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Lineage Chain Across Material Lifecycle

The lineage chain is a persistent record of credentialed events associated with a credentialed material, element, or assembly, including pre-installation credentialing, in-service operational dispatch events, state-of-health attestations, end-of-storage-life updates, decommissioning attestations, and re-credentialing attestations. Each lifecycle transition is a credentialed event signed by an appropriate authority and recorded in the lineage chain, with the chain forming a directed graph of credentialed transitions persistent across multiple structural lifetimes. The chain is the operative provenance record for the credentialed-materials primitive, carrying a structural element's lifecycle from pre-installation credentialing through in-service operation, decommissioning, recycling-grade re-credentialing, and re-installation in a subsequent structural application.

Mechanism Of The Lineage Chain

The lineage chain is a persistent record of credentialed events associated with a credentialed material, element, or assembly. Each lifecycle transition is a credentialed event signed by an appropriate authority and recorded in the lineage chain. The recorded events include pre-installation credentialing, in-service operational dispatch events, state-of-health attestations, end-of-storage-life updates, decommissioning attestations, and re-credentialing attestations. The cryptographic-signature scheme

follows the keyless-identity-through-continuity primitive of the Identity Application, providing classical public-key signature compatibility while admitting continuity-based identity verification.

The chain forms a directed graph of credentialed transitions persistent across multiple structural lifetimes. A structural element's lifecycle is recorded as a pre-installation credentialing state entered through manufacturer-authority signature, an in-service credentialed operation state entered through installation-authority signature, an end-of-storage-life substate signed by the building energy management system under evidential weighting, an end-of-structural-life decommissioning state signed by the decommissioning authority, a recycling-grade re-credentialing state signed by the recycler authority, and a re-installation state returning the substrate to the in-service state. Profile versioning is maintained through monotonically increasing version vectors with conflict-resolution policies. Authority revocation is handled through the credentialed-revocation primitive of the Identity Application: revocation events propagate through the lineage chain and are honored prospectively at admissibility evaluation time.

End-of-life recovery does not terminate the chain. The material flows themselves are credentialed transitions in the lineage chain, and biogenic carbon-credit attestations bound to a credentialed substrate migrate with the substrate across material flows and across structural lifetimes, the migration being a credentialed transaction signed by an environmental-credit authority and recorded in the lineage chain. Where the substrate carries turbostratic graphene, end-of-structural-life concrete is processed to recover the turbostratic-graphene fraction through flash re-graphenization for re-incorporation into subsequent structural-storage substrate, the recovered material being independently re-credentialed by a recycler authority. Cradle-to-cradle continuity is therefore a property of the credentialed-transition record rather than an external accounting overlay.

Recorded Credentialed Events

The chain begins at production. The flash Joule heating apparatus issues a feedstock mass-balance attestation associated with the flash event in the lineage chain of the produced turbostratic graphene, and, where the feedstock is organic waste, a methane-avoidance attestation signed by the apparatus's credentialed identity and recorded in the lineage chain. Each such event is signed by the responsible authority.

Pre-installation credentialing is entered through the manufacturer-authority signature, with the credentialed identity bound to the structural element. A batch identity established at manufacturing is subdivided into per-element identities through credentialed attestation by the installer authority. In-service credentialed operation is entered through the installation-authority signature, with each dispatch event recorded in lineage and the building energy management system signing state-of-health attestations declaring the realized storage capacity, power capacity, cycle count, calendar age, round-trip efficiency, fault history, and degradation indicators of each credentialed element.

The architecture admits continuous re-credentialing across operational material flows during a structural element's in-service lifetime, including tuck-pointing replacement of mortar joints, surface-coating refresh, cavity-fill replacement, drywall replacement during renovation, foundation surface coating, topping-slab augmentation, and substrate top-up of any surface or volumetric element. Each such material flow is a credentialed event signed by an installer authority and recorded in the lineage chain, and the substrate's composite admissibility profile is re-evaluated against the cumulative material flow rather than only at original installation. End-of-storage-life is a credentialed transition in which the realized energy storage capacity has degraded below a declared threshold, with the credentialed admissibility profile updated to reflect zero or reduced storage capacity while the structural admissibility surface continues to support the element's structural function. End-of-structural-life decommissioning is a credentialed event signed by a licensed demolition or

deconstruction contractor admitted under credentialed scope, producing a demolition-recovery attestation declaring the recovered material's grade, mass, and physical state, followed by recycling-grade re-credentialing performed by a recycler authority.

Alternative Embodiments

Under the metabolic-lifetime model of building operation, the substrate's credentialed identity persists across material flows while the material flows themselves are credentialed transitions in the lineage chain. End-of-storage-life of the original substrate composition does not require demolition of the structural element: the structural element continues in service while incoming material flows refresh, augment, or substitute the storage substrate within the cumulative composite admissibility profile, supporting structural lifetimes substantially exceeding the storage-chemistry cycle life of any individual substrate composition.

A batch identity established at manufacturing admits subdivision into per-element identities through credentialed attestation by the installer authority, so that elements cast under a common manufacturing batch acquire distinct credentialed identities at installation. The closed-loop carbon recovery operation admits a re-graphenization event consuming both virgin biomass and recovered turbostratic-graphene fraction from end-of-life elements, retaining the substrate's carbon mass within the credentialed structural-storage system across arbitrarily many recyclings.

Biogenic carbon-credit attestations bound to a credentialed substrate migrate with the substrate across material flows and across structural lifetimes through credentialed transactions signed by an environmental-credit authority and recorded in the lineage chain. The migrating carbon-attestation primitive supports continuous credentialed carbon-sequestration markets in which each cement pour, mortar repointing, surface-coating refresh, and re-credentialing event issues, transfers, or extinguishes carbon-credit attestations against specific structural mass.

Composition With Adjacent Primitives

The lineage chain composes with the substrate-mode-storage primitive: the multi-function credentialed substrate operates simultaneously as a storage body, an electrical distribution surface, a data network substrate, a lineage-recorded memory, and a thermal-coupling interface under one architectural primitive. The element's in-service operation is itself a credentialed event recorded in the lineage chain, so that the substrate carries its own operational provenance rather than referring that record to an external system.

The chain composes with the building energy management system, which signs state-of-health attestations declaring the realized storage capacity, power capacity, cycle count, calendar age, round-trip efficiency, fault history, and degradation indicators of each credentialed element, and records each dispatch event in lineage. The end-of-storage-life substate is signed by the building energy management system under evidential weighting, and authority revocation is handled through the credentialed-revocation primitive of the Identity Application, with revocation events propagating through the lineage chain and honored prospectively at admissibility evaluation time.

Composition with the continuous re-credentialing primitive means each in-place material flow that refreshes, augments, or substitutes the storage substrate is recorded as a credentialed event signed by an installer authority, and the substrate's composite admissibility profile is re-evaluated against the cumulative material flow. Downstream dispatch decisions are evaluated against the composite admissibility profile in force, and the access-evaluation module of the building energy management system produces admit, deny, or partial-admit determinations. The chain thus carries operational significance beyond audit: it is the live record against which credentialed access is evaluated.

Closed-Loop Versus Open-Loop Material Flow

The closed-loop carbon substrate flow is structurally distinct from open-loop end-of-life processing by retaining the substrate's carbon mass within the credentialed structural-storage system across arbitrarily many recyclings, the only mass losses being processing inefficiencies. Where the substrate carries turbostratic graphene, end-of-structural-life concrete is crushed and graded, the carbon-rich fraction is separated from the cementitious-aggregate fraction, the separated fraction is subjected to a flash re-graphenization event restoring electrochemical performance, the recovered turbostratic graphene is independently re-credentialed by a recycler authority, and the re-credentialed material is entered into a subsequent structural-storage admissibility profile at the recovered grade.

The lineage chain records each of these transitions as a credentialed event signed by the appropriate authority, so the recovered material's provenance is carried forward rather than reset at each recycling. Continuous re-credentialing during the in-service lifetime supports a metabolic-lifetime model in which the substrate's credentialed identity persists across material flows while the material flows themselves are credentialed transitions in the lineage chain, and biogenic carbon-credit attestations migrate with the substrate across material flows and across structural lifetimes through credentialed transactions signed by an environmental-credit authority. The chain thereby forms a directed graph of credentialed transitions persistent across multiple structural lifetimes.

Consumption At Admissibility Evaluation

The lineage chain is consumed at admissibility evaluation time. The cryptographic-signature scheme follows the keyless-identity-through-continuity primitive of the Identity Application, providing classical public-key signature compatibility while admitting continuity-based identity verification, so that each recorded event is bound to the credentialed identity of the authority that signed it. Authority revocation is handled

through the credentialed-revocation primitive of the Identity Application, and revocation events propagate through the lineage chain and are honored prospectively at admissibility evaluation time.

The building energy management system discovers credentialed structural elements, characterizes admissibility, and aggregates the distributed capacity into a coherent storage resource. Its attestation module signs state-of-health attestations declaring the realized storage capacity, power capacity, cycle count, calendar age, round-trip efficiency, fault history, and degradation indicators of each credentialed element, and its access-evaluation module evaluates incoming credentialed-access requests against the composite admissibility profile, producing admit, deny, or partial-admit determinations. Profile versioning is maintained through monotonically increasing version vectors with conflict-resolution policies, so that an evaluator resolves to the profile version in force.

Each lifecycle transition is queryable by the authority class to which it is addressed. A methane-avoidance attestation recorded in the lineage chain of produced turbostratic graphene is independently queryable by environmental-credit authorities and admissibility-evaluable by carbon-market participants, and a demolition-recovery attestation produced at end-of-structural-life decommissioning declares the recovered material's grade, mass, and physical state for the recycler authority that performs recycling-grade re-credentialing.

Disclosure Scope

This article describes subject matter disclosed in U.S. Provisional Application No. 64/050,895. The disclosure scope encompasses any persistent lineage chain that records credentialed events associated with a credentialed material, element, or assembly, including pre-installation credentialing, in-service operational dispatch events, state-of-health attestations, end-of-storage-life updates, decommissioning attestations, and re-credentialing attestations, with each lifecycle transition signed by

an appropriate authority and recorded in the lineage chain. Coverage extends across the cradle-to-cradle credentialed substrate flow spanning pre-installation credentialing, in-service credentialed operation, end-of-storage-life substate, end-of-structural-life decommissioning, recycling-grade re-credentialing, and re-installation, and across continuous re-credentialing across operational material flows under the metabolic-lifetime model. Coverage further extends across composition with the substrate-mode-storage primitive, the building energy management system, the migrating carbon-attestation primitive, and the credentialed-revocation primitive of the Identity Application, with profile versioning maintained through monotonically increasing version vectors and authority revocation honored prospectively at admissibility evaluation time.

Credentialed Surfaces (/credentialed-materials)

All 40 steps → (/inventive-steps)

Building surfaces as credentialed agents that participate in the structure's networking and electrical systems.

Provisional application

PRIMARY TECHNICAL DISCLOSURE

- credentialed-building-materials-cryptographic-admissibility-for-structural-surfaces (/articles/credentialed-building-materials-cryptographic-admissibility-for-structural-surfaces)

SECONDARY TECHNICAL

- credentialed-materials/carbon-sequestration-property-surface (/articles/credentialed-materials/carbon-sequestration-property-surface)
- Composition Rules Governing Surface Interactions (/articles/credentialed-materials/composition-rules)
- Decommissioning And Re-Credentialing Attestation (/articles/credentialed-materials/decommissioning-and-recredentialing)
- Electrical-Distribution Admissibility Surface (/articles/credentialed-materials/distribution-property-surface)

- credentialed-materials/end-of-storage-life-attestation (/articles/credentialed-materials/end-of-storage-life-attestation)
- credentialed-materials/energy-storage-property-surface (/articles/credentialed-materials/energy-storage-property-surface)
- **Lineage Chain Across Material Lifecycle (/articles/credentialed-materials/lineage-chain-across-lifecycle)**
- Master Credential Signature Binding All Property Surfaces (/articles/credentialed-materials/master-credential-binding)
- Multi-Authority Signature Block (/articles/credentialed-materials/multi-authority-signature-block)
- Data-Networking Admissibility Surface (/articles/credentialed-materials/network-property-surface)
- Profile Versioning Continuity (/articles/credentialed-materials/profile-versioning-continuity)
- credentialed-materials/structural-property-surface (/articles/credentialed-materials/structural-property-surface)
- credentialed-materials/thermal-property-surface (/articles/credentialed-materials/thermal-property-surface)
- Versioned Admissibility Profiles With Lineage Chain (/articles/credentialed-materials/versioned-profiles-with-lineage)
- credentialed-materials/water-coupled-property-surface (/articles/credentialed-materials/water-coupled-property-surface)

Credentialed Surfaces overview → (/credentialed-materials)