Practices

- Identify the main use of the map
  - Browse ✅
  - Turn on/off layers ✅
  - Scale free ✅
  - Speed *Slow*
  - Disk space requirement *Low*

Best Practices

- Identify the main use of the map
  - Browse
  - Turn on/off layers
  - Scale free *Pre-defined scales*
  - Speed *Fast*
  - Disk space requirement *High*

WMTS

Software

- WMS
  - Mapserver
  - GeoServer
  - mapnik

- WMTS
  - TileCache
  - GeoWebCache

Software

- **WFS**
  - Mapserver
  - GeoServer

- **WPS**
  - 52 North WPS
  - zoo-project

Software

- WCS
  - Mapserver
  - GeoServer
  - Grass

MAPA DIGITAL DE MÉXICO
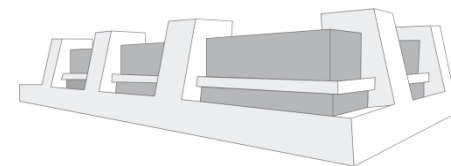
Mapa Digital de México Plataform
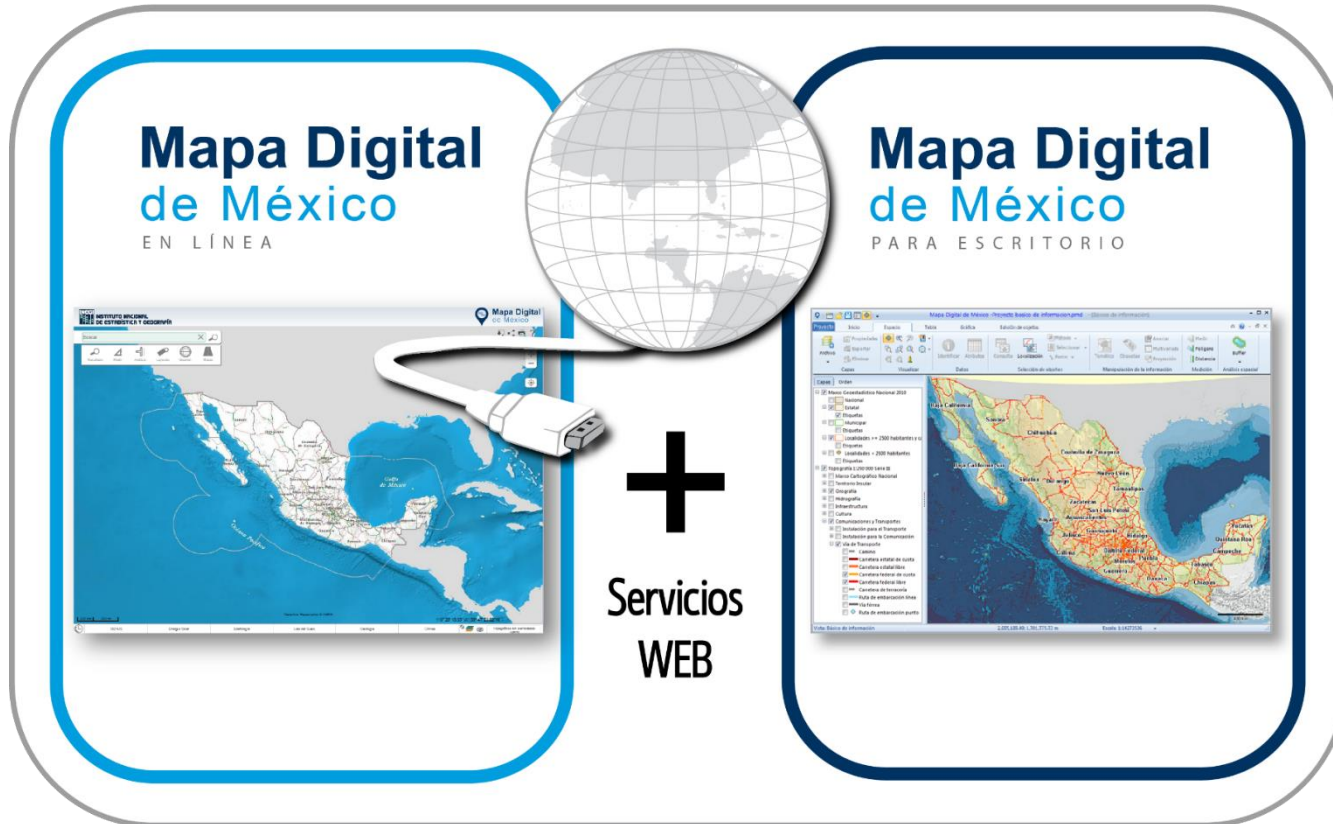
Mapa Digital de México

PARA ESCRITORIO

Desktop version

Mapa Digital de México
PARA ESCRITORIO

Geographic Information System for desktop that is developed to promote and facilitate the **integration**, interpretation, analysis and use of geographic and national statistics.
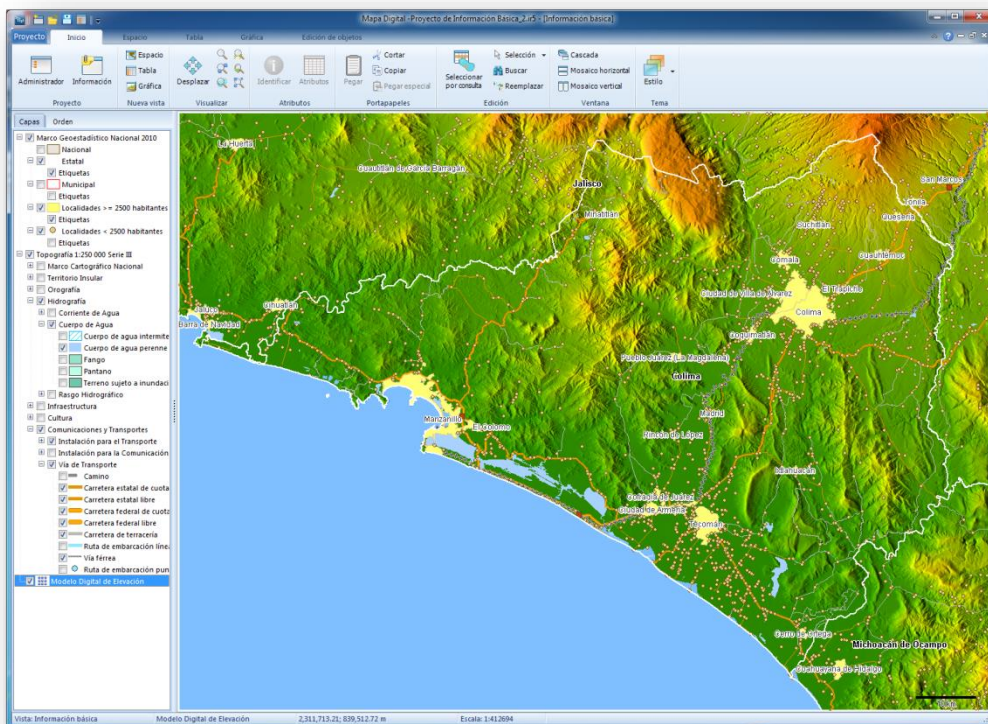
Main Users:

- Researchers
- College students
- People with experience in data analysis

Capabilities

Spatial analysis
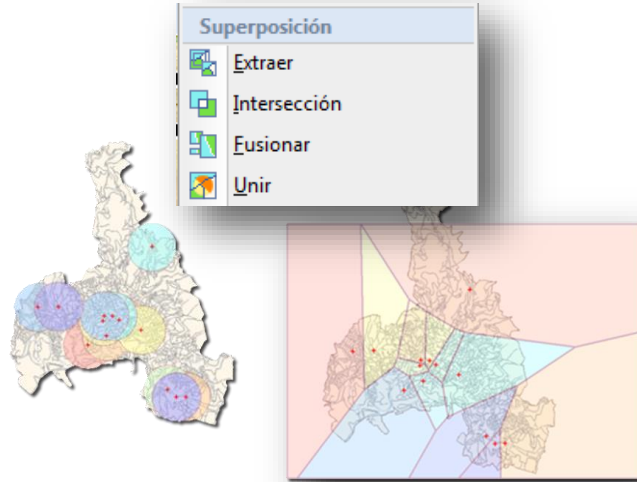
Integrate geographic, demographic and socio-economic information
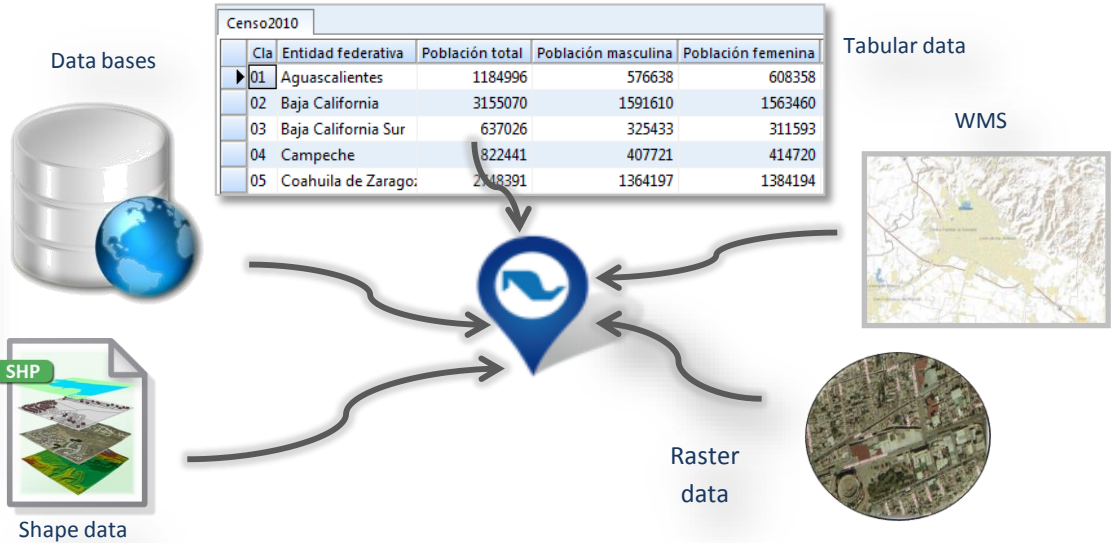
Attach document in a variaty of formats

Build own data layers
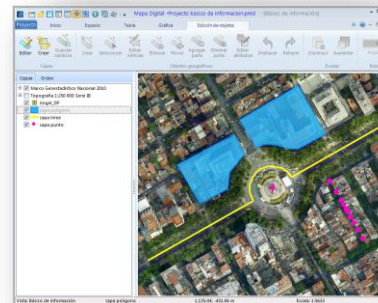
Analyse content
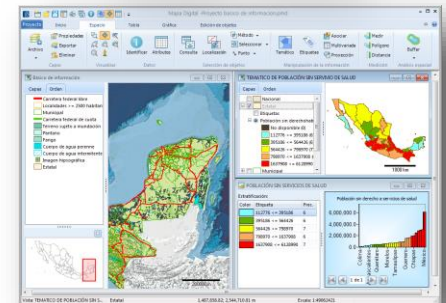
Mapa Digital
de México
E N   L Í N E A

Geographic Information System that provides a web-computing platform to facilitate the use, interpretation and analysis of geographic and georeferenced statistical information

MxSIG
Sistema de Información Geográfica

WEB Client / Mobile devices

Orchestration

| Standard web services | GeoProcessing | Accessibility |

Open Source Applications

Applications made at INEGI

Geo data bases

Main users:

- Decision makers
- Students
- People without experience in Geographic Information Systems
- General citizens

Session In a Year

March 2015 – February 2016

Total: **1,423,783**
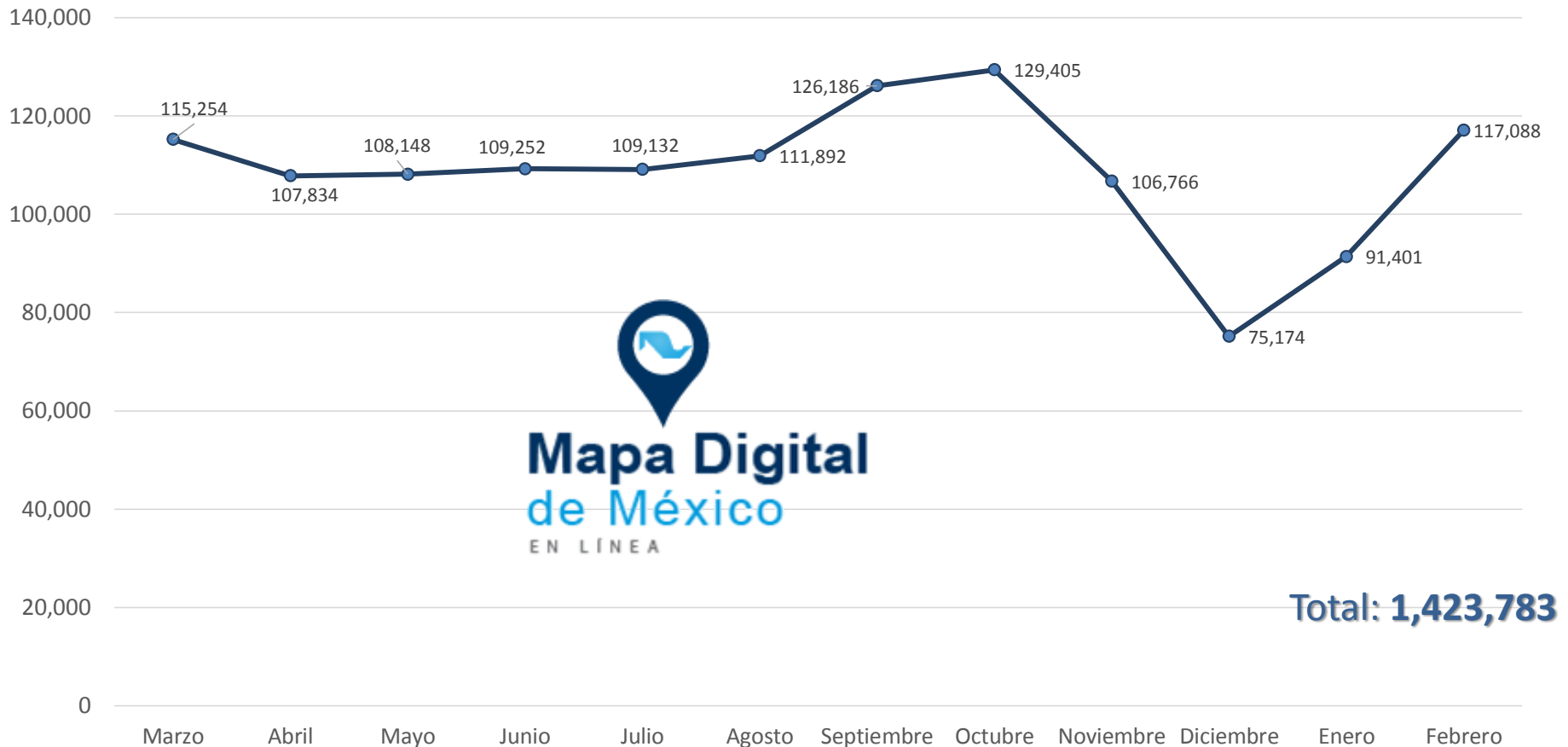
Available Information

219 layers and more than 66 millions of geographic features

New

- National Road Network
- National Statistics Directory of Economic Units
- National Inventory of Renewable Energy

Updated

- National Geostatistical Framework at the end of the 2015
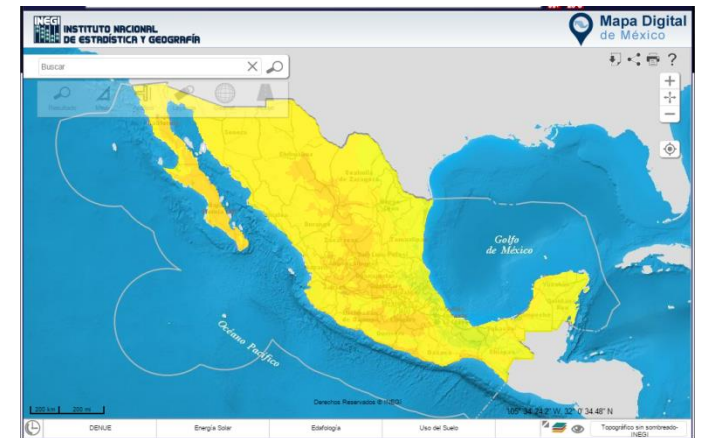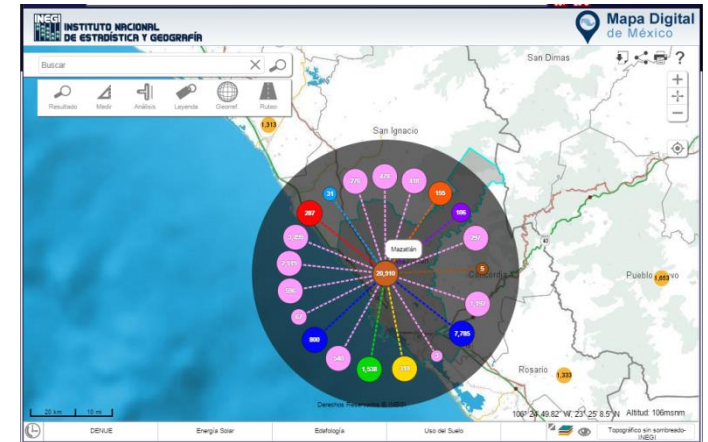
New Tools

Download shape files

Export map

DENUE

SHP
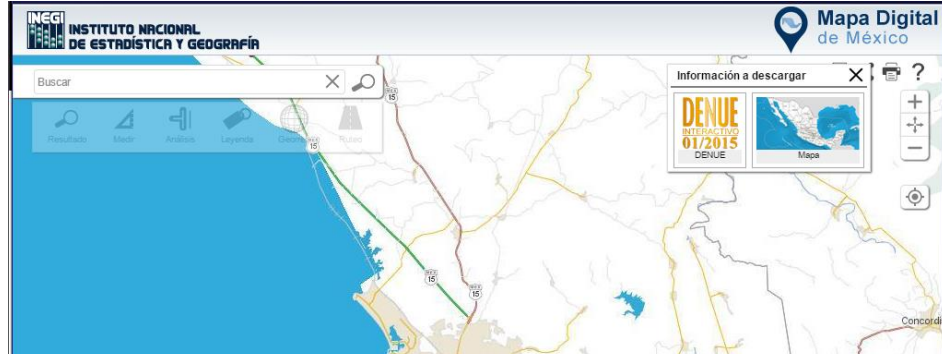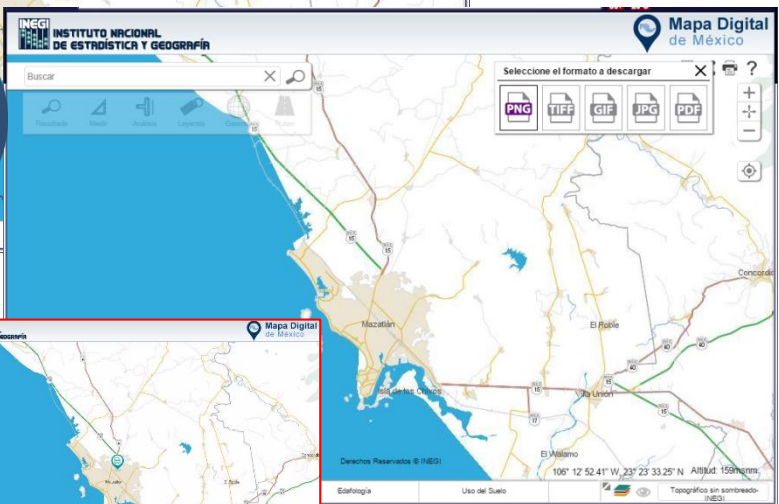
Image

New Tools

Transport routes
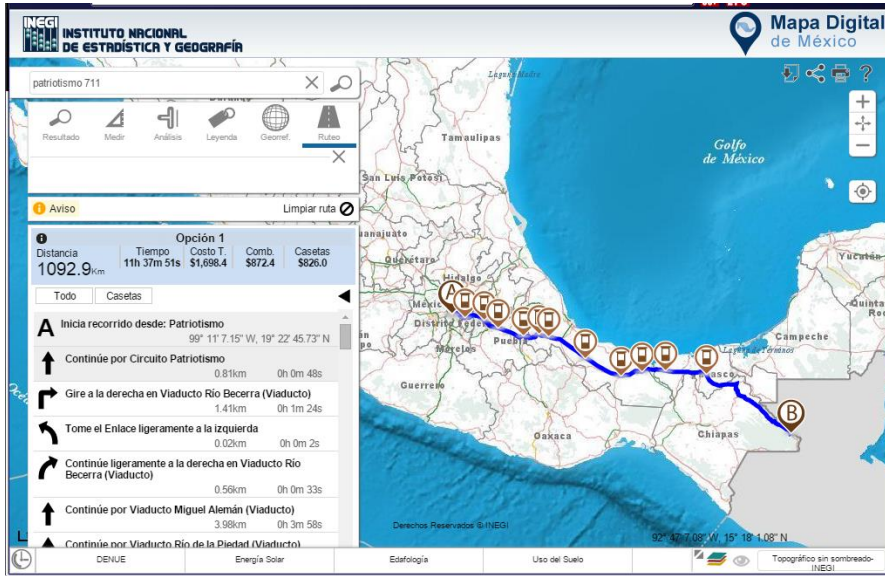
Add services: WMS / TMS / WMTS / KML

Award

What is MxSIG

- Open source platform developed by INEGI to implement geomatics solutions
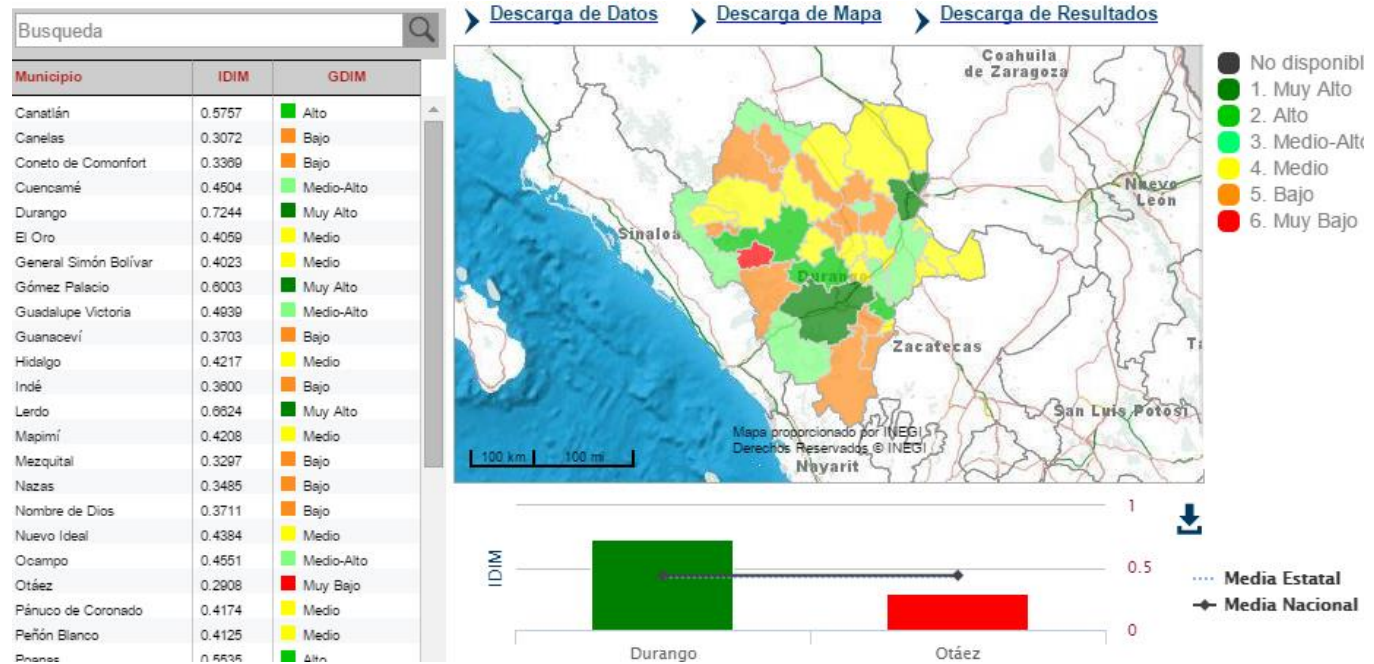
Experience Developing GIS
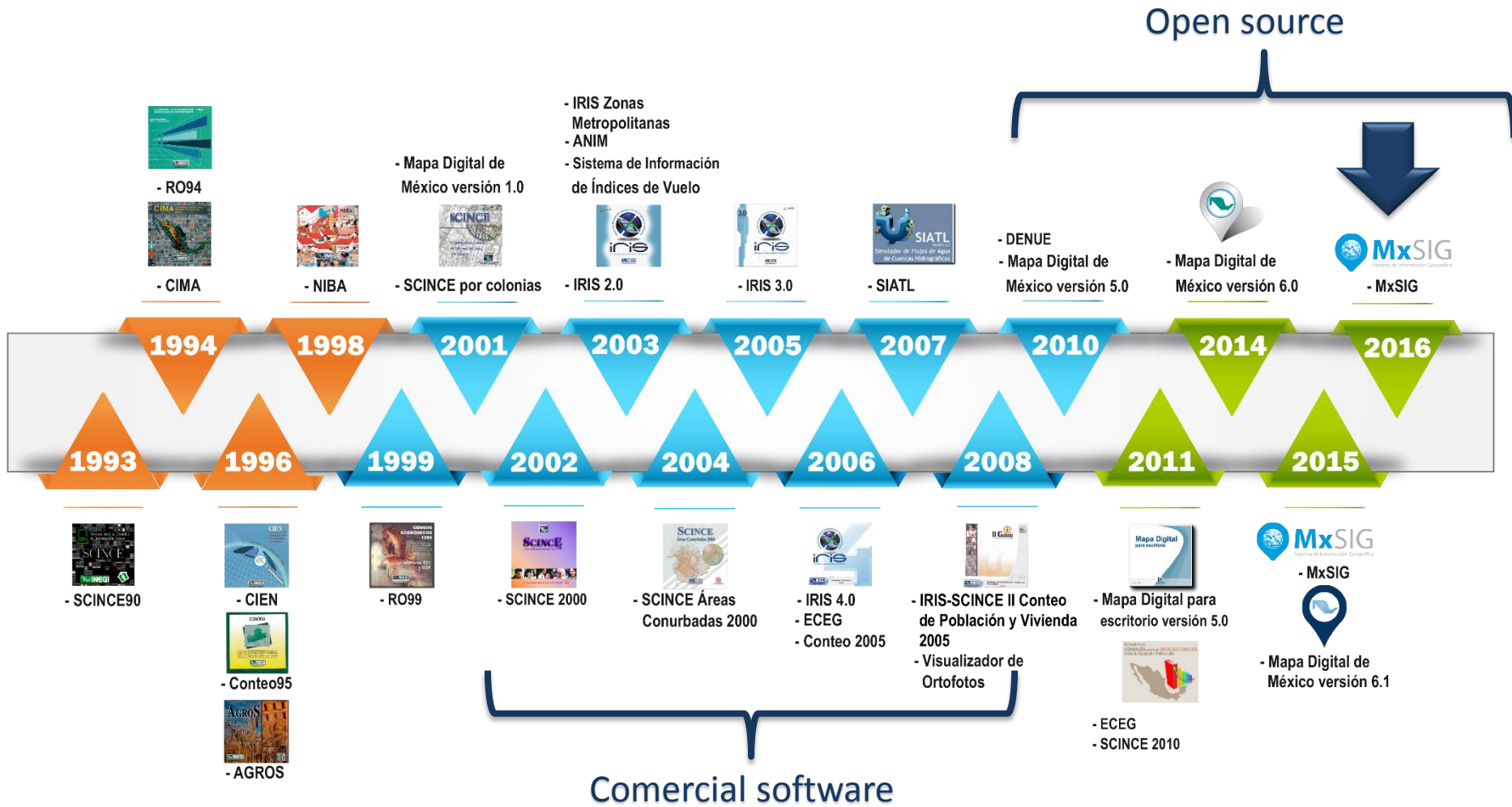
Open Source

- Integrates robust Open Source software

- Developed components released under LGPL as Open Source
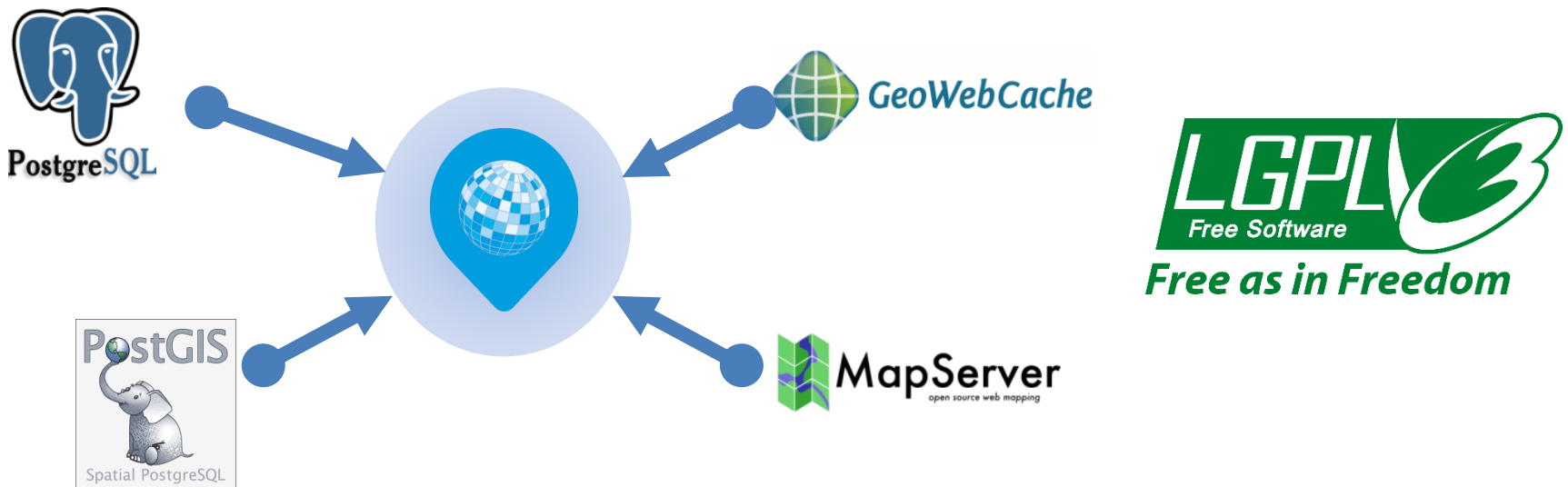
Components

- PostgreSQL/PostGIS
- Mapserver
- OpenLayers
- Apache Tomcat
- Apache HTTP Server
- jQuery

Standard Services

- Use and promote the use of standards

  - WMS
  - WFS
  - WMTS
  - TMS
  - WMS-T
  - WCS

  - KML

Architecture

✓ Service oriented

 - Maps (WMS, WMTS de la OGC)

 - Data services using REST/JSON

 - Client using HTML5/CSS3/AJAX

The core components which make up an SOA implementation

Advantage

- Advance functionality: Spatial analysis, georreferencing, statistics analysis, time series.
- No cost on licenses to implement new solutions.
- Able to implement SDI.

Resources

- Applications
  - From INEGI´s site

- Source code
  - In GitHUB portal

- Installation guide

INSTITUTO NACIONAL DE ESTADÍSTICA Y GEOGRAFÍA

| Estadística ▾ | Geografía ▾ | Investigación ▾ | Productos y Servicios ▾ | Acerca del INEGI ▾ | | IR |

Inicio > Estadística >

MxSIG
Sistema de Información Geográfica
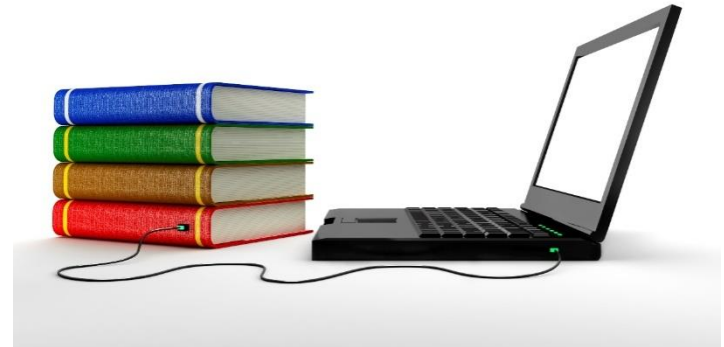
Geografía

| Inicio | Características | Recursos de Aprendizaje | Comunidad |

Software base y librerías de respaldo para la instalación de MxSIG.

Manual de instalación detallado de los componentes de soporte de MxSIG.

Procedimiento de instalación y configuración de los aplicativos de MxSIG.

Acceda a la base de conocimiento de uso frecuente de MxSIG. Visitar link Github.com/datosMXSIG.

Guía rápida

Manual

Guía de software base

Preguntas frecuentes

⬇ DESCARGA

IG INSTITUTO DE GEOGRAFÍA U N A M

AMEXCID AGENCIA MEXICANA DE COOPERACIÓN INTERNACIONAL PARA EL DESARROLLO

UN-GGIM:Americas REGIONAL COMMITTEE OF UNITED NATIONS ON GLOBAL GEOSPATIAL INFORMATION MANAGEMENT FOR THE AMERICAS

ACS AEC ASSOCIATION OF CARIBBEAN STATES ASOCIACIÓN DE ESTADOS DEL CARIBE ASSOCIATION DES ETATS DE LA CARAIBE

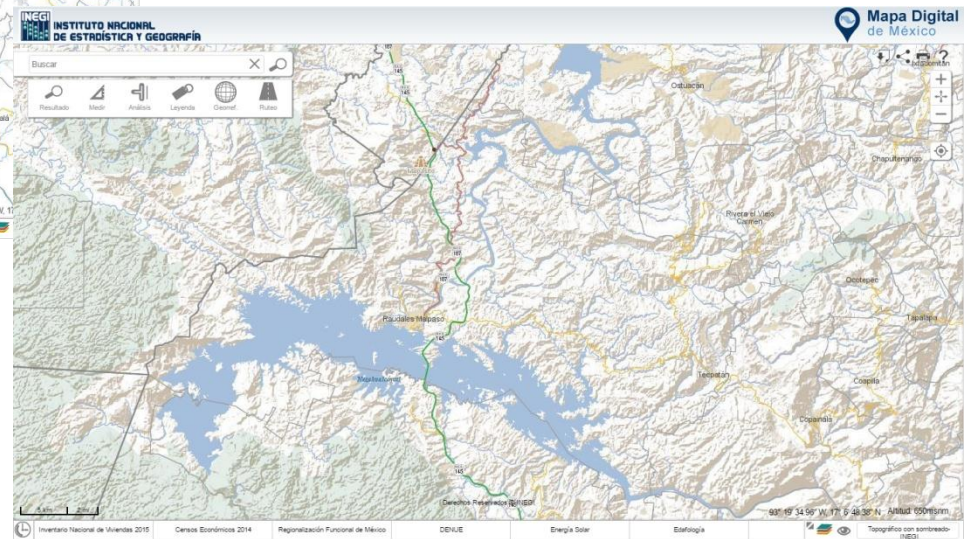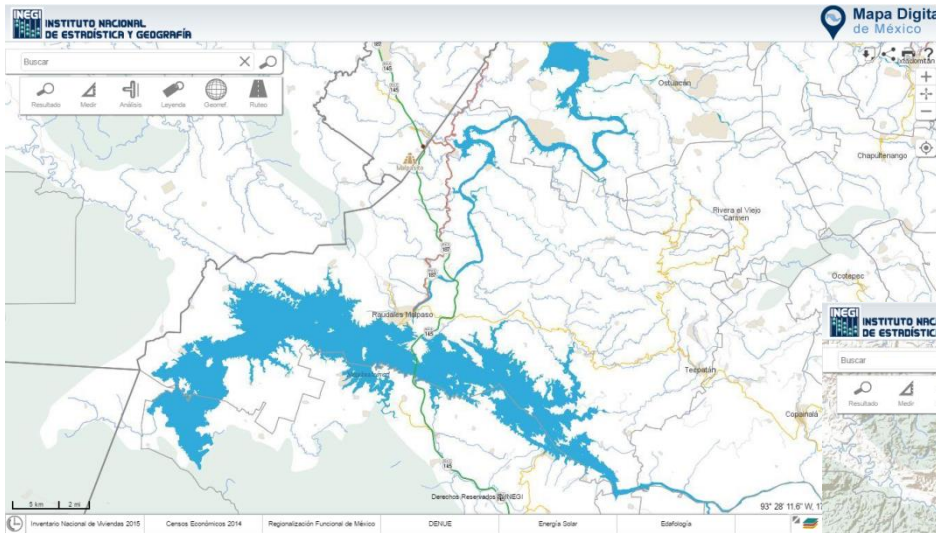INEGI INSTITUTO NACIONAL DE ESTADÍSTICA Y GEOGRAFÍA

Implementations

Base Maps

A map or chart showing certain fundamental information, used as a base upon which additional data of specialized nature are compiled or overprinted.
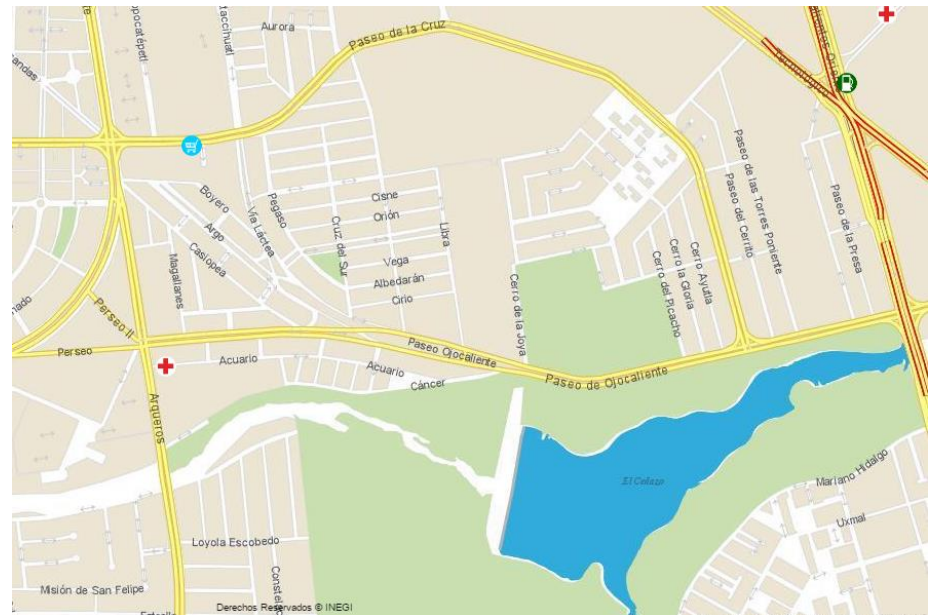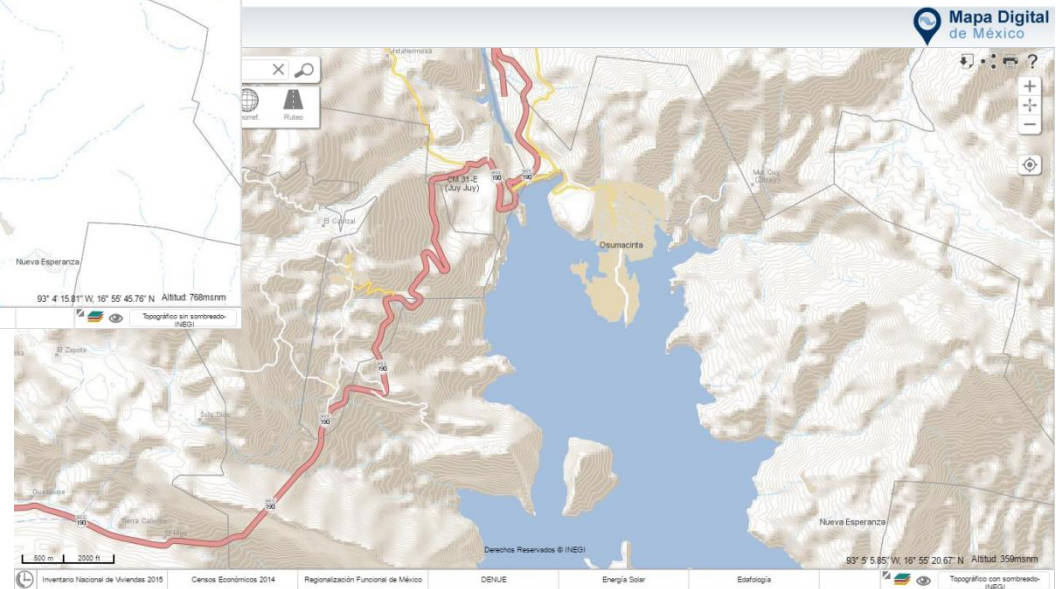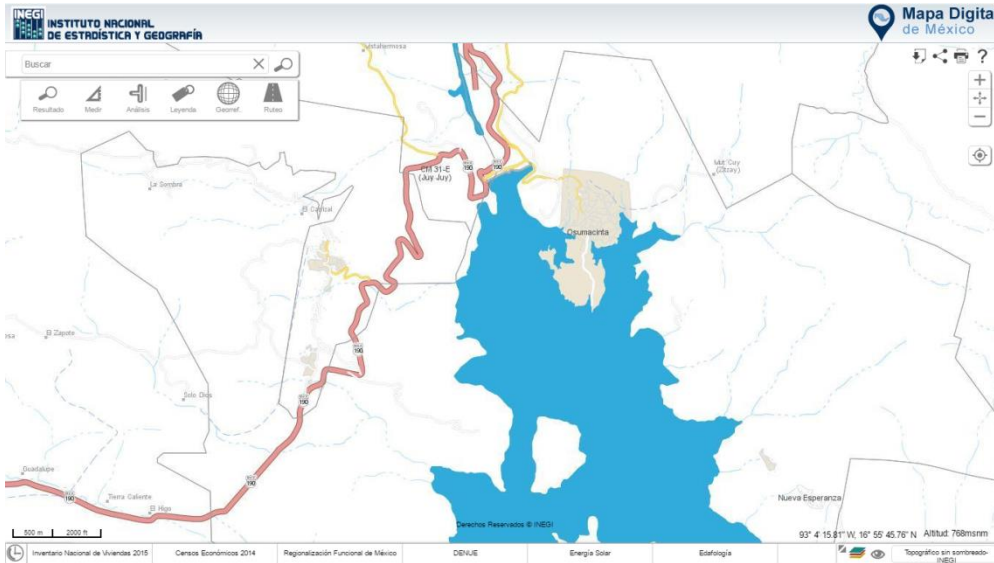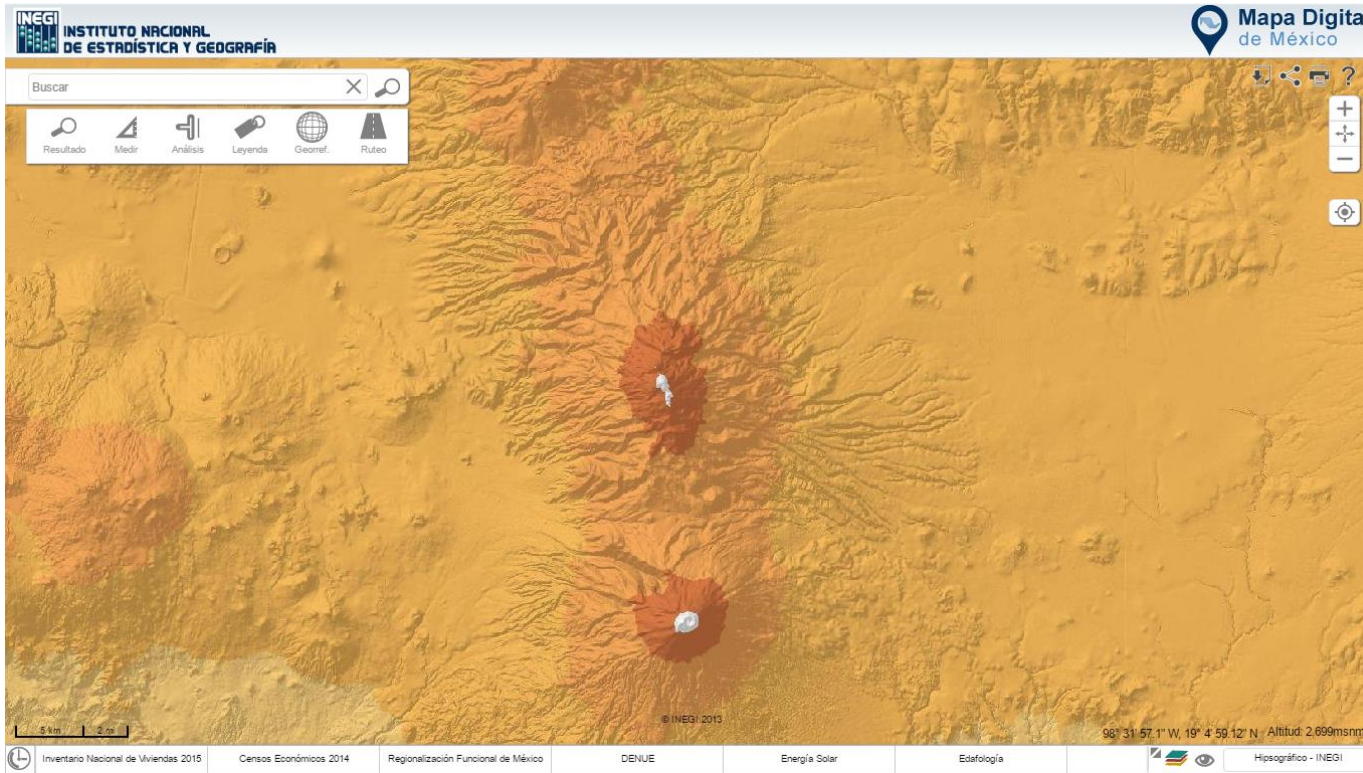
Base Maps

Topographic map

Base Maps

Topographic map

Base Maps

Hypsographic map

Base Maps

Orthophoto map

Aarón Israel Villar Mata

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