

## Description of Application

**Operating Organization:** Coeur d'Alene Tribe, Plummer, Idaho

**Community of Interest:** U.S. Indian tribes and their governments; rural governments

**OS and software requirements:** Microsoft Windows Server 2012; ESRI ArcGIS Server, SDE, Desktop version 10.1; Microsoft SQL Server 2008 R2

## Operational Requirements

**Image type (RAM, local disk):** Instance type on both remaining servers is an Amazon EC2 m1.large with 2 vCPU and 7.5 GB of memory

**Data storage:** Data storage on first test server (CDA Tribe GeoCloud Project) is 30 GB for the boot drive and 200 GB for the data drive. On the second test server (CDA Tribe GeoCloud Project From ESRI AMI), boot drive is 35 GB and the data drive is 100 GB.

**Upload monthly:** Minimal. One time upload of test data was about 50 GB

**Download monthly:** None

**Elastic IP:** None

**Redundancy and Load balancing:** None

**Backup (snapshot) requirement:** None

## Deployment in the Cloud

**Using shared platform images:** We used a shared AMI from ESRI on our second server to test the ease of setting up a cloud server from an image

**Loading application with data:** Data was uploaded from our Tribal GIS web server using standard http data transfer protocols

**Customizing application suite:** No customization was used. Standard out-of-the-box configuration for ArcGIS Server was used

**Installation scripting:** No installation scripting was used or needed

**Agency approach to system C&A:** Extremely limited; all testing was done by the GIS Analyst assigned to the project and since the Coeur d'Alene Tribe is a sovereign nation, we decide what is acceptable for certification and accreditation.

## Operations in the Cloud

**Monitoring of operations:** Monitoring consisted of the assigned GIS Analyst performing tests to access the web maps on the server and observing performance

**Configuration of services and volumes:** Configuration of services was performed directly on the server. Since there was little customization on either of the cloud servers, configuration was minimal. It was just a basic ArcGIS Server with the default configuration and security.

### Monthly usage, costs, (tables and charts):

#### Amazon Web Services EC2 Monthly Usage and Cost Coeur d'Alene Tribe GeoCloud Project

Month	AWS Data Transfer	Amazon Elastic Compute Cloud	Amazon Simple Storage Service	Total
September, 2012	\$0.00	\$1.38	\$0.00	\$1.38
October, 2012	\$0.00	\$26.59	\$0.00	\$26.59
November, 2012	\$0.00	\$364.33	\$0.00	\$364.33
December, 2012	\$0.00	\$375.82	\$0.00	\$375.82
January, 2013	\$0.00	\$375.84	\$0.00	\$375.84
February, 2013	\$0.00	\$617.01	\$0.00	\$617.01
March, 2013	\$0.00	\$1,652.48	\$0.00	\$1,652.48
April, 2013	\$0.00	\$401.74	\$0.00	\$401.74
May, 2013	\$0.00	\$242.90	\$0.00	\$242.90
June, 2013	\$0.00	\$242.90	\$0.00	\$242.90
July, 2013	\$0.00	\$242.90	\$0.00	\$242.90
August, 2013	\$0.00	\$242.90	\$0.00	\$242.90
September, 2013	\$0.00	\$242.90	\$0.00	\$242.90
October, 2013	\$0.01	\$264.46	\$0.02	\$264.49
November, 2013	\$0.01	\$263.81	\$0.00	\$263.82
December, 2013	\$0.01	\$178.34	\$0.00	\$178.35
Totals:	\$0.03	\$5,736.30	\$0.02	\$5,736.35

**Performance discussion:** We found little difference in performance between Amazon's EC2 cloud servers and our own on-site servers at the Coeur d'Alene's IT data center. Since we were not really allowed to publish these web map addresses to the public, we could only rely on our own use of these servers and compare the performance to our fairly lightly used internal servers. There are substantial differences in the design of our current ArcGIS Server system compared to what we had on Amazon's servers. All of our GIS and database servers are virtualized and so we run 5 virtual machines running ArcGIS Server in parallel. Our database server and GIS web map server are on separate virtual hosts on a separate host computer. The GIS Analyst assigned to this project did not end up having the time to set up the Amazon system similarly. Also, using this configuration on the cloud would be pretty cost prohibitive. For only being a single, fairly lightweight, virtual server running all of the database, ArcGIS Server and web services, the Amazon servers did admirably.

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## Operational cost comparison (extrapolate to one year)

Here is our monthly cost comparison:

Based on current Coeur d'Alene Tribe Servers

Fixed (one-time) costs

Physical Servers	Cost	Drive Space (GB)
Dell PE R710 Server (Microsoft Hyper-V Server 2012 host	\$20,496.00	
2, Xeon X5670 6 core processors		
96 GB RAM		
8, 146 GB 15K RPM SAS drives		
Windows Server 2012 Datacenter		945
Dell PV MD1220 Disk Array	\$16,859.00	
12, 300 GB 10K RPM SAS drives		
12, 300 GB 15K RPM SAS drives		5,920
Totals:	\$37,355.00	6,865
Two server totals:	\$74,710.00	13,730

Servers are on 24 hours, 7 days a week

Virtual Servers (on two physical hosts)	Quantity	vCPU's	Memory (GB)	Drive Space (GB)
ArcGIS Servers	5	10	50	150
Microsoft SQL Server 2012	1	6	50	3,867
ArcGIS Web map host (ArcGIS Web Adaptor)	1	4	4	380
Portal for ArcGIS	1	4	4	130
				4,527
Other storage provided by the virtual hosts:				9,203
Total storage:				13,730
Monthly cost over a 5 year lifespan:				\$1,245.17
Monthly cost over a 7 year lifespan:				\$889.40

Note: this configuration still has the capacity to add 2 to 4 additional virtual servers.

Amazon EC2 costs (US West, Oregon)				
Comparable Servers	EC2 Instances	Quantity	Hourly Rate	24 X 7 Monthly Cost
ArcGIS Server	m3.xlarge	5	\$0.450	\$1,641.60
Microsoft SQL Server	m3.2xlarge	1	\$2.844	\$2,074.98
ArcGIS Web map host (ArcGIS Web Adaptor)	m3.xlarge	1	\$0.450	\$328.32
Portal for ArcGIS	m3.xlarge	1	\$0.450	\$328.32
12 TB Additional Storage at \$0.10/GB-month		12,288		\$1,228.800
Note: costs do not include Elastic IP's or Load Balancing			Monthly total:	<b>\$5,602.022</b>
			Yearly total:	\$67,224.27

If you need servers that are on 24 hours a day, seven days a week, it would appear that owning your own is far more cost effective, at least on a small scale which is similar to our configuration. You could probably make some changes in the EC2 configurations and maybe not run them 24/7, but I don't think you would get the costs down to what our physical ownership is. Granted this comparison doesn't include the cost of maintaining the hardware, but with our Dell servers, one of which is going on 5 years old, there seems to be very little time spent maintaining them. We have an older Dell that is going on 8 years that is still going strong with little maintenance needed. Most of the maintenance time is spent on operating systems and other software and both configurations are pretty much the same that way. Hardware costs amount to replacing one or two hard drives a year, a cost that is usually less than \$1,000 per year for each server. It should also be noted that this configuration of our physical servers doesn't match exactly to what we currently have. Our two servers are identical (except for attached drive space), but we also have an additional older file server with about 5 TB of storage, and additional external arrays attached to the other two Dell PE R710's.

**Telecommunications:** Not sure what you want here . . .

**Operations and maintenance support:** See the above cost analysis.

**Security plan development and approval:** Since ours was just a test server with no real access to the outside world, security was limited to putting data on it that was not sensitive; typically just data that was already public or was derived from public data.

## Issues and Lessons Learned

**Security approval process:** We had very little issue getting approval from our IT department with the stipulation that no sensitive or valuable data was put on our cloud servers for the test period.

**Recommendations on C&A:** None.

**Software deployment:** Software deployment is pretty much the same on both systems.

**Time-to-deploy:** Deployment time is very similar, especially in our Microsoft Hyper-V system. It takes me about 15 minutes to bring up a new server on our system from one of my templates. It probably takes somewhat less time on the Amazon cloud, but the difference is pretty meaningless.

**Failover, redundancy:** This is probably where the Amazon system has us beat, but we are not an organization that can't afford to be down. If I have to rebuild a server, which I have many times in the past, it rarely takes me longer than 8-12 hours to do. If I have to restore data from backups, that could take another day, possibly two to complete.

**Project planned future environment:** For the foreseeable future, we will probably still purchase physical servers to meet our computing and storage needs. Two years ago, the Coeur d'Alene Tribe purchased a large, integrated computing system from Dell (PE M1000e) for most of our non-GIS tribal government needs that has a lot of capacity both in servers and storage. All of the physical blade servers in this system are virtualized and we have move most of our single server servers over to it. This is the most likely scenario I believe the Tribe will follow. When it is time for our GIS group to move to new servers, we will probably continue to purchase something similar to what we already have because we have so much invested in fast external direct attached storage that is still functioning, some of it since about 2001.