# permafrost-engine Scan Report

| | |
|---|---|
| Project Name | permafrost-engine |
| Scan Start | Friday, June 21, 2024 12:11:28 AM |
| Preset | Checkmarx Default |
| Scan Time | 00h:08m:24s |
| Lines Of Code Scanned | 41698 |
| Files Scanned | 20 |
| Report Creation Time | Friday, June 21, 2024 12:21:13 AM |
| Online Results | http://WIN-BA8RD5TJ8IG/CxWebClient/ViewerMain.aspx?scanid=1010007&projectid=10008 |
| Team | CxServer |
| Checkmarx Version | 8.7.0 |
| Scan Type | Full |
| Source Origin | LocalPath |
| Density | 2/1000 (Vulnerabilities/LOC) |
| Visibility | Public |

# Filter Settings

**Severity**

Included: High, Medium, Low, Information

Excluded: None

**Result State**

Included: Confirmed, Not Exploitable, To Verify, Urgent, Proposed Not Exploitable

Excluded: None

**Assigned to**

Included: All

**Categories**

Included:

| | |
|---|---|
| Uncategorized | All |
| Custom | All |
| PCI DSS v3.2 | All |
| OWASP Top 10 2013 | All |
| FISMA 2014 | All |
| NIST SP 800-53 | All |
| OWASP Top 10 2017 | All |
| OWASP Mobile Top 10 2016 | All |

Excluded:

| | |
|---|---|
| Uncategorized | None |
| Custom | None |
| PCI DSS v3.2 | None |
| OWASP Top 10 2013 | None |
| FISMA 2014 | None |

| | |
|---|---|
| NIST SP 800-53 | None |
| OWASP Top 10 2017 | None |
| OWASP Mobile Top 10 2016 | None |

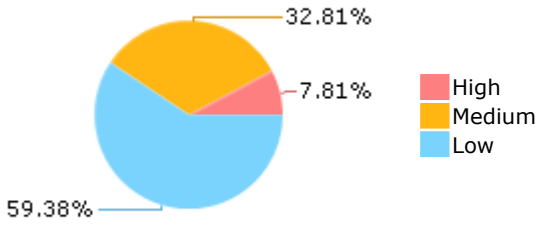
**Results Limit**

Results limit per query was set to 50

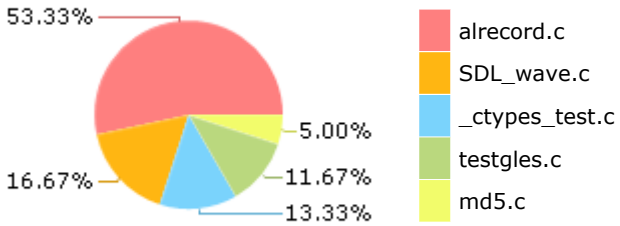
**Selected Queries**

Selected queries are listed in Result Summary

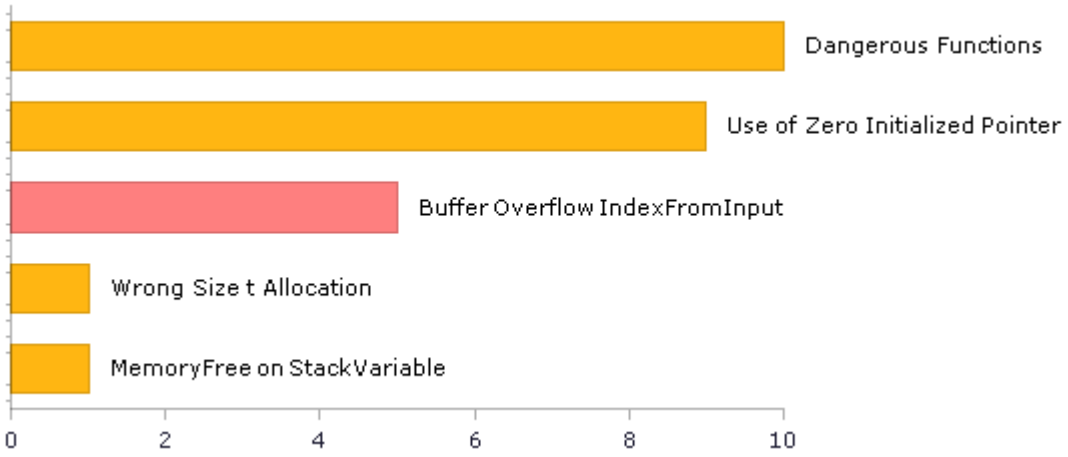
## Result Summary




## Most Vulnerable Files




## Top 5 Vulnerabilities



# Scan Summary - OWASP Top 10 2017

Further details and elaboration about vulnerabilities and risks can be found at: OWASP Top 10 2017

| Category | Threat Agent | Exploitability | Weakness Prevalence | Weakness Detectability | Technical Impact | Business Impact | Issues Found | Best Fix Locations |
|---|---|---|---|---|---|---|---|---|
| A1-Injection | App. Specific | EASY | COMMON | EASY | SEVERE | App. Specific | 5 | 1 |
| A2-Broken Authentication | App. Specific | EASY | COMMON | AVERAGE | SEVERE | App. Specific | 27 | 27 |
| A3-Sensitive Data Exposure | App. Specific | AVERAGE | WIDESPREAD | AVERAGE | SEVERE | App. Specific | 0 | 0 |
| A4-XML External Entities (XXE) | App. Specific | AVERAGE | COMMON | EASY | SEVERE | App. Specific | 0 | 0 |
| A5-Broken Access Control* | App. Specific | AVERAGE | COMMON | AVERAGE | SEVERE | App. Specific | 1 | 1 |
| A6-Security Misconfiguration | App. Specific | EASY | WIDESPREAD | EASY | MODERATE | App. Specific | 0 | 0 |
| A7-Cross-Site Scripting (XSS) | App. Specific | EASY | WIDESPREAD | EASY | MODERATE | App. Specific | 0 | 0 |
| A8-Insecure Deserialization | App. Specific | DIFFICULT | COMMON | AVERAGE | SEVERE | App. Specific | 0 | 0 |
| A9-Using Components with Known Vulnerabilities* | App. Specific | AVERAGE | WIDESPREAD | AVERAGE | MODERATE | App. Specific | 10 | 10 |
| A10-Insufficient Logging & Monitoring | App. Specific | AVERAGE | WIDESPREAD | DIFFICULT | MODERATE | App. Specific | 0 | 0 |

* Project scan results do not include all relevant queries. Presets and\or Filters should be changed to include all relevant standard queries.

# Scan Summary - OWASP Top 10 2013

Further details and elaboration about vulnerabilities and risks can be found at: OWASP Top 10 2013

| Category | Threat Agent | Attack Vectors | Weakness Prevalence | Weakness Detectability | Technical Impact | Business Impact | Issues Found | Best Fix Locations |
|---|---|---|---|---|---|---|---|---|
| A1-Injection | EXTERNAL, INTERNAL, ADMIN USERS | EASY | COMMON | AVERAGE | SEVERE | ALL DATA | 0 | 0 |
| A2-Broken Authentication and Session Management | EXTERNAL, INTERNAL USERS | AVERAGE | WIDESPREAD | AVERAGE | SEVERE | AFFECTED DATA AND FUNCTIONS | 0 | 0 |
| A3-Cross-Site Scripting (XSS) | EXTERNAL, INTERNAL, ADMIN USERS | AVERAGE | VERY WIDESPREAD | EASY | MODERATE | AFFECTED DATA AND SYSTEM | 0 | 0 |
| A4-Insecure Direct Object References | SYSTEM USERS | EASY | COMMON | EASY | MODERATE | EXPOSED DATA | 1 | 1 |
| A5-Security Misconfiguration | EXTERNAL, INTERNAL, ADMIN USERS | EASY | COMMON | EASY | MODERATE | ALL DATA AND SYSTEM | 0 | 0 |
| A6-Sensitive Data Exposure | EXTERNAL, INTERNAL, ADMIN USERS, USERS BROWSERS | DIFFICULT | UNCOMMON | AVERAGE | SEVERE | EXPOSED DATA | 0 | 0 |
| A7-Missing Function Level Access Control* | EXTERNAL, INTERNAL USERS | EASY | COMMON | AVERAGE | MODERATE | EXPOSED DATA AND FUNCTIONS | 0 | 0 |
| A8-Cross-Site Request Forgery (CSRF) | USERS BROWSERS | AVERAGE | COMMON | EASY | MODERATE | AFFECTED DATA AND FUNCTIONS | 0 | 0 |
| A9-Using Components with Known Vulnerabilities* | EXTERNAL USERS, AUTOMATED TOOLS | AVERAGE | WIDESPREAD | DIFFICULT | MODERATE | AFFECTED DATA AND FUNCTIONS | 10 | 10 |
| A10-Unvalidated Redirects and Forwards | USERS BROWSERS | AVERAGE | WIDESPREAD | DIFFICULT | MODERATE | AFFECTED DATA AND FUNCTIONS | 0 | 0 |

* Project scan results do not include all relevant queries. Presets and\or Filters should be changed to include all relevant standard queries.

# Scan Summary - PCI DSS v3.2

| Category | Issues Found | Best Fix Locations |
|---|---|---|
| PCI DSS (3.2) - 6.5.1 - Injection flaws - particularly SQL injection | 0 | 0 |
| PCI DSS (3.2) - 6.5.2 - Buffer overflows | 0 | 0 |
| PCI DSS (3.2) - 6.5.3 - Insecure cryptographic storage | 0 | 0 |
| PCI DSS (3.2) - 6.5.4 - Insecure communications | 0 | 0 |
| PCI DSS (3.2) - 6.5.5 - Improper error handling* | 0 | 0 |
| PCI DSS (3.2) - 6.5.7 - Cross-site scripting (XSS) | 0 | 0 |
| PCI DSS (3.2) - 6.5.8 - Improper access control | 0 | 0 |
| PCI DSS (3.2) - 6.5.9 - Cross-site request forgery | 0 | 0 |
| PCI DSS (3.2) - 6.5.10 - Broken authentication and session management | 0 | 0 |

***** Project scan results do not include all relevant queries. Presets and\or Filters should be changed to include all relevant standard queries.

# Scan Summary - FISMA 2014

| Category | Description | Issues Found | Best Fix Locations |
|---|---|---|---|
| Access Control | Organizations must limit information system access to authorized users, processes acting on behalf of authorized users, or devices (including other information systems) and to the types of transactions and functions that authorized users are permitted to exercise. | 0 | 0 |
| Audit And Accountability* | Organizations must: (i) create, protect, and retain information system audit records to the extent needed to enable the monitoring, analysis, investigation, and reporting of unlawful, unauthorized, or inappropriate information system activity; and (ii) ensure that the actions of individual information system users can be uniquely traced to those users so they can be held accountable for their actions. | 0 | 0 |
| Configuration Management | Organizations must: (i) establish and maintain baseline configurations and inventories of organizational information systems (including hardware, software, firmware, and documentation) throughout the respective system development life cycles; and (ii) establish and enforce security configuration settings for information technology products employed in organizational information systems. | 1 | 1 |
| Identification And Authentication* | Organizations must identify information system users, processes acting on behalf of users, or devices and authenticate (or verify) the identities of those users, processes, or devices, as a prerequisite to allowing access to organizational information systems. | 27 | 27 |
| Media Protection | Organizations must: (i) protect information system media, both paper and digital; (ii) limit access to information on information system media to authorized users; and (iii) sanitize or destroy information system media before disposal or release for reuse. | 0 | 0 |
| System And Communications Protection | Organizations must: (i) monitor, control, and protect organizational communications (i.e., information transmitted or received by organizational information systems) at the external boundaries and key internal boundaries of the information systems; and (ii) employ architectural designs, software development techniques, and systems engineering principles that promote effective information security within organizational information systems. | 0 | 0 |
| System And Information Integrity | Organizations must: (i) identify, report, and correct information and information system flaws in a timely manner; (ii) provide protection from malicious code at appropriate locations within organizational information systems; and (iii) monitor information system security alerts and advisories and take appropriate actions in response. | 0 | 0 |

***** Project scan results do not include all relevant queries. Presets and\or Filters should be changed to include all relevant standard queries.

# Scan Summary - NIST SP 800-53

| Category | Issues Found | Best Fix Locations |
|---|---|---|
| AC-12 Session Termination (P2) | 0 | 0 |
| AC-3 Access Enforcement (P1) | 28 | 28 |
| AC-4 Information Flow Enforcement (P1) | 0 | 0 |
| AC-6 Least Privilege (P1) | 0 | 0 |
| AU-9 Protection of Audit Information (P1) | 0 | 0 |
| CM-6 Configuration Settings (P2) | 0 | 0 |
| IA-5 Authenticator Management (P1) | 0 | 0 |
| IA-6 Authenticator Feedback (P2) | 0 | 0 |
| IA-8 Identification and Authentication (Non-Organizational Users) (P1) | 0 | 0 |
| SC-12 Cryptographic Key Establishment and Management (P1) | 0 | 0 |
| SC-13 Cryptographic Protection (P1) | 0 | 0 |
| SC-17 Public Key Infrastructure Certificates (P1) | 0 | 0 |
| SC-18 Mobile Code (P2) | 0 | 0 |
| SC-23 Session Authenticity (P1)* | 0 | 0 |
| SC-28 Protection of Information at Rest (P1) | 0 | 0 |
| SC-4 Information in Shared Resources (P1) | 0 | 0 |
| SC-5 Denial of Service Protection (P1)* | 9 | 4 |
| SC-8 Transmission Confidentiality and Integrity (P1) | 0 | 0 |
| SI-10 Information Input Validation (P1)* | 3 | 3 |
| SI-11 Error Handling (P2)* | 2 | 2 |
| SI-15 Information Output Filtering (P0) | 0 | 0 |
| SI-16 Memory Protection (P1) | 0 | 0 |

***** Project scan results do not include all relevant queries. Presets and\or Filters should be changed to include all relevant standard queries.

# Scan Summary - OWASP Mobile Top 10 2016

| Category | Description | Issues Found | Best Fix Locations |
|---|---|---|---|
| M1-Improper Platform Usage | This category covers misuse of a platform feature or failure to use platform security controls. It might include Android intents, platform permissions, misuse of TouchID, the Keychain, or some other security control that is part of the mobile operating system. There are several ways that mobile apps can experience this risk. | 0 | 0 |
| M2-Insecure Data Storage | This category covers insecure data storage and unintended data leakage. | 0 | 0 |
| M3-Insecure Communication | This category covers poor handshaking, incorrect SSL versions, weak negotiation, cleartext communication of sensitive assets, etc. | 0 | 0 |
| M4-Insecure Authentication | This category captures notions of authenticating the end user or bad session management. This can include:<br>-Failing to identify the user at all when that should be required<br>-Failure to maintain the user's identity when it is required<br>-Weaknesses in session management | 0 | 0 |
| M5-Insufficient Cryptography | The code applies cryptography to a sensitive information asset. However, the cryptography is insufficient in some way. Note that anything and everything related to TLS or SSL goes in M3. Also, if the app fails to use cryptography at all when it should, that probably belongs in M2. This category is for issues where cryptography was attempted, but it wasnt done correctly. | 0 | 0 |
| M6-Insecure Authorization | This is a category to capture any failures in authorization (e.g., authorization decisions in the client side, forced browsing, etc.). It is distinct from authentication issues (e.g., device enrolment, user identification, etc.).<br>If the app does not authenticate users at all in a situation where it should (e.g., granting anonymous access to some resource or service when authenticated and authorized access is required), then that is an authentication failure not an authorization failure. | 0 | 0 |
| M7-Client Code Quality | This category is the catch-all for code-level implementation problems in the mobile client. That's distinct from server-side coding mistakes. This would capture things like buffer overflows, format string vulnerabilities, and various other code-level mistakes where the solution is to rewrite some code that's running on the mobile device. | 0 | 0 |
| M8-Code Tampering | This category covers binary patching, local resource modification, method hooking, method swizzling, and dynamic memory modification. Once the application is delivered to the mobile device, the code and data resources are resident there. An attacker can either directly modify the code, change the contents of memory dynamically, change or replace the system APIs that the application uses, or | 0 | 0 |

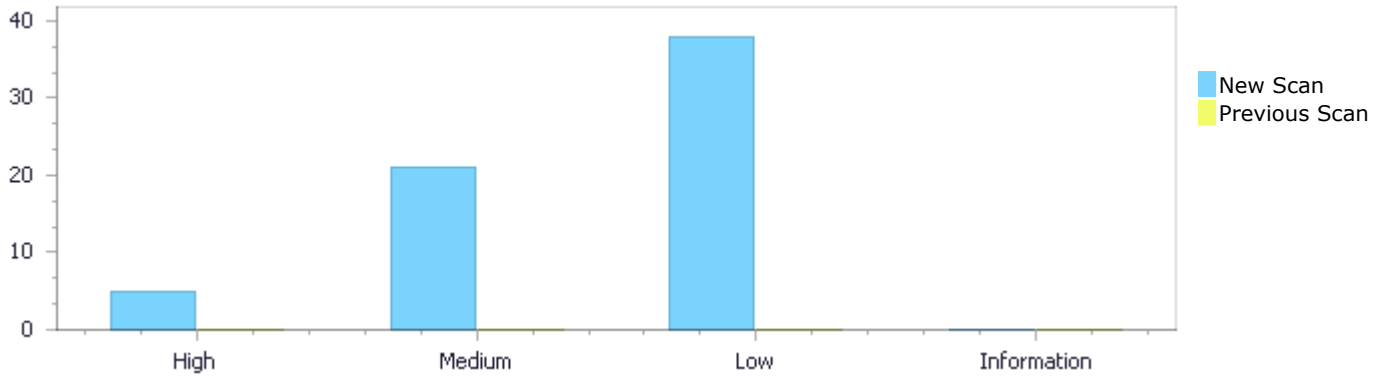
| | | | |
|---|---|---|---|
| | modify the application's data and resources. This can provide the attacker a direct method of subverting the intended use of the software for personal or monetary gain. | | |
| M9-Reverse Engineering | This category includes analysis of the final core binary to determine its source code, libraries, algorithms, and other assets. Software such as IDA Pro, Hopper, otool, and other binary inspection tools give the attacker insight into the inner workings of the application. This may be used to exploit other nascent vulnerabilities in the application, as well as revealing information about back end servers, cryptographic constants and ciphers, and intellectual property. | 0 | 0 |
| M10-Extraneous Functionality | Often, developers include hidden backdoor functionality or other internal development security controls that are not intended to be released into a production environment. For example, a developer may accidentally include a password as a comment in a hybrid app. Another example includes disabling of 2-factor authentication during testing. | 0 | 0 |

# Scan Summary - Custom

| Category | Issues Found | Best Fix Locations |
|---|---|---|
| Must audit | 0 | 0 |
| Check | 0 | 0 |
| Optional | 0 | 0 |

## Results Distribution By Status First scan of the project

| | High | Medium | Low | Information | Total |
|---|---|---|---|---|---|
| New Issues | 5 | 21 | 38 | 0 | 64 |
| Recurrent Issues | 0 | 0 | 0 | 0 | 0 |
| Total | 5 | 21 | 38 | 0 | 64 |
| | | | | | |
| Fixed Issues | 0 | 0 | 0 | 0 | 0 |




## Results Distribution By State

| | High | Medium | Low | Information | Total |
|---|---|---|---|---|---|
| Confirmed | 0 | 0 | 0 | 0 | 0 |
| Not Exploitable | 0 | 0 | 0 | 0 | 0 |
| To Verify | 5 | 21 | 38 | 0 | 64 |
| Urgent | 0 | 0 | 0 | 0 | 0 |
| Proposed Not Exploitable | 0 | 0 | 0 | 0 | 0 |
| Total | 5 | 21 | 38 | 0 | 64 |

## Result Summary

| Vulnerability Type | Occurrences | Severity |
|---|---|---|
| Buffer Overflow IndexFromInput | 5 | High |
| Dangerous Functions | 10 | Medium |
| Use of Zero Initialized Pointer | 9 | Medium |
| MemoryFree on StackVariable | 1 | Medium |
| Wrong Size t Allocation | 1 | Medium |

| | | |
|---|---|---|
| Improper Resource Access Authorization | 27 | Low |
| Unchecked Array Index | 3 | Low |
| Unchecked Return Value | 2 | Low |
| Use of Sizeof On a Pointer Type | 2 | Low |
| Exposure of System Data to Unauthorized Control Sphere | 1 | Low |
| Potential Path Traversal | 1 | Low |
| Sizeof Pointer Argument | 1 | Low |
| TOCTOU | 1 | Low |

# 10 Most Vulnerable Files

## High and Medium Vulnerabilities

| File Name | Issues Found |
|---|---|
| permafrost-engine/SDL_wave.c | 7 |
| permafrost-engine/_ctypes_test.c | 7 |
| permafrost-engine/testgles.c | 5 |
| permafrost-engine/md5.c | 3 |
| permafrost-engine/SDL_pixels.c | 2 |
| permafrost-engine/harness_argparser.c | 1 |
| permafrost-engine/alrecord.c | 1 |

# Scan Results Details

## Buffer Overflow IndexFromInput

Query Path:
CPP\Cx\CPP Buffer Overflow\Buffer Overflow IndexFromInput Version:1

### Categories

OWASP Top 10 2017: A1-Injection

*Description*

**Buffer Overflow IndexFromInput\Path 1:**

| | |
|---|---|
| Severity | High |
| Result State | To Verify |
| Online Results | http://WIN-BA8RD5TJ8IG/CxWebClient/ViewerMain.aspx?scanid=1010007&projectid=10008&pathid=60 |
| Status | New |

The size of the buffer used by main in i, at line 103 of permafrost-engine/testgles.c, is not properly verified before writing data to the buffer. This can enable a buffer overflow attack, using the source buffer that main passes to argv, at line 103 of permafrost-engine/testgles.c, to overwrite the target buffer.

| | Source | Destination |
|---|---|---|
| File | permafrost-engine/testgles.c | permafrost-engine/testgles.c |
| Line | 103 | 141 |
| Object | argv | i |

Code Snippet
File Name permafrost-engine/testgles.c
Method main(int argc, char *argv[])

```
....
103.  main(int argc, char *argv[])
....
141.                      depth = SDL_atoi(argv[i]);
```

**Buffer Overflow IndexFromInput\Path 2:**

| | |
|---|---|
| Severity | High |
| Result State | To Verify |
| Online Results | http://WIN-BA8RD5TJ8IG/CxWebClient/ViewerMain.aspx?scanid=1010007&projectid=10008&pathid=61 |
| Status | New |

The size of the buffer used by main in i, at line 103 of permafrost-engine/testgles.c, is not properly verified before writing data to the buffer. This can enable a buffer overflow attack, using the source buffer that main passes to argv, at line 103 of permafrost-engine/testgles.c, to overwrite the target buffer.

| | Source | Destination |
|---|---|---|
| File | permafrost-engine/testgles.c | permafrost-engine/testgles.c |

| | | |
|---|---|---|
| Line | 103 | 138 |
| Object | argv | i |

Code Snippet
File Name permafrost-engine/testgles.c
Method main(int argc, char *argv[])

```
....
103.  main(int argc, char *argv[])
....
138.                  if (!argv[i]) {
```

**Buffer Overflow IndexFromInput\Path 3:**

| | |
|---|---|
| Severity | High |
| Result State | To Verify |
| Online Results | http://WIN-BA8RD5TJ8IG/CxWebClient/ViewerMain.aspx?scanid=1010007&projectid=10008&pathid=62 |
| Status | New |

The size of the buffer used by main in i, at line 103 of permafrost-engine/testgles.c, is not properly verified before writing data to the buffer. This can enable a buffer overflow attack, using the source buffer that main passes to argv, at line 103 of permafrost-engine/testgles.c, to overwrite the target buffer.

| | Source | Destination |
|---|---|---|
| File | permafrost-engine/testgles.c | permafrost-engine/testgles.c |
| Line | 103 | 136 |
| Object | argv | i |

Code Snippet
File Name permafrost-engine/testgles.c
Method main(int argc, char *argv[])

```
....
103.  main(int argc, char *argv[])
....
136.              } else if (SDL_strcasecmp(argv[i], "--zdepth") == 0) {
```

**Buffer Overflow IndexFromInput\Path 4:**

| | |
|---|---|
| Severity | High |
| Result State | To Verify |
| Online Results | http://WIN-BA8RD5TJ8IG/CxWebClient/ViewerMain.aspx?scanid=1010007&projectid=10008&pathid=63 |
| Status | New |

The size of the buffer used by main in i, at line 103 of permafrost-engine/testgles.c, is not properly verified before writing data to the buffer. This can enable a buffer overflow attack, using the source buffer that main passes to argv, at line 103 of permafrost-engine/testgles.c, to overwrite the target buffer.

| | Source | Destination |
|---|---|---|

| | | |
|---|---|---|
| File | permafrost-engine/testgles.c | permafrost-engine/testgles.c |
| Line | 103 | 133 |
| Object | argv | i |

Code Snippet
File Name permafrost-engine/testgles.c
Method main(int argc, char *argv[])

```
....
103.  main(int argc, char *argv[])
....
133.              } else if (SDL_strcasecmp(argv[i], "--accel") == 0) {
```

**Buffer Overflow IndexFromInput\Path 5:**

| | |
|---|---|
| Severity | High |
| Result State | To Verify |
| Online Results | http://WIN-BA8RD5TJ8IG/CxWebClient/ViewerMain.aspx?scanid=1010007&projectid=10008&pathid=64 |
| Status | New |

The size of the buffer used by main in i, at line 103 of permafrost-engine/testgles.c, is not properly verified before writing data to the buffer. This can enable a buffer overflow attack, using the source buffer that main passes to argv, at line 103 of permafrost-engine/testgles.c, to overwrite the target buffer.

| | Source | Destination |
|---|---|---|
| File | permafrost-engine/testgles.c | permafrost-engine/testgles.c |
| Line | 103 | 130 |
| Object | argv | i |

Code Snippet
File Name permafrost-engine/testgles.c
Method main(int argc, char *argv[])

```
....
103.  main(int argc, char *argv[])
....
130.              if (SDL_strcasecmp(argv[i], "--fsaa") == 0) {
```

## Dangerous Functions

Query Path:
CPP\Cx\CPP Medium Threat\Dangerous Functions Version:1

### Categories

OWASP Top 10 2013: A9-Using Components with Known Vulnerabilities
OWASP Top 10 2017: A9-Using Components with Known Vulnerabilities

*Description*

**Dangerous Functions\Path 1:**

| | |
|---|---|
| Severity | Medium |
| Result State | To Verify |

| | |
|---|---|
| Online Results | http://WIN-BA8RD5TJ8IG/CxWebClient/ViewerMain.aspx?scanid=1010007&projectid=10008&pathid=12 |
| Status | New |

The dangerous function, memcpy, was found in use at line 203 in permafrost-engine/_ctypes_test.c file. Such functions may expose information and allow an attacker to get full control over the host machine.

| | Source | Destination |
|---|---|---|
| File | permafrost-engine/_ctypes_test.c | permafrost-engine/_ctypes_test.c |
| Line | 209 | 209 |
| Object | memcpy | memcpy |

Code Snippet
File Name permafrost-engine/_ctypes_test.c
Method EXPORT(wchar_t *) my_wcsdup(wchar_t *src)

```
....
209.      memcpy(ptr, src, (len+1) * sizeof(wchar_t));
```

**Dangerous Functions\Path 2:**

| | |
|---|---|
| Severity | Medium |
| Result State | To Verify |
| Online Results | http://WIN-BA8RD5TJ8IG/CxWebClient/ViewerMain.aspx?scanid=1010007&projectid=10008&pathid=13 |
| Status | New |

The dangerous function, memcpy, was found in use at line 133 in permafrost-engine/md5.c file. Such functions may expose information and allow an attacker to get full control over the host machine.

| | Source | Destination |
|---|---|---|
| File | permafrost-engine/md5.c | permafrost-engine/md5.c |
| Line | 170 | 170 |
| Object | memcpy | memcpy |

Code Snippet
File Name permafrost-engine/md5.c
Method md5_process(md5_state_t *pms, const md5_byte_t *data /*[64]*/)

```
....
170.                  memcpy(xbuf, data, 64);
```

**Dangerous Functions\Path 3:**

| | |
|---|---|
| Severity | Medium |
| Result State | To Verify |
| Online Results | http://WIN-BA8RD5TJ8IG/CxWebClient/ViewerMain.aspx?scanid=1010007&projectid=10008&pathid=14 |

| Status | New |
|---|---|

The dangerous function, memcpy, was found in use at line 324 in permafrost-engine/md5.c file. Such functions may expose information and allow an attacker to get full control over the host machine.

| | Source | Destination |
|---|---|---|
| File | permafrost-engine/md5.c | permafrost-engine/md5.c |
| Line | 356 | 356 |
| Object | memcpy | memcpy |

Code Snippet
File Name permafrost-engine/md5.c
Method md5_append(md5_state_t *pms, const md5_byte_t *data, unsigned int nbytes)

```
....
356.            memcpy(pms->buf + offset, p, copy);
```

**Dangerous Functions\Path 4:**

| Severity | Medium |
|---|---|
| Result State | To Verify |
| Online Results | http://WIN-BA8RD5TJ8IG/CxWebClient/ViewerMain.aspx?scanid=1010007&projectid=10008&pathid=15 |
| Status | New |

The dangerous function, memcpy, was found in use at line 324 in permafrost-engine/md5.c file. Such functions may expose information and allow an attacker to get full control over the host machine.

| | Source | Destination |
|---|---|---|
| File | permafrost-engine/md5.c | permafrost-engine/md5.c |
| Line | 370 | 370 |
| Object | memcpy | memcpy |

Code Snippet
File Name permafrost-engine/md5.c
Method md5_append(md5_state_t *pms, const md5_byte_t *data, unsigned int nbytes)

```
....
370.            memcpy(pms->buf, p, left);
```

**Dangerous Functions\Path 5:**

| Severity | Medium |
|---|---|
| Result State | To Verify |
| Online Results | http://WIN-BA8RD5TJ8IG/CxWebClient/ViewerMain.aspx?scanid=1010007&projectid=10008&pathid=16 |
| Status | New |

The dangerous function, strcpy, was found in use at line 188 in permafrost-engine/_ctypes_test.c file. Such functions may expose information and allow an attacker to get full control over the host machine.

| | Source | Destination |
|---|---|---|
| File | permafrost-engine/_ctypes_test.c | permafrost-engine/_ctypes_test.c |
| Line | 193 | 193 |
| Object | strcpy | strcpy |

Code Snippet
File Name permafrost-engine/_ctypes_test.c
Method EXPORT(char *) my_strdup(char *src)

```
....
193.        strcpy(dst, src);
```

**Dangerous Functions\Path 6:**

Severity Medium
Result State To Verify
Online Results http://WIN-BA8RD5TJ8IG/CxWebClient/ViewerMain.aspx?scanid=1010007&projectid=10008&pathid=17
Status New

The dangerous function, strlen, was found in use at line 188 in permafrost-engine/_ctypes_test.c file. Such functions may expose information and allow an attacker to get full control over the host machine.

| | Source | Destination |
|---|---|---|
| File | permafrost-engine/_ctypes_test.c | permafrost-engine/_ctypes_test.c |
| Line | 190 | 190 |
| Object | strlen | strlen |

Code Snippet
File Name permafrost-engine/_ctypes_test.c
Method EXPORT(char *) my_strdup(char *src)

```
....
190.        char *dst = (char *)malloc(strlen(src)+1);
```

**Dangerous Functions\Path 7:**

Severity Medium
Result State To Verify
Online Results http://WIN-BA8RD5TJ8IG/CxWebClient/ViewerMain.aspx?scanid=1010007&projectid=10008&pathid=18
Status New

The dangerous function, strtok, was found in use at line 110 in permafrost-engine/_ctypes_test.c file. Such functions may expose information and allow an attacker to get full control over the host machine.

| | Source | Destination |
|---|---|---|
| File | permafrost-engine/_ctypes_test.c | permafrost-engine/_ctypes_test.c |
| Line | 112 | 112 |
| Object | strtok | strtok |

Code Snippet
File Name permafrost-engine/_ctypes_test.c
Method EXPORT(char *)my_strtok(char *token, const char *delim)

```
....
112.      return strtok(token, delim);
```

**Dangerous Functions\Path 8:**

| | |
|---|---|
| Severity | Medium |
| Result State | To Verify |
| Online Results | http://WIN-BA8RD5TJ8IG/CxWebClient/ViewerMain.aspx?scanid=1010007&projectid=10008&pathid=19 |
| Status | New |

The dangerous function, strtok, was found in use at line 202 in permafrost-engine/harness_argparser.c file. Such functions may expose information and allow an attacker to get full control over the host machine.

| | Source | Destination |
|---|---|---|
| File | permafrost-engine/harness_argparser.c | permafrost-engine/harness_argparser.c |
| Line | 245 | 245 |
| Object | strtok | strtok |

Code Snippet
File Name permafrost-engine/harness_argparser.c
Method ParseConfig(char* file, SDLVisualTest_HarnessState* state)

```
....
245.              argv[i] = strtok(i == 0 ? line : NULL, "=");
```

**Dangerous Functions\Path 9:**

| | |
|---|---|
| Severity | Medium |
| Result State | To Verify |
| Online Results | http://WIN-BA8RD5TJ8IG/CxWebClient/ViewerMain.aspx?scanid=1010007&projectid=10008&pathid=20 |
| Status | New |

The dangerous function, wcslen, was found in use at line 203 in permafrost-engine/_ctypes_test.c file. Such functions may expose information and allow an attacker to get full control over the host machine.

| | Source | Destination |
|---|---|---|
| File | permafrost-engine/_ctypes_test.c | permafrost-engine/_ctypes_test.c |

| | | |
|---|---|---|
| Line | 205 | 205 |
| Object | wcslen | wcslen |

Code Snippet
File Name permafrost-engine/_ctypes_test.c
Method EXPORT(wchar_t *) my_wcsdup(wchar_t *src)

```
....
205.      size_t len = wcslen(src);
```

**Dangerous Functions\Path 10:**

| | |
|---|---|
| Severity | Medium |
| Result State | To Verify |
| Online Results | http://WIN-BA8RD5TJ8IG/CxWebClient/ViewerMain.aspx?scanid=1010007&projectid=10008&pathid=21 |
| Status | New |

The dangerous function, wcslen, was found in use at line 213 in permafrost-engine/_ctypes_test.c file. Such functions may expose information and allow an attacker to get full control over the host machine.

| | Source | Destination |
|---|---|---|
| File | permafrost-engine/_ctypes_test.c | permafrost-engine/_ctypes_test.c |
| Line | 215 | 215 |
| Object | wcslen | wcslen |

Code Snippet
File Name permafrost-engine/_ctypes_test.c
Method EXPORT(size_t) my_wcslen(wchar_t *src)

```
....
215.      return wcslen(src);
```

## Use of Zero Initialized Pointer

Query Path:
CPP\Cx\CPP Medium Threat\Use of Zero Initialized Pointer Version:1

### Categories

NIST SP 800-53: SC-5 Denial of Service Protection (P1)

*Description*

**Use of Zero Initialized Pointer\Path 1:**

| | |
|---|---|
| Severity | Medium |
| Result State | To Verify |
| Online Results | http://WIN-BA8RD5TJ8IG/CxWebClient/ViewerMain.aspx?scanid=1010007&projectid=10008&pathid=22 |
| Status | New |

The variable declared in devname at permafrost-engine/alrecord.c in line 92 is not initialized when it is used by mDevice at permafrost-engine/alrecord.c in line 92.

| | Source | Destination |
|---|---|---|
| File | permafrost-engine/alrecord.c | permafrost-engine/alrecord.c |
| Line | 101 | 261 |
| Object | devname | mDevice |

Code Snippet
File Name permafrost-engine/alrecord.c
Method int main(int argc, char **argv)

```
....
101.      const char *devname = NULL;
....
261.      recorder.mDevice = alcCaptureOpenDevice(devname,
recorder.mSampleRate, format, 32768);
```

**Use of Zero Initialized Pointer\Path 2:**

Severity Medium
Result State To Verify
Online Results http://WIN-BA8RD5TJ8IG/CxWebClient/ViewerMain.aspx?scanid=1010007&projectid=10008&pathid=23
Status New

The variable declared in palette at permafrost-engine/SDL_pixels.c in line 537 is not initialized when it is used by next at permafrost-engine/SDL_pixels.c in line 496.

| | Source | Destination |
|---|---|---|
| File | permafrost-engine/SDL_pixels.c | permafrost-engine/SDL_pixels.c |
| Line | 594 | 527 |
| Object | palette | next |

Code Snippet
File Name permafrost-engine/SDL_pixels.c
Method SDL_InitFormat(SDL_PixelFormat * format, Uint32 pixel_format)

```
....
594.      format->palette = NULL;
```

File Name permafrost-engine/SDL_pixels.c
Method SDL_AllocFormat(Uint32 pixel_format)

```
....
527.          format->next = formats;
```

**Use of Zero Initialized Pointer\Path 3:**

| | |
|---|---|
| Severity | Medium |
| Result State | To Verify |
| Online Results | http://WIN-BA8RD5TJ8IG/CxWebClient/ViewerMain.aspx?scanid=1010007&projectid=10008&pathid=24 |
| Status | New |

The variable declared in next at permafrost-engine/SDL_pixels.c in line 537 is not initialized when it is used by next at permafrost-engine/SDL_pixels.c in line 496.

| | Source | Destination |
|---|---|---|
| File | permafrost-engine/SDL_pixels.c | permafrost-engine/SDL_pixels.c |
| Line | 596 | 527 |
| Object | next | next |

Code Snippet

File Name permafrost-engine/SDL_pixels.c

Method SDL_InitFormat(SDL_PixelFormat * format, Uint32 pixel_format)

```
....
596.      format->next = NULL;
```

File Name permafrost-engine/SDL_pixels.c

Method SDL_AllocFormat(Uint32 pixel_format)

```
....
527.          format->next = formats;
```

**Use of Zero Initialized Pointer\Path 4:**

| | |
|---|---|
| Severity | Medium |
| Result State | To Verify |
| Online Results | http://WIN-BA8RD5TJ8IG/CxWebClient/ViewerMain.aspx?scanid=1010007&projectid=10008&pathid=25 |
| Status | New |

The variable declared in Pointer at permafrost-engine/SDL_wave.c in line 641 is not initialized when it is used by audio_buf at permafrost-engine/SDL_wave.c in line 2095.

| | Source | Destination |
|---|---|---|
| File | permafrost-engine/SDL_wave.c | permafrost-engine/SDL_wave.c |
| Line | 661 | 2126 |
| Object | Pointer | audio_buf |

Code Snippet

File Name permafrost-engine/SDL_wave.c

Method MS_ADPCM_Decode(WaveFile *file, Uint8 **audio_buf, Uint32 *audio_len)

```
....
661.          *audio_buf = NULL;
```

File Name permafrost-engine/SDL_wave.c

Method SDL_LoadWAV_RW(SDL_RWops *src, int freesrc, SDL_AudioSpec *spec, Uint8 **audio_buf, Uint32 *audio_len)

```
....
2126.          SDL_free(*audio_buf);
```

**Use of Zero Initialized Pointer\Path 5:**

| | |
|---|---|
| Severity | Medium |
| Result State | To Verify |
| Online Results | http://WIN-BA8RD5TJ8IG/CxWebClient/ViewerMain.aspx?scanid=1010007&projectid=10008&pathid=26 |
| Status | New |

The variable declared in Pointer at permafrost-engine/SDL_wave.c in line 1037 is not initialized when it is used by audio_buf at permafrost-engine/SDL_wave.c in line 2095.

| | Source | Destination |
|---|---|---|
| File | permafrost-engine/SDL_wave.c | permafrost-engine/SDL_wave.c |
| Line | 1054 | 2126 |
| Object | Pointer | audio_buf |

Code Snippet

File Name permafrost-engine/SDL_wave.c

Method IMA_ADPCM_Decode(WaveFile *file, Uint8 **audio_buf, Uint32 *audio_len)

```
....
1054.          *audio_buf = NULL;
```

File Name permafrost-engine/SDL_wave.c

Method SDL_LoadWAV_RW(SDL_RWops *src, int freesrc, SDL_AudioSpec *spec, Uint8 **audio_buf, Uint32 *audio_len)

```
....
2126.          SDL_free(*audio_buf);
```

**Use of Zero Initialized Pointer\Path 6:**

| | |
|---|---|
| Severity | Medium |
| Result State | To Verify |
| Online Results | http://WIN-BA8RD5TJ8IG/CxWebClient/ViewerMain.aspx?scanid=1010007&projectid=10008&pathid=27 |

| Status | New |
|---|---|

The variable declared in Pointer at permafrost-engine/SDL_wave.c in line 1170 is not initialized when it is used by audio_buf at permafrost-engine/SDL_wave.c in line 2095.

| | Source | Destination |
|---|---|---|
| File | permafrost-engine/SDL_wave.c | permafrost-engine/SDL_wave.c |
| Line | 1226 | 2126 |
| Object | Pointer | audio_buf |

Code Snippet
File Name permafrost-engine/SDL_wave.c
Method LAW_Decode(WaveFile *file, Uint8 **audio_buf, Uint32 *audio_len)

```
....
1226.           *audio_buf = NULL;
```

File Name permafrost-engine/SDL_wave.c

Method SDL_LoadWAV_RW(SDL_RWops *src, int freesrc, SDL_AudioSpec *spec, Uint8 **audio_buf, Uint32 *audio_len)

```
....
2126.           SDL_free(*audio_buf);
```

**Use of Zero Initialized Pointer\Path 7:**

| Severity | Medium |
|---|---|
| Result State | To Verify |
| Online Results | http://WIN-BA8RD5TJ8IG/CxWebClient/ViewerMain.aspx?scanid=1010007&projectid=10008&pathid=28 |
| Status | New |

The variable declared in Pointer at permafrost-engine/SDL_wave.c in line 1408 is not initialized when it is used by audio_buf at permafrost-engine/SDL_wave.c in line 2095.

| | Source | Destination |
|---|---|---|
| File | permafrost-engine/SDL_wave.c | permafrost-engine/SDL_wave.c |
| Line | 1423 | 2126 |
| Object | Pointer | audio_buf |

Code Snippet
File Name permafrost-engine/SDL_wave.c
Method PCM_Decode(WaveFile *file, Uint8 **audio_buf, Uint32 *audio_len)

```
....
1423.           *audio_buf = NULL;
```

| | |
|---|---|
| File Name | permafrost-engine/SDL_wave.c |
| Method | SDL_LoadWAV_RW(SDL_RWops *src, int freesrc, SDL_AudioSpec *spec, Uint8 **audio_buf, Uint32 *audio_len) |

```
....
2126.          SDL_free(*audio_buf);
```

**Use of Zero Initialized Pointer\Path 8:**

| | |
|---|---|
| Severity | Medium |
| Result State | To Verify |
| Online Results | http://WIN-BA8RD5TJ8IG/CxWebClient/ViewerMain.aspx?scanid=1010007&projectid=10008&pathid=29 |
| Status | New |

The variable declared in Pointer at permafrost-engine/SDL_wave.c in line 2095 is not initialized when it is used by audio_buf at permafrost-engine/SDL_wave.c in line 2095.

| | Source | Destination |
|---|---|---|
| File | permafrost-engine/SDL_wave.c | permafrost-engine/SDL_wave.c |
| Line | 2117 | 2126 |
| Object | Pointer | audio_buf |

Code Snippet

| | |
|---|---|
| File Name | permafrost-engine/SDL_wave.c |
| Method | SDL_LoadWAV_RW(SDL_RWops *src, int freesrc, SDL_AudioSpec *spec, Uint8 **audio_buf, Uint32 *audio_len) |

```
....
2117.      *audio_buf = NULL;
....
2126.          SDL_free(*audio_buf);
```

**Use of Zero Initialized Pointer\Path 9:**

| | |
|---|---|
| Severity | Medium |
| Result State | To Verify |
| Online Results | http://WIN-BA8RD5TJ8IG/CxWebClient/ViewerMain.aspx?scanid=1010007&projectid=10008&pathid=30 |
| Status | New |

The variable declared in data at permafrost-engine/SDL_wave.c in line 1511 is not initialized when it is used by data at permafrost-engine/SDL_wave.c in line 1554.

| | Source | Destination |
|---|---|---|
| File | permafrost-engine/SDL_wave.c | permafrost-engine/SDL_wave.c |
| Line | 1515 | 1563 |

| | | |
|---|---|---|
| Object | data | data |

Code Snippet
File Name permafrost-engine/SDL_wave.c
Method WaveFreeChunkData(WaveChunk *chunk)

```
....
1515.           chunk->data = NULL;
```

File Name permafrost-engine/SDL_wave.c
Method WaveReadPartialChunkData(SDL_RWops *src, WaveChunk *chunk, size_t length)

```
....
1563.           chunk->data = SDL_malloc(length);
```

## MemoryFree on StackVariable

Query Path:
CPP\Cx\CPP Medium Threat\MemoryFree on StackVariable Version:0

*Description*

**MemoryFree on StackVariable\Path 1:**

| | |
|---|---|
| Severity | Medium |
| Result State | To Verify |
| Online Results | http://WIN-BA8RD5TJ8IG/CxWebClient/ViewerMain.aspx?scanid=1010007&projectid=10008&pathid=6 |
| Status | New |

Calling free() (line 231) on a variable that was not dynamically allocated (line 231) in file permafrost-engine/SDL_wave.c may result with a crash.

| | Source | Destination |
|---|---|---|
| File | permafrost-engine/SDL_wave.c | permafrost-engine/SDL_wave.c |
| Line | 317 | 317 |
| Object | dumpstr | dumpstr |

Code Snippet
File Name permafrost-engine/SDL_wave.c
Method WaveDebugDumpFormat(WaveFile *file, Uint32 rifflen, Uint32 fmtlen, Uint32 datalen)

```
....
317.        free(dumpstr);
```

## Wrong Size t Allocation

Query Path:
CPP\Cx\CPP Integer Overflow\Wrong Size t Allocation Version:0

*Description*

**Wrong Size t Allocation\Path 1:**

| | |
|---|---|
| Severity | Medium |
| Result State | To Verify |
| Online Results | http://WIN-BA8RD5TJ8IG/CxWebClient/ViewerMain.aspx?scanid=1010007&projectid=10008&pathid=7 |
| Status | New |

The function len in permafrost-engine/_ctypes_test.c at line 203 assigns an incorrectly calculated size to a buffer, resulting in a mismatch between the value being written and the size of the buffer it is being written into.

| | Source | Destination |
|---|---|---|
| File | permafrost-engine/_ctypes_test.c | permafrost-engine/_ctypes_test.c |
| Line | 206 | 206 |
| Object | len | len |

Code Snippet
File Name permafrost-engine/_ctypes_test.c
Method EXPORT(wchar_t *) my_wcsdup(wchar_t *src)

```
....
206.      wchar_t *ptr = (wchar_t *)malloc((len + 1) * sizeof(wchar_t));
```

## Improper Resource Access Authorization

Query Path:
CPP\Cx\CPP Low Visibility\Improper Resource Access Authorization Version:1

### Categories

FISMA 2014: Identification And Authentication
NIST SP 800-53: AC-3 Access Enforcement (P1)
OWASP Top 10 2017: A2-Broken Authentication

*Description*
**Improper Resource Access Authorization\Path 1:**

| | |
|---|---|
| Severity | Low |
| Result State | To Verify |
| Online Results | http://WIN-BA8RD5TJ8IG/CxWebClient/ViewerMain.aspx?scanid=1010007&projectid=10008&pathid=31 |
| Status | New |

| | Source | Destination |
|---|---|---|
| File | permafrost-engine/alrecord.c | permafrost-engine/alrecord.c |
| Line | 111 | 111 |
| Object | fprintf | fprintf |

Code Snippet
File Name permafrost-engine/alrecord.c
Method int main(int argc, char **argv)

```
....
111.          fprintf(stderr, "Record from a device to a wav file.\n\n"
```

**Improper Resource Access Authorization\Path 2:**

| | |
|---|---|
| Severity | Low |
| Result State | To Verify |
| Online Results | http://WIN-BA8RD5TJ8IG/CxWebClient/ViewerMain.aspx?scanid=1010007&projectid=10008&pathid=32 |
| Status | New |

| | Source | Destination |
|---|---|---|
| File | permafrost-engine/alrecord.c | permafrost-engine/alrecord.c |
| Line | 146 | 146 |
| Object | fprintf | fprintf |

Code Snippet
File Name permafrost-engine/alrecord.c
Method int main(int argc, char **argv)

```
....
146.                  fprintf(stderr, "Missing argument for option:
%s\n", argv[0]);
```

**Improper Resource Access Authorization\Path 3:**

| | |
|---|---|
| Severity | Low |
| Result State | To Verify |
| Online Results | http://WIN-BA8RD5TJ8IG/CxWebClient/ViewerMain.aspx?scanid=1010007&projectid=10008&pathid=33 |
| Status | New |

| | Source | Destination |
|---|---|---|
| File | permafrost-engine/alrecord.c | permafrost-engine/alrecord.c |
| Line | 153 | 153 |
| Object | fprintf | fprintf |

Code Snippet
File Name permafrost-engine/alrecord.c
Method int main(int argc, char **argv)

```
....
153.                  fprintf(stderr, "Invalid channels: %s\n",
argv[1]);
```

**Improper Resource Access Authorization\Path 4:**

| | |
|---|---|
| Severity | Low |

| | |
|---|---|
| Result State | To Verify |
| Online Results | http://WIN-BA8RD5TJ8IG/CxWebClient/ViewerMain.aspx?scanid=1010007&projectid=10008&pathid=34 |
| Status | New |

| | Source | Destination |
|---|---|---|
| File | permafrost-engine/alrecord.c | permafrost-engine/alrecord.c |
| Line | 163 | 163 |
| Object | fprintf | fprintf |

Code Snippet
File Name permafrost-engine/alrecord.c
Method int main(int argc, char **argv)

```
....
163.                    fprintf(stderr, "Missing argument for option:
%s\n", argv[0]);
```

**Improper Resource Access Authorization\Path 5:**

| | |
|---|---|
| Severity | Low |
| Result State | To Verify |
| Online Results | http://WIN-BA8RD5TJ8IG/CxWebClient/ViewerMain.aspx?scanid=1010007&projectid=10008&pathid=35 |
| Status | New |

| | Source | Destination |
|---|---|---|
| File | permafrost-engine/alrecord.c | permafrost-engine/alrecord.c |
| Line | 171 | 171 |
| Object | fprintf | fprintf |

Code Snippet
File Name permafrost-engine/alrecord.c
Method int main(int argc, char **argv)

```
....
171.                    fprintf(stderr, "Invalid bit count: %s\n",
argv[1]);
```

**Improper Resource Access Authorization\Path 6:**

| | |
|---|---|
| Severity | Low |
| Result State | To Verify |
| Online Results | http://WIN-BA8RD5TJ8IG/CxWebClient/ViewerMain.aspx?scanid=1010007&projectid=10008&pathid=36 |
| Status | New |

| | Source | Destination |
|---|---|---|

| | | |
|---|---|---|
| File | permafrost-engine/alrecord.c | permafrost-engine/alrecord.c |
| Line | 181 | 181 |
| Object | fprintf | fprintf |

Code Snippet
File Name permafrost-engine/alrecord.c
Method int main(int argc, char **argv)

```
....
181.                    fprintf(stderr, "Missing argument for option:
%s\n", argv[0]);
```

**Improper Resource Access Authorization\Path 7:**

Severity Low
Result State To Verify
Online Results http://WIN-BA8RD5TJ8IG/CxWebClient/ViewerMain.aspx?scanid=1010007&projectid=10008&pathid=37
Status New

| | Source | Destination |
|---|---|---|
| File | permafrost-engine/alrecord.c | permafrost-engine/alrecord.c |
| Line | 188 | 188 |
| Object | fprintf | fprintf |

Code Snippet
File Name permafrost-engine/alrecord.c
Method int main(int argc, char **argv)

```
....
188.                    fprintf(stderr, "Invalid sample rate: %s\n",
argv[1]);
```

**Improper Resource Access Authorization\Path 8:**

Severity Low
Result State To Verify
Online Results http://WIN-BA8RD5TJ8IG/CxWebClient/ViewerMain.aspx?scanid=1010007&projectid=10008&pathid=38
Status New

| | Source | Destination |
|---|---|---|
| File | permafrost-engine/alrecord.c | permafrost-engine/alrecord.c |
| Line | 198 | 198 |
| Object | fprintf | fprintf |

Code Snippet

| | |
|---|---|
| File Name | permafrost-engine/alrecord.c |
| Method | int main(int argc, char **argv) |

```
....
198.                    fprintf(stderr, "Missing argument for option:
%s\n", argv[0]);
```

**Improper Resource Access Authorization\Path 9:**

| | |
|---|---|
| Severity | Low |
| Result State | To Verify |
| Online Results | http://WIN-BA8RD5TJ8IG/CxWebClient/ViewerMain.aspx?scanid=1010007&projectid=10008&pathid=39 |
| Status | New |

| | Source | Destination |
|---|---|---|
| File | permafrost-engine/alrecord.c | permafrost-engine/alrecord.c |
| Line | 205 | 205 |
| Object | fprintf | fprintf |

Code Snippet

| | |
|---|---|
| File Name | permafrost-engine/alrecord.c |
| Method | int main(int argc, char **argv) |

```
....
205.                    fprintf(stderr, "Invalid record time: %s\n",
argv[1]);
```

**Improper Resource Access Authorization\Path 10:**

| | |
|---|---|
| Severity | Low |
| Result State | To Verify |
| Online Results | http://WIN-BA8RD5TJ8IG/CxWebClient/ViewerMain.aspx?scanid=1010007&projectid=10008&pathid=40 |
| Status | New |

| | Source | Destination |
|---|---|---|
| File | permafrost-engine/alrecord.c | permafrost-engine/alrecord.c |
| Line | 215 | 215 |
| Object | fprintf | fprintf |

Code Snippet

| | |
|---|---|
| File Name | permafrost-engine/alrecord.c |
| Method | int main(int argc, char **argv) |

```
....
215.                    fprintf(stderr, "Missing argument for option:
%s\n", argv[0]);
```

**Improper Resource Access Authorization\Path 11:**

| | |
|---|---|
| Severity | Low |
| Result State | To Verify |
| Online Results | http://WIN-BA8RD5TJ8IG/CxWebClient/ViewerMain.aspx?scanid=1010007&projectid=10008&pathid=41 |
| Status | New |

| | Source | Destination |
|---|---|---|
| File | permafrost-engine/alrecord.c | permafrost-engine/alrecord.c |
| Line | 225 | 225 |
| Object | fprintf | fprintf |

Code Snippet
File Name permafrost-engine/alrecord.c
Method int main(int argc, char **argv)

```
....
225.                fprintf(stderr, "Record from a device to a wav
file.\n\n"
```

**Improper Resource Access Authorization\Path 12:**

| | |
|---|---|
| Severity | Low |
| Result State | To Verify |
| Online Results | http://WIN-BA8RD5TJ8IG/CxWebClient/ViewerMain.aspx?scanid=1010007&projectid=10008&pathid=42 |
| Status | New |

| | Source | Destination |
|---|---|---|
| File | permafrost-engine/alrecord.c | permafrost-engine/alrecord.c |
| Line | 232 | 232 |
| Object | fprintf | fprintf |

Code Snippet
File Name permafrost-engine/alrecord.c
Method int main(int argc, char **argv)

```
....
232.                fprintf(stderr, "Invalid option '%s'.\n\n"
```

**Improper Resource Access Authorization\Path 13:**

| | |
|---|---|
| Severity | Low |
| Result State | To Verify |
| Online Results | http://WIN-BA8RD5TJ8IG/CxWebClient/ViewerMain.aspx?scanid=1010007&projectid=10008&pathid=43 |
| Status | New |

| | Source | Destination |
|---|---|---|
| File | permafrost-engine/alrecord.c | permafrost-engine/alrecord.c |
| Line | 264 | 264 |
| Object | fprintf | fprintf |

Code Snippet
File Name permafrost-engine/alrecord.c
Method int main(int argc, char **argv)

```
....
264.          fprintf(stderr, "Failed to open %s, %s %d-bit, %s, %dhz
(%d samples)\n",
```

**Improper Resource Access Authorization\Path 14:**

Severity Low
Result State To Verify
Online Results http://WIN-BA8RD5TJ8IG/CxWebClient/ViewerMain.aspx?scanid=1010007&projectid=10008&pathid=44
Status New

| | Source | Destination |
|---|---|---|
| File | permafrost-engine/alrecord.c | permafrost-engine/alrecord.c |
| Line | 273 | 273 |
| Object | fprintf | fprintf |

Code Snippet
File Name permafrost-engine/alrecord.c
Method int main(int argc, char **argv)

```
....
273.      fprintf(stderr, "Opened \"%s\"\n", alcGetString(
```

**Improper Resource Access Authorization\Path 15:**

Severity Low
Result State To Verify
Online Results http://WIN-BA8RD5TJ8IG/CxWebClient/ViewerMain.aspx?scanid=1010007&projectid=10008&pathid=45
Status New

| | Source | Destination |
|---|---|---|
| File | permafrost-engine/alrecord.c | permafrost-engine/alrecord.c |
| Line | 280 | 280 |
| Object | fprintf | fprintf |

Code Snippet
File Name permafrost-engine/alrecord.c
Method int main(int argc, char **argv)

```
....
280.            fprintf(stderr, "Failed to open '%s' for writing\n",
fname);
```

**Improper Resource Access Authorization\Path 16:**

Severity Low
Result State To Verify
Online Results http://WIN-BA8RD5TJ8IG/CxWebClient/ViewerMain.aspx?scanid=1010007&projectid=10008&pathid=46
Status New

| | Source | Destination |
|---|---|---|
| File | permafrost-engine/alrecord.c | permafrost-engine/alrecord.c |
| Line | 314 | 314 |
| Object | fprintf | fprintf |

Code Snippet
File Name permafrost-engine/alrecord.c
Method int main(int argc, char **argv)

```
....
314.            fprintf(stderr, "Error writing header: %s\n",
strerror(errno));
```

**Improper Resource Access Authorization\Path 17:**

Severity Low
Result State To Verify
Online Results http://WIN-BA8RD5TJ8IG/CxWebClient/ViewerMain.aspx?scanid=1010007&projectid=10008&pathid=47
Status New

| | Source | Destination |
|---|---|---|
| File | permafrost-engine/alrecord.c | permafrost-engine/alrecord.c |
| Line | 320 | 320 |
| Object | fprintf | fprintf |

Code Snippet
File Name permafrost-engine/alrecord.c
Method int main(int argc, char **argv)

```
....
320.      fprintf(stderr, "Recording '%s', %s %d-bit, %s, %dhz (%g
second%s)\n", fname,
```

**Improper Resource Access Authorization\Path 18:**

| | |
|---|---|
| Severity | Low |
| Result State | To Verify |
| Online Results | http://WIN-BA8RD5TJ8IG/CxWebClient/ViewerMain.aspx?scanid=1010007&projectid=10008&pathid=48 |
| Status | New |

| | Source | Destination |
|---|---|---|
| File | permafrost-engine/alrecord.c | permafrost-engine/alrecord.c |
| Line | 333 | 333 |
| Object | fprintf | fprintf |

Code Snippet
File Name permafrost-engine/alrecord.c
Method int main(int argc, char **argv)

```
....
333.          fprintf(stderr, "\rCaptured %u samples",
recorder.mDataSize);
```

**Improper Resource Access Authorization\Path 19:**

| | |
|---|---|
| Severity | Low |
| Result State | To Verify |
| Online Results | http://WIN-BA8RD5TJ8IG/CxWebClient/ViewerMain.aspx?scanid=1010007&projectid=10008&pathid=49 |
| Status | New |

| | Source | Destination |
|---|---|---|
| File | permafrost-engine/alrecord.c | permafrost-engine/alrecord.c |
| Line | 380 | 380 |
| Object | fprintf | fprintf |

Code Snippet
File Name permafrost-engine/alrecord.c
Method int main(int argc, char **argv)

```
....
380.      fprintf(stderr, "\rCaptured %u samples\n",
recorder.mDataSize);
```

**Improper Resource Access Authorization\Path 20:**

| | |
|---|---|
| Severity | Low |
| Result State | To Verify |
| Online Results | http://WIN-BA8RD5TJ8IG/CxWebClient/ViewerMain.aspx?scanid=1010007&projectid=10008&pathid=50 |
| Status | New |

| | Source | Destination |
|---|---|---|
| File | permafrost-engine/alrecord.c | permafrost-engine/alrecord.c |
| Line | 382 | 382 |
| Object | fprintf | fprintf |

Code Snippet
File Name permafrost-engine/alrecord.c
Method int main(int argc, char **argv)

```
....
382.          fprintf(stderr, "Got device error 0x%04x: %s\n", err,
alcGetString(recorder.mDevice, err));
```

**Improper Resource Access Authorization\Path 21:**

| | |
|---|---|
| Severity | Low |
| Result State | To Verify |
| Online Results | http://WIN-BA8RD5TJ8IG/CxWebClient/ViewerMain.aspx?scanid=1010007&projectid=10008&pathid=51 |
| Status | New |

| | Source | Destination |
|---|---|---|
| File | permafrost-engine/alrecord.c | permafrost-engine/alrecord.c |
| Line | 285 | 285 |
| Object | fputs | fputs |

Code Snippet
File Name permafrost-engine/alrecord.c
Method int main(int argc, char **argv)

```
....
285.      fputs("RIFF", recorder.mFile);
```

**Improper Resource Access Authorization\Path 22:**

| | |
|---|---|
| Severity | Low |
| Result State | To Verify |
| Online Results | http://WIN-BA8RD5TJ8IG/CxWebClient/ViewerMain.aspx?scanid=1010007&projectid=10008&pathid=52 |
| Status | New |

| | Source | Destination |
|---|---|---|
| File | permafrost-engine/alrecord.c | permafrost-engine/alrecord.c |
| Line | 288 | 288 |
| Object | fputs | fputs |

Code Snippet
File Name permafrost-engine/alrecord.c
Method int main(int argc, char **argv)

```
....
288.        fputs("WAVE", recorder.mFile);
```

**Improper Resource Access Authorization\Path 23:**

Severity Low
Result State To Verify
Online Results http://WIN-BA8RD5TJ8IG/CxWebClient/ViewerMain.aspx?scanid=1010007&projectid=10008&pathid=53
Status New

| | Source | Destination |
|---|---|---|
| File | permafrost-engine/alrecord.c | permafrost-engine/alrecord.c |
| Line | 290 | 290 |
| Object | fputs | fputs |

Code Snippet
File Name permafrost-engine/alrecord.c
Method int main(int argc, char **argv)

```
....
290.        fputs("fmt ", recorder.mFile);
```

**Improper Resource Access Authorization\Path 24:**

Severity Low
Result State To Verify
Online Results http://WIN-BA8RD5TJ8IG/CxWebClient/ViewerMain.aspx?scanid=1010007&projectid=10008&pathid=54
Status New

| | Source | Destination |
|---|---|---|
| File | permafrost-engine/alrecord.c | permafrost-engine/alrecord.c |
| Line | 308 | 308 |
| Object | fputs | fputs |

Code Snippet

| | |
|---|---|
| File Name | permafrost-engine/alrecord.c |
| Method | int main(int argc, char **argv) |

```
....
308.       fputs("data", recorder.mFile);
```

**Improper Resource Access Authorization\Path 25:**

| | |
|---|---|
| Severity | Low |
| Result State | To Verify |
| Online Results | http://WIN-BA8RD5TJ8IG/CxWebClient/ViewerMain.aspx?scanid=1010007&projectid=10008&pathid=55 |
| Status | New |

| | Source | Destination |
|---|---|---|
| File | permafrost-engine/alrecord.c | permafrost-engine/alrecord.c |
| Line | 376 | 376 |
| Object | fwrite | fwrite |

Code Snippet

| | |
|---|---|
| File Name | permafrost-engine/alrecord.c |
| Method | int main(int argc, char **argv) |

```
....
376.           recorder.mDataSize += (ALuint)fwrite(recorder.mBuffer,
recorder.mFrameSize, (ALuint)count,
```

**Improper Resource Access Authorization\Path 26:**

| | |
|---|---|
| Severity | Low |
| Result State | To Verify |
| Online Results | http://WIN-BA8RD5TJ8IG/CxWebClient/ViewerMain.aspx?scanid=1010007&projectid=10008&pathid=56 |
| Status | New |

| | Source | Destination |
|---|---|---|
| File | permafrost-engine/alrecord.c | permafrost-engine/alrecord.c |
| Line | 62 | 62 |
| Object | fwrite | fwrite |

Code Snippet

| | |
|---|---|
| File Name | permafrost-engine/alrecord.c |
| Method | static void fwrite16le(ALushort val, FILE *f) |

```
....
62.       fwrite(data, 1, 2, f);
```

**Improper Resource Access Authorization\Path 27:**

| | |
|---|---|
| Severity | Low |
| Result State | To Verify |
| Online Results | http://WIN-BA8RD5TJ8IG/CxWebClient/ViewerMain.aspx?scanid=1010007&projectid=10008&pathid=57 |
| Status | New |

| | Source | Destination |
|---|---|---|
| File | permafrost-engine/alrecord.c | permafrost-engine/alrecord.c |
| Line | 72 | 72 |
| Object | fwrite | fwrite |

Code Snippet
File Name permafrost-engine/alrecord.c
Method static void fwrite32le(ALuint val, FILE *f)

```
....
72.      fwrite(data, 1, 4, f);
```

## Unchecked Array Index

Query Path:
CPP\Cx\CPP Low Visibility\Unchecked Array Index Version:1

### Categories

NIST SP 800-53: SI-10 Information Input Validation (P1)

*Description*

**Unchecked Array Index\Path 1:**

| | |
|---|---|
| Severity | Low |
| Result State | To Verify |
| Online Results | http://WIN-BA8RD5TJ8IG/CxWebClient/ViewerMain.aspx?scanid=1010007&projectid=10008&pathid=9 |
| Status | New |

| | Source | Destination |
|---|---|---|
| File | permafrost-engine/SDL_wave.c | permafrost-engine/SDL_wave.c |
| Line | 571 | 571 |
| Object | pos | pos |

Code Snippet
File Name permafrost-engine/SDL_wave.c
Method MS_ADPCM_DecodeBlockHeader(ADPCM_DecoderState *state)

```
....
571.          state->output.data[state->output.pos] = (Sint16)sample;
```

**Unchecked Array Index\Path 2:**

| | |
|---|---|
| Severity | Low |

| | |
|---|---|
| Result State | To Verify |
| Online Results | http://WIN-BA8RD5TJ8IG/CxWebClient/ViewerMain.aspx?scanid=1010007&projectid=10008&pathid=10 |
| Status | New |

| | Source | Destination |
|---|---|---|
| File | permafrost-engine/SDL_wave.c | permafrost-engine/SDL_wave.c |
| Line | 1261 | 1261 |
| Object | i | i |

Code Snippet
File Name permafrost-engine/SDL_wave.c
Method LAW_Decode(WaveFile *file, Uint8 **audio_buf, Uint32 *audio_len)

```
....
1261.               dst[i] = alaw_lut[src[i]];
```

**Unchecked Array Index\Path 3:**

| | |
|---|---|
| Severity | Low |
| Result State | To Verify |
| Online Results | http://WIN-BA8RD5TJ8IG/CxWebClient/ViewerMain.aspx?scanid=1010007&projectid=10008&pathid=11 |
| Status | New |

| | Source | Destination |
|---|---|---|
| File | permafrost-engine/SDL_wave.c | permafrost-engine/SDL_wave.c |
| Line | 1266 | 1266 |
| Object | i | i |

Code Snippet
File Name permafrost-engine/SDL_wave.c
Method LAW_Decode(WaveFile *file, Uint8 **audio_buf, Uint32 *audio_len)

```
....
1266.               dst[i] = mulaw_lut[src[i]];
```

## Unchecked Return Value

Query Path:
CPP\Cx\CPP Low Visibility\Unchecked Return Value Version:1

### Categories

NIST SP 800-53: SI-11 Error Handling (P2)

*Description*

**Unchecked Return Value\Path 1:**

| | |
|---|---|
| Severity | Low |
| Result State | To Verify |

| | |
|---|---|
| Online Results | http://WIN-BA8RD5TJ8IG/CxWebClient/ViewerMain.aspx?scanid=1010007&projectid=10008&pathid=2 |
| Status | New |

The EXPORT method calls the strtok function, at line 110 of permafrost-engine/_ctypes_test.c. However, the code does not check the return value from this function, and thus would not detect runtime errors or other unexpected states.

| | Source | Destination |
|---|---|---|
| File | permafrost-engine/_ctypes_test.c | permafrost-engine/_ctypes_test.c |
| Line | 112 | 112 |
| Object | strtok | strtok |

Code Snippet
File Name permafrost-engine/_ctypes_test.c
Method EXPORT(char *)my_strtok(char *token, const char *delim)

```
....
112.      return strtok(token, delim);
```

**Unchecked Return Value\Path 2:**

| | |
|---|---|
| Severity | Low |
| Result State | To Verify |
| Online Results | http://WIN-BA8RD5TJ8IG/CxWebClient/ViewerMain.aspx?scanid=1010007&projectid=10008&pathid=3 |
| Status | New |

The main method calls the data function, at line 92 of permafrost-engine/alrecord.c. However, the code does not check the return value from this function, and thus would not detect runtime errors or other unexpected states.

| | Source | Destination |
|---|---|---|
| File | permafrost-engine/alrecord.c | permafrost-engine/alrecord.c |
| Line | 342 | 342 |
| Object | data | data |

Code Snippet
File Name permafrost-engine/alrecord.c
Method int main(int argc, char **argv)

```
....
342.              ALbyte *data = calloc(recorder.mFrameSize,
(ALuint)count);
```

## Use of Sizeof On a Pointer Type

Query Path:
CPP\Cx\CPP Low Visibility\Use of Sizeof On a Pointer Type Version:1

*Description*

**Use of Sizeof On a Pointer Type\Path 1:**

| | |
|---|---|
| Severity | Low |
| Result State | To Verify |
| Online Results | http://WIN-BA8RD5TJ8IG/CxWebClient/ViewerMain.aspx?scanid=1010007&projectid=10008&pathid=4 |
| Status | New |

| | Source | Destination |
|---|---|---|
| File | permafrost-engine/testgles.c | permafrost-engine/testgles.c |
| Line | 28 | 176 |
| Object | context | sizeof |

Code Snippet

File Name permafrost-engine/testgles.c

Method static SDL_GLContext *context = NULL;

```
....
28.  static SDL_GLContext *context = NULL;
```

File Name permafrost-engine/testgles.c

Method main(int argc, char *argv[])

```
....
176.      context = (SDL_GLContext *)SDL_calloc(state->num_windows,
sizeof(context));
```

**Use of Sizeof On a Pointer Type\Path 2:**

| | |
|---|---|
| Severity | Low |
| Result State | To Verify |
| Online Results | http://WIN-BA8RD5TJ8IG/CxWebClient/ViewerMain.aspx?scanid=1010007&projectid=10008&pathid=5 |
| Status | New |

| | Source | Destination |
|---|---|---|
| File | permafrost-engine/harness_argparser.c | permafrost-engine/harness_argparser.c |
| Line | 234 | 234 |
| Object | sizeof | sizeof |

Code Snippet

File Name permafrost-engine/harness_argparser.c

Method ParseConfig(char* file, SDLVisualTest_HarnessState* state)

```
....
234.          argv = (char**)SDL_malloc((num_params + 1) *
sizeof(char*));
```

## Potential Path Traversal

Query Path:
CPP\Cx\CPP Low Visibility\Potential Path Traversal Version:0

### Categories

OWASP Top 10 2013: A4-Insecure Direct Object References
OWASP Top 10 2017: A5-Broken Access Control

*Description*

**Potential Path Traversal\Path 1:**

| | |
|---|---|
| Severity | Low |
| Result State | To Verify |
| Online Results | http://WIN-BA8RD5TJ8IG/CxWebClient/ViewerMain.aspx?scanid=1010007&projectid=10008&pathid=1 |
| Status | New |

Method main at line 92 of permafrost-engine/alrecord.c gets user input from the argv element. This element's value then flows through the code and is eventually used in a file path for local disk access in main at line 92 of permafrost-engine/alrecord.c. This may cause a Path Traversal vulnerability.

| | Source | Destination |
|---|---|---|
| File | permafrost-engine/alrecord.c | permafrost-engine/alrecord.c |
| Line | 92 | 277 |
| Object | argv | fname |

Code Snippet
File Name permafrost-engine/alrecord.c
Method int main(int argc, char **argv)

```
....
92.  int main(int argc, char **argv)
....
277.      recorder.mFile = fopen(fname, "wb");
```

## Sizeof Pointer Argument

Query Path:
CPP\Cx\CPP Low Visibility\Sizeof Pointer Argument Version:0

*Description*

**Sizeof Pointer Argument\Path 1:**

| | |
|---|---|
| Severity | Low |
| Result State | To Verify |
| Online Results | http://WIN-BA8RD5TJ8IG/CxWebClient/ViewerMain.aspx?scanid=1010007&projectid=10008&pathid=8 |
| Status | New |

| | Source | Destination |
|---|---|---|
| File | permafrost-engine/testgles.c | permafrost-engine/testgles.c |
| Line | 176 | 176 |
| Object | context | sizeof |

Code Snippet
File Name permafrost-engine/testgles.c
Method main(int argc, char *argv[])

```
....
176.      context = (SDL_GLContext *)SDL_calloc(state->num_windows,
sizeof(context));
```

## Exposure of System Data to Unauthorized Control Sphere

Query Path:
CPP\Cx\CPP Low Visibility\Exposure of System Data to Unauthorized Control Sphere Version:1

### Categories

FISMA 2014: Configuration Management
NIST SP 800-53: AC-3 Access Enforcement (P1)

*Description*
**Exposure of System Data to Unauthorized Control Sphere\Path 1:**

| | |
|---|---|
| Severity | Low |
| Result State | To Verify |
| Online Results | http://WIN-BA8RD5TJ8IG/CxWebClient/ViewerMain.aspx?scanid=1010007&projectid=10008&pathid=58 |
| Status | New |

The system data read by main in the file permafrost-engine/alrecord.c at line 92 is potentially exposed by main found in permafrost-engine/alrecord.c at line 92.

| | Source | Destination |
|---|---|---|
| File | permafrost-engine/alrecord.c | permafrost-engine/alrecord.c |
| Line | 314 | 314 |
| Object | errno | fprintf |

Code Snippet
File Name permafrost-engine/alrecord.c
Method int main(int argc, char **argv)

```
....
314.          fprintf(stderr, "Error writing header: %s\n",
strerror(errno));
```

## TOCTOU

Query Path:
CPP\Cx\CPP Low Visibility\TOCTOU Version:1

*Description*

**TOCTOU\Path 1:**

| | |
|---|---|
| Severity | Low |
| Result State | To Verify |
| Online Results | http://WIN-BA8RD5TJ8IG/CxWebClient/ViewerMain.aspx?scanid=1010007&projectid=10008&pathid=59 |
| Status | New |

The main method in permafrost-engine/alrecord.c file utilizes fopen that is accessed by other concurrent functionality in a way that is not thread-safe, which may result in a Race Condition over this resource.

| | Source | Destination |
|---|---|---|
| File | permafrost-engine/alrecord.c | permafrost-engine/alrecord.c |
| Line | 277 | 277 |
| Object | fopen | fopen |

Code Snippet
File Name permafrost-engine/alrecord.c
Method int main(int argc, char **argv)

```
....
277.      recorder.mFile = fopen(fname, "wb");
```

# Buffer Overflow IndexFromInput

## Risk

**What might happen**

Buffer overflow attacks, in their various forms, could allow an attacker to control certain areas of memory. Typically, this is used to overwrite data on the stack necessary for the program to function properly, such as code and memory addresses, though other forms of this attack exist. Exploiting this vulnerability can generally lead to system crashes, infinite loops, or even execution of arbitrary code.

---

## Cause

**How does it happen**

Buffer Overflows can manifest in numerous different variations. In it's most basic form, the attack controls a buffer, which is then copied to a smaller buffer without size verification. Because the attacker's source buffer is larger than the program's target buffer, the attacker's data overwrites whatever is next on the stack, allowing the attacker to control program structures.
Alternatively, the vulnerability could be the result of improper bounds checking; exposing internal memory addresses outside of their valid scope; allowing the attacker to control the size of the target buffer; or various other forms.

---

## General Recommendations

**How to avoid it**

- Always perform proper bounds checking before copying buffers or strings.
- Prefer to use safer functions and structures, e.g. safe string classes over `char*`, `strncpy` over `strcpy`, and so on.

- Consistently apply tests for the size of buffers.
- Do not return variable addresses outside the scope of their variables.

## Source Code Examples

**CPP**
**Overflowing Buffers**

```
const int BUFFER_SIZE = 10;
char buffer[BUFFER_SIZE];

void copyStringToBuffer(char* inputString)
{
    strcpy(buffer, inputString);
}
```

**Checked Buffers**

```
const int BUFFER_SIZE = 10;
const int MAX_INPUT_SIZE = 256;
char buffer[BUFFER_SIZE];

void copyStringToBuffer(char* inputString)
{
    if (strnlen(inputString, MAX_INPUT_SIZE) < sizeof(buffer))
    {
        strncpy(buffer, inputString, sizeof(buffer));
    }
}
```

# MemoryFree on StackVariable

## Risk

**What might happen**

Undefined Behavior may result with a crash. Crashes may give an attacker valuable information about the system and the program internals. Furthermore, it may leave unprotected files (e.g memory) that may be exploited.

---

## Cause

**How does it happen**

Calling free() on a variable that was not dynamically allocated (e.g. malloc) will result with an Undefined Behavior.

---

## General Recommendations

**How to avoid it**

Use free() only on dynamically allocated variables in order to prevent unexpected behavior from the compiler.

---

## Source Code Examples

**CPP**

**Bad - Calling free() on a static variable**

```
void clean_up(){
  char temp[256];
  do_something();
  free(tmp);
  return;
}
```

**Good - Calling free() only on variables that were dynamically allocated**

```
void clean_up(){
  char *buff;
  buff = (char*) malloc(1024);
  free(buff);
  return;
}
```

# Wrong Size t Allocation

## Risk

### What might happen

Incorrect allocation of memory may result in unexpected behavior by either overwriting sections of memory with unexpected values. Under certain conditions where both an incorrect allocation of memory and the values being written can be controlled by an attacker, such an issue may result in execution of malicious code.

---

## Cause

### How does it happen

Some memory allocation functions require a size value to be provided as a parameter. The allocated size should be derived from the provided value, by providing the length value of the intended source, multiplied by the size of that length. Failure to perform the correct arithmetic to obtain the exact size of the value will likely result in the source overflowing its destination.

---

## General Recommendations

### How to avoid it

- Always perform the correct arithmetic to determine size.
- Specifically for memory allocation, calculate the allocation size from the allocation source:
    - Derive the size value from the length of intended source to determine the amount of units to be processed.
    - Always programmatically consider the size of the each unit and their conversion to memory units - for example, by using sizeof() on the unit's type.
    - Memory allocation should be a multiplication of the amount of units being written, times the size of each unit.

---

## Source Code Examples

### CPP

**Allocating and Assigning Memory without Sizeof Arithmetic**

```
int *ptr;
ptr = (int*)malloc(5);
for (int i = 0; i < 5; i++)
{
      ptr[i] = i * 2 + 1;
}
```

**Allocating and Assigning Memory with Sizeof Arithmetic**

```
int *ptr;
ptr = (int*)malloc(5 * sizeof(int));
```

```
for (int i = 0; i < 5; i++)
{
      ptr[i] = i * 2 + 1;
}
```

### Incorrect Arithmetic of Multi-Byte String Allocation

```
wchar_t * dest;
dest = (wchar_t *)malloc(wcslen(source) + 1); // Would not crash for a short "source"
wcscpy((wchar_t *)dest, source);
wprintf(L"Dest: %s\r\n", dest);
```

### Correct Arithmetic of Multi-Byte String Allocation

```
wchar_t * dest;
dest = (wchar_t *)malloc((wcslen(source) + 1) * sizeof(wchar_t));
wcscpy((wchar_t *)dest, source);
wprintf(L"Dest: %s\r\n", dest);
```

# Dangerous Functions

## Risk

### What might happen

Use of dangerous functions may expose varying risks associated with each particular function, with potential impact of improper usage of these functions varying significantly. The presence of such functions indicates a flaw in code maintenance policies and adherence to secure coding practices, in a way that has allowed introducing known dangerous code into the application.

---

## Cause

### How does it happen

A dangerous function has been identified within the code. Functions are often deemed dangerous to use for numerous reasons, as there are different sets of vulnerabilities associated with usage of such functions. For example, some string copy and concatenation functions are vulnerable to Buffer Overflow, Memory Disclosure, Denial of Service and more. Use of these functions is not recommended.

---

## General Recommendations

### How to avoid it

- Deploy a secure and recommended alternative to any functions that were identified as dangerous.
    - If no secure alternative is found, conduct further researching and testing to identify whether current usage successfully sanitizes and verifies values, and thus successfully avoids the use-cases for whom the function is indeed dangerous
- Conduct a periodical review of methods that are in use, to ensure that all external libraries and built-in functions are up-to-date and whose use has not been excluded from best secure coding practices.

---

## Source Code Examples

### CPP

### Buffer Overflow in gets()

```
int main()
{
	char buf[10];

	printf("Please enter your name: ");
	gets(buf); // veryveryverylongname
	if (buf == ACCEPTED_NAME)
	{
		// Do something
	}
	return 0;
}
```

### Safe reading from user

```
int main()
{
	char buf[10];

	printf("Please enter your name: ");
	fgets(buf, sizeof(buf), stdin); //setting the amount of bytes to read
	if (buf == ACCEPTED_NAME)
	{
		//Do something
	}
	return 0;
}
```

### Unsafe function for string copy

```
int main(int argc, char* argv[])
{
	char buf[10];
	strcpy(buf, argv[1]); // overflow occurs when len(argv[1]) > 10 bytes

	return 0;
}
```

### Safe string copy

```
int main(int argc, char* argv[])
{
	char buf[10];
	strncpy(buf, argv[1], sizeof(buf));
	buf[9]= '\0'; //strncpy doesn't NULL terminates

	return 0;
}
```

### Unsafe format string

```
int main(int argc, char* argv[])
{
	printf(argv[1]); // If argv[1] contains a format token, such as %s,%x or %d, will cause
an access violation
	return 0;
}
```

### Safe format string

```
int main(int argc, char* argv[])
{
      printf("%s", argv[1]); // Second parameter is not a formattable string
      return 0;
}
```

# Use of Zero Initialized Pointer

## Risk

### What might happen

A null pointer dereference is likely to cause a run-time exception, a crash, or other unexpected behavior.

---

## Cause

### How does it happen

Variables which are declared without being assigned will implicitly retain a null value until they are assigned. The null value can also be explicitly set to a variable, to ensure clear out its contents. Since null is not really a value, it may not have object variables and methods, and any attempt to access contents of a null object, instead of verifying it is set beforehand, will result in a null pointer dereference exception.

---

## General Recommendations

### How to avoid it

- For any variable that is created, ensure all logic flows between declaration and use assign a non-null value to the variable first.
- Enforce null checks on any received variable or object before it is dereferenced, to ensure it does not contain a null assigned to it elsewhere.
- Consider the need to assign null values in order to overwrite initialized variables. Consider reassigning or releasing these variables instead.

---

## Source Code Examples

### CPP

**Explicit NULL Dereference**

```
char * input = NULL;
printf("%s", input);
```

**Implicit NULL Dereference**

```
char * input;
printf("%s", input);
```

### Java

**Explicit Null Dereference**

```
Object o = null;
out.println(o.getClass());
```

# Potential Path Traversal

## Risk

### What might happen

An attacker could define any arbitrary file path for the application to use, potentially leading to:

- Stealing sensitive files, such as configuration or system files
- Overwriting files such as program binaries, configuration files, or system files
- Deleting critical files, causing a denial of service (DoS).

---

## Cause

### How does it happen

The application uses user input in the file path for accessing files on the application server's local disk. This enables an attacker to arbitrarily determine the file path.

---

## General Recommendations

### How to avoid it

1. Ideally, avoid depending on user input for file selection.
2. Validate all input, regardless of source. Validation should be based on a whitelist: accept only data fitting a specified structure, rather than reject bad patterns. Check for:
   - Data type
   - Size
   - Range
   - Format
   - Expected values
3. Accept user input only for the filename, not for the path and folders.
4. Ensure that file path is fully canonicalized.
5. Explicitly limit the application to using a designated folder that separate from the applications binary folder.
6. Restrict the privileges of the application's OS user to necessary files and folders. The application should not be able to write to the application binary folder, and should not read anything outside of the application folder and data folder.

---

## Source Code Examples

### CSharp

**Using unvalidated user input as the file name may enable the user to access arbitrary files on the server local disk**

```
public class PathTraversal
{
        private void foo(TextBox textbox1)
    {
                string fileNum = textbox1.Text;
                string path = "c:\files\file" + fileNum;
                FileStream f = new FileStream(path, FileMode.Open);
```

```
                byte[] output = new byte[10];
                f.Read(output,0, 10);
        }
}
```

**Potentially hazardous characters are removed from the user input before use**

```
public class PathTraversalFixed
{
        private void foo(TextBox textbox1)
    {
                string fileNum = textbox1.Text.Replace("\", "").Replace("..", "");
         string path = "c:\files\file" + fileNum;
                FileStream f = new FileStream(path, FileMode.Open);
                byte[] output = new byte[10];
                f.Read(output,0, 10);
        }
}
```

**Java**

**Using unvalidated user input as the file name may enable the user to access arbitrary files on the server local disk**

```
public class Absolute_Path_Traversal {
    public static void main(String[] args) {
        Scanner userInputScanner = new Scanner(System.in);
        System.out.print("\nEnter file name: ");
        String name = userInputScanner.nextLine();
        String path = "c:\files\file" + name;
        try {
            BufferedReader reader = new BufferedReader(new FileReader(path));
        } catch (Exception e) {
            e.printStackTrace();
        }
    }
}
```

**Potentially hazardous characters are removed from the user input before use**

```
public class Absolute_Path_Traversal_Fixed {
    public static void main(String[] args) {
        Scanner userInputScanner = new Scanner(System.in);
        System.out.print("\nEnter file name: ");
        String name = userInputScanner.nextLine();
        name = name.replace("/", "").replace("..", "");
        String path = "c:\files\file" + name;
        try {
            BufferedReader reader = new BufferedReader(new FileReader(path));
        } catch (Exception e) {
            e.printStackTrace();
        }
```

```
        }
    }
```

# Unchecked Return Value

## Risk

### What might happen

A program that does not check function return values could cause the application to enter an undefined state. This could lead to unexpected behavior and unintended consequences, including inconsistent data, system crashes or other error-based exploits.

---

## Cause

### How does it happen

The application calls a system function, but does not receive or check the result of this funciton. These functions often return error codes in the result, or share other status codes with it's caller. The application simply ignores this result value, losing this vital information.

---

## General Recommendations

### How to avoid it

- Always check the result of any called function that returns a value, and verify the result is an expected value.

- Ensure the calling function responds to all possible return values.

- Expect runtime errors and handle them gracefully. Explicitly define a mechanism for handling unexpected errors.

---

## Source Code Examples

### CPP

**Unchecked Memory Allocation**

```
buff = (char*) malloc(size);
strncpy(buff, source, size);
```

**Safer Memory Allocation**

```
buff = (char*) malloc(size+1);
if (buff==NULL) exit(1);

strncpy(buff, source, size);
buff[size] = '\0';
```

## Use of sizeof() on a Pointer Type

**Weakness ID:** 467 *(Weakness Variant)* **Status:** Draft

### Description

### Description Summary

The code calls sizeof() on a malloced pointer type, which always returns the wordsize/8. This can produce an unexpected result if the programmer intended to determine how much memory has been allocated.

### Time of Introduction

- Implementation

### Applicable Platforms

### Languages

C

C++

### Common Consequences

| Scope | Effect |
|---|---|
| Integrity | This error can often cause one to allocate a buffer that is much smaller than what is needed, leading to resultant weaknesses such as buffer overflows. |

### Likelihood of Exploit

High

### Demonstrative Examples

### Example 1

Care should be taken to ensure sizeof returns the size of the data structure itself, and not the size of the pointer to the data structure.

In this example, sizeof(foo) returns the size of the pointer.

*(Bad Code)*

*Example Languages:* **C and C++**

```
double *foo;
...
foo = (double *)malloc(sizeof(foo));
```

In this example, sizeof(*foo) returns the size of the data structure and not the size of the pointer.

*(Good Code)*

*Example Languages:* **C and C++**

```
double *foo;
...
foo = (double *)malloc(sizeof(*foo));
```

### Example 2

This example defines a fixed username and password. The AuthenticateUser() function is intended to accept a username and a password from an untrusted user, and check to ensure that it matches the username and password. If the username and password match, AuthenticateUser() is intended to indicate that authentication succeeded.

*(Bad Code)*

```
/* Ignore CWE-259 (hard-coded password) and CWE-309 (use of password system for authentication) for this example. */

char *username = "admin";
char *pass = "password";

int AuthenticateUser(char *inUser, char *inPass) {
```

```
printf("Sizeof username = %d\n", sizeof(username));
printf("Sizeof pass = %d\n", sizeof(pass));

if (strncmp(username, inUser, sizeof(username))) {
printf("Auth failure of username using sizeof\n");
return(AUTH_FAIL);
}
/* Because of CWE-467, the sizeof returns 4 on many platforms and architectures. */
if (! strncmp(pass, inPass, sizeof(pass))) {
printf("Auth success of password using sizeof\n");
return(AUTH_SUCCESS);
}
else {
printf("Auth fail of password using sizeof\n");
return(AUTH_FAIL);
}
}

int main (int argc, char **argv)
{
int authResult;

if (argc < 3) {
ExitError("Usage: Provide a username and password");
}
authResult = AuthenticateUser(argv[1], argv[2]);
if (authResult != AUTH_SUCCESS) {
ExitError("Authentication failed");
}
else {
DoAuthenticatedTask(argv[1]);
}
}
```

In AuthenticateUser(), because sizeof() is applied to a parameter with an array type, the sizeof() call might return 4 on many modern architectures. As a result, the strncmp() call only checks the first four characters of the input password, resulting in a partial comparison (CWE-187), leading to improper authentication (CWE-287).

Because of the partial comparison, any of these passwords would still cause authentication to succeed for the "admin" user:

*(Attack)*

```
pass5
passABCDEFGH
passWORD
```

Because only 4 characters are checked, this significantly reduces the search space for an attacker, making brute force attacks more feasible.

The same problem also applies to the username, so values such as "adminXYZ" and "administrator" will succeed for the username.

## Potential Mitigations

**Phase: Implementation**

Use expressions such as "sizeof(*pointer)" instead of "sizeof(pointer)", unless you intend to run sizeof() on a pointer type to gain some platform independence or if you are allocating a variable on the stack.

## Other Notes

The use of sizeof() on a pointer can sometimes generate useful information. An obvious case is to find out the wordsize on a platform. More often than not, the appearance of sizeof(pointer) indicates a bug.

## Weakness Ordinalities

| Ordinality | Description |
|---|---|
| Primary | *(where the weakness exists independent of other weaknesses)* |

## Relationships

| Nature | Type | ID | Name | View(s) this relationship pertains to |
|---|---|---|---|---|
| ChildOf | Category | 465 | Pointer Issues | **Development Concepts (primary)699** |
| ChildOf | Weakness Class | 682 | Incorrect Calculation | **Research Concepts (primary)1000** |
| ChildOf | Category | 737 | CERT C Secure Coding Section 03 - Expressions (EXP) | **Weaknesses Addressed by the CERT C Secure Coding Standard (primary)734** |
| ChildOf | Category | 740 | CERT C Secure Coding Section 06 - Arrays (ARR) | Weaknesses Addressed by the CERT C Secure Coding Standard734 |
| CanPrecede | Weakness Base | 131 | Incorrect Calculation of Buffer Size | Research Concepts1000 |

## Taxonomy Mappings

| Mapped Taxonomy Name | Node ID | Fit | Mapped Node Name |
|---|---|---|---|
| CLASP | | | Use of sizeof() on a pointer type |
| CERT C Secure Coding | ARR01-C | | Do not apply the sizeof operator to a pointer when taking the size of an array |
| CERT C Secure Coding | EXP01-C | | Do not take the size of a pointer to determine the size of the pointed-to type |

## White Box Definitions

A weakness where code path has:

1. end statement that passes an identity of a dynamically allocated memory resource to a sizeof operator
2. start statement that allocates the dynamically allocated memory resource

## References

Robert Seacord. "EXP01-A. Do not take the sizeof a pointer to determine the size of a type". <https://www.securecoding.cert.org/confluence/display/seccode/EXP01-A.+Do+not+take+the+sizeof+a+pointer+to+determine+the+size+of+a+type>.

## Content History

| Submissions | | | |
|---|---|---|---|
| **Submission Date** | **Submitter** | **Organization** | **Source** |
| | CLASP | | Externally Mined |
| **Modifications** | | | |
| **Modification Date** | **Modifier** | **Organization** | **Source** |
| 2008-07-01 | Eric Dalci | Cigital | External |
| | updated Time of Introduction | | |
| 2008-08-01 | | KDM Analytics | External |
| | added/updated white box definitions | | |
| 2008-09-08 | CWE Content Team | MITRE | Internal |
| | updated Applicable Platforms, Common Consequences, Relationships, Other Notes, Taxonomy Mappings, Weakness Ordinalities | | |
| 2008-11-24 | CWE Content Team | MITRE | Internal |
| | updated Relationships, Taxonomy Mappings | | |
| 2009-03-10 | CWE Content Team | MITRE | Internal |
| | updated Demonstrative Examples | | |
| 2009-12-28 | CWE Content Team | MITRE | Internal |
| | updated Demonstrative Examples | | |
| 2010-02-16 | CWE Content Team | MITRE | Internal |
| | updated Relationships | | |

BACK TO TOP

## Use of sizeof() on a Pointer Type

**Weakness ID:** 467 *(Weakness Variant)* **Status:** Draft

### Description

### Description Summary

The code calls sizeof() on a malloced pointer type, which always returns the wordsize/8. This can produce an unexpected result if the programmer intended to determine how much memory has been allocated.

### Time of Introduction

- Implementation

### Applicable Platforms

### Languages

C

C++

### Common Consequences

| Scope | Effect |
|---|---|
| Integrity | This error can often cause one to allocate a buffer that is much smaller than what is needed, leading to resultant weaknesses such as buffer overflows. |

### Likelihood of Exploit

High

### Demonstrative Examples

### Example 1

Care should be taken to ensure sizeof returns the size of the data structure itself, and not the size of the pointer to the data structure.

In this example, sizeof(foo) returns the size of the pointer.

*(Bad Code)*

*Example Languages:* **C and C++**

```
double *foo;
...
foo = (double *)malloc(sizeof(foo));
```

In this example, sizeof(*foo) returns the size of the data structure and not the size of the pointer.

*(Good Code)*

*Example Languages:* **C and C++**

```
double *foo;
...
foo = (double *)malloc(sizeof(*foo));
```

### Example 2

This example defines a fixed username and password. The AuthenticateUser() function is intended to accept a username and a password from an untrusted user, and check to ensure that it matches the username and password. If the username and password match, AuthenticateUser() is intended to indicate that authentication succeeded.

*(Bad Code)*

```
/* Ignore CWE-259 (hard-coded password) and CWE-309 (use of password system for authentication) for this example. */

char *username = "admin";
char *pass = "password";

int AuthenticateUser(char *inUser, char *inPass) {
```

```
printf("Sizeof username = %d\n", sizeof(username));
printf("Sizeof pass = %d\n", sizeof(pass));

if (strncmp(username, inUser, sizeof(username))) {
printf("Auth failure of username using sizeof\n");
return(AUTH_FAIL);
}
/* Because of CWE-467, the sizeof returns 4 on many platforms and architectures. */
if (! strncmp(pass, inPass, sizeof(pass))) {
printf("Auth success of password using sizeof\n");
return(AUTH_SUCCESS);
}
else {
printf("Auth fail of password using sizeof\n");
return(AUTH_FAIL);
}
}

int main (int argc, char **argv)
{
int authResult;

if (argc < 3) {
ExitError("Usage: Provide a username and password");
}
authResult = AuthenticateUser(argv[1], argv[2]);
if (authResult != AUTH_SUCCESS) {
ExitError("Authentication failed");
}
else {
DoAuthenticatedTask(argv[1]);
}
}
```

In AuthenticateUser(), because sizeof() is applied to a parameter with an array type, the sizeof() call might return 4 on many modern architectures. As a result, the strncmp() call only checks the first four characters of the input password, resulting in a partial comparison (CWE-187), leading to improper authentication (CWE-287).

Because of the partial comparison, any of these passwords would still cause authentication to succeed for the "admin" user:

*(Attack)*

```
pass5
passABCDEFGH
passWORD
```

Because only 4 characters are checked, this significantly reduces the search space for an attacker, making brute force attacks more feasible.

The same problem also applies to the username, so values such as "adminXYZ" and "administrator" will succeed for the username.

## Potential Mitigations

**Phase: Implementation**

Use expressions such as "sizeof(*pointer)" instead of "sizeof(pointer)", unless you intend to run sizeof() on a pointer type to gain some platform independence or if you are allocating a variable on the stack.

## Other Notes

The use of sizeof() on a pointer can sometimes generate useful information. An obvious case is to find out the wordsize on a platform. More often than not, the appearance of sizeof(pointer) indicates a bug.

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| ChildOf | Category | 740 | CERT C Secure Coding Section 06 - Arrays (ARR) | Weaknesses Addressed by the CERT C Secure Coding Standard734 |
| CanPrecede | Weakness Base | 131 | Incorrect Calculation of Buffer Size | Research Concepts1000 |

## Taxonomy Mappings

| Mapped Taxonomy Name | Node ID | Fit | Mapped Node Name |
|---|---|---|---|
| CLASP | | | Use of sizeof() on a pointer type |
| CERT C Secure Coding | ARR01-C | | Do not apply the sizeof operator to a pointer when taking the size of an array |
| CERT C Secure Coding | EXP01-C | | Do not take the size of a pointer to determine the size of the pointed-to type |

## White Box Definitions

A weakness where code path has:

1. end statement that passes an identity of a dynamically allocated memory resource to a sizeof operator
2. start statement that allocates the dynamically allocated memory resource

## References

Robert Seacord. "EXP01-A. Do not take the sizeof a pointer to determine the size of a type". <https://www.securecoding.cert.org/confluence/display/seccode/EXP01-A.+Do+not+take+the+sizeof+a+pointer+to+determine+the+size+of+a+type>.

## Content History

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| 2008-07-01 | Eric Dalci | Cigital | External |
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| 2009-03-10 | CWE Content Team | MITRE | Internal |
| | updated Demonstrative Examples | | |
| 2009-12-28 | CWE Content Team | MITRE | Internal |
| | updated Demonstrative Examples | | |
| 2010-02-16 | CWE Content Team | MITRE | Internal |
| | updated Relationships | | |

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## Improper Validation of Array Index

**Weakness ID:** 129 *(Weakness Base)* **Status:** Draft

### Description

## Description Summary

The product uses untrusted input when calculating or using an array index, but the product does not validate or incorrectly validates the index to ensure the index references a valid position within the array.

### Alternate Terms

**out-of-bounds array index**

**index-out-of-range**

**array index underflow**

### Time of Introduction

- Implementation

### Applicable Platforms

## Languages

C: *(Often)*

C++: *(Often)*

Language-independent

### Common Consequences

| Scope | Effect |
|---|---|
| Integrity<br>Availability | Unchecked array indexing will very likely result in the corruption of relevant memory and perhaps instructions, leading to a crash, if the values are outside of the valid memory area. |
| Integrity | If the memory corrupted is data, rather than instructions, the system will continue to function with improper values. |
| Confidentiality<br>Integrity | Unchecked array indexing can also trigger out-of-bounds read or write operations, or operations on the wrong objects; i.e., "buffer overflows" are not always the result. This may result in the exposure or modification of sensitive data. |
| Integrity | If the memory accessible by the attacker can be effectively controlled, it may be possible to execute arbitrary code, as with a standard buffer overflow and possibly without the use of large inputs if a precise index can be controlled. |
| Integrity<br>Availability<br>Confidentiality | A single fault could allow either an overflow (CWE-788) or underflow (CWE-786) of the array index. What happens next will depend on the type of operation being performed out of bounds, but can expose sensitive information, cause a system crash, or possibly lead to arbitrary code execution. |

### Likelihood of Exploit

High

### Detection Methods

**Automated Static Analysis**

This weakness can often be detected using automated static analysis tools. Many modern tools use data flow analysis or constraint-based techniques to minimize the number of false positives.

Automated static analysis generally does not account for environmental considerations when reporting out-of-bounds memory operations. This can make it difficult for users to determine which warnings should be investigated first. For example, an analysis tool might report array index errors that originate from command line arguments in a program that is not expected to run with setuid or other special privileges.

## *Effectiveness: High*

This is not a perfect solution, since 100% accuracy and coverage are not feasible.

**Automated Dynamic Analysis**

This weakness can be detected using dynamic tools and techniques that interact with the software using large test suites with many diverse inputs, such as fuzz testing (fuzzing), robustness testing, and fault injection. The software's operation may slow down, but it should not become unstable, crash, or generate incorrect results.

**Black Box**

Black box methods might not get the needed code coverage within limited time constraints, and a dynamic test might not produce any noticeable side effects even if it is successful.

## Demonstrative Examples

### Example 1

The following C/C++ example retrieves the sizes of messages for a pop3 mail server. The message sizes are retrieved from a socket that returns in a buffer the message number and the message size, the message number (num) and size (size) are extracted from the buffer and the message size is placed into an array using the message number for the array index.

*(Bad Code)*

*Example Language:* **C**

```
/* capture the sizes of all messages */
int getsizes(int sock, int count, int *sizes) {
...
char buf[BUFFER_SIZE];
int ok;
int num, size;

// read values from socket and added to sizes array
while ((ok = gen_recv(sock, buf, sizeof(buf))) == 0)
{

// continue read from socket until buf only contains '.'
if (DOTLINE(buf))
break;
else if (sscanf(buf, "%d %d", &num, &size) == 2)
sizes[num - 1] = size;
}
...
}
```

In this example the message number retrieved from the buffer could be a value that is outside the allowable range of indices for the array and could possibly be a negative number. Without proper validation of the value to be used for the array index an array overflow could occur and could potentially lead to unauthorized access to memory addresses and system crashes. The value of the array index should be validated to ensure that it is within the allowable range of indices for the array as in the following code.

*(Good Code)*

*Example Language:* **C**

```
/* capture the sizes of all messages */
int getsizes(int sock, int count, int *sizes) {
...
char buf[BUFFER_SIZE];
int ok;
int num, size;

// read values from socket and added to sizes array
while ((ok = gen_recv(sock, buf, sizeof(buf))) == 0)
{

// continue read from socket until buf only contains '.'
if (DOTLINE(buf))
```

```
break;
else if (sscanf(buf, "%d %d", &num, &size) == 2) {
if (num > 0 && num <= (unsigned)count)
sizes[num - 1] = size;
else
/* warn about possible attempt to induce buffer overflow */
report(stderr, "Warning: ignoring bogus data for message sizes returned by server.\n");
}
}
...
}
```

## Example 2

In the code snippet below, an unchecked integer value is used to reference an object in an array.

*(Bad Code)*

*Example Language:* **Java**

```
public String getValue(int index) {
return array[index];
}
```

If index is outside of the range of the array, this may result in an ArrayIndexOutOfBounds Exception being raised.

## Example 3

In the following Java example the method displayProductSummary is called from a Web service servlet to retrieve product summary information for display to the user. The servlet obtains the integer value of the product number from the user and passes it to the displayProductSummary method. The displayProductSummary method passes the integer value of the product number to the getProductSummary method which obtains the product summary from the array object containing the project summaries using the integer value of the product number as the array index.

*(Bad Code)*

*Example Language:* **Java**

```
// Method called from servlet to obtain product information
public String displayProductSummary(int index) {

String productSummary = new String("");

try {
String productSummary = getProductSummary(index);

} catch (Exception ex) {...}

return productSummary;
}

public String getProductSummary(int index) {
return products[index];
}
```

In this example the integer value used as the array index that is provided by the user may be outside the allowable range of indices for the array which may provide unexpected results or may comes the application to fail. The integer value used for the array index should be validated to ensure that it is within the allowable range of indices for the array as in the following code.

*(Good Code)*

*Example Language:* **Java**

```
// Method called from servlet to obtain product information
public String displayProductSummary(int index) {

String productSummary = new String("");
```

```
try {
String productSummary = getProductSummary(index);

} catch (Exception ex) {...}

return productSummary;
}

public String getProductSummary(int index) {
String productSummary = "";

if ((index >= 0) && (index < MAX_PRODUCTS)) {
productSummary = products[index];
}
else {
System.err.println("index is out of bounds");
throw new IndexOutOfBoundsException();
}

return productSummary;
}
```

An alternative in Java would be to use one of the collection objects such as ArrayList that will automatically generate an exception if an attempt is made to access an array index that is out of bounds.

*(Good Code)*

*Example Language:* **Java**

```
ArrayList productArray = new ArrayList(MAX_PRODUCTS);
...
try {
productSummary = (String) productArray.get(index);
} catch (IndexOutOfBoundsException ex) {...}
```

## Observed Examples

| Reference | Description |
|---|---|
| CVE-2005-0369 | large ID in packet used as array index |
| CVE-2001-1009 | negative array index as argument to POP LIST command |
| CVE-2003-0721 | Integer signedness error leads to negative array index |
| CVE-2004-1189 | product does not properly track a count and a maximum number, which can lead to resultant array index overflow. |
| CVE-2007-5756 | chain: device driver for packet-capturing software allows access to an unintended IOCTL with resultant array index error. |

## Potential Mitigations

**Phase: Architecture and Design**

### Strategies: Input Validation; Libraries or Frameworks

Use an input validation framework such as Struts or the OWASP ESAPI Validation API. If you use Struts, be mindful of weaknesses covered by the CWE-101 category.

**Phase: Architecture and Design**

For any security checks that are performed on the client side, ensure that these checks are duplicated on the server side, in order to avoid CWE-602. Attackers can bypass the client-side checks by modifying values after the checks have been performed, or by changing the client to remove the client-side checks entirely. Then, these modified values would be submitted to the server.

Even though client-side checks provide minimal benefits with respect to server-side security, they are still useful. First, they can support intrusion detection. If the server receives input that should have been rejected by the client, then it may be an indication of an attack. Second, client-side error-checking can provide helpful feedback to the user about the expectations for valid input. Third, there may be a reduction in server-side processing time for accidental input errors, although this is typically a small savings.

**Phase: Requirements**

### Strategy: Language Selection

Use a language with features that can automatically mitigate or eliminate out-of-bounds indexing errors.

For example, Ada allows the programmer to constrain the values of a variable and languages such as Java and Ruby will allow the programmer to handle exceptions when an out-of-bounds index is accessed.

**Phase: Implementation**

## Strategy: Input Validation

Assume all input is malicious. Use an "accept known good" input validation strategy (i.e., use a whitelist). Reject any input that does not strictly conform to specifications, or transform it into something that does. Use a blacklist to reject any unexpected inputs and detect potential attacks.

When accessing a user-controlled array index, use a stringent range of values that are within the target array. Make sure that you do not allow negative values to be used. That is, verify the minimum as well as the maximum of the range of acceptable values.

**Phase: Implementation**

Be especially careful to validate your input when you invoke code that crosses language boundaries, such as from an interpreted language to native code. This could create an unexpected interaction between the language boundaries. Ensure that you are not violating any of the expectations of the language with which you are interfacing. For example, even though Java may not be susceptible to buffer overflows, providing a large argument in a call to native code might trigger an overflow.

### Weakness Ordinalities

| Ordinality | Description |
|---|---|
| Resultant | The most common condition situation leading to unchecked array indexing is the use of loop index variables as buffer indexes. If the end condition for the loop is subject to a flaw, the index can grow or shrink unbounded, therefore causing a buffer overflow or underflow. Another common situation leading to this condition is the use of a function's return value, or the resulting value of a calculation directly as an index in to a buffer. |

### Relationships

| Nature | Type | ID | Name | View(s) this relationship pertains to |
|---|---|---|---|---|
| ChildOf | Weakness Class | 20 | Improper Input Validation | **Development Concepts (primary)699 Research Concepts (primary)1000** |
| ChildOf | Category | 189 | Numeric Errors | Development Concepts699 |
| ChildOf | Category | 633 | Weaknesses that Affect Memory | **Resource-specific Weaknesses (primary)631** |
| ChildOf | Category | 738 | CERT C Secure Coding Section 04 - Integers (INT) | **Weaknesses Addressed by the CERT C Secure Coding Standard (primary)734** |
| ChildOf | Category | 740 | CERT C Secure Coding Section 06 - Arrays (ARR) | Weaknesses Addressed by the CERT C Secure Coding Standard734 |
| ChildOf | Category | 802 | 2010 Top 25 - Risky Resource Management | **Weaknesses in the 2010 CWE/SANS Top 25 Most Dangerous Programming Errors (primary)800** |
| CanPrecede | Weakness Class | 119 | Failure to Constrain Operations within the Bounds of a Memory Buffer | Research Concepts1000 |
| CanPrecede | Weakness Variant | 789 | Uncontrolled Memory Allocation | Research Concepts1000 |
| PeerOf | Weakness Base | 124 | Buffer Underwrite ('Buffer Underflow') | Research Concepts1000 |

### Theoretical Notes

An improperly validated array index might lead directly to the always-incorrect behavior of "access of array using out-of-bounds index."

### Affected Resources

- Memory

### f Causal Nature

Explicit

### Taxonomy Mappings

| Mapped Taxonomy Name | Node ID | Fit | Mapped Node Name |
|---|---|---|---|
| CLASP | | | Unchecked array indexing |
| PLOVER | | | INDEX - Array index overflow |
| CERT C Secure Coding | ARR00-C | | Understand how arrays work |
| CERT C Secure Coding | ARR30-C | | Guarantee that array indices are within the valid range |
| CERT C Secure Coding | ARR38-C | | Do not add or subtract an integer to a pointer if the resulting value does not refer to a valid array element |
| CERT C Secure Coding | INT32-C | | Ensure that operations on signed integers do not result in overflow |

### Related Attack Patterns

| CAPEC-ID | Attack Pattern Name | *(CAPEC Version: 1.5)* |
|---|---|---|
| 100 | Overflow Buffers | |

### References

[REF-11] M. Howard and D. LeBlanc. "Writing Secure Code". Chapter 5, "Array Indexing Errors" Page 144. 2nd Edition. Microsoft. 2002.

### Content History

| Submissions | | | |
|---|---|---|---|
| **Submission Date** | **Submitter** | **Organization** | **Source** |
| | CLASP | | Externally Mined |
| **Modifications** | | | |
| **Modification Date** | **Modifier** | **Organization** | **Source** |
| 2008-07-01 | Sean Eidemiller | Cigital | External |
| | added/updated demonstrative examples | | |
| 2008-09-08 | CWE Content Team | MITRE | Internal |
| | updated Alternate Terms, Applicable Platforms, Common Consequences, Relationships, Other Notes, Taxonomy Mappings, Weakness Ordinalities | | |
| 2008-11-24 | CWE Content Team | MITRE | Internal |
| | updated Relationships, Taxonomy Mappings | | |
| 2009-01-12 | CWE Content Team | MITRE | Internal |
| | updated Common Consequences | | |
| 2009-10-29 | CWE Content Team | MITRE | Internal |
| | updated Description, Name, Relationships | | |
| 2009-12-28 | CWE Content Team | MITRE | Internal |
| | updated Applicable Platforms, Common Consequences, Observed Examples, Other Notes, Potential Mitigations, Theoretical Notes, Weakness Ordinalities | | |
| 2010-02-16 | CWE Content Team | MITRE | Internal |
| | updated Applicable Platforms, Demonstrative Examples, Detection Factors, Likelihood of Exploit, Potential Mitigations, References, Related Attack Patterns, Relationships | | |
| 2010-04-05 | CWE Content Team | MITRE | Internal |
| | updated Related Attack Patterns | | |
| **Previous Entry Names** | | | |
| **Change Date** | **Previous Entry Name** | | |
| 2009-10-29 | Unchecked Array Indexing | | |

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## Improper Access Control (Authorization)

**Weakness ID:** 285 *(Weakness Class)* **Status:** Draft

### Description

### Description Summary

The software does not perform or incorrectly performs access control checks across all potential execution paths.

### Extended Description

When access control checks are not applied consistently - or not at all - users are able to access data or perform actions that they should not be allowed to perform. This can lead to a wide range of problems, including information leaks, denial of service, and arbitrary code execution.

### Alternate Terms

| | |
|---|---|
| **AuthZ:** | "AuthZ" is typically used as an abbreviation of "authorization" within the web application security community. It is also distinct from "AuthC," which is an abbreviation of "authentication." The use of "Auth" as an abbreviation is discouraged, since it could be used for either authentication or authorization. |

### Time of Introduction

- Architecture and Design
- Implementation
- Operation

### Applicable Platforms

### Languages

Language-independent

### Technology Classes

Web-Server: *(Often)*

Database-Server: *(Often)*

### Modes of Introduction

A developer may introduce authorization weaknesses because of a lack of understanding about the underlying technologies. For example, a developer may assume that attackers cannot modify certain inputs such as headers or cookies.

Authorization weaknesses may arise when a single-user application is ported to a multi-user environment.

### Common Consequences

| Scope | Effect |
|---|---|
| Confidentiality | An attacker could read sensitive data, either by reading the data directly from a data store that is not properly restricted, or by accessing insufficiently-protected, privileged functionality to read the data. |
| Integrity | An attacker could modify sensitive data, either by writing the data directly to a data store that is not properly restricted, or by accessing insufficiently-protected, privileged functionality to write the data. |
| Integrity | An attacker could gain privileges by modifying or reading critical data directly, or by accessing insufficiently-protected, privileged functionality. |

### Likelihood of Exploit

High

### Detection Methods

**Automated Static Analysis**

Automated static analysis is useful for detecting commonly-used idioms for authorization. A tool may be able to analyze related configuration files, such as .htaccess in Apache web servers, or detect the usage of commonly-used authorization libraries.

Generally, automated static analysis tools have difficulty detecting custom authorization schemes. In addition, the software's design may include some functionality that is accessible to any user and does not require an authorization check; an automated technique that detects the absence of authorization may report false positives.

### *Effectiveness: Limited*

**Automated Dynamic Analysis**

Automated dynamic analysis may find many or all possible interfaces that do not require authorization, but manual analysis is required to determine if the lack of authorization violates business logic

**Manual Analysis**

This weakness can be detected using tools and techniques that require manual (human) analysis, such as penetration testing, threat modeling, and interactive tools that allow the tester to record and modify an active session.

Specifically, manual static analysis is useful for evaluating the correctness of custom authorization mechanisms.

### *Effectiveness: Moderate*

These may be more effective than strictly automated techniques. This is especially the case with weaknesses that are related to design and business rules. However, manual efforts might not achieve desired code coverage within limited time constraints.

## Demonstrative Examples

### Example 1

The following program could be part of a bulletin board system that allows users to send private messages to each other. This program intends to authenticate the user before deciding whether a private message should be displayed. Assume that LookupMessageObject() ensures that the $id argument is numeric, constructs a filename based on that id, and reads the message details from that file. Also assume that the program stores all private messages for all users in the same directory.

*(Bad Code)*

*Example Language:* **Perl**

```
sub DisplayPrivateMessage {
my($id) = @_;
my $Message = LookupMessageObject($id);
print "From: " . encodeHTML($Message->{from}) . "<br>\n";
print "Subject: " . encodeHTML($Message->{subject}) . "\n";
print "<hr>\n";
print "Body: " . encodeHTML($Message->{body}) . "\n";
}

my $q = new CGI;
# For purposes of this example, assume that CWE-309 and
# CWE-523 do not apply.
if (! AuthenticateUser($q->param('username'), $q->param('password'))) {
ExitError("invalid username or password");
}

my $id = $q->param('id');
DisplayPrivateMessage($id);
```

While the program properly exits if authentication fails, it does not ensure that the message is addressed to the user. As a result, an authenticated attacker could provide any arbitrary identifier and read private messages that were intended for other users.

One way to avoid this problem would be to ensure that the "to" field in the message object matches the username of the authenticated user.

## Observed Examples

| Reference | Description |
|---|---|
| CVE-2009-3168 | Web application does not restrict access to admin scripts, allowing authenticated users to reset administrative passwords. |

| | |
|---|---|
| CVE-2009-2960 | Web application does not restrict access to admin scripts, allowing authenticated users to modify passwords of other users. |
| CVE-2009-3597 | Web application stores database file under the web root with insufficient access control (CWE-219), allowing direct request. |
| CVE-2009-2282 | Terminal server does not check authorization for guest access. |
| CVE-2009-3230 | Database server does not use appropriate privileges for certain sensitive operations. |
| CVE-2009-2213 | Gateway uses default "Allow" configuration for its authorization settings. |
| CVE-2009-0034 | Chain: product does not properly interpret a configuration option for a system group, allowing users to gain privileges. |
| CVE-2008-6123 | Chain: SNMP product does not properly parse a configuration option for which hosts are allowed to connect, allowing unauthorized IP addresses to connect. |
| CVE-2008-5027 | System monitoring software allows users to bypass authorization by creating custom forms. |
| CVE-2008-7109 | Chain: reliance on client-side security (CWE-602) allows attackers to bypass authorization using a custom client. |
| CVE-2008-3424 | Chain: product does not properly handle wildcards in an authorization policy list, allowing unintended access. |
| CVE-2009-3781 | Content management system does not check access permissions for private files, allowing others to view those files. |
| CVE-2008-4577 | ACL-based protection mechanism treats negative access rights as if they are positive, allowing bypass of intended restrictions. |
| CVE-2008-6548 | Product does not check the ACL of a page accessed using an "include" directive, allowing attackers to read unauthorized files. |
| CVE-2007-2925 | Default ACL list for a DNS server does not set certain ACLs, allowing unauthorized DNS queries. |
| CVE-2006-6679 | Product relies on the X-Forwarded-For HTTP header for authorization, allowing unintended access by spoofing the header. |
| CVE-2005-3623 | OS kernel does not check for a certain privilege before setting ACLs for files. |
| CVE-2005-2801 | Chain: file-system code performs an incorrect comparison (CWE-697), preventing defauls ACLs from being properly applied. |
| CVE-2001-1155 | Chain: product does not properly check the result of a reverse DNS lookup because of operator precedence (CWE-783), allowing bypass of DNS-based access restrictions. |

## Potential Mitigations

**Phase: Architecture and Design**

Divide your application into anonymous, normal, privileged, and administrative areas. Reduce the attack surface by carefully mapping roles with data and functionality. Use role-based access control (RBAC) to enforce the roles at the appropriate boundaries.

Note that this approach may not protect against horizontal authorization, i.e., it will not protect a user from attacking others with the same role.

**Phase: Architecture and Design**

Ensure that you perform access control checks related to your business logic. These checks may be different than the access control checks that you apply to more generic resources such as files, connections, processes, memory, and database records. For example, a database may restrict access for medical records to a specific database user, but each record might only be intended to be accessible to the patient and the patient's doctor.

**Phase: Architecture and Design**

### Strategy: Libraries or Frameworks

Use a vetted library or framework that does not allow this weakness to occur or provides constructs that make this weakness

easier to avoid.

For example, consider using authorization frameworks such as the JAAS Authorization Framework and the OWASP ESAPI Access Control feature.

**Phase: Architecture and Design**

For web applications, make sure that the access control mechanism is enforced correctly at the server side on every page. Users should not be able to access any unauthorized functionality or information by simply requesting direct access to that page.

One way to do this is to ensure that all pages containing sensitive information are not cached, and that all such pages restrict access to requests that are accompanied by an active and authenticated session token associated with a user who has the required permissions to access that page.

**Phases: System Configuration; Installation**

Use the access control capabilities of your operating system and server environment and define your access control lists accordingly. Use a "default deny" policy when defining these ACLs.

## Relationships

| Nature | Type | ID | Name | View(s) this relationship pertains to |
|---|---|---|---|---|
| ChildOf | Category | 254 | Security Features | **Seven Pernicious Kingdoms (primary)700** |
| ChildOf | Weakness Class | 284 | Access Control (Authorization) Issues | **Development Concepts (primary)699 Research Concepts (primary)1000** |
| ChildOf | Category | 721 | OWASP Top Ten 2007 Category A10 - Failure to Restrict URL Access | **Weaknesses in OWASP Top Ten (2007) (primary)629** |
| ChildOf | Category | 723 | OWASP Top Ten 2004 Category A2 - Broken Access Control | **Weaknesses in OWASP Top Ten (2004) (primary)711** |
| ChildOf | Category | 753 | 2009 Top 25 - Porous Defenses | **Weaknesses in the 2009 CWE/SANS Top 25 Most Dangerous Programming Errors (primary)750** |
| ChildOf | Category | 803 | 2010 Top 25 - Porous Defenses | **Weaknesses in the 2010 CWE/SANS Top 25 Most Dangerous Programming Errors (primary)800** |
| ParentOf | Weakness Variant | 219 | Sensitive Data Under Web Root | **Research Concepts (primary)1000** |
| ParentOf | Weakness Base | 551 | Incorrect Behavior Order: Authorization Before Parsing and Canonicalization | **Development Concepts (primary)699** Research Concepts1000 |
| ParentOf | Weakness Class | 638 | Failure to Use Complete Mediation | Research Concepts1000 |
| ParentOf | Weakness Base | 804 | Guessable CAPTCHA | **Development Concepts (primary)699 Research Concepts (primary)1000** |

## Taxonomy Mappings

| Mapped Taxonomy Name | Node ID | Fit | Mapped Node Name |
|---|---|---|---|
| 7 Pernicious Kingdoms | | | Missing Access Control |
| OWASP Top Ten 2007 | A10 | CWE More Specific | Failure to Restrict URL Access |
| OWASP Top Ten 2004 | A2 | CWE More Specific | Broken Access Control |

## Related Attack Patterns

| CAPEC-ID | Attack Pattern Name | *(CAPEC Version: 1.5)* |
|---|---|---|
| 1 | Accessing Functionality Not Properly Constrained by ACLs | |
| 13 | Subverting Environment Variable Values | |

| | |
|---|---|
| 17 | Accessing, Modifying or Executing Executable Files |
| 87 | Forceful Browsing |
| 39 | Manipulating Opaque Client-based Data Tokens |
| 45 | Buffer Overflow via Symbolic Links |
| 51 | Poison Web Service Registry |
| 59 | Session Credential Falsification through Prediction |
| 60 | Reusing Session IDs (aka Session Replay) |
| 77 | Manipulating User-Controlled Variables |
| 76 | Manipulating Input to File System Calls |
| 104 | Cross Zone Scripting |

## References

NIST. "Role Based Access Control and Role Based Security". <http://csrc.nist.gov/groups/SNS/rbac/>.

[REF-11] M. Howard and D. LeBlanc. "Writing Secure Code". Chapter 4, "Authorization" Page 114; Chapter 6, "Determining Appropriate Access Control" Page 171. 2nd Edition. Microsoft. 2002.

## Content History

| Submissions | | | |
|---|---|---|---|
| **Submission Date** | **Submitter** | **Organization** | **Source** |
| | 7 Pernicious Kingdoms | | Externally Mined |
| **Modifications** | | | |
| **Modification Date** | **Modifier** | **Organization** | **Source** |
| 2008-07-01 | Eric Dalci | Cigital | External |
| | updated Time of Introduction | | |
| 2008-08-15 | | Veracode | External |
| | Suggested OWASP Top Ten 2004 mapping | | |
| 2008-09-08 | CWE Content Team | MITRE | Internal |
| | updated Relationships, Other Notes, Taxonomy Mappings | | |
| 2009-01-12 | CWE Content Team | MITRE | Internal |
| | updated Common Consequences, Description, Likelihood of Exploit, Name, Other Notes, Potential Mitigations, References, Relationships | | |
| 2009-03-10 | CWE Content Team | MITRE | Internal |
| | updated Potential Mitigations | | |
| 2009-05-27 | CWE Content Team | MITRE | Internal |
| | updated Description, Related Attack Patterns | | |
| 2009-07-27 | CWE Content Team | MITRE | Internal |
| | updated Relationships | | |
| 2009-10-29 | CWE Content Team | MITRE | Internal |
| | updated Type | | |
| 2009-12-28 | CWE Content Team | MITRE | Internal |
| | updated Applicable Platforms, Common Consequences, Demonstrative Examples, Detection Factors, Modes of Introduction, Observed Examples, Relationships | | |
| 2010-02-16 | CWE Content Team | MITRE | Internal |
| | updated Alternate Terms, Detection Factors, Potential Mitigations, References, Relationships | | |
| 2010-04-05 | CWE Content Team | MITRE | Internal |
| | updated Potential Mitigations | | |
| **Previous Entry Names** | | | |
| **Change Date** | **Previous Entry Name** | | |
| 2009-01-12 | Missing or Inconsistent Access Control | | |

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# Exposure of System Data to Unauthorized Control Sphere

## Risk

### What might happen

System data can provide attackers with valuable insights on systems and services they are targeting - any type of system data, from service version to operating system fingerprints, can assist attackers to hone their attack, correlate data with known vulnerabilities or focus efforts on developing new attacks against specific technologies.

---

## Cause

### How does it happen

System data is read and subsequently exposed where it might be read by untrusted entities.

---

## General Recommendations

### How to avoid it

Consider the implications of exposure of the specified input, and expected level of access to the specified output. If not required, consider removing this code, or modifying exposed information to exclude potentially sensitive system data.

---

## Source Code Examples

### Java

**Leaking Environment Variables in JSP Web-Page**

```
String envVarValue = System.getenv(envVar);
if (envVarValue == null) {
    out.println("Environment variable is not defined:");
    out.println(System.getenv());
} else {
    //[..]
};
```

# TOCTOU

## Risk

### What might happen

At best, a Race Condition may cause errors in accuracy, overidden values or unexpected behavior that may result in denial-of-service. At worst, it may allow attackers to retrieve data or bypass security processes by replaying a controllable Race Condition until it plays out in their favor.

---

## Cause

### How does it happen

Race Conditions occur when a public, single instance of a resource is used by multiple concurrent logical processes. If the these logical processes attempt to retrieve and update the resource without a timely management system, such as a lock, a Race Condition will occur.

An example for when a Race Condition occurs is a resource that may return a certain value to a process for further editing, and then updated by a second process, resulting in the original process' data no longer being valid. Once the original process edits and updates the incorrect value back into the resource, the second process' update has been overwritten and lost.

---

## General Recommendations

### How to avoid it

When sharing resources between concurrent processes across the application ensure that these resources are either thread-safe, or implement a locking mechanism to ensure expected concurrent activity.

---

## Source Code Examples

### Java

**Different Threads Increment and Decrement The Same Counter Repeatedly, Resulting in a Race Condition**

```
	public static int counter = 0;
	public static void start() throws InterruptedException {
		incrementCounter ic;
		decrementCounter dc;
		while(counter == 0) {
			counter = 0;
			ic = new incrementCounter();
			dc = new decrementCounter();
			ic.start();
			dc.start();
			ic.join();
			dc.join();
		}
		System.out.println(counter); //Will stop and return either -1 or 1 due to race condition over counter
	}

	public static class incrementCounter extends Thread {
	    public void run() {
		counter++;
	    }
```

```
}

public static class decrementCounter extends Thread {
    public void run() {
       counter--;
    }
}
```

**Different Threads Increment and Decrement The Same Thread-Safe Counter Repeatedly, Never Resulting in a Race Condition**

```
public static int counter = 0;
public static Object lock = new Object();

public static void start() throws InterruptedException {
       incrementCounter ic;
       decrementCounter dc;
       while(counter == 0) { // because of proper locking, this condition is never false
              counter = 0;
              ic = new incrementCounter();
              dc = new decrementCounter();
              ic.start();
              dc.start();
              ic.join();
              dc.join();
       }
       System.out.println(counter); // Never reached
}

public static class incrementCounter extends Thread {
    public void run() {
       synchronized (lock) {
              counter++;
       }
    }
}

public static class decrementCounter extends Thread {
    public void run() {
       synchronized (lock) {
              counter--;
       }
    }
}
```

## Scanned Languages

| Language | Hash Number | Change Date |
|---|---|---|
| CPP | 4541647240435660 | 6/19/2024 |
| Common | 0105849645654507 | 6/19/2024 |