BallotOnline Cloud Migration Report: Architecture, Cost, and Security Comparison

Kareem Rizk

University of Maryland Global Campus

CCS 610 9040 Cloud Services and Technologies

Professor Oussama Saafein

June 9, 2025

Cloud Platform Evaluation for BallotOnline

This paper evaluates the feasibility, cost, and security of deploying BallotOnline's election platform on AWS and Microsoft Azure. Both platforms support the proposed three-tier architecture, but AWS emerges as the stronger candidate due to its maturity in LAMP workloads, automation tools like Elastic Beanstalk, and well-documented ecosystem. A detailed cost scenario simulating 50,000 users shows nearly identical pricing ($252/month), while large-scale events (500,000 users) could cost up to $700. AWS provides a smoother path for proof of concept (POC) and deployment, especially with PHP-based applications, making it the recommended choice for BallotOnline's needs.

Comparison of Architecture Deployment Feasibility

To support BallotOnline’s secure and globally scalable election platform, a three-tier cloud architecture is proposed. This model separates the application into three logical layers:

- **Presentation Layer:** Web servers deployed in public subnets behind a load balancer (e.g., AWS ELB or Azure Load Balancer).
- **Application Layer:** PHP-based logic executed on EC2 instances (AWS) or Azure VMs, configured with auto-scaling groups.
- **Data Layer:** MySQL database running on managed services such as Amazon RDS or Azure Database for MySQL, deployed in private subnets with restricted access.

Additional components include:

- **Amazon S3 or Azure Blob Storage** for static files (e.g., images, JS, CSS).
- **CloudFront or Azure CDN** for global content distribution.
- **CloudWatch or Azure Monitor** for monitoring and alerts.
- **IAM roles/Security Groups or Azure Role-Based Access Control (RBAC)** for security enforcement.

Key Services Supporting the Architecture:

Layer/Function	AWS Equivalent	Azure Equivalent
Compute	EC2, Elastic Beanstalk	Azure VMs, Azure App Service
Load Balancing	Elastic Load Balancer (ELB)	Azure Load Balancer, Azure Application Gateway
Database	Amazon RDS (MySQL)	Azure Database for MySQL
Data overload	Poor data governance	Classification, data lifecycle policies
Object Storage	Amazon S3	Azure Blob Storage
Content Delivery Network	Amazon CloudFront	Azure CDN
Monitoring & Logging	Amazon CloudWatch	Azure Monitor, Log Analytics
Infrastructure as Code	AWS CloudFormation	Azure Resource Manager (ARM)
Security & IAM	IAM Roles, Security Groups	Azure RBAC, Network Security Groups (NSG)
Auto Scaling	Auto Scaling Groups	Virtual Machine Scale Sets

AWS Feasibility

AWS provides all required components natively. The three-tier architecture can be fully automated using CloudFormation templates (Amazon Web Services, n.d.-b). AWS services such as Elastic Beanstalk (Amazon Web Services, n.d.-a), RDS, Auto Scaling Groups, S3, and CloudFront align perfectly with the proposed design. Multi-AZ and multi-region deployments are well-supported (Amazon Web Services, n.d.-e), ensuring high availability and low latency worldwide.

Azure Feasibility

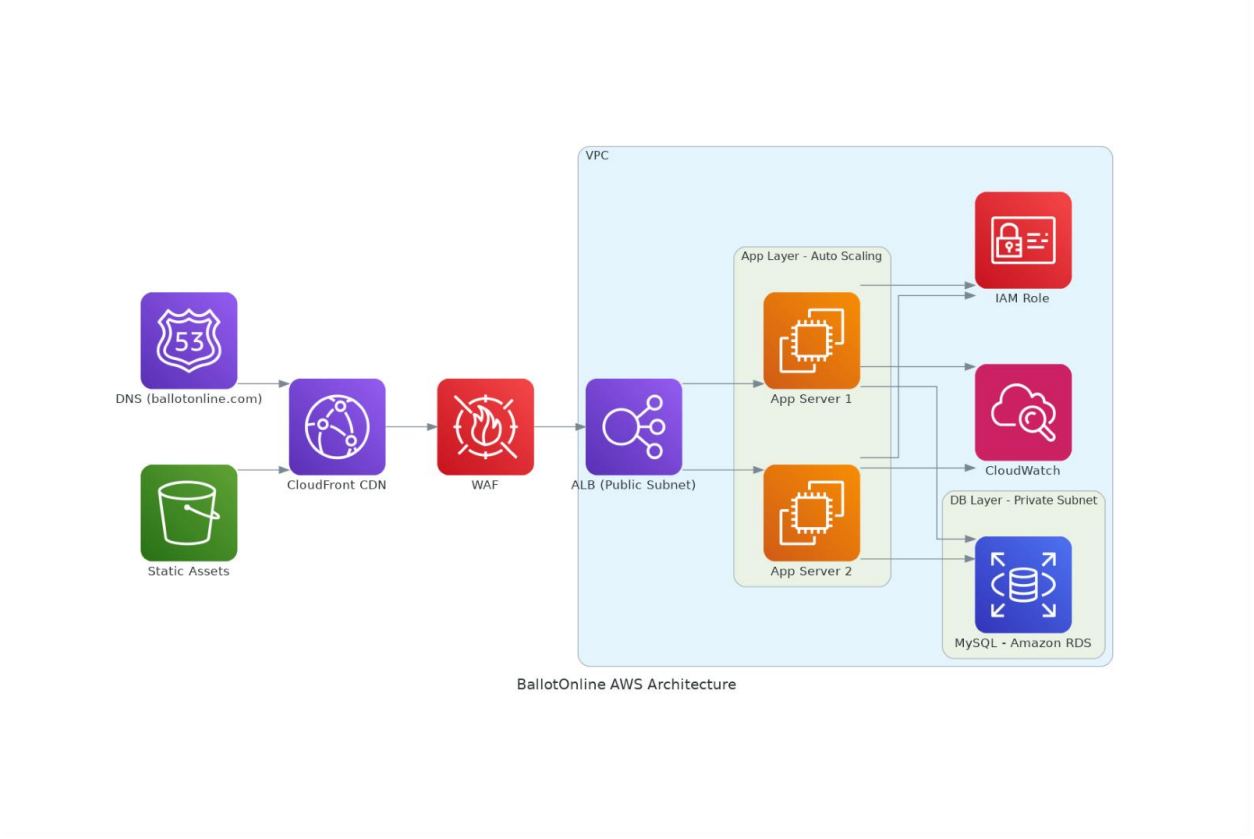
Azure also supports the proposed architecture using its equivalents: Azure Virtual Machines, Azure Database for MySQL, Azure Load Balancer, Azure Blob Storage, and Azure CDN. Azure Resource Manager (ARM) templates can automate deployments (Microsoft Azure, n.d.-c). However, Azure's LAMP

support, while viable, requires more manual setup compared to AWS, which offers more LAMP-optimized documentation and community templates (Microsoft Azure, n.d.-a).

Comparison Summary

Both platforms can host BallotOnline's architecture successfully. However, in my professional judgment, AWS offers greater maturity, flexibility, and ease-of-use for LAMP applications, making it more aligned with BallotOnline's goals of rapid deployment, scalability, and international expansion.

Figure 1: BallotOnline AWS Architecture



The figure below illustrates the proposed 3 tier architecture on AWS. It includes a public-facing Application Load Balancer, auto-scaling EC2 instances for the application layer, a MySQL RDS database in the private subnet, and additional components such as CloudFront CDN, WAF, and CloudWatch.

This architecture diagram was generated using Python's Diagrams library, a Diagram-as-Code tool that enables infrastructure modeling using code.

Comparison of Ease of Deployment

Deploying a PHP-based LAMP application on both AWS and Microsoft Azure is supported, but the ease of doing so varies based on the tools and ecosystem offered by each provider.

AWS Feasibility

AWS offers a streamlined deployment experience through Elastic Beanstalk, which simplifies provisioning, configuration, and deployment of applications (Amazon Web Services, n.d.-a). Developers can upload a ZIP package, and AWS handles infrastructure setup, scaling, and monitoring automatically. In addition, AWS provides pre-built Amazon Machine Images (AMIs) for LAMP stacks, and CloudFormation templates allow full automation of infrastructure-as-code (IaC) (Amazon Web Services, n.d.-b).

Azure Feasibility

Azure enables LAMP deployments through Azure App Service for Linux and Azure Virtual Machines. While functional, Azure requires more manual configuration for LAMP compared to AWS. Creating the LAMP stack from scratch on Azure VMs involves custom setup for Apache, PHP, and MySQL. Azure App Service supports PHP but lacks the full flexibility of EC2-based stacks (Microsoft Azure, n.d.-a).

Comparison Summary:

While both platforms support PHP deployments, AWS provides a more beginner-friendly, automated, and well-documented process. Azure is a solid alternative, especially for Microsoft-centric environments, but may not match AWS's simplicity for LAMP-based applications.

Comparison of Cost and Pricing Models

AWS and Azure both offer competitive pay-as-you-go pricing. Below is a cost breakdown of a hypothetical election scenario where 50,000 users vote over a span of 24 hours.

Assumptions:

- 4 EC2 instances (t3.medium) or 4 Azure VMs (B2s) with auto-scaling
- 1 managed MySQL database (db.t3.medium / Azure Database for MySQL Basic)
- 100 GB object storage (S3 or Blob)
- 500 GB data egress
- 1 Application Load Balancer / Azure Load Balancer
- Monitoring and CDN enabled

AWS Estimate (from AWS Pricing Calculator):

- 5 EC2: $102/month
- RDS (MySQL): $81/month
- S3 Storage: $2.30/month
- CloudFront + Data Transfer: $42/month
- ELB + Monitoring: $25/month

  Total: ~$252.30/month

Azure Estimate (from AWS Pricing Calculator):

- Azure VMs: ~$96/month
- Azure Database for MySQL: ~$80/month
- Blob Storage: ~$2.10/month
- Azure CDN + Egress: ~$44/month
- Load Balancer + Monitoring: ~$30/month

  Total: ~$250.10/month

Cost Scenario for a Hypothetical Election Event

For a large-scale voting event (e.g., 500,000 users over 2 days):

- Increased auto-scaling (10+ web instances)

- RDS or Azure Database scaled vertically
- Bandwidth egress 2+ TB
- Estimated spike cost: $500–$700 depending on usage burst and CDN hits

Evaluation of Proof of Concept (POC)

Although we did not execute a full POC lab due to course requirements, a theoretical evaluation of feasibility is provided:

AWS POC Evaluation:

Elastic Beanstalk would enable simple ZIP-based PHP deployment. The intuitive console, detailed documentation, and integrated CI/CD features would allow quick iteration. AWS's developer ecosystem and marketplace offer robust pre-configured LAMP stacks.

Azure POC Evaluation:

Azure App Service for Linux supports PHP apps, but less guidance is available for PHP/MySQL combos. VM-based setups offer flexibility but require manual configuration. Azure CLI and ARM templates help automate but involve steeper learning.

Verdict:

AWS demonstrates a clearer, faster POC path for PHP-based apps. It also offers deeper integration with CI/CD tools and infrastructure-as-code frameworks, streamlining long-term DevOps operations.

Security and Compliance Capabilities Comparison

Both AWS and Azure implement strong security frameworks and provide compliance certifications such as SOC 2, HIPAA, and GDPR alignment.

Category	AWS Features	Azure Features

IAM	IAM, Resource Policies, MFA	RBAC, Azure AD, Conditional Access
Network Security	Security Groups, NACLs, PrivateLink	NSGs, Azure Firewall, Private Endpoints
Data Protection	KMS, S3 Encryption, RDS TDE	Azure Key Vault, SQL TDE, Blob Encryption
Compliance	FedRAMP, SOC 2, HIPAA, GDPR	FedRAMP, SOC 2, HIPAA, GDPR
Logging & Audit	CloudTrail, Config, GuardDuty	Azure Monitor, Security Center, Sentinel

Final Recommendation and Justification

After evaluating architectural fit, deployment speed, cost, security, and future scalability, AWS is the preferred provider for BallotOnline.

- AWS is more mature in LAMP workloads
- Easier, faster deployment using Elastic Beanstalk
- Better ecosystem and documentation
- Nearly identical pricing with better automation flexibility

Azure remains a viable secondary option, especially for integration with Microsoft services or hybrid cloud plans.

References

Amazon Web Services. (n.d.-a). AWS Elastic Beanstalk.

https://www.businessinsider.com/ai-cloud-jobs-2025

Amazon Web Services. (n.d.-b). AWS CloudFormation.

https://aws.amazon.com/cloudformation/

Amazon Web Services. (n.d.-c). Amazon CloudWatch.

https://aws.amazon.com/cloudwatch/

Amazon Web Services. (n.d.-d). Amazon RDS.

https://aws.amazon.com/about-aws/global-infrastructure/

AWS Pricing Calculator. (n.d.). *AWS Pricing Calculator*.

https://calculator.aws.amazon.com/

Microsoft Azure. (n.d.-a). *Introduction to Azure App Service*.

https://learn.microsoft.com/en-us/azure/app-service/

Microsoft Azure. (n.d.-b). Azure Database for MySQL.

https://learn.microsoft.com/en-us/azure/azure-resource-manager/

Azure Pricing Calculator. (n.d.). Azure Pricing Calculator.

https://azure.microsoft.com/en-us/pricing/calculator/