# **Technical & Functional Concept**

**Modular Government Traceability Platform - Built for Saint Lucia's Regulatory Needs**

## **1. System Architecture: Modular, Cloud-Native, and Secure**

The system is designed as a **modular, microservices-based cloud solution** tailored for government use. It supports real-time tracking, full auditability, and regulatory oversight for controlled substances-starting with cannabis and ready to expand into mushrooms, alcohol, pesticides, and explosives.

### **Key Principles:**

* **Domain Separation by Design:** Each substance (e.g. cannabis, alcohol) is managed as a standalone logical module (subsystem) within a unified infrastructure.
* **Centralized Core Services:** Authentication, audit logging, reporting, notifications, and licensing are centralized and shared.
* **High Scalability & Availability:** Cloud deployment (e.g. AWS or Azure), using Docker containers and Kubernetes for orchestration and elasticity.
* **Infrastructure-as-Code:** Enables reproducible, portable deployments and compliance with national data policies.

### **System Diagram:**

TBD

## **2. Offline-First Architecture: Reliable in Low-Connectivity Zones**

Given Saint Lucia's island geography, the system ensures **complete offline functionality** for mobile agents and licensees. Every core feature-such as planting, inspection, and sales logging-works without an internet connection.

### **Offline Capabilities:**

* **Local Data Storage:** Records are safely stored on-device using an encrypted local database (e.g. SQLite or DataStore).
* **Sync Engine:** Automatic bidirectional synchronization occurs when a connection is restored.
* **Retry Queue:** Failed actions are retried transparently; no manual uploads required.
* **Conflict Handling:** Smart merge logic or user resolution is triggered when discrepancies are detected.
* **Background Sync Scheduling:** Optimized for low battery and slow networks.

This design guarantees continuous operability and data integrity even in remote or temporarily disconnected environments.

## **3. Modular Subsystem Strategy: Clear Expansion Path**

Each regulated substance has its own **business logic, database schema, and lifecycle workflows**. This ensures clear accountability, custom validations, and sector-specific compliance without cross-contamination of logic or data.

### **Examples:**

* **Cannabis Module:** Seed-to-sale workflows including cultivation, batch creation, lab testing, inventory, destruction, and sales.
* **Alcohol Module:** Manufacturing licensing, distribution tracking, warehouse auditing, excise duties.
* **Mushroom Module:** Cultivation records, psychoactive substance control, micro-batch management.
* **Explosives Module (Future):** Shipment tracking, expiry management, incident logging.

Modules can be turned on/off per licensee. New substances can be added via plug-and-play deployment using standard microservice blueprints.

## **4. UI/UX Strategy: Functional**

The user interface follows **METRC's pragmatic, structured approach**, favoring functionality, efficiency, and clarity.

### **UI Design Highlights:**

* **Role-Based Views:** Regulators, licensees, labs, and transporters each see a tailored interface.
* **Clear Navigation:** Menus and dashboards organized by role and module.
* **Bulk Data Handling:** CSV import/export, batch operations, and integrated barcode scanning.
* **Responsiveness:** Works seamlessly on desktops, tablets, and mobile devices.
* **Accessibility:** Follows WCAG guidelines (high contrast, screen reader support, keyboard navigation).

Language: All interfaces are delivered in **English**.

## **5. Security, Privacy & Compliance**

The system is engineered for **government-grade security**, with full adherence to GDPR and global best practices.

### **Technical Safeguards:**

* **Role-Based Access Control (RBAC):** Granular rights for every function and module.
* **Encryption:** AES-256 at rest and TLS 1.3 in transit.
* **Multi-Factor Authentication (MFA):** Required for all admin and regulatory users.
* **Blockchain Logging:** Immutable records of key lifecycle events (plant creation, test results, inventory destruction, etc.).
* **Audit Logs:** Full traceability of all user actions and system events.
* **Zero-Trust Network Design:** Cloud-native firewalling, access isolation, and regular penetration testing.

## **6. API & System Integration**

The platform is built with **open, secure APIs** to support future integrations.

### **Supported Integrations:**

* **Point-of-Sale Systems (POS):** Real-time sales sync via API.
* **Laboratory Information Systems (LIMS):** Automated test result imports.
* **Government Data Services:** Optional data sharing with customs, taxation, or public health authorities.
* **IoT Support:** Optional integration with sensors or RFID scanners for tracking inventory or grow conditions.

APIs follow the **OpenAPI (Swagger)** specification with full developer documentation.

## **7. Hosting & Deployment Model**

The solution is delivered as a **fully managed cloud deployment**, with the option for **local self-hosting** after transfer.

### **Cloud Infrastructure:**

* Hosted in AWS or Azure, depending on RSA's policy.
* Data residency and sovereignty compliance ensured.
* High availability with automatic scaling, logging, and backup.

### **Self-Hosting Option:**

* Delivered as containerized packages (Docker, Kubernetes).
* Infrastructure templates provided (Terraform, Helm).
* Full transition documentation and administrator training included.

## **8. Knowledge Transfer & Post-Launch Support**

The proposal includes **12 months of full support**, followed by optional SLA-based maintenance.

### **Included in the Package:**

* 24/7 system monitoring
* Bug fixes and security patches
* Monthly health reports
* Administrator onboarding
* User training (live and recorded)

After year one:

* The RSA may opt to continue with managed hosting.
* Alternatively, the platform may be transitioned for internal management.

All documentation, codebases, deployment scripts, and training materials will be delivered in full.

## **9. Reporting & Intelligence**

Regulators will benefit from real-time dashboards and custom reports.

### **Features:**

* Regulatory compliance dashboards
* Alerts for suspicious activity (e.g. batch mismatch, sudden inventory drop)
* Exportable audit logs
* Time-based and geographic filters
* Cross-module analytics (e.g. linking lab test trends with farm locations)

Reports are accessible via web portal and can be scheduled for email delivery.

## **10. Summary & Strategic Fit**

This platform provides Saint Lucia with a **future-proof, sovereign, and secure solution** for traceability across all regulated substances.

### **Core Benefits:**

* **Tailored for Saint Lucia** - Fully customized to the RSA's workflows and national regulations
* **End-to-end Chain-of-Custody** - Ensures integrity from production to sale
* **Modular Design** - Ready to expand into mushrooms, alcohol, pesticides, and more
* **Offline-Capable** - Built for remote and island-based work
* **Government-Grade Security** - Full compliance with GDPR and global standards
* **Handover-Ready** - Designed for long-term sustainability and local control
* **Built on Proven Standards** - Inspired by METRC, BioTrack, and Health Canada best practices