Account Takeover due to DNS Rebinding

Account Takeover due to DNS Rebinding - Yashar Shahinzadeh, Voorivex.

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Content

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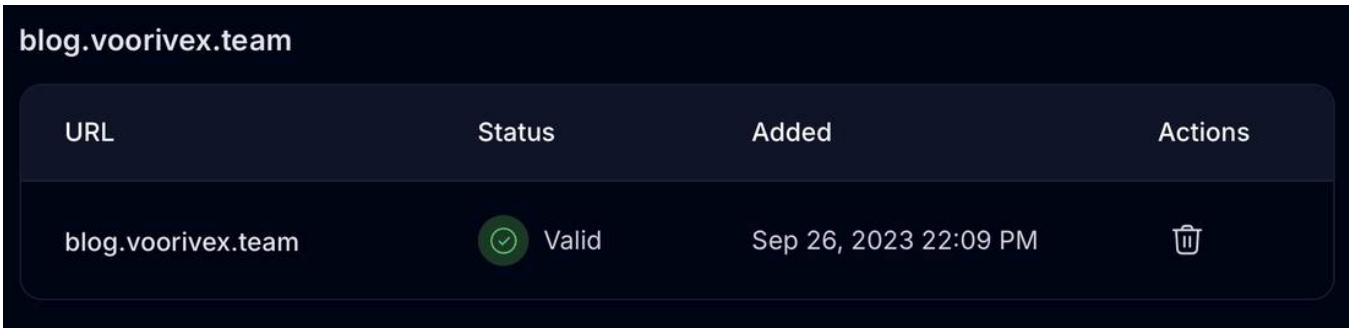
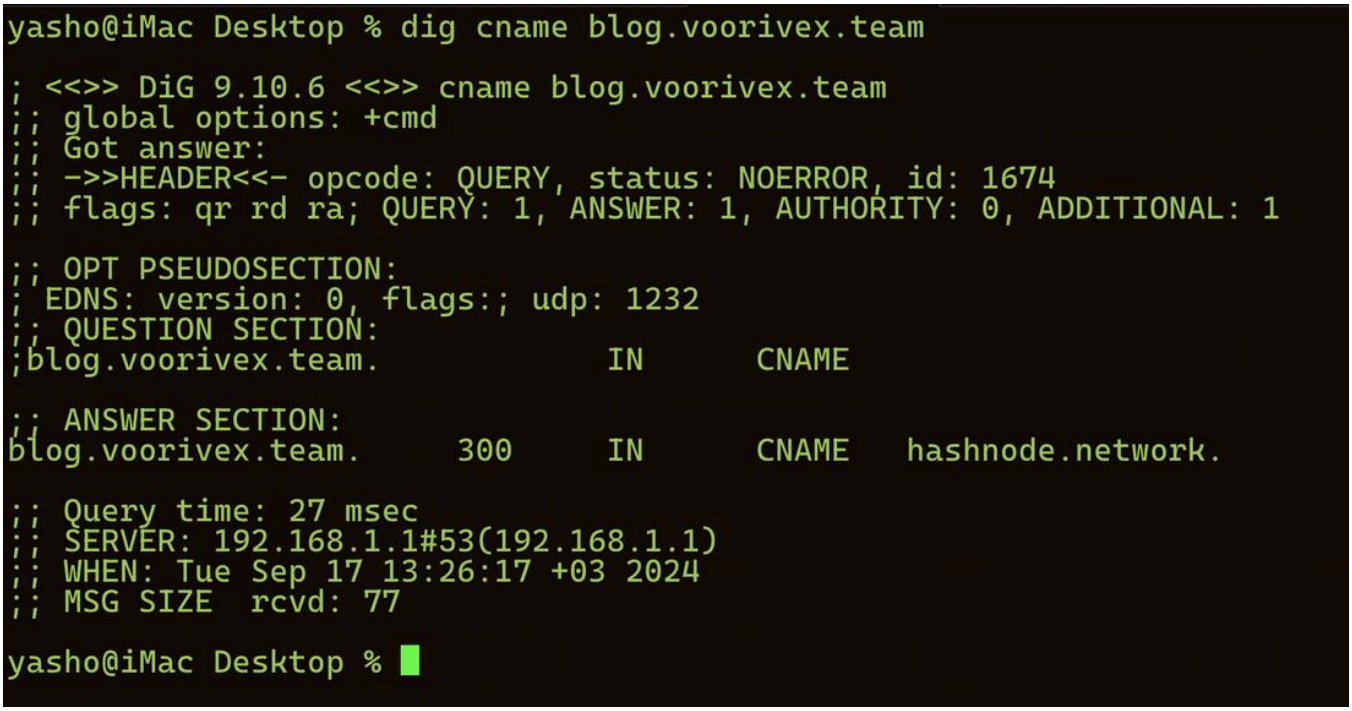
All posts

The first eye-catching feature in Hashnode is cross-domain authentication. Personally, when I hunt, I always look for authentication class vulnerabilities, which I'm stronger in, especially when an authentication token is transferring among different places. Hashnode has an option for blog owners to have their own domain, as you are reading this post on `blog.voorivex.team` and not the Hashnode website.



It's not a big deal. By setting a simple `cname` record in the DNS server, you can verify that the domain belongs to the user, and the traffic will be redirected to Hashnode servers:



From a backend perspective, everything is the same, except for the `host` header of the HTTP packet. Since the IP address is the same for all of Hashnode's blogs, Hashnode uses the `host` header to determine which blog should be loaded. However, from a browser's perspective, the URLs are different. We all know that browsers store data based on the `Origin`:

- `https://hashnode.com`
- `https://blog.voorivex.team`

So, if a user enters credentials and logs into the Hashnode website, they should repeat the procedure to log into `blog.voorivex.team` too. To be user-friendly, Hashnode uses an authentication transfer, which means when somebody has an authentication session on the Hashnode website, they will automatically get an authentication session on other CNAMed domains too. But how?

Cross-Domain Authentication

- The user opens hashnode.com/authenticate equipped with **JWT authentication Cookie**. The HTTP request has a parameter named **next** which is responsible for redirecting the user back:

```
GET /authenticate?next=https%3A%2F%2Fblog.voorivex.team%2F HTTP/1.1
Host: hashnode.com
Cookie: redacted
User-Agent: Mozilla/5.0 (Macintosh; Intel Mac OS X 10.15; rv:124.0) Gecko/20100101 Firefox/124.0
Accept: text/html,application/xhtml+xml,application/xml;q=0.9,image/avif,image/webp,*/*;q=0.8
Accept-Language: en-US,en;q=0.5
Accept-Encoding: gzip, deflate, br
Referer: https://blog.voorivex.team/
Upgrade-Insecure-Requests: 1
Sec-Fetch-User: ?1
Te: trailers
Connection: close
```

The response:

```
HTTP/2 307 Temporary Redirect
Age: 0
Cache-Control: private, no-cache, no-store, max-age=0, must-revalidate
Content-Security-Policy: default-src *; script-src * 'unsafe-eval' 'unsafe-inline'; style-src * 'unsafe-inline'; font-src *; img-
Date: Mon, 15 Apr 2024 15:25:10 GMT
Location: https://hashnode.dev/identity?guid=f4e4e11f-4c6f-43b7-ab41-6483c52a0b4d&next=https%3A%2F%2Fblog.voorive
Referrer-Policy: origin-when-cross-origin
Server: Vercel
Strict-Transport-Security: max-age=63072000
X-Content-Type-Options: nosniff
X-Frame-Options: deny
X-Matched-Path: /authenticate
X-Vercel-Cache: MISS
X-Vercel-Id: fra1::pdx1::pldpk-1713194710837-255be6ebcd6a
Content-Length: 112

https://hashnode.dev/identity?guid=f4e4e11f-4c6f-43b7-ab41-6483c52a0b4d&next=https%3A%2F%2Fblog.voorivex.team%2
```

- There is an intermediate phase here which Hashnode checks **token** and **next** URL before redirecting the user back:

```
GET /identity?guid=f4e4e11f-4c6f-43b7-ab41-6483c52a0b4d&next=https%3A%2F%2Fblog.voorivex.team%2F HTTP/1.1
Host: hashnode.dev
Cookie: redacted
User-Agent: Mozilla/5.0 (Macintosh; Intel Mac OS X 10.15; rv:124.0) Gecko/20100101 Firefox/124.0
Accept: text/html,application/xhtml+xml,application/xml;q=0.9,image/avif,image/webp,*/*;q=0.8
Accept-Language: en-US,en;q=0.5
Accept-Encoding: gzip, deflate, br
Referer: https://blog.voorivex.team/
Upgrade-Insecure-Requests: 1
Sec-Fetch-User: ?1
Te: trailers
Connection: close
```

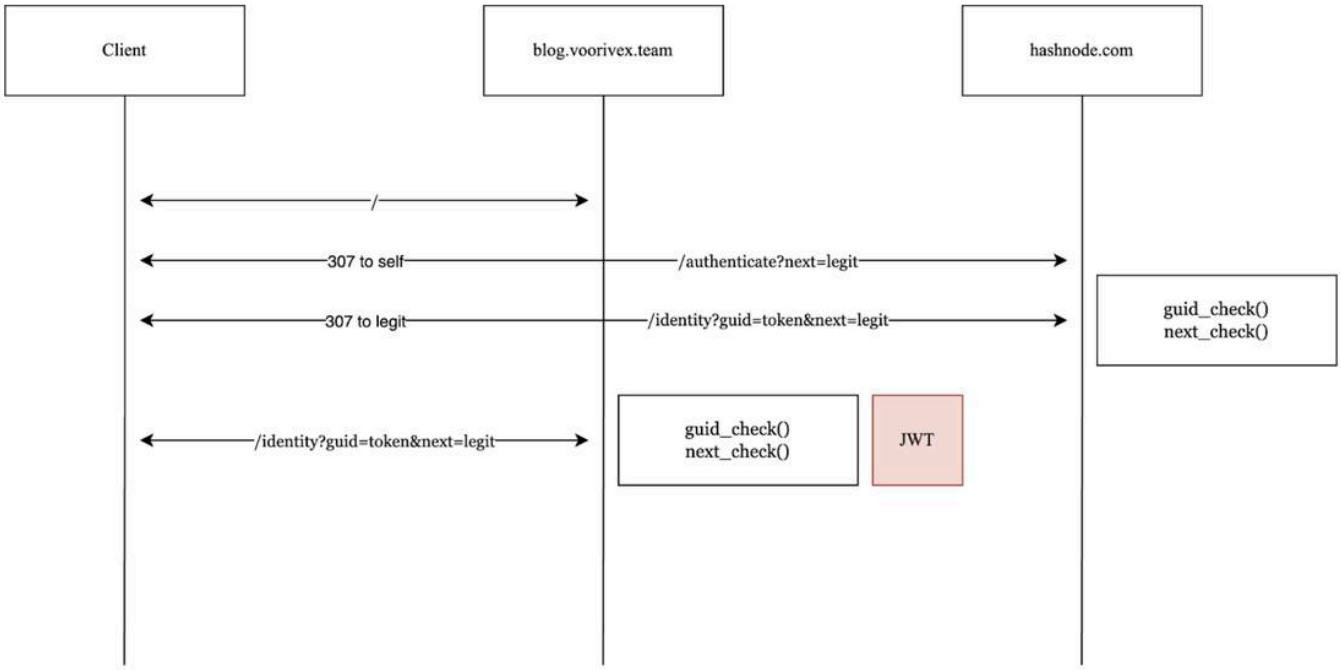
- If the user has a valid **JWT authentication Cookie and legitimate next URL value**, they will be redirected back to the **value of next parameter** (in this case, blog.voorivex.team which is legitimate in Hashnode)

```
HTTP/2 307 Temporary Redirect
Age: 0
Cache-Control: private, no-cache, no-store, max-age=0, must-revalidate
Content-Security-Policy: default-src *; script-src * 'unsafe-eval' 'unsafe-inline'; style-src * 'unsafe-inline'; font-src *; img-
Date: Mon, 15 Apr 2024 15:25:11 GMT
Location: https://blog.voorivex.team/identity?guid=f4e4e11f-4c6f-43b7-ab41-6483c52a0b4d&next=https://blog.voorivex.tear
Referrer-Policy: origin-when-cross-origin
Server: Vercel
Set-Cookie: redacted
Max-Age=315360000; Domain=.hashnode.dev; HttpOnly
Strict-Transport-Security: max-age=63072000
X-Content-Type-Options: nosniff
X-Frame-Options: deny
X-Matched-Path: /identity
X-Vercel-Cache: MISS
X-Vercel-Id: fra1::pdx1::8tmnc-1713194711393-f85cf186df76
Content-Length: 110

https://blog.voorivex.team/identity?guid=f4e4e11f-4c6f-43b7-ab41-6483c52a0b4d&next=https://blog.voorivex.team/
```

- The user opens blog.voorivex.team with an **Authentication Token** and if it is a valid token, they will be provided with a **JWT authentication Cookie**

Here is the flow of cross-domain authentication:



DNS Rebinding

I'm not going to explain the DNS rebinding vulnerability here; a quick search will give you plenty of information. The important questions for me were:

> How is the `next` parameter value validated in the backend? Can the value be anything, or does it just match against the database? What if I change the DNS records of the verified domain?

As observed, in the final stage of the flow, if the token is valid, the user will receive a **JWT authentication Cookie**. If the **next URL** can be manipulated, the **GUID token** can be stolen, leading to an account takeover. Although the checker function in the backend is quite secure, let's address this question: how does Hashnode define legitimate domains? How does the `next_check()` function operate? Upon investigation, it was found that Hashnode verifies the **next URL** against **its database**, which includes lists of **custom domains**. Therefore, an attacker could bind a legitimate domain to their account to manipulate the whitelist. Here's the attacking scenario via DNS Rebinding:

- The attacker binds a legitimate domain pointing to **hashnode.network**, in this case `https://attacker.voorivex.team`
- Since this URL is considered legitimate, the **next URL** can also be set as `https://attacker.voorivex.team`
- The attacker then changes the DNS value of `attacker.voorivex.team` to their **own IP address** (Before launching the attack, they obtain a valid SSL certificate)
- Despite changing the DNS records, the **next URL** remains **valid** as `https://attacker.voorivex.team`. It may take a significant amount of time for Hashnode to update its database (or DNS cache). Since the attacker does not remove their domain from the whitelist, just manipulates DNS records, the domain remains considered legitimate in Hashnode's system

The attacker provides the victim with a link: `https://hashnode.com/authenticate?next=https%3A%2F%2Fattacker.voorivex.team%2F`. If the victim clicks on this link, their **GUID token** will be stolen. The attacker can then produce a **JWT** using the stolen **GUID token**, gaining unauthorized access to the victim's account.

Automation

I wrote a Python script to **automatically** change the **DNS record** and then open the malicious URL on behalf of the victim. This ensures that the attack will work every time if the victim opens the attacker's website. In terms of CVSS calculation, the attack complexity is low, making the overall vulnerability score 8.0 (High). The script:

gist.github.com/Voorivex/2e1ead0c0c898be1cb24b5f873216249

Responsible Disclosure

Immediately after finding the flaw, I reported it to Hashnode. There is no obvious BBP for Hashnode, but a brief documentation worked for me. After about 20 days, they patched the vulnerability and issued a bounty to me.