

Closed Bug 1929156 (CVE-2025-0239) Opened 1 year ago Closed 1 year ago

Only the first Alt-Svc ALPN negotiation is verified

▼ Categories

Product: Core ▼

Component: Networking ▼

Type:  defect

Priority: P1 Severity: S2

▼ Tracking

Status: VERIFIED FIXED

Milestone: 135 Branch

Tracking Flags:

	Tracking	Status
firefox-esr115	-	wontfix
firefox-esr128	134+	verified
firefox133	---	wontfix
firefox134	+	verified
firefox135	+	verified

► **People** (Reporter: pspaul95+bugzilla, Assigned: valentin)

► **References**

► **Details** (Keywords: csectype-sop, reporter-external, sec-moderate, Whiteboard: [client-bounty-form][necko-triaged][necko-priority-queue][adv-main134+][adv-ESR128.6+])

▼ Attachments

alt-svc-reproducer.zip
1 year ago **Frederik Braun [:freddy]**
7.78 KB, application/zip

[Details](#)

Bug 1929156 - Check negotiated ALPN matches altSvc protocol r=#necko
1 year ago **Valentin Gosu [:valentin]**
48 bytes, text/x-phabricator-request

tjr : **sec-approval+**

[Details](#) | [Review](#)

Bug 1929156 - Test that ALPN token is checked r=#necko
1 year ago **Valentin Gosu [:valentin]**
48 bytes, text/x-phabricator-request

[Details](#) | [Review](#)

Bug 1929156 - Check negotiated ALPN matches altSvc protocol r=#necko
1 year ago **Valentin Gosu [:valentin]**
48 bytes, text/x-phabricator-request

phab-bot : **approval-mozilla-beta+**

[Details](#) | [Review](#)

Terminal output Win11, macOS13, Ubuntu22.04.txt
1 year ago **Bianca Hidecuti, Desktop Test Engineering [:bhidecuti]**
1.86 KB, text/plain

[Details](#)

Accept All Cookies

Bug 1929156 - Check negotiated ALPN matches altSvc protocol r=#neckophab-bot : **approval-mozilla-esr128+**[Details](#) | [Review](#)1 year ago **Valentin Gosu [:valentin]**

48 bytes, text/x-phabricator-request

advisory.txt[Details](#)1 year ago **Frederik Braun [:freddy]**

187 bytes, text/plain

Bottom ↓

Tags ▼

Timeline ▼

**pspaul**

Reporter

Description • 1 year ago

Version: Firefox 131.0.3 (64-bit)

OS: Manjaro Linux 24.11

How was this issue discovered?

Manual testing. I was researching cross-protocol attacks using the Alt-Svc header when I found this bypass.

General Description:

The Alt-Svc spec's section 2.4 (<https://httpwg.org/specs/rfc7838.html#switching>) mandates that the browser verifies that the alternative service negotiates the correct protocol, for example via ALPN:

If the connection to the alternative service does not negotiate the expected protocol (for example, ALPN fails to negotiate h2, or an Upgrade request to h2c is not accepted), the connection to the alternative service MUST be considered to have failed.

Firefox only verifies this for the first connection but not for subsequent ones. Therefore, a Man-in-the-Middle attacker can bypass the ALPN check by forwarding the first connection to a valid server, closing the connection after some time, and forwarding all subsequent requests to a different server.

The PoC demonstrates this by running three TLS servers, all using the same certificate:

- HTTP/1.1 on port :8443 (ALPN offers http1.1)
- HTTP/2 on port :8444 (ALPN offers h2)
- Plain TLS on port :8445 (ALPN list is empty)

Firefox should never use the alternative service "h2=" :8445" because ALPN will not negotiate h2 .

However, by forwarding the first request to :8444 , which correctly negotiates h2 , Firefox can be tricked into trusting all later connections.

Steps to reproduce:

1. Start the PoC: `node server.js`

2. Add `127.0.0.1 foo.example.com` to your `/etc/hosts` file

3. Visit `https://foo.example.com:8443/?alt-svc=:1337` in Firefox

4. Accept the self-signed certificate warning (or replace `privkey.pem` and `fullchain.pem` with valid certificates before step 1)
5. Now the following should happen:
 - i. The page will first be served via HTTP/1.1 over TLS from `:8443`, delivering the `Alt-Svc: h2=":1337"` header
 - ii. After 1 second, the page refreshes, causing the browser to make the first connection to the attacker's alternative service on `:1337`
 - iii. The attacker forwards this first request to the legitimate HTTP/2 server on `:8444`
 - iv. The new page loads, showing that it was loaded via HTTP/2
 - v. The attacker now closes the forwarded connection between the browser and the HTTP/2 server
 - vi. The page then refreshes again, causing the browser to open a new connection to the attacker on `:1337`
 - vii. The attacker now forwards the request to the invalid TLS server at `:8445`
 - viii. The page loads, showing that it was loaded from `:8445`, which shouldn't happen

The PoC script's output should demonstrate the same:

```
[h1] GET /?alt-svc=:1337
[attacker] Forwarding to h2 (:8444)
[h1] GET /favicon.ico
[h2] GET /?refresh
[attacker] Terminating first connection
[attacker] Forwarding to plain (:8445)
[plain] Got connection
[plain] Got data: GET / HTTP/1.1
[plain] Got data: Host: foo.example.com:8443
[plain] Got data: User-Agent: Mozilla/5.0 (X11; Linux x86_64; rv:131.0) Gecko/201001
...
```

I also recorded a demo of the PoC, I hope you enjoy it ;)

Root cause analysis:

I'm not very familiar with the Firefox code base, but it looks like

`TRRServiceChannel::BeginConnect()` is consulting the Alt-Svc cache here:

<https://searchfox.org/mozilla-central/rev/387f3edbef37d31b2e91fb0812c74b54729e86ff/netwerk/protocol/http/TRRServiceChannel.cpp#405-407>

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If there's a matching entry, it means that the alternative service was previously validated, and Firefox connects to the `mConnectionInfo` from the cache entry instead of the original one.

I think the problem here is that the Alt-Svc cache holds the validation state. To me, the spec sounds like each new TLS connection needs to do the validation individually to prevent a Man-in-the-Middle attacker

from switching the destination server at some point.

Flags: sec-bounty?



Frederik Braun [:freddy]

Comment 1 • 1 year ago

Attached file [alt-svc-reproducer.zip](#) — [Details](#)

Looks like the attachment did not make it through yet. Submitting for pspaul.



Frederik Braun [:freddy]

Comment 2 • 1 year ago

[Profile when running the test case](#)



Andrew McCreight [:mccr8]

Updated • 1 year ago

Group: [firefox-core-security](#) → [network-core-security](#)

Component: [Security](#) → [Networking](#)

Product: [Firefox](#) → [Core](#)



Valentin Gosu [:valentin]

Assignee

Comment 3 • 1 year ago

Attached file [Bug 1929156 - Check negotiated ALPN matches altSvc protocol r=#necko](#) — [Details](#)



Daniel Veditz [:dveditz]

Updated • 1 year ago

Status: [UNCONFIRMED](#) → [NEW](#)

Ever confirmed: true

Keywords: [csectype-sop](#), [sec-high](#)



Valentin Gosu [:valentin]

Assignee

Updated • 1 year ago

Severity: -- → S2

Priority: -- → P1

Whiteboard: [\[client-bounty-form\]](#) → [\[client-bounty-form\]\[necko-triaged\]](#)



Valentin Gosu [:valentin]

Assignee

Updated • 1 year ago

Assignee: nobody → valentin.gosu



Greg Hess

Updated • 1 year ago

Whiteboard: [client-bounty-form][necko-triaged] → [client-bounty-form][necko-triaged][necko-priority-queue]

**Phabricator Automation**

Updated • 1 year ago

[Attachment #9435935](#) - Attachment description: WIP: Bug 1929156 - Check negotiated ALPN matches altSvc protocol r=#necko
→ Bug 1929156 - Check negotiated ALPN matches altSvc protocol r=#necko

**Valentin Gosu [:valentin]**

Assignee

Comment 4 • 1 year ago

Attached file [Bug 1929156 - Test that ALPN token is checked r=#necko](#) — Details**Valentin Gosu [:valentin]**

Assignee

Comment 5 • 1 year ago

Comment on [attachment 9435935 \[details\]](#)[Bug 1929156](#) - Check negotiated ALPN matches altSvc protocol r=#necko

Security Approval Request

- **How easily could an exploit be constructed based on the patch?:** Relatively easily.
- **Do comments in the patch, the check-in comment, or tests included in the patch paint a bulls-eye on the security problem?:** Yes
- **Which branches (beta, release, and/or ESR) are affected by this flaw, and do the release status flags reflect this affected/unaffected state correctly?:** all
- **If not all supported branches, which bug introduced the flaw?:** None
- **Do you have backports for the affected branches?:** Yes
- **If not, how different, hard to create, and risky will they be?:** Applies cleanly to all branches
- **How likely is this patch to cause regressions; how much testing does it need?:** Unlikely to cause regressions.
- **Is the patch ready to land after security approval is given?:** Yes
- **Is Android affected?:** Yes

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[Attachment #9435935](#) - Flags: sec-approval?

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Do I understand correctly that exploiting this would require an unusual server configuration that is likely extremely uncommon?

Flags: needinfo?(valentin.gosu)



Valentin Gosu [:valentin]

Assignee

Comment 7 • 1 year ago

(In reply to Tom Ritter [:tjr] from [comment #6](#))

Do I understand correctly that exploiting this would require an unusual server configuration that is likely extremely uncommon?

Yes, the original server needs to provide an alt-svc directing the browser to a port it doesn't control. And even so, TLS is still required, so I'm not sure how much damage the attacker could do.

Flags: needinfo?(valentin.gosu)



Tom Ritter [:tjr]

Comment 8 • 1 year ago

Comment on [attachment 9435935 \[details\]](#)

[Bug 1929156](#) - Check negotiated ALPN matches altSvc protocol r=#necko

Approved to land and uplift

[Attachment #9435935](#) - Flags: sec-approval? → sec-approval+



Ryan VanderMeulen [:RyanVM]

Updated • 1 year ago

status-firefox133: --- → wontfix
status-firefox134: --- → affected
status-firefox135: --- → affected
status-firefox-esr115: --- → affected
status-firefox-esr128: --- → affected
tracking-firefox134: --- → +
tracking-firefox135: --- → +
tracking-firefox-esr115: --- → 134+
tracking-firefox-esr128: --- → 134+



Pulsebot

Comment 9 • 1 year ago

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Pushed by [valentin.gosu@gmail.com](#):

<https://hg.mozilla.org/integration/autoland/rev/db100843b0f0>

Check negotiated ALPN matches altSvc protocol r=necko-reviewers,kershaw



Sebastian Hengst [:aryx] (needinfo me if it's about an intermittent or backout)

Comment 10 • 1 year ago

<https://hg.mozilla.org/mozilla-central/rev/db100843b0f0>

Status: NEW → RESOLVED

Closed: 1 year ago

[status-firefox135: affected](#) → [fixed](#)

Resolution: --- → FIXED

Target Milestone: --- → 135 Branch



Valentin Gosu [:valentin]

Assignee

Comment 11 • 1 year ago

Attached file [Bug 1929156 - Check negotiated ALPN matches altSvc protocol r=#necko](#) — [Details](#)

Original Revision: <https://phabricator.services.mozilla.com/D228217>



Phabricator Automation

Updated • 1 year ago

[Attachment #9441550](#) - Flags: approval-mozilla-beta?



Ryan VanderMeulen [:RyanVM]

Updated • 1 year ago

Group: network-core-security → core-security-release



Phabricator Automation

Comment 12 • 1 year ago

beta Uplift Approval Request

- **User impact if declined:** An attacker could make Firefox use a different protocol than the one specified in the ALPN header.
- **Code covered by automated testing:** yes
- **Fix verified in Nightly:** yes
- **Needs manual QE test:** yes
- **Steps to reproduce for manual QE testing:** see [comment-0](#)
- **Risk associated with taking this patch:** medium
- **Explanation of risk level:** Our code coverage for this isn't great. I'm not 100% sure our ALPN negotiation doesn't have any bugs that would cause us to fail loading websites in specific circumstances.
- **String changes made/needed:** none
- **Is Android affected?:** yes

Flags: qe-verify+ [Help us improve your Bugzilla@mozilla experience](#)



Daniel Veditz [:dveditz]

Comment 13 • 1 year ago

I misunderstood this as a certificate check bypass. Lowering to sec-moderate

Keywords: [sec-high](#) → [sec-moderate](#)



Daniel Veditz [:dveditz]

Updated • 1 year ago

—

Flags: [sec-bounty?](#) → [sec-bounty+](#)



Mihai Boldan, Desktop QA [:mboldan]

Updated • 1 year ago

—

QA Whiteboard: [\[qa-triaged\]](#)



Phabricator Automation

Updated • 1 year ago

—

[Attachment #9441550](#) - Flags: [approval-mozilla-beta?](#) → [approval-mozilla-beta+](#)



Pulsebot

Comment 14 • 1 year ago

—

[uplift](#)

<https://hg.mozilla.org/releases/mozilla-beta/rev/34b0d8d04644>



Lando Automation

Updated • 1 year ago

—

[status-firefox134: affected](#) → [fixed](#)



Bianca Hidecuti, Desktop Test Engineering [:bhidecuti]

Comment 15 • 1 year ago

—

Attached file [Terminal output Win11, macOS13, Ubuntu22.04.txt](#) — [Details](#)

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I was able to reproduce the issue on Firefox 131.0.3 using Windows 11, macOS 13.6 and Ubuntu 22.04, as described in [Comment 0](#).

Verified this with Firefox Nightly 135.0a1 (2024-12-05) and with Firefox 134.0b7 (treeherder build from [Comment 14](#)) on the previously mentioned OSES and after accessing <https://foo.example.com:8443/?alt-svc=:1337>, the browser traffic is redirected as follows:

- from ALPN=http/1.1 (:8443) to ALPN=h2 (:8444) and then back to ALPN=http/1.1 (:8443).

Regarding the terminal/cmd output, we noticed that when the attacker executes "[attacker] Forwarding to plain (:8445)", the process is automatically interrupted on the fixed builds:

- either the server shuts down (on macOS/Windows)
- or logs stop appearing (on Ubuntu).

I will attach a file with the script output. @valentin, could you please take a look at the output and let us know if the results are as expected? Thank you in advance!

Flags: needinfo?(valentin.gosu)



Valentin Gosu [:valentin]

Assignee

Comment 16 • 1 year ago

Thank you, Bianca. That is the expected behaviour.

Flags: needinfo?(valentin.gosu)



Bianca Hidecuti, Desktop Test Engineering [:bhidecuti]

Comment 17 • 1 year ago

Thank you for the confirmation!

Based on [Comment 15](#) and 16 I am marking this verified as fixed on the previously mentioned versions.

status-firefox134: fixed → verified

status-firefox135: fixed → verified

Flags: ~~qe-verify~~+



Ryan VanderMeulen [:RyanVM]

Comment 18 • 1 year ago

Please nominate this for ESR128 approval also.

status-firefox-esr115: affected → wontfix

tracking-firefox-esr115: 134+ →

Flags: needinfo?(valentin.gosu)



Valentin Gosu [:valentin]

Assignee

Comment 19 • 1 year ago

Attached file [Bug 1929156 - Check negotiated ALPN matches altSvc protocol r=#necko](#) — [Details](#)

Original Revision: <https://phabricator.services.mozilla.com/D228217>



Phabricator Automation

Updated • 1 year ago



[Attachment #9443469](#) - Flags: approval-mozilla-esr128?



Phabricator Automation

Comment 20 • 1 year ago



esr128 Uplift Approval Request

- **User impact if declined:** An attacker could make Firefox use a different protocol than the one specified in the ALPN header.
- **Code covered by automated testing:** yes
- **Fix verified in Nightly:** yes
- **Needs manual QE test:** yes
- **Steps to reproduce for manual QE testing:** see [comment 0](#)
- **Risk associated with taking this patch:** medium
- **Explanation of risk level:** Our code coverage for this isn't great. I'm not 100% sure our ALPN negotiation doesn't have any bugs that would cause us to fail loading websites in specific circumstances.
- **String changes made/needed:** none
- **Is Android affected?:** yes

Flags: qe-verify+



Phabricator Automation

Updated • 1 year ago



[Attachment #9443469](#) - Flags: approval-mozilla-esr128? → approval-mozilla-esr128+



Pulsebot

Comment 21 • 1 year ago



uplift

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Lando Automation

Updated • 1 year ago



[status-firefox-esr128: affected](#) → [fixed](#)



Valentin Gosu [:valentin]

Assignee

Updated • 1 year ago

Flags: needinfo?(valentin.gosu)



Bianca Hidecuti, Desktop Test Engineering [:bhidecuti]

Comment 22 • 1 year ago

Verified as fixed on Firefox 128.6.0esr, build ID 20241213173517 (treeherder build from [Comment 21](#)), using Windows 11, macOS 13.6 and Ubuntu 22.04.

Status: RESOLVED → VERIFIED

[status-firefox-esr128: fixed](#) → [verified](#)

Flags: ~~qe-verify~~+



Frederik Braun [:freddy]

Updated • 1 year ago

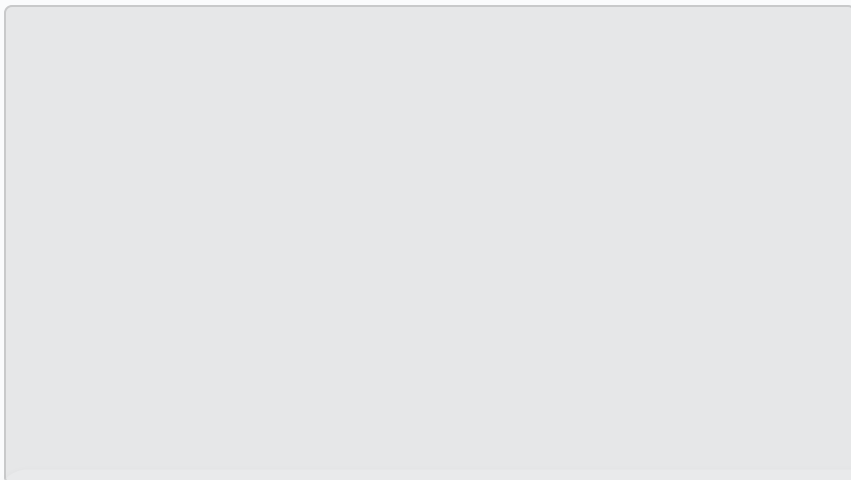
Whiteboard: [client-bounty-form][necko-triaged][necko-priority-queue] → [client-bounty-form][necko-triaged][necko-priority-queue][adv-main134+][adv-ESR128.6+]



Frederik Braun [:freddy]

Comment 23 • 1 year ago

Attached file [advisory.txt](#) — [Details](#)



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Frederik Braun [:freddy]

Updated • 1 year ago

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Ryan VanderMeulen [:RyanVM]

Updated • 1 year ago

Regressions: [1940508](#)

**Tom Schuster**

Updated • 1 year ago

—

Regressions: [1943011](#)**Valentin Gosu [:valentin]**

Assignee

Updated • 1 year ago

—

See Also: → [1943911](#)**pspaul**

Reporter

Comment 24 • 1 year ago

—

Hey, thanks for taking care of this bug and thanks for the bounty!

I would like to publish a blog post about this bug, is there any embargo period I have to take into account or could I publish it right away?

Thanks!

**Frederik Braun [:freddy]**

Comment 25 • 1 year ago

—

This was fixed last release (~4 weeks ago). We generally wait about six weeks to make sure that even users in the more remote parts of the world had the opportunity to upgrade. If possible, I would like you to wait you for another two weeks.

**pspaul**

Reporter

Comment 26 • 1 year ago

—

Sounds good to me! I'll publish it in two weeks then.

**Daniel Veditz [:dveditz]**

Updated • 10 months ago

—

Group: ~~core-security-release~~

You need to [log in](#) before you can comment on or make changes to this bug.

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