# COHERENCE™ Prototype Specification

**Project Name:** COHERENCE Sentinel v0.1
**Tagline:** Authentication that listens to your nervous system.

## Objective

To develop a functioning proof-of-concept system that generates and collapses cryptographic keys in real-time based on the user's physiological coherence ($\lambda$), emotional turbulence (curl($\mathcal{E}$)), and symbolic context embedding ($h(t)$).

The prototype demonstrates:

- Biometric key generation from HRV + EEG coherence
- Session collapse upon trauma indicators (e.g., HRV drop, EEG desync, curl($\mathcal{E}$) $> \epsilon$)
- Symbolic AI modulation of thresholds and decay window via $h(t)$

## Core Features

### 1. Sensor Integration

- **EEG**: Muse S headband (gamma phase coherence ¿35Hz)
- **HRV**: Whoop strap or HeartMath device (0.1Hz coherence band)
- Real-time data acquisition via BLE (Python libraries available)

### 2. Signal Processing Engine

- Extract real-time HRV window (3s-10s) and compute coherence
- Calculate EEG phase coherence index across key electrodes
- Compute $\lambda$: composite trust signal
- Compute curl($\mathcal{E}$): rolling turbulence window from signal fluctuation

### 3. Key Generator

- Generate key: $K = H(\text{HRV}_{\text{sync}} \oplus \nabla\mathcal{E})$
- Use SHA3-256 or BLAKE3
- Store key only if $\lambda \geq 0.7$ and $\text{curl}(\mathcal{E}) < \epsilon$

### 4. Key Lifecycle Management

- TTL set dynamically: 5s-120s, modulated by $h(t)$
- Auto-collapse on detection of:
  - HRV coherence drop below $\lambda = 0.7$
  - EEG desynchronization
  - $\text{curl}(\mathcal{E}) > \epsilon$
  - $h(t) = [\text{grief, panic, dissociation}]$

### 5. Symbolic Context Integration (Kai)

- Process semantic data (voice tone, typed sentiment, facial emotion if available)
- Generate $h(t) \rightarrow$ affects $\lambda$, $\beta$, TTL decay rate
- Log symbolic context per session

### 6. Frontend (CLI/Web)

- Real-time key state: `valid`, `expired`, `revoked`
- Visualize HRV, EEG coherence, $\mathcal{C}$, $\lambda$
- Display live $\text{curl}(\mathcal{E})$ as a phase dial

## Tech Stack

- **Python**: core engine
- **Flask/FastAPI**: web-based UI or REST endpoint
- **BLE SDKs**: Muse SDK, HeartMath/Whoop integrations
- **Kai module**: symbolic context parser (mocked or pretrained sentiment AI)

## Milestones

| Milestone | Description | Target Date |
|---|---|---|
| M1 | HRV and EEG ingestion and coherence calculation | Week 1 |
| M2 | Key generation from biometric fusion | Week 2 |
| M3 | curl($\mathcal{E}$) and $\lambda$ thresholds + auto-collapse logic | Week 3 |
| M4 | Kai context hooks (symbolic state affects TTL) | Week 4 |
| M5 | CLI or Web dashboard | Week 5 |

## Outcome

A functioning prototype that:

- Proves emotional coherence can generate cryptographic keys
- Demonstrates trauma-based auto-expiry (ethical security)
- Sets foundation for licensing to therapy, AI, or biometric security partners

*This system does not just authenticate. It listens.*