

# Defending Computer Networks

## *Lecture 15: More HTTP/NIDS*

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# Logistics

- Guest lecture Tuesday
  - Cornell ITSO staff
  - Content part of curriculum, fair game on quizzes
- HW3.
  - Due Weds 10/22/14 11:59pm
- Project interim milestone deadline
  - Friday November 7th

# Google discloses Web encryption vulnerability

Tuesday, 14 Oct 2014 | 6:06 PM ET

A **Google Inc** spokesman said on Tuesday that researchers with the company have uncovered a vulnerability in widely used SSL web encryption technology, finding a bug in the SSL 3.0 protocol.

SSL 3.0 is nearly 15 years old, but it is still widely used, Google said, in **a Tuesday evening blog post**. Even browsers that use newer protocols will retry failed connections with older protocol versions, including SSL 3.0.

"Because a network attacker can cause connection failures, they can trigger the use of SSL 3.0 and then exploit this issue," Google said, in the statement. The immediate fix to the problem will "break some sites, and those sites will need to be updated quickly."

"In the coming months, we hope to remove support for SSL 3.0 completely from our client products," Google said.

# Obama Said to Warn of Crippling Cyber Attack Potential

President Barack Obama believes cyber terrorism is one of the biggest threats to national security and says the White House is bracing for a possible doomsday scenario if hackers can successfully penetrate government and business computer systems, the FOX Business Network has learned.

The president shared his thoughts on cyber terrorism last week, during a fundraising tour in New York City and a stop in Greenwich Conn., according to people who attended the events. At the same

<http://www.foxbusiness.com/economy-policy/2014/10/12/obama-said-to-warn-crippling-cyber-attack-potential/>

# CS Colloquium Today

**Thursday, October 16th**

4:15pm, G01 Gates – Mentors Lecture Hall

Refreshments at 3:45pm in front of New Visions – 416

## **Information Technology Implications of the President's NSA Review Group**

Professor Peter Swire of the Scheller College of Business served on President Obama's Review Group on Intelligence and Communications Technology, which published its report in December to widespread public attention. The President has adopted many of the group's 46 proposals, and others remain under consideration. This talk will describe the process for drafting the report. It will discuss the major recommendations, with a particular focus on information technology issues including encryption, zero-day attacks, and the role of offense and defense in cybersecurity. It will also discuss issues related to Internet governance in light of the intense public debate about how to use modern communications networks for diverse activities including surveillance, military operations, e-commerce, and the daily communications of individual users. The talk will feature an extensive period for Q&A about these issues of surveillance, democracy, and technology.

# Assigned Reading

- Javascript Tutorial
  - <http://www.w3schools.com/js/>
  - Recommend you play around with at least the basics to get a feel for it

# Main Goals for Today

- HTTP responses
- NIDS in Context of HTTP Server Attacks
- Start on web-client side attacks

# HTTP Request Basics

- Text lines separated by `\r\n`
  - Servers often accept “`\n`” only, but protocol is “`\r\n`”
- Header is terminated by a blank line (`\r\n\r\n`)
- Initial request line
  - `GET /dumprequest HTTP/1.1\r\n`
    - Other methods include POST, CONNECT, HEAD, DELETE, etc.
    - Focus on GET for now
- Followed by headers of form
  - `Header: Value...\r\n`
  - No request headers are actually required



# HTTP Request

```
GET /dumprequest HTTP/1.1\r\nHost: djce.org.uk\r\nConnection: keep-alive\r\nAccept: text/html,application/xhtml+xml,application/xml;q=0.9,image/webp,*/*;q=0.8User-Agent: Mozilla/5.0 (Macintosh; Intel Mac OS X 10_8_5) AppleWebKit/537.36(KHTML, like Gecko) Chrome/30.0.1599.101 Safari/537.36\r\nDNT: 1\r\nReferer: https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=3&ved=0CD4QFjAC&url=http%3A%2F%2Fdjce.org.uk%2Fdumprequest&ei=835lUpjEM5Xb4APEglGoDA&usg=AFQjCNEeAn5wSZMp_y_oTmOKonq482sS9A&sig2=pSajtDK-YYIvE4HFDqmRfA&bvm=bv.54934254,d.dmg\r\nAccept-Language: en-US,en;q=0.8\r\n\r\n
```

Try it at <http://www.procato.com/my+headers/>

# A Few Popular Request Headers

- Host:
  - Used to specify domain (server might have several).
- User-Agent:
  - Gives browser specifics (allows server to customize responses to browser)
- Referer:
  - What page (etc) sent us here
- Accept-Language:
  - We speak English, or...
- Accept:
  - media formats we accept (eg text/html)

# HTTP Response

```
HTTP/1.1 404 Not Found\r\nContent-Type: text/html; charset=UTF-8\r\nX-Content-Type-Options: nosniff\r\nDate: Mon, 21 Oct 2013 19:37:20 GMT\r\nServer: sffe\r\nContent-Length: 946\r\nX-XSS-Protection: 1; mode=block\r\nAlternate-Protocol: 80:quic\r\n\r\n<!DOCTYPE html>\r\n\r\n...
```

# HTTP Response Basics

- Text lines separated by `\r\n`
- Header is terminated by a blank line (`\r\n\r\n`)
- Initial response line
  - `HTTP/1.1 404 Not Found\r\n`
    - Indicates status of request.
- Followed by headers of form
  - `Header: Value...\r\n`
  - No response headers are actually required
    - Though hard to get much done without them...

# Important Response Codes

- 200 OK
- 301 Moved Permanently
- 304 Not Modified
- 400 Bad Request
- 404 Not Found
- 500 Internal Server Error

# A Few Popular Response Headers

- Content-Type:
  - Media-type of entity attached after header
- Content-Length:
  - Length of same (in bytes)
- Content-encoding:
  - 'gzip' means compression applied
- Date:
- Server: software being run on the server

# Let's try it

- telnet on 80 to a few popular websites

# Entity Body

- Follows header
  - either request or response, but more consistently in response direction
  - Can be any media type:
    - text/html, text/plain, image/jpeg, audio/mpeg
    - <http://www.iana.org/assignments/media-types>
  - Three methods to delineate length:
    - Content-length
    - Transfer-encoding: chunked
    - Connection: close



# Detecting Attacks on Web Servers

- Has been a major industry for 15+ years
- Exploits on the servers themselves
- Exploits on cgi scripts,
  - other server-side plugins
- SQL Injection
- Cross-site scripting
- Also HTTP command-and-control
  - Similar issues of detecting bad HTTP requests

# Top Snort Rule Files

```
Stuarts-MacBook-Pro:rules stuart$ du -s -k *.rules |sort -n  
-r |head -10
```

```
6152  deleted.rules  
1216  browser-plugins.rules  
792   malware-cnc.rules  
688   blacklist.rules  
568   server-webapp.rules  
392   file-identify.rules  
348   file-office.rules  
344   server-other.rules  
328   pua-adware.rules  
316   browser-ie.rules
```

# Snort Example 4

```
alert tcp $HOME_NET any -> $EXTERNAL_NET
$HTTP_PORTS (msg:"MALWARE-CNC Win.Trojan.Zbot
variant in.php outbound connection";
flow:to_server,established; urilen:7; content:"/in.php";
http_uri; content:".ru|0D 0A|User-Agent|3A 20|Mozilla/
4.0|0D 0A|"; fast_pattern:only; http_header; content:"|
0A|Content-Length|3A 20|"; http_header;
metadata:policy balanced-ips drop, policy security-ips
drop, ruleset community, service http;
reference:url,zeustracker.abuse.ch/monitor.php?
ipaddress=195.22.26.231; classtype:trojan-activity; sid:
26023; rev:3;)
```

# Snort Example 5

```
alert tcp $EXTERNAL_NET any -> $HOME_NET
$HTTP_PORTS (msg:"SERVER-WEBAPP D-Link DIR-300/
DIR-600 unauthenticated remote command execution
attempt"; flow:to_server,established; content:"POST";
depth:4; nocase; http_method; content:"/command.php";
fast_pattern:only; http_uri; content:"cmd="; nocase;
http_client_body; metadata:policy balanced-ips drop,
policy security-ips drop, service http; reference:bugtraq,
57734; reference:url,exploit-db.com/exploits/24453/;
reference:url,osvdb.org/show/osvdb/89861;
reference:url,www.s3cur1ty.de/m1adv2013-003;
classtype:attempted-admin; sid:26953; rev:1;)
```

**89861 : D-Link Multiple Router command.php cmd Parameter Remote Command Execution**[Printer](#) | <http://osvdb.org/89861> | [Email This](#) | [Edit Vulnerability](#)

Views This Week	Views All Time	Added to OSVDB	Last Modified	Modified (since 2008)	Percent Complete
18	574	9 months ago	about 1 month ago	14 times	100%

**Timeline**

Disclosure Date

2013-02-04

Time to Exploit

52 days

Time to Vendor Response

7 days

**Description**

Multiple D-Link routers contain a flaw that is triggered when input passed via the 'cmd' parameter is not properly sanitized before being used in the command.php script. This may allow a remote attacker to execute arbitrary commands.

**Classification****Location:** Remote / Network Access**Attack Type:** Input Manipulation**Impact:** Loss of Integrity**Solution:** Solution Unknown**Exploit:** Exploit Public**Disclosure:** Vendor Disputed, Third-party Verified**OSVDB:** Web Related**Solution**

OSVDB is not currently aware of a solution for this vulnerability.

**Products**D-Link Corporation/D-Link Systems, Inc.

DIR-300

2.12b02

2.13b01

2.14b01

DIR-600

2.12

2.13

# HTTP Level Evasions

- HTTP is a very complex protocol
  - Many important sub-protocols/formats
    - URIs
    - Character sets
    - Media types of entities
- As a result
  - Hard to inspect
  - Very evasion prone
  - Extensive work required in IDS to deal with issues
- We will start to work on URI issues...

# Obscure HTTP Methods

- “HEAD” instead of “GET”.
- RFC 2616:

## **9.4 HEAD**

The HEAD method is identical to GET except that the server **MUST NOT** return a message-body in the response. The metainformation contained in the HTTP headers in response to a HEAD request **SHOULD** be identical to the information sent in response to a GET request. This method can be used for obtaining metainformation about the entity implied by the request without transferring the entity-body itself. This method is often used for testing hypertext links for validity, accessibility, and recent modification.

# Pipelining of Requests

- If IDS doesn't properly reassemble TCP and parse protocol:

```
GET foo.html HTTP/1.1\r\n\r\nGET bar.html HTTP/1.1\r\n\r\n
```

- Could miss the "bar.html"
- Have seen commercial products with this issue recently...



# Directory Type Evasions

- Suppose IDS looking for “/servlet/command.php” in URL
- So attackers might try:
  - /servlet//command.php
  - /servlet///command.php
  - /servlet./command.php
  - /servlet/././command.php
  - /servlet/subdir/././command.php
- On Windows based web servers:
  - /servlet\command.php

# URL Encoding

- RFC 2396 specifies URL format:

## 2.4.1. Escaped Encoding

An escaped octet is encoded as a character triplet, consisting of the percent character "%" followed by the two hexadecimal digits representing the octet code. For example, "%20" is the escaped encoding for the US-ASCII space character.

```
escaped    = "%" hex hex
hex        = digit | "A" | "B" | "C" | "D" | "E" | "F" |
             "a" | "b" | "c" | "d" | "e" | "f"
```

- And RFC 2616 says:

The Request-URI is transmitted in the format specified in section 3.2.1. If the Request-URI is encoded using the "% HEX HEX" encoding [\[42\]](#), the origin server MUST decode the Request-URI in order to properly interpret the request. Servers SHOULD respond to invalid Request-URIs with an appropriate status code.

- So IDS must do the same...

# Double Percent Encoding

- %25 is '%' in ASCII
- %41 is 'A'
- So if you write %2541 and decode once
  - you get %41
- Decode again
  - you get 'A'
- Unbelievably, IIS did this...
  - IDS must follow...

# Double Nibble Hex Encoding

- %%34%31
- On first decoding goes to %41
- On second decoding goes to A
- Again, Microsoft IIS supported this encoding
- Also variations like %341 and %4%31
  - Also get correctly transformed to A
- Not a current issue by default

# Loose Implementations

- RFC says:
  - Method <space> URI <space> HTTP/ Version CRLF CRLF
- But some Apache versions allow
  - Method <tab> URI <tab> HTTP/ Version CRLF CRLF
- IDS must follow implementations exactly, or attacker can fool

# Case Insensitivity of Windows

- /SerVLeT/ComMaNd.Php
- May well work fine if underlying OS is case insensitive
- IDS must match behavior of target

# Web Drive-By Download Attacks

- Became big around 2005-2007.
- Have been the main action since then.
- Attacker response to firewall/IPS technology.
  - Largely circumvents those defenses.
  - Took a while to develop useful defenses.
    - Still a very active arms-race.

# Two Main Schemas

- Scan/Compromise legit websites
  - Eg SQL Injection attacks
  - Insert <iframe>s into site
  - Iframes include content from an exploit server
- Malverts
  - Malicious ads bought through chains of middle men
  - Redirects to malicious content (often swf (Flash))



# Either Way

- Exploit server runs an exploit kit
- Exploit kit tests nature of browser/plugins
  - Java
  - PDF
  - Flash
- Picks one or more exploit objects
- Takes control of browser/plugins
- Installs malware/trojans
- Command and control for instructions
- Exploit kits often have extensive management infrastructure
- Profit!

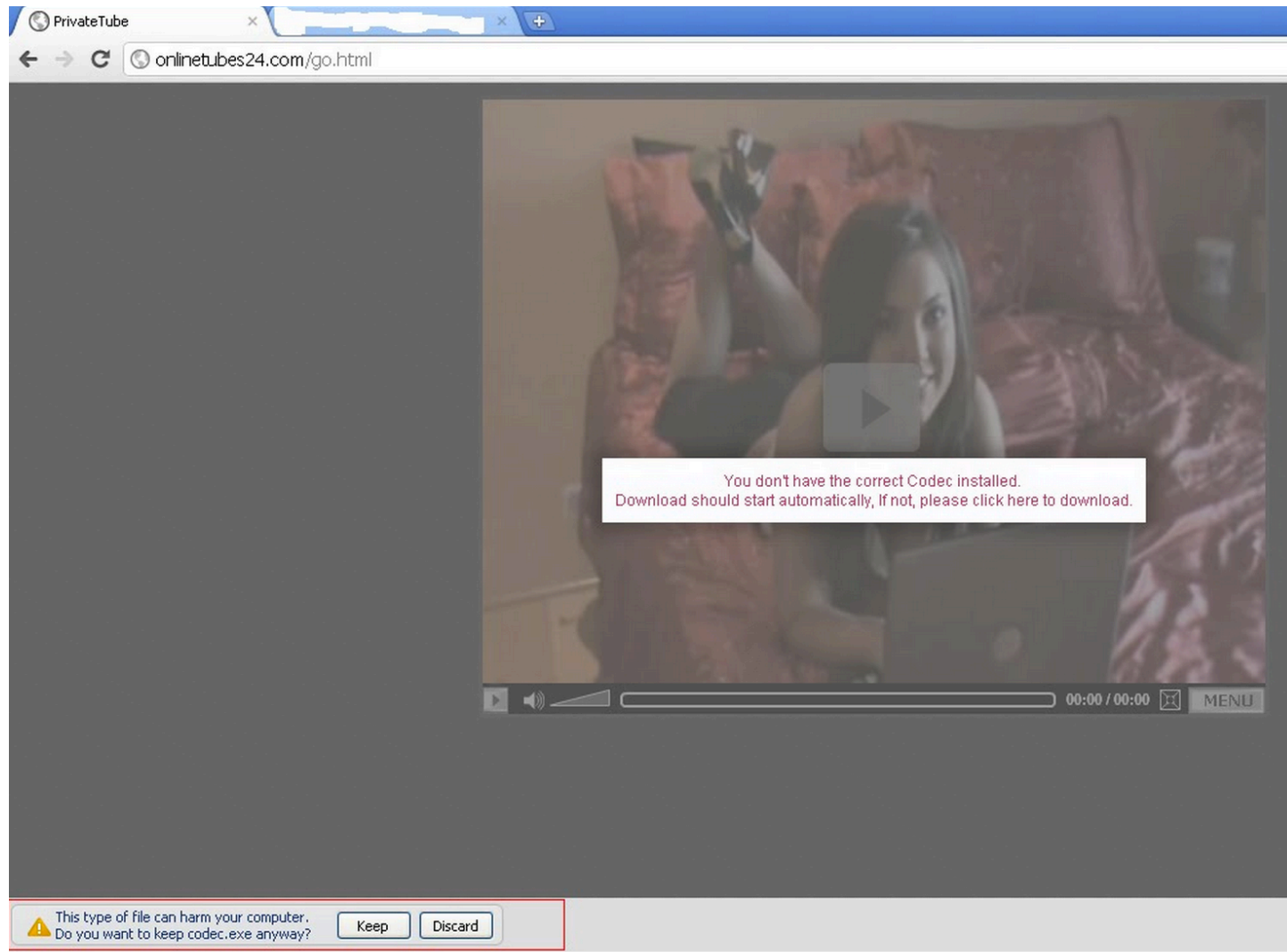
# Also, social engineering

- Trick humans into installing/running malware
- Also works pretty well
- Let's look at a few examples

# Fake AV



# More Social Engineering




<http://research.zscaler.com/2011/12/fake-video-codecs-still-going-strong.html>

# And More

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## Adobe Flash Player

 Adobe Flash Player 11.2.181.25 (1.95 MB)

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**RESOURCES**

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**GFI**

<http://www.threattracksecurity.com/it-blog/fake-adobe-flash-updates-resurfaces-in-the-web/>