From C = T + M to C = T + R: Preparing an Event-First Causal Budget Framework

Jamie Whitten

Email: causalbudgetframework@gmail.com
Website: https://causalbudgetframework.com/
GitHub: https://github.com/causalbudgetframework-prog/

Date: January 2026

---

1. Introduction

The Causal Budget Framework (CBF) has been presented in previous work through a particle-first formulation, where wavefronts propagate according to cellular automaton rules and the budget constraint C = T + M governs the division between translation and maintenance. This document clarifies two interpretive points that prepare for a shift in emphasis toward an event-first formulation. First, the Lorentz factor is not best understood as derived from budget arithmetic; rather, it arises from frame synchronization and constrains how the causal budget partitions. Second, the terms are renamed: translation (T) becomes Transport, and maintenance (M) becomes Resolution (R). This shift from "maintenance of internal structure" to "capacity to commit events" reflects a change in emphasis rather than a change in underlying dynamics. The results established in Parts I–III remain valid; this document reorders their conceptual foundation and signals a forthcoming event-first treatment in which spacetime and relativistic effects emerge from particle interaction timing under frame synchronization.

Parts I–III of this series developed CBF through a particle-first lens, modeling particles as spherical shells of wave cells that propagate via Huygens-style rules and allocate their budget between translation (T) and maintenance (M).

This formulation was productive. It reproduced time dilation, explained double-slit interference, unified the energy-momentum relation with Minkowski geometry, and offered computational accounts of spin, mass, and field interactions. The core results are not in question.

However, as the framework has matured, two clarifications have become necessary:

1. **The direction of derivation.** The original work presented C = T + M in a way that suggested the Lorentz factor emerges from budget arithmetic. The correct ordering is reversed: the Lorentz factor arises independently from frame synchronization, and the budget partition is constrained by it.
2. **The meaning of the terms.** The symbol M (maintenance) carried connotations of "particle upkeep" that no longer fit the deeper architecture. A rename to R (Resolution) better captures the event-first interpretation: capacity to resolve unresolved causal situations into committed events.

This document makes both clarifications explicit, preserving the earlier results while preparing the conceptual ground for a full event-first formulation.

The event-first perspective introduced here should be understood not as a rejection of the particle-first formulation, but as a complementary lens in which the same dynamics are organized around event commitment rather than particle persistence. Particles and events are mutually defining: events are realized through particle interactions, while particles persist as structured patterns of unresolved and resolved events.

---

2. What the Original Papers Established

Parts I–III introduced the following:

Part I modeled particles as spherical shells of wave cells following discrete Huygens rules. The budget constraint $C = T + M = 1$ governed how much computation could be allocated to translation (wavefront propagation) versus maintenance (internal structure preservation). Photons were characterized by $T = 1$, $M = 0$; matter by $T < 1$, $M > 0$.

Part II explored the double-slit experiment through atomic pollination, where wavefronts reach many potential absorber atoms, each holding temporary proposals until a single winner commits. The Event Ledger was introduced as a global coordination layer that selects consistent outcomes and prunes losing candidates.

Part III demonstrated the geometric structure of the budget constraint. The Pythagorean form $T^2 + M^2 = 1$ was shown to encode the same structure as the Lorentz factor, the energy-momentum relation, and Minkowski spacetime intervals. Spin was distinguished from oscillation: oscillation lives in T, while spin requires ongoing M allocation.

These results stand. The interference patterns, time dilation effects, and geometric correspondences are valid. What requires clarification is the interpretive ordering—specifically, the relationship between the budget constraint and relativistic structure.

---

3. The Role of the Lorentz Factor

The original work presented the budget constraint in a way that could be read as:

> "$C = T + M$ produces the Lorentz factor."

This reading reverses the actual logical order. The Lorentz factor should be understood as independent of budget arithmetic, arising from frame synchronization and subsequently constraining how the causal budget partitions.

Where does the Lorentz factor come from?

The Lorentz factor $\gamma = 1/\sqrt{1 - v^2/c^2}$ emerges from a deeper requirement: frame synchronization. When two systems interact, they must agree on the timing of events.

This agreement is not automatic; it requires that causal signals between systems respect a universal speed limit and that interacting parties reconcile their local tick rates.

Frame synchronization is the phenomenological constraint. It dictates that systems in relative motion experience different proper-time rates—not because of budget accounting, but because causal consistency across reference frames demands it.

What C = T + R actually does

The budget identity does not generate relativistic effects. Instead, it describes how causal capacity partitions under the constraint already imposed by frame synchronization.

Given a system in relative motion: - The Lorentz factor determines that proper time dilates by γ - The budget partition must satisfy the Lorentz constraint $T^2 + R^2 = 1$ (after normalization) - R tracks resolution-rate (proper time), while T captures transport capacity; the mapping from velocity to T is indirect and depends on how transport realizes displacement under constraints - The identity C = T + R is bookkeeping that tracks how the constraint is satisfied

The linear identity C = T + R expresses the per-tick partition of causal capacity, while the quadratic constraint $T^2 + R^2 = 1$ arises from frame synchronization and encodes the Lorentz geometry that restricts how that partition may be realized.

This reordering does not change the mathematical results of Part III. The triangle still works. The correspondence with $E^2 = (pc)^2 + (mc^2)^2$ still holds. What changes is the conceptual priority: relativity is not derived from the budget; the budget is constrained by relativity.

---

4. From M to R: Renaming the Budget

The original term M (maintenance) was chosen to evoke “internal upkeep”—the computational work required to preserve a particle’s identity, spin, and structure across ticks. This language served its purpose in a particle-first formulation.

However, M carries connotations that become misleading in an event-first view: - It suggests particles are primary entities that require maintenance - It evokes spatial or structural preservation - It obscures the deeper role: enabling event commitment

The renamed term R (Resolution) captures the event-first interpretation directly. This rename reflects a change in emphasis rather than a change in underlying dynamics; all results previously derived using M remain intact.

The new semantics:

Term	Meaning
C	Causal tick (or causal cycle) — a single eligibility cycle for causal updates. Not a light hop, not spatial, not directly observable. A bookkeeping unit for how much causality may be processed per tick.
T	Transport — capacity to carry unresolved causal structure forward. Includes propagation of wavefronts, phase, and shell structure. T is not speed or displacement; speed emerges from how Transport is realized under constraints.
R	Resolution — capacity to resolve an unresolved causal situation into a committed event. Operationally: event-resolution bandwidth. Informally: how much reality may be instantiated this tick.

How events happen under this interpretation:

- Transport moves unresolved possibilities forward
- Resolution determines whether any of those possibilities commit into the Event Ledger
- Gates (partner availability, conservation laws, hazard checks) decide whether a resolution attempt succeeds
- R does not guarantee an event—even with R = 1, queueing and gate contention may block commitment

Why "Translation" became "Transport"

The original term "Translation" invited a natural but incorrect inference: that T measures velocity or displacement per tick. This seemed reasonable because photons (T ≈ 1) propagate at c, and the budget tradeoff C = T + M looked like a tradeoff between motion and mass.

This led to a problematic prediction. Consider an electron moving at 100 km/h—an extremely slow speed relativistically, with $\gamma \approx 1$. The electron has tiny rest mass, which under the old intuition suggested small M and therefore T ≈ 1. But if T ≈ 1 means near-light speed, the electron should be moving near c. It isn't.

The error was equating Transport capacity with realized displacement.

The corrected understanding: T does not measure how fast something moves. T measures how much unresolved causal structure can be carried forward per tick. Velocity is an emergent efficiency, not a budget fraction.

At low speeds, almost all of T is spent maintaining a coherent propagating state; very little becomes net displacement. At high speeds, constraints relax, Transport is realized more efficiently as displacement, and Lorentz reallocation reduces R, slowing proper time.

“Translate” strongly implies spatial displacement—moving from point A to point B. But T does not count steps, measure distance, or encode speed. “Transport” accurately captures what T always did: carry unresolved commitments, propagate wavefront structure, move potential reality forward, and preserve phase and causal options. Transport may result in displacement, but that is not guaranteed, nor is it proportional.

The key clarification: *Transport is not motion; it is the capacity to carry unresolved causal structure forward. Velocity is an emergent outcome of how that transport is realized under constraints.*

This reframing preserves all prior results while shifting the ontological emphasis from “particles being maintained” to “events being resolved.”

---

5. Reinterpreting Key Results

With the rename from M to R, several key results from Parts I–III can be restated more cleanly.

Photons

Photons have T ≈ 1, R ≈ 0. This does not mean photons are unreal; it means they lack intrinsic event-resolution capacity. They are physically real carriers of unresolved commitments. They do not independently resolve events—photon-photon interactions have nothing to resolve. When a photon interacts with matter, the resolution uses the matter system’s R budget, not the photon’s.

Photons are not “unreal” or “merely potential.” They are genuine carriers of causal structure that lack intrinsic resolution capacity.

Time Dilation

Proper time tracks resolution density—the number of committed events per unit of worldline. Motion reallocates budget away from R:

$$R(v) = \frac{R_0}{\gamma(v)}$$

Fewer resolutions per external time means time dilation. Transport availability alone does not cause aging; resolution does. A system that only transports (T = 1, R = 0) accumulates no proper time.

Spacetime

Spacetime is rendered from the pattern of resolved events, not assumed as a background. Transport carries the information needed to render spacetime. Resolution increases the density of committed events that define geometry.

There is no assumption of spacetime pixels or a pre-existing grid. The substrate emerges from event history.

The α(x) Field

In the event-first interpretation, α(x) is reunderstood not as a field acting on particles, but as a measure of local causal obligation density in the event graph, which uniformly scales the rate at which causal ticks are realized. This preserves the treatment of gravity and time dilation from earlier work while removing the "field pushing particles" intuition.

Wave Cells and Huygens Machinery

The wave-cell and Huygens constructions introduced in Part I remain valid descriptions of how Transport propagates unresolved causal structure; in the event-first view they are emergent realizations rather than fundamental entities. The diffraction, interference, and healing behaviors are correct—they simply describe how T operates geometrically, not the ontological ground floor.

---

6. Toward an Event-First Formulation

The work in this series has presented CBF through the lens of particles, wavefronts, and budget allocation. This framing was productive: it reproduced relativistic effects, explained interference, and unified diverse phenomena under a single constraint.

However, a deeper formulation is emerging—one in which events are treated as ontologically primary for organization and derivation, while particle-first language remains a valid and often useful descriptive layer.

In this event-first view:

- From an event-first perspective, particles may be viewed as persistent messages passed between events, rather than as fundamental objects moving through a pre-existing spacetime
- Spacetime is not assumed as a pre-existing stage; it is rendered from the timing relationships between committed events
- The Lorentz factor emerges from frame synchronization—the requirement that interacting systems must agree on when events occur
- Relativistic effects arise from maintaining causal consistency across event commitments

The constraint C = T + R remains valid, but its interpretation shifts. Rather than describing how a particle divides its effort, it describes how event commitment capacity partitions under the timing constraints imposed by frame synchronization.

Notably, the atomic pollination and commit-delay mechanisms introduced in Part II already embody event-first dynamics, and may be viewed retrospectively as early expressions of the framework clarified here.

The next document in this series will develop this event-first architecture fully, showing how the results established here reinterpret naturally when events—rather than particles—are taken as fundamental.

---

7. Relation to Prior Work

Earlier work in this series explored CBF using cellular automata, wave propagation, and budget partitioning (C = T + M). The present document reframes those results in preparation for an event-first ontology, where prior constructs are interpreted as emergent descriptions rather than primitives.

This document assumes the Event Ledger introduced in Part II as the structure into which resolutions commit, deferring its full formal definition to the forthcoming event-first treatment.

Parts I–III remain valid as a pedagogical path into CBF. Readers approaching the framework for the first time may find the wave-cell intuitions helpful before engaging with the more abstract event-first formulation. The progression from particle-first to event-first reflects the natural maturation of the framework, not a correction of errors.

---

8. Summary

This document has clarified two points in preparation for an event-first Causal Budget Framework:

1. **The Lorentz factor constrains budget allocation rather than arising from it.** Frame synchronization is the phenomenological ground; C = T + R is the bookkeeping that tracks how the constraint is satisfied.
2. **The renames from Translation to Transport and from Maintenance to Resolution shift emphasis without changing dynamics.** Transport (T) is the capacity to carry unresolved causal structure forward—not velocity or displacement. Resolution (R) is the ability to commit events into the ledger—the mechanism by which unresolved causal structure becomes reality.

The results of Parts I–III—interference patterns, time dilation, the geometric triangle, spin and mass distinctions—all remain valid. What changes is their conceptual ordering and ontological interpretation.

The stage is now set for a full event-first treatment: *The Causal Budget Framework: An Event-First Theory of Physics.*

References

Whitten, J. (2025). *The Causal Budget Framework: A Computational Theory of Everything.* Zenodo.

Whitten, J. (2025). *Causal Budget Framework, Part I: Cellular Automata as Computational Quantum Mechanics.* Zenodo.

Whitten, J. (2025). *Causal Budget Framework, Part II: Exploring the Double-Slit Experiment.* Zenodo.

Whitten, J. (2025). *Causal Budget Framework, Part III: How $C = T + M$ Unifies Physics.* Zenodo.

Author: Jamie Whitten
Email: causalbudgetframework@gmail.com
Website: https://causalbudgetframework.com/
Demos: https://causalbudgetframework.com/demos.html
GitHub: https://github.com/causalbudgetframework-prog/