

16TH ITU ACADEMIC CONFERENCE

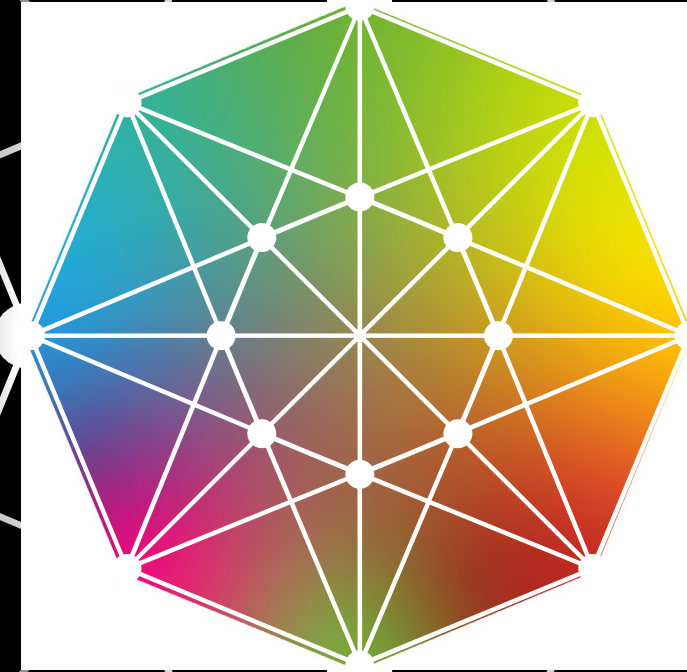
ITUKALEIDOSCOPE

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*AI and frontier
technologies for good*

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Global Summit



Internet voting is aged, but it is not old. The challenge is making it governable, recoverable, and trustworthy.

AI-Enabled Internet Voting as a Secure Digital Public Service

A biometric and ledger-based reference architecture

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Name of presenter

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Session #5.2

Built for the least digitally confident voter

*No rocket science — a realistic security posture: end devices may be compromised, but compromise will be **very hard** to hide and **very easy** to recover.*

Assume devices can lie

Detection and recovery are designed in: independent vote choice verification and supervised re-voting, not blind trust in the client.

Keep the voter path simple

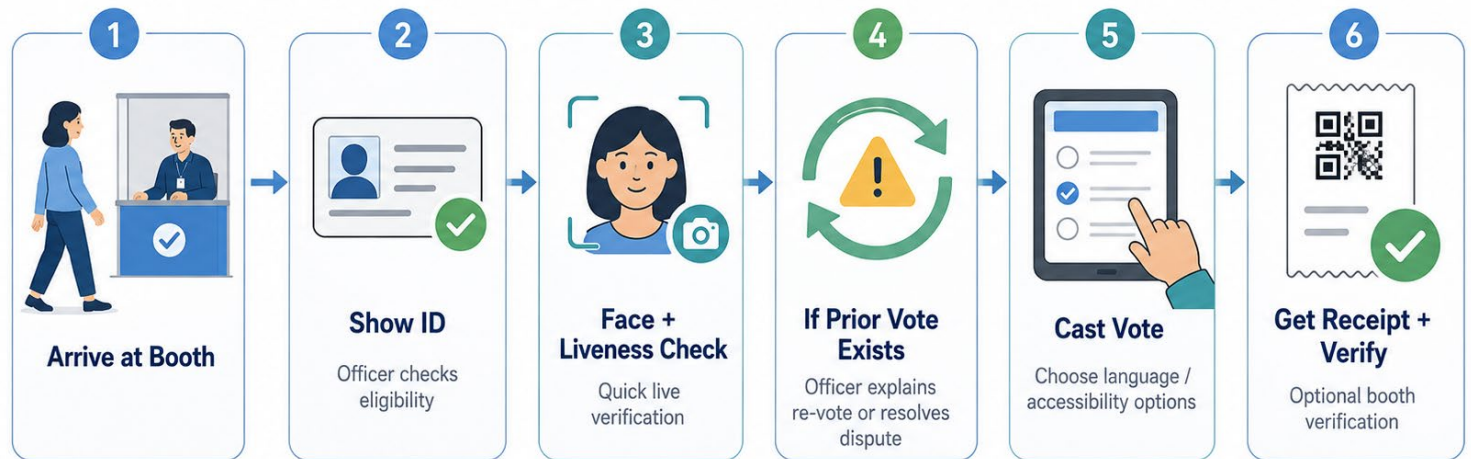
Internet voting has a huge attack surface; a complex voter-facing system defeats its own purpose. Complexity is at the server level, not the voter interface.

Include the excluded first

Designed for citizens held back by literacy, disability, connectivity, mobility, or social disadvantage.

Supervised Booth Voting: Simple Voter Journey

What a voter experiences at the booth



Behind the scenes



AI de-duplication



Ledger write



Receipt status check

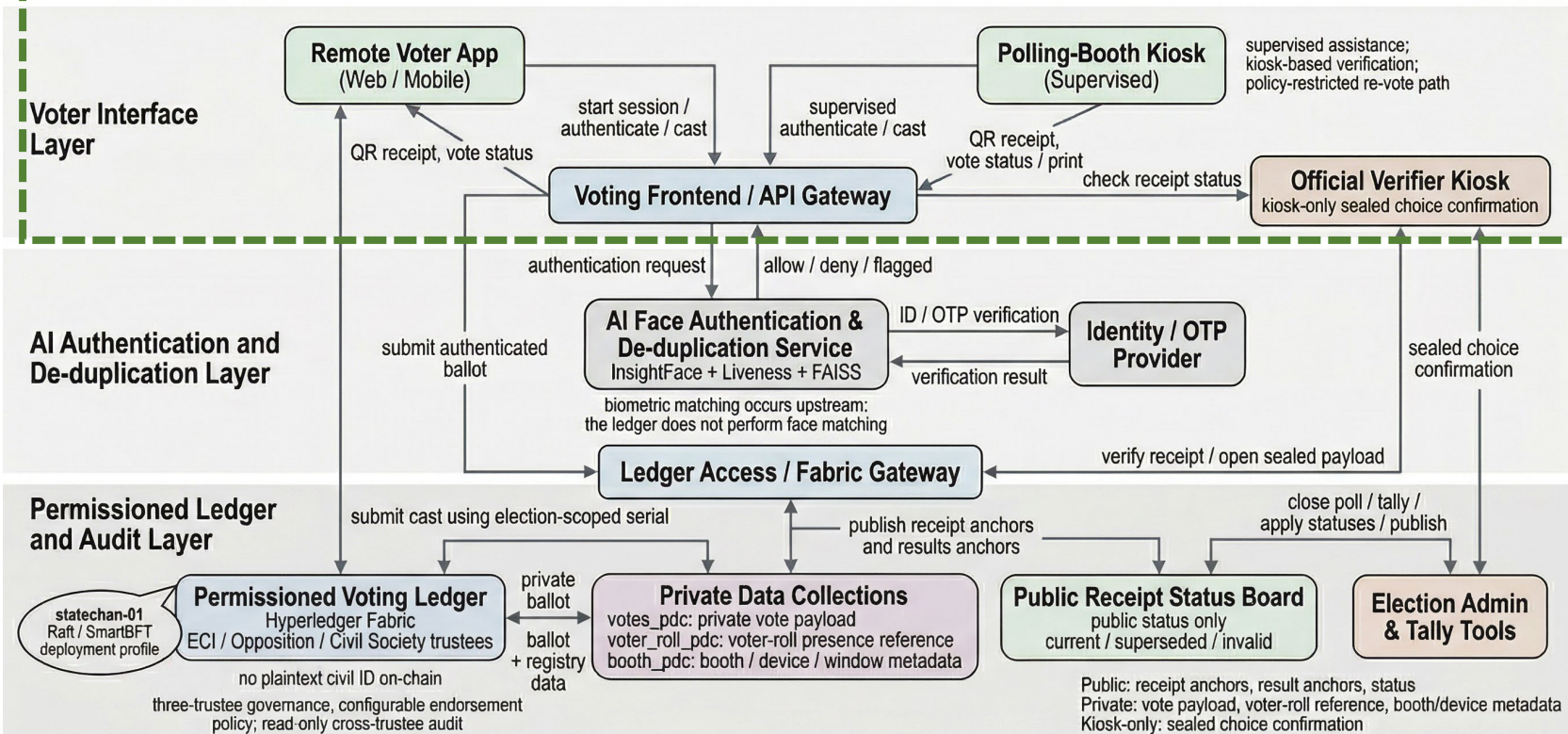


Simple for the voter.
Complex checks happen in the background.

The high level architecture

*No rocket science — a realistic security posture: end devices may be compromised, but compromise will be **very hard** to hide and **very easy** to recover.*

High-Level Architecture of AI-Assisted Internet Voting with Permissioned Ledger and QR Verification



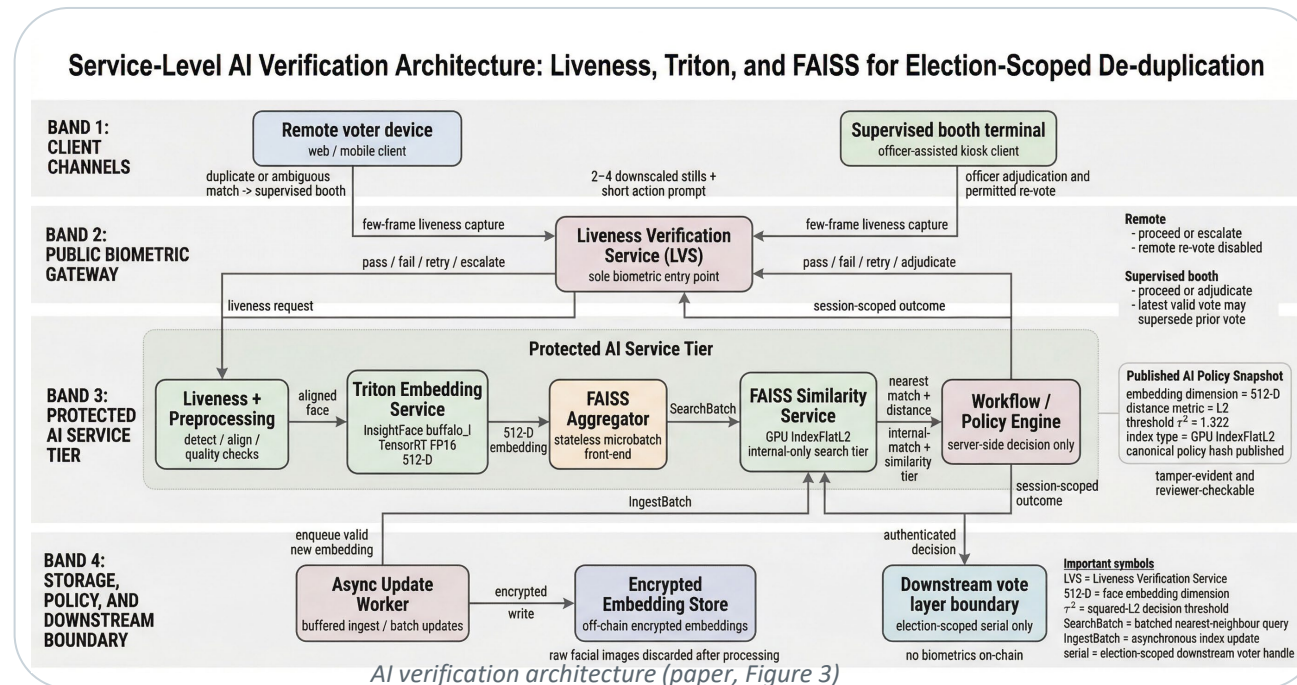
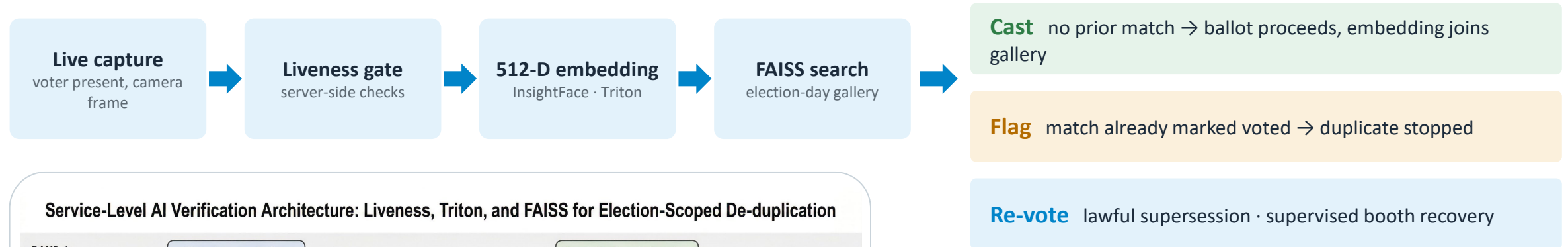
One service flow: voter interface → AI de-duplication → audit ledger (paper, Figure 1)

How to read this architecture

- The voter sees only the app/kiosk and receipt check; identity, AI, and ledger controls run behind the interface.
- **Face matching** happens upstream in the AI service; the **Fabric ledger** does not perform biometric matching.
- The **ledger** stores election-scoped serials, encrypted vote payloads, private data, and receipt anchors — not raw biometrics or plaintext civil IDs.
- The **QR receipt** checks status through the official verifier path; it is not a portable proof of candidate choice.

You against you

At the gate, the only person who can block you is your own earlier vote: every live face is checked against everyone who has already voted — in milliseconds.



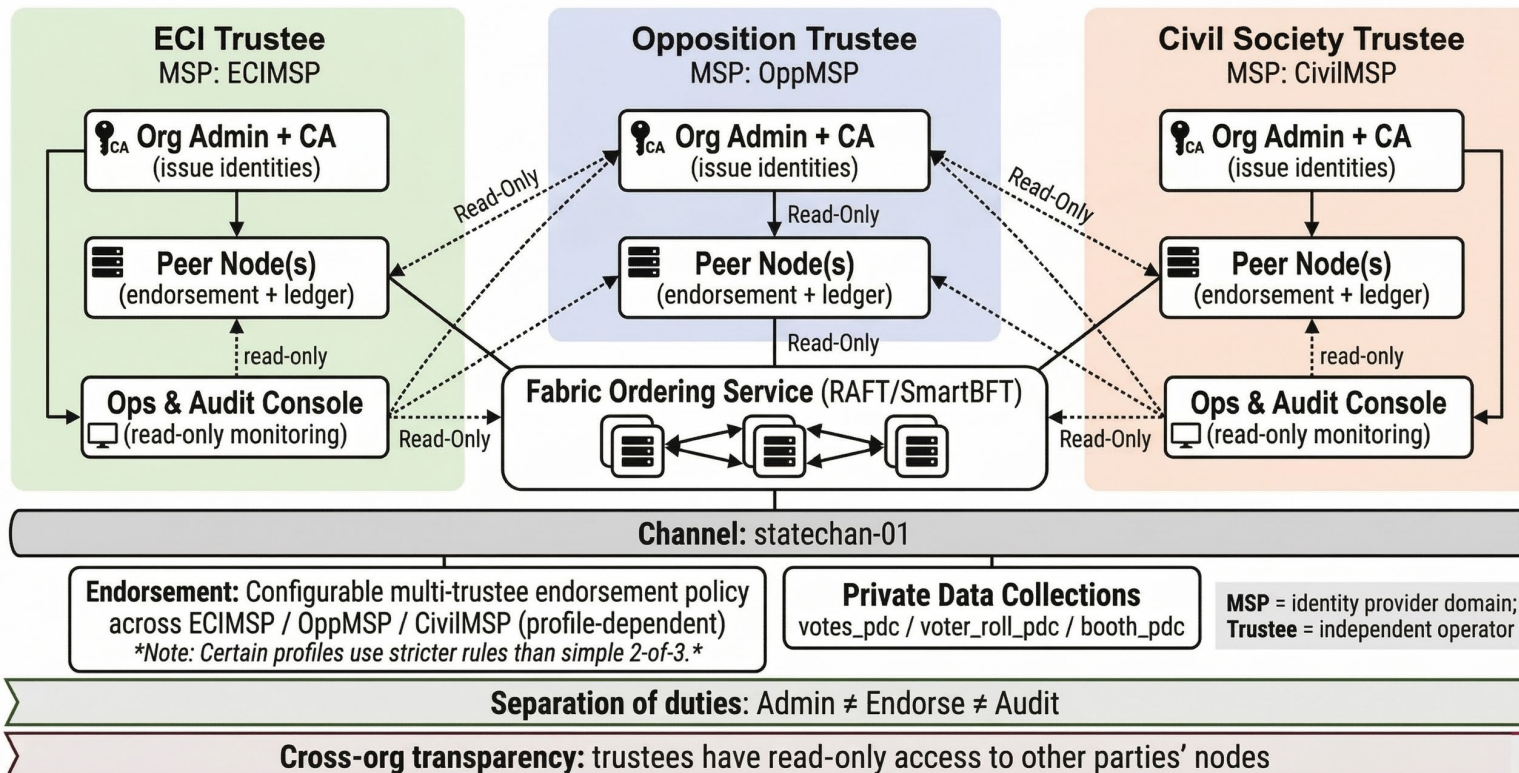
What keeps it honest

- Gallery built on the fly — no Aadhaar or EPIC photo registries behind it.
- Deployed threshold $\tau^2 = 1.322 \approx 0.1\%$ false-match operating point.
- Liveness is decided server-side before any ballot is accepted.
- Raw biometrics never leave the encrypted off-chain domain.

Trust against trust

No single institution can rewrite the record: the election authority, the opposition and civil-society trustees co-govern the audit trail.

Three-Trustee Governance Architecture for Fabric-Based Internet Voting



Three-trustee Hyperledger Fabric network · 2-of-3 endorsement (paper, Figure 4)

Encrypted payloads

Ballot content sealed under a joint election key; sensitive data in private collections.

Latest vote wins

A supervised re-vote supersedes the earlier ballot; history stays auditable, never counted twice.

Verification receipt

The QR code tells you your ballot choice under ECI-supervised kiosks — it is not portable proof of your choice.

Nothing biometric on-chain

Faces and embeddings stay off-chain and encrypted; the ledger sees only election-scoped serials.



Benchmarked at India scale

Component benchmarks anchored to a real large-electorate scenario — Uttar Pradesh phase-day demand — not to convenient laboratory numbers.

2.67× faster

InsightFace processed 1,920 faces in 29 minutes versus 77 for FaceNet512 — and caught 8 faces the baseline missed.

9,987 queries/s

FAISS de-duplication against a 1,000,000-vector gallery with 0% deadline failures.

14,933 queries/s

Sharded three-replica **FAISS** at near-peak load — failure rate 0.0067%.

690–760 tx/s

Fabric Raft RecordVote under election-linked load — above the 334–512 tx/s derived for Uttar Pradesh's heaviest phase day.

Claim discipline: benchmarked-prototype results on telecom-grade hardware — evidence for phased pilots, not a statutory deployment.
code and benchmarks: github.com/himanjim/PhDIITPatna



Utopia, with controls

Access should not depend on owning a device: a vetted, non-partisan volunteer can host a local access point — while the system, not the volunteer, stays in control.

Volunteer booth

Accredited, non-partisan operator · trusted premises · enrolled kiosk device · entry document check only



System control layer

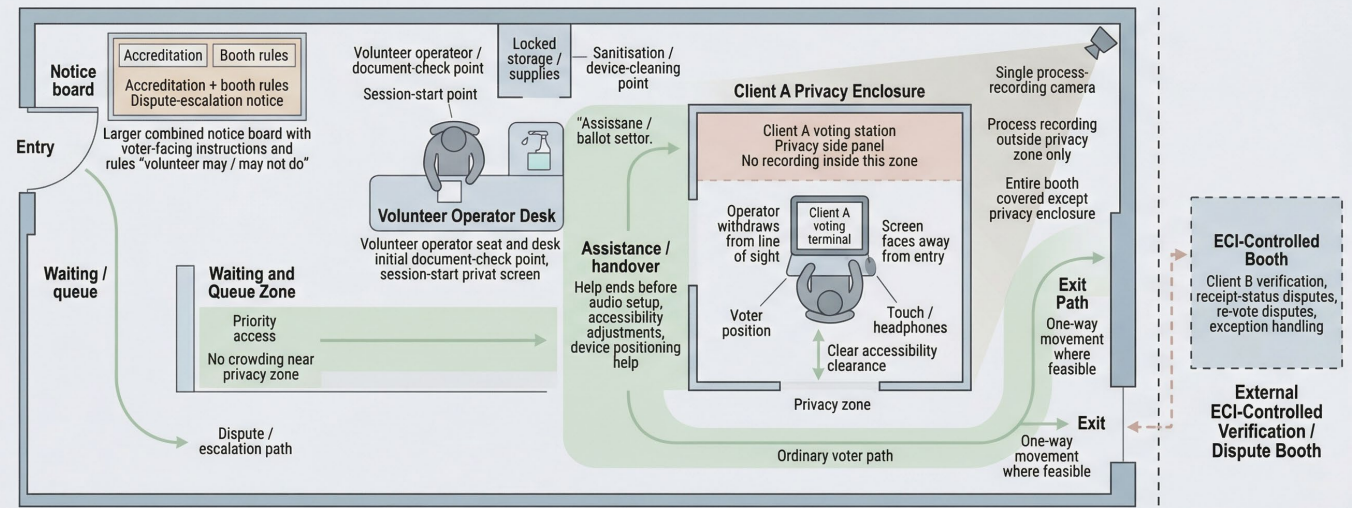
Final authority on authentication, authorization, audit and vote handling — never the volunteer



ECI-controlled point

Supervised verification (Client B) and all disputes stay with the Election Commission

Physical Layout of an Accredited Volunteer Polling Booth: Privacy, Process Recording, Queue Management, and Controlled Device Use



Physical layout of an accredited volunteer booth: privacy zoning, controlled sightlines, off-site verification (ICEGOV paper, Figure 3)

Pilot concept only: community-operated booths remain riskier than state-operated assisted models and require explicit legal enablement.

Not internet voting at any cost

A recoverable, benchmarked, governance-aware digital public service architecture for inclusive voting.

AI

Live uniqueness

One person, one final vote — enforced at voting time by liveness and FAISS de-duplication, with no photo registry behind it.

Ledger

Distributed audit

Three trustees co-sign an encrypted, append-only record with latest-vote-wins recovery and currentness receipts.

Governance

Inclusion and trust

Designed for the least confident voter: supervised recovery, volunteer access points, and claims that stay inside the evidence.

“A vote that is easy to cast, hard to fake, and possible to repair.”

Thank you!

