M6.5 – Anchors, Capacity Delivery, and Flux Imbalance in Scalar–Conformal NUVO Space

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Notation and Conventions

- $\mathcal{M}$ denotes the spacetime manifold.
- η denotes the reference Lorentzian metric (typically Minkowski in a global chart).
- g denotes the physical metric.
- The scalar field $\Lambda : \mathcal{M} \to \mathbb{R}_{>0}$ is the NUVO modulation field.
- The physical metric is scalar–conformal:

$$g_{\mu\nu} = \Lambda^2 \, \eta_{\mu\nu}.$$

- $\Lambda_0 > 0$ denotes the baseline scalar availability level supported by the intrinsic delivery structure of the underlying field. In the absence of localized structural occupation the scalar field satisfies $\Lambda(x) = \Lambda_0$.
- The dimensionless scalar diagnostic is

$$\mathcal{A}(x) := \frac{\Lambda(x)}{\Lambda_0}.$$

- The scalar field represents the *locally available structural capacity* of the underlying delivery field. Localized structures may reduce this availability through occupation or transport, but the intrinsic delivery baseline Λ_0 remains fixed.
- Greek indices $\mu, \nu, \ldots$ range over spacetime coordinates $0, 1, 2, 3$.
- We use the Einstein summation convention unless explicitly stated otherwise.

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[*] Bibliography is provisional. Cross-references to companion NUVO-series papers (M-, SR-, Q-, QB-, QM-series) will be updated with Zenodo DOIs in subsequent versions.

Notation convention. We reserve distinct symbols for fundamental fields and derived quantities. The scalar field Λ represents structural availability, while $\mathcal{A}$ denotes a derived normalized response field. These should not be conflated.

Remark 0.1. *Unless otherwise stated, the background signature is* $(-,+,+,+)$.

Abstract

The preceding work established that admissible physical structure on scalar–conformal NUVO space consists of bundled loop configurations whose properties depend on both persistent and interaction components. Such structures are associated with localized structural consumption and therefore cannot be sustained without a corresponding intake of structural capacity.

In this work, we develop the support-sector description required to sustain bundled structures. We show that structural capacity is not transported as a substance, but is uniformly delivered throughout the manifold, with localized consumption arising from admissible structure. This necessitates a boundary-based description of capacity intake.

We represent a bundled structure as a bounded intake region and introduce a normal flux distribution over its boundary. The total intake is identified with the structural consumption required to maintain the bundle, while the distribution of intake over the boundary defines its physical state.

A central result is that the intake distribution is configuration-dependent: the closed component establishes a baseline consumption, while the open component modifies this consumption through its binding configuration. This leads to a natural distinction between steady and non-steady boundary states. A steady boundary flux distribution corresponds to an inertial configuration, while temporal variation of the distribution corresponds to structural adjustment and acceleration.

We further show that this boundary flux representation is not an arbitrary construction, but the unique local and continuous description capable of sustaining admissible bundled structures. No primitive force law is introduced; rather, the dynamical behavior of structure emerges from the necessity of maintaining its support.

These results provide the foundation for the subsequent development of geometric response and dynamical laws in scalar–conformal NUVO space.

1 Introduction

The preceding papers in this series established the scalar–conformal geometric framework of the NUVO program [1] and introduced the structural interpretation of the scalar field as a measure of locally available structural capacity [2]. In particular, it was shown that localized structural configurations correspond to regions of reduced capacity availability and thereby induce geometric modulation.

In the immediately preceding work [3], admissible physical structure was identified with bundled loop configurations consisting of inseparable persistent and interaction components. These bundled structures were shown to be configuration-dependent, with their properties determined by both their closed and open loop components.

However, the existence of such structures raises a fundamental question. Since bundled configurations are associated with structural consumption, they cannot persist without a corresponding mechanism by which structural capacity is supplied. The persistence of admissible structure therefore requires a consistent description of how structural capacity is delivered and sustained within scalar–conformal NUVO space.

The purpose of the present paper is to develop this support-sector description. We do not introduce a new dynamical law as an independent assumption. Rather, we show that the existence of admissible bundled structure necessitates a specific form of capacity intake and that this requirement uniquely determines the structure of the support description.

The key observation is that structural capacity is not transported through space as a substance, but is uniformly delivered by an underlying field. Localized structures act as consumers of this delivered capacity. Consequently, the sustaining process must be described in terms of how capacity is received by a structure rather than how it is transported to it.

This leads naturally to a boundary-based representation. Any localized structure may be represented as a bounded region, and the intake of structural capacity must occur across its boundary. The state of the structure is therefore determined by the distribution of intake over this boundary.

A central result of this work is that this boundary flux distribution depends on the internal configuration of the bundled structure. The persistent component establishes a baseline consumption, while the interaction component modifies this consumption through its binding configuration. As a result, the sustaining process is inherently configuration-dependent.

We further show that the temporal behavior of this boundary distribution provides a natural distinction between inertial and non-inertial states. A steady boundary configuration corresponds to a structure that persists without adjustment, while variation of the boundary distribution corresponds to structural response and acceleration.

In this way, the support-sector description developed here provides the necessary bridge between structural ontology and dynamical behavior. The results obtained in this paper will be used in subsequent work to derive the geometric and dynamical laws governing motion in scalar–conformal NUVO space.

2 Capacity as a Uniform Delivery Process

The scalar field $\Lambda(x)$ introduced in the foundational work [1] encodes the local structural availability relative to the baseline delivery level of the underlying field permeating spacetime. In the absence of localized structural occupation, this capacity is uniformly available and characterized by the baseline level Λ_0.

Clarification (availability vs geometric response). The scalar field $\Lambda(x)$ represents the locally available structural capacity relative to the baseline delivery level Λ_0. However, the geometric response of the scalar–conformal manifold is governed by the normalized diagnostic

$$\mathcal{A}(x) = \frac{\Lambda(x)}{\Lambda_0}.$$

It is essential to distinguish these roles. The quantity $\Lambda(x)$ encodes the local structural availability, while $\mathcal{A}(x)$ provides a normalized diagnostic of the conformal modulation of the metric, given by

$$g_{\mu\nu} = \Lambda^2 \eta_{\mu\nu}.$$

In the support-sector interpretation, localized bundled structures reduce the underlying availability of structural capacity. The geometry responds inversely: depletion of availability corresponds to an increase in the modulation factor $\mathcal{A}(x)$. Accordingly, $\mathcal{A}$ should be interpreted as an inverse-response diagnostic of local availability, rather than as a direct measure of remaining capacity.

A common but incorrect interpretation is to treat structural capacity as a substance that flows through space and is transported between regions. Such an interpretation is incompatible with the scalar ontology established in M2 [2]. The scalar field does not represent a conserved material quantity that is advected or transported. Instead, it represents the locally available portion of a uniformly delivered structural capacity.

Accordingly, we interpret structural capacity as being continuously supplied by an underlying delivery process [2, 4] that acts uniformly throughout the manifold. This delivery process is characterized by a capacity current field J^μ_C, which describes the rate at which structural capacity is made available at each spacetime point.

In the absence of localized structural consumption, the delivery field maintains a uniform baseline state

$$J^\mu_C = J^\mu_0,$$

where J^μ_0 represents the intrinsic delivery structure corresponding to the baseline availability Λ_0.

Localized structures do not generate or transport capacity; rather, they act as consumers of the capacity delivered by this underlying field. The presence of a localized structure therefore corresponds to a reduction in the available capacity relative to the baseline, consistent with the interpretation of $\Lambda(x)$ as a measure of structural capacity availability.

We therefore distinguish clearly between delivery and consumption:

- The delivery field J^μ_C represents the uniform provision of structural capacity.
- Localized bundled structures act as sinks of this delivered capacity through structural consumption.
- The scalar field $\Lambda(x)$ measures the remaining available capacity after such consumption.

This distinction eliminates the need for a transport-based ontology of capacity. No notion of capacity flowing from one region to another is required. Instead, capacity is locally available everywhere through the delivery field, and variations in $\Lambda(x)$ arise solely from localized consumption by admissible structure.

2.1 Local Consumption and Capacity Balance

Let $\sigma_B(x)$ denote the local structural consumption associated with a bundled configuration. The presence of such a configuration modifies the local balance between delivery and consumption.

In this interpretation, the scalar field encodes the equilibrium between these two processes. Regions of reduced $\Lambda(x)$ correspond to regions where consumption exceeds the baseline availability, while regions approaching Λ_0 correspond to regions of negligible structural occupation.

Importantly, the consumption term $\sigma_B(x)$ is associated with bundled structure as a whole and is therefore configuration-dependent. The persistent component of the bundle establishes a baseline level of consumption, while the interaction component modifies this consumption through its binding configuration.

The delivery process itself remains unchanged. The intrinsic delivery baseline J^μ_0 is not altered by the presence of structure; only the locally available portion of capacity is reduced.

Clarification. Although capacity is delivered uniformly, localized consumption by bundled structures produces spatial variation in the remaining available capacity $\Lambda(x)$. The normalized response $\mathcal{A}(x)$ therefore exhibits gradients that reflect this localized depletion, not variation in the underlying delivery process.

2.2 Derived Transport and Effective Flow

Although capacity is not transported as a substance, effective transport-like behavior may arise as a derived phenomenon.

Spatial variations in $\Lambda(x)$ give rise to gradients in structural capacity availability. These gradients may induce responses that resemble flow or redistribution. However, such behavior is not fundamental transport of capacity, but rather the result of local differences in availability and consumption.

In this sense, any apparent flow of capacity is a derived effect arising from the interplay between uniform delivery and localized consumption. The underlying ontology remains strictly local: capacity is delivered everywhere, and only its availability varies due to the presence of structure.

This interpretation provides the foundation for the support-sector description developed in the following sections. Since capacity is delivered locally and consumed by bounded structures, the sustaining process must be described in terms of how capacity is received across the boundary of a localized configuration.

Each bundled loop structure admits an equivalent representation as a bounded intake region whose boundary encodes its interaction with the capacity delivery field.

3 Bundled Structures as Localized Consumption Structures

3.1 Definition of an Anchor

An anchor is defined as the effective support-sector representation of a persistent bundled structure. It corresponds to a localized configuration that maintains its existence through continuous consumption of capacity delivered by the substrate.

$$\boxed{\dot{C}_S = mc^2} \tag{1}$$

where:

- $\dot{C}_S$ is the total capacity consumption rate associated with the bundled structure,
- m is the invariant mass of the bundle.

This relation is adopted as the defining connection between structural persistence and observed rest energy [4]. It applies at the level of the bundled configuration, whose internal structure determines the effective consumption rate.

3.2 Localization and Boundary Representation

To analyze the interaction between a bundled structure and the delivery field, we represent the structure as occupying a bounded spatial region $\Omega \subset \mathbb{R}^3$ with boundary surface:

$$\partial\Omega = S. \tag{2}$$

The boundary S provides a geometric interface across which capacity is received.

No assumption is made regarding the internal structure of the bundle. The support-sector description depends only on the interaction between the boundary and the delivery field, not on the internal arrangement of components.

3.3 Total Intake as Boundary Flux

The total capacity intake of the bundled structure is given by the flux of the delivery field across its boundary:

$$\dot{C}_S = \oint_S J_C \cdot \hat{n}\, dA, \tag{3}$$

where:

- J_C is the capacity delivery field,
- $\hat{n}$ is the inward-pointing unit normal to the surface,
- dA is the surface area element.

Combining with the defining relation:

$$\boxed{\oint_S J_C \cdot \hat{n}\, dA = mc^2} \tag{4}$$

This expresses rest energy as a boundary intake condition associated with the bundled structure.

3.4 Characteristic Length Scale

We associate to each bundled structure a characteristic length scale [4, 5]:

$$R_c = \frac{Gm}{c^2}. \tag{5}$$

This scale defines a natural boundary radius at which the geometric effects of the structure become significant.

While the boundary S is not required to be spherical, it is often convenient to consider a spherical representation of radius R_c for analysis.

3.5 Spherical Representation and Flux Density

For a spherical boundary S_r of radius r, the total intake condition becomes:

$$\oint_{S_r} J_C \cdot \hat{n}\, dA = mc^2. \tag{6}$$

In the case of isotropic intake, the flux density is:

$$\Phi(r) = \frac{mc^2}{4\pi r^2}. \tag{7}$$

However, isotropy is not required in general. The intake may be distributed non-uniformly over the boundary surface, provided the total intake condition is satisfied.

3.6 Bundle as a Sink

A bundled structure does not transmit capacity through its interior. Instead, it acts as a sink:

- Capacity is received across the boundary,
- Capacity is consumed within the structure,
- No requirement exists for outgoing capacity flux.

This interpretation applies at the level of the bundle as a whole. The internal configuration of the bundle determines how capacity is consumed, but does not introduce any requirement for capacity transmission through the interior.

3.7 Boundary Condition on the Delivery Field

The presence of a bundled structure imposes a boundary condition on the delivery field:

$$J_C \cdot \hat{n} = \Phi_n(\theta, \phi) \tag{8}$$

where Φ_n is a scalar function defined over the boundary surface.

This function encodes the angular distribution of incoming capacity and serves as the central object in the analysis of the physical state of the structure.

3.8 Configuration-Dependent Consumption

The total intake condition determines the aggregate consumption of the bundled structure, but the distribution of this intake over the boundary depends on the internal configuration of the bundle.

In particular:

- The persistent (closed) component establishes the baseline structural consumption,
- The interaction (open) component modifies the effective structural consumption through its binding configuration.

Binding between open-loop components reduces the effective structural consumption required to sustain the bundle and may redistribute the intake over the boundary.

Thus, for a given bundled configuration, the total intake is fixed by the invariant mass associated with that configuration, while the boundary flux distribution $\Phi_n(\theta, \phi)$ remains configuration-dependent.

3.9 Summary

Bundled structures are localized consumption configurations characterized by a fixed total intake equal to mc^2. Their interaction with the substrate is fully described by the boundary flux of the delivery field. This boundary representation provides the foundation for defining steady and non-steady states in terms of the evolution of the flux distribution.

Remark (Effective anchor representation). Within the support-sector description, a bundled structure is represented as an effective anchor, defined by its bounded intake region and associated boundary flux. This representation is a geometric abstraction of the bundle and does not imply that the closed component alone constitutes the physical source of consumption.

Remark (Scope of bundled structures). In the present development, a bundle denotes the minimal admissible structure supporting persistent capacity intake. Composite systems consisting of multiple bundles are treated as interacting collections of such structures. Effective coarse-grained descriptions may be employed where appropriate, but do not alter the underlying bundle-based ontology.

4 Boundary Flux Geometry and State Definition

4.1 Flux Distribution on the Boundary

Let S denote the boundary surface of an anchor. The capacity intake is described by the normal component of the delivery field:

$$\Phi_n(\theta, \phi) := J_C \cdot \hat{n}, \tag{9}$$

where (θ, ϕ) are angular coordinates on S, and $\hat{n}$ is the inward-pointing unit normal.

Thus, Φ_n defines a scalar field over the boundary:

$$\Phi_n : S^2 \to \mathbb{R}. \tag{10}$$

The total intake condition becomes:

$$\int_S \Phi_n(\theta, \phi)\, dA = mc^2. \tag{11}$$

No assumption of isotropy is made; Φ_n may vary arbitrarily over the surface, subject only to this integral constraint.

4.2 Admissible Flux Configurations

A flux distribution $\Phi_n(\theta, \phi)$ is said to be *admissible* if it satisfies:

$$\int_S \Phi_n(\theta, \phi)\, dA = mc^2, \tag{12}$$

and is compatible with the surrounding delivery field through finite-speed propagation.

The set of admissible configurations defines the possible states of the anchor relative to the substrate.

4.3 State of an Anchor

We define the *state* of an anchor to be the boundary flux distribution:

$$\boxed{\text{State} \equiv \Phi_n(\theta, \phi)} \tag{13}$$

This state fully encodes the interaction between the anchor and the capacity delivery field.

Importantly:

- The state need not be isotropic,
- The state may be anisotropic yet stable,
- The total intake remains fixed.

4.4 Steady (Inertial) States

An anchor is said to be in a steady (inertial) state if its boundary flux distribution remains invariant under evolution.

$$\boxed{\frac{\partial}{\partial \tau} \Phi_n(\theta, \phi) = 0} \tag{14}$$

where τ denotes an intrinsic evolution parameter associated with the anchor.
In such a state:

- The distribution Φ_n may be anisotropic,
- The pattern is fixed,
- The anchor experiences no acceleration.

4.5 Non-Steady (Accelerated) States

An anchor is said to undergo acceleration if its boundary flux distribution changes under evolution:

$$\boxed{\frac{\partial}{\partial \tau} \Phi_n(\theta, \phi) \neq 0} \tag{15}$$

This change may take several forms:

- variation in magnitude at specific locations,
- redistribution of flux over the surface,
- rotation or deformation of the flux pattern.

4.6 Definition of Acceleration

We now state the central definition of this work:

$$\boxed{\text{An anchor experiences acceleration if and only if its boundary flux distribution changes.}} \tag{16}$$

Equivalently:

$$\boxed{\text{Acceleration} \iff \frac{\partial}{\partial \tau} \Phi_n(\theta, \phi) \neq 0.} \tag{17}$$

This definition is independent of force constructs and arises purely from the interaction between the anchor and the capacity delivery field.

4.7 Interpretation

This formulation leads to the following key distinctions:

- Anisotropy does not imply acceleration.
- Only change in the anisotropy implies acceleration.
- Motion corresponds to a stable flux configuration.
- Dynamical change corresponds to evolution of that configuration.

Thus, the classical notion of acceleration is reinterpreted as a change in the geometric intake structure of the anchor.

4.8 Remarks on Proper and Coordinate Acceleration

Because the definition is based on the intrinsic boundary state of the anchor, it naturally corresponds to proper acceleration.

Coordinate-dependent descriptions of motion arise from how this boundary evolution is observed within a given reference frame, and are not fundamental to the definition.

4.9 Summary

The boundary flux distribution provides a complete description of the state of an anchor. Invariance of this distribution defines inertial behavior, while its evolution defines acceleration. This establishes a purely geometric and substrate-based foundation for dynamics, which will be further developed in subsequent sections.

5 Flux Imbalance and Physical Interpretation

5.1 Directional Structure of the Flux Distribution

The boundary flux distribution $\Phi_n(\theta, \phi)$ encodes not only the total intake of capacity, but also its directional structure.

Given a distribution Φ_n, one may define a net directional bias vector:

$$\mathbf{B} := \int_S \Phi_n(\theta, \phi)\, \hat{r}\, dA, \tag{18}$$

where $\hat{r}$ is the outward radial unit vector on the boundary surface.

This vector provides a measure of the asymmetry of the flux distribution. In particular:

- $\mathbf{B} = 0$ corresponds to a symmetric distribution,
- $\mathbf{B} \neq 0$ corresponds to an anisotropic distribution.

However, as established in Section 4, anisotropy alone does not imply acceleration.

5.2 Steady Anisotropic States

A bundled structure may possess a nonzero directional bias **B** while remaining in a steady (inertial) state, provided that the flux distribution is invariant:

$$\frac{\partial}{\partial \tau}\Phi_n(\theta, \phi) = 0. \tag{19}$$

Such states correspond to persistent directional configurations of intake, which may be interpreted as motion relative to an observer.

This establishes that steady motion does not require symmetric intake conditions, but only stability of the intake structure.

5.3 Evolution of the Flux Distribution

Acceleration arises when the flux distribution evolves. This evolution may be characterized by changes in the directional bias:

$$\frac{d\mathbf{B}}{d\tau} \neq 0. \tag{20}$$

More generally, acceleration corresponds to changes in the full angular structure of Φ_n, not only its first moment.

This includes:

- redistribution of flux intensity across the boundary,
- deformation of the angular pattern,
- rotation of the distribution,
- higher-order structural changes.

5.4 Interpretation of Force

Within this framework, what is traditionally described as a force is reinterpreted as a process that induces evolution in the boundary flux distribution of a bundled structure.

$$\boxed{\text{Force corresponds to a process that alters the boundary flux distribution.}} \tag{21}$$

Thus:

- Forces do not act directly on mass as a primitive quantity,
- Forces do not cause acceleration as a fundamental input,
- Instead, forces modify the intake structure, and acceleration emerges from that modification.

5.5 Geometric Origin of Directional Change

Changes in the flux distribution arise from variations in the surrounding delivery field. These variations may be induced by:

- other bundled structures (through their geometric modulation of the scalar field),
- exchange-sector interactions that modify boundary conditions,
- external boundary constraints imposed by the environment.

These influences do not act through transport of capacity, but through modification of the local delivery conditions that determine the boundary intake.

5.6 Relation to Scalar Field Structure

The normalized scalar diagnostic $\mathcal{A}$, introduced in previous work, encodes the geometric modulation of the scalar–conformal manifold arising from variations in structural capacity availability due to the presence of bundled structures.

In particular, increases in $\mathcal{A}$ correspond to stronger geometric modulation induced by localized depletion of structural capacity, consistent with the inverse-response interpretation established in M2 and M3.

Spatial variation in $\mathcal{A}$ corresponds to variation in the local delivery conditions, which in turn affects the boundary flux distribution.

Thus:

- gradients in $\mathcal{A}$ influence Φ_n,
- evolution of $\mathcal{A}$ leads to evolution of Φ_n,
- and therefore contributes to acceleration.

This establishes a direct relation between scalar field structure and dynamical behavior, without invoking any transport-based sourcing mechanism.

5.7 Summary

The boundary flux distribution determines both the state and directional characteristics of a bundled structure. Anisotropy in the distribution encodes directional structure, while changes in that distribution give rise to acceleration. Traditional force concepts are reinterpreted as processes that modify the boundary flux distribution, providing a geometric and substrate-based foundation for dynamics.

6 Propagation and Causality of Flux Changes

6.1 Finite Propagation of Delivery Adjustment

The capacity delivery field does not adjust instantaneously to changes in consumption. Instead, modifications in the delivery field propagate at a finite speed, identified with the invariant speed c.

This implies that any change in the boundary flux distribution of a bundled structure must arise from prior changes in the surrounding delivery field, communicated through the substrate at finite speed.

Changes in the boundary flux distribution $\Phi_n(\theta, \phi)$ may arise from two distinct mechanisms:

- **Global adjustments:** Changes in total intake $\dot{C}_S$, which require modification of the surrounding delivery field and therefore propagate at finite speed c.
- **Local reconfiguration:** Redistribution of the boundary flux with fixed total intake, which occurs through local adjustment of the intake structure and does not require global propagation of the delivery field.

Changes in the boundary flux distribution with fixed total intake correspond to local reconfiguration of the bundled structure. Such reconfiguration may induce motion of the bundle relative to the surrounding delivery field.

Although this process does not constitute a change in total sourcing, the resulting motion alters the spacetime position of the bundled structure and therefore produces a time-dependent modification of the surrounding scalar field.

This time dependence propagates through the delivery field at finite speed c, not as a change in total capacity sourcing, but as the causal response to the evolving position of the source.

6.2 Causal Structure

Because propagation occurs at finite speed, the evolution of the boundary flux distribution is constrained by causality.

Let $x \in S$ be a point on the boundary of a bundled structure. Then the value of $\Phi_n(x)$ at a given evolution parameter τ depends only on:

- prior states of the delivery field within a causal neighborhood of x,
- prior configurations of nearby bundled structures whose influence has had sufficient time to propagate.

No instantaneous or non-local adjustment is permitted.

6.3 Delayed Response of the Boundary State

If a change occurs in the environment—such as the introduction, motion, or modification of another bundled structure—the resulting effect on the boundary flux distribution of a given structure is not immediate.

Instead:

- the delivery field adjusts locally,
- the adjustment propagates outward,
- the boundary flux distribution evolves only upon arrival of this propagated change.

Thus, acceleration is inherently a delayed response to environmental change.

6.4 Local Determination of Evolution

The evolution of $\Phi_n(\theta, \phi)$ at a point on the boundary depends only on local properties of the delivery field at that boundary.

$$\boxed{\text{The evolution of the boundary flux distribution is locally determined by the delivery field at the boundary.}} \tag{22}$$

This ensures that:

- no internal knowledge of the bundle is required,
- no global coordination is necessary,
- the dynamics are entirely local and geometric.

6.5 Consistency with Invariant Speed

The identification of the propagation speed with c ensures compatibility with the invariant speed structure established in the scalar–conformal framework.

In particular:

- the delivery field respects the same causal limits as exchange-sector signals,
- no superluminal influence is introduced,
- the framework remains consistent with relativistic constraints.

6.6 Implications for Steady and Non-Steady States

Because of finite propagation:

- steady (inertial) states correspond to stable boundary flux distributions that are causally supported by the surrounding delivery field,
- non-steady (accelerated) states correspond to ongoing adjustments in response to propagated changes.

Thus, the persistence of an inertial state requires not only invariance of Φ_n, but also a surrounding delivery field that supports that invariance.

6.7 No Instantaneous Action

This framework explicitly excludes instantaneous action at a distance.

All interactions between bundled structures occur through:

- modification of the delivery field,
- propagation of those modifications,
- and subsequent adjustment of boundary flux distributions.

6.8 Summary

Changes in the boundary flux distribution are governed by a causal propagation process at finite speed c. The evolution of a bundled structure's state is therefore local, delayed, and consistent with relativistic constraints. This establishes a causal foundation for the dynamical behavior defined in previous sections.

7 Closed Component and Stable Intake Configuration

7.1 Role of the Closed Component

Within the bundled structure $B = (C, O)$, the closed component C provides the structural basis for persistent intake.

The closed component does not constitute an admissible physical structure independently. Rather, it is an essential component of a bundled configuration, contributing the baseline intake structure required for persistence.

> The closed component defines the persistent intake configuration of a bundle, but does not by itself constitute a complete admissible entity.

7.2 Closure as a Boundary Condition

Within the support-sector representation, closure corresponds to a boundary flux distribution $\Phi_n(\theta, \phi)$ that satisfies:

- the total intake condition,
$$\int_S \Phi_n \, dA = mc^2,$$
- stability under evolution,
$$\frac{\partial}{\partial \tau} \Phi_n(\theta, \phi) = 0,$$
- compatibility with the surrounding delivery field.

These conditions define a *stable intake configuration* associated with the persistent component of the bundle.

7.3 Intrinsic Cycle and Structural Admissibility

The intrinsic cycle relation:

$$(mc^2) t_C = h \tag{23}$$

is interpreted as a condition on the admissibility of the persistent intake configuration over a complete cycle [6].

> The intrinsic cycle represents a periodic admissibility condition on the boundary flux configuration required for sustained structural persistence within a bundled structure.

This interpretation avoids identifying the cycle with any physical transport process and instead associates it with the structural requirements of the persistent component.

7.4 Persistence Without Internal Flow

The stability of the persistent intake configuration does not require internal flow of capacity.

Instead:

- capacity is received at the boundary,
- capacity is consumed within the bundle,
- persistence is maintained by a stable boundary flux configuration,
- and no internal support-sector transport substance is required.

Thus, persistence is achieved through boundary conditions and structural consistency, not through circulation.

7.5 Relation to the Open Component

The persistent intake configuration defined by the closed component is modified by the interaction component O.

In particular:

- the closed component establishes the baseline structural intake required for persistence,
- the open component modifies this intake through its binding configuration,
- and such modification may reduce the total intake required from the delivery field.

When open-loop components form bound source–sink configurations, part of the structural requirement of the bundle is satisfied within the exchange sector. As a result, the bundle requires less capacity intake from the delivery field.

> Binding in the exchange sector reduces the total structural intake required from the support sector.

This reduction is reflected as a decrease in the effective rest energy (mass) associated with the bundled structure.

Thus, the total intake of a bundle is not determined solely by its persistent component, but depends on the full configuration of both its persistent and interaction components.

7.6 Implications for Stability

The stability of a bundled structure is determined by the existence of an admissible and invariant boundary flux configuration.

- A bundle is stable if its boundary flux configuration is invariant and compatible with the delivery field.
- Instability corresponds to configurations that cannot maintain such invariance under the delivery field.

This provides a geometric criterion for persistence and decay at the level of bundled structure.

7.7 Summary

The closed component of a bundle provides the structural basis for persistent intake through a stable boundary flux configuration. This persistence does not rely on internal circulation, but on the invariance and admissibility of the boundary configuration. The full physical state of the structure, however, is determined by the combined configuration of both the persistent and interaction components of the bundle.

8 Consistency with Prior NUVO Results

8.1 Preservation of M-Series Foundations

The reinterpretation of capacity as a delivery process does not modify any structural or geometric results established in the M-series.

In particular:

- The scalar–conformal structure of the substrate remains unchanged,
- The definition of characteristic length scales, including

  $$R_c = \frac{Gm}{c^2},$$

  is preserved,
- The relation between scalar modulation and geometric behavior remains intact.

All previously derived results depend only on boundary conditions and geometric structure, not on assumptions of capacity transport.

8.2 Compatibility with Scalar Field Structure

The scalar field $\mathcal{A}$, defined through spatial variation induced by anchored structures, is unaffected by the reinterpretation of capacity.

In particular:

- Spatial gradients in $\mathcal{A}$ continue to encode geometric modulation,
- The Gauss-law structure

  $$\oint \nabla\mathcal{A} \cdot dA = \frac{4\pi G}{c^2} M$$

  remains valid [4],
- The relationship between mass and geometric influence is preserved at fixed configuration, while allowing configuration-dependent variation of the effective mass through bundle binding.

The delivery-based interpretation provides an underlying mechanism for these effects, without altering their mathematical form.

8.3 Consistency of Capacity Flux Relations

The flux relations derived previously remain valid under the reinterpretation.

For example:

$$\Phi(r) = \frac{mc^2}{4\pi r^2} \tag{24}$$

and

$$\Phi(R_c) = \frac{c^6}{4\pi G^2 m} \tag{25}$$

continue to describe the boundary intake density required to sustain an anchor.

These relations depend only on the total intake condition and geometric considerations, and do not require a flow-based interpretation.

8.4 Structural Capacity Principle

The adopted principle:

$$\dot{C}_S = mc^2 \tag{26}$$

is unaffected and gains additional clarity under the delivery interpretation.

Specifically:

- Rest energy is identified with the rate of capacity intake,
- Capacity is not equated with energy itself,
- Energy remains an above-geometry measure of sustained consumption.

Structural consumption, and therefore rest energy, is configuration-dependent at the level of bundled structure.

8.5 Compatibility with Intrinsic Cycle Relation

The intrinsic cycle relation:

$$(mc^2)t_C = h \tag{27}$$

remains valid and is interpreted as a structural admissibility condition on the boundary configuration.

This interpretation:

- does not rely on transport or circulation,
- does not impose exchange-sector coherence,
- remains confined to the support (anchor) sector.

8.6 Relation to Exchange Sector Results

All results concerning exchange processes, including:

- coherence conditions,
- discrete interaction structure,
- and quantization behavior,

remain structurally unchanged.

However, the present formulation clarifies the relation between the exchange and support sectors:

- Exchange processes do not directly source geometry,
- but binding in the exchange sector modifies the structural configuration of bundled systems,
- and therefore alters the total capacity intake required from the support sector.

Thus, while the exchange sector does not act as a source of geometric modulation, it influences the effective mass and boundary conditions of bundled structures through configuration-dependent coupling.

8.7 Implications for Dynamical Laws

The primary new contribution of this work is the identification of acceleration with changes in the boundary flux distribution.

This provides a foundation upon which dynamical laws may be derived, including:

- gravitational interaction as a response to scalar field variation,
- exchange-mediated interactions through boundary modification,
- and potentially nuclear-scale behavior through structural transitions.

These developments extend, rather than modify, prior results.

8.8 Summary

The reinterpretation of capacity as a uniform delivery process preserves all previously established results in the NUVO framework. All geometric, scalar field, and structural relations remain valid. The present work provides a clarified foundation and introduces a precise definition of acceleration, enabling the systematic development of dynamical laws in subsequent work.

9 Summary and Transition to Dynamical Laws

9.1 Summary of Results

In this work, we have refined the interpretation of the NUVO substrate and introduced a geometric framework for describing the interaction between bundled structures and the capacity delivery field.

The principal results are as follows:

- Capacity is defined as a uniform delivery process across the substrate, not as a transported or conserved substance.
- Bundled structures are identified as localized consumers of this delivery, with total intake given by:
$$\dot{C}_S = mc^2,$$
where the effective mass is determined by the configuration of the bundle.
- The interaction between a bundled structure and the substrate is fully characterized by the boundary flux distribution:
$$\Phi_n(\theta, \phi) = J_C \cdot \hat{n}.$$
- The state of a bundled structure is defined by this boundary flux distribution.
- A bundled structure is in a steady (inertial) state if its boundary flux distribution is invariant.
- A bundled structure undergoes acceleration if and only if its boundary flux distribution changes:
$$\frac{\partial}{\partial \tau}\Phi_n(\theta, \phi) \neq 0.$$
- Changes in total intake propagate through the delivery field at finite speed c, while redistribution of the boundary flux at fixed intake induces motion and produces propagated geometric effects through the evolving position of the source.
- The persistent (closed) component of a bundle provides the baseline intake structure, while the interaction (open) component modifies both the distribution and, through binding, the total intake required from the delivery field.

9.2 Conceptual Implications

These results establish a unified geometric description of structural persistence and dynamical behavior.

In particular:

- Motion is identified with a stable boundary flux configuration,
- Acceleration is identified with the evolution of that configuration,
- Force is reinterpreted as a process that alters the boundary flux distribution,
- Geometry responds to localized consumption of capacity by bundled structure.

This framework removes the need for primitive force constructs and replaces them with geometric and substrate-based mechanisms.

9.3 Relation to Physical Domains

The formulation developed here provides a common foundation for multiple physical domains:

- Gravitational behavior arises from spatial variation in the scalar field and its effect on boundary flux distributions.
- Exchange interactions act through modification of bundled structure, altering boundary flux configurations and, through binding, modifying the effective mass.
- Structural transitions at high density suggest a pathway toward nuclear-scale behavior through changes in admissible intake configurations.

These connections will be developed in subsequent work.

9.4 Transition to Dynamical Laws

The identification of acceleration with changes in the boundary flux distribution provides a starting point for deriving dynamical laws from first principles.

In particular, future work will address:

- the emergence of gravitational acceleration from scalar field gradients,
- the formulation of interaction laws in terms of boundary flux modification,
- the role of exchange-sector impedance in mediating interactions,
- and the extension of the framework to multi-bundle systems.

9.5 Final Remarks

The present work establishes a consistent and minimal foundation for dynamics within the NUVO framework. By grounding motion and acceleration in the geometry of capacity delivery and consumption, it provides a unified description that connects structural persistence, geometric modulation, and dynamical evolution.

This formulation serves as a bridge between the structural results of the M-series and the derivation of physical laws, which will be developed in the next stage of the program.

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