# Product Requirements Document: Monadic DNA Batcher (v2.0)

## 1. Project Overview

A privacy-first, batch-sequencing application allowing users to obtain GSA genotyping data without creating a permanent link between their physical identity and their genetic results. The system relies on **Nillion (nilDB)** for secret storage and **Smart Contracts** for batch state management.

## 2. Technical Stack

- **Identity:** Dynamic.xyz (Email/Wallet abstraction).
- **Privacy Layer:** Nillion (nilDB) for secret-sharing sensitive strings (Emails, Metadata, CSV Blobs).
- **Settlement Layer:** Smart Contract (L2) for Escrow, Slashing, and Batch status.
- **Fulfillment:** Manual (Initial Phase) with BYO (Bring Your Own Kit) bypass.

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## 3. UI/UX: The Modal Architecture

To maintain a clean, high-transparency dashboard, all core interactions are handled via triggered Modals.

### 3.1 Trust & Onboarding Modals

- **T&C Signature Modal:** Triggers after Dynamic.xyz login. Displays terms and requires a cryptographic wallet signature before the "Join Queue" button activates.
- **The "Slashing" Warning Modal:** Displays when a user initiates a withdrawal. Shows the 1% penalty calculation and the 6-month "Patience" timer status.

### 3.2 Functional Modals

- **Join Queue Modal:** Allows the user to pay the 10% deposit (USDC/Stripe).
- **Shipping & Metadata Modal:** * *Standard:* Collects name/address (stored transiently in nilDB).
    - *Metadata:* Optional fields (Age/Sex/Ethnicity) secret-shared to nilDB.
- **Kit Registration Modal:** * User enters physical **Kit ID**.
    - User sets a **PIN** (stored locally only).
    - Triggers on-chain hash: $Commitment = Hash(KitID + PIN)$.
- **Balance Payment Modal:** Triggered when a batch hits 24/24. Shows the 90% remaining fee and the 7-day expiration timer.
- **Data Reveal Modal:** Once status is "Completed." User enters PIN to decrypt the CSV blob from nilDB. Includes a "Download & Burn" warning.

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# 4. Operational Requirements

## 4.1 Batch State Machine (On-Chain)

1. **Pending:** Users join via 10% deposit.
2. **Staged:** 24 users reached. 90% payment window opens (7 days).
3. **Active:** 24/24 paid. Admin Agent marks as "Kits Shipped."
4. **Sequencing:** Samples at lab. Admin updates status to "In Lab."
5. **Completed:** CSVs uploaded to nilDB. 2-month claim window begins.
6. **Purged:** Batch finalized. All nilDB records deleted.

## 4.2 Manual Fulfillment Protocol (Admin)

- **Transient Storage:** Shipping data in nilDB must be deleted as soon as the tracking number is generated/shipped.
- **Randomization:** Admin must shuffle the physical kits before assigning to labels to prevent sequential ID mapping.
- **Metadata Manifest:** Admin pulls de-identified metadata (Kit ID + Age/Sex) from nilDB to send to the lab.

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# 5. Security & Privacy Guarantees

- **Non-Custodial Identity:** Monadic cannot recover a user's PIN or decrypt their DNA results.
- **Anti-Hijacking:** The on-chain Commitment ensures only the person with the original PIN can claim the data associated with a Kit ID.
- **Ephemeral Footprint:** * Shipping Info: Deleted post-shipment.
    - Email/Metadata/DNA: Deleted 60 days after completion.

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# 6. Dashboard Content & Components

- **Marketing Blurb:** High-level value proposition and "How it Works."
- **Live Queue Stats:** Displays $n/24$ full, recent wallet fragments, and commit timestamps.
- **Global History:** List of "Batches in Progress" and "Batches Completed" (Historical Transparency).
- **User Dashboard:**
    - Current Status (e.g., "In Queue," "Awaiting Kit Registration," "Results Ready").
    - Batch-specific timers (6-month patience, 7-day payment, 2-month burn).
- **FAQ Link:** Deep-dive into the nilDB and MPC architecture for technical users.