A Report for

City and County of San Francisco

Los Angeles County Voting Solutions for All People (VSAP) Overview

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Engagement: 330059599

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1.0 Introduction

This Overview of the Los Angeles County Voting Solutions for All People (VSAP) system is provided to the City and County of San Francisco (CCSF) as part of the Open Source Voting Partnership Strategy Project. This document provides an overview of the history and timeline of the VSAP Program, along with a depiction of the overall VSAP architecture and a description of its components. This document is intended to assist the CCSF team get a better understanding of the VSAP solution as the team considers partnership opportunities during the Open Source Voting Partnership Strategy Project.

2.0 History

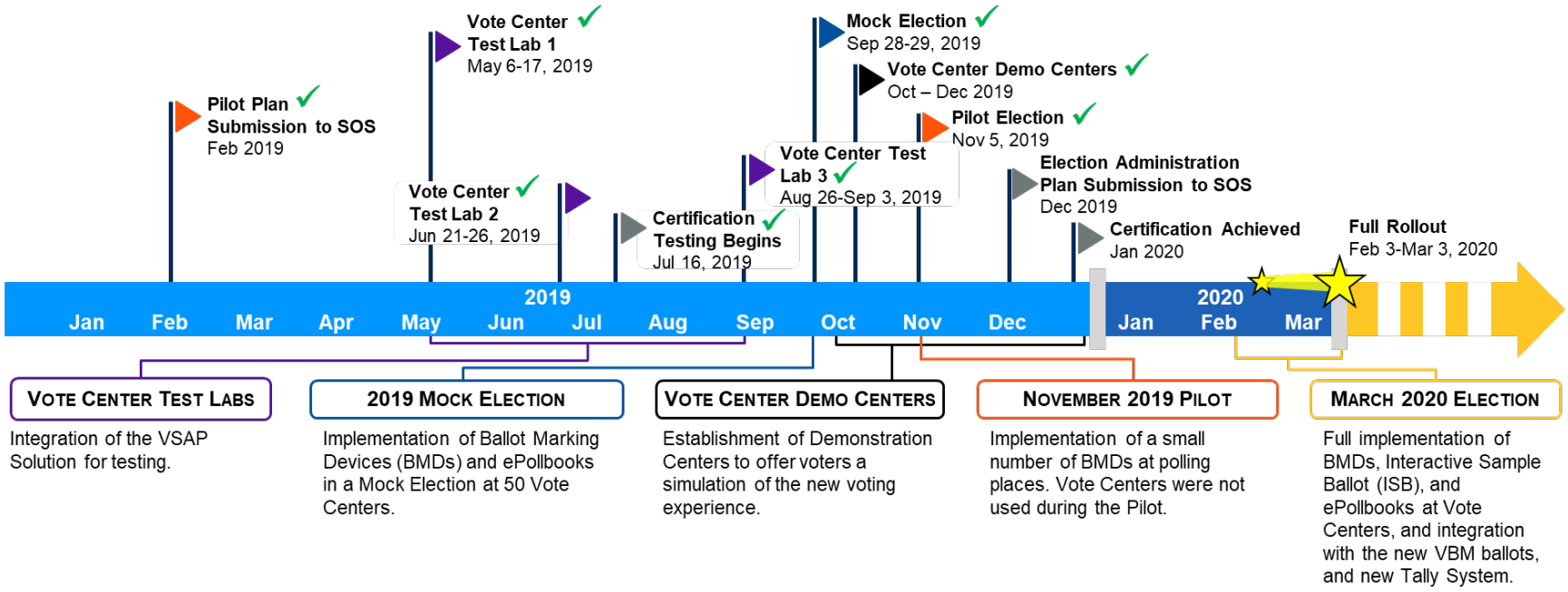
Launched in September 2009, VSAP was developed in response to the growing voting system needs and challenges faced by the County. Through public engagement and research, VSAP established a strong foundation of baseline data regarding voter and poll worker preferences and requirements. The Department also engaged with partners to gather data on the current funding, regulatory and voting systems market, and participated in a Request for Proposals (RFP) issued by the City of Los Angeles (City) in search of federally certified and state approved voting systems. None of the seven (7) voting systems evaluated met the City's requirements. The extensive research of voter behavior and the limited voting systems market, coupled with the size and diversity of the County, brought the Department to conclude that it was impossible to reasonably consider an existing commercial off-the-shelf (COTS) voting system solution. Any voting system solution would entail a significant development or customization process in order to satisfy the County's needs, VSAP General Voting System Principles and technical requirements.

In response to these needs and challenges, VSAP has taken an unprecedented and comprehensive approach at modernizing the County's voting system. The vision of the project is to implement a voting solution using a transparent process that focuses on the needs and expectations of current and future County voters.

The intent of VSAP is to transform and modernize the voting experience in a manner that is responsive to the needs, desires and behaviors of its electorate. After several years of research, design and engineering (Phases 1 through 3), the County is now executing Phase 4 and Phase 5 with respect to system engineering, manufacturing and certification as well as a phased implementation of the new voting experience model. More details on the five-phase approach are provided in the Appendix.

The County seeks not only to provide the new voting experience and system to its voters, but to develop them in a manner that allows other jurisdictions to adopt the same designs, or purchase the same solution, and provide similar voting systems and experiences to their constituents. Part of this vision is to retain ownership of the IP developed so that, under license, other jurisdictions may have systems manufactured for their use.

2.1 VSAP Program Implementation Timeline



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3.0 VSAP Components and Architecture

Figure 1. High-Level Ecosystem of the VSAP Solution

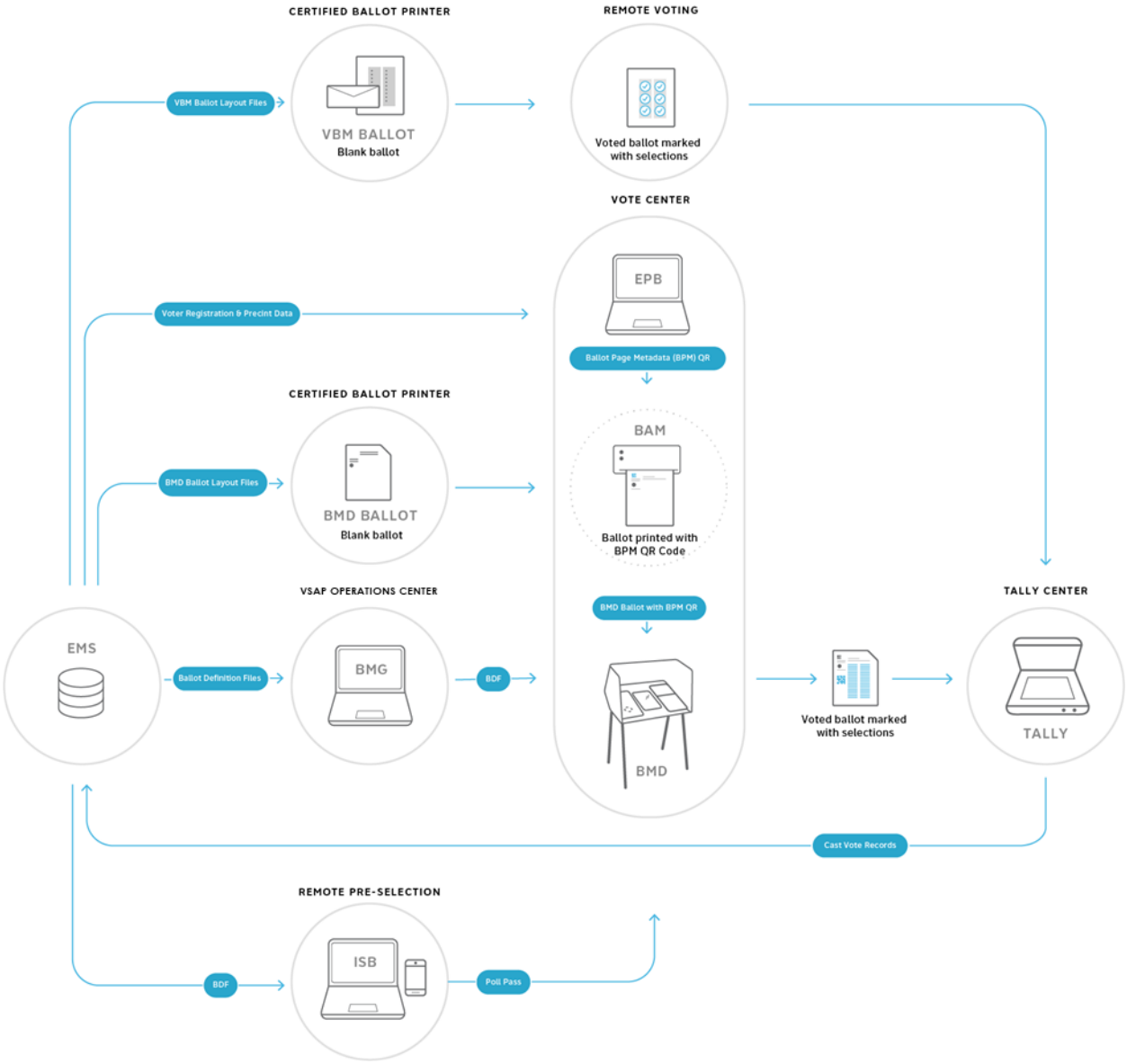
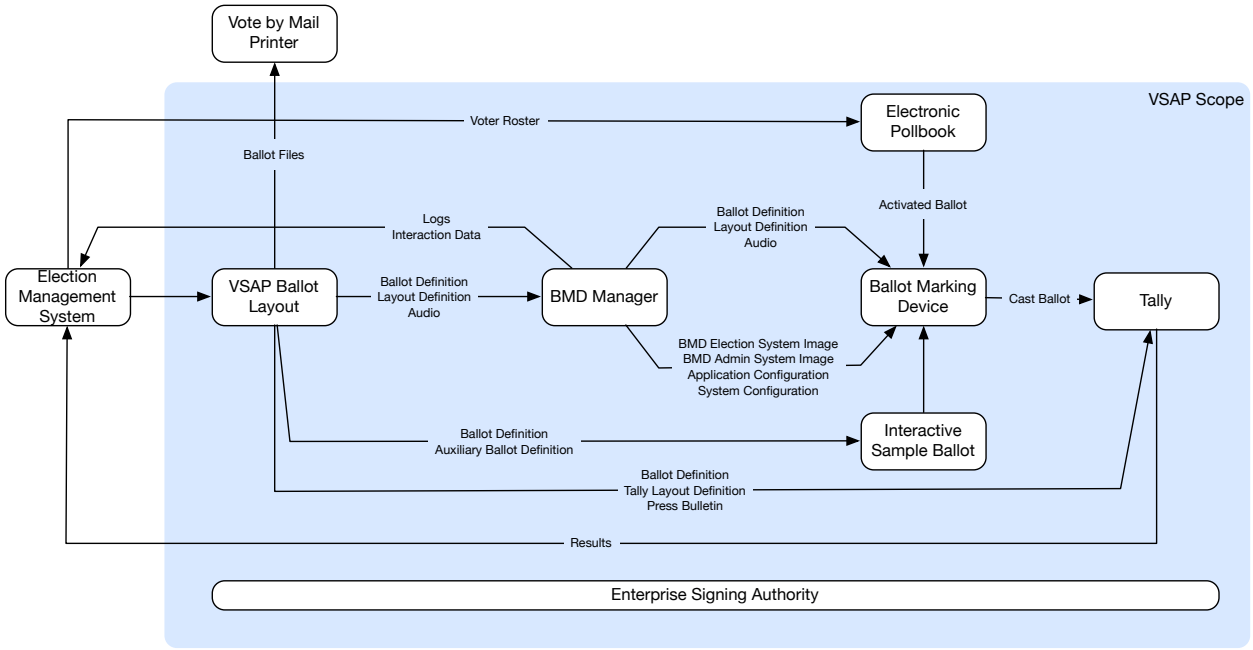


Figure 2. Overview of VSAP Architecture



3.1 VSAP Ballot Layout (VBL)

VBL is responsible for generating election data and ballot layouts, as well as application configurations for other component solutions. It generates election data and ballot layouts, and Vote by Mail (VBM) ballot files. VBL also generates Logic and Accuracy Tests for both BMD and VBM ballots.

3.2 BMD Manager (BMG)

The BMG is a centralized management tool for BMDs. It allows operators to manage data and software configurations simultaneously on as many BMDs as necessary. Software updates and assessments should not require physical access, although some diagnostics (e.g., scanner and printer diagnostics, which require paper) will require manual intervention.

BMG uses REST service endpoints to enable communication with other applications in the VSAP solution, with a mechanism to import and export data. Additional REST APIs communicate between the BMG and the BMD.

The BMG network is a completely standalone, self-contained, air-gapped network. It uses the network architecture to map exact locations of BMD devices within the warehouse, through a series of switches.

The application is based on Java/Spring Boot with a React JavaScript user interface. It operates in a secure server environment.

3.3 Ballot Marking Device (BMD)

The Ballot Marking Device (BMD) is the primary touchpoint for the voter and the hub of the new voting system. Voters can use touchscreen or audio with tactile controller to make selections,

print selections on a paper ballot in both human and machine-readable formats, and cast the paper ballot.

The BMD uses a custom-built Ubuntu Linux OS to run three applications:

1. BMD-Vote is an electoral desktop application that enables voters to vote and cast their ballots.
2. BMD-Diagnostic is a desktop application to enable hands-on diagnostic tests to verify that a BMD is fully functional and runs at the warehouse.
3. BMD-Admin enables communication with the BMG at the warehouse

BMD-Vote and BMD Diagnostic are developed with Electron JavaScript. A set of custom C++ libraries interact with BMD device hardware used by the application layer. BMG-Admin is a Node application that exposes REST service endpoints to integrate with the BMG.

3.4 Electronic Pollbook (EPB)

The Electronic Pollbook is the initial point of the voting experience in a vote center. It is a tablet-based e-roster that poll workers use to check in a voter. The EPB provides networked access to the database of all registered voters in the County. This access enables voters, who otherwise would be limited to voting at their assigned precinct, to vote at any vote center throughout the County. The VSAP solution uses the KNOWiNK PollPad. The PollPad is connected to a Brother printer which prints the ballot activation QR code on the ballot before the ballot is given to the voter.

3.5 Interactive Sample Ballot (ISB)

The Interactive Sample Ballot (ISB) supports core voting operations by enabling voters to review and pre-mark election materials at their own pace using a computer or mobile device.

The ISB supports:

1. A digital means of presenting highly engaging and accessible sample ballot material.
2. Allowing users to pre-mark their selections and generate a QR code that may be used at the vote center to transfer their selections to the BMD.
3. Enabling voters with disabilities to privately and securely access, mark, and print a Remote Accessible Vote by Mail (RAVBM) ballot on their personal devices, which may be returned with their VBM packet.
4. Enabling military and overseas voters to vote and print an electronic Uniformed and Overseas Citizens Absentee Voting Act (UOCAVA) ballot, and a privacy waiver signature form, which may be signed and faxed in.

The ISB consists of:

- A responsive web client application to support voter/address-based initiation, a ballot loader, session management, ballot marking/review and Poll Pass generation. It also supports marked ballot and Oath Sheet printing for UOCAVA and RAVBM ballots.
- A preprocessor to support ballot definition parsing, precinct/ballot style mapping, content delivery network (CDN) connectivity and ballot preview/proofing. The preprocessor places parsed ballot style JSON files into an AWS S3 bucket that is accessible through the CDN by the client application.

- Lookup services for voters and addresses, using a Google connector for display of voter address on a map and a vote center lookup.

ISB is developed with React.js.

3.6 Tally

The Tally system is responsible for capturing and processing ballot images so that voter selections from paper ballots (including both BMD and VBM ballots) can be digitally counted. Tally contains these main Tally processes:

- Scanning and creation of ballot images.
- Conversion of ballot images to cast vote records (CVR).
- Tabulation of cast vote records.
- Export of election results from tabulation for reporting and audit.

Tally runs on CentOS and uses Docker images for specific functions. The code is developed with Golang. The different stages are managed through Kafka.

There are four stages for each ballot that is scanned:

1. Receiver – collects the ballot image from the scanner
2. Recognizer – interpret the voter intent by:
    a. Decoding the QR on BMD-generated ballots
    b. Decode the marked areas on VBM ballots through Marksense
3. Verifier – verify the digital signature of the BMD that generated the ballot
4. Refine – create the cast vote record (CVR)

Once the CVRs is generated, the tabulation process tallies the results and creates the result report.

3.7 Enterprise Signing Authority (ESA)

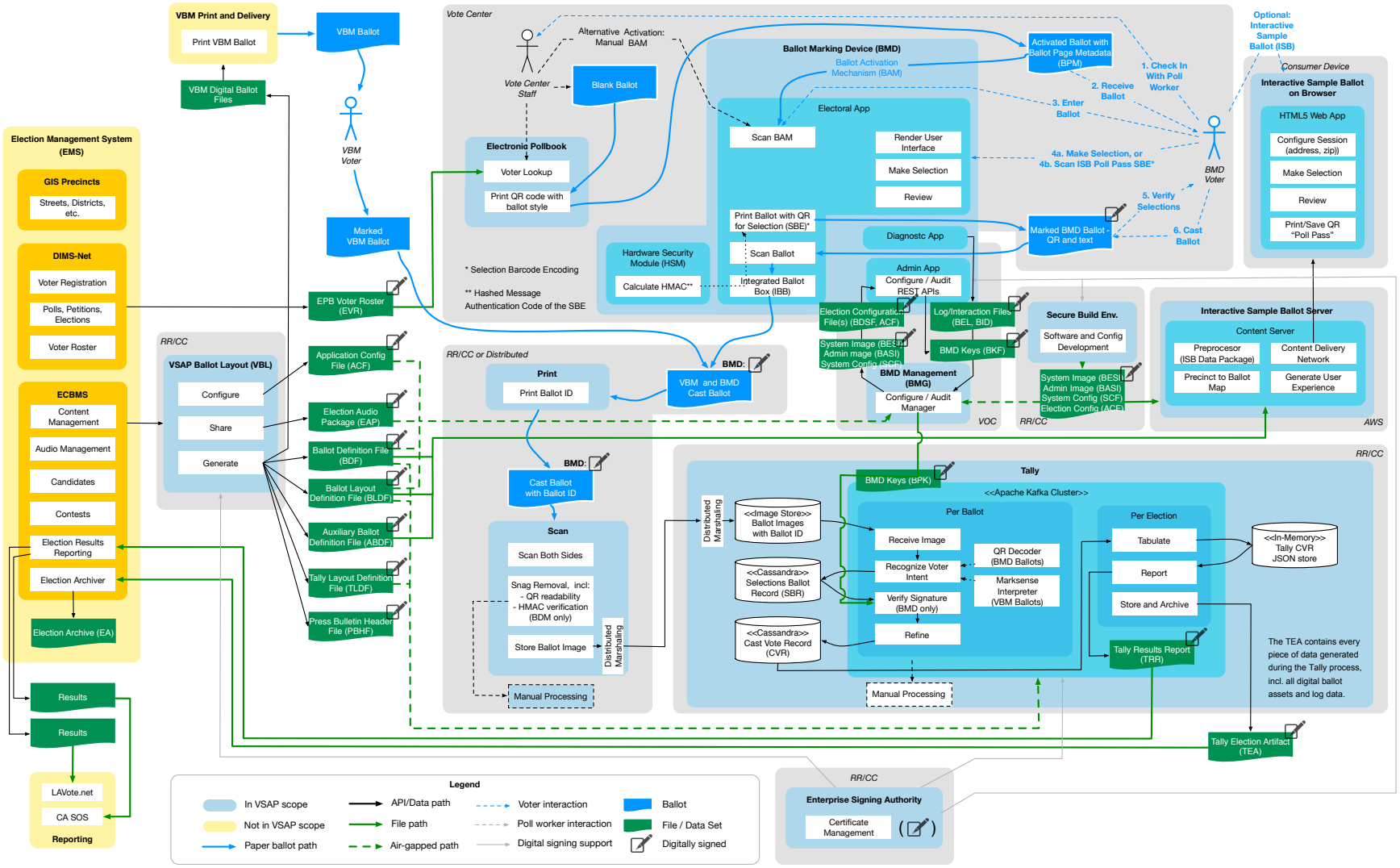
The ESA is used to secure the communications between the VSAP components. The VSAP architecture is loosely coupled by design, while some components (BMG, BMD, Tally) are air-gapped. Configuration is managed through file exchanges, where source components export specific files and file formats to garget components. The ESA secures these file exchanges, and ensures that files can only be processed if they are proven to come from a trusted source.

The ESA uses a hardware security module (HSM) compliant with FIPS 140, to generate a public/private key pair.

The ESA is deployed to a custom-built Ubunto Linux OS with a C++ library to interact with HSM device hardware. The ESA-UI desktop application enables ESA authorized users to execute the different functionalities that are available in the ESA. The ESA-Maintenance application enables hands-on diagnostic tests to verify that an ESA Hardware is fully functional.

The ESA incorporates mechanisms to keys from the ESA location to VSAP solution components within the secure ecosystem.

Figure 3. VSAP Architecture and Ballot Flow



4.0 Licensing

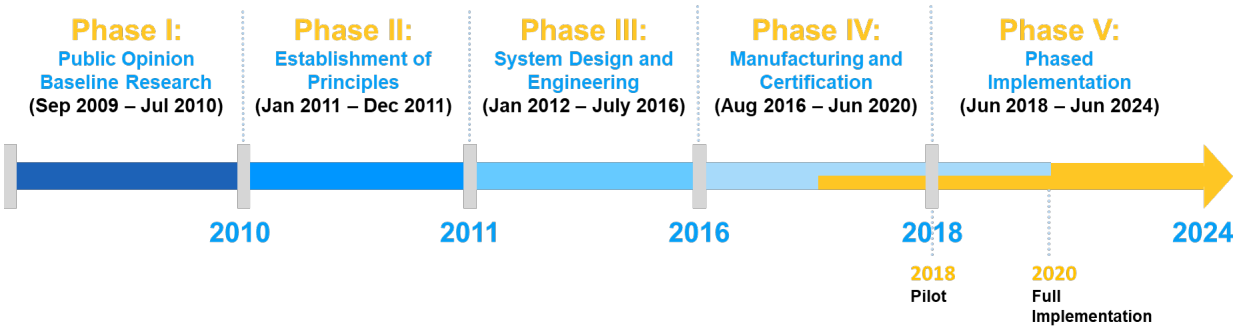
The County retains intellectual property (IP) ownership rights of the VSAP Solution, except for IP created for certain component hardware such as the thermal printers. This intention of IP ownership is not made to enter the market as a vendor, but to ensure public ownership of the rights to manage the use and transparency of the voting systems developed to ensure public trust and protect public interest. At present, the County is considering several different open source license options under which to make the VSAP Solution software available for use by other jurisdictions and entities. The County is also considering how an independent non-profit organization could serve as the repository, administrator and license holder of the resulting VSAP IP, recognizing that examples of successful open source technology solutions have had strong communities of users and developers that were supported by sound institutional structures and resources.

Appendix

Five-Phase Approach

VSAP is a five-phase plan to modernize the County's voting system and the voting experience through a voter-centered approach. The County is currently executing Phase 4 and Phase 5 in parallel.

Figure 4. Five-Phase Approach Timeline



Phase 1: Public Opinion Baseline Research

In Phase 1 of the project, VSAP partnered with CalTech and MIT's Voting Technology Project to gather an array of baseline data that would shape the overarching strategy for voting system modernization. This data was gathered from election stakeholders and subject matter experts including voters, poll workers, advocates, key community organizations and elections staff through a variety of research and engagement activities. This research focused on evaluating the current voting system and experience, and learning what users expect of the future voting system. The research revealed that users expect more than just an upgrade in voting technology, and modernization efforts are needed to improve the entire voting experience.

Phase 2: Establishment of Principles

Building on the research and lessons from Phase 1: Public Opinion Baseline Research, the VSAP Advisory Committee (AdCom) was established to ensure the voice of the voter continued to guide the voting system design process. The AdCom is a formal engagement body composed of stakeholders and advocates in elections that represent different communities in Los Angeles County. As its first task, the AdCom took the results from the research conducted in Phase 1: Public Opinion Baseline Research and used that data to create and adopt the General Voting System Principles, which acts as a guide for voting system modernization. These principles ensure the new voting system meets the diverse needs of County voters.

Following the development of the General Voting System Principles, the Department began its search for a new voting system by assessing the voting systems market and regulatory environment in which these systems are implemented. The Department also evaluated the acquisition models by which it could acquire a new voting system that would meet the needs of the County and its voters. The Department collaborated with a research team of graduate students from the UCLA Luskin School of Public Affairs to conduct research on regulations governing voting systems testing and certification and the impact on the County's goal to implement a new voting system. The research found that without changes to the regulatory environment, it would be very difficult for the Department to meet its goals of acquiring and implementing a new voting system consistent with the adopted principles. These factors along with feedback from the AdCom made a strong case for the Department to acquire a new voting system by engaging in a voting system development project.

Phase 3: System Design and Engineering

Phase 3 of the project marked a major transition from voting system research to the design and development of the new voting system, including a ballot marking device and related components. The work in Phase 3: System Design and Engineering of the project was spread across three (3) distinct and coordinated efforts: voting system design, stakeholder engagement and proactive legislative action.

In order to continue engaging stakeholders and incorporating the expertise needed in voting system design, the VSAP Technical Advisory Committee (TAC) was established. The TAC was established to provide VSAP with the necessary technical expertise in voting technology, security, transparency and accessibility during voting system design. The TAC is a diverse group composed of subject matter experts from a variety of industries and fields. The expertise and guidance provided by the TAC has been an invaluable component to the completion of Phase 3. In addition to engaging the members of the TAC, communication and outreach efforts engaged the public and kept them informed about project developments.

To begin to envision and design a new voting system and to remain aligned with VSAP values of transparency and citizen participation, VSAP launched an “Open Design Search” in January 2012. Utilizing sound data, the Open Design Search engaged, through an online crowdsourcing platform, a broad range of experts, designers and the general public to begin to gather ideas for the design of an innovative voting system to meet the unique needs of the County’s large and diverse electorate. There were two (2) primary components to the Open Design Search: 1) Open Innovation Challenge and 2) Voter Experience Brainstorming Workshops. This Open Design Search was conducted in partnership with the Information Technology Innovation Foundation’s Accessible Voting Technology Initiative, Election Verification Network, OpenIDEO, and with funding from the Election Assistance Commission, and resulted in over 150 concepts for improving the voter experience for County voters.

In 2013, the Department identified and engaged IDEO, a global design and innovation firm specializing in human-centered design, to begin analyzing all the data and concepts gathered since project kick-off and to begin translating that information into refined designs. This work produced design and engineering specifications for a new voting experience which consisted of a new BMD, an improved Vote by Mail (VBM) ballot, an innovative ISB and a Tally System based on modern scalable technologies. Each of these components was the product of extensive research, stakeholder engagement, the human-centered design process, iterative prototyping and consultation with the VSAP AdCom and VSAP TAC. Together these components will provide voters with an improved and contemporary voting experience that is more accessible, reliable, secure and transparent.

Phase 4: Manufacturing and Certification

The County is in progress with Phase 4: Manufacturing and Certification. In October 2016, the Department engaged Gartner Inc., an information technology advisory firm, to develop a sourcing strategy and to provide guidance on implementation strategies through a readiness assessment. Development of the sourcing strategy entailed conducting research into the vendor landscape to better understand the current products and services available in the marketplace. This was further complemented through the County’s release of a Request for Information (RFI) in April 2017 to hear directly from vendors about their interest in potentially partnering with the County to bring the VSAP vision to fruition.

Part of Phase 4: Manufacturing and Certification also includes the completed RFP Phase 1 and this RFP Phase 2, by which the County entered into a contract with Smartmatic as the Prime

Contractor who is developing, manufacturing and helping implement the VSAP Solution. During this phase, the VSAP Solution will achieve successful completion of the testing and certification process by the California Secretary of State, adhering to California Elections Code, Section 19000 et seq. ("**Elections Code**"), Certification of Voting Systems. At the end of this phase, the VSAP Solution will be ready for production in quantities to meet full rollout in the County no later than 2020.

Phase 5: Phased Implementation

In parallel to Phase 4, the County is implementing VSAP (Phase 5) in multiple phases in a manner that can best balance the implementation risks with the risks in continuing to conduct elections with the current, aging voting systems. The VSAP phased implementation timeline is as follows:

- **November 2018 Election (VBM and Tally 1.0) —** Implementation by the County of the new VBM ballots, which includes associated software modifications to the ECBMS, and new Tally System (for all VBM ballots).
- **2019 Vote Center Test Lab Testing 1 (May 2019) —** Integration of the VSAP Solution for testing by the County to assess the functionality and capacity of the VSAP Solution to support anticipated election processes in Vote Centers at scale. This test did not include the public.
- **2019 Vote Center Test Lab Testing 2 (June 2019) —** Integration of the VSAP Solution for further testing by the County, based on the learnings from 2019 Vote Center Test Lab Testing 1. This test did not include the public.
- **2019 Vote Center Test Lab Testing 3 (August - September 2019) —** Integration of the VSAP Solution for further testing by the County, based on the learnings from 2019 Vote Center Test Lab Testing 2. This test did not include the public.
- **2019 Mock Election (September 2019) —** Implementation of Ballot Marking Devices (BMDs) and ePollbooks in a Mock Election at 50 Vote Centers.
- **October - December 2019 Vote Center Demonstration Centers —** Establishment of Demonstration Centers to offer voters a simulation of the new voting experience.
- **November 2019 Pilot —** Implementation of a small number of BMDs at polling places. Vote Centers were not used during the Pilot.
- **March 2020 Election (Full Rollout) —** Full implementation of BMDs, Interactive Sample Ballot (ISB), and ePollbooks at Vote Centers, and integration with the new VBM ballots, and new Tally System.