Security Assessment of oLink on behalf of Open Technology Fund

OPEN TECHNOLOGY FUND

Olink

INCLUDE SECURITY

TABLE OF CONTENTS

EXECUTIVE SUMMARY

Include Security (IncludeSec)

IncludeSec brings together some of the best information security talent from around the world. The team is composed of security experts in every aspect of consumer and enterprise technology, from low-level hardware and operating systems to the latest cutting-edge web and mobile applications. More information about the company can be found at www.IncludeSecurity.com.

Assessment Objectives

The objective of this assessment was to identify and confirm potential security vulnerabilities within targets in-scope of the SOW. The team assigned a qualitative risk ranking to each finding. Recommendations were provided for remediation steps which Open Tech Fund could implement to secure its applications and systems.

Scope and Methodology

Include Security performed a security assessment of Open Tech Fund's oLink. The assessment team performed a 5 day effort spanning from January 27th – February 2nd, 2022, using a Standard Grey Box assessment methodology which included a detailed review of all the components described in a manner consistent with the original Statement of Work (SOW).

Findings Overview

IncludeSec identified 11 categories of findings. There were 1 deemed to be "Critical-Risk," 2 deemed to be "High-Risk," 1 deemed to be "Medium-Risk," and 4 deemed to be "Low-Risk," which pose some tangible security risk. Additionally, 3 "Informational" level findings were identified that do not immediately pose a security risk.

IncludeSec encourages Open Tech Fund to redefine the stated risk categorizations internally in a manner that incorporates internal knowledge regarding business model, customer risk, and mitigation environmental factors.

Next Steps

IncludeSec advises Open Tech Fund to remediate as many findings as possible in a prioritized manner and make systemic changes to the Software Development Life Cycle (SDLC) to prevent further vulnerabilities from being introduced into future release cycles. This report can be used by as a basis for any SDLC changes. IncludeSec welcomes the opportunity to assist Open Tech Fund in improving their SDLC in future engagements by providing security assessments of additional products. For inquiries or assistance scheduling remediation tests, please contact us at remediation@includesecurity.com.

RISK CATEGORIZATIONS

At the conclusion of the assessment, Include Security categorized findings into five levels of perceived security risk: Critical, High, Medium, Low, or Informational. **The risk categorizations below are guidelines that IncludeSec understands reflect best practices in the security industry and may differ from a client's internal perceived risk. Additionally, all risk is viewed as "location agnostic" as if the system in question was deployed on the Internet. It is common and encouraged that all clients recategorize findings based on their internal business risk tolerances. Any discrepancies between assigned risk and internal perceived risk are addressed during the course of remediation testing.**

Critical-Risk findings are those that pose an immediate and serious threat to the company's infrastructure and customers. This includes loss of system, access, or application control, compromise of administrative accounts or restriction of system functions, or the exposure of confidential information. These threats should take priority during remediation efforts.

High-Risk findings are those that could pose serious threats including loss of system, access, or application control, compromise of administrative accounts or restriction of system functions, or the exposure of confidential information.

Medium-Risk findings are those that could potentially be used with other techniques to compromise accounts, data, or performance.

Low-Risk findings pose limited exposure to compromise or loss of data, and are typically attributed to configuration, and outdated patches or policies.

Informational findings pose little to no security exposure to compromise or loss of data which cover defense-in-depth and best-practice changes which we recommend are made to the application. Any informational findings for which the assessment team perceived a direct security risk, were also reported in the spirit of full disclosure but were considered to be out of scope of the engagement.

The findings represented in this report are listed by a risk rated short name (e.g., C1, H2, M3, L4, and I5) and finding title. Each finding may include if applicable: Title, Description, Impact, Reproduction (evidence necessary to reproduce findings), Recommended Remediation, and References.

INTRODUCTION

The assessment team performed a five-day assessment of the **oLink** application and source code. **oLink** is a tool used to mirror web content on Amazon S3 in order to evade government-run content-blocking firewalls.

Overview of oLink

While using **oLink**, a user provides credentials to an AWS account with an S3 bucket configured to allow public access where the mirrored web content will be stored. The user then inputs a list of URLs of web pages, typically articles; then, **oLink** downloads the HTML and associated media files, reformats the HTML, and uploads it to the configured S3 bucket, where the content will be served by Amazon servers over HTTPS. Finally, **oLink** uses a URL shortening service to generate a short link to the S3 bucket URL, to be shared with users behind content-blocking firewalls. **oLink** uses a Microsoft SQL Server database to store parts of its configuration and internal state.

Assessment Overview

The assessment focused on discovering the highest risk security threats impacting **oLink** users or consumers of content mirrored with **oLink** in a variety of potential attack scenarios. These scenarios included malicious content being processed by **oLink** from a malicious or a compromised web site, attacks on the machine where **oLink** is used or the network that the machine is connected to, social engineering attacks against **oLink** users, and attacks intended to identify **oLink** users or content consumers. In addition, the PDF user-guide documentation for **oLink** was reviewed for potential security concerns in instructions or recommendations.

General patterns of potentially exploitable or overly complex coding practices were discovered during the assessment, some of which are noted here; these vulnerabilities are further discussed in the findings of the report.

First, a command injection vulnerability was discovered due to **oLink** executing **AWS** command-line tools with user input. To address this vulnerability, the code could be made more secure by using a library to access **AWS** rather than executing shell commands directly.

As another example, the dependency on Microsoft SQL Server for storing security-relevant configuration data and usage information added unneeded complexity to **oLink**, and the practice of using string replacement to construct SQL strings is potentially dangerous. Instead, a less complex and more robust method for storing configuration data which incorporates encryption, as well as advice for generally avoiding SQL Injection vulnerabilities, is included in the report.

Untrusted HTML was processed using complex systems of regular expressions in **oLink**, which proved not to be robust and led to security vulnerabilities. An HTML parsing and sanitization library is recommended instead of relying on regular expressions.

CRITICAL-RISK FINDINGS

C1: Operating System Command Injection

Description:

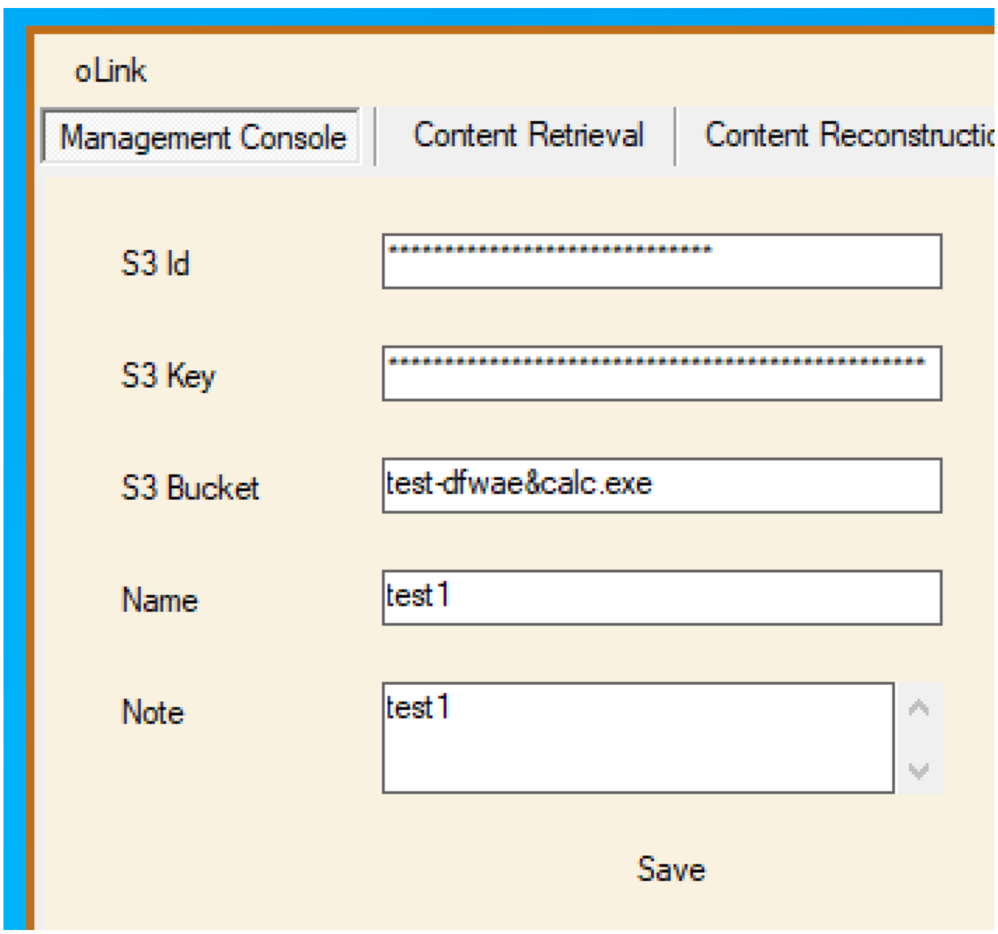
An operating system command injection vulnerability was found in the **oLink** application, which could be exploited to run arbitrary OS commands (terminal commands) on the host running **oLink**.

Impact:

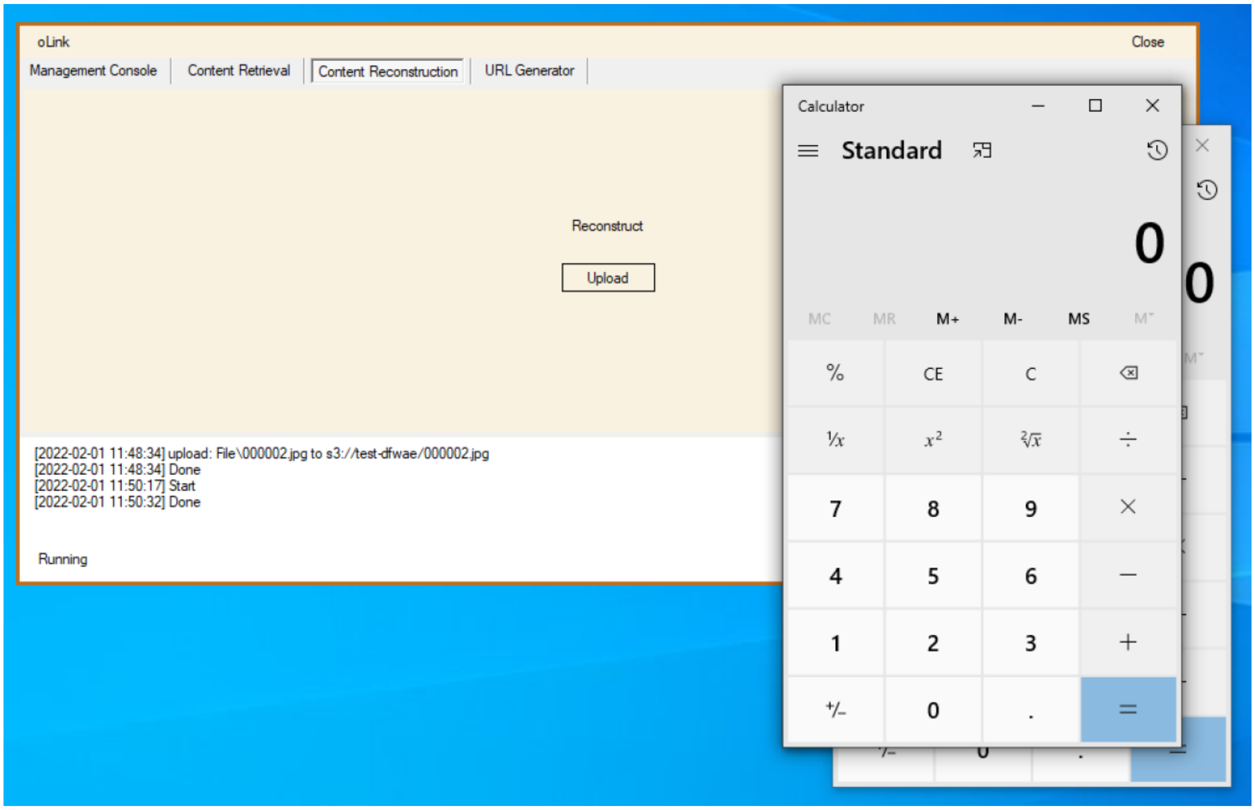
An attacker who can exploit this vulnerability would have complete and total control over the **oLink** user's machine and all data and information passing through it. On its own, this vulnerability could be exploited by the **oLink** user entering malicious commands into the **oLink** user interface themselves (for example, through social engineering). However, since the data in the affected inputs is stored in the database, an attacker who has access to the database could store malicious commands in the database, to be executed when **oLink** is next run. The database for **oLink** is a Microsoft SQL Server database, which is configured when **oLink** is installed. Depending on the SQL Server configuration, access to the database could be local or remote.

Reproduction:

To reproduce this vulnerability, the string **&calc.exe** was added to the end of the **S3 Id**, **S3 Key**, and **S3 Bucket** values in **oLink**. Note that **oLink** obscured the contents of the **S3 Id** and **S3 Key** values, making them more likely to be targeted for exploitation.



Next, when the **Upload** button was pressed, several instances of the Windows Calculator application were launched via **calc.exe**.



The root cause was identified in the file **olink/oLink/FormLink.cs**, lines 339-369:

```
339         private void Upload()
340         {
341             ShowMsgD("Start");
342             try
343             {
344                 string s0 = Path.GetDirectoryName(Application.ExecutablePath);
345                 string s = @"set AWS_ACCESS_KEY_ID=^S3Id^
346 set AWS_SECRET_ACCESS_KEY=^S3Key^
347 aws s3 sync C:\oLink\Site s3://^S3Bucket^/Site --acl public-read --region eu-west-1
348 aws s3 sync C:\oLink\File s3://^S3Bucket^/File --acl public-read --region eu-west-1"
349 .Replace("^S3Id^", textBoxS3Id.Text.Trim())
350 .Replace("^S3Key^", textBoxS3Key.Text.Trim())
351 .Replace("^S3Bucket^", textBoxS3Bucket.Text.Trim());
352                 Process p = new Process();
353                 p.StartInfo.FileName = "cmd.exe";
354                 p.StartInfo.UseShellExecute = false;
355                 p.StartInfo.RedirectStandardInput = true;
356                 p.StartInfo.RedirectStandardOutput = true;
357                 p.StartInfo.RedirectStandardError = true;
358                 p.StartInfo.CreateNoWindow = true;
359                 p.OutputDataReceived += new DataReceivedEventHandler(OnOutputDataReceived);
360                 p.Start();
361                 p.BeginOutputReadLine();
362                 ##$$
363                 p.StandardInput.WriteLine("exit");
364                 p.WaitForExit();
365                 if (p.ExitCode != 0) ShowMsgD(p.StandardError.ReadToEnd());
366             }
367             catch (Exception ex) { Log(MethodBase.GetCurrentMethod().Name + ": " + ex.Message); }
368             ShowMsgD("Done");
369         }
```

The code launches the **AWS** command-line tool in order to upload data to **S3**. It does so by starting a **cmd.exe** process and writing the commands to it. The commands themselves are constructed by replacing placeholder text within strings with the parameters from the user interface inputs, which previously were loaded from the database.

Recommended Remediation:

The assessment team recommends avoiding direct OS commands from application-layer code whenever possible, as many application frameworks provide APIs to achieve the same functionality. Amazon publishes an AWS SDK for .NET applications.

If untrusted input must be passed to OS commands, the assessment team recommends validating it against a whitelist of allowed values. For example, if the system needs an alphanumeric file name, the user input can be checked against the regular expression **/[A-Za-z0-9]/**.

References:

AWS SDK for .NET Documentation
OWASP: OS Command Injection Defense Cheat Sheet
Portswigger: OS Command Injection

HIGH-RISK FINDINGS

H1: Cryptographic Secrets Stored in Source Code Repository

Description:

A database password was found within the **oLink** application source code repository, within a configuration file. Access to the source code repository and its history could be exposed by another exploit or if the application is open sourced, which would provide access to these database credentials to an attacker. Additionally, the password would be exposed if the configuration file is distributed with the compiled application.

Impact:

The database credentials were likely used by developers and potentially by users of the application. An attacker with access to the database credentials and access to the database server (for example, the network where the database server is installed, depending on the database configuration and deployment) could cause the **oLink** application to execute arbitrary code (see the **Operating System Command Injection** issue for more details on how modifying the AWS credentials stored in the database could lead to code execution), gain access to the AWS account used by **oLink**, and learn what web pages had been copied with **oLink**, in order to target future attacks against those sites or against **oLink** and **oLink** users.

Reproduction:

The database credentials were found in the file **olink/oLink/App.config**, line 4 (the password has been redacted):

```
1 <?xml version="1.0" encoding="utf-8" ?>
2 <configuration>
3     <appSettings>
4               <add key="DB" value="server=.\SQLEXPRESS;Initial Catalog=oLink;User ID=sas;Password=[REDACTED]"/>
5       </appSettings>
6     <startup>
7         <supportedRuntime version="v4.0" sku=".NETFramework,Version=v4.5" />
8     </startup>
9 </configuration>
```

Recommended Remediation:

The assessment team recommends removing the **App.config** configuration file from the source code repository, removing it from the **git** history, and changing the password on any database that uses the password stored in the file.

References:

Cryptography API: Next Generation
The Cryptography API, or How to Keep a Secret
Windows Data Protection
Keychain Services
Essentials of the Java Programming Language Part 2 Lesson 3: Cryptography
Cryptography with Java, Cryptographic Keys

H2: HTML Sanitization Bypass

Description:

The **oLink** application contained code that attempted to sanitize HTML by removing all tags that are not explicitly allowed by the code. However, it was possible to bypass this sanitization, allowing JavaScript code and other content to be injected into a site mirrored using **oLink**.

Impact:

An attacker who controls a site that is mirrored using **oLink** could inject JavaScript code and other HTML content into the resulting mirrored page. The attacker may then host their own malicious site or attempt to put malicious code in a compromised site. The payload could allow the attacker to identify anyone viewing the mirrored page, for example, by injecting JavaScript that makes requests to an attacker-controlled host from the context of the compromised mirror on **S3**.

Reproduction:

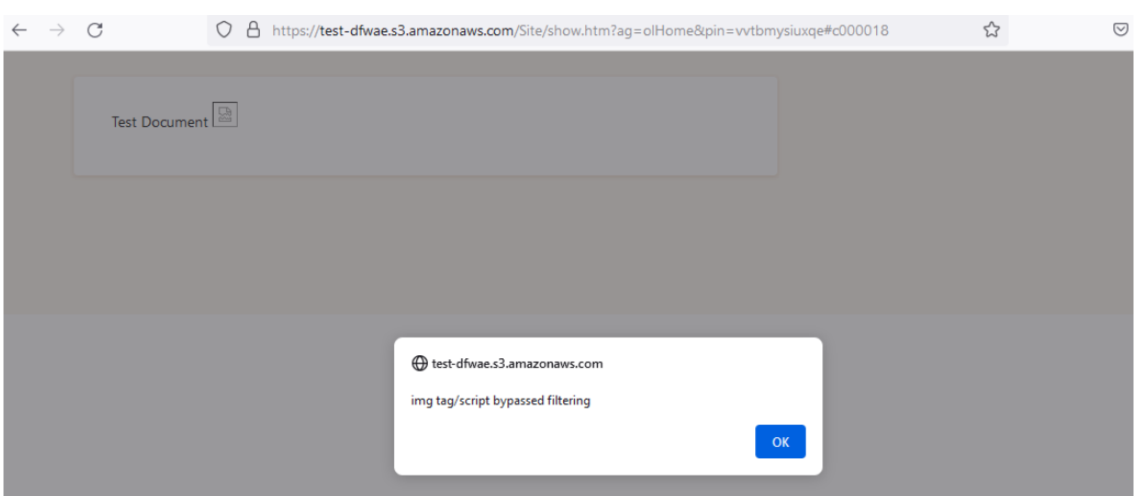
This HTML document demonstrates the vulnerability. It was retrieved, reconstructed, and uploaded using **oLink**:

```
<html>
<head>
<title>Test document</title>
</head>
<body>
Test Document
<><<>img src=x onerror="alert('img tag/script bypassed filtering');">
</body>
```

When reconstructed, this file was created at file **C:\oLink\Site\c000018.htm**, showing that an unwanted **img** tag containing JavaScript code existed in the document:

```
<div class='main'>
  <div class='maia'>
    <div class='lisc' style='padding:0 0 15px 0;'>
      <div class='artl'>
<div class="artl">
Test Document
<img src=x onerror="alert('img tag/script bypassed filtering');">
</div>
      </div>
    </div>
  </div>
  <div style='height:36px; clear:both;'></div>
</div>
```

When uploaded to **S3** and viewed in a browser, the JavaScript code executed, showing the **alert** dialog:



The root cause existed in the **HtmlDel2()** method which existed in file **olink/oLink/FormLink.cs**, lines 1051-1141. This method was used to sanitize HTML throughout **oLink**, including HTML downloaded from a site that will be mirrored.

```
1051         public string HtmlDel2(string content, string url)
1052         {
1053             try
1054             {
1055                 content = HtmlDel(content, "(<head)([\\S\\s]*?)(</head>)");
...
1075
1076                 MatchCollection mc0 = new Regex("(<)([\\S\\s]*?)(>)").Matches(content);
1077                 foreach (Match m in mc0)
1078                 {
1079                     if (m.Value == "<p>" || m.Value == "</p>" || m.Value == "<p class=\"artl\">" || m.Value == "<p
class=\"artc\">"
1080                         || m.Value == "<p class=\"artl\" style=\"text-align:center;\">" || m.Value == "<p
style=\"text-align:center;\">"
1081                         || m.Value == "<b>" || m.Value == "</b>" || m.Value == "<br/>" || m.Value == "<br>" ||
m.Value == "<br />"
1082                         || m.Value == "<strong>" || m.Value == "</strong>"
1083                         || m.Value == "</h1>" || m.Value == "</h2>" || m.Value == "</h3>" || m.Value == "</h4>" ||
m.Value == "</h5>"
1084                         || m.Value == "<em>" || m.Value == "</em>" || m.Value == "<sup>" || m.Value == "</sup>") ;
1085                     else if (m.Value.StartsWith("<h1")) { content = content.Replace(m.Value, "<h1 style=\"text-
align:center;\">"); }
1086                     else if (m.Value.StartsWith("<h2")) { content = content.Replace(m.Value, "<h2 style=\"text-
align:center;\">"); }
...
1132                     else content = content.Replace(m.Value, "");
1133                 }
1134
1135                 content = content.Replace("\t", "").Replace("\n\n", "\n").Replace("\n\n", "\n").Replace("\n\n", "\n")
1136                     .Replace("\n", "\r\n").Replace("\r\r\n", "\r\n");
1137                 return content;
1138             }
1139             catch (Exception ex) { Log(MethodBase.GetCurrentMethod().Name + ": " + ex.Message); }
1140             return "";
1141         }
```

Line 1076 searches the content for HTML tags, then lines 1079-1131 handle any allowed tags or other special cases, and finally line 1132 attempts to delete any other tag.

In the test case above, this line is of relevance:

```
<><<>img src=x onerror="alert('img tag/script bypassed filtering');">
```

The code first identified the regular expression match **<>** in line 1076 and then deleted all instances of that string within **content**, resulting in the line becoming:

```
<img src=x onerror="alert('img tag/script bypassed filtering');">
```

The next regular expression match was **<<>**; however, since **<>** was a substring of this match and was already deleted from the **content**, the **<<>** match no longer existed in **content** and the **img** tag remained.

Recommended Remediation:

In general, the **oLink** source code uses regular expressions extensively to process HTML, which can lead to security vulnerabilities such as this one. Instead, the assessment team recommends using an HTML parsing and sanitization library designed to be robust against malicious or untrusted HTML input. These libraries are often used to sanitize HTML to prevent Cross-Site Scripting attacks against web applications. The **HtmlSanitizer** library is one example of such a library.

References:

[HtmlSanitizer Library]

MEDIUM-RISK FINDINGS

M1: HTTPS Not Enforced and Certificate Legitimacy Not Confirmed by Client

Description:

The **oLink** application downloads articles from arbitrary domains to host on **S3**. These downloads were not required to be encrypted using HTTPS, and when they did use HTTPS, the application disabled certificate validation.

Impact:

As a result of this vulnerability, a server-spoofing or Man-in-the-Middle attack could be performed against the application for downloads over HTTP or HTTPS.

Reproduction:

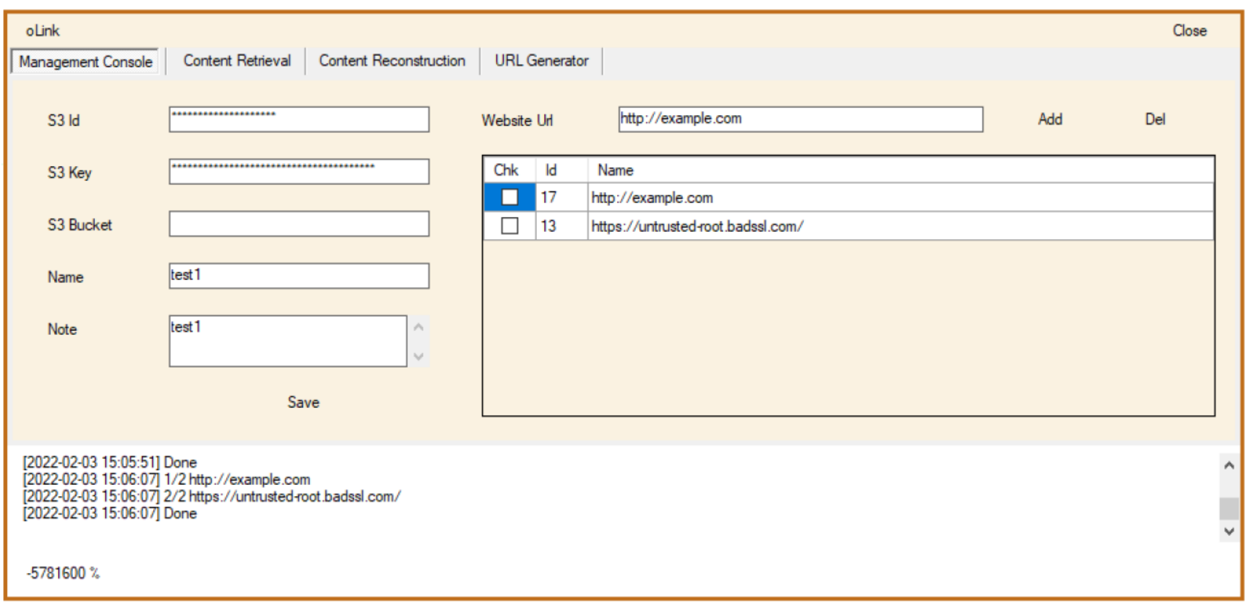
The code disabled certificate validation by setting the **ServerCertificateValidationCallback** to a function that always returns true in file **olink/oLink/FormLink.cs**, lines 37-42:

```
37          private void FormMain_Load(object sender, EventArgs e)
38          {
39              try
40              {
41                  ServicePointManager.SecurityProtocol = SecurityProtocolType.Tls12;
42                  ServicePointManager.ServerCertificateValidationCallback = delegate { return true; };
```

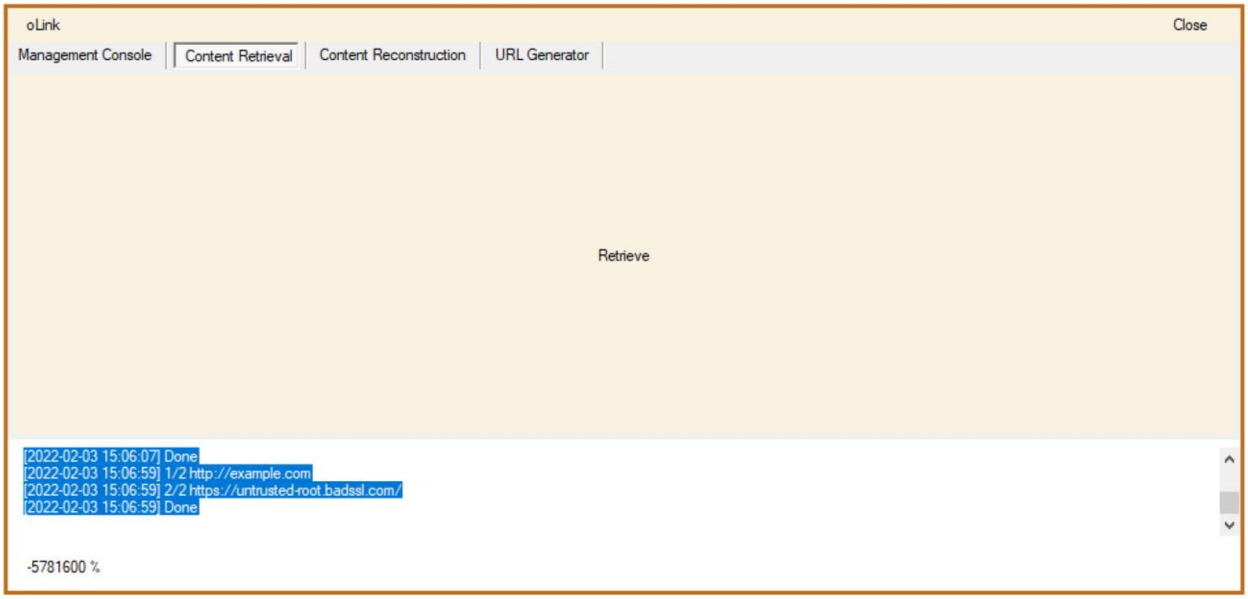
The ability to download pages over HTTP and over HTTPS with an untrusted certificate was tested by using the tool to download from the following URLs:

- http://example.com
- https://untrusted-root.badssl.com/

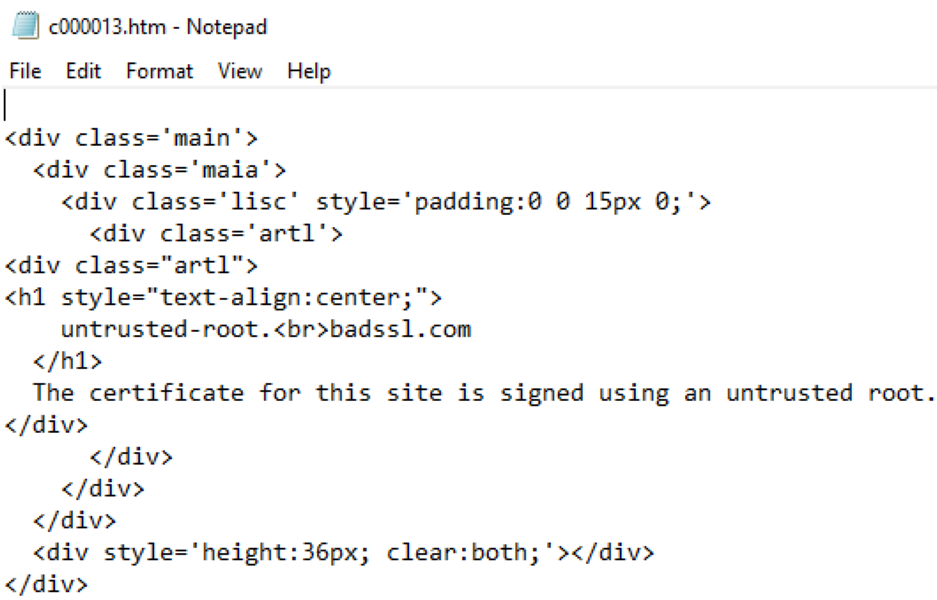
The screenshot below shows the test URLs loaded into **oLink**:



Next, the pages were retrieved using the **Retrieve** button:



The contents were saved locally; in this case the HTTPS page with untrusted certificate was saved in file **C:\oLink\Site\c000013.htm**:




```
<div class='main'>
  <div class='maia'>
    <div class='lisc' style='padding:0 0 15px 0;'>
      <div class='artl'>
<div class="artl">
<h1 style="text-align:center;">
    untrusted-root.<br>badssl.com
  </h1>
  The certificate for this site is signed using an untrusted root.
</div>
      </div>
    </div>
  </div>
  <div style='height:36px; clear:both;'></div>
</div>
```

Recommended Remediation:

The assessment team recommends allowing only downloads over HTTPS from hosts that present a valid and trusted certificate. If downloading over a plaintext HTTP connection or from hosts using invalid certificates is required, the **oLink** application could present the user with a warning of the risks of attack associated with the affected user-supplied URLs.

References:

Working with Certificates

LOW-RISK FINDINGS

L1: Application Targets Deprecated .NET Version

Description:

The **oLink** application was found to target a deprecated version of the .NET Framework. The application targeted .NET version 4.5, for which support ended in January 2016. .NET Framework versions 4.5.2, 4.6, and 4.6.1 are scheduled to have their support ended in April 2022.

Impact:

Versions of the .NET Framework that are no longer supported do not receive security updates. This means that no security patches would be released by the vendor if public or private security vulnerabilities were identified within .NET 4.5 in the future.

Reproduction:

The **oLink** project file referenced the target .NET Framework version as **v4.5** in file **olink/oLink/oLink.csproj**, line 11:

```
11      <TargetFrameworkVersion>v4.5</TargetFrameworkVersion>
```

The **App.config** file also referenced version **v4.5** in file **olink/oLink/App.config**, line 7:

```
7          <supportedRuntime version="v4.0" sku=".NETFramework,Version=v4.5" />
```

Recommended Remediation:

The assessment team recommends migrating the **oLink** application to .NET Framework version 4.6.2 or higher.

References:

[Support Ending for the .NET Framework 4, 4.5 and 4.5.1]
[.NET Framework 4.5.2, 4.6, 4.6.1 will reach End of Support on April 26, 2022]

L2: User Manual Recommends Creating a Programmatic AWS User with Excessive Administrator Permissions

Description:

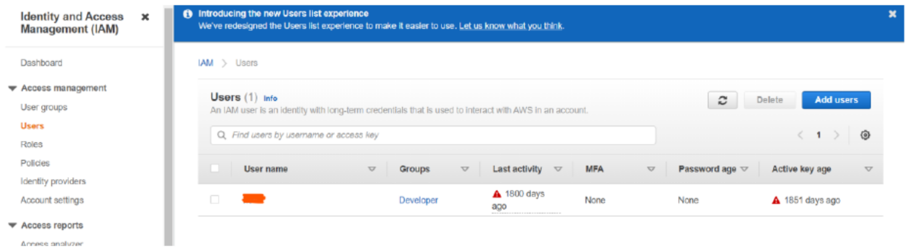
The **oLink** user manual recommended that users create an **AWS IAM** programmatic user with full administrator access permissions, which potentially violates the principle of least privilege and could expose **oLink** users to additional risk of compromise within their **AWS** environment.

Impact:

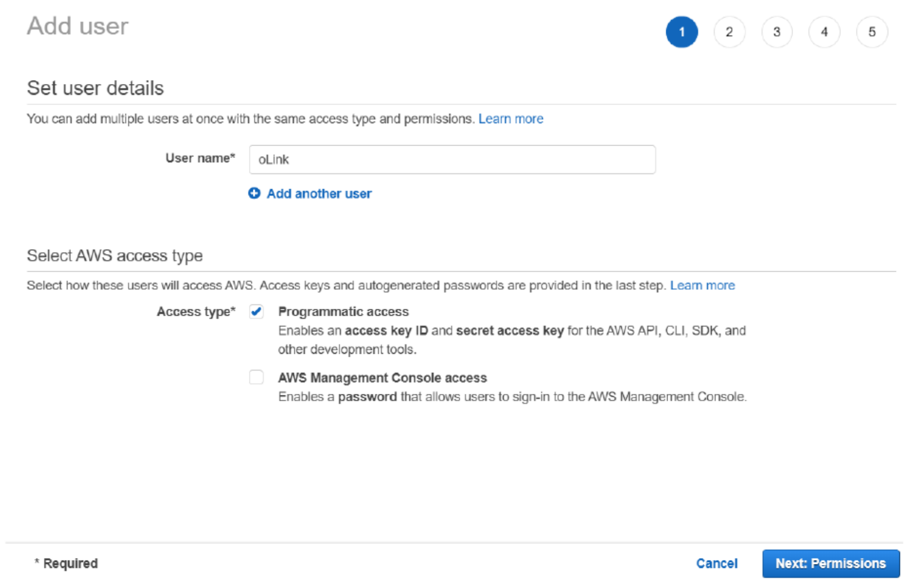
If an attacker is able to discover the administrative programmatic user's credentials, for example, by extracting them from the database of a machine where **oLink** has been used, they could gain full access to the **AWS** account, potentially exposing other confidential information or costing money by allocating **AWS** resources.

Reproduction:

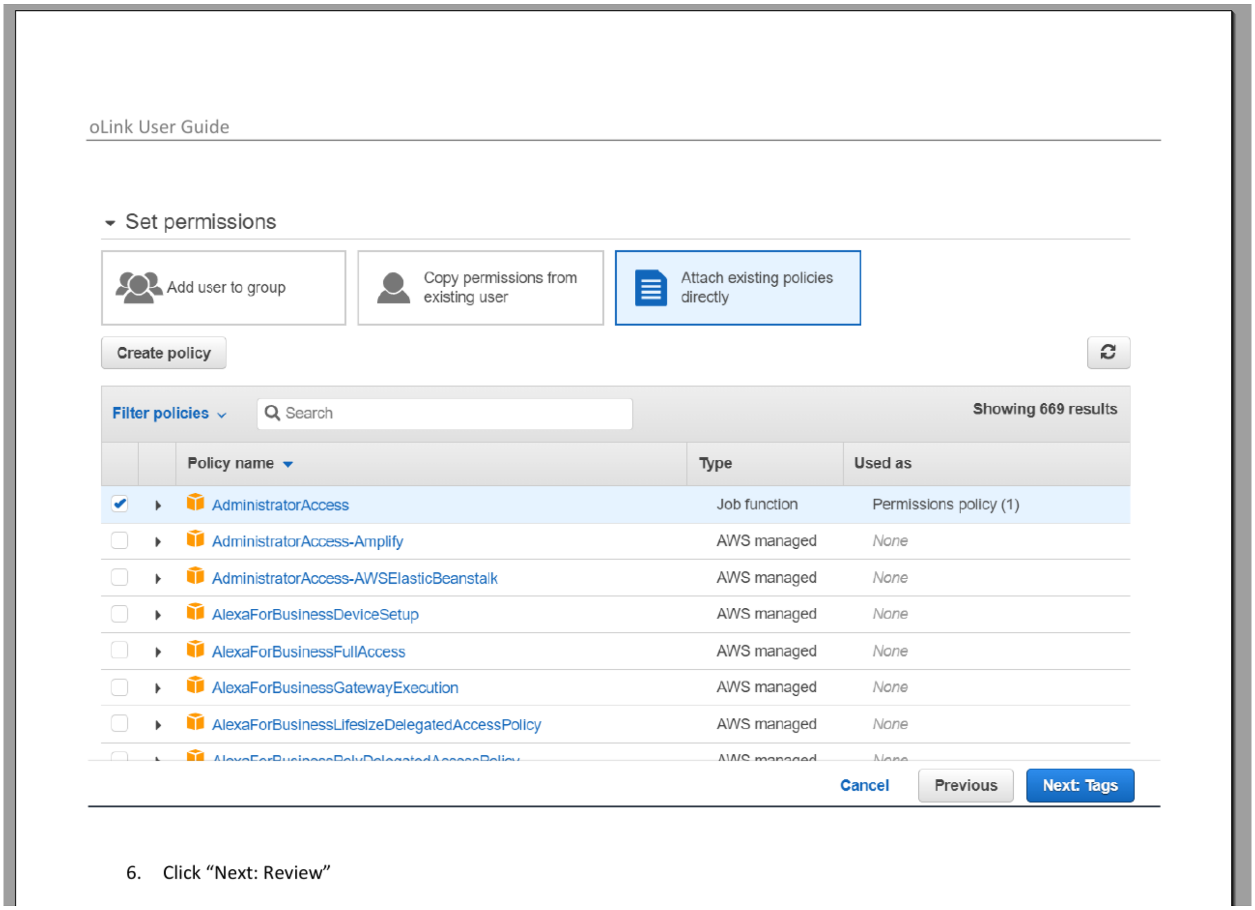
The instructions to grant administrative access to the **AWS IAM** user are depicted in pages 20-21 of the user manual:



4. Key in "User Name", Tick Access type: "Programmatic access", then click "Next Permissions"



5. Select "Attach existing policies directly", tick "AdministratorAccess", then tick "Next Tags" .



Recommended Remediation:

The assessment team recommends that **oLink** users create programmatic **AWS** users with the least privilege necessary. The manual could instruct the user to create an **IAM** policy that grants write access only to the bucket in the region that will be used by **oLink**.

References:

[Security best practices in IAM]

L3: SQL Server Database Complexity

Description:

The **oLink** application used a Microsoft SQL Server database to store **AWS** credentials, lists of URLs of sites that had been mirrored using the application, and lists of URLs of assets that had been downloaded associated with those sites. The dependency on the SQL Server adds an extra layer of complexity to installing and using **oLink**, as well to securing data. In addition, though SQL Injection vulnerabilities were not identified, the application used potentially vulnerable practices to access the database, making those security concerns potentially more likely in the future.

Impact:

Using the SQL Server for storing data creates the risk of attackers gaining access to security-relevant data or injecting malicious data via other applications running on the same host, or depending on how the database server is configured, injecting malicious data via remote connections. The use of SQL introduces the risk of SQL Injection vulnerabilities. Access to the database could also lead to code execution (see the finding **Operating System Command Injection**).

Reproduction:

One example of **oLink's** database usage is the storage of **AWS** credentials. The SQL strings related to **AWS** credentials are in file **olink/oLink/ooData.cs**, lines 11-12:

```
11          static public string sG10配置Set = @"update [oLink].[dbo].[G10配置] set 
S3Id=N'^S3Id^',S3Key=N'^S3Key^',S3Bucket=N'^S3Bucket^',Name=N'^Name^',Note=N'^Note^'";
12          static public string sG10配置Get = @"SELECT S3Id,S3Key,S3Bucket,Name,Note FROM [oLink].[dbo].[G10配置]";
```

The code to store credentials uses the **Replace()** method to replace placeholders in the **SQL** string with parameters; see file **olink/oLink/FormLink.cs**, lines 143-156:

```
143         private void button2_Click(object sender, EventArgs e)
144         {
145             try
146             {
147                 string s1 = ooData.sG10配置Set
148                     .Replace("^S3Id^", GetSqlParam(textBoxS3Id.Text.Trim()))
149                     .Replace("^S3Key^", GetSqlParam(textBoxS3Key.Text.Trim()))
150                     .Replace("^S3Bucket^", GetSqlParam(textBoxS3Bucket.Text.Trim()))
151                     .Replace("^Name^", GetSqlParam(textBoxName.Text.Trim()))
152                     .Replace("^Note^", GetSqlParam(textBoxNote.Text.Trim()));
153                 ExecuteSQL(s1);
154             }
155             catch (Exception ex) { Log(MethodBase.GetCurrentMethod().Name + ": " + ex.Message); }
156         }
```

The **GetSqlParam()** method escapes single quotes in input strings, in order to prevent injection; it is defined in file **olink/oLink/FormLink.cs**, lines 1812-1815:

```
1812         static public string GetSqlParam(string s)
1813         {
1814             return s.Replace("'", "''");
1815         }
```

Recommended Remediation:

The assessment team recommends using a simpler library or format for storing security-relevant and other persistent user data on disk. In addition, the assessment team recommends using Microsoft's Data Protection API to encrypt confidential data stored on disk.

In addition, wherever SQL is used, the assessment team recommends using parameterized SQL queries rather than string concatenation to build SQL statements throughout applications. This technique enforces separation between the structure of the SQL statement and the data it uses. Each SQL statement can still be defined with placeholders for data to be supplied at runtime, with the database library providing the escaping and placeholder replacing in a robust manner.

References:

How To: Use Data Protection
CWE-89: Improper Neutralization of Special Elements used in an SQL Command
SQL Injection Attacks by Example
OWASP: SQL Injection

L4: Application Did Not Validate Mirrored Asset File Content

Description:

When the **oLink** application retrieves a web page, it downloads HTML as well as assets associated with that page, such as image files and videos. The application does not validate that these assets are safe or have a known format.

Impact:

An attacker who controls or has compromised a site being processed by **oLink** could cause **oLink** to download malicious files. This could be used as a vector for introducing malicious code to a host running **oLink** or to **S3** as part of a larger attack.

Reproduction:

To test this vulnerability, a test document was hosted alongside a Windows executable file named **example.exe**. This was the test document:

```
<title>Title</title>
<img src="example.exe">
```

The document was retrieved using **oLink**, which resulted in **example.exe** being downloaded and stored at **C:\oLink\File\000011**.

The method that downloads HTML documents as well as other assets is named **DownloadHtml()**, which can be found in file **olink/oLink/FormLink.cs**, lines 1687-1740:

```
1687        public bool DownloadHtml(string name, string host, string referer, string sFileName)
1688        {
1689            HttpWebRequest request2 = null;
1690            HttpWebResponse response2 = null;
1691            try
1692            {
1693                request2 = (HttpWebRequest)WebRequest.Create(name);
1694                if (host != "") request2.Host = host;
1695                if (referer != "") request2.Referer = referer;
1696                response2 = (HttpWebResponse)request2.GetResponse();
1697                if (response2.StatusCode != HttpStatusCode.OK)
1698                {
1699                    if (response2 != null) { response2.Close(); response2 = null; }
1700                    if (request2 != null) request2 = null;
1701                    return false;
1702                }
1703                if (File.Exists(sFileName))
1704                {
1705                    FileInfo fi = new FileInfo(sFileName);
1706                    if (response2.ContentLength == -1 || fi.Length == response2.ContentLength)
1707                    {
1708                        ///BeginInvoke(new ShowMsgDelegate(ShowMsg), new object[] { "Skip" });
1709                        if (response2 != null) { response2.Close(); response2 = null; }
1710                        if (request2 != null) request2 = null;
1711                        return true;
1712                    }
1713                }
1714                ShowMsgD("Downloading: " + sFileName);
1715
1716                byte[] buffer = new byte[8 * 1024];
1717                Stream outStream = File.Create(sFileName);
1718                Stream inStream = response2.GetResponseStream();
1719                long length = response2.ContentLength;
1720                long total = 0;
1721                int l = 0;
1722                while ((l = inStream.Read(buffer, 0, buffer.Length)) > 0)
1723                {
1724                    total += l;
```

```
                    int progress = (int)(((float)total / length) * 100);
                    BeginInvoke(new ShowMsgDelegate(ShowLabel), new object[] { progress + " %" });
                    outStream.Write(buffer, 0, l);
                }
                outStream.Close();
                if (response2.ContentLength != -1 && length != total) { }
                //BeginInvoke(new ShowMsgDelegate(ShowLabel), new object[] { "Done" });
                if (response2 != null) { response2.Close(); response2 = null; }
                if (request2 != null) request2 = null;
                return true;
            }
            catch (Exception ex) { }
            if (response2 != null) { response2.Close(); response2 = null; }
            if (request2 != null) request2 = null;
            return false;
        }
```

The code makes an HTTP request, downloads the file to a buffer, and saves the buffered data directly to the disk.

Recommended Remediation:

The assessment team recommends adding verification that the downloaded files are of the expected file format, e.g., HTML, image, video, or audio files, before saving them to the disk. In addition, a library such as Microsoft's Antimalware Scan Interface could be used to scan files for malware before writing them to disk.

References:

[Antimalware Scan Interface (AMSI) Documentation]

INFORMATIONAL FINDINGS

I1: Unused Elements in Production Codebase

Description:

A number of methods in the **oLink** application's codebase were defined but never invoked or used. Unused code elements can provide attackers with insight into future functionality, or indicate that legacy code is being released into the production environment.

Impact:

Unused code can increase an application attack surface, as an attacker could try to insert a malicious feature with the name of an unused element to make the code function improperly. In addition, much of the unused code, if used unsafely in the future, could expose the application to additional vulnerabilities, for example, by providing ways for malicious or compromised web sites to inject malicious data into **oLink** output.

The following methods were defined but never called by the application:

- GetSoundPlayer()
- GetFlashPlayer()
- GetImagePlayer()
- GetDownloadPlayer()
- GetTwitter()
- GetTxt部分()
- GetString千万()
- GetString最长()
- Get一行()
- Get时距Param()
- GetPict中()
- GetPictParam()
- Get时间()
- HtmlEn()
- RSAEncrypt()
- RSADecrypt()
- ShowLabelD()
- WriteMsg()
- PostHtml()
- GetHtmlMethod() (This method has several overloaded definitions; three out of five are unused).
- GetHtmlMethodOrigin()
- CheckHtml()

In addition, it was noted that much of the **GetVideoPlayer()** method in particular was unreachable because it was in an **if**-statement block with a condition that could never be evaluated as **true**.

Reproduction:

The following screenshots of the **oLink** source code in **Visual Studio** show many methods that have zero references:

```
0 references
static private string GetSoundPlayer(string url, string cover = "")...

1 reference
static private string GetM3u8Player(string url)...

0 references
static private string GetFlashPlayer(string url)...

1 reference
static private string GetImagePlayerTop(string url)...

0 references
static private string GetImagePlayer(string url)...

0 references
static private string GetDownloadPlayer(string url)...

0 references
static private string GetTwitter(string co, string cover, string title)...
```

```
0 references
static private string GetTxt部分(string s摘要, string s链接, int i长度)...
0 references
static private string GetString千万(string page)...
0 references
static private string GetString最长(string sIn, int iLen)...
0 references
static private string Get一行(string sIn)...
1 reference
static private string Get换行(string sIn)...
0 references
static private string Get时距Param(DateTime dt)...
0 references
static private string GetPict中(string sPict)...
0 references
static private string GetPictParam(string sPict, string sNumb)...
0 references
static private string Get时间(string s)...

0 references
static public string HtmlEn(string input, string password)...

0 references
static public string RSAEncrypt(string publickey, string content)...

0 references
static public string RSADecrypt(string privatekey, string content)...

// Show
private delegate void ShowMsgDelegate(string msg);
2 references
private void ShowLabel(string msg)...
0 references
private void ShowLabelD(string msg)...
1 reference
private void ShowMsg(string msg)...
```

```
0 references
static private void WriteMsg(string message)[...]

1 reference
static private void WriteErr(string message)[...]
2 references
private void SaveFile(string message, string sFile)[...]

// Html Utility
8 references
static public string GetHtml(string sName, bool bFail = false)[...]

0 references
static public string PostHtml(string sName, string sData)[...]

4 references
static public string GetHtmlMethod(string sMethod, string sName, string sData, string sHeader, string sReferer,
    string sCode)[...]

1 reference
static public string GetHtmlMethod(string sMethod, string sName, string sData, string sHeader, string sReferer,
    string sCode, string sContentType, out string sCookie)[...]

0 references
static public string GetHtmlMethod(string sMethod, string sName, string sData, string sHeader, string sReferer,
    string sContentType, string sHost, string sCode)[...]

0 references
static public string GetHtmlMethod(string sMethod, string sName, string sData, string sHeader, string sReferer,
    string sContentType, string sCode)[...]

0 references
static public string GetHtmlMethod(string sMethod, string sName, string sData, string sHeader, string sReferer)[...]

0 references
static public string GetHtmlMethodOrigin(string sName)[...]

1 reference
public bool DownloadHtml(string name, string host, string referer, string sFileName)[...]

0 references
public bool CheckHtml(string sName)[...]
```

The unreachable code in the **GetVideoPlayer()** method can be identified by first noting that the method is only called twice, in file **olink/oLink/FormLink.cs**, lines 1032-1033.

File **olink/oLink/FormLink.cs**, lines 1028-1033:

```
1028                    coMedia = GetFile(coMedia);
1029                    if (coMedia.EndsWith(".jpg") || coMedia.EndsWith(".png") || coMedia.EndsWith(".jpeg")
1030                        || coMedia.EndsWith(".gif") || coMedia.EndsWith(".webp")) co = GetImagePlayerTop(coMedia) +
"\r\n" + co;
1031                    else if (coMedia.EndsWith(".mp3")) co = GetAudioPlayer(coMedia, cover) + "\r\n" + co;
1032                    else if (coMedia.EndsWith(".mp4")) co = GetVideoPlayer(coMedia, "", cover) + "\r\n" + co;
1033                    else co = GetVideoPlayer(coMedia, "", cover) + "\r\n" + co;
```

In both cases, the first parameter comes from **coMedia**, which is a return value from **GetFile()**, which will only return a numerical file name. The second parameter (**track**) is set to an empty string.

The **GetVideoPlayer()** method itself is defined in file **olink/oLink/FormLink.cs**, lines 405-639:

```
405         static public string GetVideoPlayer(string url, string track = "", string cover = "", string myip = "", bool
bDownload = true)
406         {
407             if (url == "") return "";
408             if (url.StartsWith("https://player.vimeo.com/video/")) url = url.Replace("https://player.vimeo.com/",
"https://vimeo.com/");
409             if (url.StartsWith("https://www.youtube.com/") || url.StartsWith("https://www.youtube.com/embed/"))
410                 url = url.Replace("https://www.youtube.com/watch?v=",
"https://youtu.be/").Replace("https://www.youtube.com/embed/", "https://youtu.be/");
411
412             string sVideoL = ""; string sVideoM = ""; string sVideoH = ""; string sVideoV = ""; string sVideoM2 = "";
string sVideoV2 = "";
```

```
            string sAudio140 = ""; string sAudio171 = ""; string sAudio249 = ""; string sAudio250 = ""; string sAudio251 = "";
            string sTrack = "";
            string sTrackZh = "", sTrackEn = "";
            string sTrackZhSrc = "", sTrackEnSrc = "";
            if (track != "" && track.EndsWith(".vtt"))
            {
...             [unreachable code]
            }

            if (url.StartsWith("https://www.youtube.com/") || url.StartsWith("https://youtu.be/") || url.StartsWith("https://www.youtube.com/embed/"))
            {
...             [unreachable code]
            }

...
        }
```

Recommended Remediation:

The assessment team recommends reviewing the codebase to eliminate unused and legacy code from the production codebase.

Additionally, the assessment team suggests keeping two branches of the **oLink** source: one for releases and another for development. Unused code and test features then can be removed from the release branch to minimize the attack surface.

References:

CWE-561 Dead Code

I2: Owner of S3 Bucket May Be Discoverable

Description:

The **oLink** application depends on **AWS S3** to host the contents of mirrored web pages. If an attacker is able to identify the accounts used by **oLink** users, it may help the attacker identify **oLink** users.

Impact:

An attacker may be able to discover the **AWS** account owner of an **S3** bucket used to mirror websites using the **oLink** tool. Publicly available tools exist to identify owners of **S3** buckets.

Reproduction:

An **AWS** account was not provided as part of the assessment scope, so this attack was not attempted. However, public tools exist to identify accounts to which **S3** buckets belong, e.g., https://github.com/WeAreCloudar/s3-account-search.

Recommended Remediation:

Since hosting articles on **S3** is a significantly fundamental feature of **oLink**, the assessment team recommends analyzing and acknowledging any potential risk of **oLink**-associated **S3** buckets being discoverable to the owners of **oLink**-associated **S3** buckets.

References:

S3 Account Search tool

I3: Application Third-Party Service Dependencies

Description:

The **oLink** application depends on several third-party services, the compromise of which could compromise the security of **oLink** users as well as those who visit mirrored sites generated by **oLink**.

Impact:

Since **oLink** uploads mirrored sites to Amazon **S3**, **AWS** is a third-party service that must be trusted. In addition, **oLink** relies on these services as well:

- **jsdelivr.net** is a JavaScript hosting service. Compromise of this service could allow an attacker to inject JavaScript code into mirrored sites generated by **oLink**, modifying the rendered contents of those sites and identifying visitors of those sites to the attacker.
- **is.gd** is a URL shortening service. Compromise of this service could allow an attacker to identify users of **oLink** and identify visitors of short links, as well as redirect users to malicious sites intstead of sites mirrored by **oLink**.

Finally, the **or9a.odisk.org** service is referenced by currently unused code (see the finding **Unused Elements in Production Codebase**).

Reproduction:

References to **jsdelivr.net** are in file **Site/show.htm**, lines 8 and 274-275:

```
8     <script src="https://cdn.jsdelivr.net/jquery/1.12.4/jquery.min.js"></script>
...
274     <link  href="https://cdn.jsdelivr.net/npm/video.js@7.5.4/dist/video-js.min.css" rel="stylesheet">
275     <script src="https://cdn.jsdelivr.net/npm/video.js@7.5.4/dist/video.min.js"></script>
```

The **is.gd** URL shortener is used in file **olink/oLink/FormLink.cs**, lines 391-402:

```
391         private void Generate()
392         {
393             try
394             {
395                 string url = "https://s3.amazonaws.com/^S3Bucket^/Site/show.htm?ag=olHome&pin=^random^#olHome"
396                     .Replace("^S3Bucket^", textBoxS3Bucket.Text.Trim())
397                     .Replace("^random^", GetRandom());
398                 string s = GetHtmlMethod("GET", "https://is.gd/create.php?format=simple&url=" + EnUrlSymbol(url),
"", "", "", "");
399                 ShowMsgD(s);
400             }
401             catch (Exception ex) { Log(MethodBase.GetCurrentMethod().Name + ": " + ex.Message); }
402         }
```

The **or9a.odisk.org** dependency is referenced in this code from file **olink/oLink/FormLink.cs**, lines 442-454:

```
442                 Match mM3u8 = new Regex("(?<=%22hlsManifestUrl%22%3A%22)([\\S\\s]*?)(?=%22)").Match(s1);
443                 if (mM3u8.Success)
444                 {
445                     string sM3u8 = GetHtml(mM3u8.Value.Replace("%3A", ":").Replace("%2F", "/").Replace("%252C",
",").Replace("%253D", "="));
446                     Match mM3u8_360 = new Regex("(?<=RESOLUTION=640x[\\S\\s]*?)(https[\\S]*?)(?=\\s)").Match(sM3u8);
447                     if (!mM3u8_360.Success) return sNFound;
448                     string m3u8 = GetHtml(mM3u8_360.Value);
449                     string[] m3u8s = m3u8.Split('\n'); //Log(url + " " + m3u8s.Length+" "+ mM3u8_360.Value);
450                     if (m3u8s.Length > 100 || m3u8 == "") return sConvert;
451                     sM3u8 = "http://or9a.odisk.org/oo.aspx?name=get_m3u8&ag=" +
HttpUtility.UrlEncode(mM3u8_360.Value)
452                         + "&myip=" + myip + "&type=play.m3u8";
453                     return GetM3u8Player(sM3u8);
454                 }
```

Recommended Remediation:

The assessment team recommends removing dependencies if possible. The **jsdelivr.net** dependency could be removed by hosting JavaScript dependencies alongside mirrored sites in **S3**. The use of a URL shortener could be made optional, and the use of **is.gd** in particular could be evaluated. The **or9a.odisk.org** reference can be removed by deleting unused code.

References:

[Microsoft – Supply Chain Attacks]