THE ZERO PARADOX

ZP-H: Categorical Bridge

Version 1.1 | April 2026

Supersedes v1.0 | AX-1 status updated: Derived as T-SNAP (ZP-E v2.0) | Import Registry updated to ZP-G v1.1 | OQ-G1 closed in ZP-G v1.1

This document connects ZP-G (Category Theory) to ZP-A through ZP-E. Its function is exactly analogous to ZP-E's role in the original framework: ZP-E connected the four domain documents to each other; ZP-H connects the categorical generalization back to those four domain documents. Every cross-framework claim is traced to a theorem in ZP-G or ZP-A through ZP-E, plus an explicit bridge axiom where required. No floating connections.

ZP-H cannot be written until ZP-G is internally closed. ZP-G v1.1 is closed. ZP-H inherits all open items from ZP-G with their original labels. The four open questions from ZP-G — OQ-G1 through OQ-G4 — are the primary targets of this document. OQ-G2, OQ-G3, and OQ-G4 are resolved here. OQ-G1 is resolved in ZP-G v1.1 via D7' and I-KC. All four OQ-G items are now closed.

Sequencing note: ZP-H introduces one new definition (D-H1: the morphisms of C) that was deliberately omitted from ZP-G to keep that document domain-independent. This definition belongs here because it is instantiation-specific: the morphisms of C are defined by what the functor constructions require, not by the abstract category itself.

Version 1.1 changes: (1) AX-1 (Binary Snap Causality) is no longer an axiom — it is Theorem T-SNAP, derived in ZP-E v2.0 via the P_0 / L-RUN / TQ-IH / DA-1 chain. All references to AX-1 as an axiom are updated to T-SNAP (Derived). (2) Import Registry updated from ZP-G v1.0 to ZP-G v1.1: BA-G1 is now a compatibility remark, not a bridge axiom premise. (3) OQ-G1 status updated: closed in ZP-G v1.1.

I. Imported Results

1.1 From ZP-G

Import Registry IR-G — Closed Results from ZP-G v1.1
Status: Valid — Received
D1: Category (objects, morphisms, composition, identity, associativity, unit laws)
D2: Morphism uniqueness notation (∃!)
D3: Initial object 0 — unique morphism ι_X: 0 → X for all X

Import Registry IR-G — Closed Results from ZP-G v1.1
D4: Terminal object — defined for exclusion only
D5: Morphism chain from 0
D6: Functor — object map, morphism map, preservation of composition and identity
D7': Native categorical surprisal $I(f) = K(x_B \| x_A)$ via I-KC (replaces D7/BA-G1 from v1.0)
I-KC: Conditional Kolmogorov complexity $K(x \| y)$ imported from ZP-C — named dependency, not bridge axiom
AX-G1: Asymmetry Axiom — C has initial object 0, no terminal object
AX-G2: Source Asymmetry — $\hom(X, 0) = \varnothing$ for $X \neq 0$
R-BA: Leinster categorical entropy characterization [Compatibility Remark — BA-G1 demoted from Bridge Axiom in ZP-G v1.1. No longer a theorem premise.]
T1: Initial object unique up to unique isomorphism
T2: Universal Constituent — $\forall X \in ob(C), \exists! \iota_X: 0 \to X$
T3: Unreachability — $\hom(X, 0) = \varnothing$ for $X \neq 0$
T4: Chains are forward-only — no chain returns to 0
T5: Functors preserve initial objects [OQ-G2 closed in ZP-H T-H1]
T6: Informational singularity of 0 — outward surprisal accumulates; inward undefined [rebuilt in ZP-G v1.1 on D7'; BA-G1 not a dependency]
T7: Categorical Zero Paradox — closing theorem of ZP-G
OQ-G1: Closed in ZP-G v1.1 via D7' (native categorical surprisal) and I-KC (Kolmogorov import from ZP-C). BA-G1 demoted to compatibility remark.

1.2 From ZP-A through ZP-E

Import Registry IR-ZP — Closed Results from ZP-A through ZP-E
Status: Valid — Received
From ZP-A: Join-semilattice $(L, \vee, \bot)$. $\bot$ is the unique additive identity. $\bot \leq x$ for all $x \in L$ (T2). State sequences are monotone (T3). No subtraction operator.
From ZP-B: Q_2 with ultrametric d. AX-B1 (binary existence). MP-1 (minimality principle). $p = 2$ derived (T0). Every ball is clopen (T2). Q_2 totally disconnected (T5). Topological isolation of 0 (T3). Snap irreversibility (C3).

Import Registry IR-ZP — Closed Results from ZP-A through ZP-E

From ZP-C: Incompressibility threshold P_0 (D1). RP-1 (representation principle). State representations derived from AX-B1 (T1). JSD = 1 bit (T1b). Discrete surprisal operator DF (D5, D6). Non-conservatism of DF on infinite sequences approaching 0 (T2). L-RUN (execution is non-null state change). TQ-IH (no program outputs ⊥ without non-null intermediate state). T-BUF / T-SNAP: Binary Snap derived as theorem.

From ZP-D: $H = \mathbb{C}^n$ (D1). $T: Q_2 \to H$ constructed by basis assignment (T2). T unique up to unitary equivalence (T3). Snap produces orthogonal shift (T4). Monotone sequences map to accumulating vectors (T5). DP-1 (orthogonality design commitment).

From ZP-E: Universal constituent cross-framework (T1). Hamming/JSD consistency (T2). Landauer bridge BA-1. Processing bounds T3. Unified Snap description T4. Iterative forcing T5. State representations T6. Zero Paradox T7. T-SNAP: Binary Snap is a derived theorem — AX-1 is not an axiom.

Inherited Labels Registry IR-2 — Open Items Carried into ZP-H

Status: Structural — labels preserved without laundering

OQ-G1 [Closed in ZP-G v1.1]: Native derivation of categorical surprisal without importing Shannon entropy. Closed by D7' (conditional Kolmogorov complexity K(B|A)) and I-KC. BA-G1 demoted to compatibility remark R-BA.

OQ-G2 [Resolved in Section IV]: Left adjoint verification for instantiation functors.

OQ-G3 [Resolved in Section III]: Explicit construction of four instantiation functors.

OQ-G4 [Resolved in Section V]: Reconciliation of categorical and ZP-C singularity characterizations.

II. The Morphisms of C — New Definition

ZP-G defined C abstractly: objects, morphisms, composition, identity, satisfying the category axioms plus AX-G1 and AX-G2. The morphisms of C were left unspecified because the abstract results (T1 through T7) require only the categorical axioms, not a concrete description of what morphisms are. That abstraction was correct for ZP-G.

ZP-H requires concreteness. To construct the instantiation functors, we must specify what morphisms of C are, so that we can say what the functor maps them to. That specification belongs here, not in ZP-G.

Definition D-H1 — Morphisms of C — State Transitions

Status: Definition — instantiation-specific

A morphism $f: A \to B$ in C is a state transition: a structure-preserving map from state A to state B satisfying:

Definition D-H1 — Morphisms of C — State Transitions
(i) Forward direction: Every morphism f: A → B represents a net addition of informational content. No morphism reduces state.
(ii) Compatibility with AX-G2: For any non-initial object X ≠ 0, no morphism X → 0 exists. D-H1(i) and AX-G2 are consistent: a net-additive transition cannot return to the minimal state 0.
(iii) Composition: Composition of morphisms corresponds to sequential state accumulation. f: A → B followed by g: B → C produces a state at least as large as B.
Status note: D-H1 is a design commitment, not a derivation. It is the choice that makes the instantiation functors well-defined. A different choice of morphism structure would yield different functors. D-H1 is the choice that maps correctly to all four ZP domain documents.

III. Construction of the Instantiation Functors [OQ-G3 Closed]

ZP-G Remark R3 claimed the existence of four functors F_A, F_B, F_C, F_D without constructing them. This section constructs all four. Each construction must specify the object map, the morphism map, and verify preservation of composition and identity. Each must also show that AX-G1 and AX-G2 are respected.

3.1 F_A: C → SLat (Join-Semilattices)

Construction C-H1 — Functor F_A: C → SLat
Status: Derived — OQ-G3 partially closed
Object map: F_A sends each object X ∈ ob(C) to the state S_X ∈ L in the join-semilattice (L, ∨, ⊥) of ZP-A. The initial object 0 maps to ⊥: $F_A(0) = \bot$.
Morphism map: F_A sends each morphism f: A → B to the join operation that witnesses the transition: $F_A(f) = (S_A \vee \alpha)$ for some α ∈ L such that $S_A \vee \alpha = S_B$. By ZP-A D2, every valid state transition is a join.
Preservation of composition: For f: A → B and g: B → C, $F_A(g \circ f) = S_A \vee \alpha_f \vee \alpha_g = F_A(g) \circ F_A(f)$ by associativity of ∨ (ZP-A A1). ✓
Preservation of identity: $F_A(id_A) = S_A \vee \bot = S_A$ by ZP-A A4 (additive identity). ✓
AX-G1 respected: $F_A(0) = \bot$ is the global minimum of L (ZP-A T2). No element of SLat is a terminal object because L has no top element ⊤ (ZP-A R1). ✓
AX-G2 respected: No join operation in L can return to ⊥ from a strictly larger state (ZP-A T3, monotonicity). Therefore F_A sends no non-initial morphism to a map terminating at ⊥. ✓

3.2 F_B: C → pTop (p-Adic Topological Spaces)

Construction C-H2 — Functor Fʙ: C → pTop
Status: Derived — OQ-G3 partially closed
Object map: F_B sends each object X ∈ ob(C) to an element x ∈ Q_2. The initial object 0 maps to the element 0 ∈ Q_2: $F_B(0) = 0 \in Q_2$.
Morphism map: F_B sends each morphism f: A → B to the discrete jump from x_A to x_B in Q_2. By ZP-B T2, any two distinct elements of Q_2 lie in disjoint clopen balls. The jump is across a clopen boundary — a well-defined topological transition.
Preservation of composition: Sequential discrete jumps in Q_2 compose by transitivity of the ball structure. $x_A \to x_B \to x_C$ is a valid sequence of clopen transitions. ✓
Preservation of identity: $F_B(id_A)$ is the trivial jump $x_A \to x_A$, which is the identity on Q_2. ✓
AX-G1 respected: $F_B(0) = 0 \in Q_2$ is topologically isolated (ZP-B T3). No terminal object exists in pTop because Q_2 is totally disconnected (ZP-B T5) — there is no single element to which all paths converge. ✓
AX-G2 respected: ZP-B C3 establishes that no continuous path in Q_2 returns to 0 from any non-zero element. F_B maps no non-initial morphism to a transition terminating at 0 ∈ Q_2. ✓

3.3 F_C: C → InfoSp (Information-Theoretic Spaces)

Construction C-H3 — Functor FC: C → InfoSp
Status: Derived — OQ-G3 partially closed
Object map: F_C sends each object X ∈ ob(C) to a probability distribution P_X over {0, 1}. The initial object 0 maps to the Null State distribution: $F_C(0)$ = P = (1, 0) (derived from AX-B1 and RP-1 in ZP-C T1).
Morphism map: F_C sends each morphism f: A → B to the informational transition from P_A to P_B, with informational work E = JSD(P_A ‖ P_B) ≥ 0. The fundamental transition (0 → first non-initial object) maps to JSD(P ‖ Q) = 1 bit (ZP-C T1b).
Preservation of composition: In the binary framework (Fin 2), only two non-trivial distributions exist: P = (1, 0) and Q = (0, 1). The snap f: 0 → ε_0 is the unique morphism mapping P → Q at cost JSD(P ‖ Q) = 1 bit. All successor morphisms g: $\varepsilon_n \to \varepsilon_{n+1}$ map Q → Q (Q-stability of the post-snap codomain), giving $F_C(g)$ = JSD(Q ‖ Q) = 0. Therefore $F_C(g \circ f)$ = 1 bit = $F_C(g) + F_C(f)$ = 0 + 1 bit. Composition is preserved exactly by Q-stability, not by subadditivity. (Note: JSD subadditivity is an inequality and does not establish this — the equality holds here as a structural consequence of the binary framework.) ✓
Preservation of identity: $F_C(id_A)$ = JSD(P_A ‖ P_A) = 0. No informational work is done by a trivial transition. ✓

Construction C-H3 — Functor FC: C → InfoSp
AX-G1 respected: The Null State P = (1, 0) is the unique distribution of minimum entropy (H(P) = 0 bits). No terminal object exists in InfoSp because there is no maximum entropy distribution that all transitions converge to — entropy is unbounded upward over larger alphabets. ✓
AX-G2 respected: JSD ≥ 0. A transition returning to P = (1, 0) from any Q ≠ P would require JSD(Q ‖ P) = 0, which holds only if Q = P. Since Q ≠ P by assumption, no such transition exists. ✓
Inherited label: The distributions P = (1, 0) and Q = (0, 1) are derived from AX-B1 and RP-1 (ZP-C T1, ZP-E T6). All results depending on F_C inherit the AX-B1 and RP-1 labels.

3.4 F_D: C → Hilb (Hilbert Spaces)

Construction C-H4 — Functor FĐ: C → Hilb
Status: Derived — OQ-G3 partially closed
Object map: F_D sends each object X ∈ ob(C) to a state vector T(x) ∈ H = $\mathbb{C}^n$ via the transition operator T: Q_2 → H constructed in ZP-D (T2). The initial object 0 maps to: $F_D(0) = T(0) = e_0$.
Morphism map: F_D sends each morphism f: A → B to the orthogonal extension from $T(x_A)$ to $T(x_B)$ in H. By ZP-D T4, distinct elements of Q_2 map to orthogonal basis vectors under T, so the transition is a well-defined orthogonal step in H.
Preservation of composition: Sequential orthogonal extensions compose by accumulation: $T(x_A) \to T(x_B) \to T(x_C)$ produces $\|T(x_C)\| \geq \|T(x_B)\| \geq \|T(x_A)\|$ by ZP-D T5. ✓
Preservation of identity: $F_D(id_A)$ maps to the trivial orthogonal extension $T(x_A) \to T(x_A)$, which is the identity on the basis vector e_k. ✓
AX-G1 respected: $F_D(0) = e_0$ is the anchor vector from which all other state vectors are orthogonal extensions (ZP-D T3). No terminal object exists in Hilb under this construction because the orthogonal extension sequence is unbounded in norm (ZP-D T5). ✓
AX-G2 respected: ZP-D T4 establishes that the Snap produces an orthogonal shift that cannot be reversed without violating the additive ontology (ZP-A R1). No orthogonal extension terminates back at e_0 from a non-initial vector. ✓
Design commitment inherited: DP-1 (orthogonality as representation of topological isolation) is a design commitment in ZP-D v1.2. F_D inherits this label. T4 and T5 of ZP-D depend on DP-1 as a premise.

IV. Left Adjoint Verification [OQ-G2 Closed]

ZP-G T5 stated that functors preserve initial objects, but marked it conditional on OQ-G2: verifying that the instantiation functors are left adjoints (or otherwise preserve the universal property of 0 fully, not just for objects in their image). This section closes OQ-G2.

Theorem T-H1 — Each Instantiation Functor Preserves the Initial Object
Status: Derived — OQ-G2 closed
Claim: For each functor $F \in \{F_A, F_B, F_C, F_D\}$, F(0) is an initial object in the codomain category.
Strategy: Rather than proving each functor is a left adjoint in full generality (which would require establishing adjoint pairs for SLat, pTop, InfoSp, and Hilb), we verify the universal property directly for each functor. The universal property of the initial object requires: for every object Y in the codomain, ∃! morphism $F(0) \to Y$.
F_A: $F_A(0) = \bot$. For any $S_Y \in L$, the unique morphism $\bot \to S_Y$ is the join $\bot \vee S_Y = S_Y$ (ZP-A A4). Uniqueness: ⊥ is the global minimum (ZP-A T2), so the only order-preserving map from ⊥ to S_Y is the join with S_Y. ✓
F_B: $F_B(0) = 0 \in Q_2$. For any $x \in Q_2$, the unique morphism $0 \to x$ is the discrete jump from 0 to x across the clopen boundary. Uniqueness: 0 is topologically isolated (ZP-B T3); the only clopen-respecting transition from 0 to x is the direct jump. ✓
F_C: $F_C(0) = P = (1, 0)$. For any distribution P_Y, the unique morphism $P \to P_Y$ is the informational transition with work $E = JSD(P \parallel P_Y)$. Uniqueness: JSD is symmetric and uniquely determined by P and P_Y; there is exactly one value of informational work for any pair of distributions. ✓
F_D: $F_D(0) = T(0) = e_0$. For any $T(x) \in H$, the unique morphism $e_0 \to T(x)$ is the orthogonal extension from e_0 to e_k (the basis vector assigned to x). Uniqueness: T is unique up to unitary equivalence (ZP-D T3); the orthogonal extension is unique up to the same equivalence. ✓
Conclusion: OQ-G2 is closed. ZP-G T5 is now unconditional for the four instantiation functors of this framework. The universal property of $0 \in ob(C)$ is fully preserved under F_A, F_B, F_C, and F_D. ✓

V. Singularity Reconciliation [OQ-G4 Closed]

ZP-G T6 characterized the informational singularity of 0 as an undefined domain: the categorical surprisal $I(X \to 0)$ is undefined because no such morphism exists. ZP-C established the singularity as infinite accumulation: the discrete surprisal DF diverges along infinite sequences approaching 0 in Q_2. ZP-G R4 claimed these are compatible but did not prove it. This section closes OQ-G4.

Theorem T-H2 — Compatibility of Singularity Characterizations
Status: Derived — OQ-G4 closed
Claim: The categorical singularity (undefined domain, ZP-G T6) and the ZP-C singularity (infinite accumulation, ZP-C T2) are compatible characterizations of the same structural fact under the functor F_C.
Setup: Let $\{X_n\}$ be a sequence of objects in C such that the corresponding sequence $\{F_C(X_n)\} = \{P_n\}$ in InfoSp approaches $F_C(0) = P = (1, 0)$ in distribution. Under F_B, the corresponding sequence $\{x_n\}$ in Q_2 approaches $0 \in Q_2$.

Theorem T-H2 — Compatibility of Singularity Characterizations
ZP-C side: By ZP-C T2, the discrete surprisal DF along the infinite sequence $\{x_n\}$ approaching 0 in Q_2 is non-conservative: the accumulated surprisal $\sum DF(x_k \to x_{k+1})$ diverges as $n \to \infty$. The singularity is infinite accumulation.
ZP-G side: By ZP-G T6(ii), $I(X \to 0)$ is undefined for all $X \neq 0$ because $\hom(X, 0) = \varnothing$ (AX-G2). The singularity is undefined domain.
Reconciliation: These are two descriptions of the same obstruction from different vantage points. In ZP-C, we ask: what happens to surprisal as we approach 0 along an infinite sequence? The answer is divergence — the accumulation is unbounded. In ZP-G, we ask: can we reach 0 by a morphism from outside? The answer is no — the morphism does not exist. Divergence and non-existence are consistent: if the accumulation required to reach 0 is infinite, then no finite morphism can accomplish it, which is exactly the statement $\hom(X, 0) = \varnothing$. The undefined-domain condition in ZP-G is the categorical expression of the infinite-accumulation condition in ZP-C. ✓
Precise statement: Under F_C, the statement $\hom(X, 0) = \varnothing$ in C corresponds to the statement that no finite informational path from P_X to $P = (1, 0)$ has finite total surprisal — which is exactly the content of ZP-C T2 restricted to finite paths. OQ-G4 is closed. ✓

VI. The Binary Snap — Categorical Description

Theorem T-H3 — The Binary Snap Under All Four Functors
Status: Derived — Cross-Framework
Setup: The Binary Snap is the transition from $0 \in ob(C)$ to the first non-initial object $\varepsilon_0 \in ob(C)$, driven by the incompressibility threshold P_0 (ZP-C D1) under T-SNAP (Binary Snap — Derived Theorem, ZP-E v2.0).
In C (ZP-G): The Snap is the morphism $\iota_{\varepsilon 0}: 0 \to \varepsilon_0$. By D3, this morphism is unique. By T4, no chain returns from ε_0 to 0. The Snap is categorically irreversible.
Under F_A (ZP-A): $F_A(\iota_{\varepsilon 0}) = \bot \vee \varepsilon_0 = S_1$. The Snap is the first join. Monotone and irreversible by ZP-A T3. T-SNAP is a derived theorem (ZP-E v2.0); inherited here with derived status.
Under F_B (ZP-B): $F_B(\iota_{\varepsilon 0})$ is the discrete jump $0 \to \varepsilon_0 \in Q_2$ across a clopen boundary (ZP-B T2). Topologically irreversible by ZP-B C3.
Under F_C (ZP-C): $F_C(\iota_{\varepsilon 0})$ is the informational transition $P \to Q$ with $E = JSD(P \parallel Q) = 1$ bit (ZP-C T1b). Irreversible: $JSD(Q \parallel P) = 1$ bit $\neq 0$.
Under F_D (ZP-D): $F_D(\iota_{\varepsilon 0})$ is the orthogonal shift $T(0) = e_0 \to T(\varepsilon_0) = e_1$. $\langle e_0, e_1 \rangle = 0$ (ZP-D T4). Norm-increasing (ZP-D T5). DP-1 is a design premise.

Theorem T-H3 — The Binary Snap Under All Four Functors

Cross-framework consistency: All four functors agree that the Snap is irreversible. Each irreversibility result is a closed theorem within its own domain document. Their agreement is structural consistency, not circular argument. T-SNAP (Binary Snap Causality) is a derived theorem in ZP-E v2.0 and is inherited here with derived status. DP-1 remains the only design premise. ✓

VII. Full Traceability Register

Every cross-framework claim in ZP-H is traced here to its grounding theorem and any required bridge axiom.

Claim	Grounded In	Bridge Axiom?	Status
$F_A(0) = \bot$	ZP-A T2; C-H1	None	Valid — Derived
F_A preserves composition	ZP-A A1; C-H1	None	Valid — Derived
F_A respects AX-G1, AX-G2	ZP-A T2, T3, R1; C-H1	None	Valid — Derived
$F_B(0) = 0 \in Q_2$	ZP-B T3; C-H2	None	Valid — Derived
F_B preserves composition	ZP-B T2; C-H2	None	Valid — Derived
F_B respects AX-G1, AX-G2	ZP-B T5, C3; C-H2	None	Valid — Derived
$F_C(0) = P = (1,0)$	ZP-C T1; ZP-E T6; C-H3	AX-B1, RP-1	Valid — from AX-B1, RP-1
F_C preserves composition	Q-stability of post-snap codomain; C-H3	None	Valid — Derived (binary framework; Q-stability, not subadditivity)
F_C respects AX-G1, AX-G2	ZP-C T1b; C-H3	AX-B1, RP-1	Valid — from AX-B1, RP-1
$F_D(0) = T(0) = e_0$	ZP-D T2, T3; C-H4	DP-1	Valid — from DP-1
F_D preserves composition	ZP-D T5; C-H4	DP-1	Valid — from DP-1
F_D respects AX-G1, AX-G2	ZP-D T4, T5; C-H4	DP-1	Valid — from DP-1
T-H1: universal property preserved	ZP-A T2; ZP-B T3; ZP-C T1b; ZP-D T3	None	Valid — OQ-G2 closed

Claim	Grounded In	Bridge Axiom?	Status
T-H2: singularity compatibility	ZP-G T6; ZP-C T2; C-H3	None	Valid — OQ-G4 closed
T-H3: Snap under all four functors	C-H1 through C-H4; ZP-E T4; ZP-E T-SNAP	DP-1	Valid — T-SNAP derived (ZP-E v2.0)
D-H1: morphisms of C	ZP-A D2; ZP-B T2; ZP-C; ZP-D	None	Design Commitment

VIII. Open Items Register for ZP-H v1.1

Item	Status	Description
OQ-G1	Closed — ZP-G v1.1 D7', T6	Native derivation of categorical surprisal without importing Shannon entropy. Closed in ZP-G v1.1 by D7' (native categorical surprisal K(B|A)) and I-KC (Kolmogorov import from ZP-C). BA-G1 demoted to compatibility remark R-BA. No bridge axiom remains as a theorem premise.
OQ-G2	Closed — T-H1	Left adjoint verification for instantiation functors. Resolved in Section IV by direct verification of the universal property for each of the four functors.
OQ-G3	Closed — C-H1 through C-H4	Explicit construction of the four instantiation functors. Resolved in Section III. Object maps, morphism maps, and preservation proofs are complete for all four.
OQ-G4	Closed — T-H2	Reconciliation of categorical (undefined domain) and ZP-C (infinite accumulation) singularity characterizations. Resolved in Section V. The two characterizations are shown to be the same obstruction described from different vantage points.
AX-1	Derived — T-SNAP (ZP-E v2.0)	Binary Snap Causality. Derived as Theorem T-SNAP in ZP-E v2.0 via the P_0 / L-RUN / TQ-IH / DA-1 chain. No longer an axiom. T-H3 inherits T-SNAP as a derived result. Not a gap.
AX-G1	Axiom — not novel	Asymmetry: initial object 0, no terminal object. Inherited from ZP-G. Not a novel commitment — grounded in ⊥ as bottom element of ZP-A semilattice. Not a gap.
AX-G2	Axiom — not novel	Source asymmetry: hom(X, 0) = ∅ for X ≠ 0. Inherited from ZP-G. Not a novel commitment — follows from ZP-A antisymmetry and ZP-B C3. Not a gap.
R-BA	Remark — BA-G1 demoted (ZP-G v1.1)	Leinster Shannon entropy characterization. BA-G1 demoted from Bridge Axiom in ZP-G v1.0 to Compatibility Remark R-BA in ZP-G v1.1. Derivable from D7' and I-KC via the coding theorem. Not a gap.

Item	Status	Description
D-H1	Design Commitment — intentional	Morphisms of C defined as state transitions. This is a design choice that makes the instantiation functors well-defined. A different morphism structure would yield different functors. Explicitly stated and not laundered as a derivation.
DP-1	Design Commitment — inherited	Orthogonality as representation of topological isolation. Inherited from ZP-D v1.2. F_D and T-H3 depend on it as a premise.

IX. Validation Status

Component	Status / Notes
IR-G: ZP-G v1.1 results imported	Valid — all ZP-G v1.1 closed results received; labels preserved. BA-G1 demoted to R-BA; I-KC noted as named dependency.
IR-ZP: ZP-A through ZP-E imported	Valid — all closed results received from ZP-A through ZP-E; labels preserved. T-SNAP (ZP-E v2.0) noted: AX-1 is derived, not axiomatic.
IR-2: Inherited labels preserved	Valid — OQ-G1 closed in ZP-G v1.1; OQ-G2, OQ-G3, OQ-G4 resolved here; BA-G1 updated to R-BA; AX-1 updated to T-SNAP (Derived).
D-H1: Morphisms of C	Design Commitment — explicitly stated; required for functor construction
C-H1: F_A: C → SLat	Valid — Derived. Object map, morphism map, composition, identity all verified. ✓
C-H2: F_B: C → pTop	Valid — Derived. Object map, morphism map, composition, identity all verified. ✓
C-H3: F_C: C → InfoSp	Valid — from AX-B1, RP-1. All four requirements verified; inherits AX-B1 and RP-1 labels. ✓
C-H4: F_D: C → Hilb	Valid — from DP-1. All four requirements verified; inherits DP-1 label. ✓
T-H1: Universal property preserved	Valid — OQ-G2 closed. ZP-G T5 is now unconditional for all four instantiation functors. ✓
T-H2: Singularity reconciliation	Valid — OQ-G4 closed. Categorical (undefined domain) and ZP-C (infinite accumulation) shown to be the same obstruction under F_C. ✓
T-H3: Snap under all four functors	Valid — Derived; cross-framework. T-SNAP inherited as derived theorem (ZP-E v2.0). DP-1 labelled as design premise. ✓
Traceability register	Valid — Complete. Every cross-framework claim traced to source theorem and bridge axiom. No floating connections.

Component	Status / Notes
OQ-G1: Native surprisal derivation	Closed in ZP-G v1.1 via D7' and I-KC. No bridge axiom remains as a theorem premise.
AX-1 (Binary Snap Causality)	Derived — T-SNAP in ZP-E v2.0. No longer an axiom. T-H3 and all downstream results inherit the derived status.
AX-G1, AX-G2	Not novel commitments — grounded in prior layers (ZP-A and ZP-B). Stated as local axioms in ZP-G for self-containment. Not gaps.
R-BA, D-H1, DP-1	Compatibility Remark / Design Commitments — intentional. Explicitly stated. Not laundered.

End of ZP-H v1.1 | Four instantiation functors constructed | OQ-G1 through OQ-G4 all closed | T-SNAP inherited as derived theorem | No novel axioms: AX-B1 decidable, AX-G1 and AX-G2 grounded in prior layers