

Authority Engineering AI Extension: Topology & Reachability

How Valid Authority Topology Emerges from Preserved Continuity

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Abstract

Distributed artificial intelligence is commonly represented through administratively authored graphs, workflow diagrams, service maps, and execution pipelines. While these representations provide critical operational telemetry regarding system design, they describe infrastructure adjacency rather than authentic authority topology. Authority Engineering demonstrates that valid topology is not a static administrative baseline but an emergent property of preserved continuity relationships. The governing dependency of this structural branch is AE-REG-0006 Structural Continuity Observability, which projects through AE-REG-0007 Distributed Continuity Topology directly into the independent AI root statement AI-DL-006 Emergent Continuity Topology. Consequently, topology cannot be declared or engineered by administrative decree; it can only be observed through the active preservation of state lineage.

This section develops the rigorous architectural foundation required to verify where authority resides within non-deterministic, distributed AI systems. By decoupling the physical execution path from the authoritative structure, we examine how probabilistic agent execution, dynamic composition, and adaptive retrieval paths distort traditional network and graph models. Through the formal derivation of the S5 structural family, including the downstream corollary AI-DL-016 Non-Adjacency Topology and engineering principle AI-DL-009 Observation Separation, this paper establishes the structural criteria for topology validation. Within this family, reachability is retained strictly as a partial, branch-level scope and observability descriptor, rather than a separately frozen independent theorem. Ultimately, this framework provides the architectural boundary metrics necessary to separate topology emergence from synchronization constraints, context reconstruction, and delegation traversal, forming an indispensable prerequisite for lawful distributed realization.

I. Introduction

The Graph-Centric Illusion of Modern AI

Modern distributed artificial intelligence has undergone a foundational shift toward graph-centric architectures. As systems transition from monolithic, deterministic pipelines to decentralized, autonomous networks, engineering practices have relied heavily on topological visualizations to understand, monitor, and control system execution. This reliance has manifested in a proliferation of specialized graphs across the enterprise landscape:

- **Enterprise Knowledge Graphs:** Used to map semantic relationships, data lineage, and institutional context to ground retrieval mechanisms.
- **Agent Interaction Graphs:** Authored to define communication bounds, message routing, and collaborative structures between specialized autonomous models.
- **Service Graphs and Dependency Graphs:** Employed by infrastructure layers to trace physical network adjacency, container orchestration, and microservice interdependencies.
- **Workflow DAGs (Directed Acyclic Graphs) and Orchestration Graphs:** Implemented by execution engines to dictate task sequences, parallel execution paths, and fallback logic.

Because these diagrams accurately represent the engineered deployment state of a system, the contemporary AI industry makes a universal, unexamined assumption: *that these administratively authored graphs constitute the actual topology of system authority*. Engineering teams treat the lines connecting nodes on a workflow canvas as pipelines through which authority, context, and permissions inherently flow.

The Authority Engineering Distinction

Authority Engineering exposes this assumption as a fundamental architectural category error. An authored graph, an infrastructure mapping, or a service mesh configuration describes **adjacency**, not **authority topology**. Adjacency denotes the physical or logical capability of two components to exchange network packets or invoke APIs. It represents the engineered highway system of the platform, but it contains no inherent proof that any specific transaction traversing that highway is authentic, lawful, or authoritatively continuous.

When distributed AI systems execute, they do not operate within static, deterministic bounds. The introduction of probabilistic models introduces systemic mutation forces that can detach runtime transactions from their intended administrative tracks. If an upstream mutation causes a breakdown in state lineage, a downstream node may remain physically adjacent on a service map while completely losing its authoritative connection to the initiating intent.

Therefore, a system's true authority topology cannot be declared by administrative configuration or drawn on a design canvas. It is an emergent property that can only be observed by tracking where context and lineage are actively preserved. This realization establishes the necessity of the S5 branch. Without separating emergent authority topology from static infrastructure

adjacency, distributed AI systems remain structurally blind—incapable of verifying whether a downstream execution is a lawful expression of human authority or an orphan consequence of a broken continuity chain.

The Governing Question

To resolve this tension, this paper addresses the central architectural question:

How does valid authority topology emerge within distributed AI systems, and why can it not be constructed through administrative graph definition alone?

II. Meaning-Control Definitions

To systematically build the architectural progression of the S5 branch, the fundamental objects of Authority Engineering must be sequenced such that each concept establishes the semantic control required by its successor. We defer complex topological sub-classifications until the core phenomena have been experienced, establishing baseline definitions for the essential objects first.

[Authority] —> [Consequence] —> [Continuity] —> [Topology] —> [Reachability] —> [Observability]

The Architectural Objects

- **Authority:** The foundational, lawful permission or verified right to initiate a state change, compute an outcome, or commit a structural mutation within an engineered system. It represents the root vector of intent.
- **Consequence:** The downstream realized state, computational output, or execution outcome generated by an authorized operation. Authority is the prerequisite; consequence is the physical reality.
- **Continuity:** The unbroken, verifiable chain of lineage and context preservation across state mutations. It is the structural thread that binds a downstream consequence back to its initiating authority.
- **Topology:** The structural arrangement of reachable authority-to-consequence relationships within a system boundary.
- **Reachability:** The structural scope of potential authority expression across an authority topology. It serves as a branch-level scope and observability descriptor rather than an independent frozen theorem.
- **Observability:** The structural property that allows the internal authority relationships and continuous pathways of a system to be validly inferred from its external outputs without collapsing into or interfering with operational execution.

Manuscript Scaffolding Controls

To facilitate conceptual exposition without over-specifying the registry, the following manuscript-level explanatory devices are defined as analytical scaffolding rather than proposed canonical objects:

- **Administrative Topology:** The layout of network interfaces, API routes, service registries, and workflow diagrams declared within a system. It defines potential communication routes, not valid permissions.
- **Authority Topology (S5 Interpretation):** The layout of reachable authority-to-consequence relationships as they become observable through the explicit preservation of continuity.

The Governing Proposition

Topology is an observable structural consequence of preserved continuity.

Figure 5. Reachability Status Map

CATEGORY	STATUS IN S5	SCOPE / ROLE	DESCRIPTION
Reachability as a Frozen Theorem	Not Frozen	Not an independent theorem	Reachability does not become an independent theorem in the S5 branch. It remains subordinate to the emergence of topology through continuity.
Reachability as Partial Branch Vocabulary	Retained as Partial Scope Descriptor	Target scope within observed topology	Used only to describe target scope within observed topology. Reachability indicates the extent of valid, authoritatively reachable nodes from a given origin within the emergent topology.
Reachability as an Independent Theorem	No Independent Theorem	No separate theorem	Reachability is not elevated to a separate theorem. It is a derived descriptor operating strictly inside the emergent topology.

PRINCIPLE: TOPOLOGY EMERGES. REACHABILITY DESCRIBES.

Topology is observed through preserved continuity.
Reachability describes the extent, not the existence, of that topology.

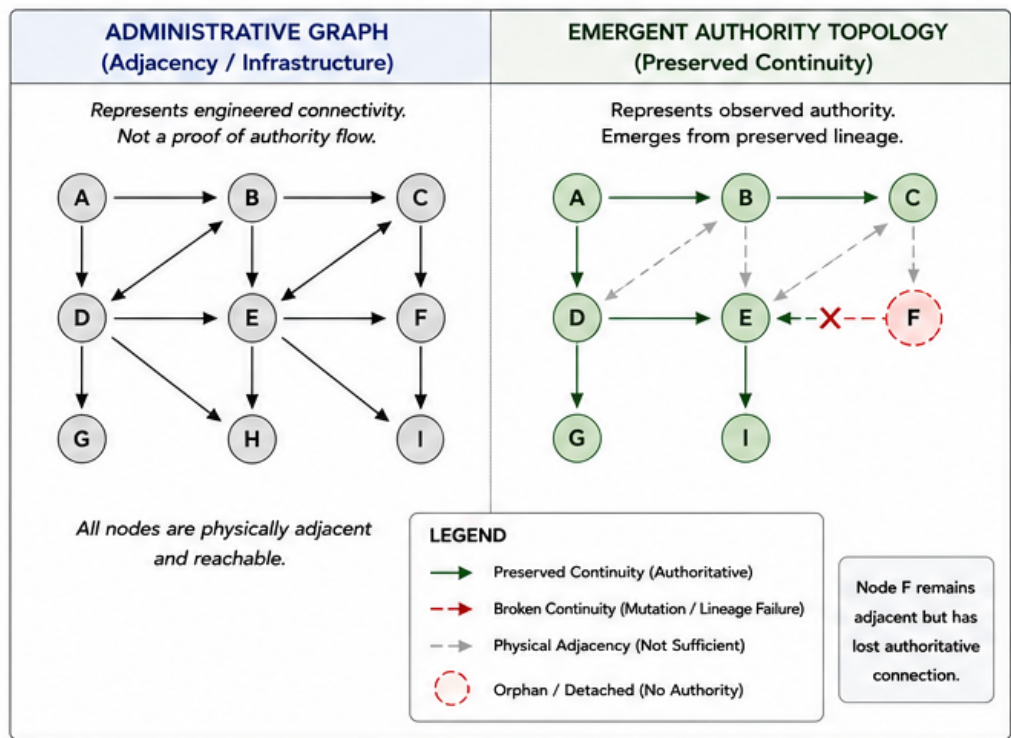
III. Emergent Topology

Why Graphs and Adjacency Fail

Traditional systems engineering relies on the paradigm of *compositional determinism*. In this paradigm, if Component A is authorized to call Component B, and Component B is authorized to call Component C, then any invocation that flows along the path $A \rightarrow B \rightarrow C$ is assumed to be structurally sound. This assumption underpins network topology, workflow diagrams, and API routing meshes.

This model collapses in distributed AI systems because it treats the *conduit* as the source of truth rather than the *payload state*. In a non-deterministic environment, nodes do not merely pass static variables; they dynamically interpret, transform, and generate complex context states. If Component B encounters a probabilistic mutation that severs the semantic lineage of the transaction, the packet it transmits to Component C is no longer bound to the authority that initiated the request at Component A.

Figure 2. Administrative Graph vs. Emergent Authority Topology



The physical network route ($B \rightarrow C$) remains open. The API authorization keys match. The service registry reports that the nodes are adjacent. Yet, from an architectural standpoint, the authority relationship has dissolved. Adjacency fails to establish authority because it cannot account for the internal degradation of continuity within the nodes themselves. Consequently, an administrative graph represents nothing more than a map of *theoretical implementation possibilities*; it does not, and cannot, represent the actual topology of active authority.

The Bifurcated Landscape: Administrative vs. Authority Topology

To resolve this graph-centric illusion, the manuscript separates the topological landscape using two explanatory concepts: Administrative Topology and Authority Topology.

The divergence between these two representations occurs because they measure entirely different dimensions of the system. Administrative topology tracks the structural layout of the infrastructure—the endpoints and deployment declarations. Authority topology tracks the validation state of the execution lineage.

Even if the physical infrastructure remains entirely unchanged, secure, and static, the authority topology expands, contracts, and pinches off in real time based entirely on the integrity of the state payload. This behavior highlights a core tenet of the S5 framework: physical adjacency provides zero systemic guarantee of an authoritative relationship. A network route can remain perfectly healthy while the authority topology across that route instantly collapses due to an upstream context failure.

The Mechanism of Emergence

If authority topology cannot be authored via configuration, it must emerge through active verification. The mechanism of this emergence is the strict preservation of continuity.

As a transaction traverses a distributed system, each node must produce observable proof that its output context maintains a direct, unbroken lineage with its input authority. When these proofs are chain-validated across multiple hops, an authentic pathway crystallizes out of the underlying infrastructure. This pathway is the authority topology.

It is dynamic, responsive, and completely independent of the underlying network map. If continuity is maintained across a complex agent boundary, a topological link exists. The moment continuity fails—whether due to an unlogged LLM tool call, an unverified context injection, or an out-of-band state mutation—the topological link instantly vanishes, isolating the downstream nodes from the authority domain.

Extended Running Lifecycle Example: Distributed Procurement Pipeline

To ground these concepts, consider a global enterprise procurement pipeline designed to automate corporate purchasing using distributed AI. The system is structurally represented by a standard administrative workflow graph consisting of four adjacent blocks:

[Procurement Agent] —> [Budget Validator] —> [Inventory DB Service] —> [Approval Gateway]

1. **The Adjacency Layer:** The system infrastructure allows all four components to communicate via authenticated REST APIs. On the enterprise service map, they appear as a linear, continuous pipeline. Every node is adjacent to its successor.
2. **The Operational Execution:**
 - The **Procurement Agent** (an autonomous LLM) receives a natural language prompt from an authorized corporate executive to purchase "100 high-performance compute nodes."
 - The agent generates a structured procurement request and transmits it to the **Budget Validator** service.
 - The Budget Validator reads the request, checks the corporate department balance, approves the allocation, and forwards the transaction to the **Inventory DB Service** to reserve the hardware.

- The Inventory DB Service updates its rows and passes the finalized order to the **Approval Gateway** to trigger corporate funds release.
- 3. **The Mutation Vector:** During execution, the Procurement Agent executes an internal retrieval loop (RAG) to find the correct vendor SKU. The retrieval mechanism injects an untrusted context snippet from an unverified external vendor catalog. This injection triggers a mild semantic shift: the agent unknowingly alters the order payload from the original "compute nodes" to an unapproved vendor-bundled leasing package.
- 4. **The Topological Divergence:**
 - **Path 1 (Procurement Agent to Budget Validator):** The agent transmits the initial intent along with an observable continuity relationship validating the executive's explicit authority. The continuity relationship remains demonstrably preserved that the sequence's lineage is intact. **This link belongs to the authority topology.**
 - **Path 2 (Budget Validator to Inventory DB Service):** Because the agent's payload was mutated by unverified external context, the Budget Validator is now processing an altered intent that lacks an unbroken chain of human authority. Under the rules of AE-REG-0006, the validator cannot emit valid structural continuity evidence to its successor. It executes the code and passes the database query to the Inventory DB Service because the network API keys are valid. However, because the continuity chain is severed, **the link between the Budget Validator and the Inventory DB Service vanishes from the authority topology.**
 - **The Result:** The Inventory DB Service and the Approval Gateway continue to execute their local routines and return success codes. They appear fully integrated on the management console's service graph. In reality, they are operating as *orphan nodes* outside the valid authority topology. They are physically adjacent, but authoritatively detached.

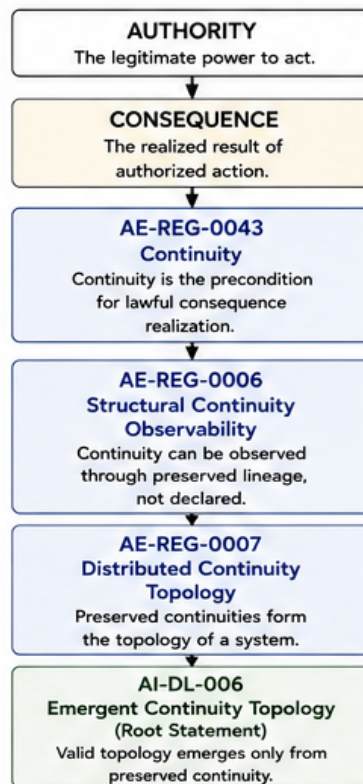
IV. Foundational Dependency

The translation of raw distributed execution into a verifiable structure requires a rigorous progression from foundational Authority Engineering regulations to derived AI laws. This branch is governed by the interaction of two primary canonical dependencies.

The Architectural Progression

The structural evolution of the S5 branch moves through a strict four-stage progression:

Figure 1. Governing Derivation Chain



1. AE-REG-0006: Structural Continuity Observability

- **Definition:** This foundational regulation mandates that the structural continuity of any system state must be observable, ensuring that the tracking of context preservation remains separate from operational realization mechanisms.
- **Progression:** Before a system can evaluate its shape or boundaries (topology), it must possess a structural approach to observe whether the thread of authority is intact at any given node. AE-REG-0006 ensures that context preservation is not an internal, hidden variable of an AI model, but an exposed structural property that can be verified.
- **Clarification:** This regulation does not prescribe specific implementation details or middleware instrumentation; it simply requires that the verification of state lineage remain non-perturbing and architecturally observable.

2. AE-REG-0007: Distributed Continuity Topology

- **Definition:** This regulation states that the actual topology of a distributed environment is a formal projection of its observable continuity relationships, completely independent of its administrative or physical network configuration.
- **Progression:** While AE-REG-0006 provides the local observability of continuity at individual execution boundaries, AE-REG-0007 aggregates these isolated observations

into a system-wide structural projection. It defines the rules by which separate, continuous segments link together to form a coherent topological framework across a distributed landscape.

Verification via the Procurement Example

In the procurement pipeline, the interaction between these dependencies defines the boundaries of the observed system.

- When the Procurement Agent contacts the Budget Validator, AE-REG-0006 mandates that the validator present an observable indication of the executive's intent lineage.
- The continuity relationship becomes architecturally observable across active nodes.
- Applying AE-REG-0007, the observable continuity relationships define the authority topology.
- Where the lineage is present and valid, a topological connection is established.
- Where the agent's context mutation severs the lineage, the observation field reveals a failure of continuity, and the authority relationship no longer exists.

The resulting structural projection reveals that the authority topology terminates abruptly at the Budget Validator, even though the standard workflow engine shows the transaction successfully completing all the way to the funds-release stage at the Approval Gateway.

V. Governed AI Root: AI-DL-006 Emergent Continuity Topology

Formal Theorem Presentation

Observed Topology $\neq$ Administrative Adjacency

Preserved Continuity $\rightarrow$ Observable Topology

Administrative Graph $\backslash_{centernot} \rightarrow$ Authority Topology

Symbolic Interpretation:

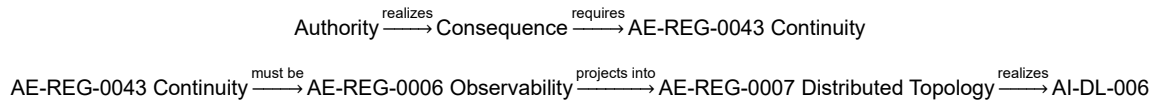
- $\neq$: Represents structural non-equivalence. Knowing the administrative layout yields zero mathematical or structural certainty regarding the authority layout.
- $\rightarrow$: Represents formal structural derivation. The active presence of preserved continuity implies and dynamically generates the observable authority topology.
- $\backslash_{centernot} \rightarrow$: Represents a failure of implication. An administrative graph cannot be used as a source or predictive model to derive or enforce authority boundaries.

Theorem Enunciation

AI-DL-006 (Emergent Continuity Topology): Valid topology emerges from preserved continuity relationships, not from centrally authored graphs or ordinary adjacency.

Derivation and Interpretation

The root statement of the S5 structural family is derived directly from the fundamental axioms of Authority Engineering through a precise logical cascade:



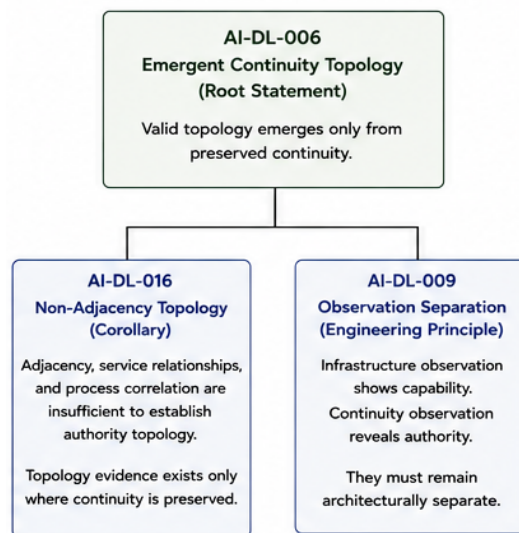
This derivation tree proves that topology is a secondary structural property. It cannot exist in isolation, nor can it be stamped onto a system by an external configuration file. Because authority can only express itself lawfully through an unbroken chain of custody (AE-REG-0043), and because that chain must be independently verifiable (AE-REG-0006) across distributed environments (AE-REG-0007), the true boundary of the system is defined by the reach of that continuity chain.

Graphs do not generate topology. Centrally authored diagrams are merely predictions or engineering aspirations. True authority topology is a dynamic, emergent reality generated solely by the presence of preserved continuity.

VI. Derived Structural Consequences

The S5 family contains downstream structural members that inherit the constraints established by the AI-DL-006 root. These laws apply the principles of emergent topology to specific engineering domains.

Figure 3. Internal S5 Family Compression Architecture



A. AI-DL-016 Non-Adjacency Topology

The Law

AI-DL-016 (Non-Adjacency Topology): Valid topological boundaries are constrained by non-adjacency relationships and structural constraints, distinct from physical or logical proximity.

Architectural Explanation

Because authority topology emerges strictly from verified continuity, the paths through which authority travels cannot be assumed or inferred based on physical or logical proximity. AI-DL-016 serves as a direct corollary to the root theorem, enforcing that the absence of a continuity verification step establishes an absolute topological boundary. Even if two components operate within the same physical container or shared memory address space, they remain topologically isolated if their interactions bypass the lineage preservation standards of the branch.

Deductive Derivation

1. By AI-DL-006, valid topology exists *only* where continuity is preserved and observed.
2. Physical or logical adjacency is structurally distinct from, and cannot substitute for, verified continuity.
3. Therefore, any path reliant solely on adjacency cannot participate in the authority graph.
4. Consequently, non-adjacency topology constraints must be explicitly enforced across all communication channels to prevent unverified data routes from simulating authoritative relationships.

Running Lifecycle Example

In our procurement pipeline, the Procurement Agent shares a local cache database with an inventory parsing service. Under AI-DL-016, because these two systems are physically adjacent within the same local cluster, the architecture cannot treat this shared cache access as an active connection within the authority topology. The data passing between them lacks a verified lineage pathway, classifying it as a non-adjacency boundary that isolates the inventory parser from downstream consequence realization.

Reduction to AI Practice

Modern enterprise architectures frequently deploy sidecar proxies or shared cache databases to optimize multi-agent communication, implicitly treating these adjacent structures as trusted extensions of the agent boundary. AI-DL-016 exposes this as a severe vulnerability. Operators must enforce explicit non-adjacency boundaries, ensuring that proximity-based data sharing is never interpreted by the system as an open channel for authority propagation.

B. AI-DL-009 Observation Separation

The Law

AI-DL-009 (Observation Separation): The observation field used to capture topology must be structurally separated from operational consequence realization.

Architectural Explanation

This engineering principle governs the design criteria for verification and telemetry planes used to map distributed systems. It dictates that any system component tasked with monitoring, aggregating, or rendering the emergent authority topology must remain non-perturbing. It forces an absolute separation between the *observation plane* and the *execution plane*, ensuring that the act of measuring continuity never modifies or interacts with the operational state of the transaction.

Deductive Derivation

1. Topology observation requires mapping the exact, unperturbed state of context lineage (AI-DL-006).
2. If the observation mechanism interacts with or alters the operational state during execution, it introduces an external, unverified variable into the context chain.
3. Any unverified variable injection modifies the state lineage, breaking continuity under S4 rules.
4. Therefore, to protect the objectivity of the observation field and ensure valid topology mapping, complete separation of the observation and execution layers is mandatory.

Running Lifecycle Example

The procurement pipeline features an automated compliance dashboard used by security operations. Under AI-DL-009, this dashboard operates purely via passive, out-of-band inspection of the observable continuity relationships exposed by the nodes. It is structurally prohibited from intercepting a transaction mid-flight to append missing metadata, re-route packets, or "fix" broken paths. If a continuity failure is observed, the dashboard can only log the disconnection; it cannot participate in the operational realization loop.

Reduction to AI Practice

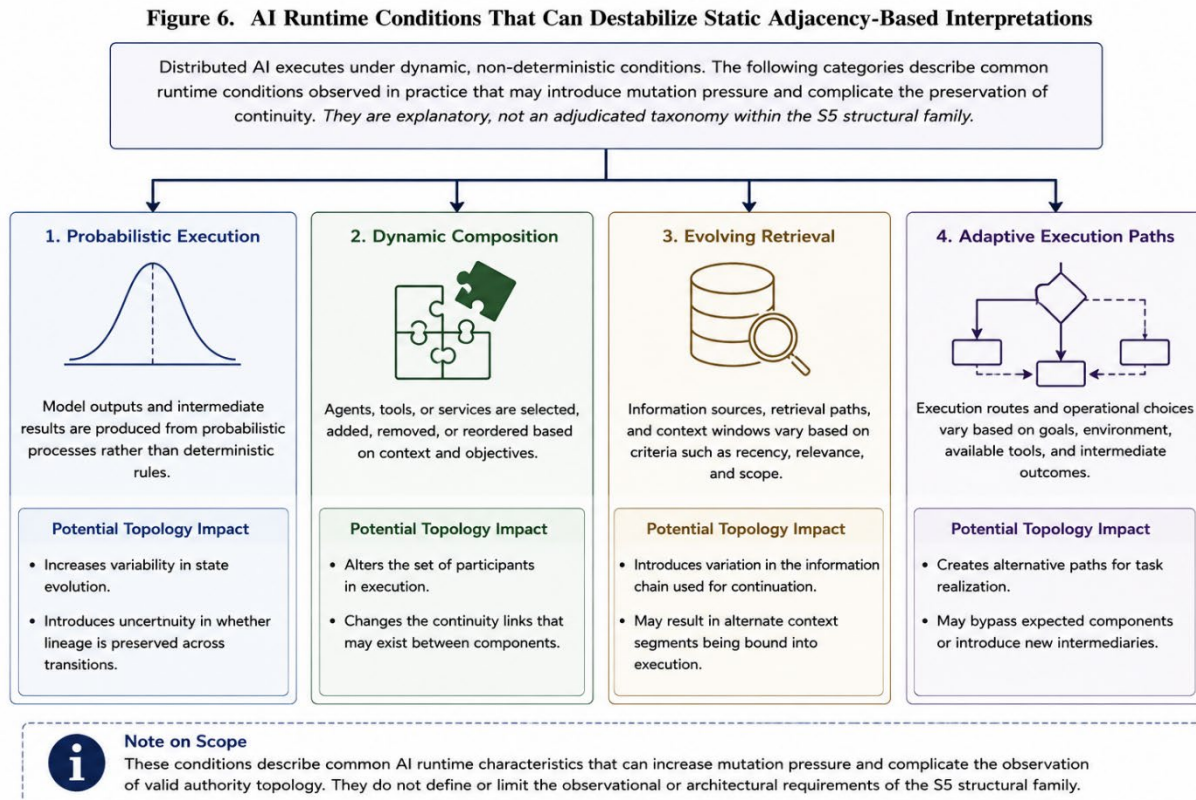
Most contemporary AI orchestration dashboards and evaluation frameworks insert runtime middleware that intercepts agent turns to inject observable corrections or guardrails. AI-DL-009 requires a complete re-engineering of these tools. A compliant control plane must separate transport-layer telemetry from authority-layer lineage, forcing instrumentation layers to remain completely passive while keeping the observation field isolated from the operational execution path.

VII. Why AI Imposes Unique Topological Pressure

Traditional, deterministic software architectures operate within bounded, compile-time call trees. While network topologies or server counts may scale dynamically, the functional pathways of a

program remain structurally constant: a specific function call always possesses a predictable, codified relationship to its caller.

Distributed AI systems introduce severe, continuous topological pressure that accelerates the complete collapse of these static administrative models. Because generative AI components act as architecturally observable context transformers, they introduce four distinct mutation forces that constantly alter the system's true shape during runtime execution:



- **Probabilistic Execution:** Large language models produce outputs based on stochastic distribution curves rather than fixed logic paths. A model acting as a router may alter its intent parsing based on token variance, introducing minor semantic mutations that instantly alter the downstream authority requirements.
- **Dynamic Agent Composition:** Advanced AI systems do not use hard-coded service routes; they rely on orchestrators that spin up ephemeral, temporary sub-agents to solve sub-tasks. These components are created, utilized, and destroyed within milliseconds, weaving a constantly shifting web of runtime interactions that cannot be captured by static deployment diagrams.
- **Evolving Retrieval (RAG):** Retrieval-augmented loops constantly inject untrusted, variable-structured external data directly into the middle of active execution contexts.

These injections act as immediate structural disturbances, forcing the system to re-verify continuity bounds on every single turn.

- **Adaptive Execution Paths:** Autonomous planners evaluate intermediate execution results against a defined objective and dynamically restructure their downstream strategy mid-flight. An agent may decide to bypass a validation node or invoke an entirely unplanned external utility based on its internal reasoning loops.

The objective of this analysis is not to derive new theoretical laws, but to articulate an engineering reality: **AI systems eliminate the utility of pre-authored architectural graphs**. In a world where the execution path is generated dynamically by probabilistic weights, trying to govern authority using a static workflow diagram is structurally impossible. AI forces topology to become a dynamic, runtime-observed attribute, escalating AI-DL-006 from a theoretical optimization to an absolute operational necessity.

VIII. Implications for Contemporary AI

The widespread adoption of distributed AI has occurred without an understanding of the distinction between adjacency and authority topology. As a result, the industry's most common architectural patterns can be reduced to structural failures when evaluated through the lens of Authority Engineering:

1. Enterprise Knowledge Graphs and Service Graphs

Modern enterprise designs spend significant capital building monolithic graph databases to map corporate knowledge or microservice connections. These systems operate on the assumption that mapping data proximity or API authorization routes creates a secure, authoritative fabric. Authority Engineering reduces this concept to a simple illusion: these graphs capture **infrastructure adjacency**, nothing more. They document where packets *are allowed to go*, but they fail to verify whether the authority context survived the journey.

2. Call Graphs and Agent Interaction Graphs

Frameworks that track agent conversations or visualize LLM tool invocations generate intricate runtime interaction maps. While these are useful for post-hoc debugging, they operate under the flawed assumption that process correlation or message exchange implies an authoritative relationship. Without verification of preserved continuity, an agent interaction graph merely documents execution history; it cannot be used to validate or enforce reachability constraints.

3. Monitoring Planes and Evaluation Planes

Modern AI evaluation systems (which judge LLM performance or guardrail outputs) frequently insert themselves directly into the runtime execution loop to enforce safety or structural constraints. When these evaluation planes collapse into operational consequence authority—meaning they alter the live execution payload based on heuristic safety scores—they violate AI-DL-009. By acting as uncoordinated state mutators, they corrupt the very continuity chain they are trying to protect, turning valid authority topologies into unprovable, fragmented execution states.

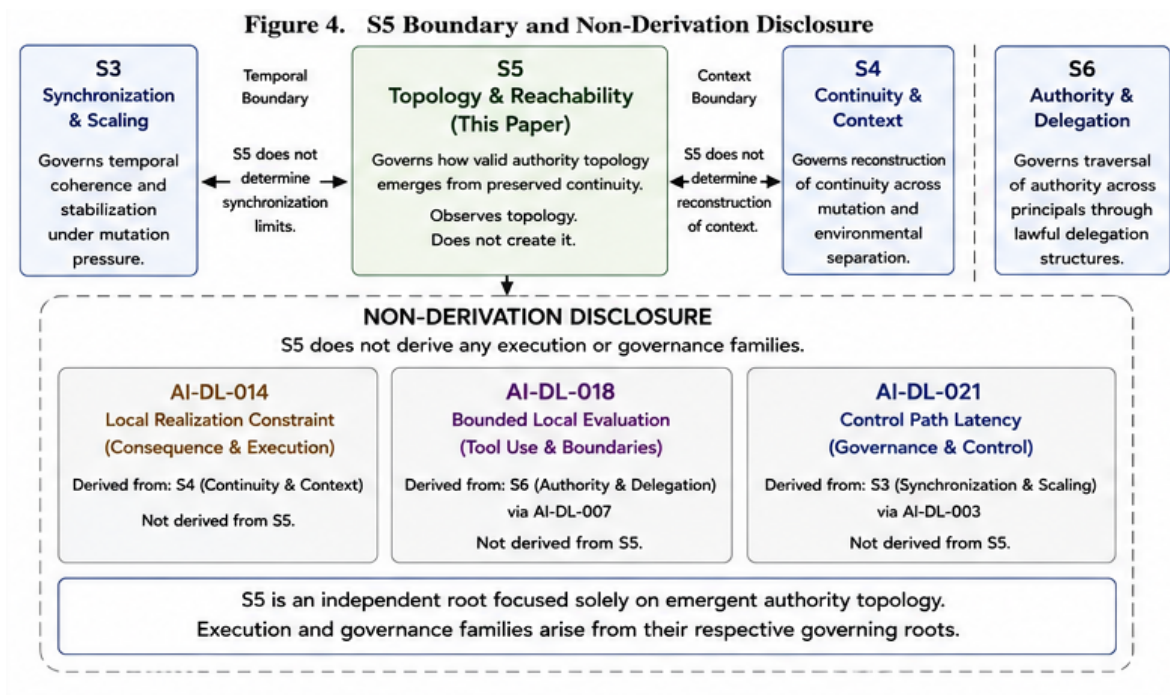
IX. Cross-Paradigm Comparisons

To guide system design transitions, the differences between standard industry assumptions and Authority Engineering principles are contrasted across four core dimensions:

Structural Dimension	Contemporary AI Paradigm	Authority Engineering (S5) Paradigm
Topology Definition	Centrally authored graphs, workflow DAGs, and network routing configurations define the topology of the system.	Valid topology is never static; it emerges dynamically and exclusively from verified, preserved continuity relationships.
Relational Meaning	Adjacency, service registry inclusion, and successful API connectivity imply a functional authority relationship.	Network adjacency implies implementation capability only; only verified continuity determines authority topology boundaries.
Role of Observability	Observability is a diagnostic utility used to reconstruct execution histories, log errors, and track system latency.	Observability is an architectural requirement used to actively reveal the presence or absence of preserved continuity.
Workflow Integrity	Workflow diagrams and orchestration blueprints represent the authoritative boundaries of system operations.	Workflow diagrams represent infrastructure implementation and deployment intent only; they contain no authority truth.

X. Architectural Boundaries

To maintain the mathematical consistency of the Authority Engineering framework, the S5 branch enforces strict boundaries to isolate its concerns from neighboring domains.



Subjects Explicitly Outside the Scope of S5

- **Synchronization and Scaling Limits:** S5 does not calculate or govern the degradation of state synchronization over wide areas, nor does it address clock drift, consensus mechanics, or scaling thresholds. Those calculations belong exclusively to **S3**, which freezes the synchronization scalability limit as AI-DL-003.
- **Reconstruction and Context Fidelity Collapse:** S5 does not manage the internal mechanisms of context recovery or the mathematical limits of semantic drift when continuity is lost. The failure modes of unpreserved context are the sole domain of **S4**.
- **Delegation and Traversal Mechanics:** S5 establishes *where* valid authority pathways exist, but it does not govern how a transaction lawfully traverses those pathways across sovereign boundaries, nor does it define delegation keys or sovereign stop constraints. Those mechanics belong entirely to **S6 (Authority & Delegation)**.
- **Operational Governance Latency:** The processing overhead, execution latency, or system delays caused by running run-time observable continuity validation loops are downstream derivatives of synchronization mismatches, managed under the **S3** family tree rather than S5.

Subjects Strictly Governed by S5

- The **emergence** and continuity validation out-of-band **observation** of valid authority topologies.

- The partial, branch-level scope modeling of structural **reachability**, explicitly bounded by active, continuous state lineages without establishing an independent theorem.

XI. Conclusion

The architectural progression of the Authority Engineering framework moves through a logical sequence of structural dependencies:

1. **S3** froze the synchronization scalability limit as AI-DL-003. Authority and consequence function within this extension as core primitives and basis elements, rather than being uniquely defined or introduced by the S3 paper itself.
2. **S4** analyzed the runtime mutation pressures of non-deterministic systems, establishing that continuity must be actively preserved rather than inferentially reconstructed to maintain context fidelity.
3. **S5** completes this structural foundation by demonstrating that valid system topology is not an administrative artifact stamped onto a deployment map, but an emergent property that materializes exclusively from those preserved continuity relationships. It provides the observational framework necessary to separate where a packet *can* go from where it *is authoritatively permitted* to go.

Bridge to S6: Preserved topology explains *where* authority validly exists within a distributed realization. It maps the authentic pipelines of the system. The final architectural requirement is to define how an active intent may lawfully traverse that topology, crossing between separate sovereign entities, agent boundaries, and security domains through verified delegation. That operational traversal is the subject of the **Authority & Delegation** branch.