I. 기술강좌

1

Web 기반 엔코딩 언어 GML

(GML - Enabling the Geo-spatial World Wide Web)

2001. 11

Ronald Lake
(President, Galdos Systems Inc. Canada)

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Geography Markup Language

Enabling the Geo-spatial World Wide Web

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Who is Galdos?

- Famous Spanish writer of the 19th century!
- Creator of Geography Markup Language (GML).
- Custom Software Developer for XML applications for geo-spatial systems.
- Developing advanced geo-spatial server and client products for GML solution deployment.
- Training & Consulting for GML (XML for Spatial!)
- Founded in 1998. 15 Employees.

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What is the Geo-spatial Web ?

What made the web work ?

HTML Linking & Web Content

HTTP Server

Made it work !!

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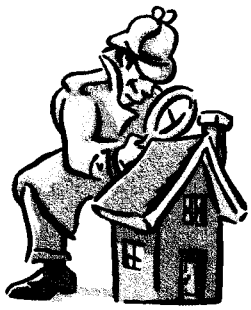
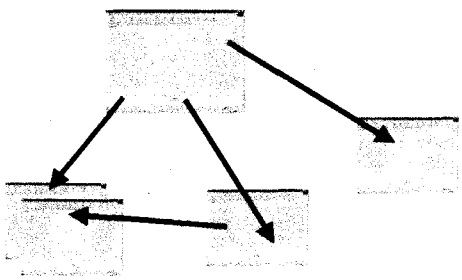
Geo-spatial Web

What made the web work ?





Hypertext acts as an organizing mechanism – build information incrementally

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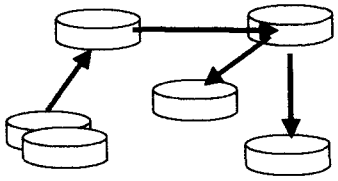
Geo-spatial Web

Geography Markup Language enables the Geo-spatial Web



Linked Geographic Features

Shareable Geographic Schema

Web-based Geo-Spatial Services

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Geography Markup Language

- XML encoding of geography
- Enables one to leverage the whole world of XML technologies.
- Provides for vector mapping in a standard browser.
- Enables complex features & feature associations

Will revolutionize the geo-spatial industry !

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GML - Builds on W3C Standards

GML
XSLT
XML
RDF/S
XPath
SVG/VML
XPointer
XLink
XSD

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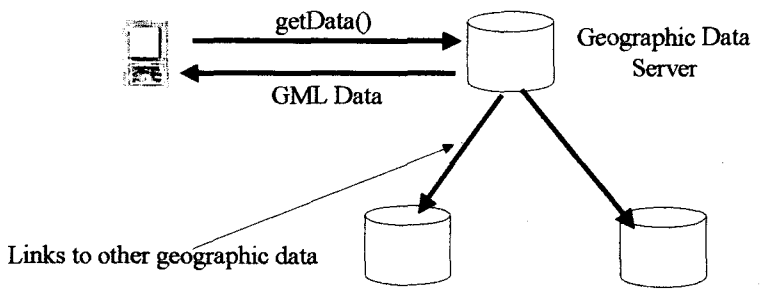
GML: What is it?



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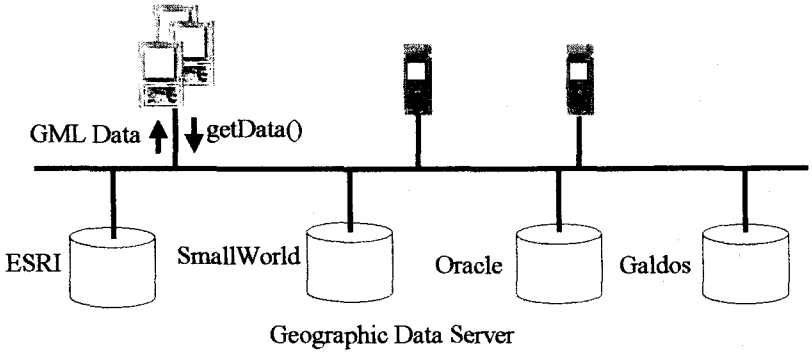
GML: What is it?



If you can get e-mail you can get spatial data !!

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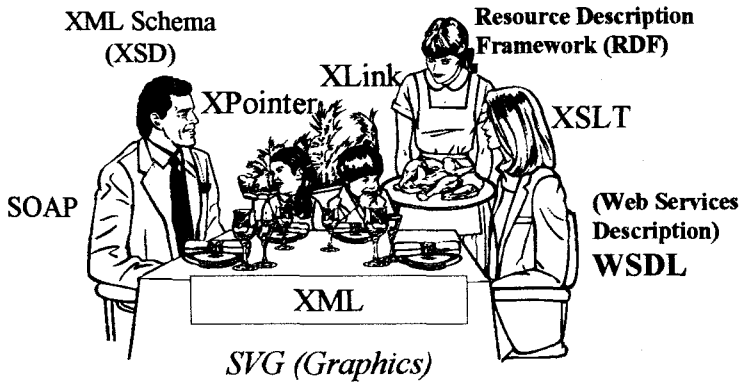
Once Over Lightly – What ?



XML is a whole family of technologies for data handling

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Once Over Lightly – Why XML ?

- Self documenting. People can read and understand the data.
- Standard tools can be used – no need to create custom tools to read/display data.
- Standard tools ensure data integrity.
- Can leverage a whole world of XML technologies and tools!
- Easy to integrate different kinds of data.

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Once Over Lightly – Why XML ?

Can leverage a whole world of XML technologies and tools

- Parsing/navigating XML data
- Selecting XML data elements/subsets.
- Querying XML data
- Transforming XML data
- Linking to XML datasets
- Creating dataset associations
- Data visualization
- Specification of web services
- Network operations

Once your data is in XML you can use standard tools to do all sorts of common tasks !!

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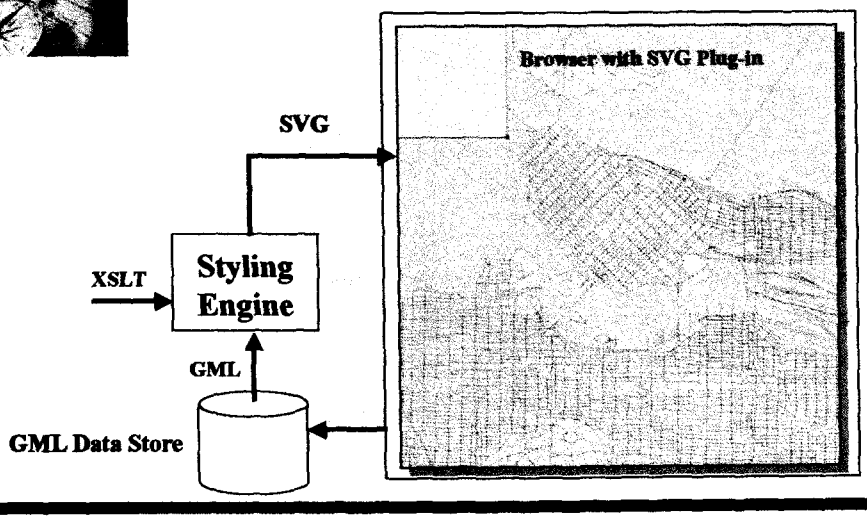
XML in Action



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XML Technology Summary

The XML Technologies for GML !!

- Technology for Encoding and Data Modeling Expression (DTD, RDF and XSD)
- Technology for Selecting & Pointing (XPath, XPointer)
- Technology for Transforming (XSLT)
- Technology for Linking and Associating (XLink)
- Technology for Graphical rendering (SVG, VML, X3D)

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GML: What is it ?

- OGC Endorsed "Adopted Specification" (GML 2.0 passed March 2001) for encoding spatial information.
- A set of XML technologies for handling spatial data on the Internet.
- Emerging international standard for spatial data—endorsed by 200 + companies and agencies around the world.
- Will converge with G-XML (Japan) – additional 600 companies. Target is GML 3.0 by December 2001

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Why GML ?

- A "**lingua franca**" for geographic information.
- GML data can be **read and understood** by people.
- GML can enable **distributed spatial datasets** that are **linked** together – **local maintenance & development /global access**. Reduced cost for data.
- GML **data can easily be mixed with non-spatial data** including text, video, and imagery. (e.g. work order)
- GML can build **shareable application schemas** for telecommunications, utilities, forestry, tourism, and location-based services.

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Why GML ?

- GML is **easily transformed** – coordinate conversion etc.
- Services can be created with specific types and then easily discovered. Services that act on features. Services that return routes or tracks. GML provides **a STANDARD means to define input & output arguments.**
- GML is **non-proprietary** and open! Any client can talk to any server!
- GML enables non-proprietary web feature servers, image/map annotation, map styling and spatial analysis.

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History

- **1998 Kurt Buehler. defines a XML DTD for spatial.**
- **Feb 99 – White paper by Galdos on XML for spatial.**
- **Feb 99 – Presentation by NTT Data**
- **Summer 99 – Xbed Group led by Galdos Systems, develops SFXML (Oracle, NTT Data, MapInfo)**
- **October 99 – Galdos Systems writes GML RFC**
- **Dec 99 – GML RFC becomes public**
- **May 2000 – GML 1.0 Passed as recommendation paper.**
- **Feb 2001 – OGC publishes GML 2.0**
- **March 2001 – GML 2.0 voted as "adopted specification"**
- **July 2001 – GML 3.0 Workshop in Vancouver**
- **Sept 2001 – OGC votes to send GML to ISO**

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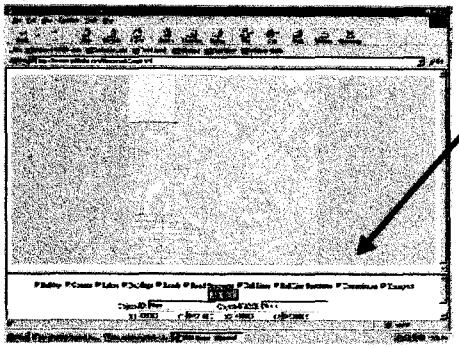
GML Focuses on Content



Vector Maps display in a standard browser web page! (SVG)

GML Separates Content & Presentation !

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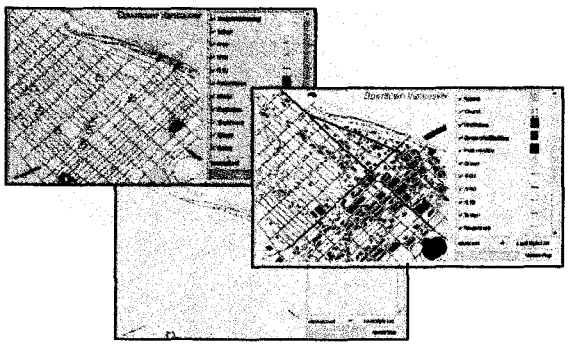
GML Mapping Examples



Same spatial data – many different styles !

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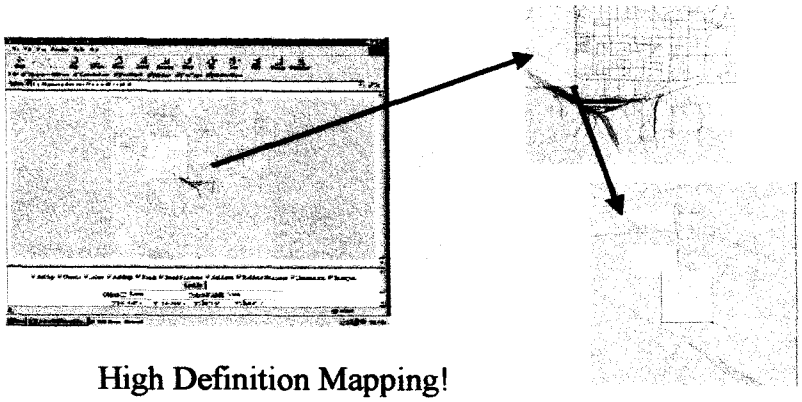
GML Mapping Examples



High Definition Mapping!

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Key Applications

- **Location-Based Services and Mobile GIS**
- Internet GIS (local/regional & national governments)
- Disaster Management
- Accident Investigation
- Telecommunication Planning, Monitoring
- Utility Planning & Coordination

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Implications of GML

Implications of GML

- Makes it possible to build a spatial infrastructure – reduces the incremental cost of building application specific data sets.
- Makes it easier to integrate spatial information with non-spatial information – "e-mail me a map I can interact with"! => Better utilization of spatial information.
- Leads to geographic standards in vertical market domains – standard shareable vocabularies – lowers cost of data sharing and increases interoperability.
- Provides a flexible, open, standard transport for geographic information for location-based applications. Allows vendors to focus on content!

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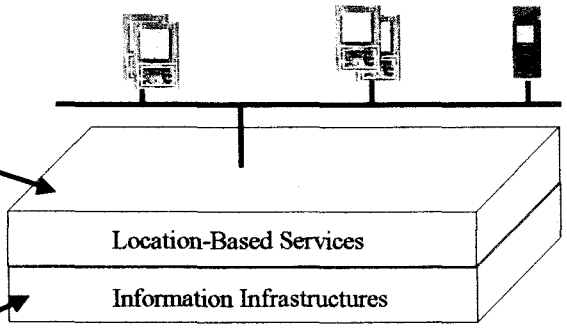
Large Scale LBS Architecture

Location Services
- routing
- tracking
- access to services
- vicinity



Wide area, integrated spatial data sets – the geo-spatial world wide web !

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Information Infrastructures!

Domain Specific Data (CRM, AVL, Telematics)

Application Data Builds on many other kinds of data !!

Housing Units | Municipal Boundaries | Other Utilities

Road Networks | Parcel Data

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Information Infrastructures!

Telco

Telephone Attachments

Utility Poles

Municipality

```
<tc:TelephonePole gml:id = "WECO1">
   <tc:carries>
          <tc:TelephoneDrop>
                 ...
          </tc:TelephoneDrop>
   </tc:carries>
   <position xlink:href = "... UtilityPole/gml:position" />
   ....
</tc:TelephonePole>
```

```
<rt:UtilityPole gml:id = "P32">
   <gml:position>
          <gml:Point srsName = "..">
                 <gml:coordinates> ... </gml:coordinates>
          </gml:Point>
   </gml:position>
<rt:UtilityPole>
```


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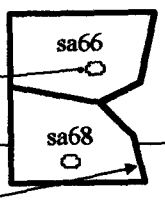
Information Infrastructures!

Serving Area

Municipal Land Parcels

Serving Area Interfaces

```
<tc:ServingArea gml:id = "Biloxia">
   <gml:extentOf>
          <gml:Polygon srsName="..">
            <gml:outerBoundaryIs>
              <gml:Ring>
                    <gml:curveMember xlink:href = " ... " />
                    <gml:curveMember xlink:href = " ... " />
                    <gml:curveMember xlink:href = " ... " />
              <gml:Ring>
            <gml:outerBoundaryIs>
          </gml:Polygon>
   </gml:extentOf>
   <servedBy xlink:href = "... #SAI36" />
   ....
</tc: ServingArea >
```



Serving Area Boundary shared with municipal boundary

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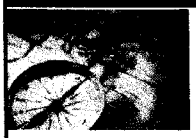

Data Integration

GML can Integrate Spatial and non-Spatial Data

Work Order

Assigned To: _____

Date: _____

StreetAddress: _____

Vehicle Route: _____

Wiring Diagram: _____

Street Address (gml:StreetAddress)

Vehicle Route (gml:Route)

Wiring Diagram (gml:Topology)

Work Order as an XML Document

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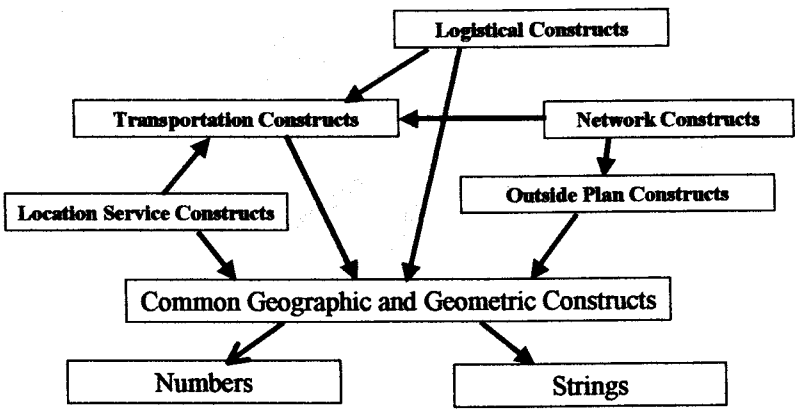
Information Community



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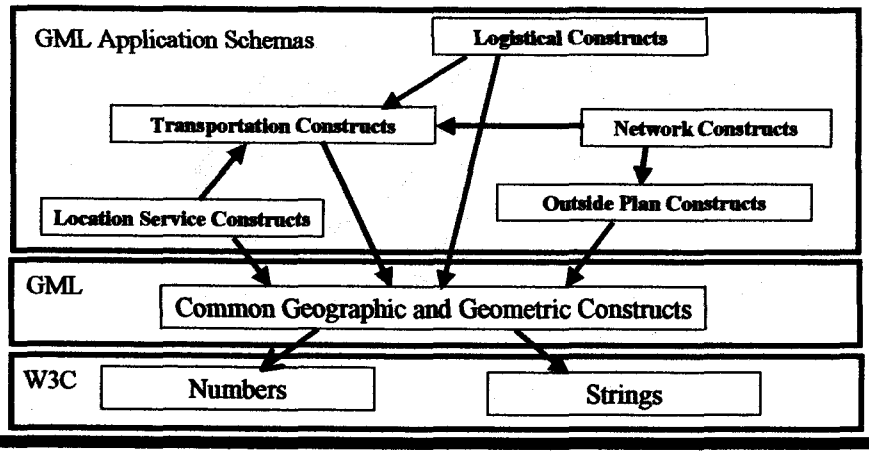
Information Community



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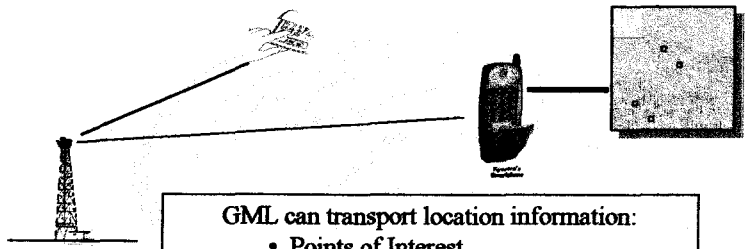
Spatial Data Transport



GML can transport location information:

- Points of Interest
- Routes
- Observations
- Qualitative Location /Postal Address

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GML Deployment

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GML Deployment

- Development of Application Schemas for Application Area
  - What existing data can I link to?
  - What data should I convert to GML?
  - What application-specific data do I create?
  - Build applications
  - Deploy Applications and new data

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Performance Issues

- GML 2.0 is text ! Without compression data volumes can be significant.
- Example: Vancouver (City Center) has 2186 features and takes 0.573 megabytes. (270 bytes/feature) (54 bytes zipped)
- Example: Vancouver (Greater City) has 76000 features and takes 25 megabytes. (340 bytes/feature) (68 bytes zipped)
- Example: Lutheran County, Pennsylvania, USA, has 4800 features and takes 3.9 megabytes (830 bytes/feature) (166 bytes zipped)
- Good news: The data is very compressible. Experiments with GZIP have provided compression factors of 5-7:1; XML-specific compression (e.g. XMil) can improve on this by a factor of 2 more.

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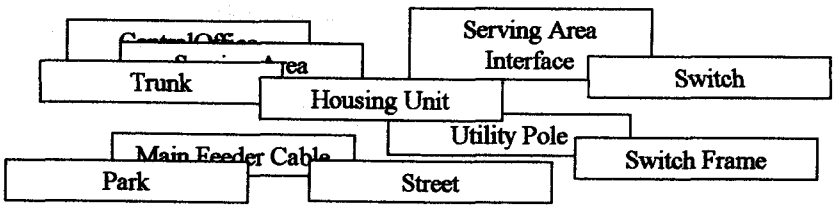
Constructing GML Application Schemas

- GML Application Schemas are necessary.
- GML Application Schemas apply to an Enterprise or an Industry.
- Tools are being developed for UML → GML Application Schema.
- GML Application Schemas provide the shared vocabulary for telecoms:



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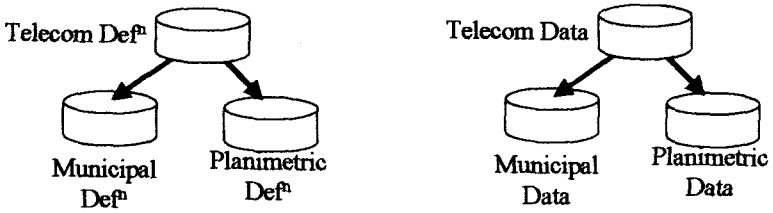
Data Conversion

- Data Conversion Tools are emerging.
- Web Feature Servers provide GML Data (no conversion)
- Schema sharing reduces conversion task
- Data sharing reduces conversion task



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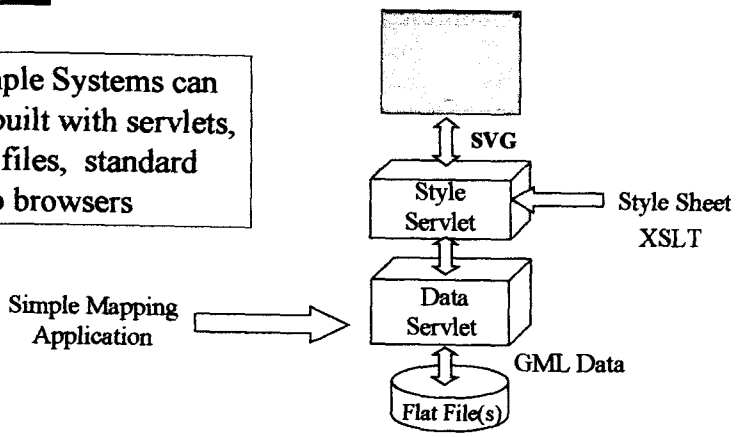
GML Implementation & Products

Simple Systems can be built with servlets, flat files, standard web browsers



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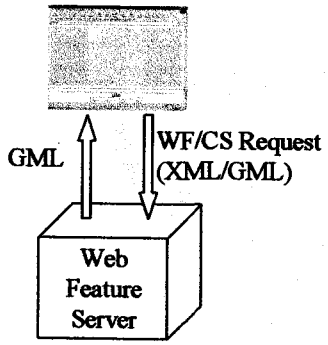
GML Implementation & Products



OGC is standardizing request & response interfaces.

GML is used in the data request and in the data response.

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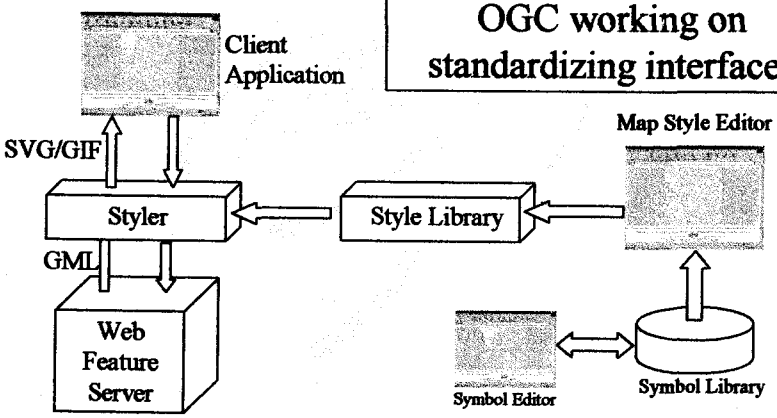
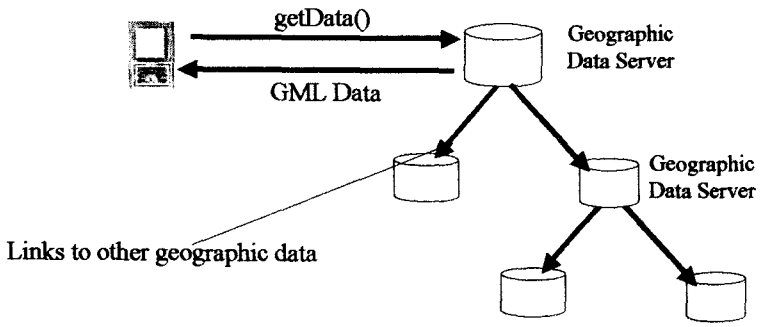
GML Implementation & Products

OGC working on standardizing interfaces



Geo-spatial Web



We build geo-spatial data on other geo-spatial data and spatial definitions

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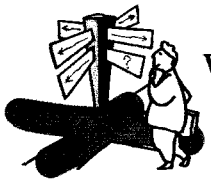

What's coming in GML ?

GML Futures !

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What's coming in GML ?

- GML 3.0 – Anticipated for December 2001
- Converge with G-XML (Japan)
- Many new features including:
  - » Topology
  - » 3D and non-linear geometries
  - » Coverages
  - » Temporal support
  - » Metadata support
  - » Units of Measure
  - » Default Styling
  - » Points of Interest

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GML 3.0

Disaster Management

- Location:
  - Geometric point (like GML 2.0) but other geometries as well.
  - Postal address with internationalization support. (FGDC compliant)
  - String address. ("corner of 5th and Hornby")
  - Keyword (from a dictionary – e.g. "Holland")
- Temporal: (based on ISO 19108)
  - Feature timestamps (time intervals, time positions)
  - Dynamic Features
  - Moving Object States

AM/FM Applications !

Location-Based Service Applications !

Customer Relationship Management

Vehicle Tracking

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GML 3.0

- Topology: (based on ISO 19107)
  - Separate topology from geometry.
  - Primitives for nodes, edges, faces and solids.
  - Handles orientation.
- Geometry Enhancements:
  - Non-linear geometries – smaller data size.
  - Curves bound polygons.
  - Polyhedral and other complex surfaces.

Utility Network Modeling, Planning & Monitoring

AM/FM

Customer Relationship Management

Traffic Management

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GML 3.0

- Points/Areas of Interest:
  - Focused on location rather than type.
  - Have simple activity or item of interest..
  - May have attached observations.
- Observations:
  - Images/multi-media content..
  - Position and time dependent..
- ViewPoints:
  - Kind of Point of Interest (direction dependent)
  - Attach observations.

Location-Based Service Applications !

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GML 3.0

- Coverages: (based on ISO 19123).
  - Distribution of quantities over surface of the earth.
  - Remotely sensed images – demographics – customer d
  - Network model – signal strength etc.
- Units of Measure:
  - Arbitrary physical quantities – physical quantity dictionaries.
  - Consistent with coverages and features.
- Reference Systems:
  - Reference System dictionaries.
  - User defined reference systems. Linear references..

Utility Network Modeling, Planning & Monitoring

Location-Based Service Applications !

AM/FM

Market Analysis

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GML 3.0

- Metadata Mechanisms.
  - Generic metadata mechanism for features, coverages etc.
  - Metadata schemas can be published and shared.
  - Metadata schemas/instances for specific domains (e.g.
- Default Styling:
  - Persistent styles for features..
  - Animation.
  - Topology Styles..

Network Modeling, Planning & Monitoring

Location-Based Service Applications !

AM/FM

Market Analysis