

**Rapid Architecture-Based Election  
Technology Verification (RABET-V)**

# Final Pilot Summary and Next Steps

March 2023

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With the support of these individuals and organizations, CIS has demonstrated a new approach to testing of non-voting election technology. With their guidance and support, the RABET-V process is ready to become a permanent fixture in the election community.

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## Pilot Technology Providers

The following Technology Providers donated time and provided access to their systems to execute the pilots.

Electronic Systems & Software  
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KNOWiNK  
[Electronic Pollbook](#)

Runbeck  
[Organizational Assessment](#)

State of South Carolina and Kopis  
[Voter Registration System](#)

VR Systems  
[Electronic Pollbook and Election Night Reporting](#)

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# Executive Summary

Since 2019, the Center for Internet Security (CIS) has been working to fill gaps in the security of non-voting election technology. This began with the publication of [Security Best Practices for Non-Voting Election Technology](#) and continued with the development and piloting of the Rapid Architecture-Based Election Technology Verification (RABET-V™, pronounced "rabbit-vee") process.<sup>1</sup> In 2020, we released a [report on our first pilot phase](#), and in 2021, we began a second pilot to implement lessons learned and test additional aspects of the process.<sup>2</sup>

This is the final report for the development and piloting phase of RABET-V. It covers specifics about the second pilot phase, lessons learned, and updates to prior reports. If you are unfamiliar with RABET-V, we suggest you read our [whitepaper](#). While many aspects of the process have evolved since the publication of this whitepaper, the fundamental concepts still apply.

We also recommend you stay up to date with CIS's efforts in RABET-V through our [website](#).

RABET-V is a unique approach to verifying election technology products. Instead of employing a monolithic and lengthy approach to testing conducted after a system is fully developed or modified, it uses an iterative, risk-based approach that supports rapid product changes by design and is more aligned with modern software development, testing, and deployment practices.

The risk estimate is based heavily on the product's architecture and provider's software development processes. Lower risk changes may be tested using streamlined methods, while higher risk changes may require more in-depth testing for verification across versions. It provides incentives for technology providers to design products with stronger organizational processes and preferred architectures, as this eases the testing process by reducing the time and cost associated with verification.

To determine the viability and effectiveness of RABET-V, we conducted six iterations of the RABET-V process between 2020 and 2023. We received feedback from a steering committee composed of election officials, a technical advisory committee composed of security experts, and five technology providers who participated in the process, not to mention many hours of other community feedback.

We learned a great deal from these pilots and have improved the process along the way. While we continue to refine, update, and respond to new challenges, circumstances, and evolutions in the election space, we've determined the following:

- 1 **RABET-V produces results** that help technology providers, election offices, and the community.
- 2 **Organizational and Architectural assessments help understand a product's risk** in downstream changes and can be effectively used to scale the testing process.
- 3 **RABET-V provides quick, reliable verification of non-voting election technology products with substantial cost and time efficiencies** over traditional testing methods.
- 4 The assessments' **scores and feedback provide incentives for continual improvement.**

We hope you enjoy this final pilot report and help us make RABET-V a fixture in the election community.

<sup>1</sup> Patent pending "RABET-V: A Better Way to Test and Verify Election Technology."

<sup>2</sup> In this document, the first person (I/we/our) refers to CIS, which acted as the creator and Administrator for the RABET-V pilot program and the coordinator for its associated committees.

# 1 Introduction

Testing non-voting election technology has received relatively little attention compared to that of voting systems. The latter has a robust voluntary program run by the Election Assistance Commission and, in many states, additional testing requirements and procedures. Non-voting election equipment, of which by some counts there are more than two dozen product categories, have no federal testing programs and, except for electronic pollbooks (ePollbooks), little or no formal testing programs at the state or local level. Even with ePollbooks, roughly 40% of states have no requirements or formal testing regime beside general requirements that apply to all information technology.

In 2019, CIS sought to change that by developing a new approach to testing election technology that meets the needs of modern software design and development. Instead of employing a monolithic and lengthy approach to testing conducted after a system is fully developed or modified, RABET-V uses an iterative, risk-based approach that supports rapid product changes by design.

CIS, from its many engagements with vendors, election officials, and other experts in the field, has high confidence that there is demand for RABET-V. The question is how to implement it properly. As such, this report will wrap up the pilot with an eye to the future as it begins the process of making RABET-V a permanent, operational interest within the election community.

## 2 Pilot Program Recap

Over the course of two pilot phases that occurred between June 2020 and November 2020 as well as between January 2022 and March 2023, CIS ran the RABET-V process six times for five different products from four technology providers across three product categories. We piloted a maximum of two iterations and piloted one “homegrown” system.

CIS tested the following systems:

- VR Systems: EViD ePollbook (2020 and 2022)
- KnowInk: PollPad ePollbook (2020)
- VR Systems: Election night reporting software (2020)
- Election Systems & Software: ExpressPoll ePollbook (2022)
- South Carolina: SCVotes & Kopis VREMS voter registration system (2022-2023)
- Runbeck (2022, organizational assessment only)

Each RABET-V iteration required the execution of three modules: (1) an organizational assessment, (2) an architecture assessment, and (3) product testing. Together, these modules resulted in a testing report comparable to other technology verification regimes as well as a novel set of maturity scores that can better inform on risk and be used to accelerate future testing.

The process has been vetted by members of the election community and security experts. CIS has confirmed that the RABET-V process is:

- **Widely applicable to different types of non-voting election equipment.** It has already been piloted with ePollbooks, election night reporting, and voter registration systems.
- **Well-liked by the technology provider community.**
- **Seen as valuable by many election officials** as an efficient and flexible approach that can work with existing administrative structures.
- Capable of completing an **initial iteration in two months.**
- Capable of completing a **revision iteration in one week to two months** depending on the type and scale of product revisions.
- Capable of identifying organizational and architectural risks and using them as a proxy for the level of testing, allowing for **rapid repeatability and accelerated deployment.**

In addition, the RABET-V process has incorporated usability and accessibility into organizational reviews, paving the way for full inclusion of usability and accessibility modules in the future.

# 3 Lessons Learned from Pilot II

## Initial Submission

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During the initial submission, providers were asked to provide brief product goals and expected usage statements. The submissions received during the second pilot were incomplete and left some doubt about the scoping of the submission. Program administrators currently provide examples of what these requested documents should look like, but in the future, they should revise examples and seek more detailed documentation from providers. This includes the specific product configuration that is being examined by the RABET-V program.

## Revision Submission

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The revision submission that was examined during Pilot II had a change list with 369 items. A change of this magnitude required extensive analysis. This highlights the need for smaller, more frequent iterations to fully realize the benefits of RABET-V.

## Organizational Assessment Review

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The RABET-V Organizational Assessment uses the OWASP Software Assurance Maturity Model (SAMM) as the basis for its evaluation with additional assessment to include principles for usability and accessibility. It is referred to as SAMM+. The providers that participated in Pilot II are all on the upper range of normal for SAMM+ scores. Due to the size of the companies and the teams working on each of these products, there is a high level of “tribal knowledge” and a culture of security as opposed to formal documentation and structures. Although the underlying SAMM structure is more focused on formal documentation, tribal knowledge is critical and sufficient for an organization that small such that informal lines of communication are still effective. The providers that participated in Pilot II, and election technology companies in general, are small enough that they don’t yet meet the threshold of requiring formal documentation. However, as the companies and development teams grow in size, this will become more necessary. RABET-V is exploring updates or modifications to the SAMM structure to account for the effectiveness of a strong security culture in smaller organizations that may not yet be large enough for formal documentation and structure to be cost effective.

Importantly, the provider that went through a second iteration of RABET-V during Pilot II saw measurable improvements in the maturity of organizational processes. Pilot II also confirmed that a quicker, less in-depth organizational assessment is possible during a second iteration, requiring just 25% of the interview time of an initial iteration. A second iteration of the organizational assessment allowed the provider to detail changes they’ve made as a result of undergoing the RABET-V program, reinforcing the assertion that the RABET-V program can provide iterative improvements to election technology providers’ development processes.

In addition to the organizational assessments that were conducted for the three providers that went through RABET-V iterations during Pilot II, the program conducted an organizational assessment for a provider while they were designing and building a new product. Ultimately, RABET-V pilot timeline constraints led to this provider being unable to go through the entire RABET-V program. Even so, feedback gained from the organizational assessment informed their development process, which will ultimately result in a better product for the election community. This is a critical finding, as it supports an approach that can lessen the time between product completion and completed RABET-V testing. Technology providers can thus take part in an organizational assessment prior to the product’s completion and, if necessary, update when the product is complete.

Overall recommendations for providers:

- Develop mature documentation and processes to support growth and security.
- Document tribal knowledge, as feasible, starting in critical areas and slowly expanding.
- Develop high-level standards and principles to guide architecture and development.
- Nurture individuals with application risk expertise and promote them to security champions.
- Develop tooling and automation to help efficiently support developers and testers.
- Ensure accessibility and usability are included throughout the process.
- Consistently validate code and dependencies during build or deploy.
- Develop metrics to help measure security and improvements.
- Establish formal feedback loops with customers and users on usability.

## Architecture Assessment

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**During Pilot II, RABET-V conducted its first iteration revision.** The architecture assessment revision saw small improvements in several security families and scoring adjustments in others as the process and scoring was refined.

During the initial assessments of the two other participating providers, interviews were considered canon. Initial submission materials were not used for the architecture assessment, as they often did not represent a complete picture of the current environment identified in the interview.

- Interviews were used as the primary method of information gathering related to the architecture. At this time, there is no audit-level production of evidence requirement.
- Architectures using standard cloud services/solutions scored higher, but we are not at the stage to verify proper configuration or usage of those services.
- More details and controls will be uncovered and identified in each iteration, improving the accuracy of the scoring. Initial and revision iterations will have gaps. This is done to manage risk while keeping the review processes manageable for time and resources.
- Two providers presented an in-house hosted solution. Because fewer assumptions can be made about a privately-hosted deployment, scores were adjusted downward somewhat compared to vendors that used major commercial cloud vendors (e.g., Azure, AWS).

RABET-V Pilot II also tested order of reviews with one provider by conducting the architecture assessment before the organizational assessment. We found that we can largely complete the assessment processes in either order but that the architecture review is dependent on some information collected in the organizational assessment. This would require the architecture review to be revised after the organizational review is completed. The ideal order is to conduct the organizational review before the architecture review.

## Software Tools: WhiteSource (now Mend) and Lattix

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Software tools are critical to executing the RABET-V process. When employed effectively, they allow for more effective code analysis that directs source code reviews and thus more predictable consequences resulting from a coding error or vulnerability.

To achieve a more efficient use of the software, a set of standard tool configurations needs to be developed to reduce the amount of churn between RABET-V and the provider. Software Bill of Material analysis tool market has greatly expanded in the last several years, so we should consider available tools for our use-cases.



Similarly, we need to provide better guidance on what to include in Lattix files. We are receiving files with test code that should not be considered during analysis. We have found that Lattix (CodeClinic) conducted training needs to be adjusted to cover the topics of most relevance to the RABET-V program.

- During one provider's Architecture Analysis, some CVEs appeared after they submitted their SBOM but before final readout. This is less likely to occur post-pilot as the iteration period should be significantly shortened.
- During a vendor's Architecture Analysis, it was discovered that an out-of-support version of .NET Core was used in one of the components. Mend did not discover this, as it does not consider the platforms that third-party software operates. We need to have a better understanding of our tooling and its limitations.
- One provider had a large, custom enterprise library that was shared by many applications developed for both elections and non-elections customers. This made analysis somewhat difficult, as large parts of this shared library were unused in its elections use-case, including security services. This demonstrates the indispensability of interviews, both initially and during iterations with major changes.

The upshot is that realizing the benefits of the RABET-V process are highly correlated with the ability of the Administrator, technology providers, and assessors to effectively use analysis software that might be new to them.

## Product Security Services Capability Maturity

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During Pilot II, we examined a revision submission for the first time and found that while technical artifacts directly measurable by the assessment team are the preferred means of assessing compliance with the requirements, there is a need to rely on the interview process, which may inadvertently introduce some level of subjectivity. As the program matures and is further refined, the program developers will assess methods in the future to reduce this issue.

In addition, we used a different organization for product testing than had been used in Pilot I during Pilot II. Scores were substantially higher than any other comparable system tested to date. It is likely a mixture of a higher maturity from this particular provider as well as differences in testing approaches. This may demonstrate difficulties in the repeatability of testing if performed by different entities, and tester training and auditing will need to address this to ensure consistency.

## Voter Registration Systems

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During Pilot II, we had the opportunity to review a voter registration system and examine the suitability of the RABET-V model for this particular type of system.

Voter registration systems communicate with a great number of outside systems. In some cases, these outside systems are critical to the function of the system itself. Scoping voter registration systems correctly may require collaboration between the vendor, customer (e.g., state), and data exchange partners in order to support a successful engagement.

- Success with South Carolina/Kopis shows that RABET-V is able to successfully test systems jointly developed and maintained by different entities, though it presents additional logistic burdens, as meetings often had to include many more individuals from different organizations and more steps to determine the individual who had the answer to any given question.

# 4 Operational Model Updates

Following additional engagement with stakeholders in the election community, CIS has identified more specifics of an operational model most likely to succeed by balancing the needs of efficiency with accountability.

## 4.1 Clarification on Operational Roles

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The roles identified in the first pilot report are unchanged. Each is listed below and defined in the RABET-V glossary:

- 1 Technology Provider
- 2 Subscriber
- 3 Approval Authority
- 4 Administrator
- 5 Testing Provider
- 6 Information Sharing Partner

While the structure hasn't changed, we'd like to clarify that states and localities remain the only viable Approval Authority, as they are responsible for running elections. Still, these Approval Authorities may defer or partially rely on decisions of another certification body. This is no different than the voluntary role the U.S. Election Assistance Commission (EAC) plays in voting systems. While it holds no authority over whether a system is used, it is a valued member of that ecosystem, and many states require its certification.

## 4.2 Expectations for Successful Operating Models

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The first pilot report identified three potential models:

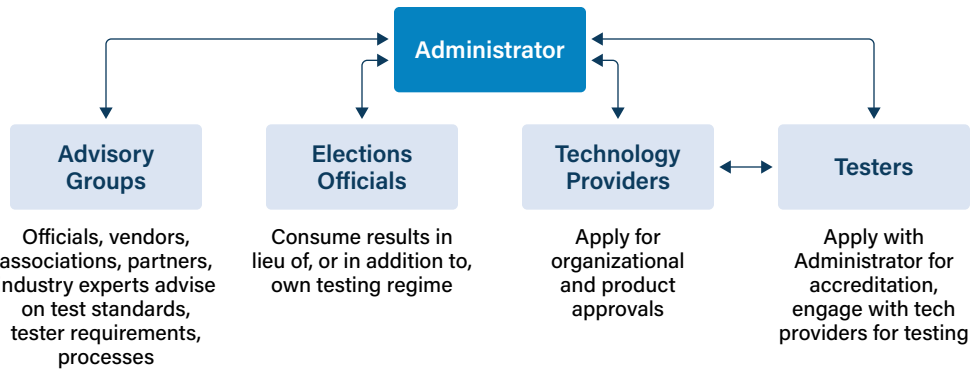
- 1 Trusted Verifier model
- 2 Verifier-Field Test model
- 3 Verifier+ model

All three models remain valid. The most efficient is the Trusted Verifier Model; however, some Approval Authorities will undoubtedly need to conduct field testing to establish approval either because of its legislative mandate or to gain appropriate user acceptance. To accommodate the bespoke needs of some jurisdictions, CIS believes the Administrator should establish a limited state-specific tailoring program as a form of the Verifier+ model and allow technology providers to opt into those modules. Over time, divergences from the primary program should be rolled into the primary verification workstream wherever possible.

## 4.3 Refined Administrative Model

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Additionally, CIS has developed a recommended model for RABET-V administration that leverages community engagement to validate requirements and procedures. This refinement describes the relationships between each of the Operational Roles that balance flexibility with accountability.



The Administrator acts as an orchestrator between the other parties. It oversees the advisory group(s) that advise on rules, test standards, accreditation standards, available product categories, and the like. The Administrator accredits testers and maintains a list of qualified testers.

When a technology provider submits a product for assessment, the Administrator determines the scope and matches it to a list of qualified assessors to the technology provider. At the time of publication, CIS is still determining how the assessor will engage contractually, but the assessor works directly with the technology provider to conduct the necessary tests.

Assessors provide the results to the Administrator. The Administrator conducts a review, asks questions it may have, makes a final determination of sufficiency, and provides a final report to the technology provider. If the product is verified, the Administrator lists the technology provider and product publicly as well as provides some information.

CIS is still considering options for what information is made available to election officials. It could host the reports for subscriber access, but because of the sensitive nature of the reports, it may be more secure to have the technology provider submit reports directly to the subscriber typically as part of a procurement process or security review with the Administrator providing a means for validating the authenticity of the report.

The Administrator will conduct other analyses, such as providing aggregate statistics on performance, that subscribers and technology providers can use to compare a single report to the whole. Some of this information will be made public, and some will be reserved for technology providers and subscribers.

# 5 Economic Model Updates

Following additional engagement with stakeholders in the election community, CIS has identified areas in which it can narrow the potential economic model.

## 5.1 Eliminating Costs to Subscribers

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CIS believes it critical to employ the option described in section 4.6.4 of the first pilot report, which is intended to overcome an early barrier by offering the subscriber side of the market for free. As such, CIS recommends not charging approval authorities and election officials for access to reports.

## 5.2 Assisting Approval Authorities with Administratively Adopting RABET-V

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CIS believes it necessary for the Administrator to provide some form of assistance for seeding approval authority changeovers, as described in section 4.6.3 of the first pilot report. CIS recommends that the Administrator provide templates, case studies, procurement guidance, 1-to-1 assistance, and other resources for making administrative rule changes, legislative modifications, and related updates for new and existing programs.

## 5.3 Allowing Technology Provider Adoption

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Section 4.6.2 of the first pilot report proposed incentives to technology providers to induce their early adoption. Based on enthusiasm from the vendor community and the likelihood that RABET-V will quickly reduce costs relative to executing on multiple testing regimes throughout the states, CIS does not believe such incentives are necessary. Adoption by approval authorities will provide sufficient incentives to move the vendor market.

## 5.4 Tester Accreditation

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The EAC's voting system testing has struggled to induce qualified testers to become Voting System Testing Laboratories. Under RABET-V, there will be more product categories, a larger number of technology providers, and a need for different types of assessments. CIS strongly believes a more vibrant market of testers is necessary. As such, it recommends the Administrator accredit third parties as competent testers under RABET-V, charging these testers a relatively small fee to maintain good standing, as well as broaden the potential qualifications for accreditation.

## 6 Conclusion

We believe the RABET-V pilot phases have been a resounding success.


With encouragement from many in the election community and beyond, CIS is taking the pilot process, incorporating lessons learned, and building an operational program set to begin in the fall of 2023. As such, this document serves as the end of a long and productive effort to imagine, and make reality of, a new approach to testing non-voting election technology.

As a community, we can continue to strengthen the technical foundation of our voting processes. CIS looks forward to many years ahead of RABET-V helping to secure and build confidence in our democracy.




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