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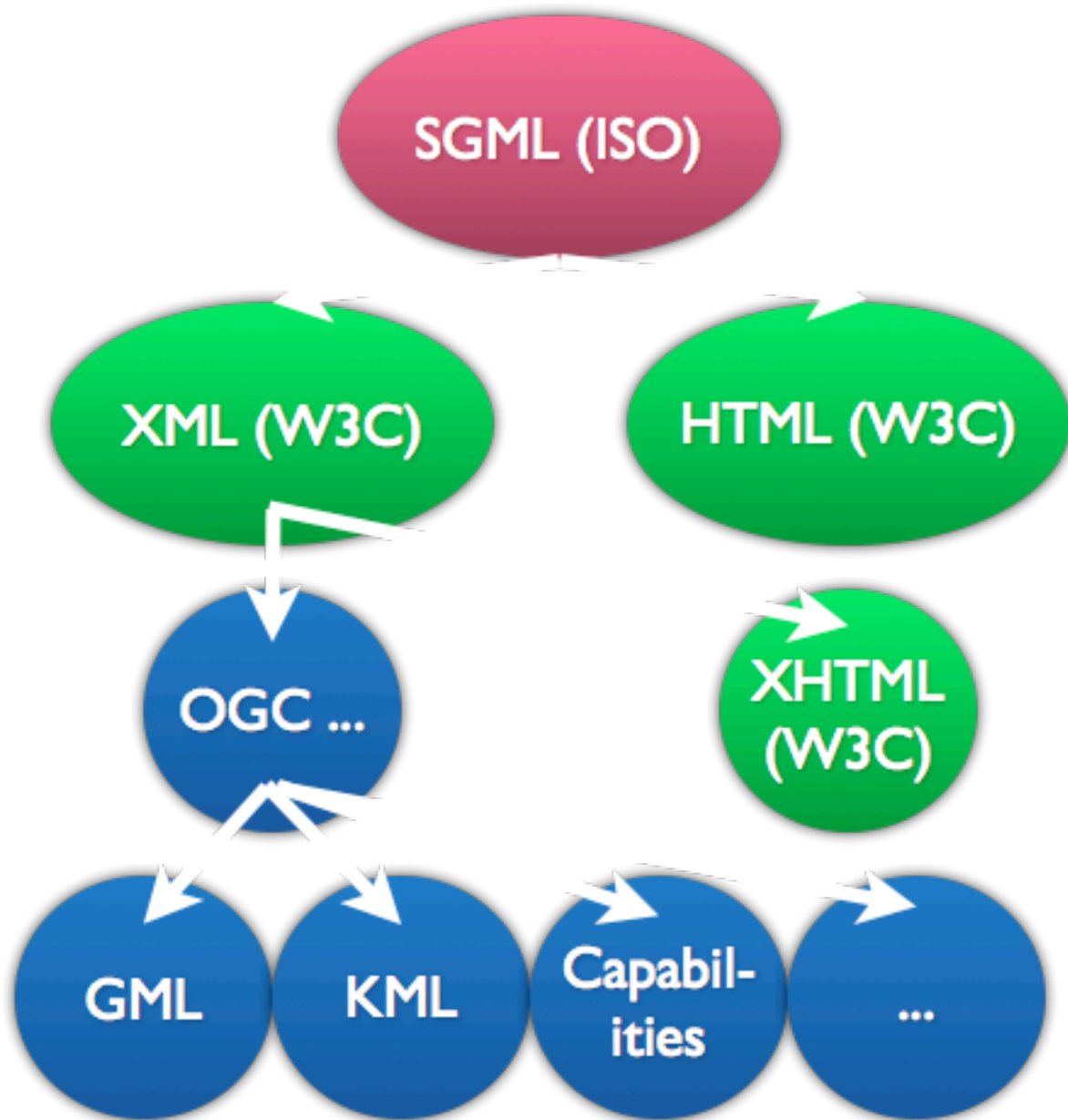
# Module 4.1 - Interoperability Standards - WMS, KML, and XML

## Outline

- Extensible Markup Language - XML
  - Definition of a markup language
  - Requirements
  - Extensible ???
- KML - AKA Keyhole Markup Language
  - An XML Document Format
  - Combined representation of spatial data and time
- OGC Web Map Services (WMS)
  - Requests and Results
  - GetCapabilities, GetMap, GetFeatureInfo
- Integration of WMS into KML

## Extensible Markup Language - XML

### XML Background



- Defined as a markup language profile of Standard Generalized Markup Language (SGML - ISO 8879:1986)
- XML 1.0 released as a W3C Recommendation in 1998
  - currently in 5th edition, released in 2008
  - version 1.1 released in 2004, but not broadly used
  - XML 1.0 (5th ed.) [Recommendation](#)

## XML Design Goals

- XML shall be straightforwardly usable over the Internet.
- XML shall support a wide variety of applications.
- XML shall be compatible with SGML.
- It shall be easy to write programs which process XML documents.
- The number of optional features in XML is to be kept to the absolute minimum, ideally zero.
- XML documents should be human-legible and reasonably clear.
- The XML design should be prepared quickly.
- The design of XML shall be formal and concise.
- XML documents shall be easy to create.
- Terseness in XML markup is of minimal importance.

From XML 1.0 (5th ed.) [Recommendation](#)

## XML Structure - Well Formed / Valid

- Well Formed XML - a document that conforms to the structural definition of XML. Either well-formed, or not XML
- Valid XML - a document that is both well-formed and conforms to a specific content structure defined by
  - A Document Type Definition (DTD) - the original XML specification for the definition of the content of a specific XML document
  - A Schema document - defined in a variety of languages (e.g. W3C Schema, RELAX NG, Schematron, ISO DSDL, etc.)

## [XML Wikipedia Article](#)

### Simple XML Document

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

XML Source (modified from original): [w3schools](#)

### Simple XML Document - Prolog

```
1 <?xml version="1.0" encoding="ISO-8859-1"?>
2 <!-- Edited by XMLSpy® -->
```

Includes XML Declaration and Comment

## Simple XML Document - Elements

```
3 <note>
4   <to>Tove</to>
5   <from>Jani</from>
6   <heading>Reminder</heading>
7   <body type="instruction" >Don't forget me this weekend!</body>
8 </note>
```

Define blocks of content

## Simple XML Document - Root Element

```
3 <note>
4   ...
5   ...
6   ...
7   ...
8 </note>
```

- Required
- There is only one
- It must be a pair of opening and closing tags

## Simple XML Document - Content Elements

```
4   <to>Tove</to>
5   <from>Jani</from>
6   <heading>Reminder</heading>
7   <body type="instruction" >Don't forget me this weekend!</body>
```

- Contain all other document content
- May be paired opening and closing tags, *or*
- May be self-closing with a terminal “/” in the element, e.g. <br />

## Simple XML Document - Attributes

```
7   <body type="instruction" >Don't forget me this weekend!</body>
```

Define additional information about elements as *name=value* pairs.

## Simple XML Document - Element Content

```
7   <body type="instruction" >Don't forget me this weekend!</body>
```

The material contained between the opening and closing tags of an *Element*.

## Simple XML Document - Valid?

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

Why is this XML *well-formed* but not *valid*?

*There is no DTD or Schema defined for the document against which it can be validated*

## Common XML Constructs That Will be Encountered

**Document Type Declaration (DTD) references (PROLOG)** definition, either by reference or by direct inclusion, the allowed structure of an XML document, for example:

```
<!DOCTYPE greeting SYSTEM "hello.dtd">
```

**CDATA Sections** blocks of XML that contain characters that would otherwise be recognized as XML markup, for example:

```
<![CDATA[<greeting>Hello, world!</greeting>]]>
```

## Common XML Constructs That Will be Encountered - cont.

**XML Namespace Declarations** additional information included in elements to distinguish between duplicate element names, for example (declared in lines 1-3, used in lines 5-17):

```
1 <root
2     xmlns:h="http://www.w3.org/TR/html4/"
3     xmlns:f="http://www.w3schools.com/furniture">
4
5 <h:table>
6     <h:tr>
7         <h:td>Apples</h:td>
8         <h:td>Bananas</h:td>
9     </h:tr>
10 </h:table>
11 <f:table>
12     <f:legs>4</f:legs>
13     <f:cost>300</f:cost>
14     <f:width>3</f:width>
15     <f:length>5</f:length>
16     <f:height>4</f:height>
17 </f:table>
18 </root>
```

# KML

## KML Background

- An XML grammar originally developed as Keyhole Markup Language by Keyhole, Inc. for use in their Keyhole Earth Viewer.
- Google acquired Keyhole, Inc. in 2004
- KML version 2.2 became an OGC standard in 2008
- Two delivered KML file formats

**KML** an XML document, with a “.kml” extension that is directly readable and editable

**KMZ** a compressed (zipped) file with a “.kmz” extension, that contains at least a KML document, but may contain other files as well

## KML Capabilities

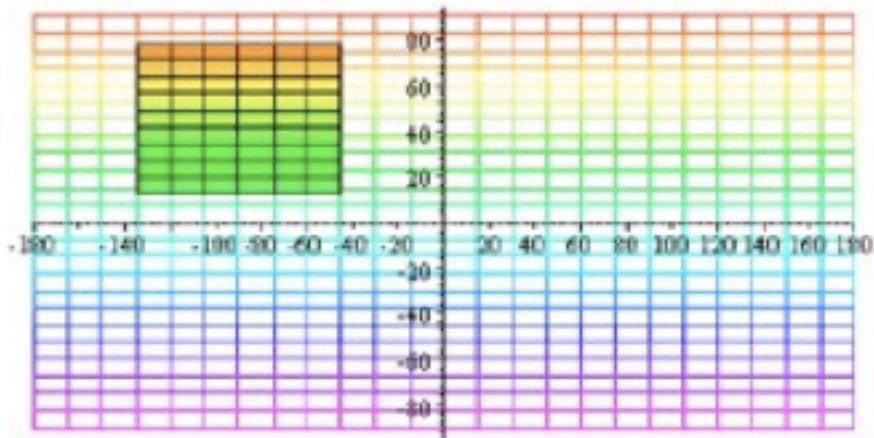
- Annotate the Earth
- Specify icons and labels to identify locations on the surface of the planet
- Create different camera positions to define unique views for KML features
- Define image overlays to attach to the ground or screen
- Define styles to specify KML feature appearance
- Write HTML descriptions of KML features, including hyperlinks and embedded images
- Organize KML features into hierarchies
- Locate and update retrieved KML documents from local or remote network locations
- Define the location and orientation of textured 3D objects

## KML Content

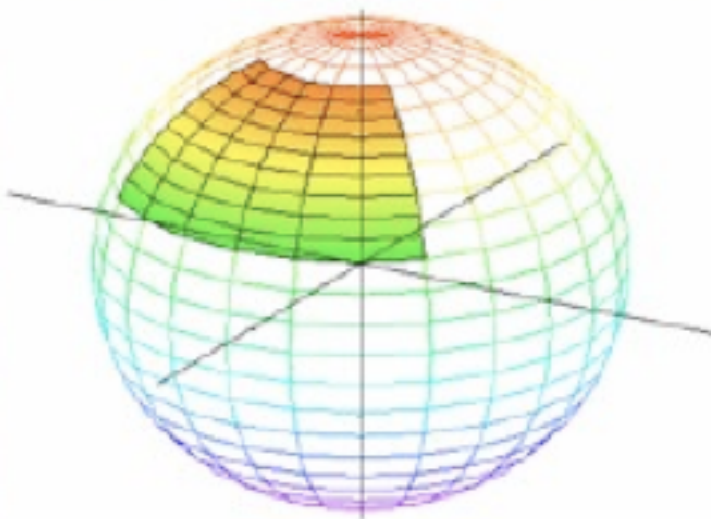
- Model for encoding 2- and 3-dimensional geometries for use in 2-D mappers and 3-D virtual globe applications
- Uses latitude-longitude (based upon WGS84 datum) for encoding horizontal position
- Represents altitude in Meters (based upon the WGS84 ellipsoid and EGM96 geoid)

## 2D and 3D KML Sample

### Polygon in plate carrée (long,lat) plane



### Polygon mapped to terrain surface



```
1 <kml xmlns="http://www.opengis.net/kml/2.2">
2 <Document>
3   <Placemark>
4     <Polygon>
5       <altitudeMode>
6         clampToGround
7       </altitudeMode>
8       <outerBoundaryIs>
9         <LinearRing>
10          <coordinates>
```



```

11             -135,78.5,300000
12             -135,12.5,300000
13             -45,12.5,300000
14             -45,78.5,300000
15             -135,78.5,300000
16         </coordinates>
17     </LinearRing>
18 </outerBoundaryIs>
19 </Polygon>
20 </Placemark>
21 </Document>
22 </kml>

```

## KML Example

Example from: KML 2.2 Specification (fig. 6)

## High-Level KML Content Types

**Features** including documents, folders, placemarks, network links

**Geometries** including points, linestrings, polygons, models, locations

**Overlays** including ground overlays, lat-lon boxes, photo overlays, screen overlays

**Styles** styles, substyles, icons, label styles

## High-Level KML Content Types - cont.

**Links** read, update, create, delete, change

**Views** camera, look at

**Time** time span, timestamp

## KML Demonstration and References

New Mexico State Boundary [KML File](#) | [KMZ File](#) (from [NM RGIS](#))

**New Mexico State Boundary KML File** [http://maps.google.com/maps?q=http://karlbenedict.com/GEOG485-585/lectures/examples/tl\\_2010\\_35\\_state10.kml](http://maps.google.com/maps?q=http://karlbenedict.com/GEOG485-585/lectures/examples/tl_2010_35_state10.kml)

[Google Code KML Documentation](#)

[OGC KML Implementation specification](#)

## OGC Web map Services - WMS

### WMS - Overview

- Open Geospatial Consortium standard for requesting
  - Service Metadata (**GetCapabilities**) - an XML file representing information about a specific WMS service and its component layers

- Map Images (**GetMap**) - graphic files representing one or more layers from a single WMS service for a specified area of interest, and, optionally, for a specified point in time
- Feature Information (**GetFeatureInfo**) - a basic representation (in a variety of formats) of the attributes associated with a specific pixel location in a map image
- A WMS will return to the requesting system one of the above products OR an error message (in XML by default)
- Related [Style Layer Descriptor](#) standard supports dynamic updating of visualization options
- [OGC WMS Documentation Access Page](#)

### WMS *GetCapabilities* Request

Request Parameter	1.0	1.1	1.1.1	1.3.0	Description
WMTVER=1.0.0	R				Request version
VERSION=version		O	O	O	Request version
SERVICE=WMS	R	R	R	R	Service type
REQUEST=capabilities	R				Request name
REQUEST=GetCapabilities		R	R	R	Request name
UPDATESEQUENCE=string		O	O	O	Sequence number or string for cache control
Vendor-specific parameters	O				Vendor-specific parameters

R=Required / O=Optional

### WMS *GetMap* Request (Core)

Request Parameter	1.0	1.1	1.1.1	1.3.0	Description
WMTVER=1.0.0	R				Request version
VERSION=version		R	R	R	Request version.
REQUEST=map	R				Request name.
REQUEST=GetMap		R	R	R	Request name.
LAYERS=layer_list	R	R	R	R	Comma-separated list of one or more map layers. Optional (ver. 1.1, 1.1.1) if SLD parameter is present.
STYLES=style_list	R	R	R	R	Comma-separated list of one rendering style per requested layer. Optional if SLD parameter is present.
SRS=namespace:identifier	R	R	R		Spatial Reference System.
CRS=namespace:identifier				R	Spatial Reference System.
BBOX=minx,miny,maxx,maxy	R	R	R	R	Bounding box corners (lower left, upper right) in SRS units.
WIDTH=output_width	R	R	R	<sup>10</sup> R	Width in pixels of map picture.

**WMS GetMap Request (Core) - cont.**

Request Parameter	1.0	1.1	1.1.1	1.3.0	Description
HEIGHT=output_height	R	R	R	R	Height in pixels of map picture.
FORMAT=output_format	R	R	R	R	Output format of map.
TRANSPARENT=TRUE or FALSE	O	O	O	O	Background transparency of map (default=FALSE).
BGCOLOR=color_value	O	O	O	O	Hexadecimal red-green-blue color value for the background color (default=0xFFFFFF).
EXCEPTIONS=exception_format	O	O	O	O	The format in which exceptions are to be reported by the WMS (default=XML).
TIME=time		O	O	O	Time value of layer desired.
ELEVATION=elevation		O	O	O	Elevation of layer desired.
Other sample dimensions		O	O	O	Values of other dimensions as appropriate.
Vendor specific parameters	O	O	O	O	Vendor specific parameters

**WMS GetFeatureInfo Request**

Request Parameter	1.0	1.1	1.1.1	1.3.0	Description
WMTVER=1.0.0	R				Request version.
VERSION=version		R	R	R	Request version.
REQUEST=feature_info	R				Request name.
REQUEST=GetFeatureInfo		R	R	R	Request name.
<map_request_copy>	R	R	R	R	Partial copy of the Map request parameters that generated the map for which information is desired
QUERY_LAYERS=layer_list	R	R	R	R	Comma-separated list of one or more layers to be queried.
INFO_FORMAT=output_format	O	O	O	R	Return format of feature information (MIME type).
FEATURE_COUNT=number	O	O	O	O	Number of features about which to return information (default=1).

**WMS GetFeatureInfo Request - cont.**

Request Parameter	1.0	1.1	1.1.1	1.3.0	Description
X=pixel_column	R	R	R		X coordinate in pixels of feature (measured from upper left corner=0)

I=pixel_column				R	i coordinate in pixels of feature in Map CS
Y=pixel_row	R	R	R		Y coordinate in pixels of feature (measured from upper left corner=0)
J=pixel_row				R	j coordinate in pixels of feature in Map CS
EXCEPTIONS=exception_format		O	O	O	The format in which exceptions are to be reported by the WMS (default=XML).
Vendor-specific parameters		O	O	O	Optional experimental parameters.

---

## WMS Sample Requests - GetCapabilities

```

1 http://gstore.unm.edu/apps/rgis/datasets/6ca5428a-a78c-4c82-8120-da70dc92f2cc/services/ogc/wms?
2 SERVICE=wms&
3 REQUEST=GetCapabilities&
4 VERSION=1.1.1

```

[Live Link](#)

```

1 <?xml version='1.0' encoding="ISO-8859-1" standalone="no" ?>
2 <!DOCTYPE WMT_MS_Capabilities SYSTEM "http://schemas.opengis.net/wms/1.1.1/
3 WMT_MS_Capabilities.dtd"
4 [
5 <!-- ELEMENT VendorSpecificCapabilities EMPTY -->
6 ]> <!-- end of DOCTYPE declaration -->
7
8 <WMT_MS_Capabilities version="1.1.1">
9
10 <!-- MapServer version 6.0.3 OUTPUT=GIF OUTPUT=PNG OUTPUT=JPEG OUTPUT=KML SUPPORTS=PROJ
11 SUPPORTS=AGG SUPPORTS=FREETYPE SUPPORTS=ICONV SUPPORTS=WMS_SERVER SUPPORTS=WMS_CLIENT
12 SUPPORTS=WFS_SERVER SUPPORTS=WFS_CLIENT SUPPORTS=WCS_SERVER SUPPORTS=SOS_SERVER
13 INPUT=POSTGIS INPUT=OGR INPUT=GDAL INPUT=SHAPEFILE -->
14
15 <Service>
16 <Name>OGC:WMS</Name>
17 <Title>rgis Dataset (6ca5428a-a78c-4c82-8120-da70dc92f2cc)</Title>
18 <Abstract>WMS Service for rgis dataset State Boundary - 2010</Abstract>
19 <KeywordList>
20 <Keyword>rgis</Keyword>
21 <Keyword> New Mexico</Keyword>
22 </KeywordList>
23 <OnlineResource xmlns:xlink="http://www.w3.org/1999/xlink" xlink:href="http://
24 gstore.unm.edu/apps/rgis/datasets/6ca5428a-a78c-4c82-8120-da70dc92f2cc/services/ogc/wms"/>
25 <ContactInformation>
26 <ContactPersonPrimary>
27 <ContactPerson>GStore Support</ContactPerson>
28 <ContactOrganization>Earth Data Analysis Center</ContactOrganization>
29 </ContactPersonPrimary>
30 <ContactPosition>technical support</ContactPosition>
31 <ContactAddress>
32 <AddressType>Mailing address</AddressType>

```

```

33     <Address>Earth Data Analysis Center, MSC01 1110, 1 University of New Mexico</Address>
34     <City>Albuquerque</City>
35     <StateOrProvince>NM</StateOrProvince>
36     <PostCode>87131</PostCode>
37     <Country>US</Country>
38 </ContactAddress>
39     <ContactVoiceTelephone>(505) 277-3622</ContactVoiceTelephone>
40     <ContactFacsimileTelephone>(505) 277-3614</ContactFacsimileTelephone>
41 <ContactElectronicMailAddress>devteam@edac.unm.edu</ContactElectronicMailAddress>
42 </ContactInformation>
43 <Fees>None</Fees>
44 <AccessConstraints>none</AccessConstraints>
45 </Service>
46
47 <Capability>
48   <Request>
49     <GetCapabilities>
50       <Format>application/vnd.ogc.wms_xml</Format>
51       <DCPType>
52         <HTTP>
53           <Get><OnlineResource xmlns:xlink="http://www.w3.org/1999/xlink" xlink:href=
54             "http://gstore.unm.edu/apps/rgis/datasets/6ca5428a-a78c-4c82-8120-da70dc92f2cc/
55             services/ogc/wms?"/></Get>
56           <Post><OnlineResource xmlns:xlink="http://www.w3.org/1999/xlink" xlink:href=
57             "http://gstore.unm.edu/apps/rgis/datasets/6ca5428a-a78c-4c82-8120-da70dc92f2cc/
58             services/ogc/wms?"/></Post>
59         </HTTP>
60       </DCPType>
61     </GetCapabilities>
62     <GetMap>
63       <Format>image/png</Format>
64       <Format>image/gif</Format>
65       <Format>image/jpeg</Format>
66       <Format>image/png; mode=8bit</Format>
67       <Format>image/tiff</Format>
68       <Format>application/vnd.google-earth.kml+xml</Format>
69       <Format>application/vnd.google-earth.kmz</Format>
70       <DCPType>
71         <HTTP>
72           <Get><OnlineResource xmlns:xlink="http://www.w3.org/1999/xlink" xlink:href=
73             "http://gstore.unm.edu/apps/rgis/datasets/6ca5428a-a78c-4c82-8120-da70dc92f2cc/
74             services/ogc/wms?"/></Get>
75           <Post><OnlineResource xmlns:xlink="http://www.w3.org/1999/xlink" xlink:href=
76             "http://gstore.unm.edu/apps/rgis/datasets/6ca5428a-a78c-4c82-8120-da70dc92f2cc/
77             services/ogc/wms?"/></Post>
78         </HTTP>
79       </DCPType>
80     </GetMap>
81     <GetFeatureInfo>
82       <Format>text/plain</Format>
83       <Format>application/vnd.ogc.gml</Format>
84       <DCPType>
85         <HTTP>
86           <Get><OnlineResource xmlns:xlink="http://www.w3.org/1999/xlink" xlink:href=

```

```

87         "http://gstore.unm.edu/apps/rgis/datasets/6ca5428a-a78c-4c82-8120-da70dc92f2cc/
88         services/ogc/wms?"/></Get>
89         <Post><OnlineResource xmlns:xlink="http://www.w3.org/1999/xlink" xlink:href=
90         "http://gstore.unm.edu/apps/rgis/datasets/6ca5428a-a78c-4c82-8120-da70dc92f2cc/
91         services/ogc/wms?"/></Post>
92     </HTTP>
93 </DCPType>
94 </GetFeatureInfo>
95 <DescribeLayer>
96     <Format>text/xml</Format>
97     <DCPType>
98         <HTTP>
99             <Get><OnlineResource xmlns:xlink="http://www.w3.org/1999/xlink" xlink:href=
100             "http://gstore.unm.edu/apps/rgis/datasets/6ca5428a-a78c-4c82-8120-da70dc92f2cc/
101             services/ogc/wms?"/></Get>
102             <Post><OnlineResource xmlns:xlink="http://www.w3.org/1999/xlink" xlink:href=
103             "http://gstore.unm.edu/apps/rgis/datasets/6ca5428a-a78c-4c82-8120-da70dc92f2cc/
104             services/ogc/wms?"/></Post>
105         </HTTP>
106     </DCPType>
107 </DescribeLayer>
108 <GetLegendGraphic>
109     <Format>image/png</Format>
110     <Format>image/gif</Format>
111     <Format>image/jpeg</Format>
112     <Format>image/png; mode=8bit</Format>
113     <DCPType>
114         <HTTP>
115             <Get><OnlineResource xmlns:xlink="http://www.w3.org/1999/xlink" xlink:href=
116             "http://gstore.unm.edu/apps/rgis/datasets/6ca5428a-a78c-4c82-8120-da70dc92f2cc/
117             services/ogc/wms?"/></Get>
118             <Post><OnlineResource xmlns:xlink="http://www.w3.org/1999/xlink" xlink:href=
119             "http://gstore.unm.edu/apps/rgis/datasets/6ca5428a-a78c-4c82-8120-da70dc92f2cc/
120             services/ogc/wms?"/></Post>
121         </HTTP>
122     </DCPType>
123 </GetLegendGraphic>
124 <GetStyles>
125     <Format>text/xml</Format>
126     <DCPType>
127         <HTTP>
128             <Get><OnlineResource xmlns:xlink="http://www.w3.org/1999/xlink" xlink:href=
129             "http://gstore.unm.edu/apps/rgis/datasets/6ca5428a-a78c-4c82-8120-da70dc92f2cc/
130             services/ogc/wms?"/></Get>
131             <Post><OnlineResource xmlns:xlink="http://www.w3.org/1999/xlink" xlink:href=
132             "http://gstore.unm.edu/apps/rgis/datasets/6ca5428a-a78c-4c82-8120-da70dc92f2cc/
133             services/ogc/wms?"/></Post>
134         </HTTP>
135     </DCPType>
136 </GetStyles>
137 </Request>
138 <Exception>
139     <Format>application/vnd.ogc.se_xml</Format>
140     <Format>application/vnd.ogc.se_inimage</Format>

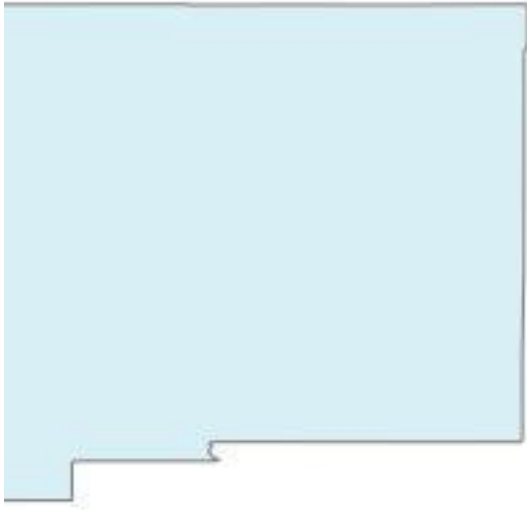
```

```

141     <Format>application/vnd.ogc.se_blank</Format>
142 </Exception>
143 <VendorSpecificCapabilities />
144 <UserDefinedSymbolization SupportSLD="1" UserLayer="0" UserStyle="1" RemoteWFS="0"/>
145 <Layer>
146     <Name>RGIS_Dataset</Name>
147     <Title>rgis Dataset (6ca5428a-a78c-4c82-8120-da70dc92f2cc)</Title>
148     <Abstract>WMS Service for rgis dataset State Boundary - 2010</Abstract>
149     <KeywordList>
150         <Keyword>rgis</Keyword>
151         <Keyword> New Mexico</Keyword>
152     </KeywordList>
153     <SRS>EPSG:4269</SRS>
154     <SRS>EPSG:4326</SRS>
155     <SRS>EPSG:4267</SRS>
156     <SRS>EPSG:26913</SRS>
157     <SRS>EPSG:26912</SRS>
158     <SRS>EPSG:26914</SRS>
159     <SRS>EPSG:26713</SRS>
160     <SRS>EPSG:26712</SRS>
161     <SRS>EPSG:26714</SRS>
162     <SRS>EPSG:3857</SRS>
163     <LatLonBoundingBox minx="-109.05" miny="31.3322" maxx="-103.002" maxy="37.0003" />
164     <BoundingBox SRS="EPSG:4326"
165         minx="-109.05" miny="31.3322" maxx="-103.002" maxy="37.0003" />
166     <Layer queryable="0" opaque="0" cascaded="0">
167         <Name>t1_2010_35_state10</Name>
168         <Title>t1_2010_35_state10</Title>
169         <Abstract>State Boundary - 2010</Abstract>
170         <KeywordList>
171             <Keyword></Keyword>
172         </KeywordList>
173         <SRS>epsg:4326</SRS>
174         <LatLonBoundingBox minx="-109.05" miny="31.3322" maxx="-103.002" maxy="37.0003" />
175         <BoundingBox SRS="epsg:4326"
176             minx="-109.05" miny="31.3322" maxx="-103.002" maxy="37.0003" />
177         <MetadataURL type="FGDC-STD-001-1998">
178             <Format>text/xml</Format>
179             <OnlineResource xmlns:xlink="http://www.w3.org/1999/xlink" xlink:type="simple"
180                 xlink:href="http://gstore.unm.edu/apps/rgis/datasets/
181                 6ca5428a-a78c-4c82-8120-da70dc92f2cc/metadata/FGDC-STD-001-1998.xml"/>
182         </MetadataURL>
183     </Layer>
184 </Layer>
185 </Capability>
186 </WMT_MS_Capabilities>

```

## WMS Sample Requests - GetMap



```
http://gstore.unm.edu/apps/rgis/datasets/  
6ca5428a-a78c-4c82-8120-da70dc92f2cc/  
services/ogc/wms?  
  VERSION=1.1.1&  
  SERVICE=WMS&  
  REQUEST=GetMap&  
  BBOX=-109,31,-102.9,37.1&  
  LAYERS=t1_2010_35_state10&  
  WIDTH=200&  
  HEIGHT=200&  
  SRS=EPSG:4326&  
  FORMAT=image/jpeg&  
  STYLES=
```

[link](#)





```
http://gstore.unm.edu/apps/rgis/datasets/  
6ca5428a-a78c-4c82-8120-da70dc92f2cc/  
services/ogc/wms?  
  VERSION=1.1.1&  
  SERVICE=WMS&  
  REQUEST=GetMap&  
  BBOX=-109,31,-102.9,37.1&  
  LAYERS=tl_2010_35_state10&  
  WIDTH=300&  
  HEIGHT=300&  
  SRS=EPSG:4326&  
  TRANSPARENT=TRUE&  
  FORMAT=image/png&  
  STYLES=
```

[link](#)

### Integraton of WMS and KML

- The KML GroundOverlay element may be used to integrate a network accessible map image into a client
- A WMS service may be used to as the source of a KML GroundOverlay element
- KML includes parameterizations that allow for dynamic generation of WMS requests using client bounding box information
- Time-enabled WMS may be accessed through use of manually configured time parameters in WMS URLs and TimeStamp or TimeSpan KML elements

## Sample WMS-KML Integration

```
1  <?xml version="1.0" encoding="UTF-8"?>
2  <kml xmlns="http://www.opengis.net/kml/2.2" xmlns:gx="http://www.google.com/kml/ext/2.2"
3    xmlns:kml="http://www.opengis.net/kml/2.2" xmlns:atom="http://www.w3.org/2005/Atom">
4    <GroundOverlay>
5      <name>RGIS Counties WMS</name>
6      <Icon>
7        <href>http://gstore.unm.edu/apps/rgis/datasets/107046/services/ogc/wms?
8          VERSION=1.1.1&SERVICE=WMS&REQUEST=GetMap&BBOX=-109,31,-102.9,37.1
9          &LAYERS=t1_2010_35_state10&WIDTH=800&HEIGHT=800&SRS=EPSG:4326
10         &FORMAT=image/png&STYLES=</href>
11        <viewRefreshMode>onStop</viewRefreshMode>
12      </Icon>
13      <LatLonBox>
14        <north>37.32753828398865</north>
15        <south>30.86418272137246</south>
16        <east>-101.3630220689848</east>
17        <west>-110.6891149310152</west>
18      </LatLonBox>
19    </GroundOverlay>
20  </kml>
```

## Sample KML File