

Cloud-based DevOps for Enhanced Internet Solutions

Introduction

In today's digitally driven world, reliable and robust internet connectivity is no longer a luxury, but a fundamental necessity for businesses and communities alike. Just as many organizations face challenges in modernizing their infrastructure to meet evolving demands, many individuals and communities struggle with bridging the digital divide. Our Client specializes in providing high speed, reliable internet solutions, particularly to underserved rural and suburban areas. The core mission is to empower these communities by delivering the essential connectivity needed to thrive in the modern age. We understand the 'compliance' of the digital world, ensuring access to the internet and mitigating the risks of being unconnected. We address the significant challenges of limited infrastructure and accessibility, enabling our customers to participate fully in the digital economy and experience the benefits of seamless connectivity.

Client Details

Name: Confidential | **Industry:** Telecommunications, Software | **Location:** USA

Technologies

Cloud Platform: GCP, AWS, Azure

CI/CD: Cloud Build, GitHub Action, Liquibase

Containerization: Docker

Monitoring: Cloud Monitoring

Security: Cloud Armor, Secret Manager, Firewall Rules, AWS Cognito, Microsoft Entra ID

Database: Cloud SQL, MongoDB Atlas

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Challenges, Objectives & Solution

1. Unified CI/CD for Multiple Projects

- **Challenge:** Current CI/CD implementations are fragmented and inconsistent across various projects, leading to inefficiencies and increased maintenance overhead.
- **Objective:** Design and implement a centralized and standardized CI/CD pipeline that can be effectively utilized for all projects, ensuring consistency and streamlining the deployment process.
- **Solution:** Implement a shared, parameterized CI/CD pipeline using Google Cloud Build and Artifact Registry, managed via a central repository with reusable configuration templates.

2. Automated Android Deployment:

- **Challenge:** Manual Android app deployment is time consuming and prone to errors, hindering rapid iteration and release cycles.
- **Objective:** Develop and integrate an automated CI/CD pipeline for Android application deployment, enabling faster and more reliable releases to various distribution channels.
- **Solution:** Automate Android app deployment using GitHub Actions and Firebase App Distribution, triggered by code commits, to streamline releases to Play Store and internal testers.

3. Automated Database Migration

- **Challenge:** Database migrations are performed manually, leading to potential inconsistencies and downtime.
- **Objective:** Implement an automated database migration solution within the CI/CD pipeline, ensuring seamless and version controlled database updates with minimal disruption.
- **Solution:** Integrate database migration with Liquibase into the CI/CD pipeline, triggered by code changes, to automate schema updates with version control and rollback capabilities.

4. Enhanced Security Vulnerability Management:

- **Challenge:** Current security vulnerability scanning and remediation processes are not fully integrated into the development lifecycle, increasing the risk of security breaches.
- **Objective:** Integrate security vulnerability scanning and automated remediation processes into the CI/CD pipeline, proactively identifying and mitigating potential security risks.
- **Solution:** Embed automated security scanning tools (Trivy & Docker scout) into the CI/CD pipeline, triggering alerts and automated remediation steps for identified vulnerabilities, integrated with issue tracking for resolution.

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5. Improved Scalability:

- **Challenge:** Current deployment infrastructure struggles to handle increasing workloads and user traffic, leading to performance bottlenecks.
- **Objective:** Design and implement a scalable deployment infrastructure that can dynamically adjust to changing demands, ensuring optimal performance and availability.
- **Solution:** Implement an auto-scaling infrastructure using Cloud Run, integrated with load balancing and monitoring, to dynamically adjust resources based on demand.

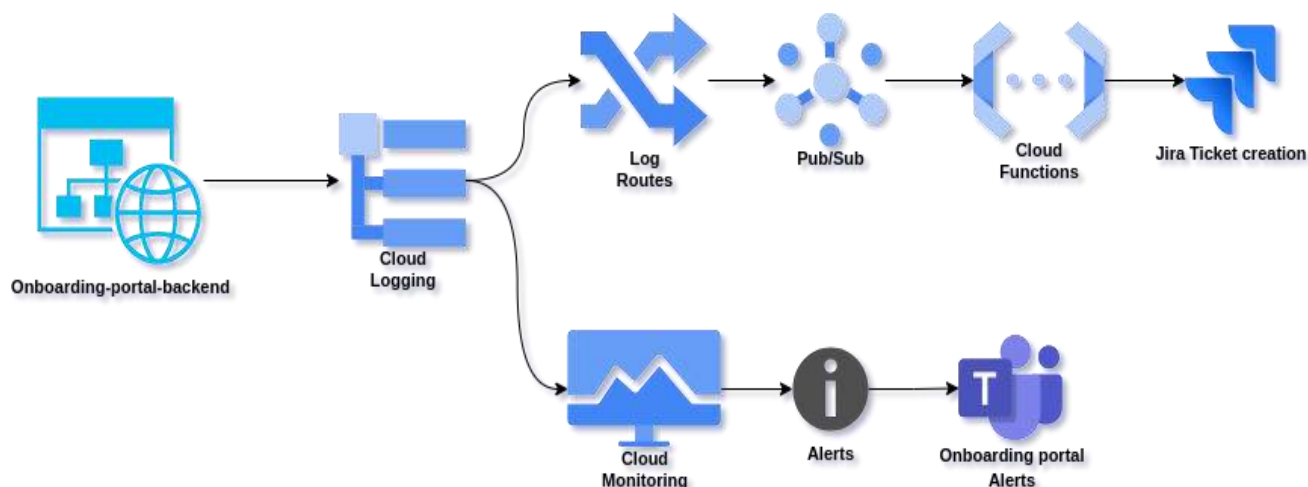
6. Accelerated and Simplified Build Deployment:

- **Challenge:** Build and deployment processes are complex and time consuming, hindering rapid development and release cycles.
- **Objective:** Optimize the CI/CD pipeline to significantly reduce build and deployment times, while simplifying the process for developers and operations teams. This includes automation of testing, packaging and deployment procedures.
- **Solution:** Implement containerized builds with Google Cloud Build, leverage Artifact Registry for optimized artifact storage and automate deployments using Cloud Deploy for rapid and simplified releases.

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Architectural Diagram

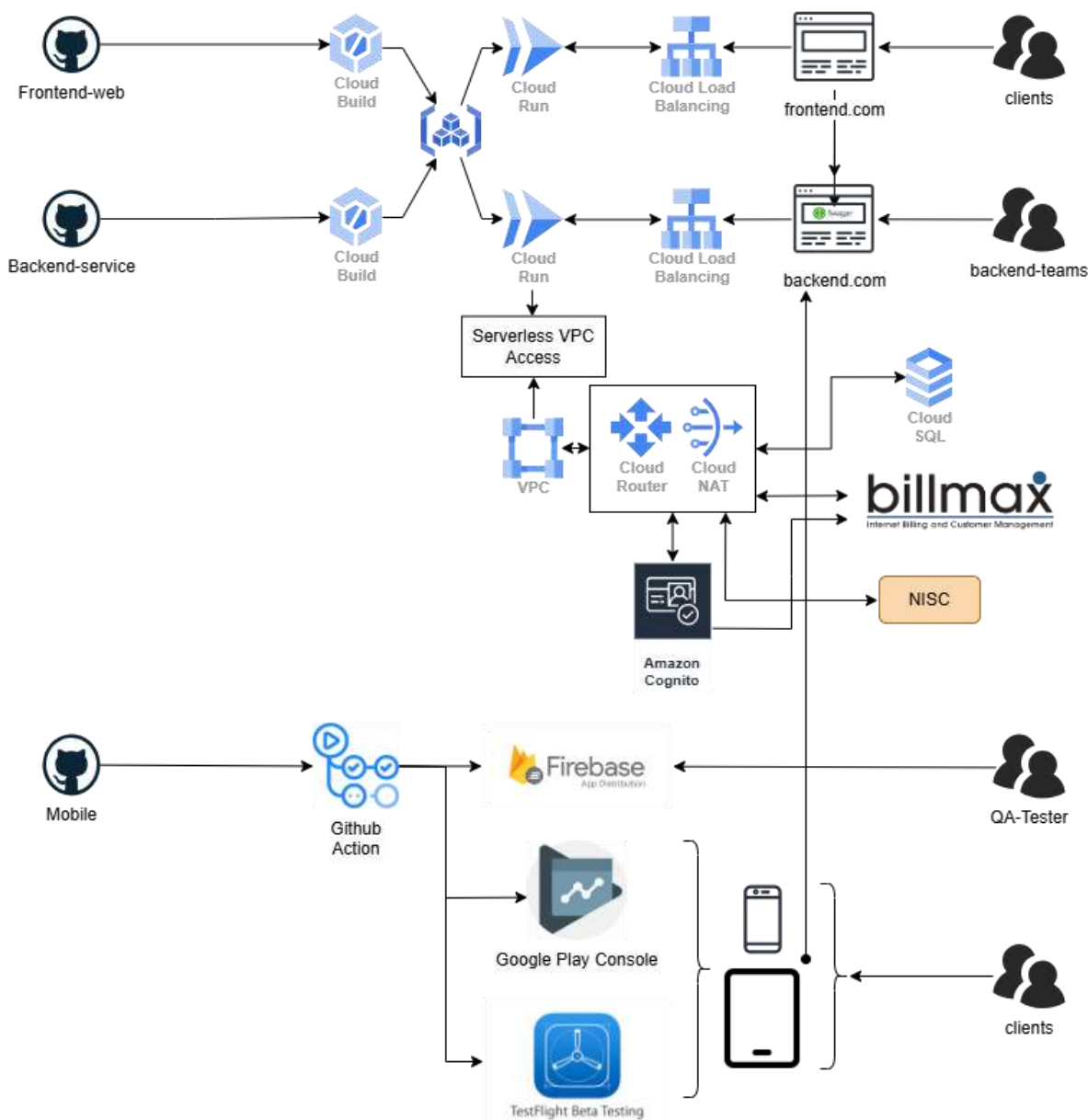
1. Alerts and Error logging



The system is designed to capture, process and provide notifications for errors generated by the backend services. The architecture leverages Cloud Logging to capture logs from the backend production environment. Log Routes are then employed to filter and direct specific logs to Cloud Pub/Sub topics. These Pub/Sub topics act as a message queue, triggering Cloud Functions when new error logs arrive. The Cloud Functions process the error information, generating notifications to team channels (via webhooks) and creating Jira tickets for tracking and resolution.

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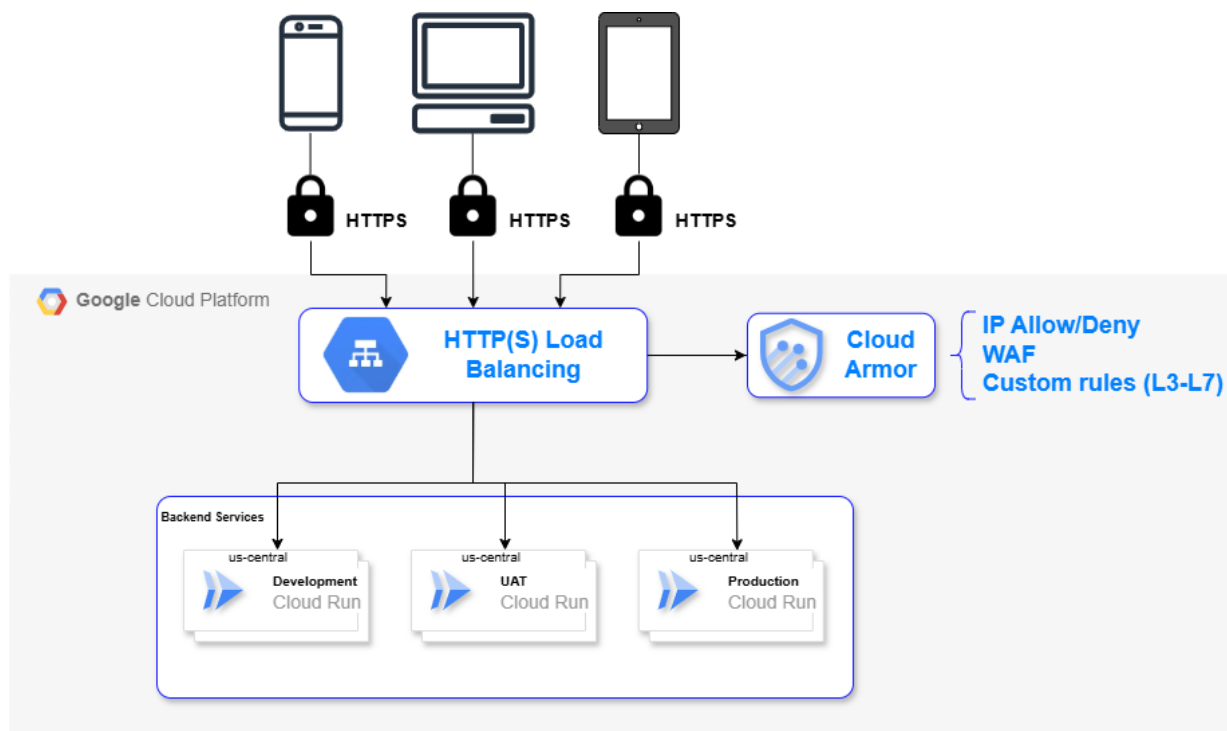
2. Application flow



This diagram depicts a cloud based application ecosystem, showcasing the deployment and interaction of frontend and backend web services through Google Cloud's infrastructure, including load balancing and serverless VPC access, alongside a mobile application deployment pipeline utilizing GitHub Actions, Firebase and platform specific distribution channels, all interconnected and integrated with external services like Billmax and Amazon Cognito.

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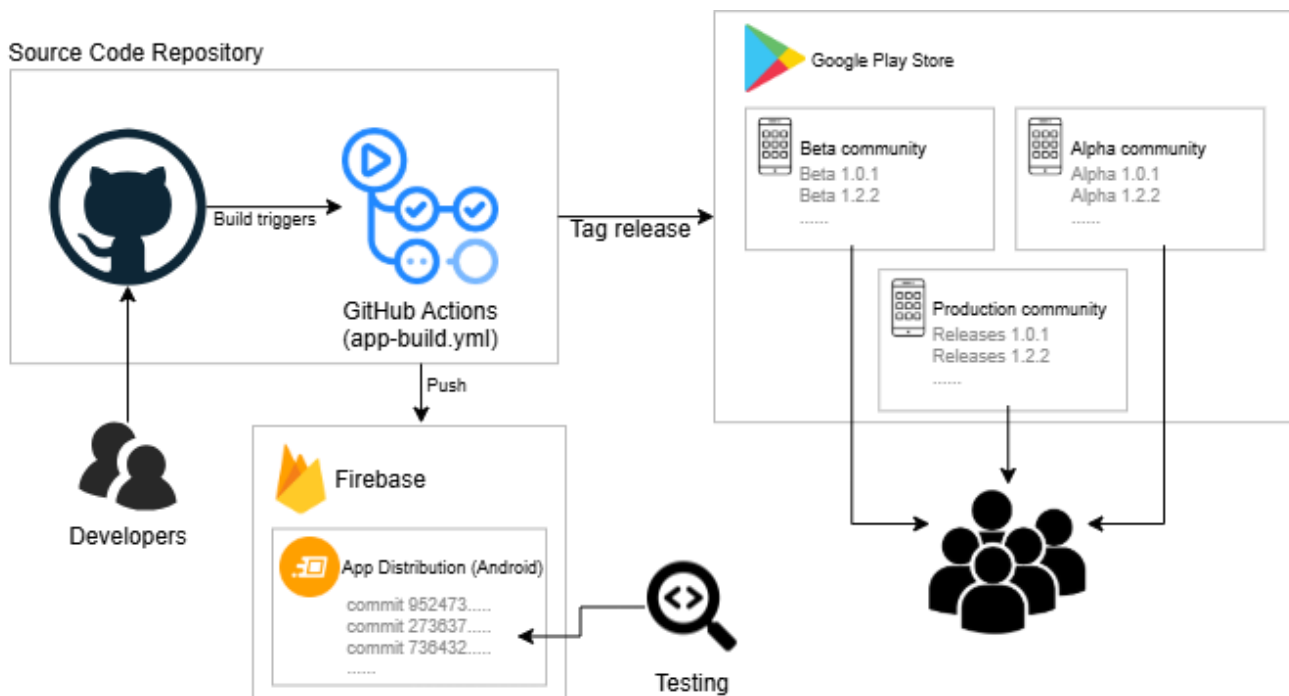
3. Cloud armor



The diagram illustrates a Google Cloud Platform architecture where user devices securely access Cloud Run services (Development, UAT, Production) through an HTTPS Load Balancer, protected by Cloud Armor for IP filtering, WAF and custom rules.

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4. Android application release flow



The diagram demonstrates a software release process that uses GitHub Actions to trigger builds when developers commit code to a repository. Firebase App Distribution then distributes these builds to the Alpha, Beta and Production communities within the Google Play Store. This allows for testing at different stages and controlled release of the Android application.

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Outcomes and Impact

1. Error Notification System (Cloud Logging, Pub/Sub, Cloud Functions, Jira Integration)

- **Proactive Issue Resolution**
 - **Real time Error Detection and Notification:** Immediate alerts for backend service errors, enabling rapid response and minimizing downtime.
 - **Automated Jira Ticket Creation:** Streamlined issue tracking and assignment, ensuring efficient resolution and accountability.
- **Improved System Reliability & Stability**
 - **Reduced Mean Time To Resolution (MTTR):** Faster identification and resolution of errors lead to increased system stability and reliability.
 - **Enhanced Monitoring and Logging:** Comprehensive log capture and analysis through Cloud Logging provide valuable insights for debugging and optimization.
- **Increased Developer Productivity**
 - **Automated Notification Workflow:** Eliminates manual error monitoring and reporting, freeing up developer time for other tasks.
 - **Centralized Error Management:** Integration with Jira provides a single platform for tracking and managing all errors.
- **Data Driven Insights**
 - **Log Analysis for Pattern Identification:** Cloud Logging enables the identification of recurring errors and trends, facilitating preventative measures.

2. Cloud Based Application Ecosystem (Load Balancing, Serverless VPC, GitHub Actions, Firebase, External Integrations)

- **Scalable and Resilient Application Architecture**
 - **Global Load Balancing for High Availability:** Distributes traffic efficiently, ensuring application availability and performance even during peak loads.
 - **Serverless VPC Access for Secure Connectivity:** Enables secure communication between cloud resources without managing infrastructure.
- **Agile Development and Deployment**
 - **Automated CI/CD with GitHub Actions:** Accelerates software release cycles and reduces manual deployment errors.

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- **Firebase for Streamlined Mobile App Deployment:** Simplifies testing and distribution across multiple user groups.
- **Seamless Integration with External Services**
 - **Unified Application Ecosystem:** Enables smooth communication and data exchange with services like Billmax and Amazon Cognito.
 - **Enhanced Functionality and User Experience:** Leverages external services for extended features and improved user interactions.
- **Cost Optimization**
 - **Serverless Architecture for Efficient Resource Utilization:** Only pay for resources used, reducing infrastructure costs.

3. Secure Access to Cloud Run Services (HTTPS Load Balancer, Cloud Armor)

- **Enhanced Security Posture**
 - **Cloud Armor for Web Application Firewall (WAF):** Protects against common web exploits and threats, ensuring application security.
 - **IP Filtering and Custom Rules:** Enables fine grained access control, restricting unauthorized access to Cloud Run services.
- **Secure and Reliable User Access**
 - **HTTPS Load Balancing for Secure Connections:** Encrypts user traffic, ensuring data confidentiality and integrity.
 - **Consistent and High Performance Access:** Provides a stable and responsive user experience.
- **Compliance and Data Protection**
 - **Adherence to Security Best Practices:** Cloud Armor and HTTPS Load Balancing help meet security and compliance requirements.
 - **Data Privacy and Integrity:** Protects sensitive data from unauthorized access and manipulation.

4. Software Release Process (GitHub Actions, Firebase App Distribution, Google Play Store)

- **Accelerated Release Cycles**
 - **Automated Build and Distribution:** Reduces manual effort and time required for software releases.

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- **Faster Time-to-Market:** Enables rapid delivery of new features and updates to users.
- **Improved Software Quality**
 - **Staged Rollouts with Alpha, Beta and Production Communities:** Allows for thorough testing and controlled releases, minimizing risks.
 - **Early User Feedback Collection:** Facilitates the identification and resolution of issues before widespread release.
- **Enhanced Collaboration and Transparency**
 - **Centralized Release Management:** Provides a clear overview of the release process and progress.
 - **Streamlined Communication:** Enables efficient communication between developers, testers and stakeholders.
- **Data Driven Release Strategy**
 - **Analytics and Feedback from Firebase and Google Play Store:** Provides insights into user behavior and app performance, informing release decisions.