



# Betting System Requirements Specification

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## Executive Summary

This document outlines the comprehensive requirements specification for the Betting Software System, detailing functional requirements across the major service categories identified. The system is designed as a microservices architecture supporting sports betting, gaming, payments, marketing, and identity service with enterprise-grade scalability, security, maintainability, and industry compliance capabilities.

The implementation details of individual functional requirements may be subject to change until the final draft of this document is approved and finalized. However, the overall integrity of the services and their subsystems identified should remain intact.

## Key Business Capabilities

- **Sports Betting Platform:** Complete pre-match and live betting with real-time odds management
- **Gaming Ecosystem:** multiple existing casino integrations with different providers and in-house games
- **Payment Processing:** payment gateway integrations with existing partner payment providers
- **Marketing Automation:** Comprehensive bonus, loyalty, and campaign management
- **Enterprise Support:** Multi-tenant architecture with full identity and notification services

## Technical Highlights

- **Microservices Architecture:** Decoupled services with clear separation of concerns, enabling parallel development and independent deployments
- **Real-time Communication:** WebSocket-based live updates and notifications
- **Multi-tenant Support:** Complete tenant isolation and management
- **Payment Integration:** Fault-tolerant payment gateway integrations
- **Compliance Ready:** Full audit trails, security monitoring, and regulatory reporting
- **CIA:** Confidentiality ensures data is private, Integrity maintains data accuracy, and Availability ensures systems and data are accessible to authorized users when needed

# Services and Requirements

## 2.1 Sportsbook Related Services

### Sportsbook Service

**Description:** The core engine for all sports betting operations. It manages the entire betting lifecycle, from event and odds ingestion to bet placement, validation, settlement, and cashout. It is the primary revenue-generating service.

**Boundary:** Owns all sports betting logic, including events, matches, odds, bet slips, tickets, and settlement. It integrates with data providers (BetRadar) and trading systems (MTS). It does not handle user authentication, payment processing, or bonus calculations.

**Business Value:** Core revenue-generating service enabling all sportsbook betting users

- **FR-001: Pre-Match Betting Operations**
  - **Core Sports Data Management:** The system must create and manage the fundamental sports data models, including Leagues, Teams, and Matches (including scheduling).
  - **Match Lifecycle Management:** The system must manage the entire match lifecycle, tracking statuses (e.g., Open, Finished, Canceled)
  - **Odds Management Engine:** The system must manage the full odds lifecycle, including:
    - Integrating with real-time odds feeds (BetRadar).
    - Validating and updating odds.
    - Maintaining a full odds history and change log.
    - Handling odds settlement and voiding based on match results.
  - **Match Curation & Featuring:** The system must allow administrators to curate and feature matches (e.g., as Top Matches or Highlighted Matches) for promotional purposes.

- **Auditing & Monitoring:** The system must maintain a complete audit trail of all match changes and track betting frequency statistics for reporting and risk analysis.
  
- **FR-002: Accumulator Betting System**
  - **Accumulator & System Bet Engine:** The system must support placing and managing standard accumulator bets and complex system bets (e.g., 2/3, 3/4 permutations)
  - **Core Calculation & Settlement:** The system must accurately calculate accumulator odds, manage combination payouts, and handle bet settlement and tracking
  - This should be done on top of the Bet Recommendation System
  - **Suggestion & Generation:** The system must provide a suggestion engine that generates multi-selection accumulator combinations based on user preferences and success probability
  - **Ranking & Value Assessment:** The system must estimate value, assess risk, and rank generated accumulators to aid user decision-making
  - **Responsible Gambling Controls:** The system must include customizable parameters (e.g., risk levels, stake limits, max number of selections) to enforce responsible gambling thresholds during bet generation and placement
  - **Bet Slip Validation:** The system must validate accumulator bet slips for correctness, potential conflicts, and operator risk
  
- **FR-003: Bet Slip Management**
  - **Unified Ticket Lifecycle Management:** The system must manage the end-to-end lifecycle of a bet slip (ticket), including creation from both online and offline channels, unique ID generation, status tracking (Open, Won, Lost, etc.), and maintaining a complete history.
  - **Bet Slip Validation Engine:** The system must validate all bet slips for correctness, odds accuracy, user limits, and potential conflicts before confirmation and acceptance.

- **Receipt & Proof-of-Bet Generation:** The system must generate a bet slip receipt (for both print and digital display) upon successful validation and acceptance, serving as the user's proof of bet.
  - **Bet Slip Integrity & Security:** The system must ensure bet slip integrity through cryptographic hash generation and validation, preventing tampering and ensuring the settled bet matches the one that was placed.
- 
- **FR-004: Bet Management and Settlement**
    - **Bet Lifecycle Management:** The system must manage the state of individual bet selections (GamePick), from confirmation through to their final result (Win, Loss, Refund/Void).
    - **Automated Settlement Engine:** The system must automatically settle bets by determining their outcome (win/loss), applying void factors where necessary, and updating bet statuses based on official results.
    - **Manual Settlement Control:** The system must provide operators with a manual override to settle, void, or adjust bets, including the ability to apply custom void factors.
    - **Settlement Audit Trail:** The system must maintain a complete, timestamped audit trail of all settlement actions (both automated and manual), including the final result, odds, and stake for every bet.
    - **Settlement Notifications:** The system must trigger notifications to users upon the settlement of their bets, informing them of the outcome.
- 
- **FR-005: Betting Limits and Controls**
    - **Flexible Limits Configuration:** The system must allow the configuration and management of various betting limits, including:
      - Stake limits (min/max per bet)
      - Win limits (max payout per bet)
      - Time-based deposit/wagering limits (daily, weekly, monthly)
      - User-specific and agent-specific restrictions.

- **Real-time Validation Engine:** The system must validate every bet in real-time against all applicable configured limits, preventing any bet that would cause a limit to be exceeded.
  - **Betting Behavior Monitoring:** The system must continuously monitor and track user betting activity (stakes, frequency, patterns) to provide data for limits enforcement and risk analysis.
  - **Proactive Risk & Fraud Detection:** The system must analyze betting patterns and historical data to automatically detect suspicious activity and potential fraud, triggering alerts for further investigation.
- **FR-006: MTS Integration**
    - **MTS Transaction Lifecycle Management:** The system must manage the end-to-end lifecycle of all MTS transactions, including:
      - Submitting new bet slips and cancellation requests.
      - Sending and receiving mandatory protocol acknowledgments.
      - Processing alternative odds from MTS responses.
    - **MTS Response Processing & Status Synchronization:** The system must validate all MTS responses and synchronize the internal ticket status (e.g., Accepted, Rejected) based on the MTS decision.
    - **Robust Error & Timeout Handling:** The system must handle MTS communication errors and enforce specific timeout rules (e.g., 3s pre-match, 16s in-play) with appropriate retry logic and failure recovery procedures.
    - **Comprehensive Audit Trail:** The system must maintain a complete, immutable audit log of every request and response exchanged with MTS for monitoring, debugging, and compliance purposes.
  - **FR-007: Real-Time Communication**
    - **Managed WebSocket Infrastructure:** The system must establish and maintain secure, scalable WebSocket connections, including handling authentication, authorization, connection pooling, and error recovery.



- **Live Data Broadcast:** The system must broadcast real-time updates for all public data, including match events, odds changes, market statuses, and system-wide notifications to all connected clients.
  - **Targeted User Notifications:** The system must push user-specific updates in real-time, such as bet slip status changes, settlement notifications, and private messages.
- 
- **FR-008: Producer Status Management**
    - **Real-Time Producer Monitoring:** The system must continuously monitor the status of the Betradar data producer in real-time.
    - **Configurable Betting Control:** The system must automatically suspend betting for an operator if their designated producer is down, with this behavior being configurable per operator.
    - **Proactive Alerting:** The system must immediately trigger notifications and alerts to both system administrators and affected operators upon any producer status change.
    - **Automated Recovery Handling:** The system must manage recovery procedures, automatically re-enabling betting and notifying relevant parties once the producer status is restored.
    - **Comprehensive Audit Trail:** The system must maintain a full audit log of all producer status changes, betting suspension events, and recovery actions for reporting and analysis.
- 
- **FR-009: Bet Recommendation System**
    - **Personalized Discovery Engine:** The system must generate personalized bet recommendations by analyzing individual user behavior, including their betting history and explicit sport/league preferences.
    - **Stake & Risk Guidance:** The system must provide stake suggestions and classify recommendations by risk level, tailored to the user's profile and responsible gambling limits.

- **Transparent Rationale:** The system must display a clear and understandable rationale for each recommendation to ensure transparency and build user trust.
  - **Continuous Learning Loop:** The system must track the performance of its recommendations and incorporate user feedback to continuously learn and improve the relevance and accuracy of future suggestions.
- 
- **FR-010: Live Betting System**
    - Real-Time Match Lifecycle Management
    - The system must monitor and manage the transition of matches from pre-match to live status, including real-time tracking of match events, timeline, and statistics.
    - The system must trigger status change notifications, audit logs, and validate all transitions, with rollback capabilities for erroneous updates.
    - Dynamic Live Betting Engine
    - The system must support placing, modifying, and cashing out of bets while a match is in play, with real-time odds updates.
    - The system must enforce live-specific bet validation, timeout handling, and risk management controls during bet placement.
    - Live Market & Trading Operations
    - The system must manage the creation, suspension, and resumption of live betting markets.
    - The system must calculate and update live market odds in real-time based on match events and trading activity.
    - Live Settlement & Risk Management
    - The system must process live match results to settle live bets and markets, including cashout execution.
    - The system must perform continuous risk assessment, fraud detection, and compliance monitoring for all live betting activity.
  
  - **FR-011: Betting Reports and Analytics**
    - The system must sync data with the reporting services

- **FR-012: Cashout Management**

- **Real-Time Cashout Offering:** The system must dynamically calculate and display a real-time cashout value for eligible bets, determining their availability based on market events and bet status.
- **Validated Cashout Execution:** The system must validate and process cashout requests, enforcing user-specific limits and restrictions, before executing the transaction through the internal betting engine and external MTS integration.
- **Cashout Settlement & Notification:** The system must immediately settle successful cashouts, updating the user's balance and notifying them of the transaction result.
- **Audit & Risk Monitoring:** The system must maintain a complete audit trail of all cash-out activity and perform continuous risk assessment to monitor for suspicious patterns and ensure compliance.

## 2.2 Gaming Services

### Casino Service

**Description:** Aggregates and manages third-party casino game content. Provides a unified platform for users to discover, launch, and play games from multiple external providers.

**Boundary:** Manages game metadata, provider integrations, and game-launching sessions. It is responsible for routing game requests and tracking game activity. It does not contain game logic internally; it orchestrates external game providers.

**Business Value:** Core revenue-generating service enabling all casino betting users

- **FR-013: Game Provider Integration**

- **Unified Multi-Provider Gateway:** The system must integrate with a wide range of third-party game providers and aggregators through a single, abstracted gateway, normalizing their diverse APIs.
- **Secure Authentication Management:** The system must manage secure authentication for all integrated providers, including the handling of API keys, tokens, and session security.

- **Real-Time Game Catalog Synchronization:** The system must synchronize game metadata, rules, and availability from all providers in real-time to maintain a unified, up-to-date game catalog.
  - **Seamless Game Launching:** The system must generate and handle provider-specific game launcher URLs to provide users with a seamless and instant transition from the platform into the game environment.
- 
- **FR-014: Game Categories and Management**
    - **Game Lifecycle & Provider Management:** The system must allow administrators to register game providers and perform full lifecycle management (create, read, update, disable/delete) of individual games, including all associated metadata.
    - **Catalog Taxonomy Management:** The system must allow administrators to create and manage a flexible taxonomy for games using categories, hierarchies, and tags to organize the library.
    - **Advanced Discovery & Filtering:** The system must provide users with robust game discovery tools, including search and filtering, based on the managed taxonomy, tags, and other game attributes.
    - **Targeted Availability Controls:** The system must allow administrators to control game and category visibility based on geographic and commercial rules, such as country restrictions and currency compatibility.
- 
- **FR-015: Game Features and Functionality**
    - **Seamless Cross-Platform Game Launch:** The system must provide a secure game launcher that manages URLs, handles user authentication, and delivers a consistent experience on both desktop and mobile devices.
    - **Engagement & Trial Features:** The system must support player engagement tools, including demo (play-for-fun) mode and free round promotions.
    - **Internationalization & Localization:** The system must support multi-language content and region-specific game availability to cater to a global audience.

## Game Engine Service

**Description:** Develops and manages proprietary, in-house games and promotional mechanics (e.g., jackpots, wheels, raffles). Creates unique gaming offerings not dependent on external providers.

**Boundary:** Owns the full lifecycle and logic of all internally developed games. This includes result generation, prize distribution, and game state management. It is completely separate from the third-party integrations of the Casino Service

**Business Value:** Internal games development for unique offerings and cost control

- **FR-016: Internal Game Development System**
  - **Jackpot Games:**
    - The system must create and manage super jackpot games
    - The system must support online and offline jackpot tickets
    - The system must manage jackpot events and prize structures
    - The system must handle jackpot result generation and settlement
    - System must support jackpot status management (Active, Inactive, Finished, Refunded)
  - **Wheel Spinning Games:**
    - The system must create wheel spinning games with multiple reward types
    - System must manage cash rewards, spin chances, free bets, and balance boosts
    - System must handle reward claiming and status tracking
    - System must support promotional wheel-spinning campaigns
    - System must manage spin limits and reward distributions
  - **Raffle System:**
    - System must generate raffle tickets based on casino game activity
    - System must manage raffle ticket allocation policies
    - System must support raffle draws and winner selection

- System must handle raffle ticket generation through casino gameplay
- System must manage raffle configuration and game filtering
- **Daily Scratch Games:**
  - System must create daily scratch card games
  - System must manage scratch card instant win mechanics
  - System must handle daily game scheduling and availability
  - System must support scratch card result generation
- **Tournament Games:**
  - System must create tournament-based games
  - System must manage tournament brackets and competitions
  - System must handle tournament scoring and rankings
  - System must support tournament prize distribution
- **Coupon Games:**
  - System must create and manage coupon-based games
  - System must handle coupon generation and distribution
  - System must support coupon validation and redemption
  - System must manage coupon terms and conditions
  - System must handle coupon analytics and reporting
- **Game Management Features:**
  - System must support game result generation and validation
  - System must manage game rules and payout structures
  - System must provide game statistics and analytics
  - System must support game customization and branding
  - System must handle game status management and scheduling

## 2.3 Payment Related Services

### Payment Service

**Description:** Acts as a unified gateway for all deposit and withdrawal transactions. It abstracts the complexity of integrating with numerous external payment providers (payment gateways, banks, mobile money, etc.) behind a single, consistent API.

**Boundary:** Responsible for initiating payment requests, handling provider callbacks, and managing the status of deposit and withdrawal transactions. It tells the Wallet Service to increase a balance but does not hold user balances itself.

**Business Value:** Critical enabler of financial transactions

- **FR-017: Payment Integration and Processing**
  - System must support CBE Birr payment integration
  - System must support Telebirr payment integration
  - System must support HelloCash payment integration (Lion Bank, Wegagen Bank)
  - System must support ArifPay payment integration
  - System must support Amole payment integration
  - System must support Chapa payment integration
  - System must support SantimPay payment integration
  - System must support DeltaPay payment integration
  - System must support BeqelalPay payment integration
  - System must support FenanPay payment integration
  - System must support FreshPay payment integration
  - System must support DigiMoney payment integration
  - System must support DigiCard payment integration
  - System must support eBirr payment integration
  - System must support Emali payment integration
  - System must support Emola payment integration
  - System must support Kacha payment integration
  - System must support Lenco payment integration

- System must support Unayo payment integration
- System must support Unipesa payment integration
- System must support Yo Uganda payment integration
- System must support M-Pesa payment integration (Kenya, Ethiopia)
- System must support cross-border payment processing
- System must support multi-currency payment handling
- System must handle payment request creation and processing (deposit, withdraw)
- System must manage payment status tracking (Pending, Successful, Failed, Declined)
- System must support payment transaction reconciliation
- System must handle payment callback processing
- System must support payment retry mechanisms
- System must manage payment transaction fees
- System must support payment method configuration and management

## Wallet Service

**Description:** Manages the central ledger for all user financial balances and internal money movements. It is the single source of truth for user funds.

**Boundary:** Owns user wallet balances and records all financial transactions (deposits, withdrawals, bet stakes, winnings, bonuses). It enforces financial consistency and is the core of the accounting system. It does not integrate directly with external payment providers.

**Business Value:** Secure financial management and user experience optimization

- **FR-018: Wallet Management System**

- **Flexible Wallet Architecture:** The system must manage user wallets, supporting multiple balance types (e.g., payable, non-withdrawable) and providing real-time balance validation, transaction history, and audit trails.
- **Secure Transaction Engine:** The system must process all fund movements (deposits, internal transfers, fees) securely, with support for transaction reversal, reconciliation, and comprehensive user notifications.



- **Comprehensive Controls & Compliance:** The system must enforce wallet limits, security authentication, administrative controls (freeze/unfreeze), operator approval optional feature with a for large withdrawal amounts and regulatory compliance, supported by detailed analytics and reporting.

## 2.4 Marketing Services

### Marketing Service

**Description:** Drives customer acquisition, retention, and engagement through automated campaigns, bonus systems, and loyalty programs. Manages the business rules for promotions.

**Boundary:** Owns all promotional logic: bonus campaigns, free bets, wagering requirements, and loyalty points. It calculates bonus eligibility and amounts, then instructs the Wallet Service to credit funds or the Notification Service to send messages. It does not process payments or manage user identities directly.

**Business Value:** Customer acquisition, retention, and revenue optimization

- **FR-019:** Deposit Bonus System

- **Flexible Campaign Management:** The system must allow the creation and management of highly customizable bonus campaigns, including defining eligibility rules, tiered structures, terms and conditions, and branding.
- **Automated Bonus Lifecycle Engine:** The system must automatically trigger, calculate, and distribute bonuses based on configured rules, managing their entire lifecycle, including wagering/rollover requirements, expiration, and tracking.
- **Configurable Bonus Triggers:** The system must support a wide range of bonus triggers, including but not limited to: welcome bonuses, deposit match milestones, specific amount thresholds, recurring frequency, and special calendar events.
- **Comprehensive Oversight & Protection:** The system must provide detailed analytics on bonus performance, enforce regulatory compliance, and include mechanisms for fraud prevention.

- **FR-020: Free Bet System**

- **Promotion Management:** The system must allow for the creation and management of free bet promotions, including their specific terms and conditions.
- **Credit Allocation & Tracking:** The system must accurately allocate free bet credits to users and maintain a full audit trail of their status.
- **Usage Enforcement:** The system must enforce all usage rules, including expiry dates, eligible markets, and any other restrictions.
- **Settlement & Payout Processing:** The system must handle the unique settlement logic for free bets, calculating and paying out winnings (typically excluding the original stake) upon a successful bet.
- **Reporting & Analytics:** The system must provide analytics and reporting data

- **FR-021: Wagering Requirements**

- **Flexible Rule Configuration:** The system must support the configuration of different wagering requirement types (e.g., bonus money, free spins) with customizable rules.
- **Automated Calculation & Rollover Tracking:** The system must automatically calculate wagering progress and track rollovers based on user betting activity.
- **Real-Time Fulfillment Monitoring:** The system must monitor wagering requirement fulfillment in real-time and automatically update their status upon completion.
- **Administrative Oversight:** The system must provide administrators with the ability to view requirement progress and make exceptions or modifications where necessary.

- **FR-022: Loyalty Program**

- **Loyalty Framework Management:** The system must create and manage the core loyalty structure, including a configurable point system and multiple membership tiers with associated benefits.

- **Point Lifecycle Engine:** The system must automatically handle the accumulation of points based on user activity and facilitate their redemption for rewards.
  - **Rewards & Benefits Catalog:** The system must manage a catalog of available rewards and benefits, linking them to specific tiers and redemption rules.
  - **Program Analytics & Reporting:** The system must provide comprehensive analytics and reporting on point accrual, redemption rates, tier distribution, and overall program performance.
- 
- **FR-023: Marketing Campaign Management**
    - **Campaign Creation & Scheduling:** The system must allow for the creation and management of marketing campaigns, including detailed scheduling and automation rules.
    - **Audience Targeting & Segmentation:** The system must support defining and targeting specific user segments based on demographics, behavior, and other attributes.
    - **Performance Analytics & A/B Testing:** The system must track campaign performance metrics and support A/B testing to compare the effectiveness of different campaign variables.
    - **Campaign Optimization:** The system must provide insights and tools to optimize live campaigns based on performance data and test results.
- 
- **FR-024: UTM Tracking and Analytics**
    - **Campaign Data Capture:** The system must capture and store UTM parameters for all incoming traffic to enable campaign and source attribution.
    - **User Journey Mapping:** The system must track user actions across sessions to map the complete customer journey from initial click to final conversion.
    - **Attribution & Conversion Analytics:** The system must attribute conversions to marketing sources using configurable models (e.g., first-touch, last-touch) and provide detailed conversion analytics.

- **ROI and Performance Reporting:** The system must calculate and report on key marketing performance indicators, including Return on Investment (ROI), to evaluate campaign effectiveness.
- **FR-025: Marketing Tools**
  - **Unified Marketing Automation Platform:** The system must provide a centralized platform for creating, managing, and automating marketing communications across multiple channels, including email, SMS, push notifications, and social media integrations.
- **FR-026: Commission Structure**
  - **Flexible Commission Configuration:** The system must support the creation and management of multiple commission structures, allowing for different types (e.g., revenue share, flat fee) and customizable rates.
  - **Automated Calculation & Tracking:** The system must automatically calculate commissions based on agent activity and maintain detailed, real-time tracking and reporting for each agent.
  - **Payout & Settlement Processing:** The system must manage the commission payout workflow, including generating settlement reports and processing payments.
  - **Administrative Oversight:** The system must allow authorized administrators to view commission records and make modifications or adjustments to structures and calculations as needed.
- **FR-027: Marketing Analytics**
  - **Campaign Performance Dashboard:** The system must provide a comprehensive view of marketing performance, tracking key effectiveness metrics across all channels and campaigns.

- **Attribution & Conversion Intelligence:** The system must attribute conversions to specific marketing touchpoints and track the entire customer journey to identify the most effective channels and strategies.
  - **Financial Performance & ROI Analysis:** The system must calculate and report on the financial efficiency of marketing activities, including Return on Investment (ROI), and support budget versus actual cost analysis.
- **FR-028: CRM Features**
    - **Centralized Customer Profile Management:** The system must maintain a unified, 360-degree view of each customer, consolidating their data, interaction history, and personal details.
    - **Advanced Segmentation & Targeting:** The system must enable the creation of dynamic customer segments based on profile data, behavior, and activity to facilitate targeted communications and campaigns.
    - **Multi-Channel Engagement Hub:** The system must support and log customer interactions across multiple channels, including email, support tickets, and other communication tools.
    - **Customer Intelligence & Analytics:** The system must provide analytics and insights into customer behavior, value, and feedback to inform business strategy and improve retention.
  - **FR-029: Cashback Management**
    - Create and manage cashback campaigns with defined parameters:
      - Eligibility Criteria: Target specific users, user tiers, or segments.
      - Cashback Trigger: Define what triggers the cashback (e.g., net losses over a period, total wagers, losses on a specific game/sport).
      - Calculation Rule: Set the cashback rate (e.g., 10% of net losses) and any maximum cap per user.
      - Validity Period: Set the campaign's active time frame (e.g., every Monday, or a specific date range).
    - Monitor User Activity: Continuously track relevant user actions (bets placed, bets settled, game rounds played) in real-time.
    - Calculate Cashback Accrual: For each user, automatically calculate the earned cashback based on the campaign rules.
    - Track Pending Cashback: Maintain a running tally of "pending cashback" for each user until it is ready to be paid out.

- Automate Payout Scheduling: Execute cashback payouts automatically according to the campaign schedule.
- Handle Fund Distribution: Credit the calculated cashback amount directly to the user's wallet.
- Support Manual Override: Allow administrators to manually trigger, adjust, or cancel payouts for specific users if needed.
- Send Notifications: Automatically notify users via push notification, email, or in-app alert when cashback has been credited to their account.
- Provide Visibility: Display pending and historical cashback earnings to the user within their account section.
- Detail Terms and Conditions: Clearly present the rules of the active cashback campaign to the user.
- Generate Campaign Reports: Provide analytics on campaign performance, including total cashback paid, number of users benefiting, and overall cost.
- Maintain Audit Trail: Log every cashback calculation and payout for every user for financial auditing and dispute resolution.
- Enforce Responsible Gambling: Ensure cashback offers comply with regulatory requirements and do not incentivize problematic gambling behavior. This could involve applying cashback to a "non-withdrawable" wallet with wagering requirements.

## 2.5. Identity Service

**Description:** The foundation for security and multi-tenancy. It manages tenants, users, applications, and their authentication and authorization across the entire platform.

**Boundary:** The single source of truth for identities (users, clients, tenants) and their permissions. It issues JWT tokens and provides user profile data. All other services delegate authentication to this service.

**Business Value:** Multi-tenant architecture enabling scalable business operations

- **FR-030: Agent System**

- Agent Onboarding & Access Management: The system must manage the complete lifecycle of agent accounts, including registration, permissions, and access controls.

- Commission & Payout Engine: The system must accurately calculate agent commissions and manage the entire payout process.
  - Performance Management & Reporting: The system must track key agent performance metrics and provide detailed reporting and analytics for both agents and administrators.
  - Training & Certification Hub: The system must manage agent training materials, track progress, and handle certification status to ensure agent competency.
  - Communication & Support Portal: The system must facilitate communication between administrators and agents and provide tools for agent support
- 
- **FR-031: Tenant Management**
    - Automated Tenant Provisioning: The system must automate tenant onboarding, including database configuration (isolated or shared), service routing setup, and application of initial settings.
    - Configurable & Branded Workspaces: The system must allow tenants to customize their workspace through configuration parameters and apply their own branding.
    - Guaranteed Data Isolation & Security: The system must enforce strict data isolation and security between all tenants at every layer (row level security , database, application, network) to ensure compliance and privacy.
    - Operational Management & Scalability: The system must monitor tenant performance, enforce SLAs, manage scaling, and handle backups and disaster recovery on a per-tenant basis.
    - Commercial & Lifecycle Management: The system must manage tenant subscriptions, billing, support communications, and facilitate tenant migration or offboarding with data portability.
- 
- **FR-032: User Management**
    - System must manage user registration and account creation
    - System must handle user authentication and login processes
    - System must support user profile management and updates

- System must manage user roles and permissions
  - System must handle user account verification and validation
  - System must support user account suspension and reactivation
  - System must manage user preferences and settings
  - System must handle user data privacy and GDPR compliance
  - System must support user account deletion and data retention
  - System must manage user session management and security
  - System must handle user password management and recovery
  - System must support user multi-factor authentication
  - System must manage user access logs and audit trails
  - System must support user communication preferences
  - System must handle user account linking and merging
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- **FR-033: OAuth 2.0 and OpenID Connect Authentication**
    - System must support OAuth 2.0 authorization server
    - System must handle OpenID Connect authentication flows
    - System must manage JWT token generation and validation
    - System must support OAuth 2.0 grant types (authorization code, client credentials, refresh token)
    - System must handle token refresh and revocation
    - System must manage OAuth scopes and permissions
    - System must support OAuth client authentication methods
    - System must handle OAuth security and PKCE
    - System must manage OAuth session management
    - System must support OAuth audit and compliance
    - System must handle OAuth integration with external providers
    - System must manage OAuth performance and optimization
    - System must support OAuth monitoring and analytics
    - System must handle OAuth backup and recovery
    - System must manage OAuth maintenance and updates



- **FR-034: Client Management**

- System must manage client registration and authentication
- System must support OAuth 2.0 client credentials flow
- System must handle client scopes and permissions
- System must manage client secret management and rotation
- System must support client rate limiting and quotas
- System must handle client monitoring and analytics
- System must manage client lifecycle and expiration
- System must support client audit and compliance
- System must handle client integration and APIs
- System must manage client security and encryption
- System must support client backup and recovery
- System must handle client maintenance and updates
- System must support client role-based access control
- System must handle client permission inheritance and delegation
- System must manage client tenant association and isolation

## 2. 6 Notification Service

**Description:** A centralized, multi-channel communication hub. It reliably delivers messages (SMS, Email, Push) triggered by any other service in the system.

**Boundary:** Owns the delivery logic, templates, and provider failover for all outbound notifications. Its only responsibility is to deliver messages; it contains no business logic about why a message is being sent.

**Business Value:** Enhanced user engagement and operational communication

- **FR-035: Notification Delivery System**

- System must provide unified notification API for all microservices
- System must support SMS, Email, and Push notification channels
- System must handle notification queuing and delivery

- System must manage notification templates and personalization
- System must support notification scheduling and retry logic
- System must provide notification status tracking and delivery reports
- System must handle notification provider management and failover
- System must support gRPC and Message Queue communication protocols
- System must manage notification rate limiting and quotas
- System must provide notification analytics and monitoring

## 2.7 Scheduler Service

**Description:** The central time-based coordinator for the ecosystem. It triggers scheduled tasks (e.g., settlement jobs, report generation, bonus expirations) in other services without containing the task logic itself.

**Boundary:** Owns the "when." It manages the schedule and triggers tasks via messages. The receiving services (e.g., Sportsbook, Marketing) own the "what" – the actual business logic executed for the task.

**Business Value:** Automated operations and reduced manual intervention

- **FR-036:** Task Scheduling System (TickerQ Integration)
  - System must provide centralized job scheduling coordination for all microservices
  - System must support cron-based and interval-based scheduling with second-precise timing
  - System must handle task queuing and priority management with throttling control
  - System must coordinate task execution triggers to individual microservices
  - System must support task monitoring and status tracking with real-time dashboard
  - System must provide gRPC and Message Queue communication protocols
  - System must handle task persistence and recovery with Entity Framework integration
  - System must support distributed task execution across microservices
  - System must manage task dependencies and workflows between services
  - System must provide task analytics and reporting

## 2.8 Localization Service

**Description:** Provides centralized internationalization (i18n) and localization (l10n) support. Manages translations, regional settings, and locale-specific content.

**Boundary:** Owns translated content and regional configuration. Other services call this service to retrieve localized strings and region-specific rules. It does not dictate UI layout or business logic.

**Business Value:** Global market expansion and compliance

- **FR-037: Regional Support**
  - System must support multi-language and localization
  - System must handle timezone management and conversion
  - System must support regional compliance and regulations
  - System must manage currency and payment method localization
  - System must handle regional data residency requirements
  - System must support regional content and service availability
  - System must manage regional user interface customization
  - System must handle regional reporting and analytics
  - System must support multi-language content translation
  - System must handle translation workflow and approval
  - System must manage translation memory and terminology
  - System must support automated and manual translation
  - System must handle translation quality assurance and validation

## 2.9 API Gateway

**Description:** The single, secure entry point for all client traffic. It handles routing, load balancing, rate limiting, and cross-cutting concerns like SSL termination and request logging.

**Boundary:** Sits at the edge of the system. It routes requests to the correct internal services but contains no business logic. It is a plumbing component for security and performance.

**Business Value:** System security, performance, and scalability

- **FR-038: API Gateway Management**
  - System must provide API gateway and routing capabilities
  - System must handle load balancing and traffic management
  - System must support caching and performance optimization
  - System must manage service discovery and registration
  - System must handle circuit breaker and fault tolerance
  - System must support monitoring and observability
  - System must manage logging and debugging capabilities
  - System must handle security scanning and vulnerability assessment

## 2.10 Reporting Service

**Description:** Provides business intelligence and operational reporting by aggregating and analyzing data from across all services. Serves both operational dashboards and compliance reports.

**Boundary:** Primarily a read-only service that consumes data from other services' databases or dedicated data streams. It uses optimized data models for analytics and should not be used for transactional operations.

**Business Value:** Business intelligence and regulatory compliance

- **FR-039: Analytics and Reporting System**
  - System must generate comprehensive user betting history reports
  - System must support date range filtering for reports
  - System must handle compliance and audit reports for operators
  - System must manage betting pattern analysis reports
  - System must support risk assessment reports
  - System must handle financial reporting and analytics
  - System must support real-time betting statistics

- System must manage user behavior analytics
  - System must handle market performance analytics
  - System must support risk monitoring and alerts
  - System must manage compliance monitoring
  - System must handle performance metrics and KPIs
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- **FR-040: Audit & Security**
    - System must maintain comprehensive audit trails for all system activities
    - System must support security event logging and monitoring
    - System must handle user access tracking and authentication logs
    - System must manage system security compliance reporting
    - System must support security incident tracking and analysis
    - System must handle regulatory compliance reporting
    - System must manage security policy enforcement monitoring
    - System must support security vulnerability assessment reporting
    - System must handle security breach detection and alerting
    - System must manage security audit scheduling and automation
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- **FR-041: Data Management**
    - System must manage data import and export operations
    - System must handle data validation and quality control
    - System must support data backup and recovery procedures
    - System must manage data archiving and retention policies
    - System must handle data migration and transformation
    - System must support data synchronization and replication
    - System must manage data security and encryption
    - System must handle data access control and permissions
    - System must support data monitoring and performance optimization
    - System must manage data compliance and regulatory requirements

- **FR-042: Business Intelligence**
    - System must provide business intelligence dashboards and reports
    - System must support data visualization and analytics
    - System must handle KPI tracking and performance metrics
    - System must manage business insights and trend analysis
    - System must support predictive analytics and forecasting
    - System must handle data mining and pattern recognition
    - System must manage business reporting automation
    - System must support executive reporting and decision support
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