DDoS Self-Defense

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State of DDoS A&D

- Attacks
  - Dozens of attack tools, methods
    - Some more effective than others
    - Readily-available to script kiddies
  - Constantly happening, but not often in the news
  - Typical attack targets:
    - IRC servers
    - Small business
    - Gaming sites
    - Rival botnets
    - Whitehats
- Defenses
  - Commercial solutions available for $$$ (₩₩₩)
  - Few alternative options other than “suffer through it”

DDoS Self-Defense

- Other options are in fact available, just not widely known or used
  - Countermeasures may be in legal grey-area
  - Difficulty in quickly bootstrapping defenses during an attack
  - Difficulty in quickly locating contacts/resources who can assist with defense
- Solution (and purpose of this talk)
  - Review legal issues around network self-defense
  - Understand active and passive network self-defense techniques
  - Find out about whitehat communities and build contacts

Passive Defense: Tarpitting 1

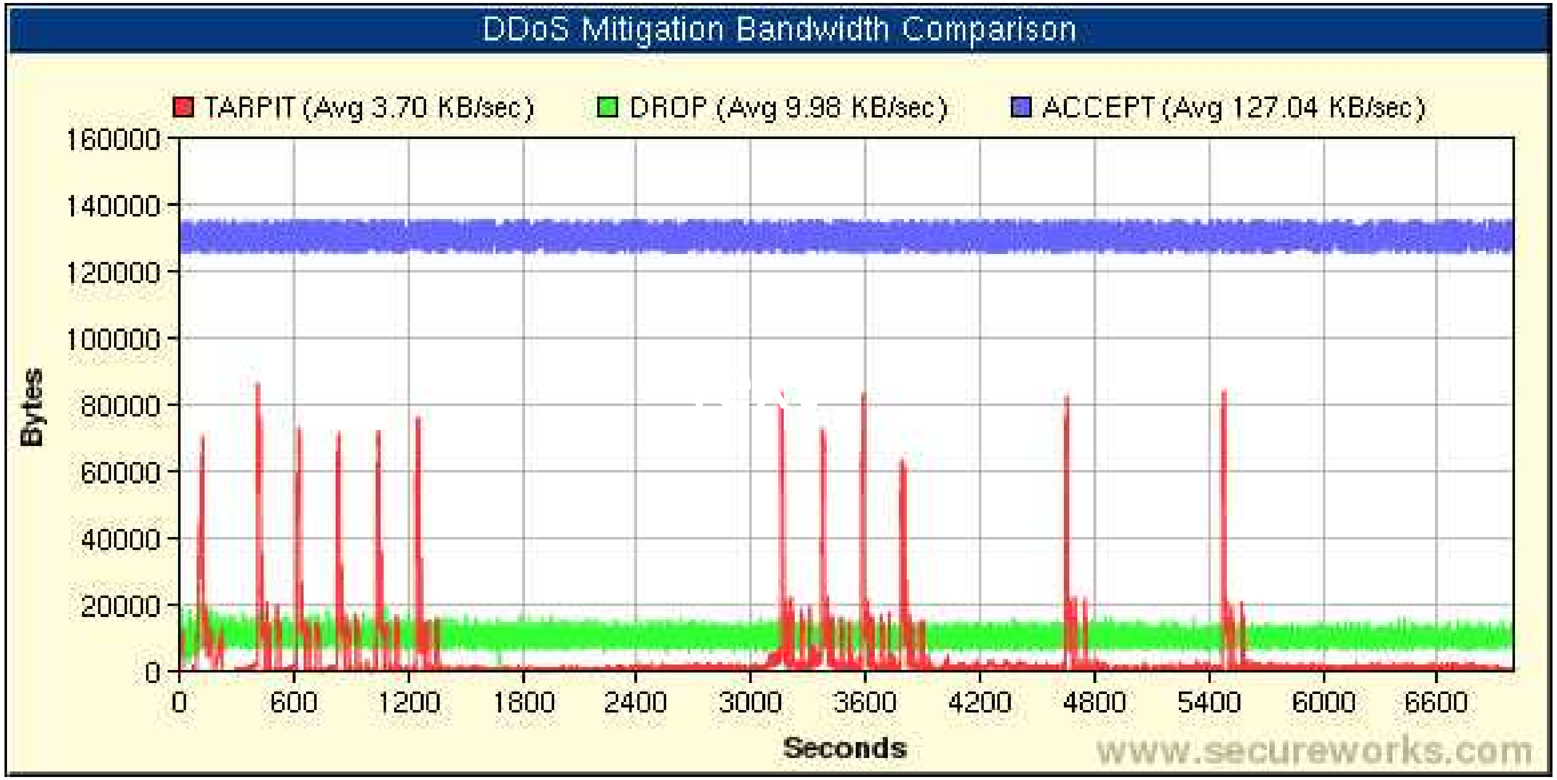
- Many attacks are HTTP-based resource exhaustion attacks
  - Synfloods not always effective against targets since servers/network providers have gotten better at dealing with them
  - Instead of “filling up the pipe”, it’s easier to overload the webserver’s max connections or available CPU/memory resources
- Most HTTP-based attacks launched in a userspace process, therefore:
  - Must use the system TCP/IP stack
  - Are limited by the rules implemented by the TCP/IP stack
  - We can take advantage of this

Passive Defense: Tarpitting 2

- On DDoS victim server:
  - Identify and handle attacker connections
  - Immediately set TCP window size to few or zero bytes
  - Send no more packets, forget about the connection
- On attacker bot machine:
  - Stack must obey the TCP window size setting and sends no more data than will fit in the window before receiving an ACK
  - Since no ACK ever comes, attacker tries to resend request no larger than the window size at ever-increasing intervals forever or until bot kills the connection
- Traffic destined to victim is significantly decreased

Passive Defense: Tarpitting 3

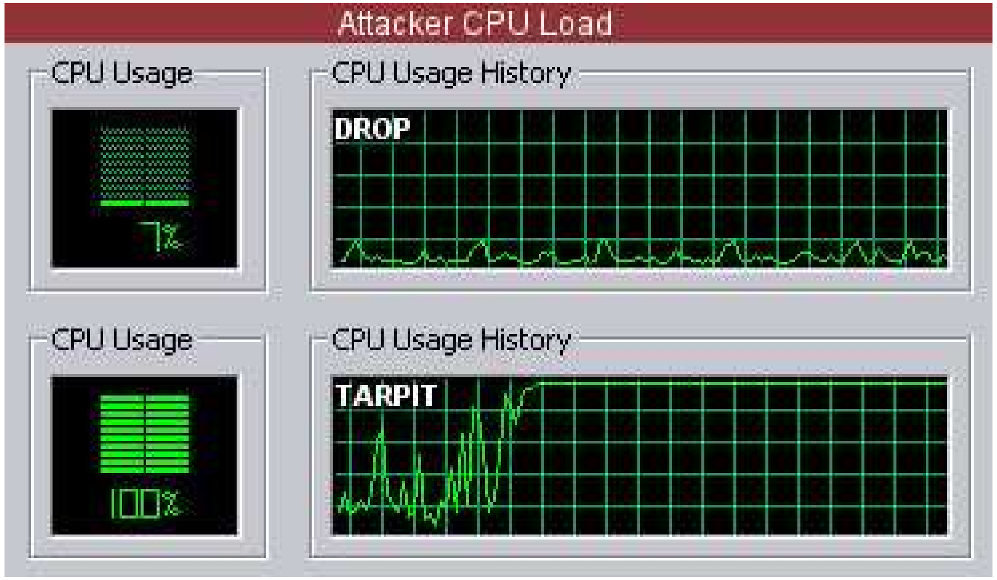
Bot Throughput During DDoS



Server Response: 🟦 Accept 🟩 Drop 🟥 Tarpit

Passive Defense: Tarpitting 4

Bot CPU Load During DDoS



DROP response

TARPIT response

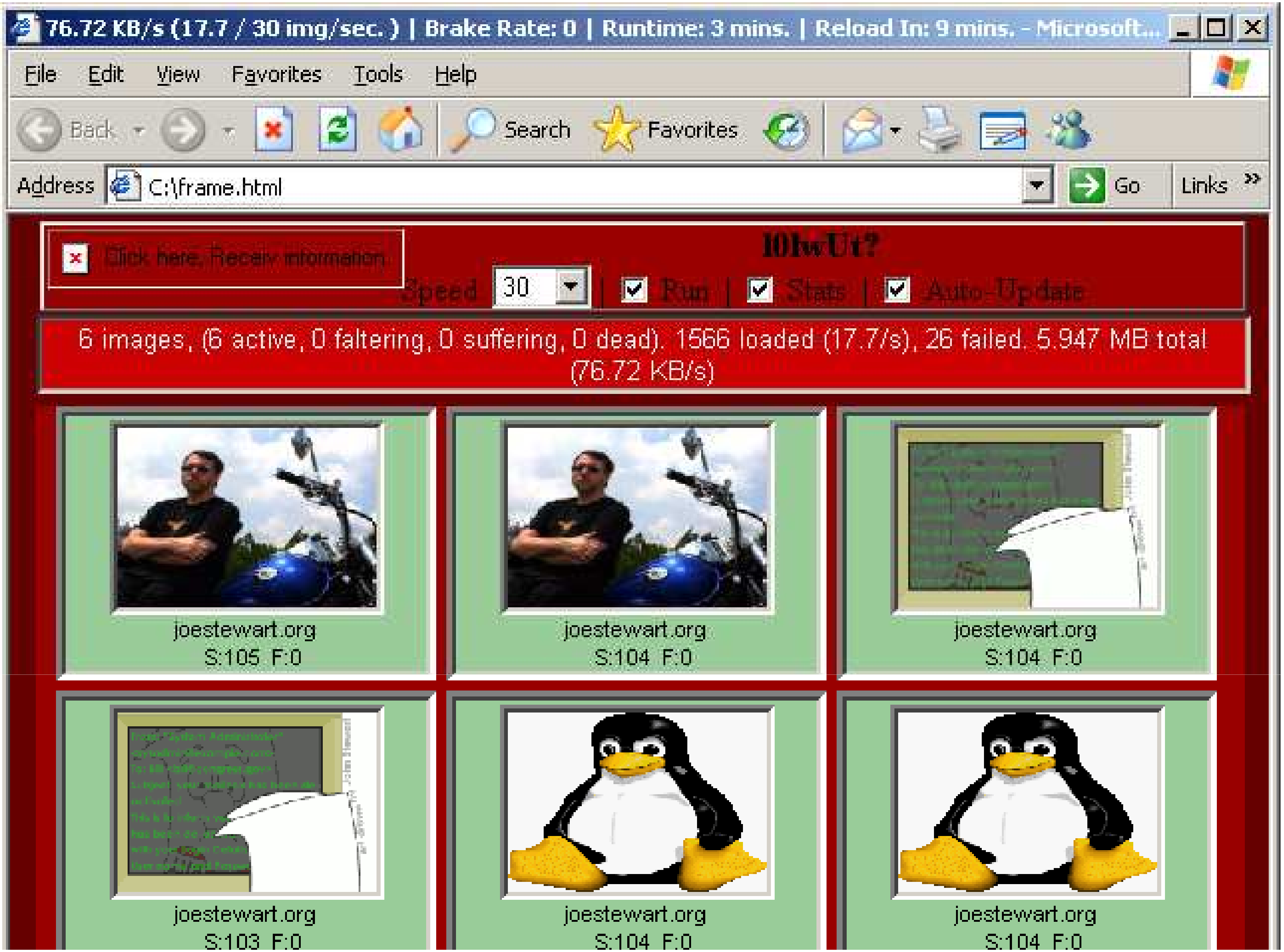
Passive Defense: Tarpitting 5

- Software for tarpitting
  - – LaBrea by Tom Liston
    - No longer distributed by Tom
    - Source code available from other sites
  - – Linux Netfilter
    - iptables -A INPUT -s x.x.x.x -p tcp -j TARPIT
- Further reading
  - – The University of Florida used tarpitting to defend against NetSky worm DDoS attack in 2004:
    - http://nersp.nerdc.ufl.edu/~oitnews/2004_06/tarpit.html
    - http://psifertex.com/download/Jordan_Wiens_GCIH.pdf

Browser-Based Attacks

- Often used during “hacktivist” activities
- No botnet required
  - HTML/javascript page distributed to willing attackers
  - Script continually reloads pages/images from victim website
  - Easy to deploy
    - Download and edit HTML page to add targets
    - Hand it out in a forum with simple instructions: “open this in your browser and let it run”
- Example: Lad Vampire
  - originally written to attack phishing pages by anti-phishing-fraud vigilante group
  - No longer distributed by same group, but still in active circulation

Lad Vampire in Action



76.72 KB/s (17.7 / 30 img/sec.) | Brake Rate: 0 | Runtime: 3 mins. | Reload In: 9 mins. - Microsoft...

C:\frame.html

Click here. Recerv information

l0lwUt?

Speed 30 | ☑ Run | ☑ Stats | ☑ Auto-Update

6 images, (6 active, 0 faltering, 0 suffering, 0 dead). 1566 loaded (17.7/s), 26 failed. 5.947 MB total (76.72 KB/s)

joestewart.org S:105 F:0	joestewart.org S:104 F:0	joestewart.org S:104 F:0
joestewart.org S:103 F:0	joestewart.org S:104 F:0	joestewart.org S:104 F:0

Lad Vampire HTTP Request

Cache prevention

```
GET /images/bg.jpg?1264undefined HTTP/1.1
Accept: */*
Accept-Language: en-us
Accept-Encoding: gzip, deflate
User-Agent: Mozilla/4.0 (compatible; MSIE 6.0; Windows NT 5.1; SV1)
Host: joestewart.org
Connection: Keep-Alive
```

Lad Vampire Mitigation

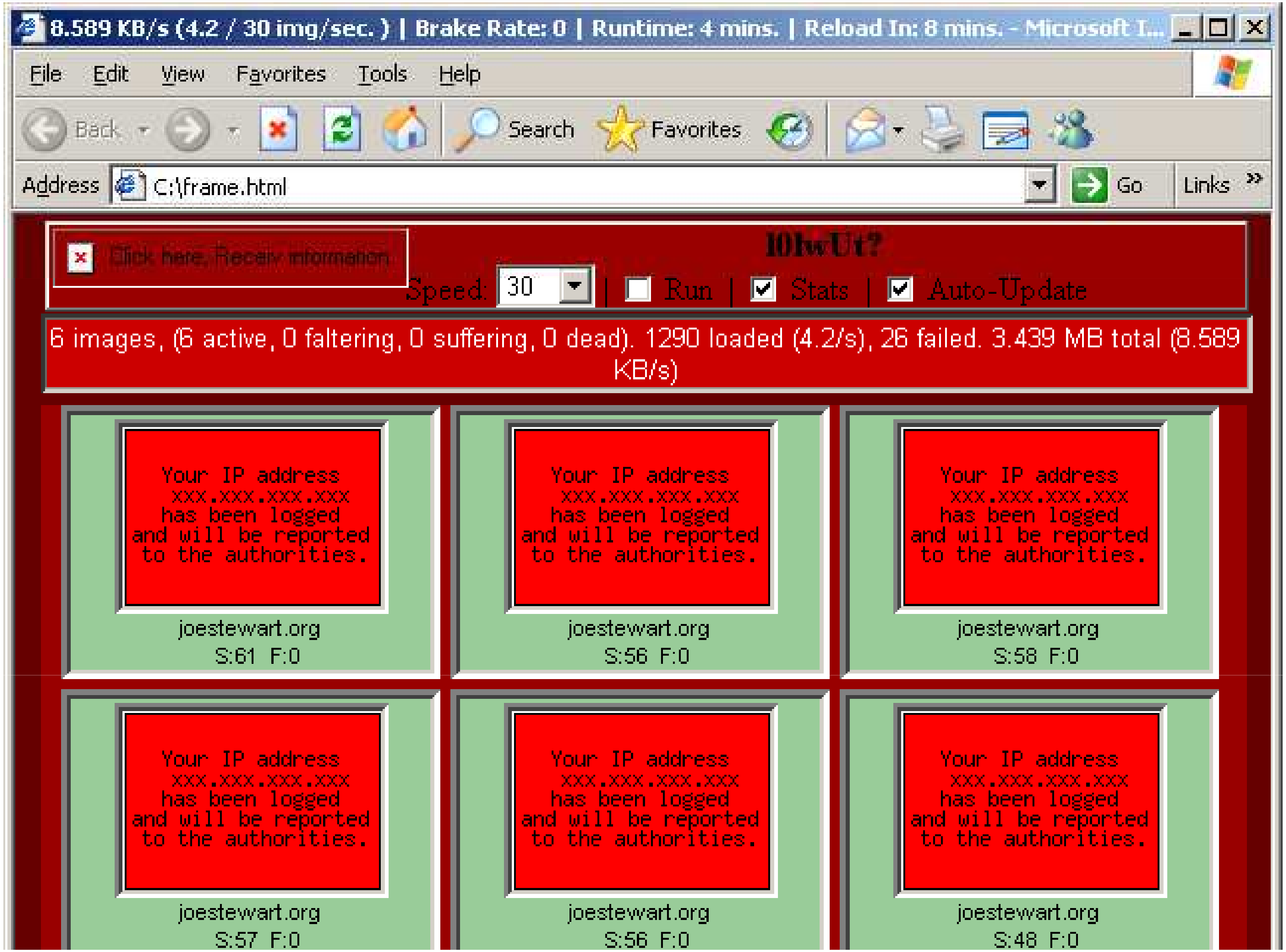
```
RewriteEngine on
RewriteCond %{QUERY_STRING} ^[0-9]+undefined
RewriteRule /.*\.(jpg|gif)$ /cgi-bin/log.cgi
```

Warning Image CGI Script

/cgi-bin/log.cgi

```
#!/usr/bin/perl
use GD::Simple;
my $i = GD::Simple->new(130, 90);
$i->bgcolor('red'); $i->fgcolor('black');
$i->rectangle(1,1,129,89);$i->moveTo(20,30);
$i->string('Your IP address');$i->moveTo(25,40);
$i->string($ENV{'REMOTE_ADDR'});$i->moveTo(20,50);
$i->string('has been logged');$i->moveTo(5,60);
$i->string('and will be reported');$i->moveTo(10,70);
$i->string('to the authorities.');
print "Content-Type: image/png\n\n";
print $i->png;
```

Lad Vampire Mitigation Result



8.589 KB/s (4.2 / 30 img/sec.) | Brake Rate: 0 | Runtime: 4 mins. | Reload In: 8 mins. - Microsoft I...

Address C:\frame.html

Speed 30 | □ Run | ☑ Stats | ☑ Auto-Update

6 images, (6 active, 0 faltering, 0 suffering, 0 dead). 1290 loaded (4.2/s), 26 failed. 3.439 MB total (8.589 KB/s)

Your IP address xxx.xxx.xxx.xxx has been logged and will be reported to the authorities. joestewart.org S:61 F:0	Your IP address xxx.xxx.xxx.xxx has been logged and will be reported to the authorities. joestewart.org S:56 F:0	Your IP address xxx.xxx.xxx.xxx has been logged and will be reported to the authorities. joestewart.org S:58 F:0
Your IP address xxx.xxx.xxx.xxx has been logged and will be reported to the authorities. joestewart.org S:57 F:0	Your IP address xxx.xxx.xxx.xxx has been logged and will be reported to the authorities. joestewart.org S:56 F:0	Your IP address xxx.xxx.xxx.xxx has been logged and will be reported to the authorities. joestewart.org S:48 F:0

Active Defense: Traceback

- With cooperation, it is possible to locate and take down (or take over) control servers for DDoS malware
- Need to establish contact with helpful persons in different business sectors:
  - ISPs
    - Knowing the target IP and network traffic type, ISPs can find infected customers and use network flow triangulation to find the common control server IP
    - Some security monitoring companies have access to similar data
  - Antivirus researchers
    - Knowing the fingerprint of the attack software may enable them to find the actual malware sample that is being used in the attack
    - Replaying the sample in a sandnet can reveal the control server IP

Active Defense: Takedown or Takeover?

- We have the IP of the controller, now what?
- Takedown may not be desirable
  - Losing connectivity with the controller may not cause the bots to stop attacking, in fact it could prolong an attack
  - Depending on the bot, a backup hostname could be in use, so the attacker is back up and running in minutes
  - Finding all backup names and IP addresses involved is crucial
- Takeover
  - Many bot types have no way to authenticate the controller
    - As long as it speaks the right protocol, the bots will obey
  - With cooperation from DNS or hosting provider, bots can be instructed to stop the attack before the final takedown

Active Defense: Becoming the Controller

- Black Energy
  - Very popular DDoS bot
  - No authentication of controller
  - Stop command:

```
10;2000;10;0;0;30;100;40;20;1000;2000#stop#1#xCOMP_ABCD1234
```

- Illusion Bot
  - Somewhat less popular DDoS bot
  - No authentication of controller
  - Stop command: `100 @stopall`

Know Your Attacker: Black Energy

```
GET / HTTP/1.1
Accept: */*
Accept-language: en-us
User-agent: Opera/9.02 (Windows NT 5.1; U; ru)
Host: example.com
Connection: Keep-Alive
```

Wrong capitalization

Know Your Attacker: Illusion Bot

```
GET http://example.com//~/~/~/~/~/ HTTP/1.1
Host: example.com
Accept: */*
User-Agent: Mozilla/4.0 (compatible; MSIE 5.5; Windows 98)
Refer: http://example.com/cgi-bin/index.pl

GET http://example.com/1.php HTTP/1.1
Host: example.com
Accept: */*
User-Agent: Microsoft-WebDAV-MiniRedir/5.1.2600
Refer: http://example.com/index.html
```

Referrer header is spelled the wrong “wrong” way

Know Your Attacker: Lyzapo/77DDoS

```
GET / HTTP/1.1
Accept: image/gif, image/x-xbitmap, image/jpeg, image/pjpeg,
application/x-shockwave-flash, application/vnd.ms-excel,
application/vnd.ms-powerpoint, application/msword, application/x-ms-
application, application/x-ms-xbap, application/vnd.ms-xpsdocument,
application/xaml+xml, */*
Accept-Language: ko
UA-CPU: x86
Accept-Encoding: gzip, deflate
User-Agent: %s
Host: [target hostname]
Connection: Keep-Alive
```

User-Agent selected at random...

Know Your Attacker: Lyzapo User-Agents

```
Mozilla/4.0 (compatible; MSIE 7.0; Windows NT 5.1; GTB6; .NET CLR 2.0.50727; .NET CLR 3.0.4506.2152; .NET CLR 3.5.30729)

Mozilla/4.0 (compatible; MSIE 7.0; Windows NT 5.1; Trident/4.0; GTB6; .NET CLR 2.0.50727; .NET CLR 3.0.4506.2152; .NET CLR 3.5.30729)

Mozilla/4.0 (compatible; MSIE 7.0; Windows NT 5.1; InfoPath.2; MAXTHON 2.0)

Mozilla/4.0 (compatible; MSIE 8.0; Windows NT 5.1; Trident/4.0; GTB6; .NET CLR 2.0.50727; .NET CLR 3.0.4506.2152; .NET CLR 3.5.30729)

Mozilla/5.0 (Windows; U; Windows NT 5.1; en-US; rv:1.8.1.20) Gecko/20081217 Firefox/2.0.0.20 (.NET CLR 3.5.30729)
```

Firefox UA, but MSIE header-ordering

Active Defense: Counter-Attack 1

- Safe haven hosting providers
  - Do not care about attacks controlled from their site
  - Will not respond or cooperate with takedowns
  - Worse, they may share your correspondence with the attacker
- What are the remedies?
  - Launch a counter-attack against the DDoS control server
    - Probably not legal most places
    - May prolong the attack same as with takedown
  - Work with ISP/Security community
    - Null route the controller IP or netblock from the rest of the world
    - Expose uncooperative hosting providers in the press - what’s known as a “Krebsing” (see McColo, 3FN)

Active Defense: Counter-Attack 2

- Many control servers are poorly programmed
- Vulnerable to SQL injection
  - Expose admin authentication credentials
  - Enumerate bots
  - Insert commands
- Vulnerable to cross-site scripting attacks (XSS)
  - Add an iframe to the attacker's stats page and track his IP
    - Add proxy-decloaking code to the iframe for extra credit
- Poorly-thought-out interface with links to third-party sites
  - Reveal the control panel URL in the referrer log
- Legality of taking advantage of these techniques still an issue

Illusion Bot SQLi Example 1

```
/* this function will be used by bots */
if ($act == "online")
{
            if (isset( $_GET["nickname"] ))
                        $nickname = base64_decode( $_GET["nickname"] );
            else            exit();

        if (isset( $_GET["s4"] )) $s4 = $_GET["s4"]; else $s4 = 0;
        if (isset( $_GET["s5"] )) $s5 = $_GET["s5"]; else $s5 = 0;
        if (isset( $_POST["msg_out"] )) $msg_out =
base64_decode( $_POST["msg_out"] ); else $msg_out = "";
#       if (isset( $_GET["msg_out"] )) $msg_out = $_GET["msg_out"]; else $msg_out =
"";
        die( db_bot_online( $nickname, $msg_out, $s4, $s5 ) );
}
```

User-supplied argument

User-supplied argument

Illusion Bot SQLi Example 2

```
/* add/update DB record about bot */
function db_bot_online( $nickname, $mo, $socks4_port, $socks5_port ){
        ...
        $msg_out = str_replace( "\\", "\\\\", $mo );
        $msg_out = htmlspecialchars( $msg_out );
        ...
                else
                {
                        if ($msg_in) $st = 0; else $st = 1;
                        mysql_query( "INSERT INTO $mysql_bots_table
VALUES($time, \"$ip\", \"$nickname\", \"$msg_in\", \"\", $st, $socks4_port,
$socks5_port)" );
```

Remembered to sanitize this user-supplied argument

Forgot about this one

Illusion Bot XSS Example

```
/* Online bots listing */
function db_list_bots()
{
        ...
        $nickname = cutstr( $arr["nickname"], 12 );
        $fullnickname = $arr["nickname"];
        ...
        if ($status)
                $nickref = "<td class=\"tableitem\"><a title=\"Add
nick\“  href=\"javascript:addn('$fullnickname');\">$nickname</a>
</td>";
```

nickname is varchar(64), enough room for an iframe tag

Final Word

- Personal networking and information sharing is key
  - Ahead of time, not after-the-fact
- Cybercrime laws not up-to-date
  - Law enforcement is unable to respond in a timely fashion to protect the innocent
  - Fear of prosecution keeps those who are able to respond from doing so with all measures available
  - Untested, but some jurisdictions have “nuisance laws” that protect citizens who take action that would be otherwide illegal
  - Legislators need to understand the issues involved and provide options for self-defense without fear of incarceration

Q&A

Questions?