

NSDI Cooperative Agreements Program

Category 7: Geospatial Platform Cloud Service Test bed

Interim Report

Date: November 1, 2012

Agreement Number: G12AC20138

Project title: **Category** 7, IndianaMap Cadastral Cloud Implementation

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Collaborating Organizations: Indiana Office of Technology (IOT), Indiana Geographic Information Council (IGIC), Indiana University Science Gateways Group and the Polis Center IUPUI.

Executive Summary

The primary objective of this project is to evaluate the technical issues, opportunities, and costs associated with deployment and geoprocessing of IndianaMap Cadastral data in FGDC GeoCloud Platforms. The IndianaMap portals were developed to provide a central single-source repository of data to support transportation planning, economic development, environmental assessment, and emergency response. The Indiana Office of Technology (IOT) working with the Indiana Department of Homeland Security (IDHS), and the Indiana Geographic Information Council (IGIC) have developed a strategy for creating a seamless parcel map for Indiana. Indiana IOT harvests parcel data from county web feature services monthly. The process includes integrated Spatial ETL (Extract, Transform, and Load) tools to build a seamless statewide parcel feature class. Currently 85 of 92 counties containing 3,225,000 parcels are included in the statewide layer.

We are testing and comparing Amazon-based deployments of GeoServer and Arc GIS Server. In order to benchmark test the cloud-based geospatial server implementations, we are developing a parcels search query application by defining a circular buffer around a given point. Upon execution of the query, the search results will be displayed and analyzed for parcel property characteristics and attributes. We will randomize the point location and the radius of the buffer in order to simulate the parcels search query application an arbitrary number of times for comprehensive benchmark testing.

Project Narrative

The list of project activities completed through November 8, 2012 is listed below.

Preparation of Parcel Data: We worked with IOT and IGIC to develop the latest harvest and enhance the statewide dataset by joining additional attributes from the state property appraisal system. No issues encountered. Figure 1 is screen capture of the August 2012 Indiana Harvest Parcel coverage.

Delivery file name: GISStatewide_Parcels_101212_NO_BOONE.gdb
Projected Coordinate System: NAD_1983_UTM_Zone_16N
Projection: Transverse_Mercator
Total Record Count: 3,221,920 parcel polygons

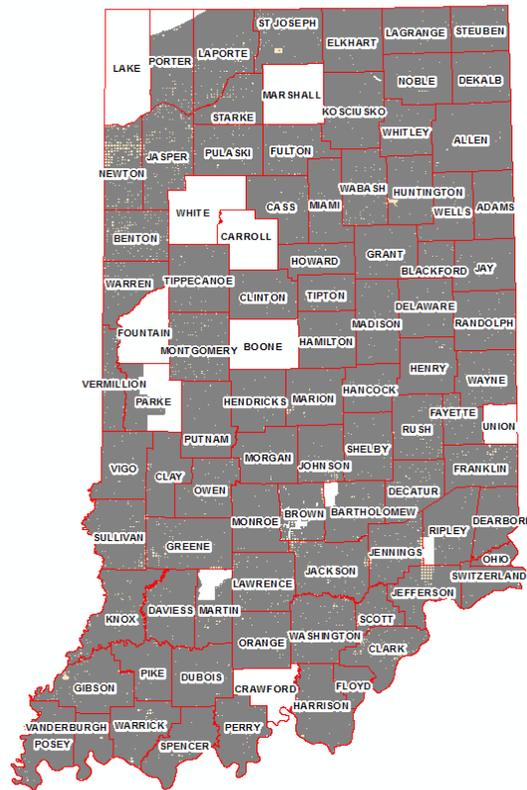


Figure1 August 2012 Indiana Harvest Parcels

OGC Web Services Development

Cloud Deployment: The team explored and experimented with the GeoCloud Sandbox environment, and established the project prototype in Amazon Elastic Computing Cloud (EC2), using Amazon Identity and Access Management (IAM) for access control of developers and collaborators. We setup two Amazon EC2 on-demand instances for the ArcGIS and Geoserver deployment. Each deployment is associated with an Elastic IP (EIP) address.

Details of the ArcGIS Server

The ArcGIS server instance is a M1 Large Instance of Windows Server 2008, running ArcGIS Server 10.0 SP1. The team created a service using ArcGIS server management application. The instance was created using the Amazon Machine Image (AMI) provided by ESRI. We encountered some licensing issues with ArcGIS Server. The team resolved the licensing issues with ESRI help.

- GIS Server: ArcGIS Server 10.0 SP1
- Geospatial Data: ESRI file geodatabase
- Parcel service API's

http://54.243.151.133/ArcGIS/services/MIBOR_Statewide_Parcel/MapServer

http://54.243.151.133/ArcGIS/services/MIBOR_Statewide_Parcel/MapServer/WMServer

http://54.243.151.133/ArcGIS/services/MIBOR_Statewide_Parcel/MapServer/KmlServer

http://54.243.151.133/ArcGIS/services/MIBOR_Statewide_Parcel/MapServer/WFSServer

Details of the GeoServer Server

The GeoServer instance is a M1 Medium Instance of Ubuntu Server 12.04.1 LTS. State parcels data is loaded into PostgreSQL, and published with GeoServer. Figure 2 shows accessing WMS service with desktop GIS.

- GIS Server: GeoServer 2.2.1:
- Geospatial database: PostgreSQL 9.1 with PostGIS 1.5 extension
- WMS service: <http://54.243.214.240:8080/geoserver/cloudgis/wms>
- WFS service: <http://54.243.214.240:8080/geoserver/cloudgis/wfs>
- Layer preview: <http://54.243.214.240:8080/geoserver/web/>

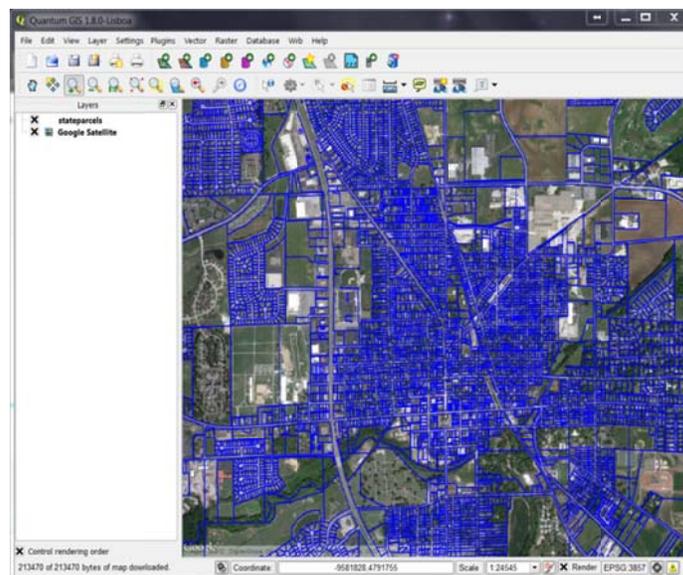


Figure 2 Access WMS service with desktop QGIS (<http://http://www.qgis.org/>)

Query Development: The team prototyped and preliminarily tested example parcel search queries with the Geoserver deployment. Querying parcels by defining a circular buffer around a given point was accomplished with CQL_Filter support for both WMS and WCS services. Two example queries were developed.

Example 1: query parcels within 2000 meters of the point (573570.19322 4405157.43581)

[http://54.243.214.240:8080/geoserver/cloudgis/wms?service=WMS&version=1.1.0&request=GetMap&layers=cloudgis:stateparcels&bbox=571000,4402800,576000,4408000&width=600&height=600&sr s=EPSG:26916&format=image/png&cql_filter=DWithin\(geom, Point\(573570.19322 4405157.43581\),2000,meters\).](http://54.243.214.240:8080/geoserver/cloudgis/wms?service=WMS&version=1.1.0&request=GetMap&layers=cloudgis:stateparcels&bbox=571000,4402800,576000,4408000&width=600&height=600&sr s=EPSG:26916&format=image/png&cql_filter=DWithin(geom, Point(573570.19322 4405157.43581),2000,meters).) The output is shown in Figure 3.



Figure 3 Example of spatial query with a circular buffer

Example 2: Query single family residential within 2000 meters of the point (573570.19322 4405157.43581) single family residential is defined by property_class_code =510-515.

[http://54.243.214.240:8080/geoserver/cloudgis/wms?service=WMS&version=1.1.0&request=GetMap&layers=cloudgis:stateparcels&bbox=571000,4402800,576000,4408000&width=600&height=600&sr s=EPSG:26916&format=image/png&cql_filter=DWithin\(geom, Point\(573570.19322 4405157.43581\),2000,meters\) and property_class_code between 510 and 515](http://54.243.214.240:8080/geoserver/cloudgis/wms?service=WMS&version=1.1.0&request=GetMap&layers=cloudgis:stateparcels&bbox=571000,4402800,576000,4408000&width=600&height=600&sr s=EPSG:26916&format=image/png&cql_filter=DWithin(geom, Point(573570.19322 4405157.43581),2000,meters) and property_class_code between 510 and 515) The output is shown in Figure 4.



Figure 4 Example of spatial and attribute query with a circular buffer

Example 3: Generator KML file for single family residential within 2000 meters of the point (573570.19322 4405157.43581). The examples with Google Earth are shown in Figure 5 and Figure 6.

[http://54.243.214.240:8080/geoserver/cloudgis/wms/kml?layers=cloudgis:stateparcels&cql_filter=DW within\(geom, Point\(573570.19322 4405157.43581\),2000,meters\) and property_class_code between 510 and 515](http://54.243.214.240:8080/geoserver/cloudgis/wms/kml?layers=cloudgis:stateparcels&cql_filter=DW%20within%28geom%2C%20Point%28573570.19322%204405157.43581%29%2C2000%2Cmeters%29%20and%20property_class_code%20between%20510%20and%20515)

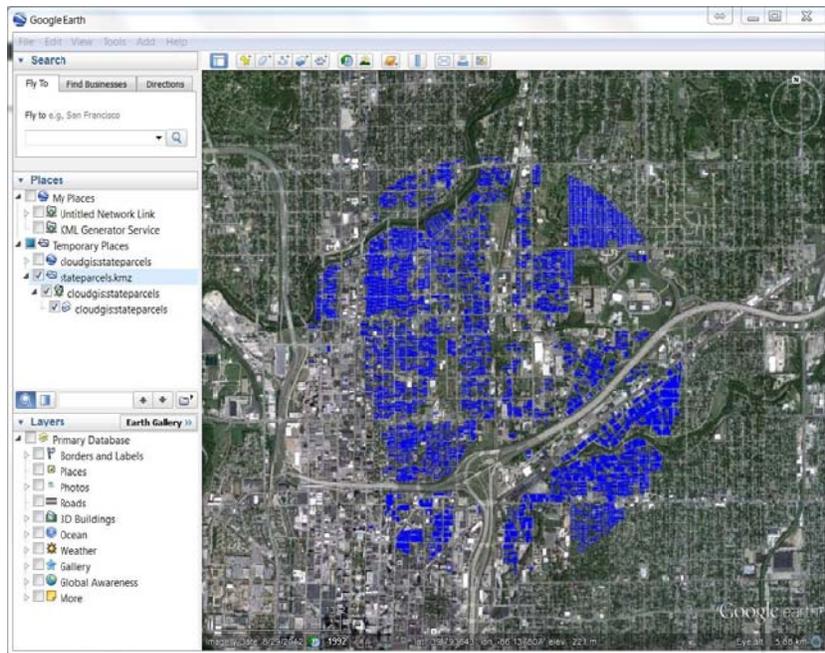


Figure 5 Sample KML in Google Earth

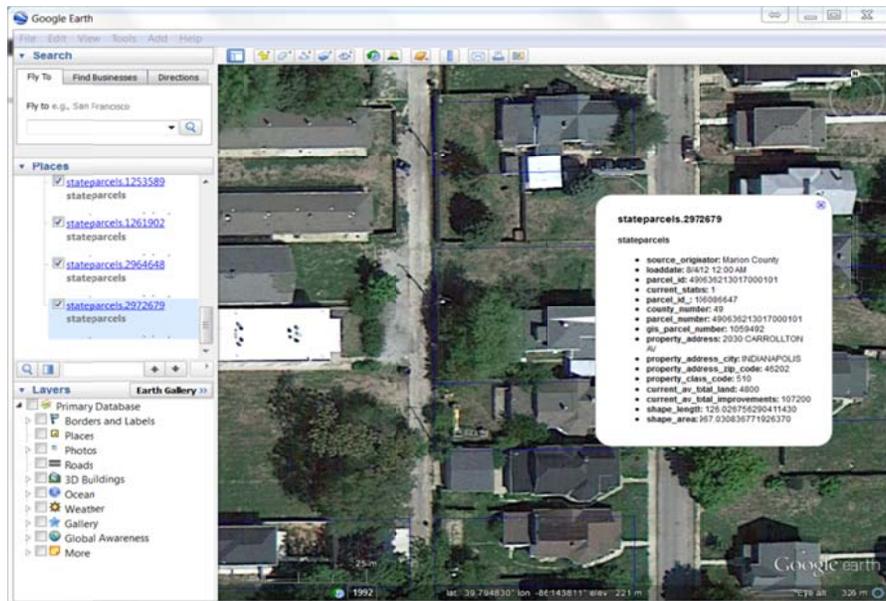


Figure 6 Sample KML in Google Earth: displaying parcel information

Next Steps

Over the next several months, the team and greater Indiana GIS community will provide feedback on the Amazon deployment. The following tasks describe the next steps.

1. Develop the full-featured parcel search query application that interacts with both ArcGIS and Geoserver;
2. Generate comprehensive, randomized, and automated query sets for benchmarking;
3. Compare the performance between the currently deployed ArcGIS and Geoserver instances;
4. Upgrade the Amazon Geoserver instance to be of comparable hardware with the ArcGIS instance, and compare the corresponding performance;
5. Compare server hosting costs among the three Amazon instances;
6. Deploy the Geoserver software stack on an in-house Intelligent Infrastructure VM, update the VM to be comparable hardware of the Amazon instance;
7. Compare the Geoserver performance between the in-house deployment and the Amazon deployment;
8. Compare the costs between the in-house deployment and the Amazon deployment;
9. To simulate wide area user access, query searches will be initiated from both Windows and Linux client in VMs located in different Amazon EC2 regions, as well as from in-house user desktops;
10. Invite typical users to test the system for feedback.