

Concept of ‘Individual Candidate Record Isolation’ in Voting

Author: Dr. Gulzar Singh

Multi Electroni-Cal Systems Co., India

Email: gulzarindri@gmail.com

DOI: 10.26821/IJSHRE.13.05.2025.130501

Abstract

This paper explores the challenges faced by global voting technology developers and voting equipment manufacturers. Traditional voting systems, including Electronic Voting Machines (EVMs) and paper-based voting, present significant security, transparency, and accessibility issues. The author presents an Indigenous Voting System (IVS) which provides a secure voting mechanism to address these challenges. The concept of IVS is based on Individual Candidate Record isolation (ICRI). The concept of ICRI in the voting records has been implicitly implemented and used in different forms without mentioning this terminology in the literature. This is the first paper to use the terminology of ICRI in voting. In this paper, the author discusses types, impact and recommendation of ICRI and presents a theoretical discussion, based on historical and current voting systems to bring out the various implicit aspects of ICRI. Further, this paper identifies the subtypes of Individual Candidate Record Isolation (ICRI) and categorizes them into No ICRI (NICRI), True ICRI (TICRI), and Virtual ICRI (VICRI), providing comparative analysis. It is seen that IVS proposed by the author is a TICRI-based voting system. This paper compares IVS with existing systems, focusing on its impact on the voting industry and its TICRI (True Individual Candidate Record Isolation) features. At last the challenges towards ICRI for voting equipment industry are discussed, with recommendations.

Keywords: Voting Systems, EVM, IVS, ICRI, TICRI, VICRI, NICRI.

In Short: *Individual Candidate Record Isolation == Individual Isolation*

Introduction

For true trustworthy voting, the individual candidate data/record isolation is very crucial. The vote count along with other credentials of candidate represents a person in itself. Therefore, it becomes essential that “Individual Record” also be treated as an “Individual Entity” and given due Rights similar to a human being. Though many voting techniques and theories have been developed, but there is no description of individual candidate record isolation term in the literature. In general, voting technology plays a crucial role in ensuring fair and credible elections. However, traditional voting systems, including paper ballots and EVMs, continue to raise security, trust, and logistical concerns. EVMs are losing public trust and faith despite various efforts to demonstrate their trustworthiness, while paper ballot face fraud risks and inefficiencies. Developers and manufacturers of voting equipment face increasing demands for security, transparency, and scalability. The Indigenous Voting System (IVS) presented in this paper is designed to address these challenges by integrating modern security technologies with isolation.

Research Focus: The research focus is “Individual Isolation” instead of “Voting Technology”. It is the objective to ensure True Individual Isolation in voting process during the complex and severe conditions as well.

Literature Review

In the current paper, the research issue is individual isolation in voting rather than technology. Various aspects of individual isolation like: Classification and impact on trust, society and natural intelligence of common man, are key factors to reveal. With this objective, two phrases “Candidate Data Isolation” and “Candidate Record

Isolation” were searched in various online database resources. The above two phrases were not found in any of the database; and the search results on Google, Google Scholar and Patent Scope. AI based ChatGPT and Grok were used for content creation, defining the types, classification, comparison, recommendations. Using AI based output, the past and existing voting tactics were allocated to the categories of Individual Isolation.

Individual Candidate Record Isolation (ICRI)

Types of ICRI

ICRI refers to how individual candidate vote records are isolated and secured within a voting system. The three primary types of storage of candidate records are:

1. **No Isolation:** Candidate vote records are not isolated and are stored in a shared system.
2. **Logical Isolation:** Vote records are logically separated within a shared system but are still vulnerable to certain threats.
3. **Physical Isolation:** Vote records are physically separated, ensuring stronger security and preventing unauthorized access.

Categories of ICRI

1. **No ICRI (NICRI):** In this category, vote records are not individually isolated. All votes are stored in a central system without individual-level security. Examples include traditional ballot-based voting and early EVM implementations.
2. **Virtual ICRI (VICRI):** This provides a hybrid model where vote records are logically isolated but not physically separate. This is used in some modern EVMs that store vote records electronically but lack full physical isolation. VVPAT stores individual vote slips means a logical isolation, but slips are put inside a common box means no physical isolation.
3. **True ICRI (TICRI):** This ensures complete individual vote record isolation.

IVS reported by the author, falls under TICRI in every aspect at every step.

Conditions for a System to be TICRI

A system qualifies as a True Individual Candidate Record Isolation (TICRI) system if it meets all of the following conditions:

1. **No Shared Candidate Storage:** The system must not use a shared repository (e.g., memory, database) for storing votes for all candidates.
2. **No Shared Input Processing:** The mechanism must not allow a single chip, microcontroller, FPGA, or computing device to process inputs for multiple candidates.
3. **No Shared Data Storage:** The system must not store all candidate credentials in a single memory unit or device.
4. **No Shared Hardware Infrastructure:** It must avoid shared Printed Circuit Boards (PCBs) and shared containers for handling votes of all candidates.
5. **No Shared Voting Activity Access:** The system must prevent shared access across multiple voting-related activities (e.g., symbol printing, authentication, vote tallying).
6. **Visible Isolation:** The isolation must be clearly visible to voters and candidates by the naked eye.
7. **No Remote Storage/Access:** The system must use on-site, on-device instant storage and must not have network connectivity.
8. **Other Conditions:** Additional requirements may be defined to ensure complete candidate record isolation (*Further Research needed*).

Definition: 1. Any system which violates even one of the above conditions does not qualify as TICRI and becomes either VICRI or NICRI.

2. If there is no isolation even at a single point in a voting system that becomes NICRI.

3. If there is logical isolation at even a single point of any system, that becomes a VICRI.

Table1: Comparison of NICRI, VICRI, and TICRI

Feature	NICRI (No ICRI)	VICRI (Virtual ICRI)	TICRI (True ICRI)
Security	Low	Moderate	High
Transparency	Low	Moderate	High
Integrity	Moderate	High	High
Cyber-Proof	Low	Moderate	High
Reliability	Moderate	High	High
Inclusivity	Ambiguous	Doubtful	Trustworthy

IVS as TICRI

Overview of Voting Methods and ICRI

1. **Paper-Based Voting Systems**
 - Separate ballot designs to reduce manipulation.
 - Sealed ballot boxes for secure vote storage.
 - Public vote counting with independent observers.
2. **Electronic Voting Machines (EVMs)**
 - Candidate-specific encryption in some systems.
 - Tamper-resistant hardware with standalone operation.
 - Additional redundancy through Voter-verifiable paper audit trails (VVPAT).
3. **Online Voting Systems**
 - Digital encryption and vote anonymization.
 - Remote vulnerability concerns.
4. **Mixed and Ranked Choice Voting**
 - Ranked choice tabulation ensures separate vote handling.
 - Multi-round counting procedures.
5. **Postal and Proxy Voting**
 - Double envelope security for postal votes.
 - Strict chain-of-custody rules for ballot tracking.

The Indigenous Voting System (IVS) is an advanced TICRI-based voting solution. It ensures that each candidate’s vote record is individually secured through strict physical isolation, making the system highly transparent and tamper-proof. Unlike traditional systems that store votes in a centralized manner, IVS distributes vote records securely, individually, preventing unauthorized modifications and ensuring trust in election outcomes.

Challenges for Voting Technology Developers and Manufacturers

Voting technology developers and equipment manufacturers encounter several challenges, including:

- **Security Vulnerabilities:** EVMs and online voting systems remain targets for cyberattacks.
- **Transparency Issues:** Existing voting systems lack public auditability.
- **Logistical Complexities:** Managing secure and scalable elections remains a challenge.
- **Regulatory Compliance:** Meeting global standards which may vary across regions.
- **Adoption Resistance:** Transitioning from legacy systems involves political and institutional hurdles.

TICRI Framework and IVS Implementation

The TICRI framework defines the core principles for an effective and secure voting system:

TICRI acronym as a dual phrase:

1. True Individual Candidate Record Isolation (TICRI)
2. Transparency, Integrity, Cyber-proof, Reliability, Inclusivity (TICRI)

- **Transparency:** Open and verifiable election processes.
- **Integrity:** Prevention of fraud and manipulation.
- **Cyber-proof:** Protection against hacking and cyber threats.

- **Reliability:** Ensuring consistent and accurate vote counting.
- **Inclusivity:** Making voting accessible to all eligible voters.

The IVS integrates all the principles of TICRI framework ensuring a tamper-proof and robust voting system.

Security and Performance Comparison

IVS enhances security and performance through:

- **Decentralized Infrastructure:** Eliminates single points of failure.
- **Immutable Data Storage:** Ensures vote transparency and auditability.

Table 2: TICRI-Based Comparison of Voting Systems

Feature	Paper Ballots	EVMs	IVS
Transparency	Moderate	Low	High
Integrity	Low	Moderate	High
Cyber-proof	Low	Moderate	High
Reliability	Moderate	High	High
Inclusivity	Ambiguous	High	High

EVM vs. IVS: A Comparative Analysis

The following table provides a detailed comparison between EVM and IVS methods based on critical voting system factors:

Table 3: EVM and IVS Features Comparison

#	EVM Method	IVS Method
1	Shared Vote Asset system	Individual Vote Asset system
2	Shared voting device	Individual voting device
3	Requires continuous power	Power loss has no impact
4	No secure copy of votes	Secure copies immediately provided

5	Candidates cannot secure their data	Candidates can secure their data
6	Security depends on transport and other protocols	Distributed security responsibility
7	No multi-stage selection	Multi-stage selection possible
8	Stored inside EVM only	Multiple copies securely stored
9	No immediate upload	Data uploaded immediately
10	Printed slips cut/stored	Printed as continuous roll
11	VVPAT is only verification	Multiple verification copies exist
12	Record store isolation not visible	Visible isolated record storage
13	Counting takes a day	Instant results
14	No external progress display	Voting progress displayed externally
15	Configuration few days earlier	On Booth Configuration

Conclusion

The global voting technology landscape presents significant challenges for developers and manufacturers. The IVS model addresses these issues by enhancing security, transparency, and scalability. By adhering to the TICRI framework and incorporating True Individual Candidate Record Isolation (TICRI), IVS provides a robust alternative to traditional voting systems. Further research and pilot implementations are required to evaluate its large-scale feasibility and industry adoption. On the other side, the evolution of new terminologies, NICRI, VICRI and TICRI poses a challenge for voting technology developers and equipment manufacturers to ensure the TICRI in voting. This paper opens path to establish the global standardization levels of TICRI.

References

1. "Voting Machines: History, Security, and Potential Problems," FindLaw, 2024. [Online]. Available: <https://www.findlaw.com>
2. "Voting Technology Security Analysis" Grok, 2024. [Online]. Available: <https://grok.com>
3. "Analysis of EVM Vulnerabilities" ChatGPT, 2024. [Online]. Available: <https://chatgpt.com>
4. "Paper Ballot Security Concerns" ChatGPT, 2024. [Online]. Available: <https://chatgpt.com>
5. "Blockchain-Based Voting Systems" ChatGPT, 2024. [Online]. Available: <https://chatgpt.com>
6. "Global Electronic Indigenous Voting System", Dr. Gulzar Singh, *National Conference on Emerging Micro/Nano-Electronic: Devices, Technology and VLSI Design* EMNE-2024.