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LifeOS: An Explainable Web Architecture for Human-Centric Systems

Technical Note v0.2

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Abstract

We present LifeOS, a human-centric system architecture grounded in Web standards and designed for explainability by construction. LifeOS explicitly separates symbolic reasoning from perceptual and interpretative intelligence, enabling decisions that remain inspectable, attributable, and context-aware across layers. Rather than focusing on Explainable AI models, this work frames an **Explainable Web** perspective, where facts, relations, and decisions can be audited in terms of *what* was decided, *why*, *by whom*, and *when*.

Keywords: explainable web, human sovereignty, symbolic reasoning, Solid Protocol, cognitive architecture, auditable systems

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1. Motivation: Explainable Web ≠ XAI

1.1 The Problem

Current approaches to AI explainability focus on making neural networks interpretable *after the fact*. This creates a fundamental mismatch:

XAI Approach	Limitation
Attention visualization	Shows correlation, not causation
Feature importance	Model-specific, not transferable
Saliency maps	Fragile to perturbation
Post-hoc rationalization	May not reflect actual decision process

The deeper problem: **these techniques try to explain opaque systems rather than building transparent ones.**

1.2 The Explainable Web Alternative

LifeOS takes a different approach: design for explainability from the ground up.

Principle	Implementation
Facts are structured	RDF/Linked Data on Solid pods
Rules are explicit	Symbolic deduction, deterministic
Interpretation is bounded	Logged, versioned, confidence-scored
Decisions are attributed	Presence timestamp + consent record

This is not post-hoc explanation. It is **structural transparency**.

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2. Architectural Principle

2.1 Separation: Symbolic vs. Perceptual

LifeOS explicitly separates two types of intelligence:

Aspect	Symbolic (Deductive)	Perceptual (Neural)
Nature	Deterministic	Probabilistic
Compute	CPU, milliseconds	GPU, variable
Trust	Verifiable	Attributable
Explainability	Complete	Partial
Role in LifeOS	Core reasoning	Augmentation only

2.2 Why This Matters

```
Neural networks excel at perception.
Symbolic systems excel at reasoning.
LifeOS uses each where appropriate.
```

Key constraint: Perceptual outputs are never directly actionable. They must pass through symbolic verification before reaching the user.

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3. Explainability by Design

3.1 The Four-Question Audit

Every LifeOS decision can answer:

Question	Layer	Source
What was decided?	L0/L1	Action log with RDF provenance
Why this decision?	L1	Rule trace (premises conclusion)
Who decided?	L3	Presence + consent timestamp
When was this decided?	L3	Temporal context + role

3.2 Auditability Across Layers

```
AUDIT TRAIL

L3: Who confirmed? When? In what role?
L2: Which model? What confidence? What inputs?
L1: Which rules fired? What was the deduction chain?
L0: What facts were queried? From which pod?
```

Every layer produces auditable output. No black boxes.

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4. Reasoning Layers (L0–L3)

4.1 Architecture Overview

```
L3: INTENTIONAL GATING
    Human presence, consent, final authority
    → "Is this what I actually want?"

L2: CONTEXTUAL INTERPRETATION
    LLM/multimodal, probabilistic, expensive
    → "What does this mean? What pattern is emerging?"

L1: DEDUCTIVE RULES
    Symbolic, deterministic, cheap, explainable
    → "Given these facts, what follows?"

L0: FACTS & GRAPH
    Solid pods, RDF triples, structured data
    → "What do I actually know?"
```

4.2 L0: Facts & Graph (Solid/RDF)

The ground truth layer. Queryable, ownable, portable.

- **Storage**: Solid pod (user-controlled)
- **Format**: RDF triples, JSON-LD
- **Trust**: Verifiable (cryptographic proofs possible)
- **Cost**: Storage only, near-zero compute

4.3 L1: Deductive Rules

Cheap, deterministic, fully explainable. **Default layer for all decisions.**

```
IF presence.fatigue > 0.7 AND time.hour > 21
THEN flag.defer_external_actions = true
```

- **Compute**: Minimal (any CPU)
- **Explainability**: Complete (rule trace)
- **Latency**: Milliseconds

4.4 L2: Contextual Interpretation

Invoked **only when L1 is insufficient**. Probabilistic, attributable, bounded.

- **Compute**: Variable (GPU optional, local preferred)
- **Explainability**: Partial (model + input attribution)
- **Constraint**: Outputs never directly actionable

4.5 L3: Intentional Gating

The irreducible human element. Only presence can authorize.

- **Compute**: Human attention (scarce resource)
- **Trust**: Sovereign (only the user can validate)
- **Mechanism**: Double Lock for external actions

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5. Anonymized Examples

5.1 Example 1: Family Context

Actors: Person A (adult), Person B (adult), Person C (child), Person D (child)

L0 — Facts:

```
:personA rel:spouseOf :personB .
:personA rel:parentOf :personC, :personD .
:personB rel:parentOf :personC, :personD .
```

L1 — Deduction: - Rule: `shared parents  siblingOf` - Derived: `personC siblingOf personD`

L2 — Interpretation: > “The relationship between Person A and Person C is currently focused on academic support.”

L3 — Decision: - Role: Parent - Context: Upcoming evaluation - Action: “Surface a supportive memory related to Person C”

Audit: What (reminder), Why (parental role + context), Who (Person A), When (time-sensitive)

5.2 Example 2: Professional Context

Actors: Person E (author), Person F (reviewer), Project X

L0 — Facts:

```
:personE schema:worksOn :projectX .
:personF schema:collaboratesWith :personE .
```

L1 — Deduction: - Rule: `collaboratesWith  professional relationship`

L2 — Interpretation: > “Person F acts as a critical semantic reference for Project X.”

L3 — Decision: - Role: Editor - Context: Pre-publication phase - Action: “Review this section using Person F’s perspective”

Audit: What (review suggestion), Why (audience alignment), Who (Person E), When (pre-publication)

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6. Cost & Scalability

6.1 Why Reasoning Is Cheap by Default

Operation	Layer	Cost
Memory query	L0	~0 (storage lookup)
Rule evaluation	L1	~0 (CPU milliseconds)
Pattern detection	L1	~0 (graph traversal)
Text summarization	L2	$$ (LLM call)
Voice transcription	L2	$ (Whisper local)
Human confirmation	L3	Attention (priceless)

6.2 Typical Flow Distribution

```
95% of operations:  L0 → L1 → Done        (free)
 4% of operations:  L0 → L1 → L2 → L1     (local compute)
 1% of operations:  L0 → L1 → L2 → L3     (human attention)
```

Design principle: Stay in L0/L1 as long as possible. Escalate only when necessary.

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7. Positioning & Scope

7.1 What LifeOS Is

- A **specification** for human-centric cognitive systems

- An **architecture** separating symbolic and perceptual intelligence
- A **framework** for explainability by construction
- **Solid Protocol compatible** (W3C standards)

7.2 What LifeOS Is Not

- Not a product or application
- Not a replacement for existing AI assistants
- Not an XAI technique (it's an alternative paradigm)
- Not dependent on specific AI models or vendors

7.3 Relation to Standards

Standard	Relation
Solid Protocol	L0 storage layer
RDF/Linked Data	Fact representation
W3C PROV	Provenance tracking
SHACL	Rule validation

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8. Status & Next Steps

8.1 Current Status

- □ Specification complete (8 documents)
- □ Conceptual framework validated
- □ Examples documented
- □ Reference implementation in progress

8.2 Invitation to Discuss

This work is intentionally published early to invite feedback from:

- The Solid community
- XAI researchers interested in alternative approaches
- Practitioners building human-centric systems

Contact: via GitHub issues or Solid forum

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Citation

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"Logic grounds decisions. Intelligence augments meaning. Intent remains human."