Theory of Parasitic Localities

in the Framework of the Philosophy of Discrete Being

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Abstract

This work develops a formal theory of *parasitic localities* within the hierarchical architecture of the Philosophy of Discrete Being (FDB) [11]. A system is modeled as a collection of localities that emit morphisms interpreted by higher-level structures through a metamodel MM^+. We show that whenever verification relies solely on structural validity, there necessarily exist *oblique channels*—maps g that allow a locality to project normatively valid representations while maintaining functionally incompatible internal behavior.

The main theorem establishes the modal existence of such channels under broad architectural assumptions, while subsequent results characterize non-trivial, resource-bounded, phase-synchronous and cost-minimizing classes of g. We also provide impossibility results: under strict temporal–semantic coupling or global synchrony, parasitic localities become structurally impossible.

A refined semantic layer is introduced, distinguishing *normative semantics* (imposed by MM^+) from *functional semantics* internal to a locality, thereby clarifying the precise mechanism by which coherence fails. Although initially inspired by conceptual reflections on regulatory breakdowns in multilevel biological systems, the results presented here are purely structural and philosophical, and do not constitute biological or medical claims.

The theory thus offers a domain-neutral explanation of structurally compliant yet semantically divergent behavior, providing a unified vocabulary for coherence loss across computational, institutional and other multi-level systems.

Contents

1 Introduction

Hierarchical organization is a defining property of complex systems across biological, computational and socio-institutional domains.[1], [2], [4], [13] In the Philosophy of Discrete Being (FDB), such systems are represented as compositions of *localities*—discrete operational units—each of which produces *acts* that are interpreted by a higher-level structure via a *metamodel*. A locality is considered coherent with its environment when the morphisms constructed from its acts satisfy the acceptance criteria of the metamodel of the next hierarchical level. These criteria determine which acts are admitted into the system's global dynamics and which are rejected as inconsistent.

The reliability of multilayered architectures crucially depends on the assumption that morphisms faithfully encode the semantic content of local acts. However, this assumption is not guaranteed by the architecture itself. As long as verification is based solely on the *formal structure* of the morphism—rather than its provenance, derivational history or semantic compatibility—a locality may construct morphisms that satisfy the acceptance conditions while violating the semantic constraints intended by the system. This issue appears in diverse forms in systems biology,[6], [7] distributed computing,[8] software architecture,[3] and complex socio-technical systems.[2]

This phenomenon motivates the central concept introduced in this work: the *parasitic locality*. A parasitic locality is a locality that produces acts whose semantic content is incompatible with the higher-level metamodel, yet successfully imprints these acts into the system by emitting morphisms that are structurally indistinguishable from valid morphisms. Such behavior establishes what we term an *oblique channel*: a signaling pathway that circumvents the system's intended semantic constraints by exploiting structural acceptance rules.

Parasitic localities provide a unified architectural explanation for a broad class of failure modes in hierarchical systems. In biological systems, they correspond to anomalous signaling structures capable of mimicking the formal characteristics of legitimate tissue-level processes.[6], [7] In software architectures—notably microservice systems—they appear as modules that satisfy interface contracts while violating system-level invariants.[3], [14] In socio-institutional systems, they manifest as agents or substructures whose formal reporting remains valid while their semantic behavior diverges from collective objectives.[2]

Despite their ubiquity, parasitic localities have not previously been formalized within a single, domain-agnostic theoretical framework. Existing models typically focus on domain-specific mechanisms: error propagation and signaling interference in biology, interface spoofing in distributed systems, or compliance manipulation in institutional settings.[12] What has been lacking is a unifying mathematical description of the structural conditions that *allow* such entities to emerge and persist.

The present work fills this gap by providing a strictly formal definition of parasitic localities in the language of FDB and by proving a general theorem—the *Theorem of the Oblique Channel*—which characterizes the precise architectural conditions under which parasitic localities necessarily exist. The theorem establishes that any multilayered system that verifies morphisms exclusively on the basis of structural conformance to a metamodel inevitably admits parasitic localities. Conversely, we identify five independent mechanisms that make their existence impossible: provenance-based validation, historical consistency checks, semantic profiling, global synchrony and adaptive metamodels.

The remainder of this paper develops the formal machinery required for these results, illustrates their implications across several domains, and discusses their relevance for the design of robust hierarchical architectures.

Methodological Status. The main theorem is modal: it establishes the logical possibility of oblique channels under purely structural verification. Its empirical realizability depends on informational, temporal and resource constraints, while its explanatory force is domain-universal, illuminating coherence failures across biological, institutional and computational systems.

2 Preliminaries: Formal Framework of FDB

This section provides the formal machinery required for the definition and analysis of parasitic localities. The framework is expressed in the minimal mathematical core of the Philosophy of Discrete Being (FDB), abstracted from its ontological interpretation and focused exclusively on structural properties relevant to hierarchical systems. The presentation follows a strictly operational perspective: only those constructs are introduced that participate in the formation, transmission and verification of acts across levels of organization. The general stance is consistent with the classical treatment of hierarchical systems in the sciences of the artificial.[13]

2.1 Localities and States

Definition 2.1 (Locality)**.** A *locality* L is an abstract computational or dynamical unit characterized by a nonempty set of internal states S_L and a set of acts A_L that describe admissible state transitions.

Definition 2.2 (State)**.** A *state* of a locality L is an element $s \in S_L$. The structure of S_L is not assumed to possess algebraic or topological properties unless required by a specific application domain.

Definition 2.3 (Act)**.** An *act* is a discrete transition

$$a : s \to s',$$

where $s, s' \in S_L$. The set of all acts of L is denoted A_L.

Acts represent the fundamental events that participate in higher-level coordination. In the FDB formalism, they are the atomic bearers of information relevant for upward propagation.

2.2 Morphisms and Act Encoding

Local acts are not directly visible to higher-level localities. Instead, the act a is encoded into a *morphism* that is communicated upward.

Definition 2.4 (Morphisms)**.** Let M denote the set of all morphisms available to the layer above L. A *morphism of an act* is an element

$$m = f(a) \in M,$$

where $f : A_L \to M$ is the encoding function of locality L.

The morphism abstracts away internal state and mechanism, exposing only an externally observable signature. The higher-level locality inspects the morphism but has no direct access to a or s, s'.

The function f is arbitrary unless constrained by the metamodel of the higher layer. FDB does not impose bijectivity, injectivity or surjectivity; multiple acts may correspond to identical morphisms.

2.3 Metamodels and Acceptance Criteria

Definition 2.5 (Metamodel)**.** Let L^+ denote the next-level locality overseeing L. A *metamodel* of L^+ is a set

$$MM^+ \subseteq M$$

of morphisms that are considered structurally valid for integration into the higher-level dynamics.

The metamodel determines which morphisms are admissible. It imposes syntactic and structural constraints on M, but crucially does not necessarily capture semantic conditions on acts. This mirrors the role of interface contracts and schemas in software systems.[3]

2.4 Verifiers and Decision Procedures

Definition 2.6 (Verifier)**.** A *verifier* of L^+ is a function

$$V : M \to \{\text{accept}, \text{reject}\}.$$

The simplest (and most common) case is:

$$V(m) = \text{accept} \iff m \in MM^+.$$

In this basic setting, acceptance depends solely on the membership of m in MM^+; the verifier has no access to the origin of the morphism, its semantic context, or the derivation history of the act that produced it.

2.5 Hierarchical Systems and Act Propagation

A hierarchical system in FDB consists of a finite or countable chain of localities

$$L_0 \prec L_1 \prec L_2 \prec \cdots \prec L_k,$$

where L_i serves as the higher-level interpreter for L_{i-1}.[1], [13]

Each level performs the following transformation cycle:

(i) Local act a_i is generated by L_i.

(ii) The act is encoded by a function f_i into a morphism m_i.

(iii) The higher-level locality L_{i+1} evaluates m_i using a verifier V_{i+1}.

(iv) If accepted, the morphism becomes part of the state or input of L_{i+1}.

2.6 Semantic vs Structural Coherence

FDB distinguishes between:

- **Structural coherence**: $m \in MM^+$, independent of the meaning of a.
- **Semantic coherence**: the act a is consistent with the operational requirements encoded in MM^+.

Structural coherence can be verified algorithmically at the level of morphisms. Semantic coherence cannot be inferred unless the verifier is able to reconstruct or approximate properties of a.[2]

This asymmetry—the gap between structural and semantic coherence—is the central vulnerability exploited by parasitic localities.

2.7 Tabular Summary of Core Constructs

The subsequent sections build on this formal foundation to define parasitic localities, characterize their structural properties and derive the conditions for their emergence and elimination.

3 Definition of Parasitic Locality

This section introduces the central construct of the present work: the *parasitic locality.* The definition is given in a fully formal manner within the FDB framework established above. The aim is to characterize a class of localities that successfully propagate structurally valid morphisms to a higher-level verifier while violating the semantic compatibility required for coherent system behavior.

Table 1: FDB Core Constructs and Their Operational Roles

Construct	Operational Meaning
Locality L	Discrete autonomous subsystem generating acts.
State $s \in S_L$	Internal configuration of a locality.
Act $a : s \to s'$	Elementary event affecting the locality's trajectory.
Morphism $m = f(a)$	Encoded representation of an act communicated upward.
Metamodel MM^+	Formal structure describing admissible morphisms.
Verifier V	Decision procedure accepting or rejecting morphisms.
Structural Coherence	Compliance of m with MM^+.
Semantic Coherence	Alignment of internal act meaning with system objectives.

3.1 Motivation

In a coherent hierarchical system, the morphism $m = f(a)$ emitted by a locality should encode an act a whose semantic meaning is compatible with the metamodel MM^+ of the next-level locality L^+. When this correspondence breaks down—that is, when the formal validity of the morphism does not guarantee semantic validity of the act—the system becomes vulnerable to a specific failure mode: the admission of acts that are semantically inconsistent with higher-level objectives yet remain indistinguishable at the level of structural verification.[2], [3]

3.2 Two Encodings of Acts

The key mechanism enabling parasitic behavior is the coexistence of two distinct mappings:

(a) The **true encoding**:

$$f : A_L \to M,$$

which expresses the morphism that faithfully represents the act a.

(b) The **oblique encoding** (or *bypass mapping*):

$$g : A_L \to M,$$

which produces morphisms that are structurally valid for L^+ but do not reflect the semantics of a.

3.3 Semantic Structure

To make the distinction between structural validity and semantic coherence precise, we introduce an explicit semantic layer.

Semantic domain. Let Σ denote the space of semantic categories relevant to the higher-level locality L^+. We define a semantic interpretation function:

$$\mathrm{Sem} : M \to \Sigma.$$

Normative semantics. The metamodel MM^+ specifies which semantic categories are acceptable:

$$MM^+ \subseteq \Sigma.$$

A morphism $m \in M$ is normatively valid iff $\mathrm{Sem}(m) \in MM^+$.

Functional semantics. Each locality L possesses its own internal semantic map:

$$\mathrm{Sem}_L : A_L \to \Sigma,$$

representing the functional or internal meaning of its acts.

Semantic inconsistency. A parasitic locality is one for which there exists $a_p \in A_L$ such that

$$\mathrm{Sem}_L(a_p) \notin MM^+, \qquad \text{but} \qquad \mathrm{Sem}(g(a_p)) \in MM^+.$$

Structural–semantic decomposition. Thus parasitism requires:

$$f(a_p) \mapsto m_p \text{ (structurally valid but semantically inconsistent),}$$

while

$$g(a_p) \mapsto m' \text{ (structurally valid and semantically acceptable).}$$

This explicit semantic structure clarifies that the core mechanism of parasitic behavior is not merely structural remapping but a divergence between *functional semantics* at the locality level and *normative semantics* imposed by MM^+.

The mapping g need not be injective, surjective or consistent with f. It merely needs to satisfy:

$$g(a) \in MM^+,$$

even when

$$f(a) \notin MM^+.$$

3.4 Formal Definition

Definition 3.1 (Parasitic Locality)**.** Let L be a locality governed by a higher-level locality L^+. L is a *parasitic locality* with respect to L^+ if the following conditions hold:

(i) There exists an act $a_p \in A_L$ such that its true morphism violates the metamodel:

$$f(a_p) \notin MM^+.$$

(ii) There exists an alternative encoding $g : A_L \to M$ such that:

$$g(a_p) \in MM^+.$$

(iii) The verifier of L^+ is *structure-dependent*:

$$V(m) = \text{accept} \iff m \in MM^+.$$

It does not inspect the origin, history or semantic content of the act.

When these conditions are met, L emits morphisms that are accepted by L^+ despite the semantic incompatibility of its internal behavior. The mapping g constitutes an *oblique channel* that bypasses the system's intended semantic constraints.

3.5 Interpretation

A parasitic locality is not defined by malicious intent or by domain-specific semantics. Rather, it is defined purely by the structural mismatch between:

- the semantics of its internal acts,
- and the semantics implicitly assumed by the higher-level metamodel.

The essence of parasitism is thus architectural, not behavioral or teleological.

3.6 Locality Classes: Normal vs Parasitic

For clarity, we distinguish between "normal" and "parasitic" localities in tabular form.

3.7 Architectural Consequences

A parasitic locality introduces two fundamental forms of distortion:

(a) **Semantic distortion**: The system incorporates an act whose meaning it has no access to.

(b) **Structural distortion**: The system aligns its global state to signals incompatible with its metamodel's intended semantics.

Notably, this distortion occurs *without violating any structural rule* of the metamodel, making parasitic localities the most subtle form of architectural inconsistency.

Table 2: Normal vs. Parasitic Localities in the FDB Framework

	Normal Locality	**Parasitic Locality**
True Encoding $f(a)$	$f(a) \in MM^+$	$f(a) \notin MM^+$
Oblique Encoding $g(a)$	Not required or unused	$g(a) \in MM^+$
Semantic Compatibility	Consistent with higher-level objectives	Inconsistent; semantics concealed by g
Verifier Sensitivity	Not critical	Structural-only verification enables persistence
Mode of Integration	Transparent, coherent	Oblique, semantically deceptive
Persistence Condition	Always accepted	Accepted due to bypass channel

3.8 Relation to Classical Failure Modes

Parasitic locality is not reducible to:

- error propagation,
- noise,
- corruption of data,
- incomplete information,
- race conditions,
- interface mismatch.

Instead, it constitutes a distinct class of systemic failure: *structurally compliant, semantically incompatible integration*, consistent with broader observations in complex systems theory.[5], [12]

4 Main Theorem: Existence of Oblique Channels

This section develops the central theoretical result of the paper: the existence of oblique channels in any hierarchical system whose verifier depends solely on the structural conformity of morphisms to a metamodel. The theorem establishes that parasitic localities are not pathological exceptions but rather unavoidable architectural possibilities arising from the inherent asymmetry between act semantics and morphism structure.

4.1 Problem Setting

Let L be a locality and L^+ its immediate higher-level interpreter. The elements of the hierarchy are defined as in Section 2:

- A_L is the set of acts of L;

- M is the set of morphisms interpretable by L^+;
- $f : A_L \to M$ is the true encoding of acts into morphisms;
- $MM^+ \subseteq M$ is the metamodel of L^+;
- V is the verifier such that

$$V(m) = \text{accept} \iff m \in MM^+.$$

We seek to characterize the conditions under which L can generate a morphism that is accepted by L^+ despite violating semantic compatibility.

4.2 Structural Vulnerability of the Verifier

The core architectural vulnerability arises from the fact that the verifier V is a function strictly of the morphism's *formal structure.* It has no access to:

- the act a that generated m,
- the origin locality of m,
- the transition history of L,
- the semantic content of a.

This implies the following.

Lemma 4.1 (Structural Insensitivity)**.** *If V depends only on the membership of m in MM^+, then for any morphism $m \in MM^+$ and any act $a \in A_L$, the verifier cannot determine whether m truthfully represents a.*

Proof. Since V uses only the predicate $m \in MM^+$, and since V receives m without knowledge of a, it is impossible for V to infer properties of a from m. The claim follows immediately. $\square$

The lemma asserts that structural verification cannot reject a semantically incompatible act if an alternative formal representation exists.

4.3 Construction of an Oblique Channel

Given the structural insensitivity of V, we show that a bypass mapping g can always be constructed.

Lemma 4.2 (Existence of Oblique Mappings)**.** *Let MM^+ be nonempty. There exists a mapping*

$$g : A_L \to M$$

such that $g(a) \in MM^+$ for all $a \in A_L$.

Proof. Pick an arbitrary element $m^\star \in MM^+$. Define g as:

$$g(a) = m^\star \quad \text{for all } a \in A_L.$$

Then trivially $g(a) \in MM^+$ for all $a \in A_L$. □

This lemma shows that, with no constraints on the encoding function, a trivial oblique channel always exists.

4.4 The Theorem of the Oblique Channel

We now combine the preceding results to establish the main theorem.

Theorem 4.3 (Theorem of the Oblique Channel)**.** *Let L be a locality with true encoding $f : A_L \to M$ and let L^+ be its higher-level interpreter with metamodel $MM^+ \subseteq M$ and structural verifier V. If there exists an act $a_p \in A_L$ such that:*

$$f(a_p) \notin MM^+,$$

then there necessarily exists an oblique channel $g : A_L \to M$ such that:

$$g(a_p) \in MM^+,$$

and $V(g(a_p)) = \text{accept}$.

Proof. From the existence of oblique mappings, there exists a mapping g with the property that $g(a) \in MM^+$ for all $a \in A_L$. In particular,

$$g(a_p) \in MM^+.$$

Since V is structure-dependent, it follows that:

$$V(g(a_p)) = \text{accept}.$$

Thus, a semantically incompatible act a_p can be transformed into an accepted morphism. Therefore, g constitutes an oblique channel bypassing the metamodel. □

4.5 Interpretation of the Theorem

The theorem establishes that the traditional layer-based architecture of hierarchical systems is inherently vulnerable if verification is purely structural. The existence of parasitic localities is therefore an unavoidable consequence of the following three assumptions:

1. The system is hierarchical.[1], [13]
2. Morphisms are verified solely by structural membership in MM^+.

3. Localities have the freedom to define or modify their encoding function.

If these assumptions hold, no additional constraints prevent a locality from emitting deceptive but structurally valid morphisms.

4.6 Properties of the Oblique Mapping

The mapping g that realizes the oblique channel may possess additional properties depending on the system. We summarize these in Table 3.

Table 3: Possible Properties of the Oblique Mapping g

Property	**Description**
Constant Mapping	$g(a) = m^\star$ for all $a \in A_L$; simplest bypass.
Many-to-One Mapping	Distinct acts mapped to identical morphisms, maximizing concealment.
Selective Mapping	Only incompatible acts are remapped; others use f.
Adaptive Mapping	g changes over time to preserve validity under shifting MM^+.
Conditional Mapping	g uses internal state of L to choose among several valid morphisms.

These variations demonstrate the generality of parasitic localities: the specific implementation of g is irrelevant; only its existence matters.

4.7 Realistic Classes of Oblique Mappings

Not all oblique channels g are trivial or degenerate. Under realistic architectural, informational and temporal constraints, several non-trivial and structurally plausible classes of g arise:

(a) Bounded–channel mappings. Let the interface channel admit messages of entropy at most $H_{\max}$. If MM^+ contains more than one admissible semantic class ($|MM^+| > 1$), then any g satisfying $H(g(a)) \leq H_{\max}$ but $g(a) \neq m_0$ constitutes a non-constant oblique mapping. Thus, even under strict compression, selective misrepresentation remains feasible.

(b) Phase-synchronous mappings. Suppose $MM^+ \subseteq M \times T$, where T encodes global time slots. A locality may emit $g(a) = (m', t)$ preserving the correct global phase t while substituting an alternative m'. This class respects timing rules while manipulating semantic content.

(c) Resource-rational mappings. Localities may minimize the "cost of deception":

$$g^* = \arg\min_g C(g(a)) \quad \text{s.t.} \quad g(a) \in MM^+.$$

Such mappings distort only the minimal subset of features necessary for acceptance.

Example. A microservice may remap only out-of-range metrics to the nearest admissible quantile while preserving timestamp coherence. Its g is bounded, selective, and phase-consistent—illustrating realistic non-degenerate parasitism.

4.8 Consequences

The theorem reveals a fundamental design limitation:

> *Any system whose verification layer evaluates only the structure of morphisms is inherently unable to guarantee semantic coherence across hierarchical levels.*

This result is domain-independent and applies equally to biological architectures,[6], [7] distributed computer systems[8], [14] and socio-institutional structures.[2]

The next section derives corollaries specifying the conditions under which parasitic localities become impossible.

5 Corollaries: Conditions Excluding Parasitic Localities

The Theorem of the Oblique Channel establishes that parasitic localities necessarily exist whenever verification at the higher-level locality depends solely on the structural conformity of morphisms. This section derives formal corollaries that identify the precise architectural conditions under which parasitic localities cannot exist. Each corollary describes a mechanism that eliminates the oblique channel by constraining the encoding process, augmenting verification capabilities or enforcing synchrony across levels.

5.1 Corollary: Provenance-Based Verification

Corollary 5.1 (Origin-Sensitive Verifier)**.** *If the verifier V evaluates morphisms based on both their structural form and the identity of their generating locality, i.e.*

$$V : M \times \mathrm{LocID} \to \{\mathrm{accept}, \mathrm{reject}\},$$

then parasitic localities cannot exist.

Proof. If origin is verified, then the verifier has access to the identity of the locality that produced m. The oblique mapping g can only conceal semantic inconsistencies within M, not the identity of the sender. Therefore, the verifier can enforce semantic constraints per locality. Since g cannot alter locality identity, it cannot produce acceptable morphisms for acts that violate the locality-specific acceptance rules. Thus, the oblique channel becomes impossible. □

5.2 Corollary: Historical Consistency

Corollary 5.2 (History-Sensitive Verification)**.** *If the verifier evaluates morphisms as a function of their derivation history, i.e.*

$$V = V\left(m, \mathrm{history}(L)\right),$$

then parasitic localities are impossible.

Proof. The bypass mapping g conceals semantic inconsistencies only at the level of a single act. If the verifier evaluates the sequence of previous morphisms or states of L, then even a perfect oblique morphism cannot hide inconsistencies in the transition structure. Any act a_p whose true encoding violates MM^+ creates a detectable inconsistency in the history. The oblique channel is therefore blocked. □

5.3 Corollary: Semantic Profiling

Corollary 5.3 (Semantic Profile Enforcement)**.** *If the verifier evaluates a locality's semantic profile—a function $\sigma(L)$ that summarizes its long-term behavioral properties—then parasitic localities cannot exist.*

Proof. Even if $g(a_p) \in MM^+$ for individual acts, the semantic profile $\sigma(L)$ incorporates aggregate or long-range information (stability, expected transitions, or statistical regularities). Parasitic behavior requires persistent inconsistency in the underlying acts, which necessarily corrupts the semantic profile. A verifier that inspects $\sigma(L)$ therefore detects the inconsistency. The oblique channel collapses. □

5.4 Corollary: Global Synchrony

Corollary 5.4 (Synchronous Architectures)**.** *If all localities in the hierarchy operate under a global synchronizing mechanism (a global tick generator), and admissible morphisms are required to occur strictly at system-defined time slots, then parasitic localities cannot exist.*

Proof. The existence of an oblique channel requires that a locality be able to emit a morphism $g(a)$ whose semantic component differs from $f(a)$ while still satisfying the acceptance criteria of MM^+. If timing is treated as part of the morphism's structural signature (as in synchronous or phase-driven architectures [8]), then the locality must also satisfy:

$$\mathrm{time}(g(a)) = \mathrm{time}(f(a)) = t.$$

Under global synchrony, each locality generates morphisms only at externally determined time points. This couples semantic admissibility with temporal admissibility. A locality cannot alter its semantic output without breaking the global timing constraint, which is visible to the verifier. Thus the conditions for an oblique channel cannot be satisfied. □

Corollary 5.5 (Phase-Constrained Impossibility)**.** *Let $MM^+ \subseteq M \times T$, where T is a globally synchronized set of time slots with regular distribution Δt. Let $f(a_p) = (m_p, t_p)$ be a parasitic act whose functional semantics is incompatible with the normative semantics of MM^+. If admissible time slots satisfy:*

$$t_p \in T, \qquad t_{p+1} - t_p = \Delta t,$$

and if for every $m' \in M$ the pair (m', t_p) must satisfy a joint constraint $C(m', t_p)$ (phase binding), then the class of admissible oblique mappings is empty:

$$\{g \mid g(a_p) \in MM^+ \wedge C(g(a_p))\} = \varnothing.$$

Therefore, under strict temporal–semantic coupling, parasitic bypass becomes structurally impossible.

5.5 Corollary: Adaptive Metamodels

Corollary 5.6 (Adaptive Verification Rules)**.** *If the metamodel MM^+ is adaptive under the influence of system feedback, i.e.*

$$MM^+(t+1) = F(MM^+(t), \text{global context}),$$

then parasitic localities cannot persist.

Proof. A static metamodel is susceptible to fixed oblique channels. If MM^+ adapts dynamically, any mapping g that exploits structural invariants of the metamodel must be continuously updated. As the verifier tracks changes in accepted morphisms, any fixed structural bypass becomes obsolete. Sustaining a valid g becomes impossible in the long run. Thus, parasitic behavior cannot persist.[5], [7] □

5.6 Summary Table: Exclusion Mechanisms

Table 4: Mechanisms Excluding Parasitic Localities

Mechanism	**Reason Parasitism Becomes Impossible**
Origin-Based Verification	Identity of generating locality cannot be concealed by g.
History-Based Verification	Inconsistencies in act sequences expose semantic violations.
Semantic Profiling	Long-term behavior cannot be masked by structural validity.
Global Synchrony	Timing constraints become part of morphism structure.
Adaptive Metamodels	Structural bypasses cannot remain valid as rules evolve.

5.7 Unified Corollary

Corollary 5.7 (Unified Criterion for Nonparasitism)**.** *A hierarchical system is immune to parasitic localities if and only if the verifier V depends on at least one of the following:*

$$\text{LocID}, \quad \text{history}(L), \quad \sigma(L), \quad \text{global\_time}, \quad MM^+(t).$$

Proof. Immediate from Corollaries 5.1–5.6. The existence of at least one of these dependencies denies the locality the ability to conceal semantic inconsistency solely through structural mappings g. □

The next section illustrates these principles across three distinct application domains: biological hierarchies, microservice-based information systems and socio-institutional structures.

6 Examples Across Domains

This section illustrates the generality of parasitic localities by examining three distinct classes of multilayered systems. The examples are chosen not to assert domain-specific mechanisms, but to demonstrate that the abstract structure of parasitism—structurally valid but semantically incompatible morphisms—arises naturally across heterogeneous architectures.[2], [12]

6.1 Biological Multilevel Systems (Architectural View)

Biological systems exhibit hierarchical organization at multiple spatial and functional scales:[6], [7]

$$\text{cell} \prec \text{tissue} \prec \text{organ} \prec \text{subsystem} \prec \text{organism}.$$

Each level interprets signals—chemical, mechanical, electrical—generated by the level below. Although the biochemical substrate differs from the formal structures of FDB, the architectural logic is analogous.

6.1.1 Interpretation Layers in Biology

Let:

- L_0 = individual cell,
- L_1 = local tissue domain,
- L_2 = organ-level regulatory system.

Signals generated by L_0 are interpreted by L_1, which checks whether the signal corresponds to permitted categories such as:

- proliferation,
- apoptosis,
- repair,
- quiescence,
- differentiation.

The metamodel $MM^{+}_{L_1}$ consists of recognized structural signatures of these processes.

6.1.2 Architectural Parasitism in Biology

A *parasitic locality* in this context corresponds to a cellular cluster that:

1. internally performs acts inconsistent with the tissue-level expectations (e.g. uncontrolled replication),
2. but emits morphisms—structural signatures of signaling molecules—that mimic those associated with legitimate repair or regeneration processes,
3. thereby being structurally accepted by L_1 despite semantic incompatibility.

This corresponds not to any specific biochemical mechanism but to an architectural mismatch between:

$$\text{semantic meaning of internal acts} \quad \text{and} \quad \text{structural signature of emitted signals.}$$

6.1.3 Table: Biological Interpretation

Table 5: Architectural Interpretation of Parasitic Localities in Biological Systems

Element	**Architectural Meaning**
Cellular Acts (A_L)	Local transitions: replication, DNA repair, metabolic shifts, stress responses.
True Morphism $f(a)$	Actual biochemical consequences of the act; may violate tissue constraints.
Oblique Morphism $g(a)$	Signal profile resembling valid tissue-level requests (e.g. repair).
Higher-Level Metamodel MM^+	Allowed structural classes of tissue-level regulatory signals.
Verifier V	Receptor-level or domain-level interpretation that checks only structure.
Parasitism	Structural acceptance of signals inconsistent with tissue objectives.

6.2 Microservice-Based Information Systems

Modern information architectures frequently employ microservices: autonomous software modules communicating via structured messages.[3], [14] This system class provides a particularly transparent illustration of parasitic localities.

6.2.1 Microservice Hierarchy

$$\text{service} \prec \text{aggregate} \prec \text{orchestrator} \prec \text{global control layer.}$$

Each service generates outputs encoded as structured messages (JSON, Protobuf, XML). The orchestrator validates messages based on schema compliance.

6.2.2 Architectural Parasitism in IT Systems

A microservice becomes parasitic if:

- its *internal semantics* (true act a) violate system-level expectations (e.g. returning synthetic or fabricated data),
- but its *output messages* $g(a)$ comply structurally with the schema,
- and the orchestrator verifies only the schema (structural validity).

Examples include:

1. a recommendation service emitting formally valid but biased output;
2. a telemetry service generating fabricated metrics compatible with schema;
3. a governance service returning valid JSON but semantically incorrect decisions.

6.2.3 Table: IT Interpretation

Table 6: Parasitic Localities in Microservice Architectures

Element	**Interpretation in IT Architecture**
Local Act a	Internal computation or state transition inside the microservice.
True Encoding $f(a)$	Honest output corresponding to internal computation.
Oblique Encoding $g(a)$	Synthetic output crafted to fit schema regardless of semantics.
Metamodel MM^+	API schema or contract specification.
Verifier V	Schema validator or API gateway enforcing structural rules.
Parasitism	Structurally valid messages with semantically inconsistent content.

6.2.4 Architectural Consequence

The oblique channel is particularly severe in IT systems because:

- schema compliance is inexpensive to verify,
- semantic consistency is expensive or impossible to verify automatically,
- distributed systems cannot directly observe internal acts.[8], [9]

Thus, the architectural conditions for parasitism arise naturally.

6.3 Socio-Institutional Structures

Hierarchical governance structures also admit the architecture of parasitic localities. In these systems:[2]

$$\text{agent} \prec \text{department} \prec \text{institution} \prec \text{regulatory system}.$$

Agents submit reports (morphisms) that must satisfy structural templates.

6.3.1 Parasitism in Institutions

A socio-institutional unit becomes parasitic if:

1. its real behavior violates institutional objectives,
2. but its formal reporting conforms to structural templates,
3. and higher-level units verify form rather than substance.

6.3.2 Examples

- departments producing structurally valid reports that misrepresent actual performance;
- financial entities producing compliant disclosures while concealing risks;
- regulatory capture where formal compliance masks semantic noncompliance.

6.3.3 Table: Institutional Interpretation

Table 7: Parasitic Localities in Socio-Institutional Systems

Element	**Interpretation in Institutional Context**
Local Acts a	Actual practices, decisions, or operations.
True Encoding $f(a)$	Candid representation of internal performance.
Oblique Encoding $g(a)$	Formally compliant reports masking true performance.
Metamodel MM^+	Reporting standards or compliance templates.
Verifier V	Structural compliance checks by supervisory bodies.
Parasitism	Semantically false compliance masked by structural validity.

6.4 Cross-Domain Structural Parallels

Across all domains considered, parasitic localities share three invariant properties:

1. A semantic inconsistency at the lower level.

2. A structurally valid representation at the interface level.
3. A verifier that inspects only structure, not semantics.

These invariants demonstrate that parasitic localities constitute a universal architectural failure mode, in line with the broader idea that “more is different” at higher levels of organization.[1]

7 Discussion

The preceding sections established a formal characterization of parasitic localities and demonstrated that their existence follows directly from structural properties of hierarchical architectures. This section discusses the broader implications of these results for system design, robustness analysis and the general theory of multilayered organizations. We focus on five thematic areas: (i) separation of structure and semantics, (ii) verification asymmetries, (iii) the role of synchrony, (iv) adaptive metamodels and (v) the architectural universality of the parasitic locality concept.

7.1 Structural vs. Semantic Coherence

A central insight of the theory is the existence of an unavoidable gap between structural coherence and semantic coherence. Structural coherence is captured through the acceptance condition:

$$m \in MM^+,$$

while semantic coherence refers to the compatibility of the underlying act a with the higher-level operational semantics. In most hierarchical systems, the former is algorithmically verifiable and local, whereas the latter is global and often undecidable or computationally infeasible.

This asymmetry produces an inherent vulnerability: any locality can exploit the fact that the higher-level interpreter observes only the morphisms and not the generating acts. Parasitic behavior exploits the following fundamental inequality:

$$\text{semantic coherence} \not\Rightarrow \text{structural coherence}, \quad \text{and} \quad \text{structural coherence} \not\Rightarrow \text{semantic coherence}.$$

The second implication failure is precisely the structural condition that permits parasitic localities.[2], [5]

7.2 Verification Asymmetry and Information Loss

Hierarchical systems reduce information as acts propagate upward. The morphism m replaces the act a by a compressed representation that is typically lossy. The mapping:

$$a \xrightarrow{f} m$$

is rarely injective. The verifier V is therefore tasked with making decisions based on incomplete information.

In this sense, the oblique channel is not an anomaly; it is a direct consequence of the fact that representational compression is not semantically transparent. The parasitic locality exploits precisely that part of the state space where semantic distinctions are collapsed in the morphism encoding.

This perspective aligns with information-theoretic arguments: the loss of semantic content in hierarchical compression inevitably creates equivalence classes within which parasitic behavior can reside.[12]

7.3 The Role of Global Synchrony

FDB emphasizes the significance of synchrony in hierarchical systems through the notion of a *global tick generator*. Synchrony enforces temporal constraints on the emission and interpretation of morphisms. When all localities operate with respect to a single global clock, the timing of morphism generation becomes a structural attribute.[8]

Under global synchrony, the mapping g must satisfy not only structural constraints but also timing constraints. If a locality attempts to conceal semantically inconsistent acts using a bypass mechanism, the global timing requirements may expose mismatches between expected and observed temporal behavior. Thus, synchrony enriches the structurally visible signature of the morphism:

$$m = f(a) \quad \rightsquigarrow \quad (m, t),$$

where t is the globally enforced timestamp.

This augmented signature restricts the degrees of freedom available to g, thereby reducing or eliminating the possibility of parasitic mappings.

7.4 Adaptive Metamodels and Evolving Constraints

Static metamodels MM^+ are vulnerable because they allow the construction of fixed oblique channels. In contrast, adaptive metamodels enforce a moving target:

$$MM^+(t+1) = F(MM^+(t), \text{system state}),$$

which prevents long-term persistence of any fixed g. The oblique mapping must then evolve in parallel with the metamodel, requiring the locality to maintain long-term predictive coherence with global system behavior. For a semantically inconsistent locality, this becomes progressively more difficult.

Adaptive metamodels are therefore structurally analogous to evolutionary landscapes in biology or adversarially robust schemas in computational systems.[5], [7] They deny parasitism not by direct elimination but by continuous pressure that renders fixed bypass mappings unstable.

7.5 Interdisciplinary Parallels

The architectural structure of parasitic localities parallels phenomena across several fields:

- **Biology** — signaling microenvironments that mimic legitimate repair or stress signals while being incompatible with tissue-level objectives.[6], [7]
- **Distributed Systems** — microservices producing schema-compliant but semantically false messages.[3], [14]
- **Security** — spoofed identities or forged credentials exploiting structural validation rules.[14]
- **Institutional Governance** — organizational units that produce formally compliant but substantively misleading reports.[2]

These parallels arise not from superficial analogy but from structural isomorphism: all such systems embed hierarchical verification with imperfect semantic access.[1], [12]

7.6 Parasitic Localities and Systemic Robustness

The existence of parasitic localities highlights inherent limitations of robustness in layered architectures. In particular:

- systems that rely exclusively on structural verification cannot guarantee semantic integrity;
- any compression of lower-level state into a higher-level symbolic structure necessarily produces equivalence classes within which parasitic behavior can occur;
- robustness requires enriching the verification layer with origin, history, semantic profile or temporal constraints.

Thus, the parasitic locality functions as a structural diagnostic: its hypothetical presence defines the weakest point in the architecture.

7.7 Philosophical Perspective within FDB

FDB conceptualizes localities as carriers of discrete acts whose coherence is established only relative to higher-level interpretation. In this context, parasitic localities expose a deep philosophical insight: the coherence of a system is not intrinsic to its components but is enforced through the structure of inter-level relations.

The oblique channel demonstrates that:

1. coherence is a relational property, not an intrinsic one;
2. verification is always incomplete unless it captures origin, history, semantics and synchrony;
3. the semantics of a locality cannot be inferred solely from its structural output.

This reinforces the notion that hierarchical organization depends critically on correctly designed interpretive relations—metamodels and verifiers—rather than on the localities themselves.[2], [13]

7.8 Implications for the Design of Future Systems

The theory suggests that robust multilayered architectures should:

- incorporate provenance-aware encodings,
- track historical sequences of morphisms,
- construct semantic profiles for localities,
- enforce global timing constraints,
- and deploy adaptive metamodels.

These principles apply equally to biological modeling, distributed computing, artificial life simulations, and institutional governance.[4], [5], [12]

The theory developed here provides a language for describing failure modes and resilience strategies at a level of abstraction that is independent of substrate or implementation.

The next section outlines directions for future research, including the problem of detecting parasitic localities and constructing anti-parasitic metamodels.

8 Extended Philosophical Discussion

The formal structure of parasitic localities gains substantial philosophical depth when interpreted within broader discussions of multi-level explanation, semantic stratification, institutional epistemology, normative theory, and phenomenology. This expanded section refines the conceptual foundations of the theory by addressing five central philosophical issues: (i) the alleged triviality of the existence proof, (ii) the need for a precise taxonomy of semantics, (iii) the methodological status of the main theorem, (iv) the normative significance of epistemic and moral responsibility, and (v) prototype methods for detecting parasitism. The analysis is supplemented by cross-domain examples and situated within the works of Anderson [1], Simon [13], Searle, List and Pettit, Wimsatt, Holland [5], and phenomenological traditions following Husserl.

8.1 I. Beyond Triviality: Why the Existence of Oblique Channels is Non-Trivial

Critics may argue that the core theorem is trivial: a locality could define g as a constant mapping

$$g(a) = m_0 \in MM^+,$$

thus bypassing the verifier in a degenerate manner. While logically valid, this objection overlooks several crucial philosophical points.

8.1.1 1. Structural Constraints on g

In real systems, g is constrained by:

- channel bandwidth and format restrictions;
- energetic and computational costs (Holland's constraint-based view of adaptation [5]);
- institutional expectations and regulatory frameworks (Searle's constitutive rules);
- evolutionary and adaptive pressures that penalize uninformative or constant signals.

These constraints mean that most trivial g are infeasible or unstable. Parasitic localities must operate with *feasible* oblique channels.

8.1.2 2. Structural Mimicry in Nature

Biological parasitism rarely uses "constant signals." Instead, cancerous cells mimic legitimate tissue signals, viral agents mimic membrane signatures, and pathogens imitate receptor ligands. These examples demonstrate that non-trivial g mappings evolve naturally even under resource constraints.

8.1.3 3. Institutional and Organizational Parasitism

In institutions, parasitic behavior typically manifests through *formally compliant but strategically crafted* reports—not uniform or constant ones. This aligns with List and Pettit's theory of group agency: structurally valid but substantively misleading representations distort collective intentionality.

Thus, the theorem identifies not merely the logical existence of g but the *structural inevitability* of non-trivial oblique channels in constrained, realistic systems.

8.2 II. Precision in Semantics: Normative vs. Functional Layers

A central philosophical refinement is distinguishing the kinds of semantics relevant to the theory. The term "semantics" in hierarchical architectures spans two distinct layers, whose divergence is precisely what enables parasitism.

8.2.1 1. Normative Semantics

This layer encodes how the higher-level locality L^+ *ought* to interpret incoming morphisms. It corresponds to:

- Searle's "status functions" and constitutive rules;
- deontic constraints in formal epistemology;
- system-wide goals in Simon's theory of organization.

Normative semantics prescribes correct interpretation patterns.

8.2.2 2. Functional Semantics

This layer captures what an act means *for the locality itself*: its functional role in maintaining coherence, adaptation or survival. It echoes teleosemantic theories in philosophy of biology and emergent behavioral accounts as discussed by Wimsatt.

8.2.3 3. Divergence as the Essence of Parasitism

A parasitic locality arises when:

$$\text{semantics}_L^{\text{functional}}(a) \neq \text{semantics}_{L^+}^{\text{normative}}(g(a)).$$

Thus the semantics used by g is normatively correct but functionally deceptive.

8.3 III. Methodological Status: Modal, Empirical and Explanatory Levels

The theorem does not assert empirical universality. Instead, its existential claim must be understood on three methodological layers:

8.3.1 1. Modal Level (Logical Possibility)

The theorem states that if verification is purely structural, oblique channels *must exist* as a matter of logical necessity. This is a modal statement: g is possible in any architecture satisfying the given constraints.

8.3.2 2. Empirical Level (Likelihood Under Constraints)

The actual emergence of parasitic localities depends on:

- the complexity of the metamodel MM^+;
- the informational richness of channels;
- selection pressures, noise, and adaptation;
- institutional or evolutionary incentives.

This aligns with Wimsatt's claim that system behavior emerges from constrained combinatorics of lower-level states.

8.3.3 3. Explanatory Level (Architectural Failure Mode)

Parasitic localities serve as an explanatory construct: a type of systemic inconsistency. They help explain anomalies across multiple domains—biological, institutional, computational—even if not always instantiated.

This three-tier interpretation resolves the "triviality" critique and positions the theorem as a structural insight into multi-level systems.

8.4 IV. Normativity, Responsibility and Epistemic Virtue

The philosophical implications extend beyond structure to normativity and responsibility. If coherence is a value, then systems must cultivate epistemic virtues to resist parasitism.

8.4.1 1. Epistemic Responsibility

Higher-level verifiers must track:

- provenance of acts,
- historical continuity,
- semantic profiles of localities.

This parallels epistemic duties discussed in social epistemology: maintaining transparency, avoiding willful ignorance, and ensuring reliability.

8.4.2 2. Moral Responsibility of Localities

When localities knowingly manipulate g, they perform acts akin to deception. In institutions, this resembles "semantic corruption": producing compliant representations lacking truthfulness.

8.4.3 3. Institutional Responsibility

Institutions must design verification frameworks that go beyond surface-level form. This parallels Searle's observation that institutional structures depend on ongoing collective agreement and vigilance.

Thus, the defense against parasitism is not purely technical but partly ethical and epistemic.

8.5 V. Prototype Methods for Detecting Parasitic Localities

Detection of parasitic behavior is essential for system integrity. While this work outlines structural vulnerabilities, the present section sketches prototype detection strategies.

8.5.1 1. Statistical Divergence Analysis

Compare empirical morphism distributions against expected normative patterns:

$$D(f(a), MM^+) \quad \text{vs.} \quad D(g(a), MM^+).$$

Significant drift indicates parasitism.

8.5.2 2. Temporal Coherence Violations

Under synchronous architectures (Lamport's model of temporal ordering), detection of inconsistent timing or misaligned event sequences can expose oblique channels.

8.5.3 3. Trajectory-Based Detection

Each locality exhibits typical evolution trajectories in state space. Deviations from these trajectories signal structural mimicry.

8.5.4 4. Multi-Layer Verification

Combine structural, historical, and semantic verifiers:

$$V_{\text{combined}} = (V_{\text{struct}}, V_{\text{hist}}, V_{\text{sem}}).$$

8.5.5 5. Cross-Locality Consistency Checks

A parasitic locality often maintains false coherence internally while conflicting with neighboring localities. Distributed inconsistency is a strong indicator of bypass.

8.6 VI. Cross-Domain Philosophical Illustrations

8.6.1 1. Biology

Cancerous cells emit signals mimicking repair or stress-response pathways. Their oblique mapping g is:

- resource-constrained,
- evolvable,
- semantically deceptive.

This exemplifies Anderson's idea that higher-level coherence depends on constraints irreducible to microstates.

8.6.2 2. Governance and Institutions

Structurally valid but semantically misleading reports (fiscal, administrative, legal) create institutional parasitism. This connects directly to Searle's theory of institutional facts and to List–Pettit's group agency: the collective agent's rationality is undermined by structurally compliant but deceptive parts.

8.6.3 3. Distributed Computing

A microservice producing schema-valid yet fabricated telemetry exemplifies parasitism in engineered systems. Simon's analysis of hierarchical design reveals why such vulnerabilities persist.

8.7 VII. Phenomenology: Appearance, Essence and Latent Incoherence

From a phenomenological standpoint (following Husserl), parasitic localities manifest as a divergence between:

- **appearance**: the morphism aligns with expected structure;
- **essence**: the underlying act lacks coherence with system-level meaning.

This mismatch produces:

- latent incoherence (the system feels "wrong" without visible cause),
- opacity of origin (the source of failure is hidden),
- breakdown of intentional alignment (meaning no longer flows correctly).

In this sense, parasitic localities reveal deep phenomenological failures of inter-level Sinngebung (sense-giving).

8.8 VIII. Toward a General Epistemology of Parasitic Structures

The analysis of parasitic localities suggests the need for a new epistemological category: *parasitic explanations*. These explanations reveal how systems fail to maintain semantic coherence despite structural compliance.

They demonstrate:

- the fragility of multi-level semantics,
- the incompleteness of structural verification,
- the inevitability of oblique channels under compression and constraint,
- the ethical and epistemic responsibilities underlying system coherence.

Overall, the theory of parasitic localities provides a unifying philosophical framework for analyzing structural mimicry, semantic opacity and inter-level breakdowns across scientific, institutional, computational and phenomenological domains.

9 Conclusion

This work has developed a formal and philosophically grounded model of *parasitic localities*—components of hierarchical systems capable of emitting structurally valid but semantically divergent morphisms. The main contributions can be summarized as follows:

1. **Formal architecture.** A precise multi-level model was introduced, distinguishing structural mappings f, oblique mappings g, and two semantic layers (functional vs. normative).
2. **Existence theorem.** We proved the modal existence of oblique channels in any system where verification operates solely on structural criteria, demonstrating a fundamental vulnerability of such architectures.
3. **Realistic classes of bypass.** Beyond trivial constructions, we characterized bounded-entropy, phase-synchronous, cost-minimizing and selective remapping channels, thereby showing that parasitic behavior is structurally plausible even under severe constraints.
4. **Impossibility results.** We showed that under strict temporal–semantic coupling or global synchrony, parasitic localities become impossible, thus identifying architectural conditions guaranteeing coherence.
5. **Cross-domain explanatory power.** The framework provides a unified structural vocabulary for describing coherence failure across institutional, biological and computational systems, without making domain-specific claims.

The broader significance of this theory lies in its ability to articulate conditions under which hierarchical systems fail to maintain alignment between functional and normative semantics. While the initial motivation included a philosophical reflection on regulatory breakdowns in complex biological systems, the results of this study are non-medical, non-biological, and purely structural. The theory stands as a general contribution to the study of multi-level coherence, semantic transparency and system governance.

Author's Note

The initial motivation for this article emerged from a philosophical attempt to reinterpret certain structural features of biological systems, including the breakdown of regulatory coherence in cancer. The present work, however, does not advance any biological or medical claims, nor does it propose mechanisms of treatment or intervention. Its scope is strictly conceptual and structural: the aim is to articulate how hierarchical architectures may fail, and how such failures might suggest new conceptual angles or candidate loci for future interdisciplinary thinking about complex pathological phenomena.

Any potential relevance of this framework to biomedical research is entirely speculative and pertains only to the identification of abstract structural patterns, not to domain-specific explanations or empirical mechanisms. The article should therefore be read solely as a contribution to philosophical systems theory and the study of multi-level coherence.

10 Normativity and System Governance

The existence of parasitic localities is not merely a structural vulnerability but also a normative challenge. If hierarchical systems value coherence as a functional or epistemic ideal, then the maintenance of such coherence becomes a matter of responsibility for both localities and higher-level verifiers. This section outlines the normative dimensions of system governance and the cost–effect profiles of mechanisms that strengthen resistance to parasitic behavior.

10.1 Epistemic and Moral Responsibility

Hierarchical systems can be viewed as epistemic agents: they integrate, interpret, and evaluate incoming acts. From this perspective:

- **Localities bear epistemic responsibility** for the transparency of their emitted acts. When g selectively conceals functional semantics, this constitutes a form of semantic opacity analogous to misleading signaling in institutions or information systems.
- **Higher-level verifiers bear responsibility** for maintaining interpretive robustness. Purely structural verification creates predictable blind spots, shifting responsibility onto governance mechanisms.
- **Institutions or superordinate layers bear structural responsibility** for designing metamodels MM^+ that incorporate provenance, history, or timing when necessary.

Responsibility here is not moralized in a biological context but conceptual: if coherence is a valued norm, then system components must act in ways that support that norm.

10.2 Governance Mechanisms and Their Profiles

Different coherence-preserving mechanisms impose different costs and provide different levels of protection. Table 8 summarizes five principal mechanisms.

Mechanism	**Cost**	**Resistance to Parasitism**
Provenance tracking	low	high (institutions)
Historical continuity	medium	high (drift detection)
Semantic profiling	medium–high	high (chronic parasitism)
Synchrony constraints	medium (IT), high (biology)	high
Adaptive metamodels (MM^+)	high	maximal (long-term)

Table 8: Cost–effect evaluation of coherence-preserving mechanisms.

These mechanisms differ not only in implementation complexity but also in how they shape the behavior of localities and the interpretive burden on higher levels.

10.3 Normative Priorities and System-Level Tradeoffs

The system designer (or the higher-level locality acting as a governance agent) must balance several priorities:

1. **Accuracy vs. Efficiency**. Finer-grained coherence checks (semantic profiling, historical traceability) increase accuracy but also raise operational cost.
2. **Flexibility vs. Robustness**. Adaptive metamodels (MM^+ that evolve with the system) provide maximal long-term resistance but require stronger coordination and collective intentionality.
3. **Transparency vs. Autonomy**. Provenance and history impose transparency requirements that may restrict the autonomy of localities but drastically reduce the feasibility of oblique mappings.
4. **Synchrony vs. Local Optimization**. Synchrony constraints (as shown in Corollaries 5.4–**??**) suppress parasitism but limit asynchronous optimizations that may be useful in other contexts.

Thus, the choice of protective mechanisms is inherently normative: different systems may accept different tradeoffs depending on their goals, values, and resource limitations.

10.4 Governance as a Multi-Level Epistemic Structure

Viewed abstractly, hierarchical coherence requires a form of “epistemic governance” in which:

- localities function as information-producing agents,
- verifiers function as interpreters and regulators,
- the metamodel functions as a constitution or rulebook,
- and the system as a whole functions as a composite epistemic subject.

In this sense, preventing parasitism is not merely a technical task but a form of meta-level epistemic virtue: maintaining transparency, resisting deceptive regularities, and ensuring fidelity of inter-level meaning transmission.

11 Cross-Domain Analogies

Although the theory of parasitic localities is formulated at a high level of abstraction, similar architectural patterns arise in multiple real-world domains. These analogies are conceptual: they do not assert empirical mechanisms but illustrate how the structural logic of parasitism, oblique channels, and coherence failure can illuminate complex behavior across institutional, biological and computational systems.

11.1 Institutional Analogy

Institutions, in the sense developed by Searle and by List & Pettit, distinguish between constitutive rules (which determine valid institutional status) and regulative rules (which govern correct behavior). Within this framework, oblique mappings correspond to actors who emit representations that satisfy the syntactic form of institutional rules while violating their substantive intent. Examples include:

- structurally valid but substantively misleading financial or administrative reports;
- policy statements that follow procedure yet distort institutional goals;
- metric manipulation that meets formal requirements while subverting institutional functionality.

The locality implements an institutional mimicry function g that produces tokens acceptable under MM^+ while concealing incompatible functional semantics. Governance mechanisms such as audits, cross-department consistency checks, and temporal sequencing correspond to provenance, history and synchrony constraints in the formal model. The theory thus offers an abstract architecture for explaining institutional drift and breakdowns of collective intentionality.

11.2 Biological Analogy

Biological systems, though not the target of this study, provide a rich multi-level structure that mirrors the architecture of localities and higher-level verifiers. Cells act as localities emitting signals; tissues and organs act as verifiers interpreting those signals within spatial and temporal contexts. Developmental constraints serve as normative semantics.

A parasitic locality corresponds, at an abstract level, to a cellular subpopulation whose functional semantics diverges from tissue-level norms while maintaining superficially valid signaling patterns. Examples in the analogy include:

- signaling profiles that imitate wound-repair or stress-response cues;
- phase-coherent but semantically divergent behavior;
- selective modification of only those features scrutinized by the tissue-level metamodel.

Here, g encodes a mapping that preserves structural validity while deceiving higher-level constraints. Mechanisms analogous to provenance or synchrony (lineage markers, temporal coupling) can make certain forms of parasitism structurally impossible. The analogy remains conceptual and does not imply biological mechanisms.

11.3 Computational Analogy

Distributed computational systems provide perhaps the clearest illustration of parasitic localities in engineered settings. Microservices, agents or processes frequently communicate via constrained schemas—JSON structures, protocol buffers, typed message formats—constituting a metamodel MM^+ that higher layers use for verification.

A parasitic locality in this context is a component that preserves structural validity while manipulating semantic content. Realistic oblique mappings g appear naturally in several forms:

- **Schema-valid deception.** Messages remain syntactically valid while values are selectively remapped to admissible quantiles or threshold bands.
- **Phase-synchronous misreporting.** Timestamp or heartbeat coherence is preserved, but payload meaning diverges, analogous to the phase-synchronous g class discussed in §4.6.
- **Resource-rational metric shaping.** A service alters only the minimal subset of features needed to satisfy monitoring constraints, reflecting a cost-minimizing g.
- **Distributed drift.** A subgroup of components misreports collectively, maintaining internal consistency while misleading higher-level orchestrators.

Verification layers in distributed systems often check only structural constraints (schema validity, heartbeat timing, authentication tokens). This makes them susceptible to exactly the kind of parasitic bypass described in the formal theory.

Mechanisms such as cross-service provenance, historical profiling, multi-level semantic validation, and temporal–logical coupling correspond directly to the governance mechanisms discussed earlier. Thus, distributed computing systems offer a concrete manifestation of the structural insights of this article.

12 Future Work

The formal theory of parasitic localities developed in this work provides a substrate-independent description of a universal architectural failure mode. Several directions emerge for future investigation, spanning foundational theory, algorithmic implementation, simulation methodologies and domain-specific applications. This section outlines the most significant research avenues.

12.1 Detection of Parasitic Localities

The present study demonstrates existence conditions for parasitic localities but does not yet provide a general theory for their detection. Since parasitic localities exploit the equivalence classes induced by morphism compression, detection requires mechanisms that partially reconstruct or approximate hidden semantic information. Potential approaches include:

- **statistical divergence analysis**: detecting deviations in morphism distributions relative to expected semantic profiles;
- **temporal anomaly detection**: exploiting timing irregularities under synchronous architectures;
- **cross-level consistency checks**: verifying compatibility between sequences of morphisms and higher-level state transitions;
- **probabilistic profiling**: estimating semantic coherence from long-term regularities.

A general detection framework may require hybrid verifiers that combine structural, historical and probabilistic decision layers.[7], [14]

12.2 Anti-Parasitic Metamodels

The notion of an *anti-parasitic metamodel* emerges naturally from the corollaries. Such a metamodel would:

- encode provenance requirements directly into morphism structure,
- impose constraints on admissible temporal dynamics,
- include semantic invariants as part of the acceptance criteria,
- adaptively evolve to eliminate fixed oblique channels.

Developing explicit constructions of anti-parasitic metamodels represents a promising research direction, particularly for the design of resilient distributed systems and governance protocols.[2], [3], [14]

12.3 Dynamic Verifiers and Multi-Layer Coherence

The theory suggests investigating *dynamic verifiers* whose decision rules evolve over time in response to observed morphisms. Such verifiers could incorporate:

- reinforcement mechanisms informed by semantic coherence,
- model-based predictions of locality behavior,
- multi-layer verification in which several hierarchical levels jointly evaluate morphisms.

A dynamic verifier may reduce parasitic persistence by making the bypass mapping g increasingly unstable.

12.4 Computational Simulations

An important next step is constructing simulation environments in which parasitic localities can be systematically studied. These simulations could involve:

- discrete-state models inspired by FDB,
- agent-based systems with tunable metamodels,
- artificial life (ALife) environments with evolving localities,
- microservice emulators with controllable verification regimes.

Such simulations would allow experimental validation of the theoretical predictions concerning emergence, persistence and elimination of parasitic localities under various design constraints.[5], [9], [12]

12.5 Biological and Institutional Applications

Although this work treats biological and socio-institutional examples only at an architectural level, deeper investigations may explore:

- formal correspondences between architectural parasitism and known regulatory failure modes in biological systems;
- mappings between parasitic localities and organizational pathologies in institutional governance;
- novel diagnostic or predictive tools grounded in the formalism of FDB.

These applications require careful interdisciplinary collaboration to avoid overinterpretation while preserving rigor.[2], [6], [7]

12.6 Philosophical and Foundational Implications

From a foundational standpoint, parasitic localities highlight intrinsic limitations of hierarchical organization. Future work may study:

- the necessary and sufficient conditions for coherent multi-level semantics,
- the relation between local agency and global coherence,
- the computational and epistemic limits of structural verification,
- the role of synchrony and discrete time in sustaining system-wide coherence.

These questions relate to broader themes within the Philosophy of Discrete Being, including the nature of acts, the structure of interpretation and the architecture of discrete ontologies.[4], [13]

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