Web GIS: Principles and Applications

Pinde Fu, Ph.D.
pfu@esri.com
Project Lead / Senior Developer
Professional Services Division
Web GIS: Principles and Applications

Pinde Fu & Jiulin Sun

Web GIS course
Henan University, China
Contents

• Introduction
• Technical evolutions
• Applications

• Demos:
  - ArcGIS.com
  - EPHT
  - EJScreen
  - Cluster mapping
  - MWRD Incident reporting
  - ArcGIS for iOS
  - Spatial analysis online
The Web has changed everything

USPS

Washington Post / Newsweek

Blockbuster v.s. Netflix

...

New and more efficient business models have emerged, making previous models increasingly obsolete.

How does it affect you?
GIS is no exception

1962
CGIS
Roger Tomlinson
Father of GIS

1969
Internet

1990
WWW
Tim Berners-Lee
Father of the Web

1993
Web GIS
Xerox PARC Viewer

URL, HTTP, HTML

Global reach; large number of users; better cross-platform; low cost; easy to use; diverse applications
Basic System Architecture

Data tier
- GIS database server
- GIS server
- Web server
- Internet
- Client (Web browser, desktop, or mobile)
- HTTP Request
- HTTP Response
- URL
- HTTP
- HTML

Logical tier (i.e., middle tier)
- GIS server

Presentation tier
- Web server
- Internet
- Client (Web browser, desktop, or mobile)
- HTTP Request
- HTTP Response
- URL
- HTTP
- HTML

...
Evolutions

• From Web sites to Web services
• From SOAP to REST
• Web Services extended by browser side APIs
• From 3 tiers to n-tiers
• From local to the cloud
• From one way to two ways
• From wired to wireless
• More than just mapping
From Web sites to Web services

ArcGIS Server

2D Map  3D maps  Image  Geometry  Feature  Search  Tracking  Routing  Geoprocessing  Catalog

Internet
From web services to browser side APIs

Server side
- Map making and other processes
- Receive requests and send responses

Scope of Web services

Internet

Scope of browser-side APIs
- Send requests and receive responses
- Display maps, interact with users

Browser side

ArcGIS API for JavaScript, Flex, Silverlight
From 3 tiers to n-tiers

Most of today’s Web GIS applications are mashups

Impacts on NSDI, app dev, research
Web application server is used to process data such as highway incidents, highway speed, and hospital status to GeoRSS format. The processed data is then available via a mashup on smartphones using ArcGIS Mobile and a mashup in Web browsers using ArcGIS JavaScript API and AJAX.
Geoparsing, screenscraping

The internet is your geodatabase
Design pattern

Web GIS application =
   basemaps +
   operational layers +
   tools
Geoportal & Cloud GIS, hubs of today’s Web GIS
Cloud GIS

Upload data to ArcGIS Online

ArcGIS | My Map

Search for layer by:
Find: census
In: ArcGIS Online

Get help with file search

Add Layer from File

Locate the file you want to import. You can import a zipped shapefile (ZIP), a comma or tab delimited text file (CSV or TXT), or GPS data file (GPX) with up to 1000 features in it.

File: C:\Student\WebGIS\eqs7day-M2.5.txt

Tip: You can also drag and drop a CSV or GPX file from your desktop onto your map.

Import Layer Cancel

File Upload

Look in: WebGIS

Recent

Recent Files:
eqs1day-M1.txt
eqs7day-M2.5.txt
hurricane_2008.zip
Louisville_Bridges.zip
SchoolTaxDistrict.zip
TrafficCams.csv

Demo
Cloud GIS

Publish to ArcGIS Online
Lots of applications

- **e-Government**
  - Public information service
  - Two way communication
  - Operation and decision support

- **e-Business**
  - Advertisement
  - Customer service
  - Business analysis and decision support

- **e-Science**

- **daily life: the 4\textsuperscript{th} R.**
Public information service

Online, not in line
Demos

• Environmental Public Health Tracking prototype

• Harvard cluster mapping prototype

• EPA Environmental Justice Screening tool

• Florida EPHT

....
Reverse information flow & VGI

Mapping the spatial-temporal patterns of VGI, tweets, YouTube, Flickr ....

ArcGIS Server feature service
From wired to wireless

Post PC era

Application dev paths
- Native application based
- Browser based

Important client for Web GIS
Browser-based approach

- ArcGIS API for JavaScript
  - iOS

Still have access to GPS & other positioning technologies via HTML 5
Native application based approach

Esri products

ArcGIS Mobile
ArcPad
Windows Mobile
.NET Mobile

iOS
Objective C

Microsoft Windows Phone
Silverlight

Android
Java

Applications & SDKs
Demos

ArcGIS.com on iPad
ArcGIS for iOS

(my maps, data uploaded, web editing...)
More than just mapping

Pennsylvania Radio Network Outage Management
Map algebra

If one or more towers are down, Where & who will be affected?

ArcGIS Flex Viewer
Demos

- Geospatial analysis online
  - Publish a geoprocessing service
  - Use it via JavaScript and ArcGIS Flex Viewer
User Experience Design Principles

1. Make it fast.
   “Don’t make me wait”

2. Make it simple.
   “Don’t make think”

3. Make it enjoyable.
   “Let me have fun!”

ArcGIS APIs for JavaScript Flex and Silverlight
ArcGIS Explorer
Technologies

Server:
- Author with ArcGIS Desktop
- ArcGIS Server, ArcGIS.com Cloud

Client:
- Geoportal
- Connect and use

ArcGIS.com Catalog:
- Search and discover
- Metadata

Publish:
- No programming

Programming:
- Web APIs, Mobile APIs, ...

ArcGIS.com, ArcGIS Explorer, ArcGIS Flex Viewer, ArcGIS for iOS/Android ...
## Web GIS Course

<table>
<thead>
<tr>
<th>Lectures</th>
<th>Labs</th>
</tr>
</thead>
<tbody>
<tr>
<td>GIS in the Web era</td>
<td>Build a Web GIS application Using ArcGIS Online</td>
</tr>
<tr>
<td>Cloud GIS</td>
<td></td>
</tr>
<tr>
<td>Web Services Overview</td>
<td>Publish and use your own map service</td>
</tr>
<tr>
<td>Web Services optimization</td>
<td>Optimize your map services</td>
</tr>
<tr>
<td>Web Services Standards</td>
<td>Animate your space-temporal data</td>
</tr>
<tr>
<td>Geospatial mashup (I)</td>
<td>Use ArcGIS Viewer for Flex</td>
</tr>
<tr>
<td>Geospatial mashup (II)</td>
<td>Configure ArcGIS Viewer for Flex</td>
</tr>
<tr>
<td>ArcGIS API for JavaScript (I)</td>
<td>Build a Web GIS application using JavaScript (I)</td>
</tr>
<tr>
<td>ArcGIS API for JavaScript (II)</td>
<td>Build a Web GIS application using JavaScript (II)</td>
</tr>
<tr>
<td>Volunteered Geographic Information and Web Editing</td>
<td>Map social media data</td>
</tr>
<tr>
<td>GIS Analysis on the Web</td>
<td>Publish and use feature services; Publish and use geoprocessing services</td>
</tr>
<tr>
<td>Mobile GIS; Web GIS Applications in e-Bus &amp; e-Gov</td>
<td>Use ArcGIS for iOS and Android; Application case studies</td>
</tr>
<tr>
<td>Web GIS Frontiers and Prospects</td>
<td>Preview the next release of ArcGIS Server</td>
</tr>
</tbody>
</table>

Student final project presentation
Technologies covered

1. ArcGIS.com (with free account)

2. **ArcGIS Server**
   - local or in Amazon cloud
   - One server shared by multiple users

3. ArcGIS Viewer for Flex (free)
4. ArcGIS API for JavaScript (free)
5. ArcGIS for iOS and Android (free)

6. ArcSDE + Postgres (or SQL Express…)
7. ArcGIS Model Builder or Python
Challenges, science, research areas

- Security
- Reliability
- Scalability
- Privacy
- Data quality and uncertainty
- Standards and Interoperability
- Semantic interoperability
- Copyright
- Business models
- Dynamic Demography
- …
Questions?

Pinde Fu
pfu@esri.com

Adding Web GIS to your curriculum!