Link Genetic

LINK GENETIC
STAY UNBROKEN

TPAC 2025 Breakout submission

Monday, 10 November 2025, 17:00–18:00 Japan Standard Time

LinkID – Toward a Persistent Identifier Standard for Hyperlinks

Resilient, Bidirectional, and Persistent Linking for a Sustainable Web

Presented by:

- Christian Nyffenegger, Founder & CEO, Link Genetic
- Daniel Fragoso, Software Developer, Link Genetic
- Gabriela Tazima, Customer Success, Link Genetic

Agenda

LINK GENETIC
STAY UNBROKEN

1. Introduction “TPAC 2025 Breakout submission»
2. Agenda
3. The motivation: the scale and impact of link decay
4. Challenges
5. What LinkID?
6. Technical Architecture and components
7. What LinkID is NOT
8. Security & Privacy Principles
9. Interoperability with DOI, ARK, UUID and archives
10. Why W3C?
11. Possible standardization pathways
12. Open discussion and next steps

Motivation: The Link Decay Problem

LINK GENETIC
STAY UNBROKEN

- Over **40–70%** of links **decay** within a **few years**
- Broken links harm **accessibility, interoperability, compliance**, and **knowledge preservation**
- Massive hidden cost: maintenance, SEO loss, re-crawling, re-hosting
- Growing **CO_2 impact** due to redundant crawling and mirror duplication
- No general-purpose, cross-domain **persistent hyperlink standard** exists today

URLs were never designed for permanent identity, stability, or migration.

Challenges

LINK GENETIC
STAY UNBROKEN

- URLs depend on publisher infrastructure and hosting lifespan
- Content moves (versioning, migration, replatforming)
- Redirect chains break or expire
- Archived versions are not linked in a consistent way
- No common governance model for long-term link persistence
- Existing systems (DOI, ARK) are domain-specific or centralized

What is LinkID?

LINK GENETIC
STAY UNBROKEN

LinkID is a **persistent, unique** bidirectional **identifier** for hyperlinks.
It separates **a link's identity** from its **current URL**.

Key properties:

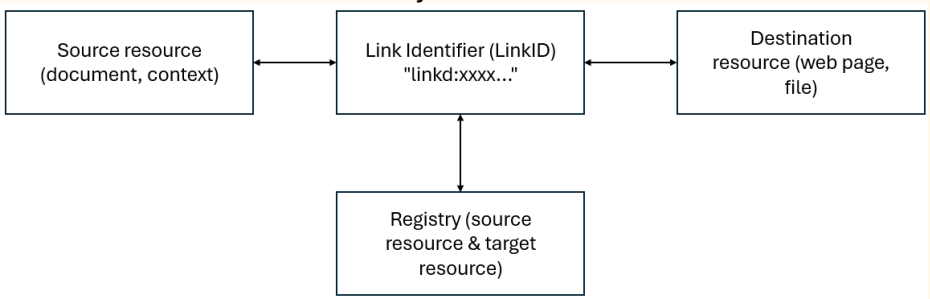
- Stable, permanent identifier: *linkid:027f6ceb-7bb9-44f9-8750-efd3fa2cfa9c*
- Can store multiple destinations (mirrors, versions, archives)
- Works across domains, platforms and content types
- No central authority required — distributed governance
- Open and extensible metadata model

Components

LINK GENETIC
STAY UNBROKEN

The patented system consists of five key components:

- **LinkID Generator** – Creates unique, persistent identifiers (e.g., linkid:7e96f229-...) using cryptographic, UUID, or AI-based algorithms.
- **Source Registry** – Records the original source of each link, including document context and author.
- **Destination Registry** – Manages one or more target resources dynamically (e.g., different URLs, versions, or mirrors).
- **Mapping Module** – Maintains bidirectional relationships between sources and destinations.
- **Resolver Module (AI-powered**) – Automatically redirects broken links to semantically equivalent resources using AI and metadata analysis.



What LinkID is NOT

LINK GENETIC
STAY UNBROKEN

- **Not** a blockchain/Web3 protocol
  → No heavy consensus, no tokens, no global ledger
- **Not** a replacement for DOI or ARK
  → Instead: complementary + interoperable
- **Not** a tracking mechanism
  → Privacy-preserving, minimal metadata
- **Not** tied to a single vendor
  → Fully open, distributed governance

Security & Privacy Principles

LINK GENETIC
STAY UNBROKEN

- Privacy-preserving by design
- No behavioural identifiers, no user-level metadata
- Identifier does not expose URLs or content
- HTTPS-only resolution
- Tamper-resistant registry entries
- Transparent auditability
- Optional local resolution (offline-safe)

Interoperability

LINK GENETIC
STAY UNBROKEN

How LinkID Fits In:

- **DOI (Digital Object Identifier):** Designed for publications → excellent for versioned, static resources, not general web linking.
- **ARK (Archival Resource Key):** Strong for archival objects → less adoption outside libraries.
- **UUID (Universally Unique Identifier):** Good for internal systems → no semantic or web-facing meaning.
- **LinkID Advantages:**
  - Web-native
  - Bidirectional
  - Metadata-rich
  - Works with *dynamic* content
  - Complements existing persistent identifier systems

LinkID is not a replacement — it fills a **gap** in general-purpose web linking.

Why W3C?

LINK GENETIC
STAY UNBROKEN

Why W3C is the right venue for LinkID

- Link decay affects accessibility, interoperability, web integrity, and long-term preservation
- No W3C-backed general persistent hyperlink mechanism exists today
- Web-scale adoption requires neutral governance
- Browsers, archives, CMSs, publishers need a shared model

W3C provides:

- Multi-stakeholder consensus
- Web Architecture review
- Community Group formation
- Test suite + implementation guidelines

Goal: **W3C Community Group → LinkID Candidate Draft (2026)**

Standardisation Path

LINK GENETIC
STAY UNBROKEN

Current status

- linkid: URI Scheme registered with IANA (provisional)
- WICG Proposal: Link Genetic Identifier (LINKID)

Next steps

- Form a **W3C Community Group**
- Align with W3C TAG, Web Architecture, and WICG
- Develop metadata model, privacy principles, and resolution behaviour
- Publish an open-source reference implementation (Apache 2.0)
- Optional: explore an **IETF draft**, if beneficial for wider adoption

Discussion and Next Steps

LINK GENETIC
STAY UNBROKEN

Suggested discussion points:

- How should LinkID integrate with existing PID systems?
- Should browsers support direct resolution?
- Governance models (distributed vs. centralized registry operators)
- Required metadata schema for cross-domain use
- Privacy boundaries and auditability
- Steps for forming a W3C Community Group

References & Links

LINK GENETIC
STAY UNBROKEN

- TPAC 2025 Issue: GitHub link
- W3C Community Group Proposal (draft)
- IANA-Registration: linkid: URI Scheme
- LinkID Repository (GitHub)
- Link Genetic Website

Closing & Contact

LINK GENETIC
STAY UNBROKEN

Christian Nyffenegger
Founder & CEO, Link Genetic GmbH
Switzerland
📧 contact@linkgenetic.com
🌐 www.linkgenetic.com
🔗 GitHub: https://github.com/Link-Genetic-GmbH/lid/
☎️ +41 58 717 70 00