Software Architecture Document

Mobile platform for integrating and managing sport locations in Kyiv

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Version 1.0

Revision History

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# 1. Introduction

## 1.1 Purpose

The purpose of this Software Architecture Document (SAD) is to provide a comprehensive and structured overview of the architectural design for the mobile platform project aimed at integrating and managing sport locations in Kyiv. This document aims to guide developers, stakeholders, and other relevant parties involved in the project by detailing the architectural decisions, components, and interactions that shape the system. By clearly defining the purpose, the SAD establishes a foundation for understanding the project's goals and the underlying architectural principles that drive its development.

## 1.2 Scope

The scope of this document encompasses the architectural aspects of a mobile application dedicated to integrating and managing sport locations within the city of Kyiv. This project targets both Android and iOS platforms, with a focus on delivering a seamless and user-friendly experience for individuals interested in exploring and participating in sports activities across Kyiv. The architectural scope extends to key functionalities such as location integration, user authentication, data management, and overall system performance. While addressing the architectural concerns, the document will also touch upon the constraints, definitions, and acronyms relevant to the project, providing a holistic view of the software architecture for all stakeholders involved.

# 2. Architectural Representation

The architectural representation serves as a visual guide to the overall structure and organization of the system. It provides stakeholders with a clear and concise view of the system's components, their interactions, and the flow of data. The representation aids in understanding the high-level architecture and serves as a foundation for detailed discussions and decision-making.

In the context of this project, the architectural representation will include diagrams and charts that illustrate the key components of the mobile platform designed for integrating and managing sport locations in Kyiv. These visual aids will highlight the relationships between different modules, the flow of information, and the integration points crucial for the successful functioning of the application. Additionally, the representation will help communicate the system architecture to various stakeholders, fostering a shared understanding of the project's structure and design principles.

# 3. Architectural Goals and Constraints

The architectural goals and constraints articulate the fundamental objectives and limitations that shape the software architecture for the mobile platform dedicated to integrating and managing sport locations in Kyiv.

## 3.1 Architectural Goals

1. **Scalability:**
   * *Objective:* Design the architecture to seamlessly scale with increased user demand, ensuring optimal performance as the user base and data volume grow.
   * *Rationale:* Accommodating scalability is crucial for handling varying loads, especially during peak usage times or periods of rapid platform adoption.
2. **User Experience (UX):**
   * *Objective:* Prioritize an intuitive and engaging user experience in the mobile application, emphasizing ease of use and efficient interaction with sport location functionalities.
   * *Rationale:* Enhancing UX contributes to user satisfaction, encouraging continued platform use and positive feedback.
3. **Security:**
   * *Objective:* Implement robust security measures to protect user data, authentication processes, and sensitive transactions within the mobile platform.
   * *Rationale:* Safeguarding user information and ensuring secure interactions are paramount for building trust and complying with privacy standards.
4. **Flexibility and Adaptability:**
   * *Objective:* Design the architecture to be flexible and adaptable to future technological advancements and changes in sport location management requirements.
   * *Rationale:* Embracing flexibility ensures the platform's longevity and the ability to integrate new features or technologies seamlessly.
5. **Performance Optimization:**
   * *Objective:* Optimize system performance to minimize latency, enhance responsiveness, and provide a smooth user experience for both sport enthusiasts and venue administrators.
   * *Rationale:* Improved performance contributes to user satisfaction and retention, critical for the success of a mobile platform.

## 3.2 Architectural Constraints

1. **Platform Compatibility:**
   * *Constraint:* The mobile platform must be compatible with both iOS and Android devices, ensuring broad accessibility for users in Kyiv.
   * *Rationale:* The constraint arises from the need to reach a diverse user base on different mobile operating systems.
2. **Regulatory Compliance:**
   * *Constraint:* Ensure strict adherence to local regulations and data protection laws governing the integration and management of sport locations in Kyiv.
   * *Rationale:* Compliance is essential to maintain legal and ethical standards, fostering trust among users and stakeholders.
3. **Budgetary Limitations:**
   * *Constraint:* Adhere to specified budget constraints for the development, deployment, and maintenance of the mobile platform.
   * *Rationale:* Budgetary limitations influence technology choices and development strategies, requiring a balance between functionality and cost-effectiveness.
4. **Data Privacy and Consent:**
   * *Constraint:* Implement a comprehensive data privacy framework, obtaining explicit user consent for data collection and processing.
   * *Rationale:* Respecting user privacy is essential for compliance with regulations and ethical considerations, building trust in the platform.
5. **Technology Stack:**
   * *Constraint:* Utilize a predefined technology stack, aligning with organizational standards and compatibility requirements.
   * *Rationale:* A predefined technology stack ensures consistency, ease of maintenance, and adherence to established development practices.

Articulating these architectural goals and constraints provides a roadmap for the development team, guiding decision-making processes and ensuring that the resulting software architecture aligns with the project's vision and requirements.

# 4. Use-Case View

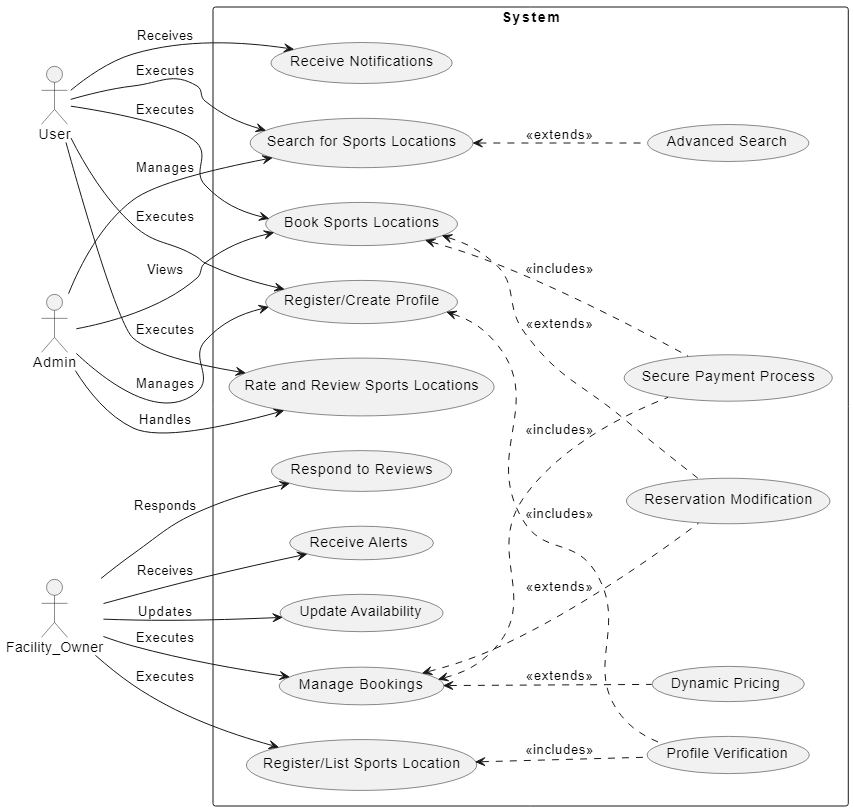
The Use-Case View provides a detailed analysis of the architecturally significant use cases that play a pivotal role in shaping the system's design and functionality. These use cases capture the major interactions between actors and the system, highlighting critical scenarios related to the integration and management of sport locations in Kyiv.

The mobile platform for integrating and managing sport locations in Kyiv use cases are:

* Receive Notifications
* Search for Sports Locations
* Advanced Search
* Book Sports Locations
* Secure Payment Process
* Register/Create Profile
* Profile Verification
* Rate and Review Sports Locations
* Respond to Reviews
* Receive Alerts
* Update Availability
* Manage Bookings
* Reservation Modification
* Dynamic Pricing
* Register/List Sports Location
* Profile Verification

## 4.1 Architecturally-Significant Use Cases

The architecturally-significant use cases, integral to shaping the system's design, encompass a diverse range of functionalities pivotal for the successful operation of the mobile platform dedicated to integrating and managing sport locations in Kyiv:



*Figure 4.1: Use-case Diagram*

1. **Receive Notifications:**
   * *Description:* Users receive real-time notifications regarding updates, promotions, and relevant information, necessitating seamless integration with the Notification Service and Mobile Application Interface components.
   * *Architectural Significance:* Involves interactions with the Notification Service component and influences the Mobile Application Interface.
2. **Search for Sports Locations:**
   * *Description:* Users can search for sport locations based on preferences such as sport type, location, and amenities, necessitating robust interactions with the Sport Location Integration and External Data Sources components.
   * *Architectural Significance:* Influences the Sport Location Integration component and requires communication with External Data Sources for comprehensive search results.
3. **Advanced Search (Extended by Search for Sports Locations):**
   * *Description:* Enhances the basic search functionality by providing advanced filters and criteria, extending the capabilities of the Search for Sports Locations use case.
   * *Architectural Significance:* Builds upon the Search for Sports Locations use case, requiring additional functionalities in the Mobile Application Interface and Sport Location Integration components.
4. **Book Sports Locations:**
   * *Description:* Users can book available sport locations, initiating interactions with the Booking Service, Secure Payment Process, and influencing the Mobile Application Interface component.
   * *Architectural Significance:* Involves interactions with the Booking Service and Secure Payment Process components, and influences the Mobile Application Interface.
5. **Secure Payment Process (Included in Book Sports Locations):**
   * *Description:* Ensures secure payment transactions during the booking process, forming an integral part of the Book Sports Locations use case.
   * *Architectural Significance:* Included within the Book Sports Locations use case, requiring robust integration with the Secure Payment Process component.
6. **Register/Create Profile:**
   * *Description:* Users can create profiles or register on the platform, influencing the Authentication and Security component and the Mobile Application Interface.
   * *Architectural Significance:* Directly impacts the Authentication and Security component and interfaces with the Mobile Application Interface.
7. **Profile Verification (Extended by Register/Create Profile):**
   * *Description:* Validates user profiles through a verification process, extending the functionality initiated by the Register/Create Profile use case.
   * *Architectural Significance:* Extends the Register/Create Profile use case, requiring additional verification functionalities within the Authentication and Security component.
8. **Rate and Review Sports Locations (Included in Book Sports Locations):**
   * *Description:* Allows users to provide ratings and reviews for booked sport locations, influencing the Mobile Application Interface and Sport Location Integration components.
   * *Architectural Significance:* Included within the Book Sports Locations use case, requiring interactions with the Mobile Application Interface and Sport Location Integration.
9. **Respond to Reviews (Included in Rate and Review Sports Locations):**
   * *Description:* Enables sport venue administrators to respond to user reviews, forming an integral part of the Rate and Review Sports Locations use case.
   * *Architectural Significance:* Included within the Rate and Review Sports Locations use case, requiring additional functionalities in the Mobile Application Interface and Sport Location Integration components.
10. **Receive Alerts:**

* *Description:* Users receive alerts regarding bookings, updates, or special offers, necessitating integration with the Notification Service and influencing the Mobile Application Interface.
* *Architectural Significance:* Involves interactions with the Notification Service component and influences the Mobile Application Interface.

1. **Update Availability:**
   * *Description:* Venue administrators can update the availability of their sport locations, influencing the Sport Location Integration and Backend Services components.
   * *Architectural Significance:* Requires interactions with the Sport Location Integration and Backend Services components for seamless availability updates.
2. **Manage Bookings (Extended by Reservation Modification):**
   * *Description:* Enables users to manage their bookings, extending functionalities for modifications and cancellations.
   * *Architectural Significance:* Extends the Manage Bookings use case, requiring additional functionalities in the Booking Service and Mobile Application Interface components.
3. **Reservation Modification (Extended by Manage Bookings):**
   * *Description:* Allows users to modify existing reservations, extending the functionalities initiated by the Manage Bookings use case.
   * *Architectural Significance:* Extends the Manage Bookings use case, requiring additional capabilities within the Booking Service and Mobile Application Interface components.
4. **Dynamic Pricing (Extended by Register/List Sports Location):**
   * *Description:* Implements dynamic pricing strategies for sport venues, extending functionalities related to registration and listing of sport locations.
   * *Architectural Significance:* Extends the Register/List Sports Location use case, requiring additional capabilities in the Sport Location Integration and Backend Services components.
5. **Register/List Sports Location (Included in Dynamic Pricing):**
   * *Description:* Allows venue administrators to register and list their sport locations on the platform, influencing the Sport Location Integration and Backend Services components.
   * *Architectural Significance:* Included within the Dynamic Pricing use case, requiring interactions with the Sport Location Integration and Backend Services components.

These architecturally significant use cases collectively define the core functionalities of the system, guiding the subsequent architectural decisions and development efforts. Each use case will be further elaborated in subsequent sections, providing a comprehensive understanding of their impact on the overall system architecture.

# 5. Logical View

The Logical View of the mobile platform is presented through a UML Class Diagram, emphasizing the key layers and their interrelationships. This diagram delineates the logical organization of the system, showcasing classes within the Database, User Interface, Notification Service, Payment Service, Booking Service, Review Service, Search Service, and Authentication Service layers.

## 5.1 Architecture Overview - Package and Subsystem Layering

Изображение выглядит как текст, линия, диаграмма, Шрифт

Автоматически созданное описание

*Figure 5.1: UML Class Diagram - Logical View*

**Diagram Description:**

* **Database Layer:**
  + *Classes:* DatabaseConnector, SportLocationData, UserData
  + *Description:* Represents classes responsible for database connectivity and data storage, including entities like SportLocationData and UserData.
* **User Interface Layer:**
  + *Classes:* UserInterfaceController, UserInterfaceView, UserInterfaceService
  + *Description:* Encompasses classes handling user interface interactions, such as UserInterfaceController and UserInterfaceView.
* **Notification Service Layer:**
  + *Classes:* NotificationService, NotificationMessage, NotificationSubscriber
  + *Description:* Manages notification-related classes, including NotificationService, NotificationMessage, and NotificationSubscriber.
* **Payment Service Layer:**
  + *Classes:* PaymentService, PaymentTransaction, PaymentGateway
  + *Description:* Represents classes involved in payment processing, such as PaymentService, PaymentTransaction, and PaymentGateway.
* **Booking Service Layer:**
  + *Classes:* BookingService, Reservation, BookingConfirmation
  + *Description:* Encompasses classes responsible for handling booking-related activities, including BookingService, Reservation, and BookingConfirmation.
* **Review Service Layer:**
  + *Classes:* ReviewService, UserReview, VenueReview
  + *Description:* Manages classes pertaining to user and venue reviews, including ReviewService, UserReview, and VenueReview.
* **Search Service Layer:**
  + *Classes:* SearchService, SearchQuery, SearchResults
  + *Description:* Represents classes facilitating search functionalities, including SearchService, SearchQuery, and SearchResults.
* **Authentication Service Layer:**
  + *Classes:* AuthenticationService, UserAuthentication, AuthorizationManager
  + *Description:* Handles authentication and authorization classes, including AuthenticationService, UserAuthentication, and AuthorizationManager.

**Diagram Justification:** The UML Class Diagram is chosen to visually convey the static structure of the logical architecture, showcasing the classes and their relationships within each layer. This diagram provides a comprehensive overview of how different layers collaborate and contribute to the overall functionality of the mobile platform. The logical view with the UML Class Diagram serves as a reference for developers, aiding in the comprehension and maintenance of the system's architecture.

This logical view lays the foundation for subsequent sections, where each class and its relationships will be explored in greater detail, offering insights into the functionality and interactions within the mobile platform.

# 6. Process View

The Process View is detailed through a UML Class Diagram, offering insights into the system's processes and their corresponding classes. This diagram highlights the classes related to User, Notification, Booking, Payment, Admin, FacilityOwner, Facility, and Review, showcasing their functions and interactions.

## 6.1 Processes

Изображение выглядит как текст, снимок экрана, диаграмма, Шрифт

Автоматически созданное описание

*Figure 6.1: UML Class Diagram - Process View*

**Diagram Description:**

* **User Class:**
  + *Functions:* logout(), login(), searchFacility(), bookFacility ()
  + *Description:* Represents the User class with functions related to user authentication, browsing facilities, and submitting reviews.
* **Notification Class:**
  + *Functions:* sendNotification()
  + *Description:* Encompasses functions for sending and receiving notifications within the Notification class.
* **Booking Class:**
  + *Functions:* createBooking(), cancelBooking ()
  + *Description:* Manages reservation-related functions, including making, modifying, and canceling reservations, within the Booking class.
* **Payment Class:**
  + *Functions:* processPayment()
  + *Description:* Represents functions for initiating and processing payments within the Payment class.
* **Admin Class:**
  + *Functions:* manageUsers(), generateReports()
  + *Description:* Handles functions related to admin authentication, facility management, and processing reviews within the Admin class.
* **FacilityOwner Class:**
  + *Functions:* respondToReview(), manageFacilities ()
  + *Description:* Encompasses functions for owner authentication, adding facilities, and managing bookings within the FacilityOwner class.
* **Facility Class:**
  + *Functions:* checkAvailability(), updateAvailability()
  + *Description:* Represents functions for checking facility availability and updating facility details within the Facility class.
* **Review Class:**
  + *Functions:* submitUserReview()
  + *Description:* Manages functions for submitting user and venue reviews, as well as responding to reviews within the Review class.

**Diagram Justification:** The UML Class Diagram is selected to visually represent the static structure of the system's processes, showcasing the functions and interactions among key classes. This diagram provides a clear overview of how different classes collaborate to execute various processes within the mobile platform. The process view with the UML Class Diagram serves as a reference for developers, aiding in the understanding and development of the system's processes.

This process view establishes a foundation for subsequent sections, where each class and its functions will be explored in greater detail, offering insights into the processes and interactions within the mobile platform.

## 6.2 Process Model to Design Model Dependencies

Изображение выглядит как текст, линия, диаграмма, Шрифт

Автоматически созданное описание *Figure 6.2: UML Communication Diagram - Process View*

**Diagram Description:**

* **User Layer:**
  + *Activities:* **selectFacility()**
  + *Description:* Represents the user initiating the process by selecting a sports facility.
* **User Interface Layer:**
  + *Activities:* **checkAvailability()**, **sendNotification()**
  + *Description:* Facilitates user interface interactions, checking availability, and triggering notifications.
* **Notification System Layer:**
  + *Activities:* **processPayment()**
  + *Description:* Represents the notification system layer, orchestrating the processing of payment transactions.
* **Payment System Layer:**
  + *Activities:* -
  + *Description:* Focuses on the payment system layer, handling activities related to secure payment processing.
* **Booking System Layer:**
  + *Activities:* **availabilityStatus()**
  + *Description:* Manages the booking system layer, specifically addressing the activity of checking the availability status of sports facilities.

**Diagram Justification:** The UML Communication Diagram is chosen to visualize the dynamic interactions and communication paths between different layers of the system during specific activities. This diagram efficiently illustrates the flow of activities and how different layers collaborate to fulfill user actions in real-time. By focusing on communication flows, it provides a clear understanding of the processes and their interactions within the mobile platform.

Creating a full UML Component Diagram with a comprehensive representation of all the listed processes might be a bit overwhelming due to the number of processes and their components. However, I'll provide a description of how these processes might map to components in a UML Component Diagram:

## 6.3 Processes to Implementation

The Processes to Implementation are detailed through a UML Component Diagram, offering a comprehensive overview of the processes and their corresponding components within the mobile platform dedicated to integrating and managing sport locations in Kyiv.

Изображение выглядит как текст, диаграмма, линия, Шрифт

Автоматически созданное описание

Figure 6.3: UML Component Diagram - Processes to Implementation

**Components:**

1. **User Interface Component:**
   * Houses components for **respondToReviews()**, **submitReview()**, **sendReviewNotification()**, **receiveBookings()**, **bookFacility()**, **searchFacility()**, **bookingConfirmation()**, **searchResults()** for user interaction.
2. **Notification Service Component:**
   * Manages components for **reviewNotification()**, **sendBookingNotification()** to handle notifications.
3. **Booking System Component:**
   * Contains components for **bookingDetails()**, **bookingConfirmation()**, **receiveBookings()** for managing booking-related functionalities.
4. **Authentication Service Component:**
   * Includes components for **authenticate()**, **authStatus()**, **accessPlatform()** for user authentication and authorization.
5. **Review Management Component:**
   * Holds components for **respondToReviews()**, **submitReview()**, **reviewResponseConfirmation()**, **managementConfirmation()** for review-related activities.
6. **Facility Management Component:**
   * Contains components for **manageFacilities()** to handle facility management processes.
7. **Payment Processing Component:**
   * Includes components for **processPayment()**, **paymentStatus()** for managing payment transactions.
8. **Compliance Management Component:**
   * Manages components for **complianceStatus()**, **checkCompliance()**, **generateReports()**, **reports()** for compliance checks and report generation.

Creating a UML Component Diagram with this level of granularity will provide a visual representation of how various processes align with different components in the system, aiding in understanding the system's architectural structure and the relationships between different functionalities.

# 7. Deployment View

The Deployment View provides an insight into the physical architecture of the mobile platform, illustrating the distribution of components across various servers. The UML Deployment Diagram is utilized to depict the deployment configuration, showcasing the interaction between the web server, application server, client server, and database server.

**Deployment Configuration Overview:**

* User interactions are facilitated through the Web Server, which hosts the User Interface, Authentication Service, and Review System components.
* The Application Server manages the core business logic, handling processes related to booking, notifications, facility management, and compliance.
* The Client Server hosts client-side components responsible for user interactions, including the User Interface, Authentication Service, and Review System.
* The Database Server stores and manages essential data entities, such as Sport Location Data, User Data, Booking Data, and Review Data.

Изображение выглядит как текст, диаграмма, снимок экрана, Шрифт

Автоматически созданное описание *Figure 7: UML Deployment Diagram - Deployment View*

## 7.1 Web Server

* Description: The Web Server serves as the entry point for user interactions, hosting components responsible for the user interface and initial processing of user requests. It communicates with both the Application Server and the Client Server to facilitate seamless user experiences.
* Components:
  + User Interface: Handles the presentation layer, providing a visual interface for users to interact with the platform.
  + Authentication Service: Manages user authentication, ensuring secure access to the platform.
  + Review System: Supports the presentation of user and venue reviews, enhancing the user experience.

## 7.2 Application Server

* Description: The Application Server acts as the central processing hub, managing the core business logic and application processes. It processes user requests, interacts with the database for data retrieval and storage, and communicates with both the Web Server and the Database Server.
* Components:
  + Booking System: Manages booking-related processes, including reservation, modification, and cancellation.
  + Notification System: Orchestrates the sending of notifications to users, enhancing communication.
  + Facility Management System: Handles processes related to the management of sports facilities on the platform.
  + Compliance System: Ensures compliance with regulatory requirements and standards.

## 7.3 Client Server

* Description: The Client Server represents the client-side components hosted on users' devices, facilitating direct interactions between users and the platform. It communicates with both the Web Server and the Application Server to enable dynamic and responsive user experiences.
* Components:
  + User Interface (Client-Side): Provides an interactive and responsive interface for users on their devices.
  + Authentication Service (Client-Side): Facilitates client-side authentication processes.
  + Review System (Client-Side): Manages client-side presentation and interaction with user and venue reviews.

## 7.4 Database Server

* Description: The Database Server serves as the central repository for data storage and retrieval. It stores crucial information such as sport location details, user profiles, booking records, and reviews. The Database Server communicates with the Application Server to provide necessary data for processing user requests.
* Components:
  + Sport Location Data: Stores information about sports facilities, including location, amenities, and availability.
  + User Data: Manages user profiles, authentication credentials, and preferences.
  + Booking Data: Stores records of user bookings, including reservation details and payment information.
  + Review Data: Stores user and venue reviews, supporting the feedback and rating system.

# 8. Size and Performance

The chosen software architecture aligns with the specified sizing and timing requirements outlined in the Supplementary Specification for the mobile platform dedicated to integrating and managing sport locations in Kyiv:

* The system is designed to efficiently support up to 2000 simultaneous users accessing the central database concurrently, with an additional capacity of handling up to 500 simultaneous users interacting with local servers concurrently.
* The architecture prioritizes responsiveness by ensuring that access to the platform's central database maintains a latency of no more than 10 seconds, optimizing user experience in retrieving critical information.
* A critical performance metric dictates that 80% of all transactions must be successfully completed within 2 minutes, emphasizing the importance of timely and efficient user interactions.
* The client portion is meticulously engineered to operate within resource constraints, demanding less than 20 MB of disk space and 32 MB of RAM on user devices, promoting efficiency in resource utilization.

This architecture, exemplified by its client-server model, effectively addresses these sizing and timing requirements. The client-side implementation accommodates diverse user scenarios, whether on local devices or remote connections, emphasizing a design approach that minimizes disk and memory requirements on the client side.

# 9. Quality

The software architecture strongly upholds the quality requirements stipulated in the Supplementary Specification for the mobile platform:

* The user interface is designed for optimal user experience, ensuring ease of use for individuals within the sport-oriented community in Kyiv. The design aims to be intuitive, reducing the need for additional training.
* Comprehensive online help is integrated into each feature of the mobile platform, offering step-by-step instructions and clear definitions for terms and acronyms, enhancing user understanding and promoting a user-friendly experience.
* The mobile platform guarantees 24/7 availability, with downtime restricted to no more than 4%, ensuring continuous access for users and reliability in service provision.
* The Mean Time Between Failures exceeds specified requirements, signifying the robustness and reliability of the system architecture in handling potential issues.
* Upgrades to the client portion of the mobile platform can be seamlessly downloaded, providing users with convenient access to system updates and enhancements. This feature facilitates system evolution while ensuring user accessibility and satisfaction.