



# Election Night Results

*An architecture for accurate and reliable reporting  
in the age of the cloud - a VR Systems White Paper*

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# Executive Summary

The effective and timely delivery of Election Night Results (ENR) is a highly visible and important part of the modern democratic process. It is a function that has high interest to candidates, politicians, governing jurisdictions, and the public at large. All eyes are focused on the election results on Election Day.

The demanding service loads of election night can put a strain on even the most robust websites and servers. VR has designed the ENR Cloud to surpass the specific, demanding requirements of ENR to ensure complete scalability, superior accuracy, and unfailing performance.

## Designing for Infinite Load

When designing the technical systems necessary to handle rapidly scaling demand — such as election night website requests — the systems architect is usually faced with a dilemma:

- Create a wide, distributed system of servers and website instances that protect against localized disruption, but are hard to maintain and synchronize; or,
- Build out a deep, vertical network of servers that can handle the loads, but are expensive, subject to localized service interruptions, and are likely to spend most of their functional lives sitting idle or under-utilized.

Modern cloud infrastructures and virtualization technology have allowed VR engineers to architect a purpose-built system that captures the benefits of both approaches while avoiding the pitfalls. The result is a technology platform that is — for all practical purposes — infinite in both width and depth. This unique solution delivers superior levels of performance and instant scalability.



*Delivering timely and accurate election results is a core part of our mission...and the ENR system makes that possible.*

- PAUL LUX,  
SUPERVISOR OF  
ELECTIONS, OKALOOSA  
COUNTY, FLORIDA



## Delivering Results

The ENR Cloud for election night reporting yields several significant tangible benefits:

- Security and data integrity are maintained.
- Elections teams retain complete control over when results and updates are made public.
- Accuracy is enhanced, mitigating potential human error.
- All requirements regarding voting system security and isolation are supported.
- Daily functions and services of primary websites are secured from heavy traffic loads.
- There is never any software to install, configure, manage, or maintain.
- Constituent satisfaction is maintained across browsers and devices.
- Constituent service requests are reduced, freeing staff to do work in service of their communities.

# Defining the Need

ENR is a highly visible and important part of the modern democratic process. It is a function that the voter constituent is virtually unaware of most of the time. But for a few hours on election night, it becomes a central focus of attention and a pivot point of satisfaction — all eyes are on the election results from voting day through the following morning.

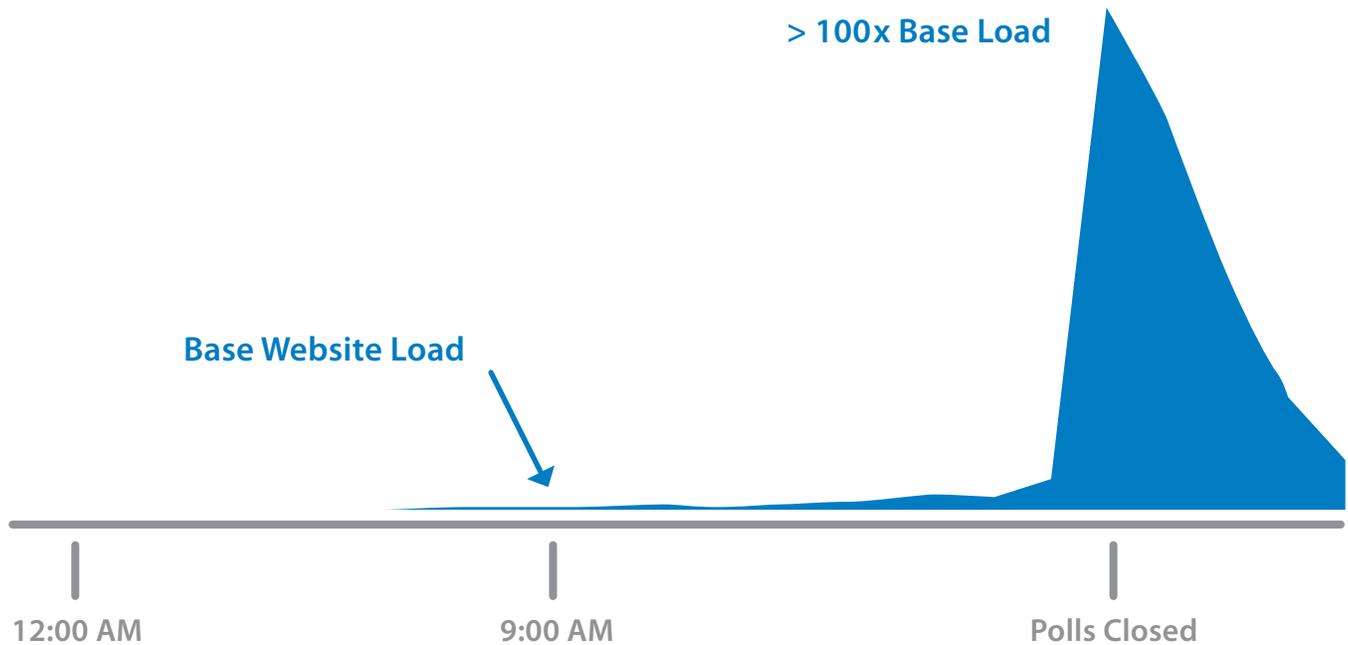
Failure to make timely and accurate results immediately available not only engenders frustration, but can reduce confidence in the people and process itself. Even if the voting and tabulation process are perfectly orchestrated, it is the results that are “seen” and therefore become the measurement by which the entire process is evaluated.

Delivering results over the internet is the obvious choice. The challenge comes specifically because of the limited time in which results are reported. Physical and virtual systems that have more than sufficient resources for daily traffic and utilization are quickly — nearly instantaneously — pressed into levels of service that might challenge even the most robust local systems.

Figure 1 below provides a real-time data capture of increased website traffic on election night. This measurement is consistent with our experience of more than 20 years support election efforts across multiple jurisdictions.

“  
By the end of the test run, over 2,000,000 hits per second were being served — the highest we’ve ever measured on a production system.  
”  
- CZEISZPERGER, WEB PERFORMANCE INC.

**Figure 1: Election Day — From Zero to Full Load in an Instant**



## The Engineer's Dilemma: Designing for Depth or Width?

When designing an internet-based system for peak loads, there are two conventional approaches: Depth and Width.

### DESIGNING DEEP

In a deep architecture, one very large or several locally networked computers are arrayed in a single location. Each unit is configured to engage as demand increases.

#### *Benefits*

- Single point of architecture and administration.
- Large vertical capacity to handle increased loads.

#### *Downside*

- Single point of failure.
- Risk shifts to the access point:
  - Bandwidth / competing traffic.
  - Local network interruption.
  - Last mile issues.
- High up-front hardware costs.
- Always questioning:
  - "Is the infrastructure deep enough?"

### DESIGNING WIDE

In a wide architecture, individual internet-facing computers are located in separate locations to serve distributed loads

#### *Benefits*

- Access point issues mitigated.

#### *Downside*

- Risk shifts to maintenance:
  - Distributed version and security updates
  - Maintaining data integrity and concurrency across a distributed system
- Always questioning:
  - "Is the infrastructure wide enough?"

## The Solution: Infinite Depth and Infinite Width

Significant advancements in internet cloud technology have allowed the technical engineering team at VR to design a response system that envisions all possible loads. This system automatically scales both vertically and horizontally to create an infrastructure that — for all intents and purposes — is infinite in both width and depth.

Thus the upside benefits of both are retained, while the downside risks of each system are cancelled out. This yields a best of all possible worlds scenario within a seamless architecture that is easy to maintain, invisible to the user experience, and internally redundant.

The next section will provide a brief overview of the architecture utilized.

# An Architectural Overview

## Understanding the Process — It All Begins at the Ballot Box

In most jurisdictions, votes are cast on either paper or electronic ballots as prescribed by law. These ballots are correlated and tabulated in one of several secure, proprietary, vote-counting machines or special-purpose computers. The vast majority of jurisdictions require that these tabulation processes remain as separate isolated systems — disconnected from local networks and the internet.

The detailed results and personal data attributes are submitted to relevant controlling authorities at the county, state, and federal level according to law and local regulation.

Voting jurisdictions have a compelling interest in ensuring that certain statistics are made available to the general public quickly, accurately, and securely. This includes not only overall results, but also things like total votes cast and how many were vote-by-mail, via early voting, or cast on election day.

All modern tabulation systems have a means for exporting these kinds of statistics. Previously, voting staff might have had to record these statistics by hand at each update point, manually enter this data into public websites, and then “publish” the site live. Obviously, this is not ideal in terms of efficiency and error minimization.

Thus the first order of business was to create a system that increased efficiency and removed error at this crucial point.

The statistical file is specifically limited to raw, anonymous data and can only be loaded via an “air gap” transfer — meaning through the use of a convenient external drive. Thus, tabulation systems remain secure on their private networks. Voter data and official tabulated results are never exposed over less secure networks and the manual process of data entry is eliminated.

The VR ENR begins with secure web portal access via a separate, local computer. Authorized users simply upload the statistical output file to the secure web portal, which is preconfigured by VR to accept the standard file format used. Importantly, the local jurisdiction staff retains complete control — even after a statistical upload is completed, updated statistics are not published for public viewing until the user specifically initiates that action. And the report displayed on the web portal can be quickly compared to that displayed on the tabulation system to ensure accuracy.

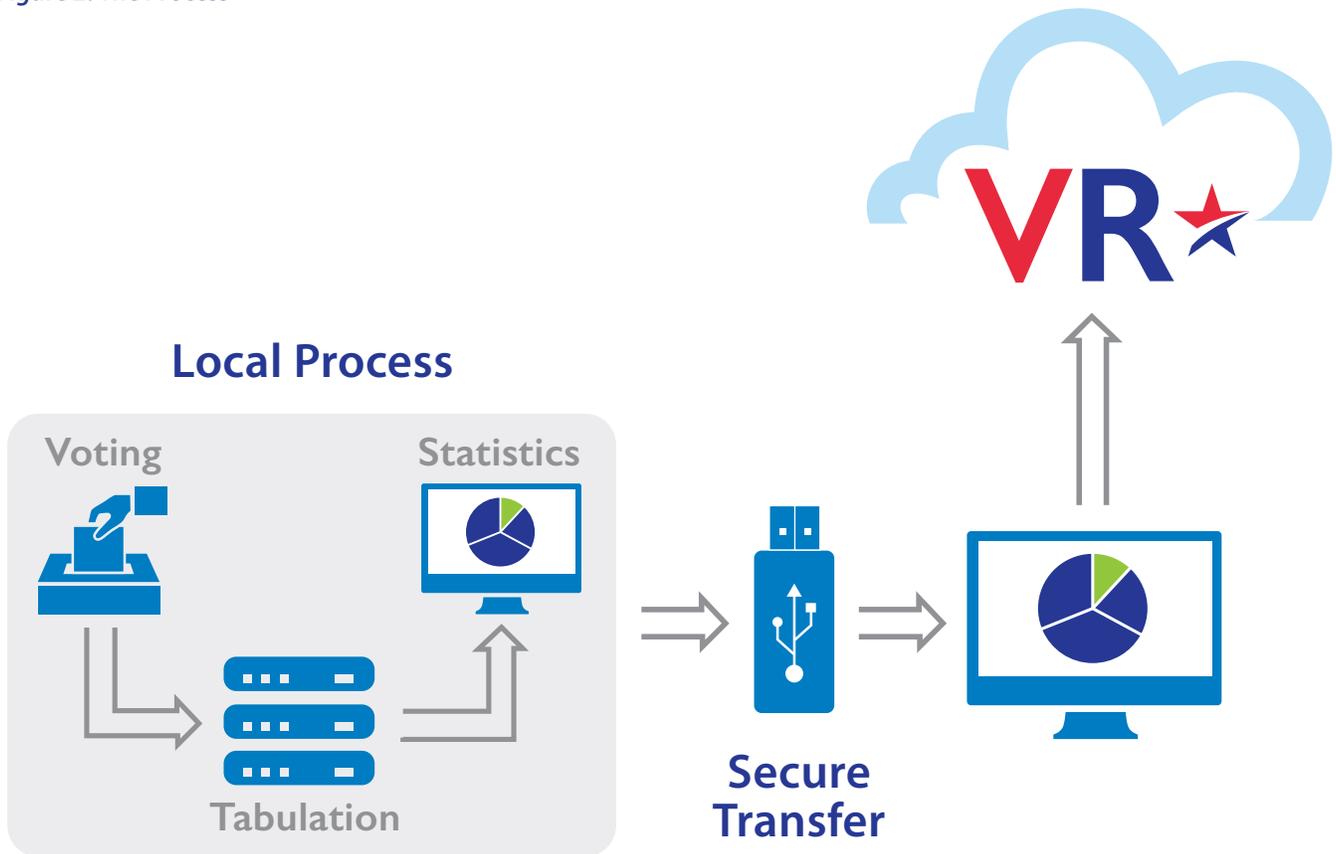


*With VR’s innovative cloud architecture, our office can let go of old worries and have every confidence we will provide swift, reliable results for our public, candidates, and local media.*

**- WILL BOYETT,  
ELECTIONS CHIEF  
DEPUTY, ALACHUA  
COUNTY, FLORIDA**



Figure 2: The Process



## What is the ENR Cloud?

As previously discussed, election night traffic is a significant pinch point for jurisdictional websites — generating page view requests hundreds and thousands of times greater than normal. This is made even more problematic if local webmasters are tasked with uploading or publishing refreshed data during these peak episodes. This can not only interfere with the reporting of election results, but if the results are being published directly to live jurisdictional or municipal websites it can potentially interrupt the delivery or limit constituent access to other website functions, such as community services.

The ENR Cloud was engineered to be a specific solution to this need.

## The Solution

The ENR cloud solution was born of a fundamental insight. Namely, that if the excessive traffic generated by election night interest is problematic, then the best solution is to devise a way for the excess traffic to be directed elsewhere — freeing the primary website to serve community needs under more normal loads. VR engineers set about designing an infrastructure purpose-built to manage these excess loads. It was quickly determined that the advent of cloud technology provided the ideal starting point.

## A Regional and National Platform

VR evaluated several world-class cloud infrastructures to determine the best solution based upon the following criteria:

**Highly Secure** – The infrastructure had to not only have industry-leading protections from intrusion and malicious code attacks, but it had to have superior strategies to recognize the difference between rapidly spiking endemic traffic and Distributed Denial of Service attacks (DDoS), and respond accordingly.

**Highly Elastic** – The infrastructure had to have a built-in flexible capacity to instantly increase resource allocations across a broad range of requirements, including CPU, RAM, Disk, Bandwidth, and Network.

**Superior Automation** – The infrastructure had to have automation as a core component of service — allowing systems to respond to resource requests in real time.

**Highly Redundant** – The infrastructure had to have multiple access nodes, multiple fail-over datacenters, internally redundant computational resources, and all of the redundant power supplies, certifications, and security systems expected of a modern technology platform.

### THE INFRASTRUCTURE PLATFORM

After significant cross-platform testing, the AWS cloud platform consistently out-performed competing solutions for ENR requirements — checking all the boxes.

#### *Security*

The platform has a large contingent of federal and state government sites and applications currently running on the infrastructure. In addition, a significant number of financial institutions and healthcare providers rely on robust, existing compliance programs — some of the most stringent in the world. And the unequaled number of in-network edge nodes ensures an added level of protection against load-based disturbances such as DDoS attacks.

#### *Elasticity*

The platform was architected to be elastic before the first hardware resource was purchased. The extensible architecture allows load capacities to expand and contract seamlessly.

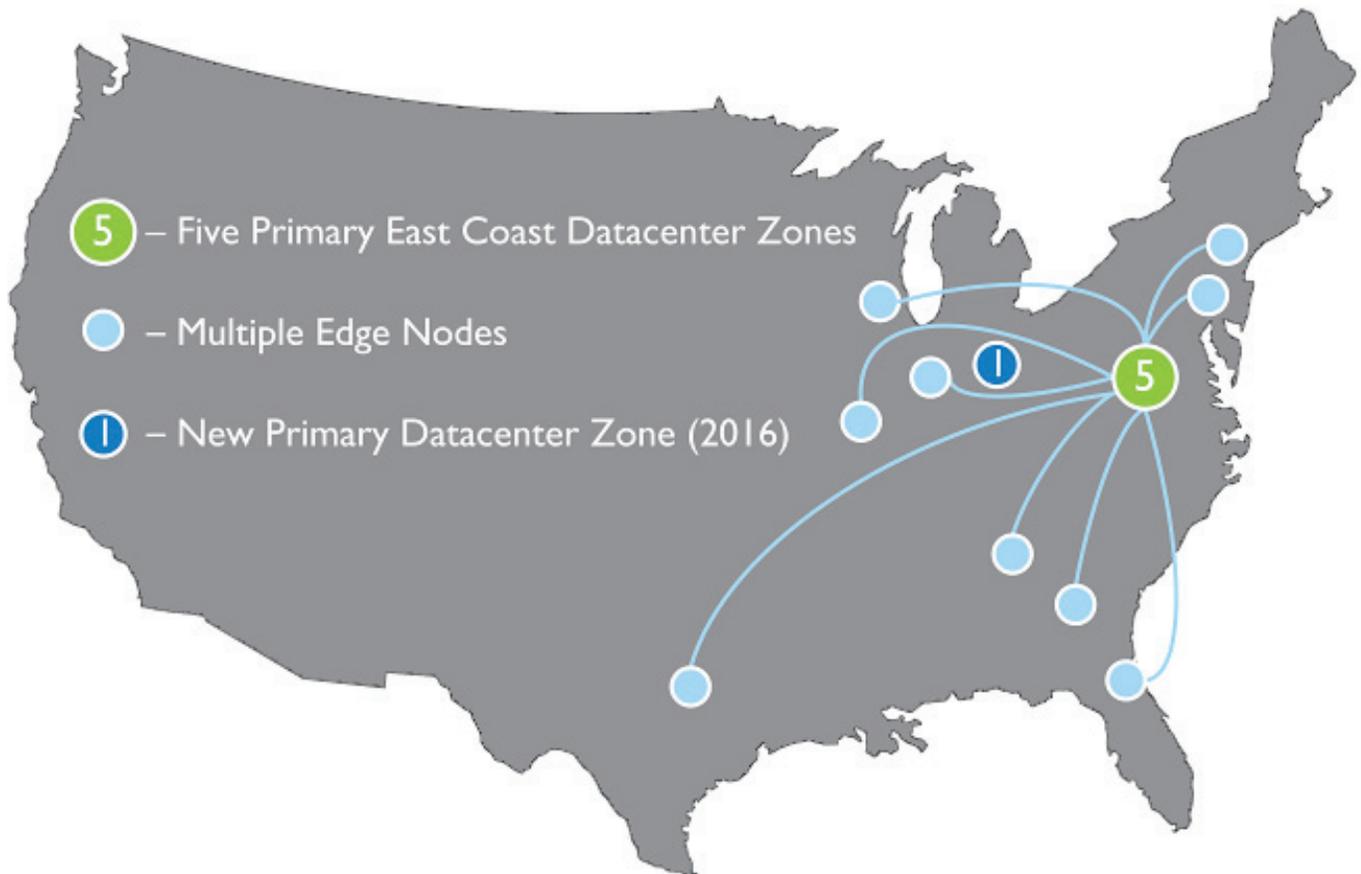
#### *Automation*

The entire infrastructure has been built around secure API automation protocols that allow instant configuration of all systems and services in real time without diminishing control.

## Redundancy

Even the backups have backups. Not only is hardware and network supported by multiple spares, but the systems are designed so that application and website instances exist concurrently on multiple physical devices. This ensures that — even in the unlikely event of a mechanical failure — the concept of “fail-over” ceases to have meaning since the instance is still being simultaneously presented from more than one physical location zone.

*Figure 3: Designing Infinitely Deep and Infinitely Wide in a Distributed Architecture*



## TRUST BUT VERIFY

Once the technical evaluation was complete, the software engineering team built a web application platform optimized to take full advantage of the physical infrastructure — yielding a complete and cohesive environment that was purpose-built for the specific requirements of election night reporting services. This environment was subjected to robust internal testing under all possible anticipated loads.

The system performed flawlessly and the success of these tests was encouraging. But the mission-critical nature of election reporting warranted the extra step of independent verification. A professional, independent, third-party testing service subjected the ENR system to industry-leading load testing — synthesizing millions of concurrent services requests. The combination of the custom web portals, backend ENR cloud infrastructure, and real-time results display exceeded all requirements.

# User Experience/Constituent Satisfaction

The first two elements of the ENR architecture — the software and backend infrastructure — having now been covered, we turn our attention to the customized reporting engine. This is the element that resides in the ENR Cloud and is the public-facing product seen by constituencies.

## Your Community Website

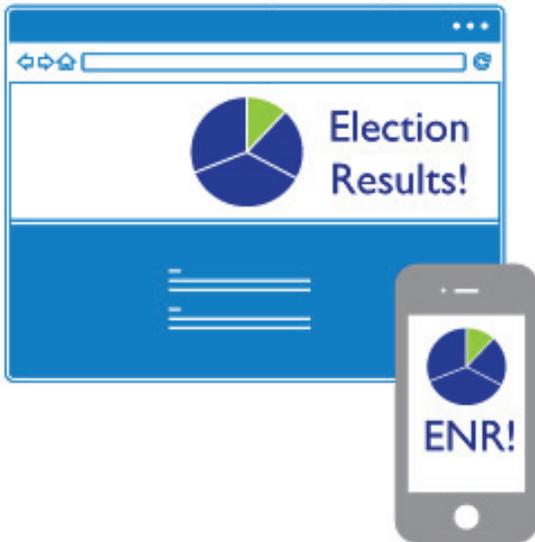


## Seamless Progression from Your Site to the Cloud

As previously discussed, election staff has total control over when election results are displayed publicly. Statistical data files are loaded into the ENR software which has been preconfigured by VR engineers to point to a custom reporting page in the ENR Cloud.

It is important that constituents have the highest quality experience as possible. So all reporting page instances are designed to coordinate with the styles and themes of the primary jurisdiction websites.

## Your ENR Reporting Page

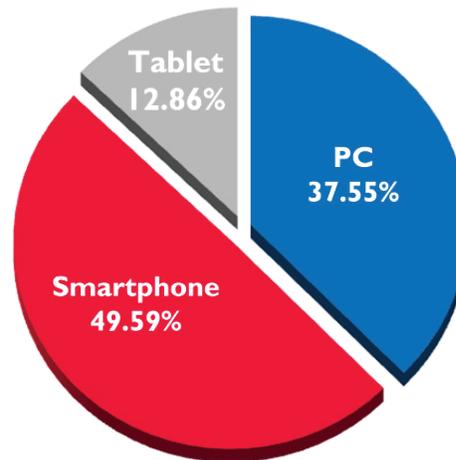


This allows the user to have a seamless experience in arriving at the election information that they want — quickly, easily, and without interruption — while directing the heaviest traffic load to a platform designed to manage it.

## COMMITMENT TO RESPONSIVE DESIGN AND MOBILE DEVICES

Our statistics show that across all election night website visits, more than 56% originate from modern mobile devices. But when those visits are isolated to “new visits” (those visits that have not previously visited), the number is even higher — exceeding 63%. This means that there is a large majority of interested constituents who’s first and perhaps only web interaction occurs on election night, seeking results.

We expect this trend to only accelerate going forward—greatly increasing the importance of a fully supported, responsive solution. That’s why all ENR reporting page instances are created with a light-weight, responsive design that functions across all major mobile devices. This ensures a consistent user experience with high levels of satisfaction.



## No Software to Install, Manage, or Maintain

All components of the ENR system reside in the ENR cloud, including:

- Statistic file upload web portal
- Back-end database and management system
- Public-facing ENR reporting web pages

All elements are set-up, managed, and maintained by VR Engineers. This means that there is never any software to install or configure and the entire system is fully supported 24/7/365 by trained technicians — ensuring that users always access the latest, most secure product versions.

## Results

The ENR architecture for election night reporting yields several significant tangible benefits:

- Security and data integrity are maintained.
- Elections teams retain complete control over when results and updates are made public.
- Accuracy is enhanced since only exported statistical data files can be entered into the system, mitigating potential human error.
- All requirements regarding voting system security and isolation are supported.
- Daily functions and services of primary jurisdictional and municipality websites are secured from heavy traffic loads incumbent in the election process.
- There is never any software to install, configure, manage, or maintain.
- Constituent satisfaction is maintained by ensuring reliable and immediate access to election results and community services in a seamless integration — even on mobile devices.
- Constituent complaints and service requests are reduced, freeing staff and leaders to do other work in service of their communities.

# About VR Systems

We've been providing elections hardware and software to Supervisor of Elections offices since 1992. We believe that public trust in the elections process is the foundation of democracy. We aim to secure that trust by making every election fair, efficient and transparent.

Over 100 jurisdictions, large and small, across seven states have chosen our products because they are simple to use, economical to buy and respected for quality and reliability. But, our offering only begins with the products. Personal customer service is the cornerstone of our business and is included with every purchase. Our team is committed to a successful election for every customer, every time.