Principle 11
Access Control
The voting system authenticates administrators, users, devices, and services before granting access to sensitive functions.

Requirements for Principle 11
Principle 11 Access Control The voting system authenticates administrators, users, devices, and services before granting access to sensitive functions.

11.1 - Access privileges, accounts, activities, and authorizations are logged, monitored, and reviewed periodically and modified as needed.

11.1-A – Logging activities and resource access
11.1-B – Voter information in log files
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11.2 - The voting system limits the access of users, groups or roles, and processes to the specific functions and data to which each entity holds authorized access.

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11.4 - Default access control policies enforce the principles of least privilege and separation of duties.
   11.4-A – Least privilege for access policies
   11.4-B – Separation of duties

11.5 - Logical access to voting system assets are revoked when no longer required.
   11.5-A – Access time period
   11.5-B – Account lockout
   11.5-C – Lockout time duration
11.1 - Access privileges, accounts, activities, and authorizations are logged, monitored, and reviewed periodically and modified as needed.

11.1-A – Logging activities and resource access

The voting system must log any access to, and activities performed on, the voting system, including:

1. timestamps for all log entries
2. all failed and successful attempts to access the voting system
3. all events which change the access control system including policies, privileges, accounts, users, groups or roles, and authentication methods.

Discussion

In the event of an error or incident, the user access log can assist in narrowing down the reason for the incident or error.

- Timestamped log entries will allow for easy auditing and review of access to the voting system.
- Access control logging supports accountability of actions by identifying and authenticating users.
- Groups are a collection of users that are assigned a specific set of permissions. Roles are an identity that is given specific permissions and can be assigned to a user. Any changes to the permissions assigned to groups and roles should be logged to identify updates to a user’s privileges.

Prior VVSG source: 2007 VVSG 4.2.1-A

11.1-B – Voter information in log files

The voting system must prevent the logging of any voter identifying information.

Discussion

The logging and storing of voter identifying information after a ballot is cast violates voter privacy.

Related requirements

10.2.4-C Logging of ballot selections

11.1-C – No disabling logging

The voting system must prevent...

1. the logging capability from being disabled, and
2. the log entries from being modified.

Discussion
• This requirement promotes the integrity of the information logged by ensuring all activities are logged. Additionally, it prevents these abilities from being an option within the user interface.
• This requirement promotes the integrity of the information logged by ensuring all activities are not modifiable.

11.1-D – On-demand access to logs
The voting system must provide administrators access to logs on demand, allowing for continuous monitoring and periodic review.

Discussion
Enabling administrators to export and review the logs is a useful feature. Continuous monitoring and review of access control logs gives the administrator the opportunity to analyze and make changes to permissions and privileges, and quickly identify issues.

Prior VVSG source: 2007 VVSG 4.2.1-A
11.2 - The voting system limits the access of users, groups or roles, and processes to the specific functions and data to which each entity holds authorized access.

**11.2.1 – Authorized access**

**11.2.1-A – Ensuring authorized access**

The voting system must allow only authorized users to access the voting system.

**Discussion**

Authorized users include voters, election officials, and election workers.

**11.2.1-B – Modifying authorized user lists**

The voting system must allow only an administrator to create or modify the list of authorized users.

**Discussion**

This requirement assists with ensuring only authorized users are given access to the voting system.

**11.2.1-C – Access control by voting stage**

The voting system access control mechanisms must distinguish at least the following voting stages from Table 11-1:

1. Pre-voting
2. Activated
3. Suspended
4. Post-voting

**Table 11-1 – Voting stage descriptions**

<table>
<thead>
<tr>
<th>Stage</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-voting</td>
<td>Powering-on, loading, and configuring device software, maintenance,</td>
</tr>
<tr>
<td></td>
<td>loading election-specific files, preparing for election day usage</td>
</tr>
<tr>
<td>Activated</td>
<td>Activating the ballot, printing, casting, spoiling the ballot</td>
</tr>
<tr>
<td>Suspended</td>
<td>Occurring when an election official suspends voting</td>
</tr>
<tr>
<td>Post-voting</td>
<td>Closing polls, tabulating votes, printing records, powering-off</td>
</tr>
</tbody>
</table>

**Discussion**

The groups or roles in 11.2-H (Table 2) will be given specific permissions which can be affected by the voting stage (Table 11-1).
11.2.1-D – Access control configuration

The voting system must allow only an administrator to configure the permissions and functionality for each identity, group or role, or process to include account and group or role creation, modification, disablement, and deletion.

Discussion

For vote-capture devices, it is possible for each group or role to have (or not have) permissions for every voting stage. Additionally, the permissions that a group or role has for a voting stage can be restricted to certain functions. Table 3 shows an example matrix of group/role to system to voting state access rights; the table is not meant to include all activities. This requirement extends [VVSG2005] I.7.2.1.1-a by allowing configuration flexibility for permissions and functionality for each identity or group/role.

Privileged accounts include any accounts within the operating system, voting device software, or other third-party software with elevated privileges such as administrator, root, and maintenance accounts. This requirement extends [VVSG2005] I.7.2.1.2 by allowing the creation and disabling of privileged accounts.

The administrator is the only user authorized to make major changes within a voting system. Administrators are given this group or role to ensure all other users have proper access to the information necessary to perform their duties.

11.2.1-E – Administrator modified permissions

The voting system must allow only an administrator to create or modify permissions assigned to specific groups or roles.

Discussion

The administrator’s authority to create or modify permissions restricts users from gaining unauthorized permissions.

11.2.1-F – Authorized assigning groups or roles

The voting system must allow only an administrator to create or assign the groups or roles.

Discussion

Table 2 is a list of groups or roles that need to be included within the voting system.

Related requirements: 11.2.2-B – Minimum groups or roles
11.2.2 – Role-based access control

11.2.2-A – Role-based access control standard

Voting systems that implement role-based access control must support the recommendations for Core Role Based Access Control (RBAC) in the ANSI INCITS 359-2004 American National Standard for Information Technology – Role Based Access Control document.

**Discussion**

This requirement extends [VVSG2005] I. 7.2.1.1-a by requiring role-based methods to follow ANSI INCITS 359-2004.

- **External references:** ANSI INCIS 359-2004
- **Source:** VVSG 1.0 I.7.2.1.1

11.2.2-B – Minimum groups or roles

At minimum, voting systems that implement RBAC must define the following groups or roles within Table 11-2.

**Table 11-2 – Minimum Voting System Groups or Roles for RBAC**

<table>
<thead>
<tr>
<th>Group or role</th>
<th>Role description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Administrator</td>
<td>Can update and configure the voting devices and troubleshoots system problems.</td>
</tr>
<tr>
<td>Voter</td>
<td>A restricted process in the vote-capture device. It allows the vote-capture device to enter the Activated state for voting activities.</td>
</tr>
<tr>
<td>Election Judge</td>
<td>Has the ability to open the polls, close the polls, recover from errors, and generate reports.</td>
</tr>
<tr>
<td>Election Worker</td>
<td>Checks in voters and activates the ballot style.</td>
</tr>
<tr>
<td>Central Election Official</td>
<td>Loads ballot definition files.</td>
</tr>
</tbody>
</table>

**Discussion**

Table 11-2 is a baseline list of groups or roles to be included in the voting system.

11.2.2-C – Minimum group or role permissions

At minimum, the voting system must use the groups or roles from Table 11-2 and the voting stages from Table 11-1, to assign the minimum permissions in Table 11-3.

**Discussion**

Table 11-3 defines the minimum functions according to user, voting stage, and system. Other capabilities can be defined as needed by jurisdiction.
Table 11-3 - Minimum permissions for each group or role

<table>
<thead>
<tr>
<th>Group/Role</th>
<th>System</th>
<th>Pre-Voting</th>
<th>Activated</th>
<th>Suspended</th>
<th>Post-Voting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Administrator</td>
<td>EMS</td>
<td>Full Access</td>
<td>Full Access</td>
<td>Full Access</td>
<td>Full Access</td>
</tr>
<tr>
<td></td>
<td>BMD/Electronic</td>
<td>Full Access</td>
<td>Full Access</td>
<td>Full Access</td>
<td>Full Access</td>
</tr>
<tr>
<td></td>
<td>PCOS</td>
<td>Full Access</td>
<td>Full Access</td>
<td>Full Access</td>
<td>Full Access</td>
</tr>
<tr>
<td>Voter</td>
<td>EMS</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td></td>
<td>BMD/Electronic</td>
<td>---</td>
<td>Vote and cast ballots</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td></td>
<td>PCOS</td>
<td>---</td>
<td>Ballot Submission</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Election Judge/Precinct Captain</td>
<td>EMS</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td></td>
<td>BMD/Electronic</td>
<td>Open polls, L&amp;A</td>
<td>Close or suspend polls, Recover from errors</td>
<td>Exit suspended state</td>
<td>Generate reports</td>
</tr>
<tr>
<td></td>
<td>PCOS</td>
<td>Open polls, L&amp;A</td>
<td>Recover from errors</td>
<td>Exit suspended state</td>
<td>Generate reports</td>
</tr>
<tr>
<td>Election Worker</td>
<td>EMS</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td></td>
<td>BMD/Electronic</td>
<td>---</td>
<td>Activate ballot and cancel ballots</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td></td>
<td>PCOS</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Central Election Official</td>
<td>EMS</td>
<td>---</td>
<td>Define and load ballot</td>
<td>---</td>
<td>Reconcile provisional-challenged ballots, write-ins, generate reports</td>
</tr>
<tr>
<td></td>
<td>BMD/Electronic</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td></td>
<td>PCOS</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
</tbody>
</table>
11.2.2-D – Applying permissions

The voting system must be capable of applying assigned groups or roles and permissions to authorized users.

Discussion

Once the user is assigned a group or role, the voting system needs to be capable of making the necessary changes to the user’s permissions. The permissions are changed based on the assigned group or role.
11.3 - The voting system supports strong, configurable authentication mechanisms to verify the identities of authorized users and includes multi-factor authentication mechanisms for critical operations.

11.3.1 – Access control mechanism

11.3.1-A – Access control mechanism application

The voting system must use access control mechanisms to permit authorized access or prevent unauthorized access to the voting system.

**Discussion**

Access controls support the following concepts:

- Limiting the actions of users, groups or roles, and processes to those that are authorized.
- Limiting entities to the functions for which they are authorized.
- Limiting entities to the data for which they are authorized.
- Accountability of actions by identifying and authenticating users.

Most modern operating systems natively provide configurable access control mechanisms that the voting system application can use.

Prior VVSG Source: VVSG 1.1 I.7.2.1.2-1, I.7.2.1.2-2

11.3.1-B – Multi-factor authentication for critical operations

The voting system must be capable of using multi-factor authentication to verify a user has authorized access to perform critical operations, including:

1. Software updates to the certified voting system
2. Aggregation and tabulation
3. Enabling network functions, wireless, and use of telecommunications
4. Changing device states, including opening and closing the polls
5. Deleting or modifying the audit trail
6. Modifying authentication mechanisms

**Discussion**

NIST SP 800-63-3 Digital Identity Guidelines provides additional information useful in meeting this requirement. NIST SP 800-63-3 defines Multi-factor authentication (MFA) as follows:

“An authentication system that requires more than one distinct authentication factor for successful
Multi-factor authentication can be performed using a multi-factor authenticator or by a combination of authenticators that provide different factors. The three authentication factors are something you know, something you have, and something you are. Multifactor authenticators include, but are not limited to the following:

- Username & password
- Smartcard (for example, voter access card)
- iButton
- Biometric authentication (for example, fingerprint)

**11.3.1-C – Multi-factor authentication for administrators**

The voting system must authenticate the administrator with a multi-factor authentication mechanism.

**Discussion**

This requirement extends [VVSG2005] I.7.2.1.2-e by requiring multi-factor authentication for the voting system administrator group or role.

Prior VVSG source: VVSG 1.1 I.7.2.1.2-e

**11.3.2 – Username and password**

**11.3.2-A – Username and password management**

If the voting system uses a user name and password authentication method, the voting system must allow only the administrator to enforce password strength, histories, and expiration.

**Discussion**

This requirement extends [VVSG2005] I.7.2.1.2-e by requiring strong passwords, password histories, and password expiration.

Prior VVSG source: VVSG 1.1 I.7.2.1.2-1

**11.3.2-B – Password complexity**

The voting system must allow only the administrator to specify password strength for all accounts including minimum password length, use of capitalized letters, use of numeric characters, and use of non-alphanumeric characters per NIST 800-63 Electronic Authentication Guideline standards.

**Discussion**
This requirement extends [VVSG2005] I.7.2.1.2-e by allowing the administrator flexibility in configuring password strength. It also requires the use of NIST 800-63 standards.

Prior VVSG source: VVSG 1.1 I.7.2.1.2-1

11.3.2-C – Minimum password complexity
The voting system must compare all passwords against a manufacturer-specified list of well-known weak passwords.

**Discussion**
Examples of common weak passwords include 0000, 1111, 1234.

Prior VVSG source: VVSG 1.1 I.7.2.1.2-1

11.3.2-D – Usernames within passwords
The voting system must ensure that the username is not used in the password.

**Discussion**
This requirement extends [VVSG2005] I.7.2.1.2-e by restricting the use of usernames and related information in passwords.

Prior VVSG source: VVSG 1.1 I.7.2.1.2-e
11.4 - Default access control policies enforce the principles of least privilege and separation of duties.

11.4-A – Least privilege for access policies
By default, the voting system must implement the principle of least privilege including denying access to functions and data unless explicitly permitted.

Discussion
This requirement extends [VVSG2005] I.7.2.1.2-a by requiring explicit authorization of subjects based on access control policies.

Prior VVSG source: VVSG 1.1 I.7.2.1.2-1

11.4-B – Separation of duties
Voting system documentation must include suggested practices for dispersing critical operations across multiple groups or roles.

Discussion
Guidance for implementing separation of duties within the voting system is imperative to implement the separation of duties principle. Separation of duties is meant to divide user functions and roles so that there is no conflict of interest.
11.5 - Logical access to voting system assets are revoked when no longer required.

11.5-A – Access time period
The voting system must only allow users authorized access within a time period specified by the administrator.

Discussion
After authentication, a user’s access to a voting system will time-out after a specified period of time. This will avoid unauthorized access to the voting system by unauthorized users. Once a user’s access has timed-out, the user will have to re-authenticate to continue using the voting system.

11.5-B – Account lockout
The voting system must lockout roles or individuals after an administrator-specified number of consecutive failed authentications attempts.

Discussion
This requirement prevents certain classes of password guessing attacks. This requirement can be implemented using a technique such as exponential backoff. Exponential backoff requires that after each unsuccessful authentication attempt, the time period before another authentication attempt can be made grows exponentially. For instance:

- The wait after 1 unsuccessful authentication attempt is 0 seconds
- The wait after 2 unsuccessful attempts is 2 seconds
- The wait after 3 unsuccessful attempts is 4 seconds, and so on

Prior VVSG source: VVSG 1.1 I.7.2.1.2-1

11.5-C – Lockout time duration
The voting system must allow only an administrator to define the lockout duration.

Discussion
This requirement extends [VVSG2005] I.7.2.1.2 by allowing the administrator flexibility in configuring the account lockout policy. The lockout policy should not lockout voters.

Prior VVSG source: VVSG 1.1 I.7.2.1.2-1