

This comprehensive technical specification provides the structural, algorithmic, and operational depth required for full-scale development. It synthesizes forensic methodology with advanced technical architecture to create an investigative engine for the 2SLGBTQIA+ community.

Out & Found: Technical Specification & Implementation Blueprint

1. Core System Architecture

The application is built on a high-availability microservices architecture to ensure data integrity and real-time cross-jurisdictional analysis.

- **Frontend:** React (Web) and React Native (Mobile) utilizing a unified design system (Figma tokens).
- **Backend:** Node.js/TypeScript (API Gateway) and Python (Forensic/ML Services).
- **Primary Data Layers:**
 - **Relational (PostgreSQL):** Transactional data, user accounts, and case metadata.
 - **Graph (Neo4j):** Relationship mapping for serial pattern recognition.
 - **Vector (OpenSearch):** Biometric and semantic search for matching unidentified remains to missing reports.

2. Database Schema & Data Models

A. Case Management (PostgreSQL)

SQL

```
CREATE TABLE cases (  
  id UUID PRIMARY KEY,  
  status VARCHAR(20) CHECK (status IN ('active', 'cold', 'recovered', 'unidentified')),  
  identity_type VARCHAR(20) CHECK (identity_type IN ('identified', 'john_doe', 'jane_doe')),  
  full_name VARCHAR(255),  
  last_seen_date TIMESTAMP,  
  last_seen_coords GEOGRAPHY(POINT),
```

```
phash_id VARCHAR(64), -- Perceptual hash for image deduplication
autism_spectrum BOOLEAN DEFAULT FALSE, -- Triggers "Water-First" search alerts
validation_score INT DEFAULT 0, -- 1-100 based on multi-source consensus
source_attribution JSONB -- Maps every field to a specific source URL or API
);
```

B. Signature Logic (Neo4j Graph)

Nodes represent Case, Signature, Location, and Suspect.

- **Relationship:** (c:Case {id: '123'})-[:EXHIBITS {confidence: 0.85}]->(s:Signature {type: 'Ritualistic_Staging'})
- **Cross-Border Link:** (c1:Case)-[:CROSS_JURISDICTIONAL_LINK]->(c2:Case) generated when Rossmo heatmaps overlap across state lines.

3. Module 1: Forensic Rendering Engine

A. Cognitive Sketching (CI Protocol)

The UI implements a structured 5-stage **Cognitive Interview** workflow:

1. **Context Reinstatement:** UI prompts for weather, scent, and emotional state.
2. **Open Narrative:** Text-to-speech ingestion of witness account.
3. **Witness Rendition:** User-drawn rough sketch to anchor spatial memory.
4. **Holistic Warping:** StyleGAN-based interface where users adjust "Face Manifolds" (e.g., jaw width, eye spacing) rather than picking individual parts.
5. **Uncertainty Heatmap:** Layer allowing witnesses to "blur" areas of low confidence, stored as a separate alpha-channel mask.

B. Multi-Path Age Progression

Python-based service utilizing **IPA-GAN** (Identity-Preserving Aging).

- **Growth Logic:** Applies vertical growth coefficients (\$V_g\$) to mid-face landmarks.
- **Triptych Output:**
 - **Path A (Baseline):** Standard biological trajectory.
 - **Path B (High-Stress):** Accelerated dermal aging and volume loss (trafficking/homelessness markers).
 - **Path C (High-BMI):** Jawline rounding and neck expansion.

4. Module 2: Investigative Intelligence

A. Geographic Profiling (Rossmo Algorithm)

Calculates the "Anchor Point" probability surface $P_{\{x,y\}}$.

Python

```
def rossmo_score(grid_point, crime_sites, buffer_b, decay_h):
    score = 0
    for site in crime_sites:
        dist = manhattan_distance(grid_point, site)
        if dist > buffer_b:
            score += 1 / (dist**decay_h)
        else:
            score += (buffer_b**(decay_h-1)) / ((2*buffer_b - dist)**decay_h)
    return score
```

- **Cross-Jurisdictional Sweep (CJS):** Automatically includes LEA data from a 300-mile radius regardless of borders.

B. Multi-Source Validation (OSINT)

The system concurrently queries:

- **NamUs API:** Federal missing/unidentified records.
- **Social Archives:** Scraping of Wayback Machine snapshots for school athletic rosters (matching height/weight metrics).
- **NCMEC CyberTipline:** Ingesting exploitation markers (File 13, 15).

5. Developer & API Documentation

I. Automated Digital Takedown API

Interface for the post-recovery scrubbing of a child's digital footprint (File 30).

- **Endpoint:** POST /api/v1/takedown/scrub
- **Header:** Authorization: Bearer <Non-Profit_Token>
- **Payload:** { "case_id": "UUID", "pHash": "HASH", "affidavit_url": "S3_LINK" }
- **Integrated Service:** **Google Search Console Indexing API** (Requesting removal of cached/outdated URLs).

II. Law Enforcement Entity API

Aggregates contact points for state bureaus (GBI, CBI, SLED).

- **Utility:** Maps the last_seen_coords to the nearest state bureau headquarters and identifies FOIA request portals for autopsy/body-cam footage.

III. Forensic Data Integration

- **NVIDIA StyleGAN3:** Used for photorealistic rendering of forensic sketches.
- **Landmark Mapping:** Utilizes **Dlib** or **MediaPipe** for the 68-point facial landmarking required for age progression.

6. Operational Implementation: "Get Involved"

A. Submission & Intake (HITL)

1. **User Submission:** Encrypted via AES-256.
2. **Deduplication:** pHash check against existing entries.
3. **Human-in-the-Loop (HITL) Review:** Dashboard for non-profit staff to verify against official LE records (NCIC compliance) before public promotion.

B. The "Signature" Matcher

Identifies serial offenders by matching rituals across county lines.

- **Logic:** If Case_A(GA) and Case_B(AL) share Signature_X (e.g., specific ligature/ligature-mark), trigger a **Multi-Jurisdictional Conflict Alert**.

7. Key Investigative Resources (Extended)

- **APCO ANS 1.101.4-2022 (File 29):** Standardizes intake fields to ensure compatibility with 911 dispatch systems.
- **NCMEC Missing Children on the Autism Spectrum (File 5):** Forces immediate "Water-First" spatial analysis upon intake.
- **The Hague Convention Litigation Manual (File 31):** Automates "Border-Watch" checklists for cases with international movement potential.
- **Search Protocol Workbook (NLSARA):** Provides the "Searcher Competency" framework for organizing local volunteer efforts.

This specification provides the technical and methodological "source of truth" for constructing **Out & Found** as a secure, forensic-grade platform for justice.