Supplement II — Adaptive Systems Formal Supplement

Formal anchor of the cognitive program

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Citation rule. This supplement is the single formal home for the cognitive program’s definitions, axioms, constructs, and propositions. Papers cite results by their stable name (e.g., “Inferential Coherence Bound,” “Axiom of Relational Temporality,” “Ordering-Sensitivity Non-Commutativity Proposition”), never by position number — so renumbering can never again drift against citations. Each object is stated once here; companion papers reference rather than restate.

Cross-regime discipline. Within the cognitive regime the program grounds upward with no internal firewall (IGAF, TNI, and MRIF describe one regime at three levels). The locked firewall applies wherever a construct borrows a physical-regime template (the “inferential light cone,” cone-limited reconstruction, OTOC) or asserts a parallel to the physical program (SPI <-> TPI). At every such seam the following is stated verbatim, never paraphrased:

“The parallel asserted is structural only. The same grammar recurs across regimes; no evidential weight transfers between them. A result in one regime is not evidence about another.”

No-upward-claims hierarchy holds throughout: TNI does not redefine physical time; MRIF does not assert physical ontology; IGAF does not assert factuality. Admissibility (Axiom 7 of the stack) is never evidence.

One-line architecture (from the glossary’s cross-framework alignment, canonical names restored). MRIF specifies what must be structurally true for an adaptive system to remain coherent; IGAF (Information Geometry of Adaptive Fields) describes how inference lives as motion on a geometric manifold under those constraints; TNI (Temporal Neuroscience Index) projects the resulting temporal geometry into a small descriptive index. Operationally (IGAF §A.7): the TNI chart modulates demand on the system (||thetadot||_g), and the MRIF envelope sets supply (c_eff).

Part 1 — Shared Geometric Substrate (Definitions)

Notation. A state space carrying the system’s information state: MRIF writes the abstract information field |Psi(t)> in H_space; IGAF/TNI write a point theta(t) on a statistical manifold M_manifold. Per the glossary’s reuse convention, shared symbols denote the same structural role even when instantiated differently. Sets/spaces are calligraphic (H_space, M_manifold, S_realized); maps are script/Roman (F_load, Phi, c_eff); the tuple Theta_TNI is the TNI projection’s image. The Dirac-like |Psi> implies no quantum claim.

Definition (Information State). The system’s internal state at external time t in R is represented either as an information field |Psi(t)> in H_space (MRIF) or as a point theta(t) in M_manifold (IGAF/TNI). A mapping π : H_space -> S_realized (MRIF-1) takes information states to realized configurations; a family of observables {O_obs_k} expresses any measurable output as a function of the state. (Informal reading: what matters is the pattern of distinguishability, constraint, and change — not the material substrate.)

Definition (Statistical Manifold and Metric). M_manifold is a differentiable manifold of belief/model states, endowed with a Riemannian metric g_ij(theta) encoding local distinguishability. The canonical choice, when applicable, is the Fisher information metric g_ij(theta) = E_expect_{x~p(x|theta)}[d__i log p(x|theta) dot d__j log p(x|theta)]; more generally g_ij is any symmetric positive-definite field encoding prediction sensitivity to parameter change (TNI App B §B1; IGAF Section B.15).

Definition (Distinguishability). A function D : H_space × H_space -> [0,∞) with D(|Psi>,|Psi>) = 0 and D >= 0 (MRIF-1), specialized in the geometric setting to the geodesic/path distance induced by g.

Definition (Inferential Load and Inferential Speed). The instantaneous inferential load is L(t) = F_load(|Psi(t)>, |Psidot(t)>), where F_load : H_space × TH_space -> [0,∞) is a load functional (MRIF-2). Its canonical geometric instantiation is the inferential speed ||thetadot(t)||_g = sqrt(thetadot(t)^T g(theta(t)) thetadot(t)) (IGAF §A.1). MRIF does not fix a unique F_load; the cognitive program adopts the information-geometric speed as F_load.

Definition (Internal Time as Path Length). Internal (subjective) time accumulated over [t_0, t_1] is

tau(t_0, t_1) = integral_{t_0}^{t_1} F_load(|Psi(t)>, |Psidot(t)>) dt = integral_{t_0}^{t_1} ||thetadot(t)||_g dt.

This single object is stated identically by MRIF-2 (Def. A.2), TNI Axiom 3, and IGAF §A.1 — it is the spine of the program. The TNI form is a direct instantiation of the MRIF form under F_load = ||thetadot||_g. (Informal reading: subjective time tracks accumulated structured belief change, not elapsed clock time.) Called temporal strain when the same integral is read as cost/burden of coherence maintenance rather than as “time” (IGAF §A.2).

Definition (Effective Capacity Envelope). A function c_eff(t) : R -> [0,∞) such that, during viable operation, L(t) <= c_eff(t) (MRIF Def. A.9). Equivalently in speed form, ||thetadot(t)||_g <= c_eff (IGAF §A.4). (Notation resolution: c_eff is canonical for the envelope and carries time / Architect-Frame / context dependence; TNI App B §B3.2 writes the same ceiling state-locally as kappa(theta) — retained as the per-point expression of c_eff, c_eff = kappa(theta) evaluated along the trajectory. Glossary §X.1’s stray C_eff is normalized to c_eff.)

Definition (Reachable Set / Horizon). Given coherence bound c_eff, the reachable set from theta_0 over horizon T is

R_reach(T) = { theta(T) : exists theta(t), theta(0) = theta_0, ||thetadot(t)||_g <= c_eff for all t in [0,T] } (IGAF §A.6).

(Informal reading: “future openness” is reachability under constraint, not abstract freedom.) The TNI horizon H (Part 4) is the chart coordinate of this reachability.

Part 2 — Axioms for Adaptive Inferential Systems

Minimal structural commitments, not a theory of neural computation. Each is stated by stable name with its provenance across the two axiom numberings (MRIF-1…4; TNI 1–6).

Axiom of Structured Inference. (MRIF-1 / TNI Axiom 1.) There exists a manifold M_manifold with metric g such that internal states are points on M_manifold and inferential updates are trajectories theta(t); equivalently, an abstract state space H_space with distinguishability D and an admissible-transition set T_time_t ⊆ H_space × H_space. Belief updates occur within a structured space of possibilities, not arbitrarily.

Axiom of Path-Dependent Cost. (TNI Axiom 2.) For any trajectory theta(t) there is a path-cost functional L_path[theta(t)] = integral sqrt(thetadot^T g thetadot) dt, finite for admissible trajectories. Different routes between the same endpoints can differ in accumulated effort.

Axiom of Relational Temporality. Internal time is the path-length functional of Part 1; temporal properties (slowed, fragmented, collapsed time) are functions of |Psi(t)> and tau, not of external t alone; two systems over the same clock interval can accumulate different internal times.

Axiom of Capacity Constraint. (TNI Axiom 4 / MRIF capacity condition.) Over any finite external interval there exist bounds: admissible update magnitude is bounded, tolerable curvature/metric variation is bounded, and beyond threshold, trajectories are redirected into regime shifts or defensive configurations. Formally the system operates within the capacity envelope C_cert = { (theta, thetadot) | sqrt(thetadot^T g thetadot) <= kappa(theta) } (TNI App B §B3.2), i.e. L(t) <= c_eff(t).

Axiom of Mirror Duality. (MRIF-3.) Any structurally coherent description admits a geometric/topological view F_geom (states, basins, barriers) and a dynamical/regulatory view F_dyn (flows, updates, controllers), related by a structure-preserving mirror map Phi (Part 3).

Axiom of Bounded Recursive Self-Modeling. (MRIF-4.) Systems of interest can instantiate a non-trivial model tower {M_k}_{k=1}^{K} with K >= 2 (Part 3); there is a practical bound K_max beyond which recursion fails to be maintained or yields net instability (runaway loops, paralysis, fragmentation). Recursion reshapes the effective geometry of M_manifold (adding meta-state dimensions/basins) and consumes capacity from a finite envelope.

Axiom of Meta-Regulatory Structure. *(TNI Axiom 5; realized by the MRIF Architect Frame, Part 3.)* The system possesses meta-regulatory structure constraining how much inferential work is undertaken (magnitude), how deep recursion goes (depth), and how coherence is maintained across scales (integration/repair). This structure need not be localized in a module. *(Guard, locked: the Architect Frame is not a homunculus — it is a structured set of mechanisms/parameters, not an internal agent.)*

Axiom of Projection. (TNI Axiom 6.) TNI is a projection Pi : M_manifold × Trajectories -> R^5 yielding the core vector Theta_TNI = (H, W, J, C, B), with psi reported only as a derived augmented readout Theta_TNI$^+$ = (H, W, J, C, B; psi), where psi = Psi(H, W, J, C, B) and the semicolon marks augmentation rather than a sixth coordinate. The projection does not uniquely determine the underlying mechanism: many micro-dynamics map to the same macro-configuration. (Notation resolution: Pi denotes this projection map only; the IGAF strain-pressure heuristic formerly written Pi is renamed P_strain in Part 3.)

Part 3 — Core Constructs, Theorems, and Propositions

3.1 Mirror duality

Definition (Geometric and Dynamical Descriptions). F_geom = a state space M_manifold with metric/divergence g, a decomposition into attractor sets A_alpha ⊆ M_manifold, basins B_alpha, and boundaries/saddles d_B_alpha, plus optional topological constraints. F_dyn = a state variable x(t) in X_space with an evolution rule (ẋ = f(x,u,theta), discrete map, or stochastic transition) and control/regulatory mechanisms (gains, precision weights, thresholds, meta-parameters) (MRIF Defs. A.3–A.4).

Definition (Mirror-Consistent Pair). A pair (F_geom, F_dyn) is mirror-consistent if there exists Phi : F_geom <-> F_dyn preserving: (1) Stability — attractor sets correspond to invariant sets of the dynamics; (2) Reachability — paths in M_manifold correspond to feasible transition sequences under constraint; (3) Capacity — geometric costs (distance, barrier height, curvature) correspond to dynamical costs within bounded distortion; (4) Causal consistency — irreversibility, hysteresis, and path dependence appear in both views (MRIF Def. A.5).

Axiom statement (Mirror Duality, MRIF-3). For any admissible system at least one mirror-consistent pair exists; a model that cannot in principle be cast as such a pair is structurally incompatible with the program. Phi is the stack's own coherence criterion.

3.2 Recursive self-modeling

Definition (Model Tower). A finite sequence M_1, …, M_K where M_1 models World and/or self-state, M_2 models how M_1 is updated/used, M_3 models M_2, etc.; each M_k in M_manifold_k (MRIF Def. A.6).

Definition (Recursive Self-Modeling Capacity). A system has capacity up to depth K if it can intermittently instantiate a tower {M_k}_{k=1}^{K}, update each M_k in response to observations/internal states, and have those updates influence its dynamics (models are not inert) (MRIF Def. A.7).

3.3 The Architect Frame

Definition (Architect Frame). The structured set of mechanisms and parameters A_frame (with configuration theta_AF(t)) that monitor operation (error statistics, volatility, resource use), adjust control/inference parameters (step sizes, gains, recursion depth, policy selection), and restructure trajectories (simplification, pacing, prioritization) to keep |Psi(t)> evolving lawfully within feasible limits. May include local control loops, global modes (focus vs. explore), and meta-policies on when to engage recursion (MRIF §A.6). (Guard, locked: not a homunculus.)

3.4 The Inferential Coherence Bound ("inferential light cone")

Cross-regime seam — firewall applies. "The parallel asserted is structural only. The same grammar recurs across regimes; no evidential weight transfers between them. A result in one regime is not evidence about another." The light-cone language is a formal template for reconstruction under finite propagation/ordering limits; no physical constants or mechanisms are imported (Appendix X §X.1).

Definition (Coherence Bound and Budget). ||thetadot(t)||_g <= c_eff (bound); B(T) = c_eff dot T (budget). Three regimes follow (IGAF §A.4):

- Coherent updating: tau(T) <= B(T).
- Boundary: tau(T) ≈ B(T).
- Over-capacity: tau(T) > B(T).

Scope. This is a structural analogue of a causal limit, not a claim of one. Together with Part 8 (cone-limited reconstruction), it specifies the validity-cone constraint inside the cognitive regime. Felt urgency rises as demand approaches capacity; regulation operates by lowering demand (tau) or raising capacity (c_eff).

Definition (Strain-Pressure Proxy P_strain). (Heuristic; renamed from the IGAF symbol Pi to resolve collision with the TNI projection map. IGAF §A.3.) P_strain proportional to E_expect[||thetadot(t)||_g] / c_eff.

3.5 The IGAF action functional

Definition (Information-Geometric Action). A structural template (optimal-control-Lagrangian form, not a claimed mechanism; IGAF §A.9):

J_action[theta] = integral_0^T (1/2 ||thetadot(t)||^2_g + lambda Phi(theta(t), t)) dt,

with Phi a constraint/penalty term (model mismatch, control cost) and lambda a weighting. Trajectories are governed by minimizing J_action; experienced time/strain is measured by path length (Part 1). (IGAF is shorthand for “geometry + variational updating.”)

3.6 Path dependence and ordering sensitivity

Definition (Internal-Time Inequality). For two trajectories joining the same endpoints — Trajectory 1: theta_0 -> theta_1 -> theta_2, Trajectory 2: theta_0 -> theta_2 -> theta_1 — with tau_1, tau_2 their path lengths, internal time is path-dependent over the transition when tau_1 != tau_2 (TNI §A5.1).

Proposition (Ordering Sensitivity as Non-Commutativity of Path Length). (TNI Prop. A5.1.) Under the Axioms of Path-Dependent Cost and Relational Temporality, if M_manifold has non-uniform curvature or update magnitudes differ by step, then for matched interventions A, B:

tau(theta_0 -> ^A theta_A -> ^B theta_AB) != tau(theta_0 -> ^B theta_B -> ^A theta_BA)

in general, even when theta_AB ≈ theta_BA in a coarse state description. The same content in different orders accumulates different internal time and strain.

Definition (Ordering Sensitivity psi). With d(dot , dot) a distance in TNI-parameter or outcome space, psi(A,B) = d(TNI[theta_AB], TNI[theta_BA]); psi = 0 indicates effective commutativity, psi > 0 order dependence. Estimated via sequence-comparison designs, not computed directly from trajectories (TNI Def. A5.2).

Proposition (Conditions for Low psi). (TNI Prop. A5.2.) Where curvature is low and approximately uniform, updates small and symmetric, and coherence high with capacity not approached, many sequences behave approximately commutatively (psi ≈ 0). Ordering effects are context-dependent, not universal; empirical null effects constrain where psi is expected non-negligible rather than falsifying the framework.

Proposition (Regime Dependence of psi). (TNI Prop. A5.3, empirical prediction.) psi increases when J is high, C is low, H is short, and the system operates near capacity; psi is small in well-regulated regimes (low J, high C, adequate H, B).

3.7 Empirical estimator

Definition (Discrete Path-Length Estimator). For trajectories sampled at discrete times t_k,

taû = Sigma_{k=0}^{K-1} sqrt(Δtheta_k^T ĝ_ij(theta_k) Δtheta_k), Δtheta_k = theta_{k+1} - theta_k,

where ĝ may be a simplified context-specific metric (identity, diagonal weights) or a task-derived Fisher proxy (TNI App B §B4.1).

Part 4 — The TNI Coordinate Chart (temporal projection)

The TNI core vector is Theta_TNI = (H, W, J, C, B) — five core parameters (TNI §5.1; Axiom 6; glossary §X.4). For visualization or projection, use the augmented tuple Theta_TNI^{+} = (H, W, J, C, B; psi), where psi is a derived coherence/ordering readout — a function psi = Psi(H, W, J, C, B) over the five core parameters, not an independent sixth coordinate; the semicolon marks an augmented readout, not a six-dimensional state space. Parameters are defined as patterns of geometry, not diagnostic categories.

- Horizon H (TNI Def. A3.1): the maximal future extension over which the system maintains a coherent, reachable representation of trajectories without collapse — the chart coordinate of R_reach(T). Bounded by finite-tolerable internal time, coherence above failure threshold, and capacity.
- Future width W (Def. A3.2): effective breadth of reachable, viable futures within H — number/diversity of trajectories that stay coherent, constraint-compatible, and non-negligible.
- Temporal jitter J (Def. A3.3): instability/volatility in temporal structure — variance in short-horizon predictions, inconsistency in ordering, rapid fluctuation in trajectory selection.
- Coherence C (Def. A3.4): degree to which temporal representations are internally consistent and integrable across scales; low C => fragmentation, isolated temporal islands.
- Branch richness B (Def. A3.5): number of viable future paths available / complexity of the decision space (TNI §5.1.5).
  Derived readout (not a core coordinate). psi — ordering sensitivity (Def. A3.6 / §3.6): dependence of geometry/outcomes on the order of matched interventions, content held fixed. Computed as psi = Psi(H, W, J, C, B) over the five core parameters (and the trajectory) and reported in the augmented tuple Theta_TNI^{+}; never an independent sixth axis.

Definition (TNI as Coordinate Chart). TNI axes are coordinates/features that modulate either demand or capacity (IGAF §A.7):

||thetadot||_g = f(TNI coordinates, context), c_eff = h(MRIF state, context).

This is the honest statement: TNI and MRIF are operational layers; IGAF supplies the geometric backbone they coordinate. The projection is non-unique (Axiom of Projection).

Empirical proxies (TNI App B §B4.2): H = maximum delay at which coherent goal-consistent plans are produced; W = count/diversity of viable options generated; J = variance in timing/ordering judgments across probes; C = narrative-continuity / cross-scale consistency scoring; B = count/distinctness of stable behavioral-temporal strategies across sessions; psi = matched-sequence (A -> B vs B -> A) outcome difference. Proxies do not recover the manifold but let structural predictions be tested. Model-agnostic implementation (App B §B4.3): treat responses as low-dimensional coordinates, construct a data-driven metric, approximate path lengths and parameters.

Part 5 — Regimes and Failure Modes (descriptive attractors)

Definition (Temporal Regime). A region of TNI-parameter space within which trajectories share qualitatively similar temporal geometry over relevant timescales (TNI Def. A4.1). Labels are shorthand for geometry patterns, not diagnoses — all three frameworks state this.

The three frameworks' breakdown taxonomies are the same object under three vocabularies; canonical correspondence:

TNI regime (A4.1)	MRIF failure mode (A.10)	IGAF budget regime (A.4)	Geometry
Regulated	(viable regime)	$\tau(T) \leq B(T)$	moderate H, sufficient W, low–moderate J, high C, adequate B
Looping	Runaway recursion / fragmentation	$\tau(T) \approx B(T)$	restricted H, circular W, elevated J, meta-level basins dominate; "spinning wheels"
Collapsed	Rigidification	$\tau(T) > B(T)$	short H, narrow W, low C, rigid/deep-narrow basins

MRIF's three structural failure modes are defined precisely (MRIF Def. A.10): Fragmentation (high-frequency transitions among shallow basins; low coherence, high jitter), Rigidification (deepening of few basins, raised barriers; narrowed width/horizon), Runaway recursion (trajectories dominated by meta-level basins — self-judgment about self-judgment — oscillatory/stuck, consuming capacity without resolving). The MRIF capacity condition: a viable regime requires the Architect Frame to keep L(t) within c_eff(t) on most intervals and prevent persistent occupation of any failure mode.

Proposition (Regime Stability under Small Perturbations). *(TNI Prop. A4.1.)* Within a regime, small parameter perturbations that do not violate capacity yield trajectories that remain in the same basin.

Proposition (Threshold-Induced Transitions). There exist thresholds in the joint (H, W, J, C, B) configuration such that crossing them under load induces regime transitions (regulated -> looping, regulated -> collapsed). Transitions are nonlinear: slow drift can produce sudden change.

Proposition (Asymmetry of Recovery). *(TNI Prop. A4.3.)* Recovery from collapsed/looping back to regulated typically requires partial restoration of the capacity envelope (lowered load or increased resources) *and* reconsolidation of coherence C — not mere reversal of the entry trajectory. The path in and the path out are generally not mirror images.

Part 6 — Subjective Publicization Index (SPI)

Cross-regime seam — firewall applies. “The parallel asserted is structural only. The same grammar recurs across regimes; no evidential weight transfers between them. A result in one regime is not evidence about another.”

Placement and provenance. Per the locked TPI/SPI split (Option 1, marked lineage), the Subjective Publicization Index (SPI) is the cognitive analogue of the physical-program Temporal Publicization Index (Supplement I, Part 5), owned here by Supplement II, named by structural analogy only. It is transcribed from the cognitive publicization source (the document filed as “Temporal Publicization Index TPI 2.pdf,” Drive 1vnMFHZ…), whose content is the subjective construct — “a measure of event formation in subjective time,” explicitly not physical time, and explicitly derived from TNI. The source’s “TPI” label is the pre-split name; it is renamed SPI here.

Purpose. The SPI quantifies how reliably an agent turns evolving internal states into temporally definite *events* — internal experiences that become durable (stable over a window), redundant (represented across multiple subsystems), and accessible (for action and narrative).

Definition (SPI — canonical multiplicative form).

SPI ≡ (Δtau_self / Δtau_0) dot (R̄_self / M) dot exp(-t_pub,self / tau_0) dot exp(-lambda_rev dot tau_1)

with the four factors reading, in order, durability (Δtau_self / Δtau_0), redundancy (R̄_self / M), fast consensus (exp(-t_pub,self / tau_0)), and low reopening (exp(-lambda_rev dot tau_1)); Δtau_0, tau_0, tau_1 are normalization constants fixed per measurement context. Reading: high SPI = stable, shared, quickly-formed internal events that do not reopen constantly.

Relationship to the physical TPI (firewall). The SPI shares the TPI’s multiplicative grammar and its durability + redundancy core (Supplement I Part 5), and adds two subjective-regime-specific factors — fast consensus and low reopening. It is derived from the TNI projection (below) rather than from sector separation. The indices are structurally analogous, not identical, and measure different regimes — internally established representations vs. public physical facts. No evidential weight transfers.

Derivation from TNI (parameter mapping). The SPI is derived from the TNI chart (Part 4), not a replacement.

Primary drivers: - W (window) ↑ -> Δtau_self ↑ (durability up) - C (coherence/constraint) ↑ -> R̄_self ↑ and lambda_rev ↓ - J (jitter/noise) ↑ -> t_pub,self ↑ and lambda_rev ↑ - psi (ordering sensitivity / instability) ↑ -> lambda_rev ↑ and Δtau_self ↓

Secondary modulators:

- B (branch richness) ↑ -> can increase R̄_self when additional viable branches remain coherent and integrated, because the event can be supported across a richer set of reachable interpretations or action paths. If paired with low C or high J, high B may instead slow t_pub,self or raise lambda_rev by increasing unresolved branching.
- H (horizon) ↑ -> reduces reopening from short-horizon oscillation, but can increase reopening if paired with high psi.

Compact functional relation: SPI ≈ f(W, C, H, B_coherent) / g(J, psi, B_unintegrated), with f and g increasing in their arguments. Branch richness supports SPI only when branches remain coherent and integrated; unintegrated branching can increase reopening. (Here B_coherent and B_unintegrated are informal reading-aids naming the integrated and unintegrated portions of branch richness B, not separate formal coordinates; B remains the single canonical parameter of Part 4.)

Reconciliation flag (resolved). Canonical B = Branch Richness (number of viable futures / decision-space complexity), fixed against the TNI paper (§5.1.5). The source's "embodied anchor" gloss and Part 4's earlier "basin richness" gloss are both normalized to Branch Richness.

Modeling-choice boundary. The normalization constants (Δtau_0, tau_0, tau_1), the reopening rate lambda_rev, and any threshold for "publicized" status are per-system modeling choices, justified empirically per context — mirroring the TPI's modeling-choice boundary. The form fixes structure; specific values are contextual.

Part 7 — Collective Extension (full)

Full treatment of the collective regime. The no-upward-claims and firewall disciplines carry unchanged; |Psi> follows the Part-intro convention (abstract information field, no quantum claim). Structure mirrors the program's layering: geometry -> regulation -> projection.

7.1 Collective geometry

Definition (Collective Information Field / Product Manifold). For N interacting systems with fields |Psi^{(i)}(t)>, a collective field |Psi^{(1,…,N)}(t)> over a joint space H_space^{(1,…,N)} with interaction structure (coupling matrix G_ij); equivalently in IGAF coordinates a product manifold Theta = Theta_1 × ⋯ × Theta_N with coupling cross-terms.

Definition (Collective Free Energy). F_col = Sigma_i F_i + Sigma_{i<j} Phi_ij — individual variational free energies plus pairwise relational-mismatch terms Phi_ij.

Definition (Collective Attractors). Persistent group patterns realized as system-level minima of F_col — properties of the coupled field, not individual traits.

Definition (Dyadic / Collective Strain Mismatch). Strain_{i,j}(T) = integral_0^T ||thetadot_i(t) - thetadot_j(t)||_g dt; normalized scalar Δ_dyad = (1/T) integral_0^T ||thetadot_i - thetadot_j||_g dt. Coordination failure is divergence in update dynamics (temporal coupling), not merely disagreement in content.

7.2 Collective regulation

Definition (Collective Architect Frame and Capacity). A_frame_group = the roles/norms/procedures coordinating individual Architect Frames A_frame^{(i)} plus group-level monitoring/pacing/restructuring; an effective group capacity envelope c_eff^{group}(t) is defined as in Part 1 over joint load L_group(t) (MRIF Def. A.12). Collective failure modes (fragmentation, rigidification, runaway meta-process) follow by applying the Part 5 taxonomy to the collective field.

Coherence diffusion, jitter contagion, collapse propagation (MRIF §7.3). In coupled systems coherence and jitter behave field-like: a regulated agent lowers others' effective load (diffusion of coherence, deepening collective basins); an agent persistently above c_eff propagates volatility (contagion of jitter, raising collective strain); repeated collapse of one agent drives others to over-function or co-collapse (collapse propagation, reorganizing collective basins).

Collective metastability and synchronization (MRIF §7.4). Groups occupy metastable regimes with measurable dwell/transition statistics. Synchronization is *stabilizing* when shared rhythm reduces net strain across members (deepening viable basins) and *destabilizing* when the group synchronizes at a pace tolerable only to its most resilient members (forcing others past c_eff). Pacing result (structural prediction): collective stability is maximized when synchronization is paced by the most-constrained safe capacity, and most at risk when paced by the highest-capacity members or by external demand that ignores the capacity distribution.

7.3 Collective projection

Group-level temporal field (TNI §9.6). The Part-4 TNI chart applies at the group level: shared horizons (H), collective jitter (J), collapses of coherence / collective trauma (C), shared future width (W), with branch richness (B) read over the joint decision space. Change in one part of a coupled system can shift temporal dynamics across the whole.

7.4 Structural predictions (MRIF §7.5)

Group failure modes mirror individual ones — fragmented (rapid strategy shifts, inconsistent messaging), rigid (entrenched norms), runaway-recursive (meta-process without substantive change). Pacing and load distribution predict breakdown: groups chronically at or above aggregate capacity show elevated turnover, conflict, and collapse events. The weakest-link vs extreme-member pacing contrast (7.2) is directly testable via dyadic/group coordination and contagion paradigms (MRIF §8.3).

7.5 Collective cones (interpretive; Appendix X §X.6)

Interacting agents operate under distinct cones (differing update rate, capacity, ordering sensitivity, access); coordination occurs across partially overlapping temporal frames, not a single shared "now." Apparent disagreement can reflect orientation differences — coherent reconstructions in incompatible coordinate frames — rather than factual error. Coordination depends on alignment of temporal geometry, not synchronization alone.

7.6 Non-claims

The collective extension posits no group mind and no agent over and above its members; its constructs are structural descriptors of coupled field dynamics, not categories for groups or persons, and are non-diagnostic. Clinical or organizational application of this material is reserved for the separate clinical companion.

Part 8 — Cone-Limited Reconstruction (interpretive complement)

Cross-regime seam — firewall applies. References to light cones and relativistic imaging are formal templates for reconstruction under finite propagation/ordering constraints; no physical constants, mechanisms, or claims are imported (Appendix X §X.1). "The parallel asserted is structural only. The same grammar recurs across regimes; no evidential weight transfers between them. A result in one regime is not evidence about another."

This part discharges (with §3.4) the validity-cone debt. It introduces no new formal machinery (Appendix X §X.1).

- Cone-limited reconstruction is geometry, not filtering (X.2): a constraint cone — propagation, attention, bandwidth, or coordination — defines the geometry in which information is integrated (simultaneity rules, accessibility constraints, ordering/delay structure). A system perceives the world expressed in the coordinate frame induced by its cone, not directly.

- Rotation vs. distortion (X.3): under coherent but asymmetric delay, coherent systems preferentially preserve local structure by re-expressing it in a rotated/curved frame rather than tearing it. Rotation is a change of basis preserving adjacency; apparent distortion is mistaking a rotated frame for a deformed structure.

- Subjective time as memory of integration (X.4): since internal representations are assembled from delayed, ordered signals, subjective time reflects the cost/structure of integration. Smooth inference through low curvature with regulatory margin => elastic, navigable time; effortful integration (load, delay, elevated psi) => time thickens, compresses, or fragments. Subjective spacetime is the memory of how change was integrated.

- Frame rotation without collapse (X.5): rotating between frames while preserving continuity of inference/identity is an adaptive capacity that aligns with the Architect Frame and capacity envelope (it does not redefine them). Collapse occurs when rotation exceeds regulatory capacity -> fragmentation, rigidification, or runaway recursion (Part 5).

Part 9 — Borrowed Standards (inventory)

These are borrowed, not program results, and are marked as such:

- Fisher information metric g_ij(theta) = E_expect[d__i log p dot d__j log p] — the canonical distinguishability metric on belief manifolds (IGAF §B.15).
- Variational free energy F(q) = E_expect_q[-log p(x,z)] + E_expect_q[log q(z)] — negative ELBO up to convention; the standard variational-Bayes / free-energy functional underlying the IGAF action's penalty term (IGAF §B.16).