

Peer Review

Review of: "Truvry: Portable, Decentralized Trust Proofs for Inclusive Digital Participation and Democratic Decision-Making"

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Review Summary

The manuscript presents **Truvry**, a decentralized protocol designed to convert behavior-based evidence into portable cryptographic proofs for democratic decision-making and digital trust. *The topic is timely and highly relevant*, particularly given the increasing reliance of democratic institutions on verifiable digital trust systems and the challenges of inclusion, transparency, and AI-mediated governance.

Strengths

1. Relevance and Novelty

- The work tackles a pressing issue: digital trust mechanisms beyond traditional identity-based systems.
- Framing trust as “portable behavioral proofs” is *conceptually novel* and significant for democratic governance contexts.

2. Interdisciplinary Scope

- The paper bridges cryptography, digital identity, and democratic governance, appealing to both technical and policy audiences.

3. Prototype Results

- Empirical performance metrics (issuance latency, verification time, entropy, cost) demonstrate feasibility.
- Zero-knowledge compatibility is a forward-looking design choice.

4. Literature Review

- The review is well done, showing awareness of relevant decentralized identity and trust frameworks.
- Subsection 2.4 (“Positioning Truvry”) could be further enhanced to clearly demonstrate **how Truvry compares with W3C DIDs, verifiable credentials, and other state-of-the-art solutions**, making its novelty more explicit.

Points Requiring Enhancement

1. Research Objectives and Hypotheses

- The paper addresses the stated objectives and hypotheses, but articulation is not always systematic.
- *A stronger alignment between hypotheses, methodology, and results is needed to clearly demonstrate how objectives are met.*

2. Methodology and Compliance-by-Design

- The simulation methodology is well-described, but reliance on synthetic data raises ecological validity concerns. Empirical validation or pilot deployment would strengthen the claims.
- Compliance is discussed in Section 6.3 (cross-border data compliance), but the manuscript should **demonstrate compliance-by-design directly in the use case** and show how the protocol ensures regulatory alignment in practice.
- Validation metrics (91% precision) are promising but would benefit from broader evaluation dimensions: recall, robustness under adversarial behavior, and scalability.

3. Scalability and Governance

- Discussion on scaling across jurisdictions and governance implications (e.g., verifier control, bias mitigation in peer attestations) could be more detailed.

4. AI Integration

- Concrete examples of how Truvry proofs **feed into AI-mediated governance pipelines** (e.g., participatory budgeting, digital referenda) would strengthen the argument.

5. Clarity and Structure

- Some sentences are dense; separating design and results in the introduction would improve readability.
- Ensure consistent terminology and proper formatting of references. A structured abstract with Objectives, Methods, Results, Implications is recommended.

Summary and Recommendation

The paper is **well done** and presents a promising approach to decentralized trust and digital identity. The literature review is good (**still more work is needed**) and the prototype demonstrates potential.

However, to strengthen the manuscript, the authors should:

- More explicitly demonstrate compliance-by-design in the use case.
- Clearly align research hypotheses with methodology and results.
- Enhance positioning against state-of-the-art frameworks (W3C DIDs, verifiable credentials).

Recommendation : Weak Accept

The work is promising and addresses an important problem. With focused improvements on compliance demonstration, hypothesis articulation, and positioning in the literature, the paper could make a meaningful contribution to the community.

Declarations

Potential competing interests: No potential competing interests to declare.