

System Architecture for the Montgomery County Department of Health and Human Services

Prepared by

Azeez Saba, Waleed Falak, Anna Mulli, Andrew Pham

Under the supervision of

Professor Elizabeth M. Bonsignore

Course #: INST490

The University of Maryland – College Park

Spring 2018

PALS - Partnership for Action Learning in Sustainability

An initiative of the National Center for Smart Growth



Gerrit Knaap, NCSG Executive Director

Uri Avin, PALS Director

Contents

Project Goal and Description

Background

Procedure

Pricing

Obstacles

Deliverables

Next Steps

Sources

Project Goal and Description

This design-oriented, community service project has the potential to improve productivity in Montgomery County's Department of Health and Human Services (DHHS) by providing a central standardized management system. The project goal is to evaluate and assess existing cloud-based data storage systems for a future developer to implement.

Client: Nouné Sekhpossian, Nouné.Sekhpossian@montgomerycountymd.gov

DHHS collects ongoing data to regulate whether its programs are following through with actions and results. It is important to frontline staff and to their managers, administrators, commissions, and elected officials. DHHS collects numerous metrics from its more than 130 direct service programs and its 700 contracted service providers.

To improve productivity of DHHS staff, the team will design a way to more easily access and track performance measures and reports. The new system will be a cloud-based storage system that is archivable and compatible with industry-standard browsers. This storage system will provide adequate security and tools to perform any analysis or filtering DHHS may need.

The proposed project will include an evaluation and assessment of existing cloud-based data storage systems that a future developer (e.g., MIM capstone students) will use as a first step in implementing the cloud-based system. The final document will be one component of a system synthesis that will include comprehensive cloud-based data storage, as well as user interface (UI) and business intelligence (BI) solutions for DHHS performance metrics.

Background

DHHS currently lacks a central standardized management system for its program performance data. There is no user interface for defining and collecting these data. Neither is there a business intelligence tool to report or display data. Metrics are reported in various ways including DHHS Monthly Trend Reports (MTR), Office of Management and Budget (OMB), CountyStat, and data Montgomery. Data is tracked through spreadsheets or in paper reports that are analyzed or consolidated only on an ad-hoc basis.

The project will address these gaps by evaluating existing cloud-based storage systems that meet the constraints presented by the client. Sekhpossian proposed a list of requirements that can be funded by yearly budget of less than \$5,000. That fund should cover the cloud storage service, a security protocol (due to the sensitive nature of the information), and enough storage to hold current data as well as 10 years of past data.

Procedure

DHHS's main mission and strategic vision is to build an archivable cloud database that will store all of their current physical documents, which will be processed and transferred. This approach will make it easier for other stakeholders and for program managers to view and edit the data, thus enhancing their productivity. This project's deliverables will help advance the DHHS

mission by allowing us to track our progress while moving forward, clarifying which project sections need work.

Currently, most government agencies use inefficient data recording and storing methods, such as surveying and manually transcribing onto paper. The proposed solution will mitigate this problem by allowing relevant agencies and service providers to transfer their archivable documents into one central cloud database.

To begin this project, we looked up the top 100 cloud database storage systems based on constraints provided by the client. The first constraint was financial—the budget could not exceed \$5,000 dollars. The second constraint was memory—the system must be able to store at least five TB of data. These constraints eliminated many options, including Salesforce, Onedrive, HP cloud. These providers couldn't hold the necessary amount of data.

The first hurdle to overcome was finding a cloud service provider with memory of at least five TB at a reasonable price. A lot of database providers, such as Onedrive and Verizon cloud, charge a standard fee which becomes more expensive the more storage you use. This eliminated more providers given the budget limit.

A further narrowed list left three cloud database services: AWS, Microsoft Azure, and Google Cloud. Researching these providers showed all three offered on-demand instances, letting you pay for computing capacity by the hour or second, with no long-term commitments. This made these cloud service providers stand out for their reasonable price.

Another variable we considered was elasticity and scalability. Elasticity is a system's ability to monitor user demand and automatically increase or decrease deployed resources. Scalability is a system's ability to monitor user demand and automatically increase or decrease storage capacity. Understanding the importance of these variables informed the choice of provider.

After comparing each provider's costs, the least expensive option was Microsoft Azure, but the best option was AWS, which has better scalability and elasticity than its competitors. AWS also stands out for its practice of Reserved instances. Reserved instances are a discount on cloud services in exchange for making a one-year or three-year commitment. The longer the commitment, the higher the discount. The discount increases further with upfront payment. Discounts range from 24 to 75 percent depending on the RI term, the instance type, and the region. This makes AWS the best option for DHHS.

After researching AWS' storage system options, we chose Amazon Simple Storage Service (S3) because the uploaded data would be archivable and static, which means it won't be tampered with and will have limited access.

This is the best option in terms of memory and pricing. AWS S3 is affordable and reduces the operational costs associated with maintaining legacy data storage infrastructure, such as tape management, security, and manual data transfers starting at just \$0.004/GB/month. By comparison, Google cloud charges \$0.23/GB/month. The S3 system also supports secure data transfers over Secure Sockets Layer and can automatically encrypt data at rest using Advanced Encryption Standard 256-bit symmetric keys. Following a shared security model, AWS cloud storage solutions provide data protection throughout the infrastructure. The following tables outline the pros and cons of each cloud service provider.

Table 1. Provider Comparison

	Security	Cost	Storage	Additional Features
AWS	Data stored in highly secured data centers	No upfront cost, only pay for what is used First 12 months free \$23/month for 1TB of storage	Scalability, use what you need	Widest selection of third party tools
Azure	Wide array of security tools and capabilities	Approximately \$750 per month for storage and SQL Database functionality	Secure, scalable and redundant	Cost only accounts for database functionality and storage, limits availability of additional features
Google Cloud	Identity and access management Ability to make sensitive data more secure		Single API across storage classes Scalability to exabytes of data (1,000,000TB)	

Table 2. Amazon Web Services

PROS	CONS
<p>Largest and most mature public IaaS cloud provider, with most advanced and diverse feature set.</p> <p>The safest choice for the widest range of use cases.</p>	<p>Although it's easy to get started with AWS, it requires master expertise.</p>
<p>Market leader and innovator, particularly in new IaaS cloud features, such as its Lambda serverless computing platform.</p>	<p>AWS sometimes innovates so quickly that organizational practices and implementation can become outdated, requiring an organization to constantly update features.</p>
<p>Amazon Marketplace has the widest selection of third party tools that integrate with or are hosted on AWS. AWS also has the broadest market of consultants and experts to help customers use the platform.</p>	<p>AWS is pricey and discounts are achieved only by pre-purchasing services.</p>

Table 3. Microsoft Azure

PROS	CONS
<p>Microsoft has invested heavily in building a global cloud data center footprint and broad feature set in Azure.</p>	<p>Azure has most features but some of those products and APIs are not as mature or user-friendly as Amazon Web Services versions.</p>
<p>Microsoft has long-standing relationships with most large enterprises and offers attractive financial incentives as part of enterprise agreements.</p>	<p>A limited number of vendors integrate their products with Azure cloud and a smaller network of Azure experts and consultants compared to AWS.</p>
<p>Microsoft offers an integrated IaaS, PaaS, and SaaS (Office 365). Azure is ideal for IT shops invested in other Microsoft products.</p>	<p>Unlike AWS, Azure does not have a "zones" concept in its region designs, which makes backing up work slightly more difficult.</p> <p>Azure is not seen as an open source leader compared to Google and AWS, which tend to be more natural destinations for open source-based workloads.</p>

Table 4. Google Cloud

PROS	CONS
<p>Google is a savvy technology company that has built a powerful platform to power its popular internal applications. Google Cloud platform offers some of that technology to customers as a cloud service, and makes it easy for customers to use.</p>	<p>More limited feature set compared to AWS and Azure.</p> <p>Enterprise features are still in development or not as fully-functional compared to AWS and Azure.</p>
<p>Google excels at hosting big data applications and is seen as a leader in application container management.</p>	<p>Google is in the early stages of engaging with enterprise clients.</p>
<p>Google is used as a specialty provider for certain tasks and use cases in conjunction with another primary IaaS vendor.</p> <p>Offers per minute compute billing and sustained usage discount pricing.</p>	<p>Google has ambitious plans to build its international data center footprint but that is currently a work in progress.</p>

Pricing

AWS vs. Azure vs. Google On-Demand Prices

Resource Type (us-east, Linux)	AWS Instance	Azure Instance	Google Instance	AWS OD Hourly	Azure OD Hourly	Google OD Hourly	AWS /GB RAM	Azure /GB RAM	Google /GB RAM
Standard 2 vCPU w SSD	m3.large	D2 v2	n1-standard-2	\$0.133	\$0.114	\$0.212	\$0.017	\$0.016	\$0.028
Highmem 2 vCPU w SSD	r3.large	D11 v2	n1-highmem-2	\$0.166	\$0.149	\$0.238	\$0.011	\$0.011	\$0.018
Highcpu 2 vCPU w SSD	c3.large	F2	n1-highcpu-2	\$0.105	\$0.099	\$0.188	\$0.028	\$0.025	\$0.104
Standard 2 vCPU no SSD	m4.large	D2 v2	n1-standard-2	\$0.120	\$0.114	\$0.100	\$0.015	\$0.016	\$0.013
Highmem 2 vCPU no SSD	r3.large	D11 v2	n1-highmem-2	\$0.166	\$0.149	\$0.126	\$0.011	\$0.011	\$0.010
Highcpu 2 vCPU no SSD	c4.large	F2	n1-highcpu-2	\$0.105	\$0.099	\$0.076	\$0.028	\$0.025	\$0.042

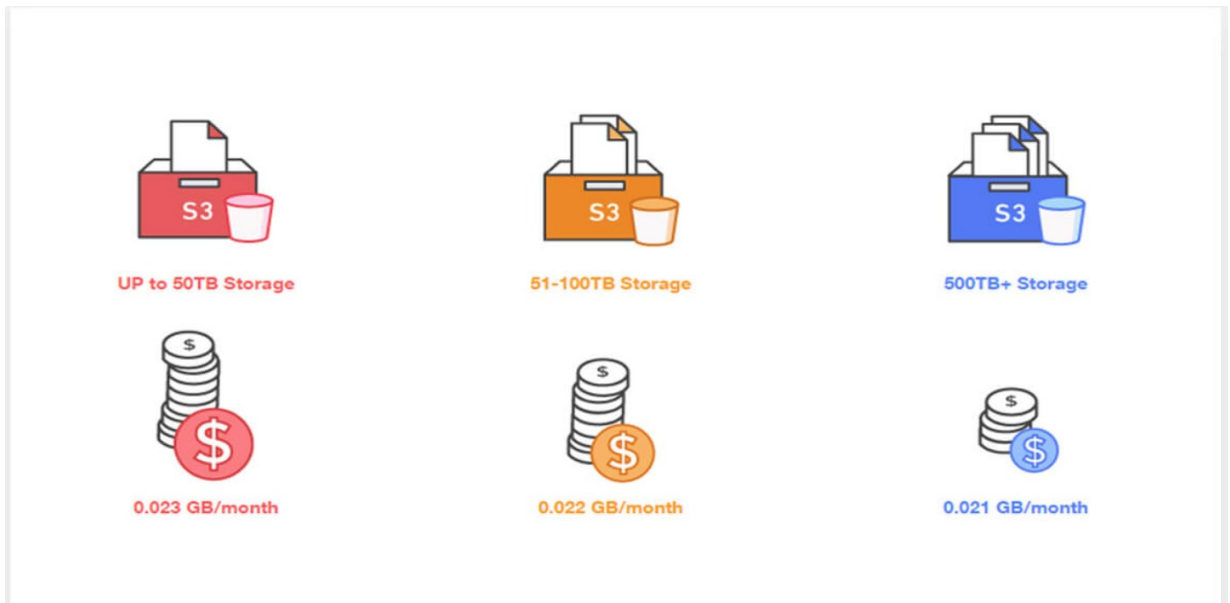
As of Oct 25, 2016

Source: RightScale



RIGHT SCALE

Amazon S3



Deliverables

The two main deliverables are the process of analyzing 100 cloud storage systems and eventually choosing three storage options (Microsoft Azure, Google Cloud, and Amazon Web Service). This process included a cost comparison analysis with a breakdown of the security, cost, storage, and additional features to give a more complete understanding of why AWS is the preferred cloud storage system. These deliverables meet the project goals because we include back-up research such as cost comparison charts, pro and con charts, and resources.

Overall, AWS can provide Montgomery County's Department of Health and Human Services the kind of storage they need to back up ten years of data, as well as data from their 700 contracted providers. AWS's scalability feature monitors any kind of data and automatically adjusts capacity to maintain steady, predictable performance at the lowest possible cost. Using AWS S3 storage, DHHS can be sure that their data is secured using a state-of-the-art security system.

Next Steps

Future actions will need to adjust as constraints or requirements are added to the project. Amazon Web Service works differently compared to other cloud storage systems. Data from the Metrics team will need to be placed in different buckets depending on client specifications. For example, if the data should only be accessible to the administrator, permissions will need to be assigned to those buckets. The UI/UX team should have access to those buckets, and links will need to be generated depending on the data they require. If the client prefers some data to be more secure than others, security measures should be applied to those buckets. Lastly, the client should decide between having the data readily available for easy accessibility or limiting cost by placing data in a low-cost storage bucket, which can slow access time.

All these issues will need to be addressed as more progress is made and more requirements are developed. However, for further documentation and questions on this project's deliverables please contact:

- Azeez Saba, project manager at Sabaazeez12@gmail.com.
- Waleed Falak, analyst, at waleedfalak@gmail.com.
- Anna Mulli, tester, at mutianna27@yahoo.com.
- Andrew Pham, researcher, aapham126@terpmail.umd.edu.

Sources

<https://www.networkworld.com/article/3145470/cloud-computing/how-to-compare-cloud-costs-between-amazon-microsoft-and-google.html>

<https://www.cloudberrylab.com/blog/amazon-s3-azure-and-google-cloud-prices-compare/>

<https://www.thebalanceeveryday.com/free-cloud-storage-1356638>

<https://www.pcmag.com/roundup/306323/the-best-cloud-storage-providers-and-file-syncing-services>

<https://www.techradar.com/news/the-best-cloud-storage>

<https://www.cloudwards.net/the-top-5-cloud-companies-with-large-free-service-plans/>

<https://www.business.com/articles/top-10-cloud-storage-services-for-business/>

<https://www.reviews.com/cloud-storage/>