# Enhanced ML Based Security framework for Cloud Security

**Presented**
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# Outline

# Introduction

- Cloud Computing - efficient data handling, processing and storage
- Benefits
  - Resource Scalability
  - Cost Effectiveness
  - Availability of Resources
- However, this also brings some security issues, security of sensitive data and management
- Key management will have creation, distribution, revoking and storage of the required keys for cryptographic algorithms
- So, key management is important for overall security
- Comprimising of key management leads to data leaks, accessing of sensitive information and leakage of important information

# Introduction

- This is a major challenge for storing sensitive information like bank information and medical records.
- Cloud Security should protect information from attacks like
  - Intrusion
  - Data leakage
  - Data Loss
  - Internal and external threats
  - Attacks on infrastructure, applications and data
- Cloud security applications - typically deployed as SaaS
- SaaS Layer provides security

# Cloud Security

- This work - Enhances security and integrity between application and KMS
- Uses Machine Learning and actively detect any anomaly and detects baseline deviation
- Guarantees security by reducing probability of unauthorized access and security issues

# Challenges in Cloud Security

- Many cloud platforms - Each has unique system for secure cloud
- This leads to minimum standardization across different systems
- Also, ensuring accuracy of existing policies and checking if they align with actual enforcement is a big challenge

# Access Control and Data Security

- Fundamental aspect of cloud security
- Amazon - AWS IAM Systems - Commonly used for authentication and authorisation, which enforces policies and manage privileges
- Similarly, Google has IAM, Azure has RBAC, Kubernetes has its own RBAC, etc.
- Another important aspect - Data Security
- Encryption methods - Used when storing and transfer of data

# Network Security

- Network security - implemented to protect from network attacks and data interception
- Uses techniques like Firewalls, VPNs, Intrusion Detection Systems
- For efficient management of cloud security, organisations uses SIEM (Security Information and Event Management) Systems
- SIEM Systems gather and access information and logs them
- Helps in detection and responding to any security issues

# Existing Frameworks

- CSA
  - Offers thorough recommendations and best practices
  - Addresses several aspects like Data protection, identity, access control and incident handling
- NIST
  - Has a special article published
  - Users can use security controls and suggestions provided in article
  - Addresses aspects like key management, access control, encryption
- TCI
- PCI DSS
  - Offers security requirements for handling Credit Card Information in cloud

# Proposed Framework

- KMS - Common Component
- Normally uses envelope encryption for key management
- In development environment, server-side applications are built through VMs and deployed on cloud
- In building mobile application, same environment is used, which makes client side REST API calls to server-side apps hosting REST APIs
- Mobile apps - Can be any business apps like Amazon, Flipkart, etc.

# Continued....

- Permission Detection Engine
  - Evaluates permissions by looking at manifests and byte codes
  - Also verifies the validity
- Applications - deployed on different mobile devices
- When apps are used by users,
  - User authentication
  - REST API Calls to server-side applications on cloud VMs, securely using OAuth2.0 based protocol and HTTPS Layer security
- Here, KMS Layer acts as key vault, client and server gets required keys from KMS
- Cloud directory acts as OAuth2.0 authorization server

# Continued....

- ML will be used to detect outliers during interactions of apps with KMS
- Log data from KMS is stored in a big data repository
- For each app that interacts with KMS, will be placed in clusters
- Checks will be made on a scheduled basis for any deviation using an algorithm like K Means
- If any anomaly, the app will be blocked from using KMS

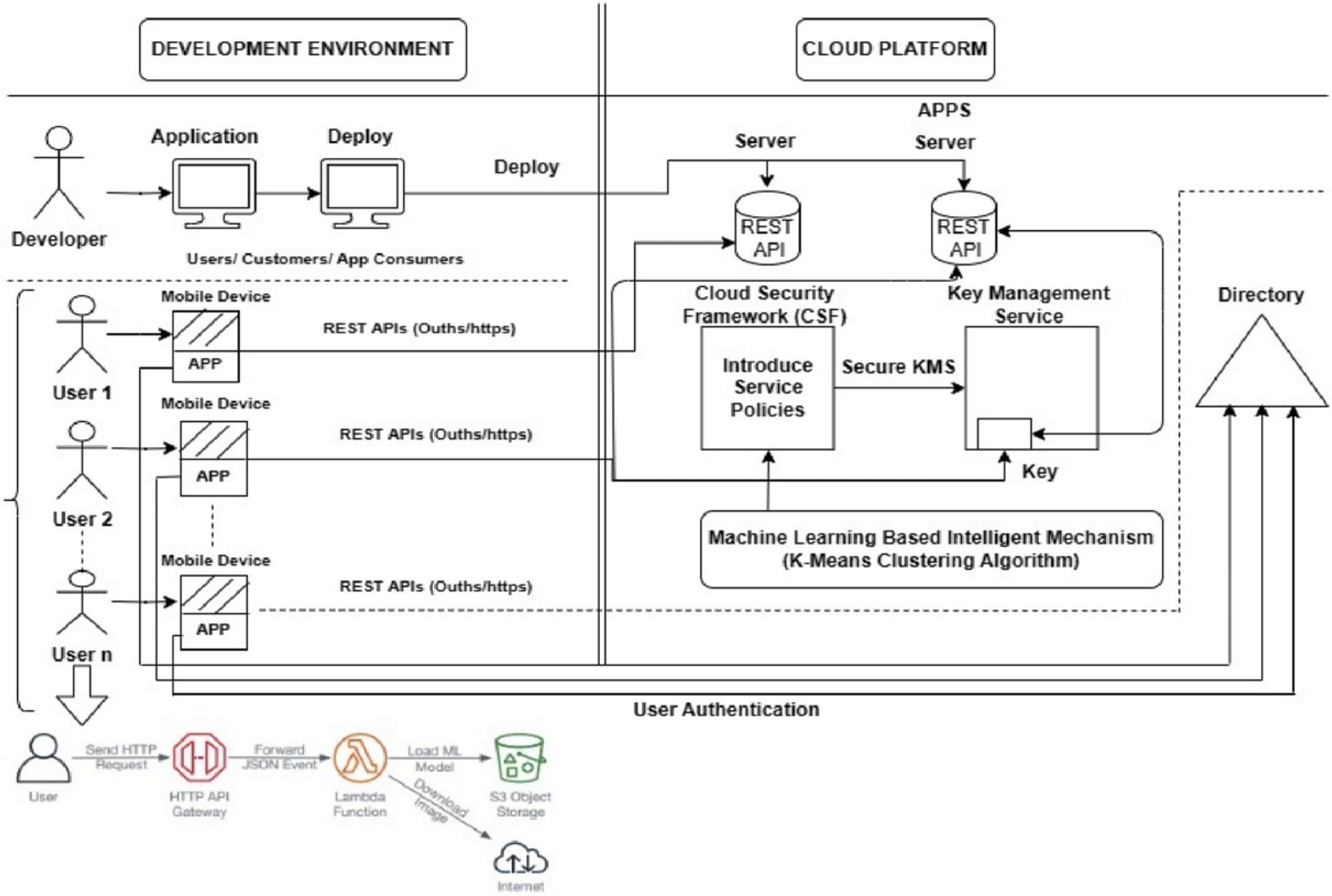
# User Authentication

- Initially, when a user registers, a pair of keys, Public Key (P0) and Private key (P1) will be generated and associated with identity of user
- Public Key P0 will be stored in Cloud, whereas the private key P1 will be stored in the application
- When user logins, the private key will be sent along with Username and Password, and compared if it is matching, access will be granted
- This adds extra layer of security

# Access Control

- For each record, a Data Encryption Key will be generated by KMS and stored in KMS
- Data is encrypted using DEK, and then DEK is encrypted using Role based Master Key
- When ever a REST API call requests a record, it first decrypts the DEK, and thereby using DEK, the final data is accessed
- In this way, access control is achieved using REST APIs

# Framework


DEVELOPMENT ENVIRONMENT
CLOUD PLATFORM
Application
Deploy
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Developer
APPS
Server
Server
REST API
REST API
Users/ Customers/ App Consumers
Mobile Device
REST APIs (Ouths/https)
APP
User 1
Cloud Security Framework (CSF)
Key Management Service
Directory
Introduce Service Policies
Secure KMS
Mobile Device
REST APIs (Ouths/https)
APP
User 2
Key
Machine Learning Based Intelligent Mechanism (K-Means Clustering Algorithm)
Mobile Device
REST APIs (Ouths/https)
APP
User n
User Authentication
Send HTTP Request
Forward JSON Event
Load ML Model
User
HTTP API Gateway
Lambda Function
S3 Object Storage
Download Image
Internet

# Drawbacks

- Scalability : This might not be scalable, Lambda functions and KMS are used for Key management
- Offline Accessibility : Since there should be continuous interaction between client and server, there is no possibility of offline accessibility
- False Positives and False Negatives: These will be issue at a large scale
- Single Point of Failure : If any of the Lambda function or KMS has a breakdown, entire system will be disturbed

# Improvements - Scalability

- Scalability : This might not be scalable, as Lambda functions and KMS are used for Key management
- Since Lamda function is causing issue, Amazon EC2 instances with auto-scaling groups can be used
- Based on active no. of users, the system will automatically scale
- This also allows more flexibility in handling high loads
- Can be customized with instance types which are optimized for some applications
- Elastic Kubernetes Service (EKS) service provided by Amazon also can be used for rapid scaling and isolation
- To avoid issue with KMS
  - Local caching of encrypted keys
  - Instead of encrypting entire data, encrypt only Data Encryption Key (DEK) and encrypt the data locally using DEK, thereby reducing interactions with KMS

# Improvements - Offline Access

- Offline access
- Implementation of local caching, where we store essential data needed for communications
- Amplify DataStore service can be used for this
- Synchronizes data whenever there is connection

# Improvements - Offline Access

- Offline access
- Another way is to implement for conditions with low bandwidth
- Although internet connectivity is needed, low bandwidth also works
- CloudFront Service can be used to implement this

# Improvements - Single Point of Failure

- Single Point of Failure
- Hybrid Cloud Management System
- Establishing a backup KMS using another service provider
- Ex : Using Google KMS and AWS KMS
- Deploying the services in multiple regions, so we can switch to another region

# Improvements

- Encrypting sensitive data all the time - during rest and transit
- Implementing multi factor authentication on top of cryptographic encryption to achieve more security
- K-Means algorithm also can be optimized for more efficiency and avoiding false positives and false negatives

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# Thank you!