CityMap SDK: Assembling Web Services into a Batch Geocoding Application

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Objectives

1. Why web services?
2. Which services were useful?
3. How can we demonstrate their utility?
4. What has gone wrong?
1. Introduction and Overview of CityMaps
2. Toward a CityMaps SDK
3. Web Services
4. Batch Geocoding Application
5. Lessons Learned
CityMaps: Aerial Photo

Address: 1911 BRANDYWINE ST

The red star indicates an approximate address location.
CityMaps: Zoning

- Developed for a business purpose
- Custom symbology
CityMaps: Nearest Facilities

<table>
<thead>
<tr>
<th>Name</th>
<th>Address</th>
<th>Distance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hahnemann University</td>
<td>Broad &amp; Vine Sts Mail Stop 400</td>
<td>3,103 ft.</td>
</tr>
<tr>
<td>Hospital</td>
<td></td>
<td>0.59 mi.</td>
</tr>
<tr>
<td>St Joseph Hospital</td>
<td>16Th St &amp; Girard</td>
<td>3,203 ft.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.61 mi.</td>
</tr>
<tr>
<td>Magee Rehabilitation</td>
<td>Six Franklin Plaza</td>
<td>2,823 ft.</td>
</tr>
<tr>
<td>Hospital</td>
<td></td>
<td>0.52 mi.</td>
</tr>
</tbody>
</table>
CityMaps

• TODAY:
  – Applications that use the City’s spatial data
  – Uses ArcIMS and Windows 2000 to serve maps and spatial services to public

• TOMORROW
  – Tools for incorporating spatial intelligence into City business processes

Important: CityMaps is just one window on a much larger infrastructure
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What is CityMaps?

- Address Parsing and Location (Geocoding)
- Mapping Services
- Point-in-Polygon Service
- Nearest Location Service

9 July 2003: ESRI User Conference

Robert Cheetham
Integrating GIS with City Business

- CityMaps and the Web-based GeoServices should be treated as the way in which agencies interact with spatial data and services.
- We want to minimize the amount of work required to both implement new services and maintain existing ones.
Different ways to Integrate?

- EXTERNAL: Phila.gov agency sites
- EXTERNAL: City-affiliated sites - PPDOnline.org, CDC’s, etc.
- INTERNAL: Agency web sites and applications
- INTERNAL: Agency desktop applications
Integrating GIS with City Business

- Multiple application could obviously be developed independently, but there are obvious advantages to developing a range of techniques to plug them in:
  - Single set of current data
  - Projects costs less
  - Better services
  - Better coordination
  - Re-usable/shared building blocks encourage standardization and interoperability
  - Common user interface standard
Lots of Moving Parts

- Windows 2000
- IIS
- ArcIMS
- .Net Framework
- Oracle
- ArcSDE
- Firewall/DMZ
- Networks
- CityMaps components

Q. How can we make it easier to deploy these capabilities to agencies?
CityMaps SDK

Toolkit for Spatially Enabling Applications

What’s in the toolkit?

- Customizable set of building blocks for embedding spatial intelligence in agency applications
- URL-based request capability
- Set of Templates for quickly generating map-based enterprise applications + Configuration Wizard
- Documentation
- Parameterized Configuration
- Same look and feel on any application (zoom tools don’t change, for example).
- Standards-based API → Web Services
SDK: URL-based Requests

moisMapActionOrtho.asp?ADDRESS=340+N+12TH+ST
SDK: Map Templates

• Configuration Wizard - desktop application that interacts with ArcIMS, sets up a virtual directory, copies files to target directory, creates and edits XML configuration files.

• Further Parameterization

• Add new features
  - Email a map
  - Generate PDF of a map
  - Identify feature (for future parcel map)
Storm Drains

- Ad Hoc
- Developed in 6 hours
SDK: Parameterized Configuration

```xml
<?xml version="1.0" ?>
<citymaps>
  <parameters type="APPLICATION">
    <parameter name="APPLICATION_NAME" value="CityMaps" />
    <parameter name="APPLICATION_VERSION" value="1.2" />
    <parameter name="APPLICATION_OWNER" value="Mayor's Office of Information Services" />
    <parameter name="APPLICATION_OWNER_LOGO" value="" />
    <parameter name="SDE_SERVER_NAME" value="" />
    <parameter name="SDE_INSTANCE_NAME" value="" />
    <parameter name="SYSTEM_DATABASE_WILDCARD_SYMBOL" value="" />
    <parameter name="SYSTEM_DATABASE_CONNECTION_FILE" value="" />
    <parameter name="SYSTEM_DATABASE_CONNECTION_PASSWORD" value="" />
    <parameter name="AIMS_SERVER_NAME" value="ASPEN" />
    <parameter name="AIMS_SERVER_PORT" value="5300" />
    <parameter name="AIMS_GEOCODING_SERVICE_NAME" value="" />
    <parameter name="AIMSORTHOPHOTOGRAPHY_SERVICE_NAME" value="" />
    <parameter name="AIMS_AREA_CENTERLINE_LAYER" value="street_centerline" />
    <parameter name="AIMS_OVERVIEW_MAP_WIDTH" value="280" />
    <parameter name="AIMS_OVERVIEW_MAP_HEIGHT" value="300" />
    <parameter name="AIMS_EXTENT_WIDTH" value="1500" />
    <parameter name="AIMS_EXTENT_HEIGHT" value="1000" />
    <parameter name="AIMS_AREA_SEARCH_RADIUS" value="150" />
    <parameter name="ZONING_SERVICE_LAYERS_MIN" value="7" />
    <parameter name="ZONING_SERVICE_LAYERS_MAX" value="16" />
    <parameter name="ZONING_UPDATE_SQL" value="SELECT MAX(a.SOURCE_UPDATE_DATE) as SOURCE_UPDATE_DATE from AREA a, SOURCE s WHERE s.SOURCE_ID = a.SOURCE_ID and s.SOURCE_UPDATE_DATE > a.SOURCE_UPDATE_DATE" />
    <parameter name="ZONING_CODE_URL" value="http://maps.phila.gov/zoning_codes/" />
  </parameters>
</citymaps>
```
SDK: Documentation

CityMaps version 1.2
City of Philadelphia, GIS Service Group
SDK: Web Services

- SOAP-based
- Intranet-use only
- Sample app for batch geocoding
- Authentication
- Address Parsing, Spell-checking, Aliasing
- Geocoding
- Point-in-Polygon
- Nearest Location
- Map/PDF Generation
DISTRIBUTED GEO SPATIAL SERVICES

GIS Warehouse

ULRS Warehouse

DESKTOP GIS CLIENTS (E.G., ARCVIEW)

CUSTOM EXTENSIONS

GIS WAREHOUSE

ULRS GEOWEB SERVICES

ENTERPRISE & DEPARTMENTAL APPLICATIONS

NEIGHBORHOOD INFORMATION SYSTEM (NIS)
(UNIVERSITY OF PENNSYLVANIA)

CITYMAPS SDK

GEOWEB SERVICES
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Service: Authentication

- Created to address potential for unauthorized use
- Developed in anticipation of future availability in the DMZ

- 2 Methods accepted:
  - IP Address
  - User Name/Password
  - Returns a token that can be passed to other services

- Not currently required as app is only for intranet use and don’t want performance hit
Service: Address Geocoding

- Custom SpellChecker
  - Place Name aliases
  - Street Name aliases (w/ ranges)
  - Street Type aliases

- Custom Geocoder
  - Uses MasterAddress and MasterIntersection tables rather than spatial data
  - Very fast

- Falls back to ArcIMS and street centerline for failed addresses

- XML configuration files
Service: Service Areas

- Service Areas are polygon feature classes stored as shapefiles or in geodatabase

- Point-in-Polygon for most service areas
  - Uses ArcIMS Phila_ServiceAreas map service

- Find Nearest Arc necessary for some service areas
  - Streets Department has feature classes in which both sides of a street are in same service area.
  - Separate polyline feature class for these.
  - Check for proximity to such an arc for these service areas
Service: Service Areas

- Requests submitted to ArcIMS map service as a query with spatial filter
- Responses returned as XML document string with service area id and label
- XML configuration files
Service: Nearest Facilities

- Facilities are points stored as ArcSDE layers in City’s Enterprise GIS server

- 2 Methods Provided:
  - FindNearestLocation()
  - FindLocationsWithinRadius()

- Requests submitted to ArcIMS map service as a query with spatial filter

- Responses returned as XML document string with locations, labels, x/y coordinates and distance

- XML configuration files
Service: Map/PDF Generation

- Request for maps are defined using a ReportRequest object (XML)

- 2 Objects Provided:
  - MapImage - returns 1 or more PNG file locations
  - MapReport - returns a PDF file location

- Map Image requests submitted to ArcIMS map service

- MapReport requests generate PDF files using ABCpdf
Service: Map/PDF Generation

- Responses returned as modified ReportRequest (XML)
- ReportRequest object has many elements to set optional parameters that include an envelope, layer visibility, user name, etc.
- XML configuration files
Service: Activity Tracking

- Web logs are rarely sufficient

- We want to understand:
  - Which applications are being used?
  - By whom?
  - When did geocoding fail?
  - Specialized info for batch geocoding
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Process

GeoProcessing Queue polls DB

Pending Action?

Yes

Notify User via E-Mail

Write to Activity Log

Create Output FileCatalog (XML)

Create Output MDB file

Geocode, ServiceRequest, Nearest Facility

No

Export to XLS or TXT if necessary

Export to SHP

Create Map Image

Create PDF

Notify User via E-Mail

Pending Action?

Yes

Notify User via E-Mail

Write to Activity Log

Create Output FileCatalog (XML)

Create Output MDB file

Geocode, ServiceRequest, Nearest Facility

Export to XLS or TXT if necessary

Export to SHP

Create Map Image

Create PDF

Notify User via E-Mail
Batch Geocoding App

Request Parameters

1. Thank you. Your request has been submitted to the CityMaps Geocoding Engine. You will receive a confirmation e-mail shortly.
2. When the request has been processed, you will receive a second e-mail informing you how to retrieve the results.
3. The request ID for your geocoding job is 1045. Please use this id in any correspondence with the system administrators.
4. To check the status of your request, you may point your browser to http://localhost/CM_BatchGeocoder/mbatchPickup.aspx?

ID=1045

E-mail Address: cheetham@pobox.upenn.edu
Uploading Filename: CHEALDCYM. mdb
Address Table: Addresses
Address Field: address
ID Field: name
Output File Type: .txt
Project Title: Batch Geocoding Project
Create PDF: true

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For comments and suggestions, please contact the GIS Services Group at citymaps@phila.gov

This application was designed and developed by Avenica Incorporated and the Mayor’s Office of Information Services
Batch Geocoding App

Zooms to the extent of active themes
Additional Services

- **Server Components**
  - PageClass
  - Navigation Menu
  - CheckBoxList

- **Queue Manager and Queue Service**
  - Windows Service
  - Queue Database

- **Service Request Manager**
  - GeoProcessor class
  - Mailer class
  - ServiceRequest class (XML document)
  - ServiceReponse class (XML document)
Additional Services

- **Address Request Manager**
  - FileCatalog class (XML document)
  - ForeignFile class (reads and generates Access, Excel, Text, SHP, etc.)

- **Shapefile Generator**
  - MapObjects (would prefer ArcGIS Engine) - wrapped in RCW
  - Zip component (for assembling shapefile pieces)

- **GML Generator**
  - Not currently used b/c want to support DBF/Excel/TXT
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Lessons Learned

- XML is good, long live XML!!
  - XML for Configuration
  - XML for passing messages
  - AXL for ArcIMS work
- SOAP is good over the wire, but don’t use it locally or for .Net apps that are nearby on the network
  - Verbose
  - Too Slow
  - Unnecessary
- Web Services are rarely sufficient for a complete application
- Create Components first, add web service as a facade
- We can’t wait for ArcGIS Engine and ArcGIS Server
  - ArcIMS is not best solution for FindNearest and PointInPoly services
  - We’d prefer to use ArcObjects for PDF generation, shapefile generation and other functions
Things we like

- **Message Queue Service** works really well for asynchronous processing - We were expecting this to be difficult, but .Net Framework made development of Windows service very straightforward.

- **Geocoding, Service Requests and Nearest Facilities** are really fast - but we think Service Requests and Nearest Facilities could be dramatically faster using ArcGIS Engine or ArcGIS Server rather than ArcIMS.
Things we don’t like

- **More testing required** - b/c we didn’t use web services for sample app, we need to do more testing before rolling out to agencies and will also have to produce some more sample apps.

- **Flying blind** - we’re a little ahead of where most agency developers are, so we are uncertain how much the web services or the batch geocoding will be used. It’s tough to spec and purchase equipment in that environment.

Technologies

Software
- ArcIMS
- ArcSDE
- MapObjects
- Web Supergoo ABCpdf
- Visual Studio .Net

Hardware
- Application Server: Dual Processor Xeon Server
- Database Server: HP Unix server + Hitachi storage array enterprise GIS server