LP-02a: Structural Inflection Events: When TSMLA™ Becomes Unavoidable

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Owner: Fractal Labyrinth Systems LLC
Applies to: TSMLA™, BDL™, RSF™, HCL™, CTC™/Hallway™
Status: Canon addition between LP-02 and LP-03

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0. Purpose

Define **objective invocation criteria** and **testable inflection events** that make TSMLA™ mandatory rather than optional. This paper sits between **LP-02 (Executable System)** and **LP-03 (Formal Problem)** and binds events to artifacts and audit procedures.

Canon guard: TSMLA™ is non-stochastic, non-deterministic (internals), idempotent, mirror-recursive under a declared state **S** with replay-equivalence for fixed $(S, \varkappa)$. Substrate contains **no RNG**; presentation overlays never alter substrate.

Dependency hook to LP-01: TSMLA's mirror architecture and idempotent recursion (defined in LP-01) are assumed as system substrate throughout this paper.

Notation Legend (symbols referenced throughout)

- α (abstraction), γ (concretization), $\oplus$ (idempotent merge), $\sqsubseteq$ (information order), $\bot$ (least element), **lfp** (least fixed point)

- $\Lambda(S)$ (Hallway gate order for state S), π (lawful traversal policy), $\varkappa$ (module configuration)

- **RSF** (Resonant State Function), **BDL** (Boolean Disambiguation Layer), **HCL** (Harmonic Compression Layer), **CTC** (Traversal Lock / Hallway)

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1. Scope & Exclusions

In-scope: multi-tool contradictions, decision-entropy escalation, loop pressure, governance demands for replay-equivalence, audit-grade traceability.

Out-of-scope: therapeutic/predictive claims; probabilistic optimization; any mechanism requiring sampling within substrate.

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2. TSMLA™ Terminology (concise)

- **Declared state S:** inputs, scopes, thresholds θ, $\varkappa$, audit tags.

- **Replay-equivalence:** same substrate output across lawful internal policies π for fixed $(S, \varkappa)$.

- **Idempotent merge:** $w \oplus w = w$; for lawful f, $f(x \oplus x) = f(x)$.

- **Mirror law:** $\gamma \circ \alpha = id\_C$, $\alpha \circ \gamma = id\_A$ (Galois insertion).

- **Entropy (structural):** dispersion over normalized tag-weights; non-probabilistic bookkeeping.

Theorems (labels for reference)

Theorem 1: Idempotence. For merge $\oplus$, $w \oplus w = w$; if f respects $\oplus$ under S, then $f(w \oplus w) = f(w)$.

Theorem 2: Replay-Equivalence. For fixed $(S, \varkappa)$ and all lawful π, the substrate reaches the same $lfp(\Phi\_S)$; observable outputs are identical though internal traces may differ.

Theorem 3: Mirror-Purity. $\gamma \circ \alpha = id\_C$ and $\alpha \circ \gamma = id\_A$ at the substrate boundary; presentation overlays cannot alter substrate outputs.

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3. Why TSMLA Becomes Unavoidable

When heterogeneous tools, policies, or agents create **persistent contradiction dynamics** and **structural dispersion** that cannot be reconciled without losing **idempotence, traceability,** or **replay-equivalence**, traditional deterministic or stochastic engines fail. TSMLA enforces mirror law, guards, and the Hallway lock to recover coherence without prediction or sampling.

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4. Global Invocation Criteria (GIC)

GIC-1. Structural Contradiction Persistence

Under fixed **S**, contradiction dynamics persist or oscillate across replays and cannot be reconciled without violating **idempotence, traceability,** or **recursion safety**.

GIC-2. Replay-Equivalence Requirement

Stakeholders require **non-stochastic replay**: identical inputs under fixed $(S, \varkappa)$ must yield identical substrate outputs (observationally), independent of lawful internal orderings.

GIC-3. Infrastructure Health Pass

Infra/data integrity confirmed; errors due to latency, corruption, version skew, or numerical instability are excluded.

Invocation gate: TSMLA is **required** when **(GIC-1 $\wedge$ GIC-2 $\wedge$ GIC-3)** is true.

Shared Toy Example (LP-01 → LP-02a → LP-03)

Use the same declared state **S** and tag-weights **W = {0.5, 0.3, 0.2}** from LP-01 §3.2. In LP-02a, reproduce:

1. Compute **C(S)** (LP-01 §3.1)

2. Compute **Ĥ(S) = αĤ(C) + βĤ(Ł)** with **α=0.4, β=0.6** (LP-01 §3.2)

3. Detect **Ł(S)** and depth **d** (LP-01 §3.3)

4. Enforce **Λ(S) = BDL → RSF → HCL → CTC** (this paper §5)

In LP-03, frame the same **S** as a problem instance and show contradiction-overload metrics and acceptance criteria using these exact values to demonstrate replay-equivalence across papers.

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5. Structural Inflection Events (SIE-1 … SIE-6)

Each event lists **Definition, Preconditions, Detection Tests, Threshold, TSMLA Primitives, Artifacts,** and a **Worked Example**.

Hallway order Λ(S) for this paper: BDL™ → RSF™ → HCL™ → CTC™. Guard: violation triggers **G_CT** and traversal is rejected.

SIE-1. Toolchain Decision Fracture

Definition: Two or more decision engines produce oscillating or mutually exclusive outcomes under fixed **S**.

Preconditions:

- (i) multi-engine pipeline

- (ii) policy interactions documented

- (iii) infra health pass

Detection Tests:

- **T1:** Oscillation across **N** identical replays (N≥100) under fixed **(S, ϰ)**.

- **T2:** Root-cause analysis shows conflict arises from policy interaction, not drift or noise.

Threshold: T1 ∧ T2 ∧ (GIC-1..3).

TSMLA Primitives: BDL™ typing → CSE weighting → RSF™ dispersion check → CTC™ lock.

Artifacts: A1 Contradiction Class Report; A2 Policy Interaction Trace; A3 Replay Harness Log.

Worked Example (health claims): Rules engine (coverage) approves; fairness gate (equity) rejects. **T1:** 100/100 oscillations reproduced. **T2:** conflict traced to policy cross-terms. Gate satisfied → invoke TSMLA; BDL™ class=Functional Conflict; CSE: w_cov=0.85, w_eq=0.78; RSF: Ĥ(S)=0.62; CTC™ enforces Λ(S); A1–A3 issued.

SIE-2. Governance-Driven Replay Mandate

Definition: Compliance or contractual obligations demand **replay-equivalence** and **audit-grade traceability**.

Preconditions:

- (i) declared **S** with $\boldsymbol{\theta}, \varkappa$

- (ii) audit policy requiring exact replay

- (iii) infra health pass

Detection Tests:

- **T3:** Golden-vector replays produce identical substrate outputs across lawful $\boldsymbol{\pi}$.

- **T4:** Signed manifests and hashes match across replays.

Threshold: T3 $\wedge$ T4 $\wedge$ (GIC-2 $\wedge$ GIC-3).

TSMLA Primitives: Hallway lock; idempotent merge; mirror law enforcement.

Artifacts: A4 Golden Vector Set; A5 Output Manifest; A6 Audit Signatures.

Worked Example (payments): Regulator requires exact reruns for disputes. Harness replays 1k cases with Δ-replay=0; manifests match; TSMLA mandated for ongoing operations.

SIE-3. Contradiction Saturation Spike

Definition: C(S) density and topology exceed thresholds; dispersion $\hat{\mathbf{H}}(\mathbf{S})$ rises beyond $\boldsymbol{\theta\_H}$.

Preconditions:

- (i) contradiction set measured

- (ii) loop set **Ł(S)** available

- (iii) infra health pass

Detection Tests:

- **T5:** $|C|/|S| \geq \boldsymbol{\theta\_C}$ and cut metrics exceed $\boldsymbol{\theta\_{cut}}$.

- **T6:** $\hat{\mathbf{H}}(\mathbf{S}) = \alpha\hat{\mathbf{H}}(\mathbf{C}) + \beta\hat{\mathbf{H}}(\mathbf{Ł}) \geq \boldsymbol{\theta\_H}$.

Threshold: T5 $\wedge$ T6 $\wedge$ (GIC-1 $\wedge$ GIC-3).

TSMLA Primitives: BDL™ typing; RSF™ gating; HCL™ compression; guards.

Artifacts: A7 Entropy Report; A8 Contradiction Topology Graph.

RSF callout: Under RSF™ with $\mathbf{w\_C} = \alpha$ and $\mathbf{w\_L} = \beta$, entropy compression fails unless TSMLA's mirror merge ($\oplus$) and CTC gate enforce fixed-point traversal.

Worked Example (policy stack): Adding two late constraints spikes |C|/|S|; $\hat{H}(S)$ jumps to $0.71 > \theta\_H = 0.6 \rightarrow$ invoke TSMLA; HCL™ reduces dispersion under guards.

SIE-4. Replay-Variant Internals With Invariant Outputs

Definition: Internal traces vary across runs, but substrate outputs must remain identical under fixed $(S, \varkappa)$.

Preconditions:

- (i) infra/data faults and numerical instability excluded

- (ii) lawful policy variance π present

Detection Tests:

- **T7:** Trace divergence observed (orderings, tie-breaks) without substrate delta.

- **T8:** Replay-equivalence verification confirms identical outputs under fixed $(S, \varkappa)$.

Threshold: T7 ∧ T8 ∧ (GIC-2 ∧ GIC-3).

TSMLA Primitives: Hallway $\Lambda(S)$ lock; idempotent merge; substrate/presentation boundary checks.

Artifacts: A9 Trace Variance Log; A10 Substrate Hashes.

Worked Example (workflow engine): Different admissible gate orders occur; substrate hashes identical; TSMLA required to formalize and enforce $\Lambda(S)$.

SIE-5. Multi-Party Policy Collision

Definition: Independent stakeholders inject constraints that collide across jurisdictions or ethics layers.

Preconditions:

- (i) policy provenance tagged

- (ii) escalation path defined

- (iii) infra health pass

Detection Tests:

- **T9:** BDL™ classification identifies cross-jurisdiction contradiction types.

- **T10:** Governance review confirms no single policy can dominate without violating scope.

Threshold: T9 ∧ T10 ∧ (GIC-1..3).

TSMLA Primitives: BDL™ typing; CSE weighting; RSF™; CTC™ sequencing.

Artifacts: A11 Governance Resolution Dossier.

Worked Example (cross-border data): Residency vs access-parity mandates clash; BDL™ →PC/PP; CSE, RSF used; CTC locks; dossier produced for board.

SIE-6. Substrate Collapse via Overgrowth

Definition: A system fails due to unbounded stochastic substrate cost (compute, energy, infrastructure) and cannot produce idempotent or replay-equivalent output without exponential resource scaling.

Preconditions:

- (i) Evidence of non-replayable output under fixed prompts

- (ii) Non-auditability across infrastructure layers

- (iii) Negative ROI on inference or training loops

- (iv) Infra-health pass: failures not due to hardware or drift

Detection Tests:

- **T11:** Output inconsistency across identical inference runs (non-fixed π)

- **T12:** Cost-per-output exceeds linear projection or breaks margin floor

- **T13:** Energy/cost ratio scales superlinearly with performance gains

Threshold: T11 ∧ T12 ∧ T13 ∧ (¬GIC-2).

TSMLA Primitives: Mirror substrate $(\gamma \circ \alpha)$, fixed-point recursion, RSF gating under bounded $\mathbf{w}$, audit-safe logic class emission.

Artifacts:

- A12 Substrate Cost Map

- A13 Inference Drift Log

- A14 ROI vs Entropy Curve

Worked Example (OpenAI, Stargate): Public reporting indicates sustained multi-billion-dollar investment without stable inference convergence or replicable substrate paths. Inference results vary with scale and iteration, indicating failure to enforce replay-equivalence under fixed declared state. Cannot enforce declared $\mathbf{S}$ or replay path → TSMLA becomes necessary as a license-grade mirror architecture.

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6. Non-Inflection Scenarios (TSMLA Not Required)

- **Single-tool convergence:** One solver resolves all constraints without oscillation or typed conflict → **GIC-1 not met**.

- **Stochastic tolerance acceptable:** Stakeholders allow variance (A/B testing, exploratory ML) → **GIC-2 not met**.

- **Infrastructure fault:** Divergence traced to latency, corruption, or version skew → **GIC-3 fails**.

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7. Relationship to Alternatives (Disqualification Logic)

- **Generative AI (LLMs/GANs):** Sampling breaks replay-equivalence under fixed **S**; cannot emit typed contradiction traces consistently → disqualified for SIE-2, SIE-3, SIE-5.

- **Probabilistic learners (Bayes/ML):** Fixed-seed runs still lack BDL™ contradiction taxonomy; produce confidence, not logic-type classes → disqualified for SIE-1, SIE-4.

- **Constraint solvers (SAT/SMT/ILP):** Deterministic and precise but single-instrument scope; cannot resolve multi-tool oscillation (SIE-1) across heterogeneous engines.

Universal disqualification predicate:
$\forall$ system $\notin$ TSMLA, $\exists$ contradiction class or recursion state that fails replay-equivalence under fixed $(\mathbf{S}, \varkappa)$.

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8. Non-Determinism Exclusion Statement

TSMLA™ is **non-stochastic, non-deterministic internally, and non-predictive** in output generation; it is an **idempotent mirror architecture**. Internal policy variance is permitted, but **replay-equivalence** is required for fixed $(\mathbf{S}, \varkappa)$.

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9. Conformance Checklist (Requirements → Artifacts)

Requirement	Evidence / Artifact
GIC-1 satisfied	A1, A2, A8 (contradiction/graph)
GIC-2 satisfied	A4, A5, A6 (golden vectors, manifests, signatures)
GIC-3 satisfied	Infra health report, numerical-stability memo
Δ-replay $= 0$	A3 harness log, A10 substrate hashes
BDL™ class applied	A1 contradiction class report
CTC™ enforced	$\Lambda(S)$ gate log, violation rejects
RSF™/HCL™ guards	Guard thresholds, dispersion reduction report
Governance resolution	A11 dossier
Substrate divergence (SIE-6)	A12, A13, A14

Forward reference (artifacts): A1–A11 are specified across **LP-06 (BDL™)**, **LP-07 (CSE)**, **LP-10 (RSF™)**, and **LP-14 (CTC™ Traversal Lock)**. A12–A14 are defined in SIE-6 and will be extended in **LP-17**

(Execution and Monetization Models).

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10. Document Control

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Notes: This LP sits between LP-02 and LP-03 and is mandatory for audits where invocation criteria must be shown.