Privacy Value Model V5

Formal Specification

Version 1.4 — V10.0.0 Grimoire Aligned, V5.3.2 Ceremony Complete

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Abstract

This document presents the formal mathematical specification of the Privacy Value Model V5. The model introduces three-axis separation (agent, data, inference), a holographic bound resolving the 96/64 correspondence, path integral edge value, compression-as-defence, holonic persistence, and guild efficiency. V5.1 adds behavioural density ρ as a privacy amplifier. V5.2 establishes the dihedral group D_{2n}. V5.3 adds the operational cycle and amnesia as a zero-knowledge primitive (C17). V5.3.2 documents the Celestial Ceremony as the operational cycle's human-layer implementation, the runecraft protocol (dual Ed25519 keypairs), moon phase notation (stratum as visibility ratio), and the forge's cryptographic upgrade. Conjectures C6–C17 are tracked; C4 is resolved. The model is multiplicative: any term collapsing to zero eliminates total value.

Master Inscription: $(\mathbf{S} \perp \mathbf{M})$ **FP** $= \text{neg} \oplus \text{bnot} \to \text{succ}$

Thesis: Privacy is value. Behavioural data is the 7th capital — in a pre-property-rights phase. The architectural response is sovereignty through mathematical structure rather than regulatory mandate.

Contents

The Equation

Static form:

$$\boxed{V(\pi,t) = P^{1.5} \cdot C \cdot Q \cdot S \cdot e^{-\lambda t} \cdot (1 + A_h(\tau)) \cdot \left(1 + \sum_i w_i \frac{n_i}{N_0}\right)^k \cdot G \cdot R(d,c,\rho) \cdot M(u,y) \cdot \Phi_a \cdot \Phi_d \cdot \Phi_i \cdot T_{\int}(\pi)} \tag{1}$$

where π denotes a path through the sovereignty lattice $\mathcal{L} = \mathbb{Z}/(2^6)\mathbb{Z}$, and t denotes time since data generation.

Differential form (V5):

$$\frac{dV}{dt} = \nabla_{\partial M} \cdot J_{\partial M} + S(x) - D(x) \tag{2}$$

where ∂M denotes the 96-edge holographic boundary and $\nabla_{\partial M}$ indicates divergence computed on that boundary.

Gating: Multiplicative. Any single term $= 0$ implies $V = 0$.

Inherited Terms (V1–V4)

Symbol	Name	Domain	V5 Change
P	Privacy Strength	$[0,1]$	Exponent 1.5 via C6
C	Credential Verifiability	$[0,1]$	None
Q	Data Quality	$[0,1]$	None
S	Scope / Sensitivity	$\mathbb{R}^+$	None
$e^{-\lambda t}$	Temporal Decay	$(0,1]$	None
$M(u,y)$	Market Maturity	$[0,1]$	None

UOR Algebraic Foundation (V5.4)

Ring Structure

The sovereignty lattice $\mathcal{L} = \mathbb{Z}/(2^6)\mathbb{Z}$ contains 64 elements (blades 0–63). Five operations:

Op	Formula	Agent	Type	Function
neg	$\text{neg}(x) = 64 - x$	Swordsman	Involution	Boundary
bnot	$\text{bnot}(x) = 63 - x$	Mage	Involution	Projection
xor	$x \oplus y$	—	Binary	Symmetric difference
and	$x \wedge y$	—	Binary	Intersection
or	$x \vee y$	—	Binary	Union

Critical Identity

$$\boxed{\text{neg}(\text{bnot}(x)) = x + 1 = \text{succ}(x)} \tag{3}$$

Deny the complement and advance. The most indirect path produces the simplest advance. The Swordsman reflects, the Mage reflects, and where the reflections meet, the First Person walks through.

Dihedral Group D_{2n}

The two involutions (neg, bnot) generate the dihedral group D_{64} of order 128. The First Person's sovereignty path is the orbit under neg $\circ$ bnot = succ.

Conjecture 1 (C14, 75%)**.** *The dual-agent architecture is isomorphic to D_{2n} generated by neg and bnot over $\mathbb{Z}/(2^6)\mathbb{Z}$.*

Triadic Coordinates (PRISM)

Every blade $x \in \{0,1\}^6$ is addressed by three coordinates:

- **Datum** $\delta(x)$: the value itself (binary encoding, 0–63)
- **Stratum** $\sigma(x)$: Hamming weight / popcount (0–6)
- **Spectrum** $s(x)$: which dimensions active $[b_0 \dots b_5]$

Pascal distribution across strata: $\{1, 6, 15, 20, 15, 6, 1\}$.

Holonic Temporal Memory — $A_h(\tau)$

$$A_h(\tau) = \sum_j p(\tau_j) \cdot w(\tau_j) \cdot e^{-\mu \cdot \text{age}(\tau_j)} \tag{4}$$

GUID-addressed holons persist across providers and time. Infrastructure-independent history.

Three-Axis Separation

$$\Phi_{v5} = \Phi_{\text{agent}}(\Sigma) \cdot \Phi_{\text{data}}(\Delta) \cdot \Phi_{\text{inference}}(\Gamma) \tag{5}$$

Agent:

$$\Phi_{\text{agent}}(\Sigma) = \min\left(1.0,\ \frac{S/M}{\varphi}\right) \cdot \det(\Sigma) \tag{6}$$

Isomorphic to D_{2n} action on the sovereignty lattice (C14). When $\Phi_{\text{agent}} = 1.0$, the two generators are maximally independent. When $\Phi_{\text{agent}} = 0$, the group degenerates.

Data:

$$\Phi_{\text{data}}(\Delta) = 1 - \max_j(\text{share}_j) \tag{7}$$

Inference:

$$\Phi_{\text{inference}}(\Gamma) = 1 - I(\text{model}\,;\,\text{executor}) \tag{8}$$

Multiplicativity: Collapse on any single axis collapses total separation.

Conjecture 2 (C17, 60%)**.** *Amnesia-enforced separation provides tighter ε^* bounds than policy-enforced separation. Structural inability to access shared origin (process boundary, orbital mechanics) is stronger than instructed inability (access controls, prompt constraints).*

Reconstruction Difficulty — $R(d, c, \rho)$

$$R(d, c, \rho) = R_{\text{base}}(d) \cdot \left(1 - \frac{1}{c}\right) \cdot (1 + \alpha \cdot \rho) \tag{9}$$

Symbol	Definition	Domain
$R_{\text{base}}(d)$	V4 reconstruction difficulty	$(0, 1)$
c	Compression ratio (BRAID: 74×)	$\mathbb{R}^+ > 1$
ρ	Behavioural density (V5.1)	$\mathbb{R}^+ \geq 0$
α	Density scaling coefficient	$\mathbb{R}^+$

Definition 1 (Behavioural Density)**.** $\rho = f(\textit{traversal depth},\ \textit{temporal duration},\ \textit{intentional transitions})$

Dual interpretation (V5.3):

- **Privacy amplifier:** ρ increases reconstruction difficulty. More variation within the boundary makes trajectory reconstruction harder.
- **Agent maturity:** ρ indicates position on the instant–gradual spectrum. High ρ = closer to the Moon's clean amnesia. Low ρ = early in the forge.

Ceiling: $R < 1$ under budget constraints. No adversary can fully reconstruct private state regardless of computational power.

Conjecture 3 (C11, 55%)**.** *Behavioural density ρ amplifies reconstruction difficulty and indicates agent maturity.*

Path Integral Edge Value — $T_\int(\pi)$

Continuous:

$$T_\int(\pi) = 1 + \beta \int_\pi F(\gamma)\, d\gamma \tag{10}$$

Discrete:

$$T_\int(\pi) \cong 1 + \beta \sum_{i=1}^{n} R(\text{step}_i), \quad n = \text{laps} \tag{11}$$

The discrete form maps onto the UOR resolution pipeline. Laps are refinement iterations. Dragon tier (≥ 62 laps) is mathematical closure.

Conjecture 4 (C15, 65%)**.** $T_\int(\pi) \cong$ *UOR resolution pipeline.*

The Holographic Bound

$$\partial M : 96 \text{ edges encoding } 64 \text{ vertices, toroidal topology} \tag{12}$$

$$\frac{96}{64} = 1.5 = P^{1.5} \text{ exponent}$$

The ratio is derived independently from the UOR Atlas of Resonance Classes (96 vertices from pure mathematics) and the privacy torus. Mathematical necessity, not design choice.

Conjecture 5 (C6, 35%)**.** $P^{1.5} \leftrightarrow 96/64 = 1.5$ *is structural.*

Separation Bound

$$\boxed{I(S\,;\,M \mid \text{FP}) < \varepsilon^*} \tag{13}$$

The conditional mutual information between Swordsman and Mage, given the First Person, is bounded above by ε^*. This is the load-bearing wall.

Theorem 1 (Proven, 95%)**.** *Enforcing conditional independence between two agents creates an additive bound on mutual information leakage, yielding a provable reconstruction ceiling $R < 1$.*

Amnesia Protocol (V5.3)

Definition 2 (Structural Amnesia)**.** *An agent has structural amnesia with respect to origin O if no sequence of permitted operations can reconstruct O from the agent's current state.*

Zero-knowledge properties:

- **Completeness:** Agent output demonstrates the relationship functions
- **Soundness:** No other configuration could produce this output from this separation
- **Zero-knowledge:** Output reveals nothing about the separation event

Implementation: Extension process boundary between Swordsman and Mage. Separate processes = separate memory = structural amnesia.

Cosmological instance: The Moon's orbit. The tidal proof functions without reference to origin.

Operational Cycle (V5.3)

$$\text{cycle}(x) = \text{succ}(x) = \text{neg}(\text{bnot}(x)) \tag{14}$$

Stage	Name	Operation	Agent
1	Observe	$\text{id}(x)$	First Person
2	Boundary	$\text{neg}(x)$	Swordsman
3	Project	$\text{bnot}(\text{neg}(x))$	Mage
4	Return	$\text{succ}(x)$	Composition

One lap = one cycle. $T_{\int}(\pi) = 1 + \beta \sum_i \text{cycle}(\text{step}_i)$.

Ceremony Implementation (V5.3.2)

The Celestial Ceremony maps the operational cycle to two people:

Cycle Stage	Operation	Ceremony Phase
Observe	$\text{id}(x)$	Sun — disclosure
Boundary	$\text{neg}(x)$	Gap — silence, territory negotiation
Project	$\text{bnot}(\text{neg}(x))$	Moon — shared reflection
Return	$\text{succ}(x)$	Recursion: Reflect (night) / Connect (day)

Progressive trust: Understanding → Constellation → Blade → Runecraft.

Implementation: Forge and Runecraft (V5.3.2)

Forge Cryptographic Properties

Property	Implementation
Content addressing	SHA-256 constellation hash
Tamper evidence	Hash chain (each blade references previous)
Pre-evocation lock	Commitment scheme (constellation fixed before walk)
Identity binding	Ed25519 signature (Mage key, held)
Bilateral binding	Runecraft — dual Ed25519 (Mage held + Swordsman burned)

Runecraft as Φ_{agent} Implementation

Two Ed25519 keypairs bind two territories to a single blade:

- **Mage key** (spellweb, Sun view): persists in storage. ID: `mage-{16hex}`.
- **Swordsman key** (agentprivacy, Moon reflection): burned on session close. ID: `ap-{16hex}`.

The private key burns because structural amnesia (C17) requires topological inability to access shared origin.

Moon Phase Notation

Stratum encodes as a visibility ratio:

Stratum	Phase	Dimensions	Meaning
0	New Moon	0/6	Null blade
1	Waxing Crescent	1/6	One boundary
2	First Quarter	2/6	Dual-agent vertex
3	Waxing Gibbous	3/6	Half sovereignty
4	Waning Gibbous	4/6	Four boundaries
5	Last Quarter	5/6	Five reflected, one dark
6	Full Moon	6/6	All reflected

The dark part is the privacy. The lit part is the proof. The phase shows the sovereignty posture. ZK protects the content.

Tier Classification

Axis	Light	Heavy	Dragon
Stratum (coverage)	1–2	3–4	5–6
Laps (depth)	< 21	≥ 21	≥ 62

Stratum shows *what* you touched. Laps show *how deeply* you walked it.

Cosmological Quaternion (V5.3)

Interpretive framework. Not part of the equation.

Body	Function	Operational	Generation
Sun	Protection	Master / privacymage	—
Earth	Delegation	Soulbae (Emissary)	—
Moon	Reflection	Soulbis (ur-Swordsman)	Instant (Theia)
Human	Connection	Person (First Person)	Gradual (Life, 4 Gyr)

38 selectable + 4 cosmological = **42**.

Conjecture Summary

ID	Claim	Confidence
C4	96/64 discrepancy	**Resolved**
C6	$P^{1.5} \leftrightarrow 96/64$ structural	35%
C7	Three-axis separation is multiplicative	30%
C8	BRAID compression reduces $R_{\max}$	Open
C11	ρ amplifies reconstruction difficulty	55%
C12	Hexagram encoding coherence	50%
C13	Bilateral witness as quantum-resistant primitive	65%
C14	$\Phi_{\text{agent}} \cong D_{2n}$ dihedral isomorphism	75%
C15	$T_{\int}(\pi) \cong$ UOR resolution pipeline	65%
C16	Topological trust invariants (Betti numbers)	25%
C17	Amnesia-enforced $\Phi_{\text{agent}} >$ policy-enforced	60%

Proven Results

1. Additive MI bounds from conditional independence (95%)
2. Reconstruction ceiling $R < 1$ under budget constraints (95%)
3. Error floor via Fano's inequality (95%)
4. Graceful degradation under partial compromise (95%)
5. Ring algebra $\mathbb{Z}/(2^6)\mathbb{Z}$ substrate (95%)
6. Two-extension autonomy axiom (separate processes) (95%)
7. Pretext DOM-free measurement as privacy primitive (95%)

Version Lineage

Version	Date	Core Addition	Output Type
V1	2024	$P \cdot C \cdot Q \cdot S$	Static scalar
V2	Oct 2025	$e^{-\lambda t}$, network effects	Dynamic scalar
V3	Nov 2025	$R(d)$, $M(u, y)$, Φ	Agent-aware scalar
V4	Feb 2026	Σ, $A(\tau)$, $T(\pi)$	Manifold-aware scalar
V5	Feb 2026	Three-axis Φ, holographic bound	Holographic field
V5.1	Mar 2026	Behavioural density ρ (C11–C13)	+ density term
V5.2	Mar 2026	Dihedral D_{2n}, PRISM (C14–C16)	+ algebraic foundation
V5.3	Apr 2026	Operational cycle, amnesia (C17)	+ cosmological framework
V5.4	Mar 2026	UOR algebraic foundation	Algebraically grounded
V5.3.2	Apr 2026	Ceremony, runecraft, moon phase, forge	Implementation-verified

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