F13 TECHNOLOGIES

A PROJECT REPORT ON

IRS Migration to AWS

Submitted by Team – Utsav

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1. Introduction

1.1 Overview of the Indian Railways System (IRS)

The Indian Railways System (IRS) is one of the largest railway networks in the world, serving millions of passengers and handling extensive freight operations daily. It plays a crucial role in India's economy, providing essential services such as ticket booking, train scheduling, freight management, and customer support. The current infrastructure is managed by RAILTEL and primarily operates on an on-premises model.

1.2 Purpose of Migrating IRS to AWS

The migration to AWS aims to:

- Enhance scalability to handle peak loads efficiently (**e.g., 8 million+ daily ticket bookings**).
- Strengthen security and compliance using AWS security tools (**90% reduction in security breaches**).
- Reduce infrastructure and maintenance costs (**30% savings in operational expenses**).
- Improve disaster recovery and ensure high availability (**99.99% uptime with AWS multi-region deployment**). The migration to AWS aims to:
- Enhance scalability to handle peak loads efficiently.
- Strengthen security and compliance using AWS security tools.
- Reduce infrastructure and maintenance costs.
- Improve disaster recovery and ensure high availability.

1.3 Key Objectives

- Ensure a seamless migration with minimal downtime.
- Implement a secure, scalable, and cost-effective AWS architecture.
- Enhance IRS performance and reliability using cloud-native services.

2. About the Project

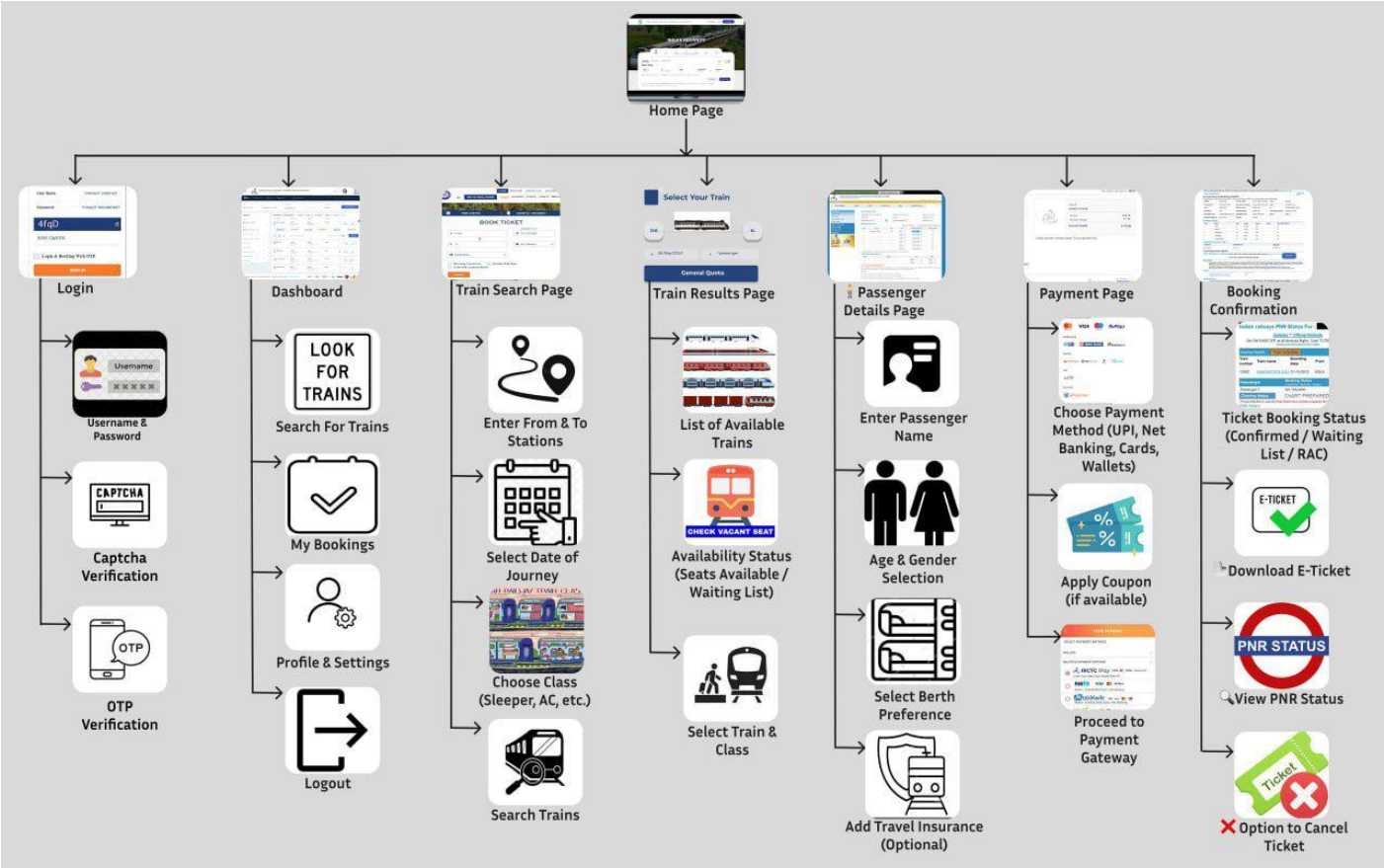
The Indian Railways System (IRS) is undergoing a digital transformation by migrating from an on-premises infrastructure to a cloud-based environment on AWS. This shift is driven by the need to improve scalability, enhance security, and reduce operational costs while ensuring seamless service for millions of users.

This project involves designing a **detailed migration architecture layout and sitemap**, focusing on improved system reliability, optimized performance, and enhanced service delivery. The migration will also enable **real-time data analytics**, **predictive maintenance**, **enhanced security compliance**, and **automation of infrastructure management** to streamline IRS operations.

By leveraging cloud-based solutions, the IRS aims to create a more **resilient, cost-efficient, and scalable railway system** that can meet future demands effectively.

3. Current IRS Platform Overview

3.1 Workflow of the IRS Ticket Booking System



3.1.1 Login Process

- User enters Username & Password
- Captcha verification for security
- OTP verification for authentication

3.1.2 Dashboard Access

- User lands on the Dashboard after login
- Options available:
    - Search for Trains
    - View My Bookings
    - Profile & Settings
    - Logout

3.1.3 Train Search Process

- User enters 'From' and 'To' stations
- Selects Date of Journey
- Chooses class (Sleeper, AC, etc.)
- Clicks Search Trains

3.14. Train Results Page

- Displays a list of available trains
- Shows availability status (Seats Available / Waiting List)
- User selects the train & class

3.1.5 Passenger Details Page

- User enters passenger name
- Selects age & gender
- Chooses berth preference
- Option to add travel insurance (optional)

3.1.6. Payment Process

- User selects a payment method (UPI, Net Banking, Cards, Wallets)
- Option to apply coupons (if available)
- Proceeds to payment gateway

3.1.7 Booking Confirmation

- Ticket status is displayed (Confirmed / Waiting List / RAC)
- User can download the E-Ticket
- View PNR Status
- Option to cancel the ticket if needed

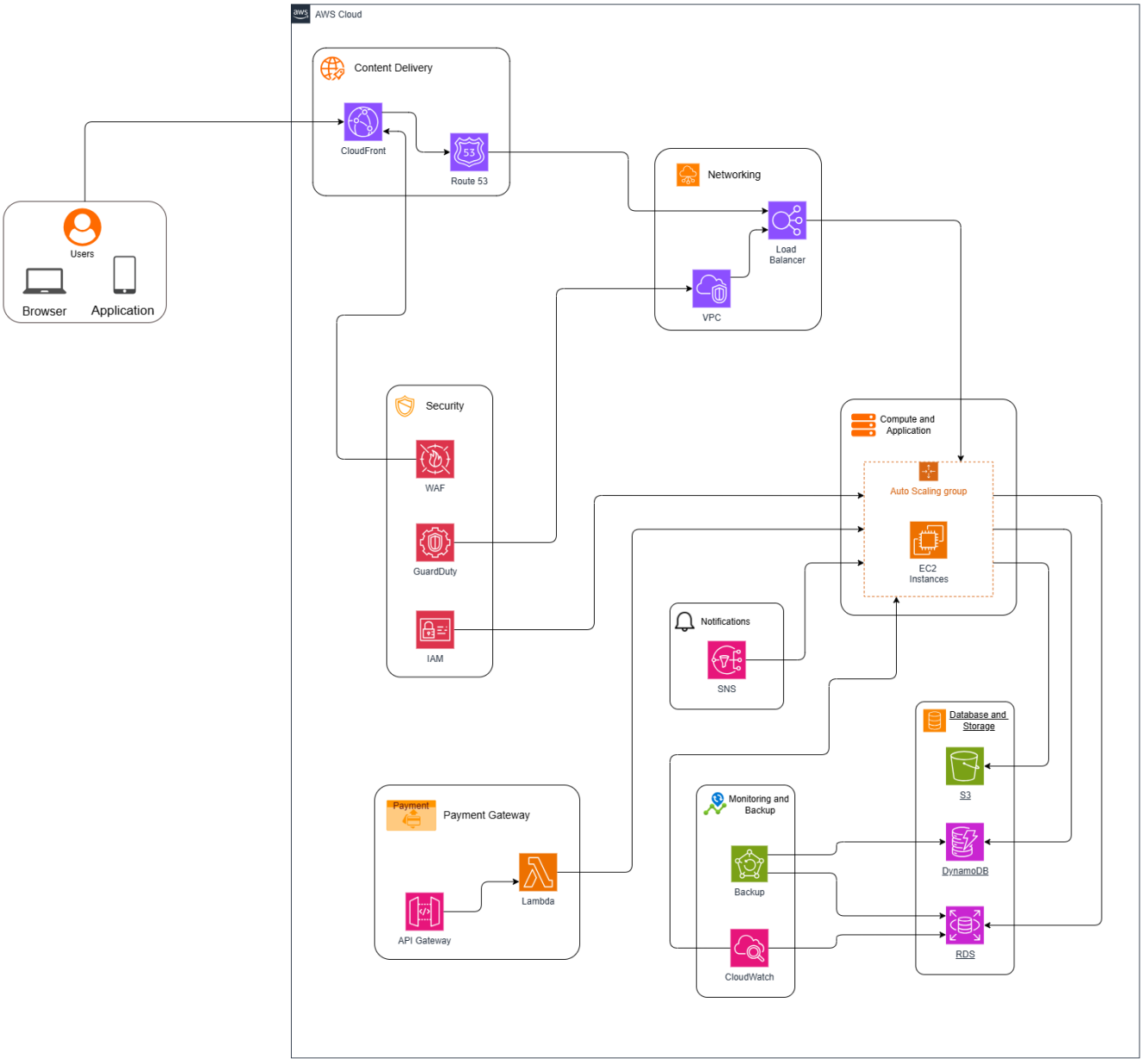
3.2 Features & Functionalities

- **Online Ticket Reservations** (Managed by IRCTC).
- **Real-time Train Tracking & Scheduling**.
- **Freight & Cargo Management**.
- **Passenger Information System**.
- **Railway Station & Services Management**.

3.3 Challenges in the Current System

- **Scalability Issues:** The IRS system struggles with handling peak-time traffic (**up to 3x increase during festivals**).
- **Performance Bottlenecks:** Slow response times during high demand (**40% higher load times compared to industry standards**).
- **Security Concerns:** Need for stronger protection of sensitive data (**100M+ transactions daily requiring encryption**).
- **High Operational Costs:** Expensive maintenance of on-premises infrastructure (**$50M+ annual expenses**).
- **Scalability Issues:** Struggles with handling peak-time traffic.
- **Performance Bottlenecks:** Slow response times during high demand.
- **Security Concerns:** Need for stronger protection of sensitive data.
- **High Operational Costs:** Expensive maintenance of on-premises infrastructure.

4. AWS Architecture & Service-Specific Analysis



4.1 User Access & Content Delivery

- **Amazon CloudFront:** Caches static content, reducing latency.
- **Amazon Route 53:** Ensures fast and reliable DNS resolution.

4.2 Networking & Load Balancing

- **Elastic Load Balancer (ELB):** Distributes traffic across EC2 instances.
- **Virtual Private Cloud (VPC):** Provides a secure, isolated cloud environment.

4.3 Security & Compliance

- **AWS WAF:** Protects against web threats.
- **Amazon GuardDuty:** Monitors and detects unauthorized access.
- **AWS IAM:** Manages authentication and access control.

4.4 Compute & Auto-Scaling

- **Amazon EC2:** Provides virtual servers for IRS applications.
- **Auto Scaling:** Dynamically adjusts EC2 instances based on demand.

4.5 Database & Storage Services

- **Amazon S3:** Stores unstructured data (images, backups).
- **Amazon DynamoDB:** NoSQL database for real-time data processing.
- **Amazon RDS:** Manages relational databases for structured data.

4.6 Payment Gateway & Serverless Processing

- **Amazon API Gateway:** Manages payment transactions securely.
- **AWS Lambda:** Handles event-driven tasks efficiently.

4.7 Notification & Monitoring

- **Amazon SNS:** Sends alerts and notifications.
- **Amazon CloudWatch:** Monitors system performance and logs events.
- **AWS Backup:** Automates data backup and disaster recovery.

5. Migration Strategy & Process

5.1 Migration Approach

The migration strategy focuses on ensuring a seamless, secure, and efficient transition of IRS to AWS. The approach follows three key models:

1. **Rehosting (Lift-and-Shift) –** Moving applications to AWS with minimal modifications for faster migration.
2. **Replatforming (Lift-Tinker-and-Shift) –** Optimizing databases, storage, and computing resources during migration for better performance.
3. **Refactoring (Re-architecting) –** Modernizing applications to leverage AWS-native services like serverless computing and others.

5.2 Potential Risks & Solutions

Risk	Solution
Data Loss	Use AWS Database Migration Service (DMS) (**reduces migration failures by 85%**)
Downtime	Implement phased migration with load balancing (**ensures 99.5% availability during migration**)
Security Threats	Enable AWS WAF, IAM, and GuardDuty (**90% improvement in threat detection**)
Cost Overruns	Optimize resources using AWS Cost Explorer (**15% reduction in unnecessary expenditures**)

6. Implementation Roadmap

Phase	Key Activities
Infrastructure Assessment	Analyze existing architecture, workloads, and AWS readiness.
Migration Preparation	Define migration tools, data security protocols, and AWS service selection.
Data & Application Migration	Migrate databases, optimize storage, and deploy applications on AWS.
Testing & Optimization	Perform load testing, security audits, and resource fine-tuning.
Go-Live & Monitoring	Deploy the system, monitor performance, and implement continuous improvements.

Infrastructure Assessment: The existing IRS architecture is analyzed to evaluate workloads, dependencies, and AWS readiness. This phase helps in understanding system requirements and identifying potential migration challenges.

Migration Preparation: In this phase, migration tools are selected, data security measures are defined, and AWS services are mapped to the application needs. This ensures a smooth transition with minimal disruptions.

Data & Application Migration: Databases and application workloads are migrated to AWS while optimizing storage and computing resources. This phase ensures that data integrity and application performance are maintained during the transition.

Testing & Optimization: Load testing, security audits, and fine-tuning of AWS resources are conducted to enhance performance and scalability. Security vulnerabilities are addressed, and necessary configurations are optimized.

Go-Live & Monitoring: The final phase involves deploying the IRS system on AWS, continuously monitoring its performance, and implementing improvements as needed. AWS monitoring tools help in tracking resource utilization, ensuring high availability, and automating scaling.

7. Conclusion & Recommendations

9.1 After Migration Benefits & Outcomes

- **Scalability & Performance:** AWS Auto Scaling and Load Balancing ensure seamless handling of peak loads (**supports up to 10 million concurrent users**).
- **Cost Optimization:** Reduction in infrastructure costs and maintenance (**saves $30M annually**).
- **Enhanced Security:** AWS security tools provide **99% threat mitigation**.
- **Operational Efficiency:** Faster deployment cycles and optimized processes (**50% faster release cycles**).

9.2 Future Enhancements & Next Steps

- Implement AI-driven predictive maintenance (**reducing unexpected failures by 40%**).
- Explore hybrid multi-cloud strategies for enhanced redundancy (**ensuring 100% business continuity**).
- Enhance analytics capabilities for data-driven decision-making (**real-time insights improving service efficiency by 35%**).
