

Software Requirements Specification (SRS) & Technical Architecture

Integration of Telebirr SuperApp SDK (In-App Payment)

Project Name: Suuq S - Multi-Vendor Marketplace

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1. Executive Summary

This document outlines the security architecture, data flow, and functional specifications for the integration of the Telebirr In-App Payment SDK within the "Suuq S" digital marketplace platform. It demonstrates compliance with financial security standards, focusing on the integrity of the **Merchant of Record** model where Suuq S acts as the primary payment acceptor before disbursing funds to sub-merchants (vendors).

2. System Architecture

2.1 Overview

The system operates on a Microservices-based architecture comprising three primary distinct entities:

1. **Client Layer (Flutter Mobile App):** Determines user intent and interfaces with the Telebirr Android/iOS SDK. Protected via ProGuard obfuscation (`com.huawei.ethiopia.pay.sdk.api.core.**`).
2. **Application Layer (NestJS Backend):** Acts as the secure orchestrator. It holds the RSA Private Keys, manages Fabric Tokens, and processes callbacks. Hosted at Static IP `134.209.94.162`.
3. **Gateway Layer (Ethio Telecom Fabric):** The external payment processor handling the ledger and fund movements.

2.2 Component Diagram

Interaction logic utilizes a "Server-Signed, Client-Executed" pattern to prevent client-side tampering.

- **Fabric Token Service:** A dedicated backend service manages the lifecycle of the Telebirr access token, auto-refreshing it before expiration to prevent transaction failures.
 - **Crypto Module:** Handles RSA-2048 encryption and SHA256WithRSA signing.
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3. Data Flow Diagram (DFD)

3.1 Transaction Lifecycle

The transaction follows a strict **Asynchronous Verification** model. The mobile app is never trusted with payment confirmation; only the server-to-server callback validates a purchase.

Sequence:

1. **Request Initialization:** User selects "Pay with Telebirr". Backend generates a signed `receiveCode` payload.
2. **SDK Handoff:** App invokes Telebirr App via SDK using the signed payload.
3. **Payment Execution:** User confirms PIN in Telebirr App.
4. **Callback (Notify URL):** Telebirr server POSTs result to `https://api.suuq.ugasfuad.com/api/payments/telebirr-callback`.
5. **Reconciliation & Disbursement:** Backend verifies signature, updates local ledger, and triggers 95/5 split via `/merchant/transfer`.

3.2 Mermaid.js Visualization

(Copy the code below into a Mermaid-compatible viewer or VS Code Preview)

```
sequenceDiagram
    participant User
    participant App as Suuq Flutter App
    participant Backend as NestJS Server (134.209.94.162)
    participant Telebirr as Telebirr Fabric System

    Note over Backend, Telebirr: Phase 1: Pre-Order
    User->>App: Checkout (Total: 100 ETB)
    App->>Backend: POST /api/v1/orders/initiate
    Backend->>Backend: Generate RSA-2048 Signature
    Backend->>Telebirr: Request Prepay ID
    Telebirr-->>Backend: Return rawRequest & Sign
    Backend-->>App: Return Encrypted String (H5/SDK Payload)

    Note over App, Telebirr: Phase 2: Execution
    App->>Telebirr: Invoke SDK (startPay)
    User->>Telebirr: Enter PIN & Confirm
    Telebirr-->>App: Payment Success UI (Unverified)

    Note over Backend, Telebirr: Phase 3: Settlement
    Telebirr->>Backend: POST /notify_url (Async Callback)
    Backend->>Backend: Verify SHA256WithRSA Signature
    Backend->>Backend: Update Order Status -> PAID
    Backend->>Backend: Calculate Split (95 ETB Vendor / 5 ETB Platform)
    Backend->>Telebirr: POST /merchant/transfer (Disbursement)
```

4. Business Logic & Merchant of Record

4.1 Merchant of Record (MoR) Model

Suuq S acts as the single point of entry for funds to ensure compliance and trust.

- **Inflow:** 100% of the cart value is debited from the customer to the "Suuq S" Master Merchant Account.
- **Ledgering:** An internal immutable ledger (`telebirr_transaction` table) records the Fabric Reference ID against the local Order ID.
- **Outflow (Disbursement):** Upon successful callback verification, the system executes an automated B2B transfer to the Vendor's registered merchant ID for their share (95%), retaining the commission (5%).

4.2 Data Integrity

- **Anti-Tampering:** Order amounts are stored server-side. The client cannot modify the amount sent to Telebirr; the signature is generated on the backend using the stored database value.
- **Double-Spending Prevention:** The system enforces standard Idempotency keys based on `OrderId`. Duplicate callbacks for the same ID are logged but not re-processed.

5. Threat Model & Security Mitigations

5.1 Identified Threats

Threat ID	Description	Severity	Mitigation Strategy
TR-01	Replay Attacks	High	Implementation of Timestamp Nonce . Requests outside a 60-second window (NTP Synced) are rejected by the Fabric Gateway.
TR-02	Man-in-the-Middle (MITM)	Critical	1. Strict SSL/TLS enforcement. 2. RSA-2048 Encryption (PKCS1 Padding) for sensitive payload data.
TR-03	Unauthorized Disbursement	Critical	Disbursement API endpoints are firewalled and accessible only via internal logic triggers, not exposed to the public API client.
TR-04	SDK Reverse Engineering	Medium	ProGuard Obfuscation applied to <code>com.huawei.ethiopia.pay.sdk.api.core.**</code> to hide internal logic in the Android APK.
TR-05	Fake Callbacks	High	All incoming callbacks to <code>notify_url</code> must pass SHA256WithRSA signature verification using the Telebirr Public Key.

5.2 Cryptographic Standards

- **Asymmetric Key:** RSA 2048-bit keys generated via OpenSSL.
- **Signature Algorithm:** `SHA256WithRSA`.

- **Payload Encryption:** AES / RSA hybrid approach where applicable (following Fabric V3 specs).
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6. Functional & Non-Functional Requirements

6.1 Functional Requirements

1. **FR-01:** The system must generate a unique `outTradeNo` for every transaction.
2. **FR-02:** The system must verify the Fabric signature on the `notify_url` endpoint before updating order status.
3. **FR-03:** The system must support manual reconciliation via the `queryOrder` interface if a callback is missed.

6.2 Non-Functional Requirements

1. **NFR-01 (Uptime):** The Payment Gateway Service must maintain 99.9% availability.
 2. **NFR-02 (Latency):** Token generation and signing must complete within <200ms.
 3. **NFR-03 (Security):** Private keys must be stored in environment variables, never in source control.
 4. **NFR-04 (Traceability):** All financial API interactions must be logged with timestamp, IP, and Request ID (excluding sensitive PII/PINs).
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7. Configuration Details (For Auditor Reference)

- **Environment:** Production
- **Backend Framework:** NestJS (Node.js)
- **Callback IP Allowlist:** Configured to accept specific Telebirr Gateway ranges (if applicable) or validated strictly via Signature.
- **NTP Server:** `pool.ntp.org` (Ensures synchronized timestamps for API requests).