AMTRAK®

"Premium WI-FI Billing System"

INFX 580 Project Report

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Executive Summary

The premium WI-FI billing system project is one which helps the management of AMTRAK to cede the cost of upgrading its WI-FI infrastructure to the passengers. The new system provides passengers with the option of accessing a faster 5G internet connection during long train rides for an extra fee paid through the mobile application. The project does not replace the 4G internet accessible by all passengers on all AMTRAK's rides.

With the implementation of this new system, management would be more committed to improving the WI-FI infrastructure along its routes knowing fully well that the costs would be recovered in the foreseeable future.

Contents

1. Project Title and Scope

a) Project Title: Premium WI-FI Billing System: Ceding The 5G WI-FI Upgrade Costs to Passengers.

b) Project Scope: This defines what, how, why and how to of this project.

- What: The Premium WI-FI Billing System project is designed to introduce a billing mechanism for passengers to subscribe to premium 5G WI-FI via a mobile app during their train ride bookings, aiming to offset the operational costs associated with maintaining a robust 5G network.

- How: Creating an App which gives passengers the option to subscribe to 5G WI-FI when booking a train ride.

- Who: Key stakeholders in this project are train passengers (users), management, IT, and the accounting departments.

- How To: It would be implemented at the end of 2024 summer. It would take approximately three (3) months.

2. Business Case

As part of its overall strategy of improved services to passengers, AMTRAK has commenced the upgrade of its WI-FI infrastructure from 4G to 5G. The upgrade is estimated as an $87 million project expected to be implemented on all routes in the summer of 2024. Management has expressed concerns about the cost of ownership and the business function of assigning the cost.

This Premium WI-FI Billing focused on helping management solve the cost of ownership problem by designing a system that transfers the cost of the 5G WI-FI upgrade to passengers.

a) Constraints

The following constraints have been identified for the Premium WI-FI Billing System:

- Passengers' willingness to pay for premium WI-FI services.
- Delivery of the WI-FI upgrade to 5G by the technical consultants.
- Addition of the "Premium WI-FI" feature before the ticket checkout page on AMTRAK's mobile app by the full-stack development team.

b) SWOT Analysis

We performed the SWOT analysis for the proposed system. From our analysis, the cost of upgrading the current WI-FI infrastructure from 4G to 5G is high and is a threat to the successful execution of the project by Management. The Premium WI-FI Billing System is a solution that helps Management to transfer the costs of the WI-FI upgrade to the passengers.
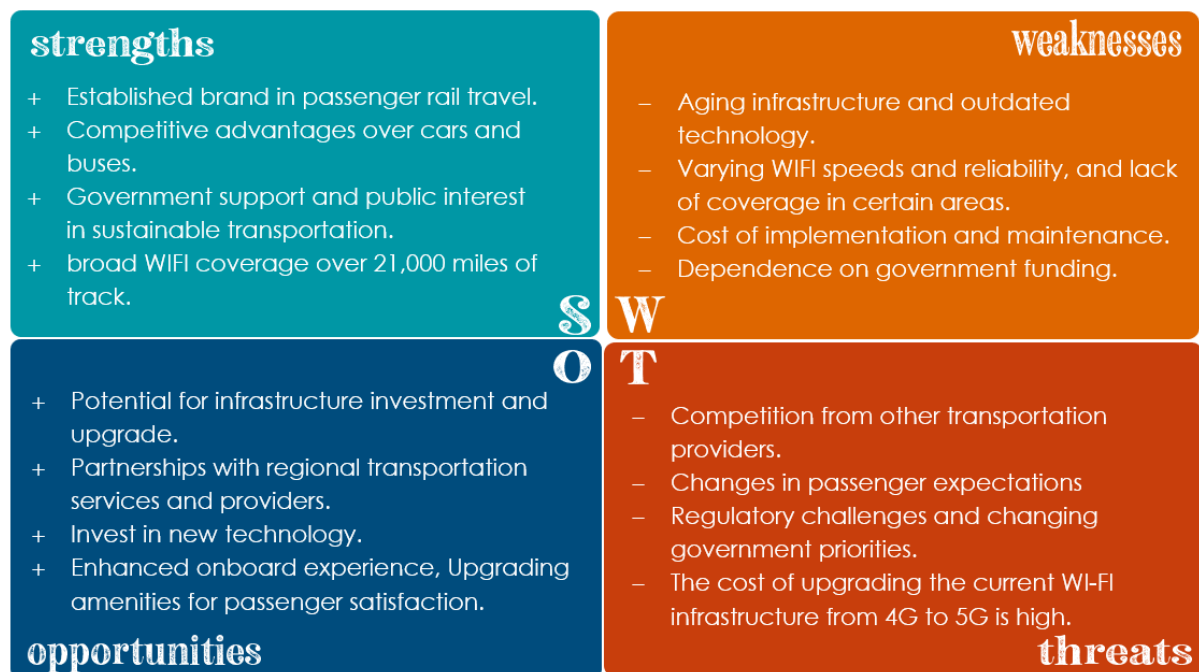
strengths

+ Established brand in passenger rail travel.
+ Competitive advantages over cars and buses.
+ Government support and public interest in sustainable transportation.
+ broad WIFI coverage over 21,000 miles of track.

weaknesses

– Aging infrastructure and outdated technology.
– Varying WIFI speeds and reliability, and lack of coverage in certain areas.
– Cost of implementation and maintenance.
– Dependence on government funding.

opportunities

+ Potential for infrastructure investment and upgrade.
+ Partnerships with regional transportation services and providers.
+ Invest in new technology.
+ Enhanced onboard experience, Upgrading amenities for passenger satisfaction.

threats

– Competition from other transportation providers.
– Changes in passenger expectations
– Regulatory challenges and changing government priorities.
– The cost of upgrading the current WI-FI infrastructure from 4G to 5G is high.

Figure 1: SWOT Analysis Snapshot

3. System Planning (Information Gathering)

In analyzing the business case and feasibility of the proposed WI-FI billing system for AMTRAK rides, we gathered facts using the following reliable approaches.

a) Document Review: The document review reveals that while AMTRAK's existing free WI-FI service offered in stations and on trains suffers from issues like unstable signal strength and connectivity due to factors such as the pending upgrade to 5G, aging infrastructure, and heavy traffic, it still functions (Appendix 1). The Premium WI-FI Billing System project is set to capitalize on these challenges by transitioning the cost of WI-FI services to the users, making it a chargeable upgrade. Importantly, many current and potential customers are not aware that the service is complimentary and show a willingness to pay for a premium service that offers improved connectivity (Appendix 2). By structuring the subscription costs to allow for business expense deductions and potentially employer-covered payments, the project could encourage longer-term subscriptions, thereby providing discounts and adding value for users seeking dependable internet access during their travels.

b) User Survey: We also conducted a survey to assess the willingness of customers to pay a token for better WI-FI on their train rides. The survey comprised of two descriptive questions to understand the demographics of the population, and five feedback soliciting questions to understand their reception to the idea of paying a premium for the WI-FI (Appendix 5).

Based on our analysis of the responses, 26.3% are willing to pay less than $1, another 26.3% are willing to pay between $1 and $5, while 47.4% do not want to pay extra for the WI-FI services. These data shows that the project will be viable provided the premium to be paid by passengers does not exceed $5. Furthermore, free and limited WI-FI will still be available for the passengers who do not want to subscribe to the premium WI-FI services.

4. System Analysis (Logical modeling)

a. Modeling Requirement Gathering and Documentation

i. Description of the Current System: The current system is a 4G WI-FI Network for all passengers, with free WI-FI connectivity along the train routes nationwide. AMTRAK owns the cost of the current 4G WI-FI, and they do not charge the passengers for this service.

ii. Requirements for the New System: The proposed new system is a transfer of the 5G WI-FI upgrade cost to the passengers.

- Output/Input: The ticket with a premium WI-FI passcode will be provided to passengers who select the premium WI-FI services during ticket purchasing or afterward. Passengers opting for this service will pay an additional fee of up to $5 for unlimited access to premium WI-FI. All other passengers will continue to have access to the basic free WI-FI. This premium WI-FI option could be particularly advantageous compared to cell data services. It offers a potentially more stable and faster connection on trains, where cellular service can be inconsistent due to varying coverage and the physical constraints of railway travel. This makes the premium WI-FI a valuable alternative for passengers needing reliable internet access while on the move.

- Performance: The premium WI-FI would provide passengers with faster and more responsive WI-FI connection that will support real-time video streaming, fast data processing and communication.

- Control and Security: A critical security measure that will be put in place in the new system includes ensuring that no customer is able to sabotage or bypass the subscription for the WI-FI.

b. Data and Process Modelling

i. Data Flow Diagram: Figure 1 below is the context diagram and the level-0 diagrams for the Premium WI-FI Billing System. The context diagram shows 1 system, 7 data

flows and 5 entities. We exploded the context diagram in Figure 2 to show more details about the new system. The 0-level DFD has 3 processes, 11 data flows, 1 data store and 5 entities.
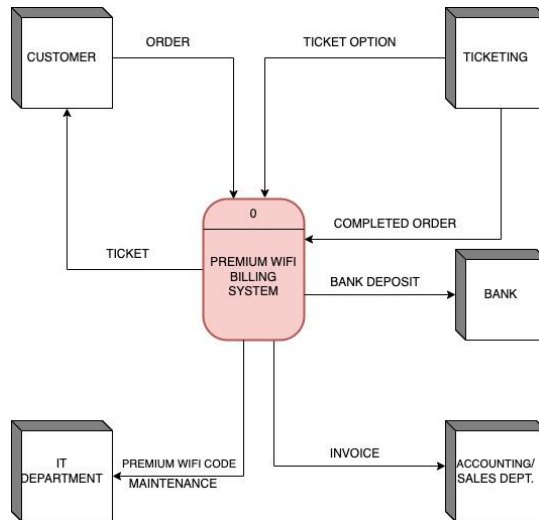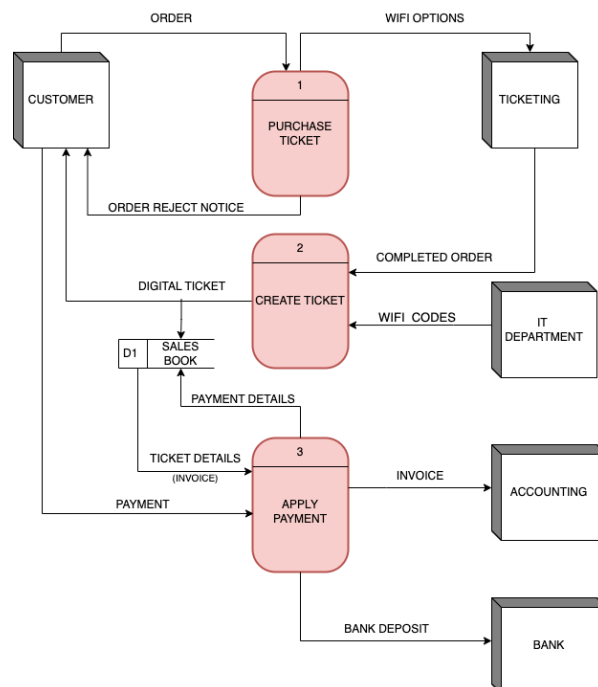

Figure 2: The Context Diagram

Figure 3: Level 0 DFD

ii. Data Dictionary: The Data Dictionary provides a detailed description of the data elements and structures used in the Data Flow Diagram (DFD) above. It is used to document and describe the data that flows through the system being modeled in the DFD. Below is the description of the entities in the DFD diagrams.

Item	Description
Entity	Stakeholders in the system. They include, Customer, Ticketing Department, Accounting Department, IT department, and the Bank.
Process	The relevant business process which plays a crucial role in the new system. These include the Purchase Ticket process, the Create Ticket process, and the Apply Payment process.
Data Store	The database which warehouses relevant data in the new system. The Sales Book has been identified as a data store used by both the Create Ticket and Apply Payment processes.
Data Flow: The WI-FI Codes	The premium WI-FI passcodes are printed on the tickets of passengers who checked the option when purchasing train ticket. The WI-FI passcode works for a single device per time.
Requirements for the DFD	- The process names must be a verb. - Processes should have inputs and outputs. - Data cannot flow from an entity to another entity.

5. Systems Architecture/Design

To support the new premium WI-FI billing system, Amtrak's mobile application architecture has been significantly upgraded. Originally based on a simple client-server model for ticket bookings, the updated system now features a more complex, modular design. This includes a new WI-FI billing module and a WI-FI Management System, enhancing the app's functionality and ensuring a seamless experience for users purchasing WI-FI packages.

a) Design specification

Before: Prior to the introduction of the premium WI-FI billing system, the Amtrak mobile application primarily supported the purchasing of train tickets and seat selections. The system was built on a simplified client-server architecture, where user requests were handled centrally without extensive data integration for additional services such as internet connectivity. The following are the architecture of the current system:

i. Client Devices (Mobile Phones, Tablets): These devices access the server through a basic mobile application interface.

ii. Application Server: Handles requests for ticket bookings and seat selections, and a Simple database interaction for user and ticket data.

iii. Database (MySQL):

- *Stores user data and ticket information.*

- *Minimal interaction with other services.*

iv. Network Interaction: Limited to database and application server communications.

After: The revised design incorporates a more complex and modular architecture to support the new feature of WI-FI package purchases. The application now integrates with an additional billing module specifically for the WI-FI services, which communicates with both the primary ticketing system and a new network management system that monitors

and controls WI-FI access according to the packages purchased. The following are the architecture of the new system:

i. Client Devices (Mobile Phones, Tablets): Same as before, but now with enhanced functionality to select and purchase WI-FI packages.

ii. Application Server:

- *Manages ticket bookings, seat selections, and WI-FI package purchases.*

- *Interacts with the WI-FI Management System to authenticate and authorize WI-FI access based on user purchases.*

iii. WI-FI Management System:

- *New component managing WI-FI access permissions.*

- *Tracks WI-FI usage per package and user.*

iv. Database (No SQL or Mango DB):

- *Enhanced to include tables for WI-FI packages, user purchases, and session logs.*

- *Relationships between tickets, users, and WI-FI packages.*

v. Network Interaction: Increased complexity with added interactions between the application server, WI-FI management system, and enhanced database.

vi. Front-end:

Front-end interface of the WI-FI billing system using React.js, implementing features such as account registration, usage monitoring, and invoice generation.

vii. Backend:

- *Enhancing Backend logic with Node.js to handle user authentication, billing calculations, and communication with third-party payment gateways.*

- *Integrate with external systems such as network routers and billing software using RESTful APIs to retrieve usage data and generate invoices automatically.*

b. Users Requirement – Iterations

To ensure optimal user experience, every mobile app must consider user requirements during its design or enhancement process. By prioritizing user needs and preferences, the app can deliver a seamless experience that aligns with user expectations. We considered Passenger requirements, and our internal stakeholders including IT, Ticketing, Accounting, and Customer service. For the Amtrak Mobile App, our requirements may encompass various aspects:

i. Passenger's Requirements- Core Functionalities:

- Ticket Booking: Passengers want a seamless, easy-to-navigate system for booking tickets.
- Schedule Checking: Passengers prefer Real-time updates and browsing capabilities for train schedules.
- Service Status: Passengers expect Live updates on train statuses, including delays or cancellations.
- High-Speed Internet: passengers expect uninterrupted and seamless high-speed connectivity throughout the journey.
- Secure Connectivity: Secure login and encrypted data transmissions to safeguard user privacy.
- Flexible Options: Passengers prefer package options in short increments for brief trips and Full-passes for longer travel.
- Affordable 5G WI-FI Pricing: Competitively priced options accessible to all passengers.
- Instant Connectivity and real-time Support: Immediate assistance available within the app for WI-FI connectivity issues.

- Multilingual Support: Service support in multiple languages to cater to all passengers.
- Accessibility: Interface should be designed to be accessible for passengers with disabilities.
- Ease of Use: Simplified, intuitive app navigation, and user-friendly design.
- Visual and Navigation Aids: High contrast mode, text-to-speech, and voice command features to assist visually impaired users.
- Performance: Optimization for fast load times and minimal crashes.
- Customer Support- Live Chat and FAQs: Round-the-clock chat support and accessible troubleshooting guides.
- Promotional Access: passengers expect Special offers and discounts available directly through the app.
- Push Notifications: Customizable notifications for deals, travel reminders, and updates.

ii. Internal Stakeholder Requirements:

- Accounting and Reporting Features: Detailed breakdown of costs for effective tracking and reporting, meeting the needs of the Accounting Department.

- IT and Security Enhancements: Robust encryption and fraud detection systems to enhance security, fulfilling IT Department requirements. Compliance with data protection regulations to ensure legality and security.

- Ticketing Flexibility: Ability to adjust or cancel WI-FI packages in line with travel plan changes. Provision of digital receipts for both ticket and WI-FI purchases to facilitate easy management and refunds, addressing the Ticketing Department's needs.

We also performed iterations based on the requirements above. These iterations have focused on refining the app's capabilities, enhancing user experience, and ensuring that operational requirements from internal stakeholders are met effectively. Each iteration

brought closer alignment with passenger needs and operational efficiencies, providing a robust, user-friendly service that supports Amtrak's strategic goals.

First Iteration:

- Implementation of a Help Center within the app to assist passengers with issues during ticket and WI-FI purchase, as suggested by the Customer Service Department and Passengers preference.
- Accounting requirements for tracking sales data of WI-FI packages led to backend improvements to ensure accurate financial reporting.

Second Iteration:

- Integration of additional WI-FI package options (15 minutes, an hour) based on passenger feedback, focusing on shorter journey needs.
- Enhancements in the user interface to simplify the WI-FI package selection during the ticket purchasing process.
- Ticketing and Customer Service Departments provided insights on common passenger queries and transactional challenges, leading to interface improvements.

Third Iteration:

- Enhanced features for choosing seats and packages in a more integrated manner, improving the booking experience and more user satisfaction.

Fourth Iteration:

- Addition of a loyalty program and offers section to the mobile app that provides discounts and deals to passengers.

Fifth Iteration:

- Incorporation of dynamic pricing models for WI-FI packages as influenced by feedback from the Accounting Department, aiming to maximize revenue during peak travel times.
- Enhancements to security features, based on IT Department audits, to protect user data and transaction integrity.

c. Usability Testing

Usability testing was conducted in phases corresponding to each iteration to ensure the efficiency, effectiveness, and accessibility of the mobile app.

Overall Strategy:

- Across all phases, usability testing was iterative, allowing for continuous refinement. After each phase, the app was updated based on user feedback and retested to confirm the effectiveness of the changes. This process helped ensure that the final product was not only functionally robust but also aligned with user expectations and preferences, providing a seamless and satisfying experience.

Participants:

- Five frequent business travelers
- Five Amtrak Employee as a representative of each internal stakeholder (IT, accounting, ticketing, customer service)
- Five casual travelers who use the service occasionally.

Location:

- Lafayette Rail Station for passengers, and Video call with Amtrak main office participants (Second group) via Google meet.

Phase 1: Initial WI-FI Package Purchase Testing

- Objective: This phase focused on the basic functionality of the new WI-FI package purchasing feature. The goal was to assess the ease of navigation and understandability of the WI-FI options presented to the users.
- Methodology: A diverse group of users was selected, ranging from tech-savvy individuals to those less familiar with digital apps. Participants were asked to complete tasks involving the selection and purchase of initial WI-FI packages offered (e.g., 15 minutes, an hour).
- Key Metrics: The primary metrics included task completion time, error rate, and the number of help requests made. Subjective feedback was also gathered through structured interviews to gauge user satisfaction with the interface and the clarity of the information provided.
- Outcomes and Adjustments: Based on the results, adjustments were made to improve menu layouts, simplify language, and enhance on-screen instructions to better guide users through the purchasing process.

Phase 2: Effectiveness of New Package Options and Interface Updates

- Objective: With the introduction of extended package options like 3 hours and unlimited usage, this phase tested the updates to the user interface that accommodated these new choices.
- Methodology: Participants were asked to perform a series of tasks that involved evaluating and choosing among the various WI-FI packages. The interface's new design elements, such as dropdowns, sliders for duration, and package comparisons, were key focuses.
- Key Metrics: Effectiveness was measured by the accuracy of package selection, understanding of package details, and overall satisfaction with the diversity of options. Usability issues reported in real-time were recorded, and post-task surveys captured detailed user feedback.
- Outcomes and Adjustments: Insights from this phase led to refinements in the graphical presentation of package options, optimization of the information architecture, and the introduction of tooltips to explain less intuitive elements.

Phase 3: Reliability and Speed of Integrated Ticket and WI-FI Purchase

- Objective: The final phase of testing centered on the reliability and performance of the app when handling integrated transactions — purchasing train tickets and WI-FI packages simultaneously.

- Methodology: This phase involved comprehensive scenario-based testing, where participants completed purchases under simulated conditions to mimic real-world usage. Stress testing was also conducted to evaluate the system's handling of high traffic and data processing demands.

- Key Metrics: Performance metrics such as transaction speed, system responsiveness, and error rates were closely monitored. Reliability was assessed through repeated task execution, and user satisfaction was measured through exit surveys focusing on their overall experience.

- Outcomes and Adjustments: The feedback resulted in optimizations to the backend systems to improve processing speed, enhancements to the UI to reduce transaction time, and robustness checks to ensure reliability under various network conditions.

5.1 Data Design

a. Data Structure

The data structure of Amtrak's system was upgraded to encompass a more comprehensive range of information, integrating details regarding both ticketing and WI-FI packages. This enhancement involved the creation of relational tables to organize and manage data efficiently. The key tables include:

- Passengers: Stores information about passengers, including their unique identifiers (Passenger ID) and other relevant details such as name and contact information.

- Tickets: Contains data related to ticket bookings, including a Ticket ID linked to specific passengers (Passenger ID), as well as additional ticketing information such as date, time, and seat selection.

- WI-FI Packages: This table stores details about the available WI-FI packages, including a WI-FI Access Code, Package Duration (validity), and Package Price.

b. Data Elements

Several essential data elements were introduced to facilitate the management of WI-FI packages and ticketing information:

- WI-FI Access Code: A unique identifier assigned to each WI-FI package, enabling users to access the WI-FI service.

- Package Duration (validity): Specifies the duration for which a WI-FI package remains valid after purchase, determining the access period for users.

- Ticket ID: An identifier assigned to each ticket booking, linking it to the respective passenger and containing details such as date, time, and seat selection.

- Package Price: The cost associated with each WI-FI package, allowing users to make informed decisions based on pricing options.

- Passenger ID: A unique identifier associated with each passenger, facilitating the linkage between ticket purchases and individual users. This ensures that ticket bookings and WI-FI package purchases are correctly attributed to the respective passengers, enabling personalized services and user-specific data management.
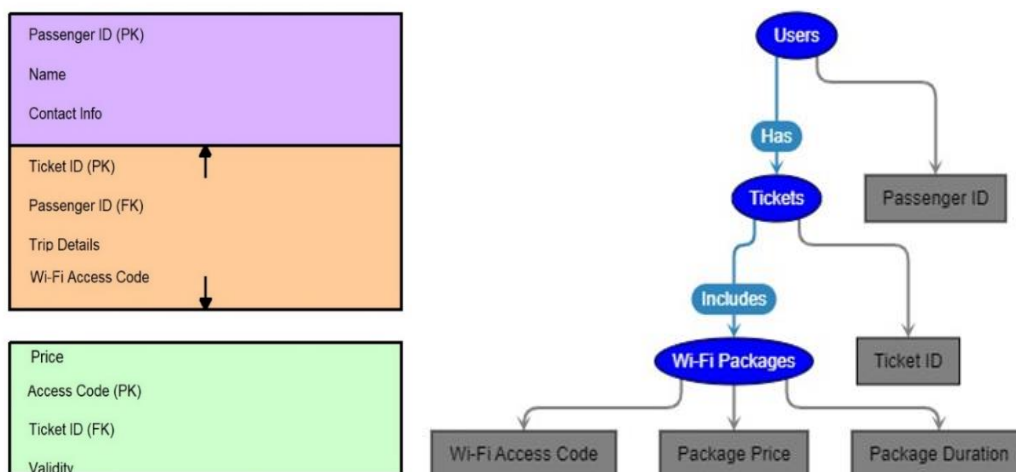
The relationships among these data elements are crucial for maintaining data integrity and facilitating efficient data retrieval and management within the system.

- Users to Tickets: This relationship is established through the Passenger ID attribute, creating a one-to-many relationship where one user (passenger) can have multiple ticket bookings. This linkage enables users to manage their ticket bookings effectively.

- Tickets to WI-FI Packages: The connection between ticket bookings and WI-FI packages is facilitated through the Ticket ID attribute, establishing a many-to-many relationship. This relationship signifies that a single ticket booking can include multiple WI-FI packages, and conversely, a WI-FI package can be associated with multiple ticket bookings. This flexibility allows users to choose and purchase WI-FI packages according to their preferences, enhancing their travel experience.

By organizing data into relational tables and defining clear relationships among data elements, the system can efficiently manage ticketing and WI-FI package information, ensuring accuracy, consistency, and accessibility for users.

c. Entity-Relationship Diagram (ERD)

An Entity-Relationship Diagram (ERD) was developed to illustrate the connections between tickets, users, and WI-FI packages within the Amtrak system. The schema underwent normalization up to the third normal form (3NF) to streamline data storage and enhance integrity. The ERD encompasses three primary entities: Passengers, Tickets, and WI-FI Packages. Passengers are identified by a unique Passenger ID and include relevant user details. Tickets are characterized by a Ticket ID, linked to Passenger IDs, and contain additional ticket specifics such as date and time. WI-FI Packages feature a WI-FI Access Code, alongside duration and pricing information. Relationships within the ERD include a one-to-many connection from Users to Tickets, signifying that one user can purchase multiple tickets. Moreover, the Tickets to WI-FI Packages relationship is many-to-many, allowing a ticket to encompass multiple WI-FI packages, managed through a junction table named Ticket_Package.
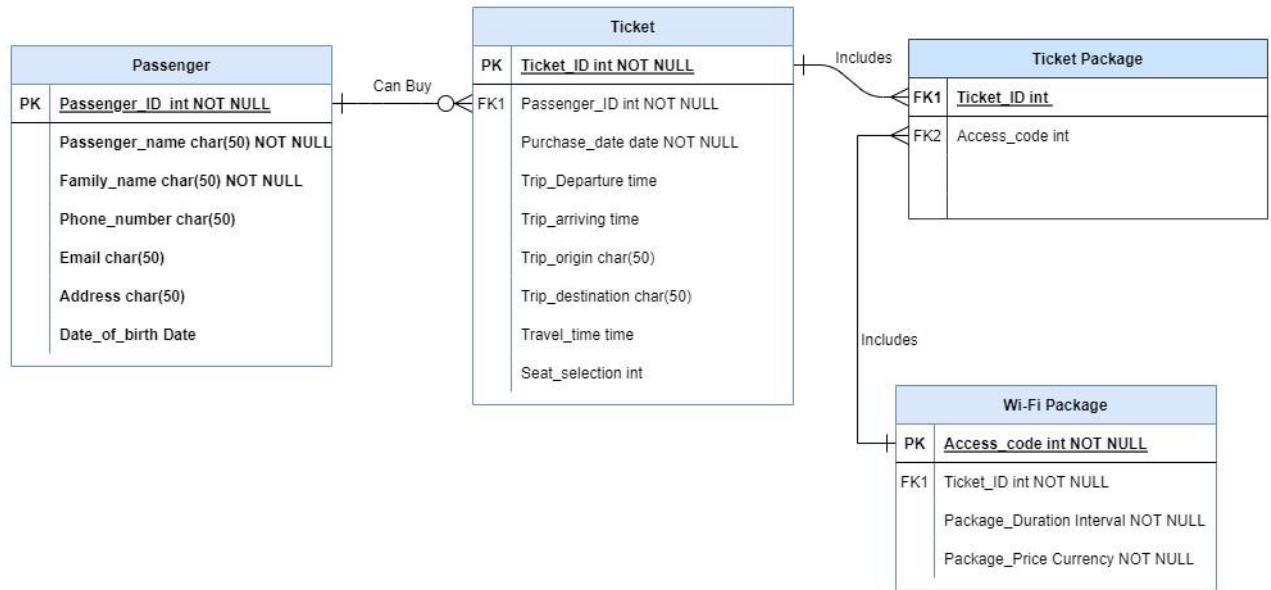
Entities and Attributes:

i. Passenger

- Passenger ID (Primary Key)
- Other relevant user information (e.g., name, email)

ii. Ticket

- Ticket ID (Primary Key)
- Passenger ID (Foreign Key, references Users)
- Other ticket details (e.g., date, time)

iii. WI-FI Packages

- WI-FI Access Code (Primary Key)
- Package Duration
- Package Price
- Relationships: Users to Tickets is one-to-many (One user can purchase multiple tickets); Tickets to WI-FI Packages is many-to-Many (A ticket can include multiple WI-FI packages, and a WI-FI package can be included in multiple tickets). This relationship typically requires a junction table:

iv. Ticket_Package

- Ticket ID (Foreign Key, references Tickets)
- WI-FI Access Code (Foreign Key, references WI-FI Packages)

5.2 Application Development

In this section, we delve into the development of the Amtrak mobile application, highlighting its updated features and functionalities aimed at enhancing the user experience. From streamlined ticket booking to seamless WI-FI package purchases, the app's development strategy prioritizes convenience and user satisfaction. We'll explore the application's content, workflow, and user interfaces, detailing how each element contributes to a seamless journey for travelers seeking reliable internet access and efficient ticketing services.

a. Content of the Application: The updated mobile application includes the following content:

- Home Screen: Displays options for sign in, register, and WI-FI package purchasing.
- WI-FI Package Selection: Users can choose from different packages: 15 minutes, 1 hour, 3 hours, or unlimited usage. Each package includes pricing and details on the speed and data limits.
- Booking Interface: Integrates train selection, seat booking, and WI-FI package addition in a single flow.
- Payment Gateway: Secured transactions for purchasing tickets and WI-FI packages.
- User Profile: Management of user preferences, purchase history, and access to current and past WI-FI codes.

b. Workflow: The application workflow for purchasing a train ticket along with a WI-FI package is outlined as follows:

- User Login/Registration: Users start by logging into their account or registering if they are new.

- Select Train: Users choose their train based on destination, date, and time.

- Seat Selection: After selecting a train, users choose their preferred seat.

- Add WI-FI Package: Users are prompted to add a WI-FI package during the checkout process. They can select from multiple options based on their needs.

- Payment: Users enter payment details to finalize the purchase of both the train ticket and the WI-FI package by Credit/debit cards, apple pay, and other online payment methods are available for them to use.

- Payment validation: Upon successful payment, users are directed to the confirmation page; alternatively, if the payment is declined, users are redirected back to the payment page for further action.

- Confirmation: Users receive confirmation with ticket and WI-FI access details, including Username, password, and QR cod. Users can also print this information directly.
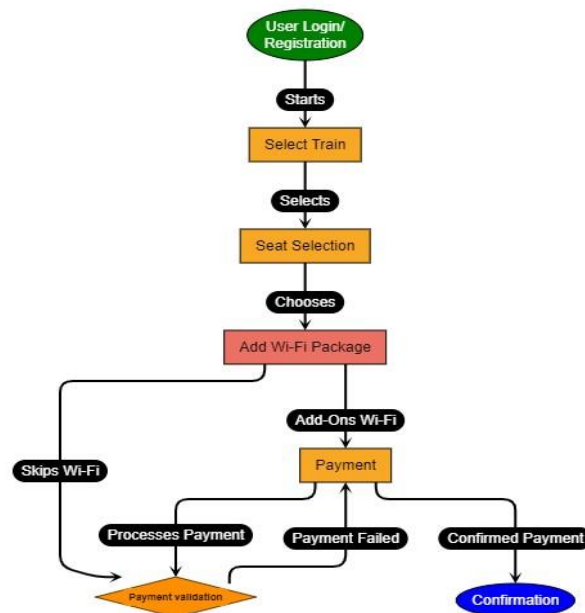

Figure 4 Workflow diagram.

c. User's Interfaces

The Amtrak mobile app features a user-friendly interface designed for easy navigation. The home screen offers simple options for ticket booking and WI-FI access. WI-FI packages are presented with clear icons indicating duration and size. The booking process integrates seat and WI-FI selection, confirming choices visually. Payment is secure and transparent, with clear cost breakdowns. The confirmation screen provides comprehensive purchase details and immediate access to WI-FI services.

- Home Screen Layout: Simple and clean, with prominent buttons for ticket booking and additional services like WI-FI.
- WI-FI Selection Screen: Visually distinct options for each WI-FI package, including icons representing the duration and size of the package.
- Booking Flow: A step-by-step process that integrates seat and WI-FI package selection, visually confirming each choice before moving to the next step.
- Payment Interface: A secure and straightforward payment process, with clear information on total cost and breakdown of charges.
- Confirmation Screen: Provides all the details of the purchase, along with a digital ticket and a code or link to access the WI-FI service and A QR code.
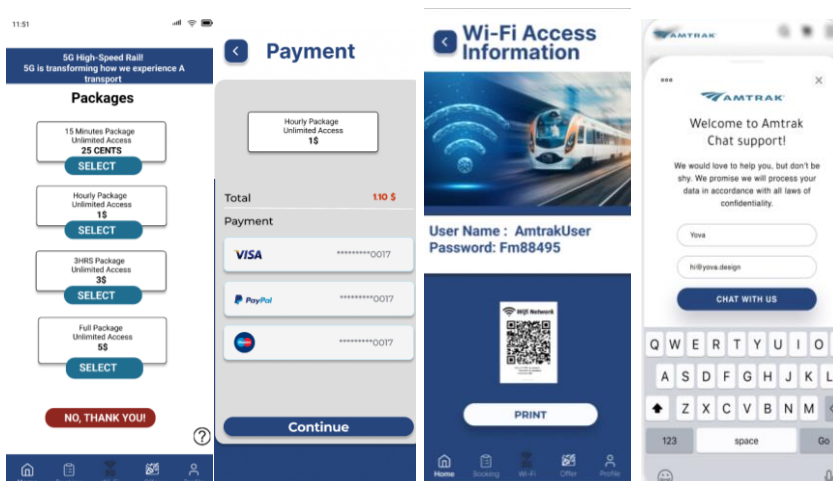
See the following screenshots for the high-fidelity prototypes.

i. Buy ticket and WI-FI package together:
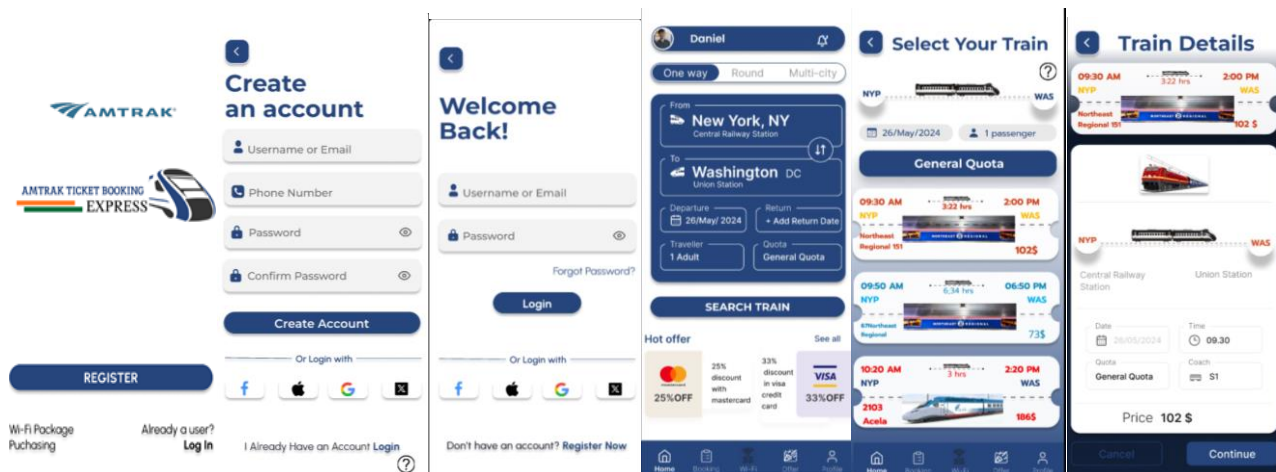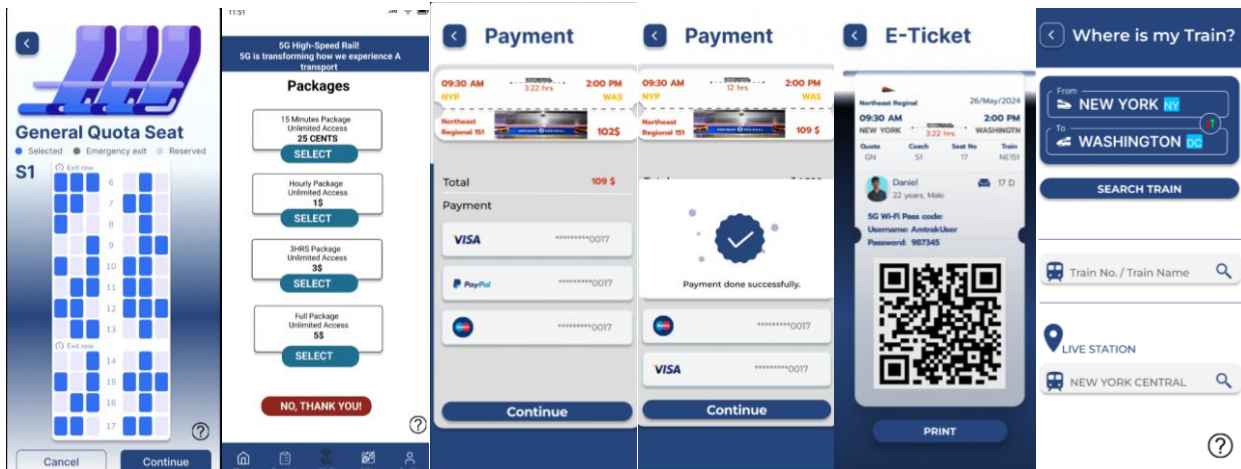
ii. Buy only WI-FI package:

6. Management System Implementation plan

The implementation plan for the WI-FI billing system involves several key components to ensure a smooth transition and successful deployment. The primary objectives of this implementation plan include:

- Developing the application for managing WI-FI billing and customer accounts.

- Establishing a comprehensive testing plan to verify system functionality and reliability.

- Preparing a training program for staff to effectively operate and support the new system.

- Planning for the transition from the existing system to the new billing system.
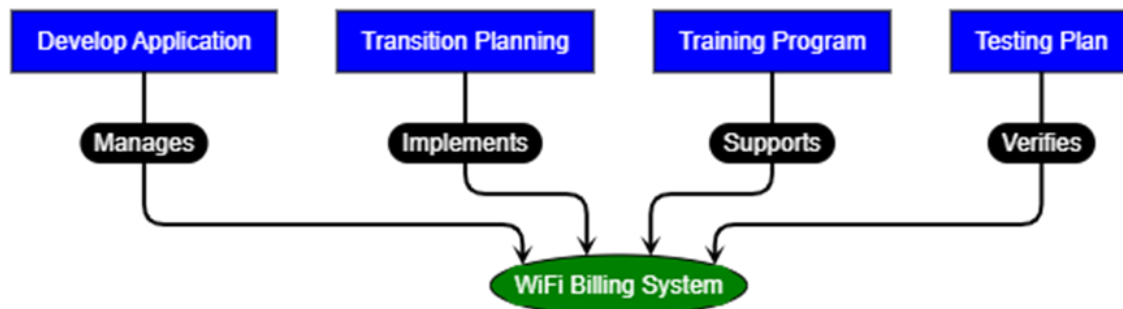
A. Application Development Tasks

Application development involves essential steps from planning to deployment, ensuring software solutions meet stakeholder and end-user needs. These tasks encompass planning, design, coding, testing, and deployment, contributing to reliable and user-friendly applications. We initiated the development lifecycle by focusing on requirements gathering and system design, progressing to subsequent phases such as development, integration, testing, and documentation. Modern frameworks and methodologies were employed to ensure scalability, security, and usability. Key functionalities, including customer registration and billing calculation, were implemented using React.js and

Node.js. Integration efforts focused on seamless connectivity with existing systems, while rigorous testing and comprehensive documentation ensured functionality validation throughout the process. We developed new features and enhanced other features based on the user's feedback:

i. Home Screen Redesign

- Task: Update the application's primary interface to include new functionalities for purchasing WI-FI packages.
- Detail: Incorporate a distinct section on the home screen that prominently displays available WI-FI plans, facilitating easy access for users.
- How we do it: Collaborate with user experience (UX) and user interface (UI) designers to ensure that the redesign enhances usability without compromising aesthetic or functional quality.

ii. WI-FI Package Selection

- Task: Develop an interface within the application that allows users to select from various WI-FI packages seamlessly.
- Detail: Enable users to choose from multiple WI-FI options, such as 15-minute increments or unlimited usage, directly within the booking process.
- How we do it: Design and implement a user-friendly selection tool that integrates with the existing booking workflow, ensuring a smooth transition and minimal user input.

iii. Booking Integration

- Task: Streamline the process by which users can simultaneously select train tickets and WI-FI packages.
- Detail: Allow users to add WI-FI packages to their ticket purchases in a unified booking experience.

- How we do it: Update the current booking system to accommodate the addition of WI-FI selections, ensuring that the integration is logical, intuitive, and maintains transaction continuity.

iv. Payment Gateway Integration

- Task: Implement a robust and secure payment system capable of handling combined transactions for train tickets and WI-FI packages.
- Detail: Users should be able to complete their purchases using various payment methods (Apple pay, Paypal, etc) while ensuring data security.
- How we do it: Integrate advanced payment processing solutions that support multiple payment methods, focusing on security measures such as encryption and compliance with international payment standards.

v. User Profile Management

- Task: Enhance the functionality of the user profile section to better manage preferences, purchase history, and access to WI-FI codes.
- Detail: Users will have the ability to view detailed records of their WI-FI package purchases, manage their account settings, and retrieve active WI-FI codes directly from their profile.
- How we do it: Redesign the profile management area to include comprehensive information about user activities and interactions with the WI-FI services, alongside providing enhanced support features for troubleshooting and assistance.

B. Testing Plan

In our software testing methodology plan, we employ a comprehensive approach to ensure the reliability and functionality of our mobile app. Unit testing meticulously examines each component in isolation, guaranteeing the flawless performance of critical features such as user registration and billing accuracy. Integration testing ensures smooth compatibility between new and existing systems, validating seamless communication between different components. User Acceptance Testing (UAT) involves real users,

evaluating the system's alignment with their needs through tasks like account creation and bill verification. Performance testing assesses the system's capacity to handle heavy user loads, while security testing identifies and addresses potential vulnerabilities, safeguarding user data. Through these methodologies, we ensure the integrity of individual components and seamless integration, user satisfaction, scalability, and robust data security. Let's take a closer look at the unit testing plan and delve into its details.

Test Scenario: Ticket Booking Functionality

Test Case: Verify that users can successfully book tickets for desired routes, select a WI-FI package, and proceed to the payment page.

Participants: Our participant group consists of fifteen individuals in total, categorized into three distinct segments. The first group includes five frequent business travelers who regularly use our services. The second group comprises five Amtrak employees, each representing different internal stakeholders such as IT, accounting, ticketing, and customer service. Lastly, the third group contains five casual travelers who use our services occasionally, providing a broader perspective on our customer experience.

Location: Lafayette Rail Station for passengers, and Video call with Amtrak main office participants (Second group) via Google meet.

Test Steps:

i.   Launch the Amtrak mobile app:

- Action: Open the Amtrak mobile app.

- Expected Result: The app launches successfully, displaying the home screen with navigation options.

ii.   Sign in to the app:

- Action: Enter valid credentials (username and password) and sign in to the app.

- Expected Result: The user is successfully logged in and directed to the app's main interface.

iii. Navigate to the ticket booking section:

- Action: Tap on the "Book Tickets" option from the main menu.

- Expected Result: The user is directed to the ticket booking interface without any errors.

iv. Enter the desired departure and destination stations, along with the travel date:

- Action: Enter "New York Penn Station" as the departure station and "Washington Union Station" as the destination. Select May 15, 2024, as the travel date.

- Expected Result: The entered information is accepted, and the system proceeds to the next step without issues.

v. Select the preferred seat number:

- Action: Choose 2 adult passengers and select standard seats.

- Expected Result: The selected options are reflected accurately, and the system moves to the next step smoothly.

vi. Select a WI-FI package option after choosing the seat type:

- Action: Select the "Standard WI-FI Package" option for $1.

- Expected Result: The user can choose a WI-FI package option after selecting the seat type, and the selected WI-FI package is added to the booking details.

vii. Proceed to the payment section:

- Action: Tap on the "Proceed to Payment" button.

- Expected Result: The app prompts the user to enter payment details without any errors, displaying the total cost including the ticket and WI-FI package.

viii. Complete the booking process by providing payment information:

- Action: Enter valid credit card details (card number, expiration date, CVV).

- Expected Result: The payment is processed successfully, and the user receives confirmation of the transaction.

ix. Verify that a confirmation message is displayed upon successful booking:

- Expected Result: A confirmation message is displayed on the screen, confirming the successful booking of tickets and the selected WI-FI package.

x. Check the user's email or app notifications to confirm receipt of the booking confirmation:

- Expected Result: The user receives an email and/or app notification containing the booking confirmation details, including the itinerary, ticket numbers, a QR code, and WI-FI package Username and password.

C. Training Plan

i. Technical Training for IT Staff

- Objective: Equip IT staff with the necessary knowledge to maintain, troubleshoot, and upgrade the new system.
- Tasks: Organize workshops and hands-on sessions that cover system architecture, security protocols, and troubleshooting common issues that might arise with the new features.

ii. Customer Service Training

- Objective: Prepare customer service teams to handle inquiries and issues related to the new mobile app features.

- Tasks: Develop training modules that include common questions, troubleshooting guides, and escalation procedures. Use role-playing scenarios to practice handling typical customer interactions.

iii.End-User Education

- Objective: Assist users in navigating the new features effectively.

- Tasks: Create easy-to-follow video tutorials and written guides on how to use the new WI-FI billing system. Distribute these resources through the app, company website, and via email to registered users.

iv.Feedback and Continuous Improvement: Use feedback to make necessary adjustments to training materials and sessions, ensuring continuous improvement in the training program.

- Objective: Gather feedback from trainees and stakeholders to identify areas for improvement in the training program.

- Tasks: Distribute post-training surveys and conduct follow-up meetings to collect feedback and suggestions.

D. System changeover plan
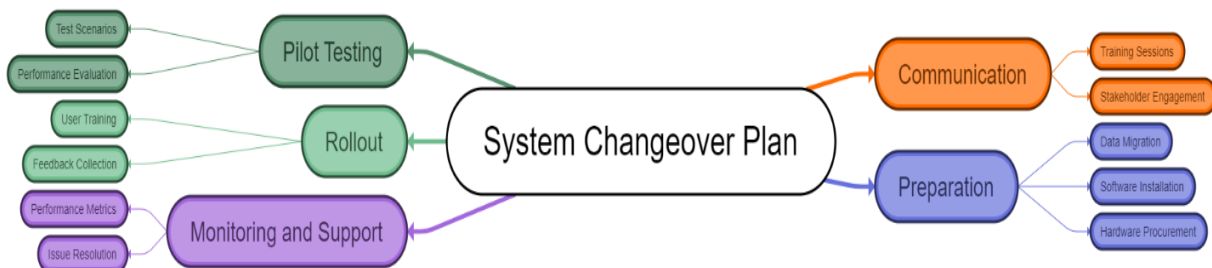
i. Communication: Amtrak is dedicated to ensuring all involved parties are fully aware of the changes ahead. To achieve this, communicate the upcoming changes to

stakeholders, including customers, IT, Ticketing, Customer service staff, and management. Conducting training sessions for them highlight the benefits of the new WI-FI billing system and provide a timeline for the transition process.

ii. Preparation: This phase involves preparing the necessary infrastructure and resources for the deployment of the new system. This includes hardware procurement, software installation, and data migration from existing systems.

iii. Pilot Testing: The pilot testing aims to evaluate the new billing system under real-world conditions before full deployment by selecting a small group of passengers for testing. An introductory session will explain the pilot program, after which participants will gain access to the system to purchase WI-FI packages based on test Scenario that we will mention it later. These users will be encouraged to use the system as they typically would, providing a robust feedback mechanism for reporting any issues encountered. Surveys and interviews will be conducted to gather in-depth feedback, and system performance will be closely monitored. Regular meetings to review this feedback will ensure any issues are identified and resolved promptly. This meticulous approach is expected to yield valuable user experience data and provide insights into the system's technical performance and stability before full deployment.

Test Scenario for Pilot Test: Booking a Train Ticket

Participants: Our participant group consists of fifteen individuals in total, categorized into three distinct segments. The first group includes five frequent business travelers who regularly use our services. The second group comprises five Amtrak employees, each representing different internal stakeholders such as IT, accounting, ticketing, and customer service. Lastly, the third group contains five casual travelers who use our services occasionally, providing a broader perspective on our customer experience.

Location: Lafayette Rail Station for passengers, and Video call with Amtrak main office participants (Second group) via Google meet.

Preconditions:

- Pilot users have access to the new Amtrak system.

- Test environment is set up with relevant data for booking train tickets.

- Users are familiar with the booking process and system interface.

Steps:

- User navigates to the "Book a Ticket" section of the Amtrak mobile application.

- User selects the desired origin and destination stations, as well as the travel date and time.

- User reviews available train options, including departure times, durations, and ticket prices.

- User selects a specific train, seating preferences (e.g., seat number) and WI-FI packages.

- User proceeds to the payment section and selects a payment method (e.g., credit card, Amtrak rewards points).

- User enters payment details and confirms the booking.

- System displays a confirmation message with booking reference number and detail.

- User receives a confirmation email with the booking details.

Expected Results:

- The user can successfully navigate through each step of the booking process without encountering errors or interruptions.

- All available train options are displayed accurately, including relevant details such as schedules and ticket prices.

- The system correctly processes payment transactions and generates a booking confirmation.

Postconditions:

- The booking information is stored accurately in the system database.

- The user can access and manage their booking through their Amtrak account or booking reference number.

By executing this test scenario, we can ensure that the ticket booking functionality in the new Amtrak system meets the required standards of accuracy, reliability, and user-friendliness before full deployment.

iv. Rollout: Gradually roll out the new WI-FI billing system to all locations, starting with a small number of users and expanding gradually. The intention is to manage the scale of adoption in such a way that any unexpected challenges can be addressed without widespread impact. As each group of users receives access to the new system, their experiences are closely monitored to ensure that the performance aligns with expectations and that any feedback can be swiftly acted upon to refine and improve the system. This phased approach mitigates risk and allows for adjustments to be made in a controlled manner. Providing support and assistance to users during the transition period to minimize disruption to operations is necessary.

v. Monitoring and Support: Monitoring the system closely after deployment is crucial. The IT and customer service teams will continuously track the performance of the system against established benchmarks. Key performance indicators (KPIs) such as system uptime, transaction processing times, and user engagement levels will be closely scrutinized to ensure the system operates optimally. Monitoring tools and analytics will be employed to provide real-time insights into system behavior. Support structures will be put in place to assist users who may encounter difficulties or have questions about the new system. This might include a dedicated help desk, in-app support guides, FAQs, and a responsive customer service team trained to address WI-FI billing queries. Issue resolution protocols will be established to ensure that any technical problems are resolved promptly and effectively, minimizing inconvenience to passengers. The goal is to maintain a high level of service quality and user satisfaction, and to ensure that the billing system functions as a reliable and valuable service for all Amtrak customers.

7. Managing System Support/Security

a. User support: The IT department will provide user support through a help desk powered by Cisco Network to answer questions, troubleshoot problems, and provide solutions related to the Premium WIFI Billing System. Passengers will be able to submit their requests via email, test messages or through a cloud-based portal integrated into the system which requires no WIFI connection. The help desk team will access users request and provide real-time solutions to enhance the passenger experience throughout the journey.

b. Maintenance management: The maintenance plan will require passengers and users to submit requests or feedback about the WIFI through the cloud-based portal integrated into the WIFI Billing System. The IT department will use Cisco platform tools to manage these requests, determine their priority, and assign tasks to the maintenance team. The maintenance team will use their experienced personnel to work on the request and provide immediate solutions if possible. After the execution of each task, the update will be sent back to the IT department for due diligence and other necessary actions.

How to implement the maintenance plan:

After a user submits a request or complaints, the help desk in the train will analyze and synthesis the request to know it depending on the nature or complexity. Based on this, the following actions will be taken:

- For an urgent but simple request like password or connection issue, help-desk attendance on the train will render assistance to the passenger on a first come first serve basis and in the case of multiple requests, an automated guides will be provided to the user through Cisco Network management system embedded within the Premium WIFI Billing system.

- For non-urgent requests within the cost limit, for instance incessant network fluctuation, the network administrator managing the Premium WIFI Billing system will organize the request in terms of priority and assign maintenance team to analyze and synthesis the cause of the issue and resolve it within the earliest

possible time, and all affected trains or routes will be notifying immediately the issue is resolved.

- For non-urgent requests that exceed the cost limit, a system review committee will assess the request and either approve it with priority or reject it. When the decision is made to address the issue, cost estimation and robust plan will be developed to provide solution to the problem.

7.1 Mid-term Maintenance plan

In the next 6 -12 months, we will focus on improving the passenger WIFI experience. Users (passengers) feedback will be collected through surveys to identify pain points and improve the cloud-based portal for easier interaction. Furthermore, AI-powered diagnostics will be integrated to automate troubleshooting and use of predictive maintenance to anticipate WIFI issues.

Our network monitoring capabilities will also undergo enhancements during this period. By strengthening our real-time monitoring and alert systems, we will be better equipped to detect and address network fluctuations proactively. This proactive approach will minimize downtime and ensure that our passengers enjoy a consistently high-quality WIFI experience.

To ensure long-term quality and future capacity, WIFI usage patterns will be analyzed to plan for scalability and meet growing passenger demands. Furthermore, Amtrak's IT staff and maintenance teams will receive ongoing training to effectively leverage these new technologies.

7.2 Long-term maintenance plan

Looking further into the future, our long-term maintenance plan extends beyond 12 months and focuses on strategic initiatives to future-proof our Premium WIFI billing system. One of the key areas of focus will be infrastructure upgrades. We will start by evaluating the need for equipment replacement and network expansion to support future growth, investing in next-generation WIFI technologies to enhance performance and reliability.

Also, we plan to explore opportunities to integrate our WIFI system with Internet of Things (IoT) devices onboard trains. By leveraging real-time data on train conditions and passenger behavior, we can optimize WIFI service delivery and further improve the passenger experience. This integration will enable us to adapt to evolving passenger needs and stay ahead of the curve in terms of technological innovation and development.

In addition to the above-mentioned plans, predictive maintenance will remain a cornerstone of our long-term strategy. Building on our mid-term efforts, we'll continue to develop and refine predictive analytics models, forecasting potential WIFI issues and taking proactive measures to prevent downtime. This proactive approach will minimize service disruptions and ensure that our passengers can rely on our WIFI system whenever they need it.

Collaboration will also be key to our long-term success. We will encourage partnerships with train manufacturers, technology vendors, and telecommunications companies to explore innovative solutions and leverage existing infrastructure. When we work together with industry leaders, we can unlock new opportunities for WIFI connectivity onboard trains and deliver even greater value to our passengers. In conclusion, we believe that the combination of our short-term and long-term WIFI maintenance plans will guarantee a consistently improving and dependable WIFI system. This will ultimately lead to a more enjoyable and positive experience for our train passengers.

8. SWOT Analysis After the Project

With the rollout of the new system, the high cost of the WI-FI upgrade is no longer a threat to AMTRAK's business. The new system brings exciting and improved experiences for passengers, including a user-friendly mobile app and diverse WI-FI choices. While challenges like integrating the system and training staff persist, this strategic initiative offers opportunities for increased revenue and competitiveness. Please see the revised SWOT analysis below for details.

strengths

+ Enhanced Customer Experience
+ Advanced Technology
+ Increased Revenue Streams
+ Operational Integration

S   W

weaknesses

- Cost Sensitivity
- Operational Training Needs
- Technical Challenges
- Dependency on Technology

O   T

+ Market Differentiation
+ Partnership Potential
+ Invest in new technology.
+ Customer Data Utilization

opportunities

- Technological Obsolescence
- Changes in passenger expectations.
- Competitive Pressure
- Security Risks

threats

Figure 5: Post-Implementation SWOT Analysis snapshot

9. Next Steps (Roadmap for Future Development)

This roadmap aims to build upon current successes while progressively adapting to technological advancements and changing passenger needs.

Short-term Initiatives (1-2 Years):

- System Integration with IoT: Integrate the WI-FI billing system with IoT devices on trains to automate service adjustments based on real-time data, enhancing passenger experience and operational efficiency.

- User Feedback System: Implement an automated, real-time feedback system within the app to gather and analyze passenger satisfaction more efficiently, enabling quicker responses to user needs.

Mid-term Initiatives (3-5 Years):

- AI and Machine Learning: Deploy AI technologies to predict WI-FI demand and adjust resources dynamically. Machine learning models can also be utilized to personalize marketing efforts and package recommendations based on user behavior.

- Expansion to Other Platforms: Extend the WI-FI billing system to other platforms such as onboard screens and kiosks, allowing passengers who may not use smartphones to access WI-FI services easily.

Long-term Initiatives (5+ Years):

- 5G and Beyond: Prepare for future telecommunications advancements by ensuring the infrastructure can support 5G and later technologies, keeping the service at the cutting edge of connectivity technology.

- Global Standardization: Explore opportunities to standardize this service model for use in other railway services internationally, potentially creating a new revenue stream and setting industry standards.

10. Recommendations

As Amtrak advances its Premium WI-FI Billing System, it's crucial to focus on key improvements that will enhance the overall passenger experience and align with current technological and environmental trends. Addressing these areas will help Amtrak stay competitive and meet the evolving needs of its passengers more effectively:

i. Enhance User Interface Further: Although the system has improved user experience significantly, continuous testing and user feedback suggest there are opportunities to

further simplify the navigation and streamline the process for purchasing WI-FI packages. Regular updates to the UI/UX should be pursued to maintain user satisfaction and ease of use.

ii. Expand Payment Options: To enhance accessibility and convenience for a wider range of passengers, incorporating additional payment options, such as cryptocurrency or e-wallet integrations, could cater to the evolving digital finance landscape and passenger preferences.

iii. Increase Marketing Efforts: To maximize the adoption of the new premium WI-FI services, robust marketing strategies should be employed. This could include promotional campaigns, partnerships with credit card companies for rewards on purchases, or discounts during off-peak hours.

iv. Data Utilization for Service Improvement: Utilizing collected data on passenger usage patterns to adjust WI-FI package offerings can help in tailoring services more effectively. Analyzing peak usage times, preferred package types, and passenger feedback can inform better product adjustments and pricing strategies.

iv. Sustainability Practices: Considering the environmental impact of upgrading hardware and infrastructure, sustainability should be a core aspect of future upgrades. This could involve investing in energy-efficient systems and promoting sustainable practices within the company.

11. Conclusion

The Premium WI-FI Billing System project is positioned to significantly enhance Amtrak's service delivery by providing passengers with a premium, high-speed internet service during their train journeys. The successful implementation of this project is expected to address the dual objectives of generating additional revenue to offset the substantial costs of upgrading the WI-FI infrastructure to 5G and enhancing passenger experience.

Appendices

1. https://www.washingtonpost.com/travel/tips/amtrak-wifi-free/

2. Quora forum - https://www.quora.com/Is-there-WiFi-on-Amtrak-trains-If-so-how-much-does-it-cost-per-hour-or-per-day-for-unlimited-use-of-the-Internet-while-traveling-by-train

3. Mobile app wireframes link in Figma:

   https://www.figma.com/file/S8QepSuD1Uk21oo7NFFfTc/Amtrak?type=design&node-id=0%3A1&mode=design&t=j7SlbyQIt9EIxV5y-1

4. Mobile app prototype link in Figma:

   https://www.figma.com/proto/S8QepSuD1Uk21oo7NFFfTc/Amtrak?type=design&node-id=1-156&t=0NcIC7uUOCfZtqK2-1&scaling=min-zoom&page-id=0%3A1&mode=design
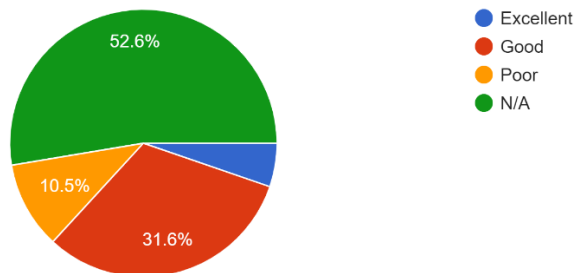
5. Survey questions and responses (https://forms.gle/ru14SvGLegwgc61r6)

What would you rate the overall train ride experience?

19 responses

- ● Excellent
- ● Good
- ● Poor
- ● N/A

42.1%
21.1%
31.6%
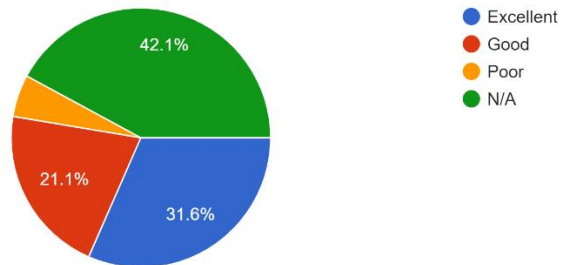
What would you rate the Wi-Fi at the train station?

19 responses

- ● Excellent
- ● Good
- ● Poor
- ● N/A

52.6%
10.5%
31.6%

What would you rate the Wi-Fi signal on the train?

19 responses

- ● Excellent
- ● Good
- ● Poor
- ● N/A

52.6%
15.8%
31.6%
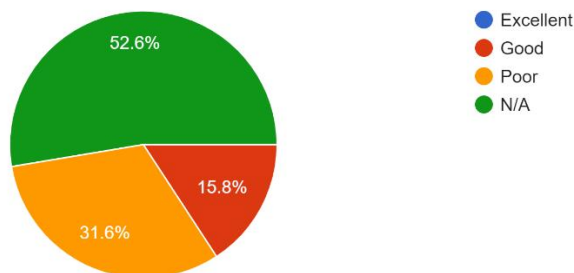
Would you pay a little extra to enjoy better Wi-Fi on trains?
19 responses

- Yes
- No
- N/A

31.6%
36.8%
31.6%
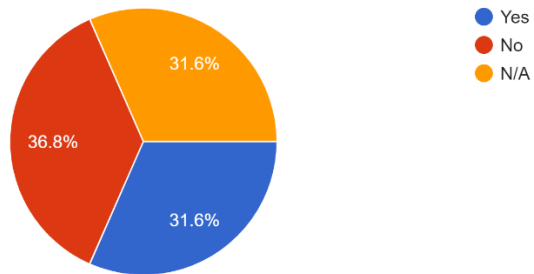
How much extra will you be willing to pay for better Wi-Fi on trains?
19 responses

- None
- Less than $1
- Between $1 and $5
- Above $5

26.3%
26.3%
47.4%

********* End of Survey questions and responses *********