Northeastern University
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Cached and Confused: Web Cache Deception in the Wild

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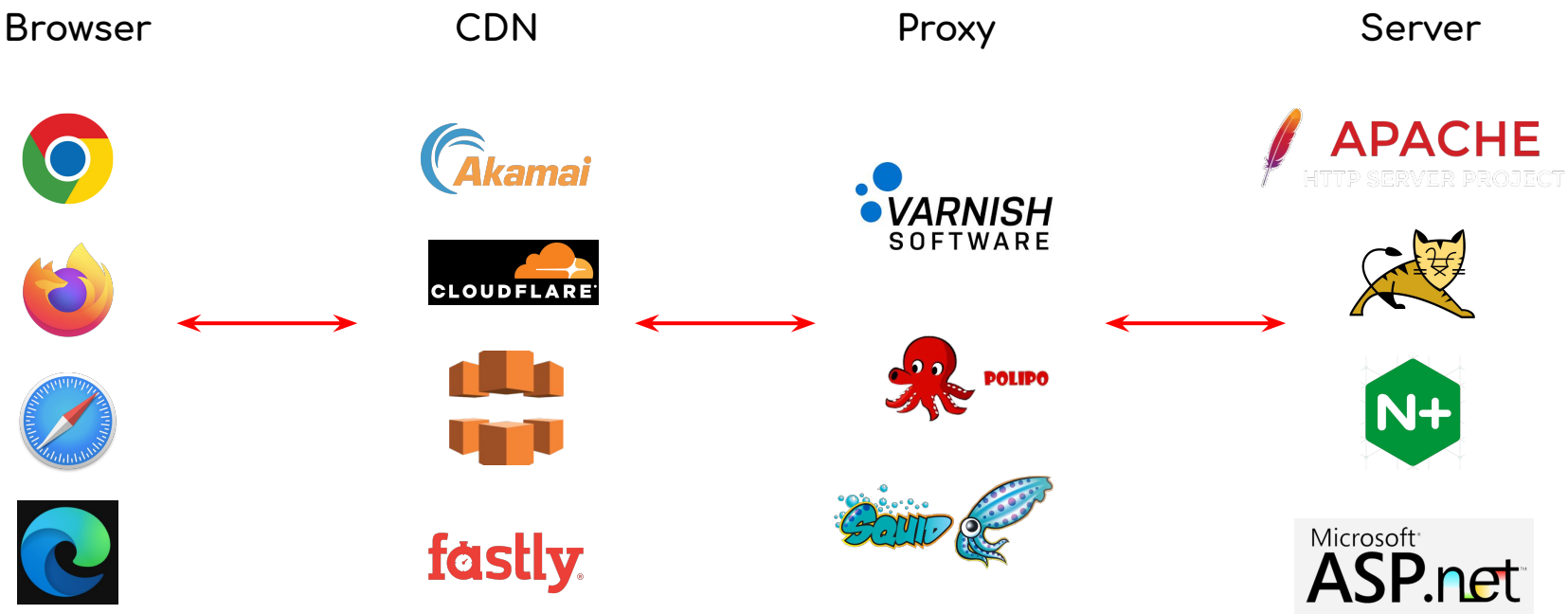
Web Caches



scheme://user:password@host:port/path?query#fragment

Path Confusion

scheme://user:password@host:port/path?query#fragment

➔ URL rewriting mechanisms: Clean URLs (a.k.a. RESTful URLs)

- ◆ Web servers interpret URLs in ways that are not clearly reflected in the externally-visible of the URL string.

Web Server: http://example.com**/index.php/v1** => http://example.com**/files/index.php?p1=v1**

➔ Browsers, caches or proxies are not aware of this abstraction

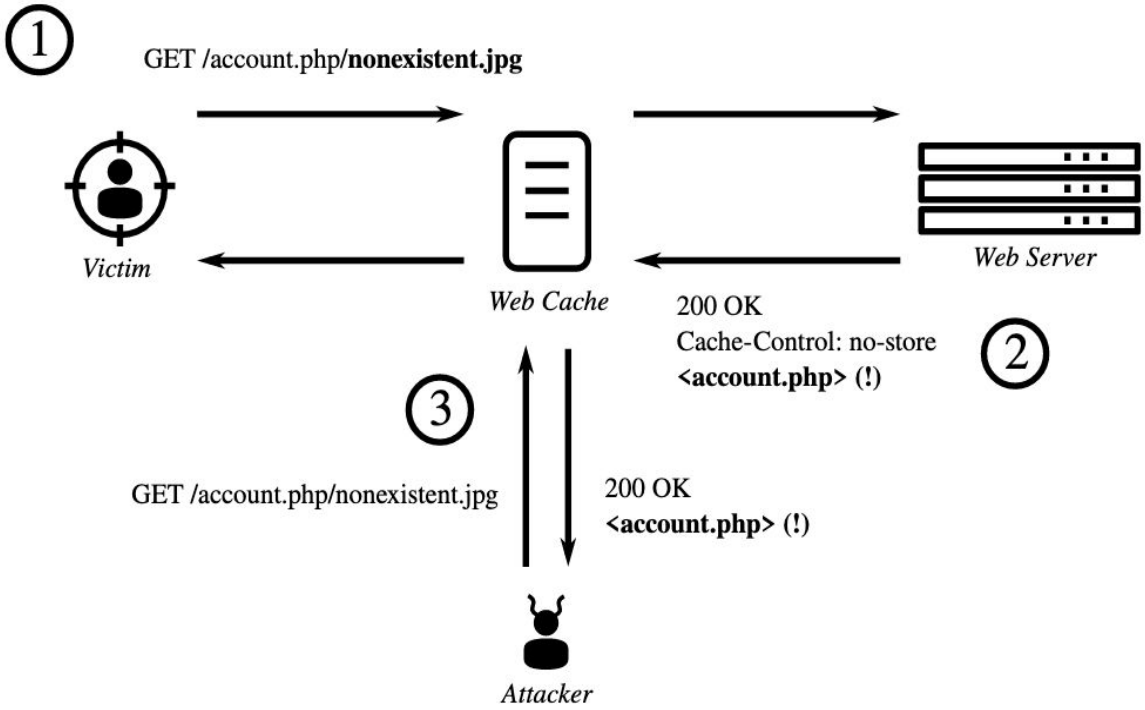
Other Components: http://example.com**/index.php/v1**

➔ What about : http://example.com/index.php**\n%2F**v1**%2Ff**ake.css**%3F%23**fake.css ?

- ◆ Browsers & CDNs can get more *confused* with customized encoding URL!

Web Cache Deception (WCD)

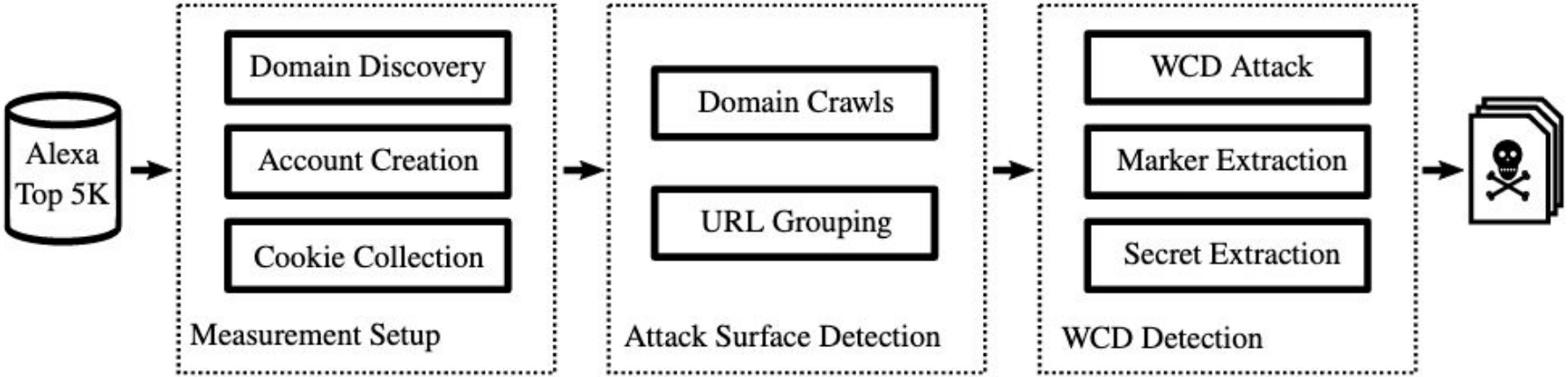
WCD: Different interpretations of a URL (*path confusion*) between a server and a cache.



Research Questions

- ➔ How common is WCD on popular, high-traffic sites?
- ➔ What is the impact ?
- ➔ Can variation of Path Confusion expand the number of vulnerable sites?
- ➔ Are CDN’s vulnerable by default?

Methodology



- ➔ Appended **"/<random>.css"** to each URL from the victim account.
- ➔ Visited same page from the (un)authenticated attack crawler and compare responses.
- ➔ Novel Path Confusion techniques applied to the attack URLs

Results

- ➔ 50K vulnerable pages in 37 sites out of 349 (10.7%)!
  - ◆ Personally Identifiable Information (PII), Security tokens, session identifiers and authorization keys leaked on vulnerable pages.
- ➔ Sophisticated attack scenario using WCD.
  - ◆ CSRF token bypass, session hijacking, XSSI, OAuth Covert Redirect, etc.
- ➔ Proposed novel Path Confusions are quite effective to confuse most of CDNs.
  - ◆ Increased detection rate by **45%**.

- ➔ Voted and led to an award as Top Web Hacking Technique of 2019 by Portswigger!
- ➔ Selected among Top 10 Application Vulnerabilities of 2019 by WhiteHat Security.

Lessons Learned : System Safety Problem

- ➔ WCD is a "*system safety*" problem.
  - There are no isolated faulty components.
  - There is no complete solution such as a Hotfix.
- ➔ Mitigation remains a *cross-functional* responsibility.
  - Complex interactions among different technologies should be evaluated.
  - Examining not only individual system components but also their interactions.
  - Reviewing how vendor configurations interact with internal systems!

Conclusions

- ➔ WCD: The origin server and cache disagree about cacheability.
- ➔ WCD can impose critical risk to the system!
- ➔ We developed a repeatable methodology to discover WCD.
  - ◆ ~11% of tested sites were vulnerable!
- ➔ WCD impacts all cache technologies.
- ➔ Caching rules based on file extensions are prone to security problem.
- ➔ Path confusion techniques make it possible to exploit 45% more sites.
- ➔ There is a widespread lack of user awareness.
- ➔ CDNs are not intended to be plug & play solutions.

Thanks! Questions?

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