Fortify Security Report

Jan 28, 2020

psdravid

Executive Summary

Issues Overview

On Jan 28, 2020, a source code review was performed over the registrationcore code base. 141 files, 1,598 LOC (Executable) were scanned and reviewed for defects that could lead to potential security vulnerabilities. A total of 9 reviewed findings were uncovered during the analysis.

Issues by Fortify Priority Order

High	8
Critical	1

Recommendations and Conclusions

The Issues Category section provides Fortify recommendations for addressing issues at a generic level. The recommendations for specific fixes can be extrapolated from those generic recommendations by the development group.

Project Summary

Code Base Summary

Code location: /srv/openmrs_code/org/openmrs/module/registrationcore
Number of Files: 141
Lines of Code: 1598
Build Label: <No Build Label>

Scan Information

Scan time: 01:51
SCA Engine version: 19.1.0.2241
Machine Name: vclv99-200.hpc.ncsu.edu
Username running scan: psdravid

Results Certification

Results Certification Valid

Details:

Results Signature:

SCA Analysis Results has Valid signature

Rules Signature:

There were no custom rules used in this scan

Attack Surface

Attack Surface:
Private Information:
null.null.null

System Information:
null.null.null
java.lang.ClassLoader.getResource
java.lang.Throwable.getMessage

Filter Set Summary

Current Enabled Filter Set:
Quick View

Filter Set Details:

Folder Filters:
If [fortify priority order] contains critical Then set folder to Critical
If [fortify priority order] contains high Then set folder to High
If [fortify priority order] contains medium Then set folder to Medium
If [fortify priority order] contains low Then set folder to Low

Visibility Filters:

If impact is not in range [2.5, 5.0] Then hide issue

If likelihood is not in range (1.0, 5.0] Then hide issue

Audit Guide Summary

Audit guide not enabled

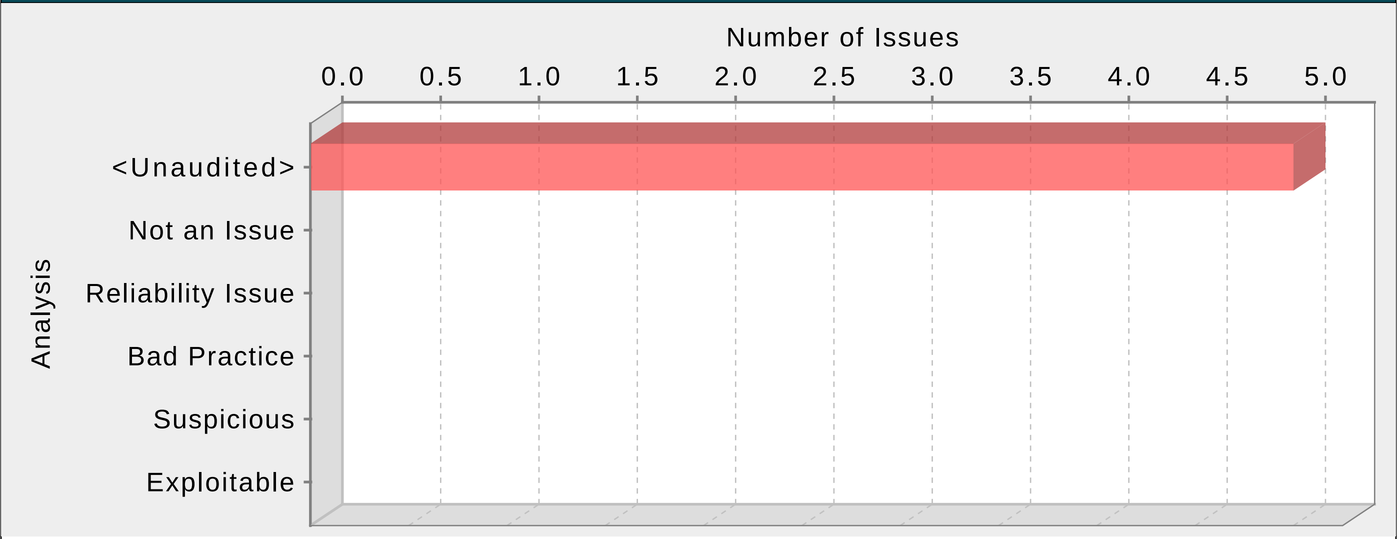
Results Outline

Overall number of results

The scan found 9 issues.

Vulnerability Examples by Category

Category: Password Management: Hardcoded Password (5 Issues)



Abstract:

Hardcoded passwords may compromise system security in a way that cannot be easily remedied.

Explanation:

It is never a good idea to hardcode a password. Not only does hardcoding a password allow all of the project's developers to view the password, it also makes fixing the problem extremely difficult. After the code is in production, the password cannot be changed without patching the software. If the account protected by the password is compromised, the owners of the system must choose between security and availability.

Example 1: The following code uses a hardcoded password to connect to a database:

```
...
DriverManager.getConnection(url, "scott", "tiger");
...
```

This code will run successfully, but anyone who has access to it will have access to the password. After the program ships, there is likely no way to change the database user "scott" with a password of "tiger" unless the program is patched. An employee with access to this information can use it to break into the system. Even worse, if attackers have access to the bytecode for the application they can use the javap -c command to access the disassembled code, which will contain the values of the passwords used. The result of this operation might look something like the following for Example 1:

```
javap -c ConnMngr.class
22: ldc   #36; //String jdbc:mysql://ixne.com/rxsql
24: ldc   #38; //String scott
26: ldc   #17; //String tiger
```

In the mobile environment, password management is especially important given that there is such a high chance of device loss.

Example 2: The following code uses hardcoded username and password to setup authentication for viewing protected pages with Android's WebView.

```
...
webview.setWebViewClient(new WebViewClient() {
public void onReceivedHttpAuthRequest(WebView view,
HttpAuthHandler handler, String host, String realm) {
handler.proceed("guest", "allow");
}
});
...
```

Similar to Example 1, this code will run successfully, but anyone who has access to it will have access to the password.

Recommendations:

Passwords should never be hardcoded and should generally be obfuscated and managed in an external source. Storing passwords in plain text anywhere on the system allows anyone with sufficient permissions to read and potentially misuse the password. At the very least, passwords should be hashed before being stored.

Some third-party products claim the ability to manage passwords in a more secure way. For example, WebSphere Application Server 4.x uses a simple XOR encryption algorithm for obfuscating values, but be skeptical about such facilities. WebSphere and other application servers offer outdated and relatively weak encryption mechanisms that are insufficient for security-sensitive environments. Today, the best option for a secure generic solution is to create a proprietary mechanism yourself.

For Android, as well as any other platform that uses SQLite database, SQLCipher is a good alternative. SQLCipher is an extension to the SQLite database that provides transparent 256-bit AES encryption of database files. Thus, credentials can be stored in an encrypted database.

Example 3: The following code demonstrates how to integrate SQLCipher into an Android application after downloading the necessary binaries, and store credentials into the database file.

```
import net.sqlcipher.database.SQLiteDatabase;
...
SQLiteDatabase.loadLibs(this);
File dbFile = getDatabasePath("credentials.db");
dbFile.mkdirs();
dbFile.delete();
SQLiteDatabase db = SQLiteDatabase.openOrCreateDatabase(dbFile, "credentials", null);
db.execSQL("create table credentials(u, p)");
db.execSQL("insert into credentials(u, p) values(?, ?)", new Object[]{username, password});
...
```

Note that references to android.database.sqlite.SQLiteDatabase are substituted with those of net.sqlcipher.database.SQLiteDatabase.

To enable encryption on the WebView store, WebKit has to be re-compiled with the sqlcipher.so library.

Tips:

1. The Fortify Java Annotations FortifyPassword and FortifyNotPassword can be used to indicate which fields and variables represent passwords.

2. To identify null, empty, or hardcoded passwords, default rules only consider fields and variables that contain the word password. However, the Fortify Custom Rules Editor provides the Password Management wizard that makes it easy to create rules for detecting password management issues on custom-named fields and variables.

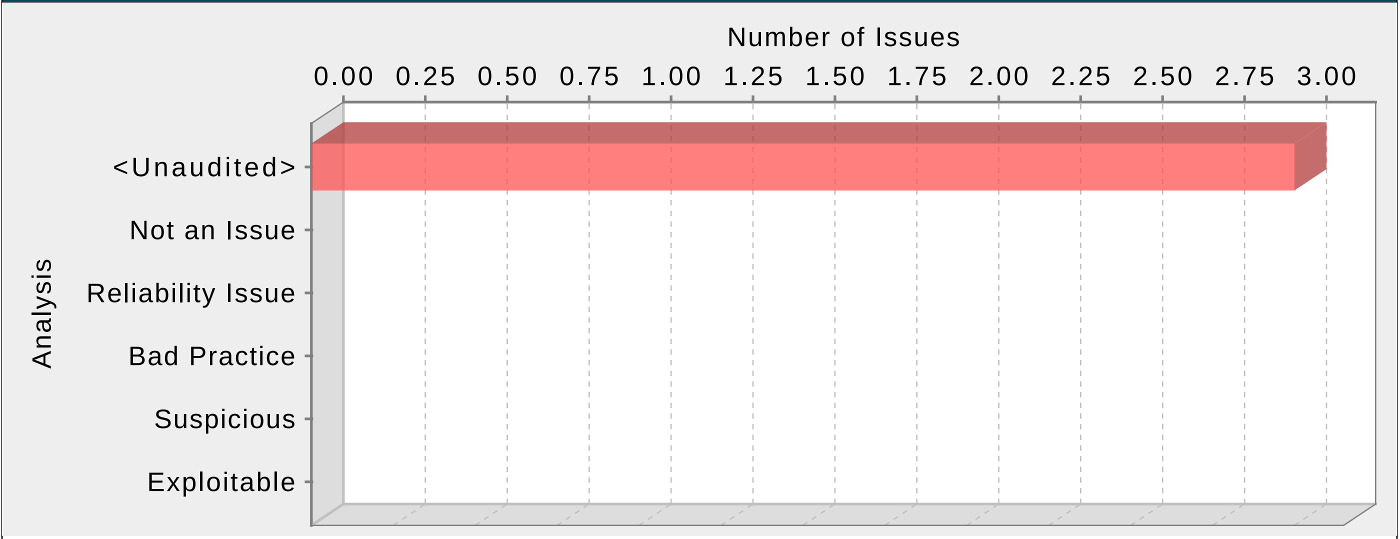
MpiProperties.java, line 38 (Password Management: Hardcoded Password)

Fortify Priority:	High	**Folder**	High
Kingdom:	Security Features		
Abstract:	Hardcoded passwords may compromise system security in a way that cannot be easily remedied.		

Sink: MpiProperties.java:38 VariableAccess: passwordPropertyName()

```
36          String username = getProperty(usernamePropertyName);
37
38          String passwordPropertyName =
      RegistrationCoreConstants.GP_MPI_ACCESS_PASSWORD;
39          String password =******
```

Category: Race Condition: Singleton Member Field (3 Issues)



Abstract:

The class IdentifierBuilder is a singleton, so the member field iss is shared between users. The result is that one user could see another user's data.

Explanation:

Many Servlet developers do not understand that a Servlet is a singleton. There is only one instance of the Servlet, and that single instance is used and re-used to handle multiple requests that are processed simultaneously by different threads.

A common result of this misunderstanding is that developers use Servlet member fields in such a way that one user may inadvertently see another user's data. In other words, storing user data in Servlet member fields introduces a data access race condition.

Example 1: The following Servlet stores the value of a request parameter in a member field and then later echoes the parameter value to the response output stream.

```
public class GuestBook extends HttpServlet {
String name;
protected void doPost (HttpServletRequest req, HttpServletResponse res) {
name = req.getParameter("name");
...
out.println(name + ", thanks for visiting!");
}
}
```

While this code will work perfectly in a single-user environment, if two users access the Servlet at approximately the same time, it is possible for the two request handler threads to interleave in the following way:

Thread 1: assign "Dick" to name
Thread 2: assign "Jane" to name
Thread 1: print "Jane, thanks for visiting!"
Thread 2: print "Jane, thanks for visiting!"

Thereby showing the first user the second user's name.

Recommendations:

Do not use Servlet member fields for anything but constants. (i.e. make all member fields static final).

Developers are often tempted to use Servlet member fields for user data when they need to transport data from one region of code to another. If this is your aim, consider declaring a separate class and using the Servlet only to "wrap" this new class.

Example 2: The bug in Example 1 can be corrected in the following way:

```
public class GuestBook extends HttpServlet {
protected void doPost (HttpServletRequest req, HttpServletResponse res) {
GBRequestHandler handler = new GBRequestHandler();
handler.handle(req, res);
}
}
public class GBRequestHandler {
String name;
public void handle(HttpServletRequest req, HttpServletResponse res) {
name = req.getParameter("name");
...
out.println(name + ", thanks for visiting!");
}
}
```

Alternatively, a Servlet can utilize synchronized blocks to access servlet instance variables but using synchronized blocks may cause significant performance problems.

Please notice that wrapping the field access within a synchronized block will only prevent the issue if all read and write operations on that member are performed within the same synchronized block or method.

Example 3: Wrapping the Example 1 write operation (assignment) in a synchronized block will not fix the problem since the threads will have to get a lock to modify name field, but they will release the lock afterwards, allowing a second thread to change the value again. If, after changing the name value, the first thread resumes execution, the value printed will be the one assigned by the second thread:

```
public class GuestBook extends HttpServlet {
String name;
protected void doPost (HttpServletRequest req, HttpServletResponse res) {
synchronized(name) {
name = req.getParameter("name");
}
...
out.println(name + ", thanks for visiting!");
}
}
```

In order to fix the race condition, all the write and read operations on the shared member field should be run atomically within the same synchronized block:

```
public class GuestBook extends HttpServlet {
String name;
protected void doPost (HttpServletRequest req, HttpServletResponse res) {
synchronized(name) {
name = req.getParameter("name");
...
out.println(name + ", thanks for visiting!");
}
}
}
```

IdentifierBuilder.java, line 80 (Race Condition: Singleton Member Field)

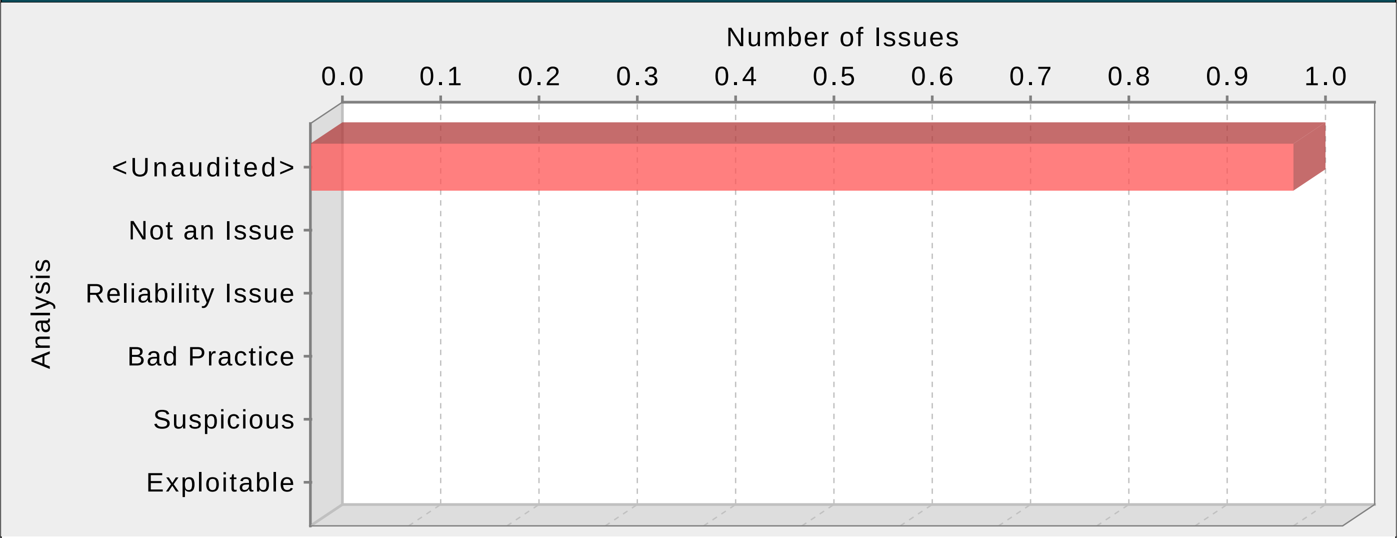
Fortify Priority:	High	**Folder**	High
Kingdom:	Time and State		

Abstract: The class IdentifierBuilder is a singleton, so the member field iss is shared between users. The result is that one user could see another user's data.

Sink: IdentifierBuilder.java:80 AssignmentStatement()

```
78      private IdentifierSourceService getIss() {
79          if (iss == null) {
80              iss = Context.getService(IdentifierSourceService.class);
81          }
82          return iss;
```

Category: XML External Entity Injection (1 Issues)



Abstract:

XML parser configured in XmlMarshaller.java:14 does not prevent nor limit external entities resolution. This can expose the parser to an XML External Entities attack.

Explanation:

XML External Entities attacks benefit from an XML feature to build documents dynamically at the time of processing. An XML entity allows inclusion of data dynamically from a given resource. External entities allow an XML document to include data from an external URI. Unless configured to do otherwise, external entities force the XML parser to access the resource specified by the URI, e.g., a file on the local machine or on a remote system. This behavior exposes the application to XML External Entity (XXE) attacks, which can be used to perform denial of service of the local system, gain unauthorized access to files on the local machine, scan remote machines, and perform denial of service of remote systems.

The following XML document shows an example of an XXE attack.

```
<?xml version="1.0" encoding="ISO-8859-1"?>
<!DOCTYPE foo [
<!ELEMENT foo ANY >
<!ENTITY xxe SYSTEM "file:///dev/random" >]><foo>&xxe;</foo>
```

This example could crash the server (on a UNIX system), if the XML parser attempts to substitute the entity with the contents of the /dev/random file.

Recommendations:

The XML unmarshaller should be configured securely so that it does not allow external entities as part of an incoming XML document.

To avoid XXE injection do not use unmarshal methods that process an XML source directly as java.io.File, java.io.Reader or java.io.InputStream. Parse the document with a securely configured parser and use an unmarshal method that takes the secure parser as the XML source as shown in the following example:

```
DocumentBuilderFactory dbf = DocumentBuilderFactory.newInstance();
dbf.setFeature("http://apache.org/xml/features/disallow-doctype-decl", true);
DocumentBuilder db = dbf.newDocumentBuilder();
Document document = db.parse(<XML Source>);
Model model = (Model) u.unmarshal(document);
```

Tips:

1. Fortify RTA adds protection against this category.

XmlMarshaller.java, line 14 (XML External Entity Injection)

Fortify Priority:	High	**Folder**	High
Kingdom:	Input Validation and Representation		
Abstract:	XML parser configured in XmlMarshaller.java:14 does not prevent nor limit external entities resolution. This can expose the parser to an XML External Entities attack.		
Sink:	XmlMarshaller.java:14 unmarshal()		

```
12              JAXBContext jaxbContext =
JAXBContext.newInstance(OpenEmpiPatientResult.class);
13              Unmarshaller jaxbUnmarshaller = jaxbContext.createUnmarshaller();
```

```
                              return (OpenEmpiPatientResult) jaxbUnmarshaller.unmarshal(file);
                          }
                      }
```

Issue Count by Category

Issues by Category	
Password Management: Hardcoded Password	5
Race Condition: Singleton Member Field	3
XML External Entity Injection	1

Issue Breakdown by Analysis

Issues by Analysis