Persistent Infrastructure Identity (PIID)

Establishing a Digital Identity Layer for the Built Environment

White Paper v1.2

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Abstract

The global built environment generates extensive operational information across the lifecycle of infrastructure assets. Design documentation, construction records, inspection reports, maintenance histories, and risk assessments accumulate over decades of asset operation.

Despite the growing digitization of infrastructure systems, the physical assets themselves rarely maintain a persistent digital identity across the many systems used to design, construct, operate, and insure them. As a result, infrastructure lifecycle records often become fragmented across platforms, organizations, and ownership transitions.

This white paper introduces Persistent Infrastructure Identity (PIID), a framework designed to assign infrastructure assets a stable digital identity that remains associated with the asset throughout its lifecycle.

The PIID framework establishes an identity layer for the built environment, enabling lifecycle records generated across different systems and stakeholders to remain connected to the same physical asset.

The framework is implemented through the UMIP infrastructure identity registry, which issues persistent identifiers and supports governed lifecycle record continuity for infrastructure assets.

1. Introduction

Infrastructure assets operate across long operational lifespans and complex stakeholder ecosystems.

Buildings, industrial facilities, infrastructure networks, and other physical assets generate large volumes of operational data across multiple lifecycle phases. These records may include engineering documentation, construction records, maintenance activities, inspection reports, and risk mitigation improvements.

While the systems used to manage infrastructure information have become increasingly digital, the physical assets themselves often lack a stable digital identity capable of linking these records across systems.

Instead, infrastructure information is frequently distributed across independent platforms operated by various stakeholders.

Over time, this fragmentation can make it difficult to reconstruct the historical lifecycle of an infrastructure asset.

Persistent Infrastructure Identity introduces a framework designed to address this structural challenge.

2. The Infrastructure Identity Gap

Infrastructure lifecycle information is typically distributed across multiple stakeholders and digital systems.

Examples include:

• engineering design systems

• construction management platforms

• facility management systems

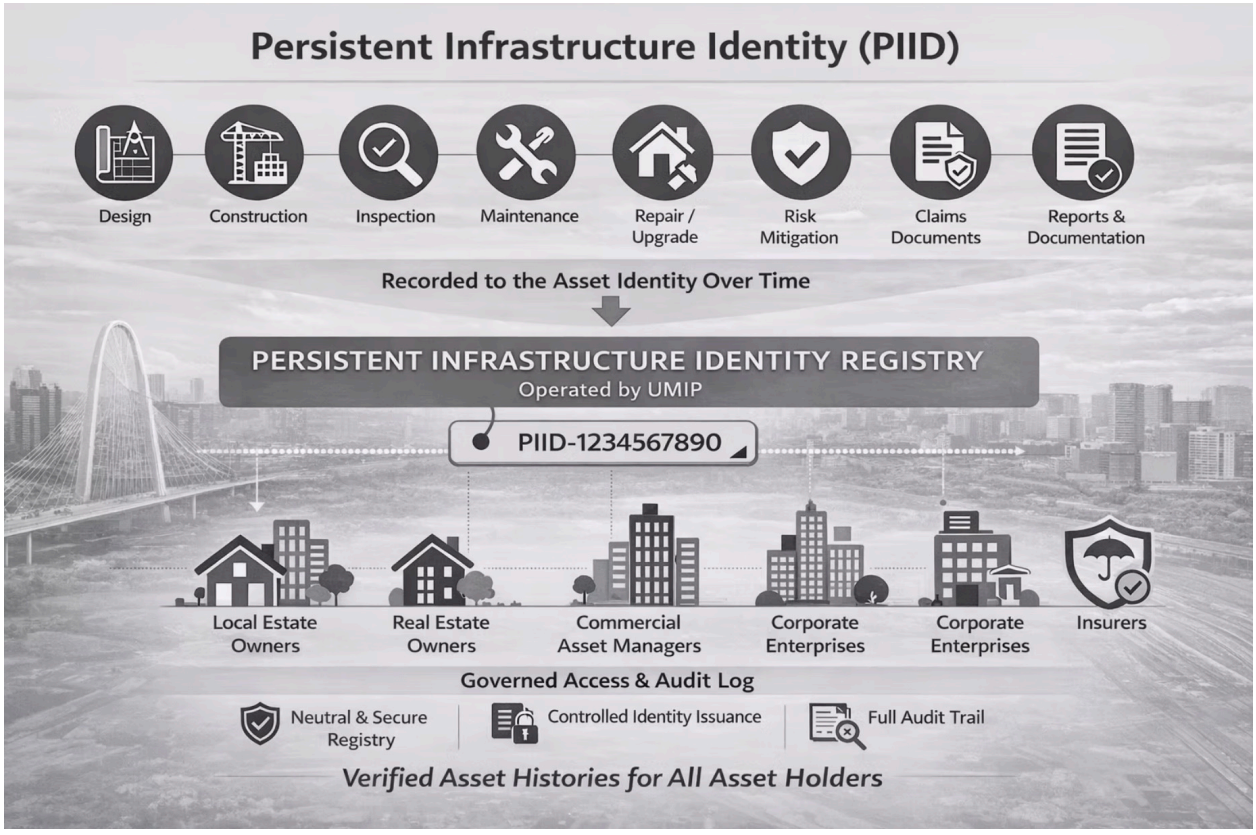
• inspection documentation systems

• insurance risk evaluation platforms

Each of these systems may assign its own internal identifiers to infrastructure assets.

Because these identifiers are not persistent across systems, infrastructure records may become fragmented over time.

This fragmentation contributes to what can be described as the Infrastructure Identity Gap — the absence of a stable identity reference capable of linking infrastructure lifecycle information across systems and stakeholders.


Persistent Infrastructure Identity (PIID)
Design
Construction
Inspection
Maintenance
Repair / Upgrade
Risk Mitigation
Claims Documents
Reports & Documentation
Recorded to the Asset Identity Over Time
PERSISTENT INFRASTRUCTURE IDENTITY REGISTRY
Operated by UMIP
PIID-1234567890
Local Estate Owners
Real Estate Owners
Commercial Asset Managers
Corporate Enterprises
Corporate Enterprises
Insurers
Governed Access & Audit Log
Neutral & Secure Registry
Controlled Identity Issuance
Full Audit Trail
Verified Asset Histories for All Asset Holders

3. The Concept of Persistent Infrastructure Identity

Persistent Infrastructure Identity introduces the concept of assigning infrastructure assets a stable digital identifier that persists across the lifecycle of the asset.

This identifier functions as the permanent digital identity of the infrastructure asset.

Lifecycle records generated by different stakeholders can attach to this identifier, allowing infrastructure information to remain connected across systems and organizations.

Similar identity frameworks exist in other industries:

• VIN numbers uniquely identify vehicles

• CUSIP identifiers identify financial securities

• Domain registries identify internet domains

In each case, the identity layer enables multiple systems to reference the same asset through a shared identifier.

Persistent Infrastructure Identity applies a similar identity model to the built environment.

4. The UMIP Infrastructure Identity Registry

The Persistent Infrastructure Identity framework is implemented through the UMIP infrastructure identity registry.

The registry performs three core functions:

Infrastructure Identity Issuance

The registry issues Persistent Infrastructure Identity Identifiers (PIIDs) for infrastructure assets.

Each identifier serves as the permanent digital identity of the asset.

Identifiers remain associated with the asset across ownership changes and system transitions.

Lifecycle Record Continuity

Lifecycle records generated across the infrastructure lifecycle may attach to the identifier.

Examples include:

• engineering documentation

• construction records

• inspection reports

• maintenance activities

• repair and upgrade documentation

• insurance inspection data

These records accumulate into a longitudinal lifecycle history for the asset.

Identity Resolution

The registry provides a shared identity reference that allows multiple systems to interact with the same infrastructure asset.

This enables interoperability across infrastructure systems without requiring direct system integration.

5. Infrastructure Identity Architecture

The infrastructure identity system consists of several core architectural components.

These include:

Identity Registry

The registry issues and maintains persistent identifiers.

Identity Resolution Layer

Allows infrastructure systems to reference assets through the shared identifier.

Lifecycle Record Framework

Infrastructure lifecycle events attach to the persistent identifier over time.

Access Control Framework

Role-based access permissions allow multiple stakeholders to contribute lifecycle records under governed participation rules.

6. Governance Principles

Infrastructure identity registries must function as trusted digital infrastructure.

The PIID framework incorporates governance principles designed to support long-term system stability.

Neutral Infrastructure Position

Infrastructure identifiers are tied to the physical asset rather than to any individual organization.

Identity Continuity

Identifiers remain persistent across ownership changes and system transitions.

Registry Integrity

The registry incorporates safeguards designed to prevent duplicate or conflicting infrastructure identities.

Lifecycle Record Preservation

Lifecycle records maintain an append-only structure to preserve historical continuity.

7. Applications for Insurance and Risk Evaluation

Persistent infrastructure identity has potential applications across several areas of infrastructure lifecycle management.

In insurance environments, persistent infrastructure identity may support:

• improved verification of maintenance history

• enhanced visibility into infrastructure lifecycle records

• reduced documentation fragmentation

• improved risk evaluation transparency

By linking lifecycle records to persistent infrastructure identifiers, insurers may gain improved visibility into the operational history of infrastructure assets.

8. Global Infrastructure Identity Expansion

Infrastructure systems operate across global markets and jurisdictions.

The PIID framework is designed to support globally unique identifiers capable of referencing infrastructure assets across regions.

Identifiers may incorporate structured geographic components such as:

- country codes
- regional identifiers
- jurisdictional references

This structure enables the infrastructure identity framework to scale across international infrastructure environments.

9. Current Development Progress

The development of Persistent Infrastructure Identity has progressed from conceptual framework toward operational implementation.

Key milestones include:

- development of the PIID identity framework
- establishment of the UMIP infrastructure identity registry
- issuance of the first Persistent Infrastructure Identities
- development of governance and registry architecture
- engagement with institutional stakeholders exploring pilot programs

These developments represent early steps toward establishing persistent identity infrastructure for the built environment.

10. Future Research and Development

The infrastructure identity framework continues to evolve through ongoing research and development.

Areas of ongoing exploration include:

• infrastructure lifecycle documentation frameworks

• infrastructure identity governance models

• interoperability with infrastructure lifecycle systems

• risk evaluation applications

• global infrastructure identity networks

As infrastructure systems continue to digitize, identity frameworks may play an increasingly important role in supporting lifecycle continuity across the built environment.

11. Conclusion

The absence of persistent digital identity for infrastructure assets contributes to fragmented lifecycle records across the built environment.

Persistent Infrastructure Identity introduces a framework designed to provide infrastructure assets with stable digital identities capable of linking lifecycle information across systems and stakeholders.

Through the establishment of the UMIP infrastructure identity registry, the PIID framework seeks to introduce a foundational identity layer for infrastructure assets.

As infrastructure systems continue to evolve and digitize, persistent identity frameworks may become an important component of infrastructure lifecycle management.

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