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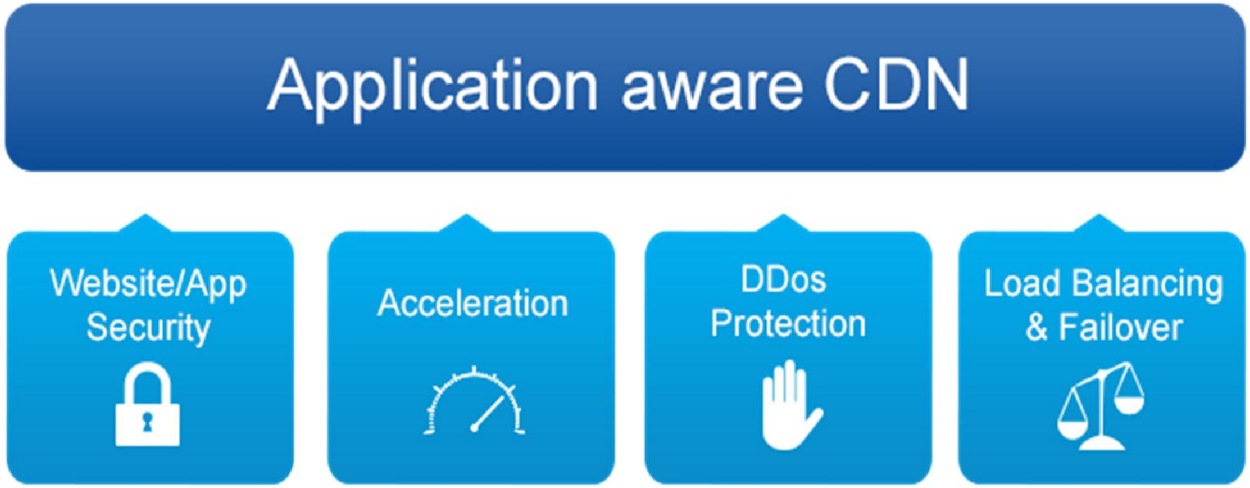
An Imperva Company

DDoS Attacks - Peeling the Onion on One of the Most Sophisticated Ever Seen

Eldad Chai, VP Product

Incapsula – Application Delivery from the Cloud



Application aware CDN

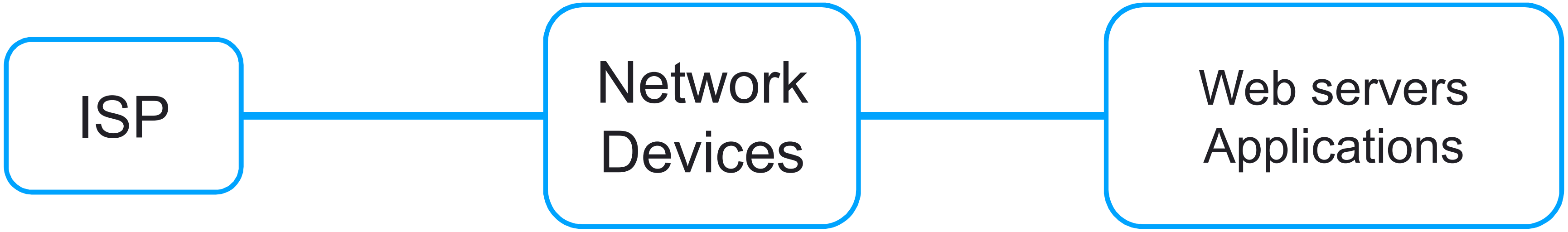
Website/App Security

Acceleration

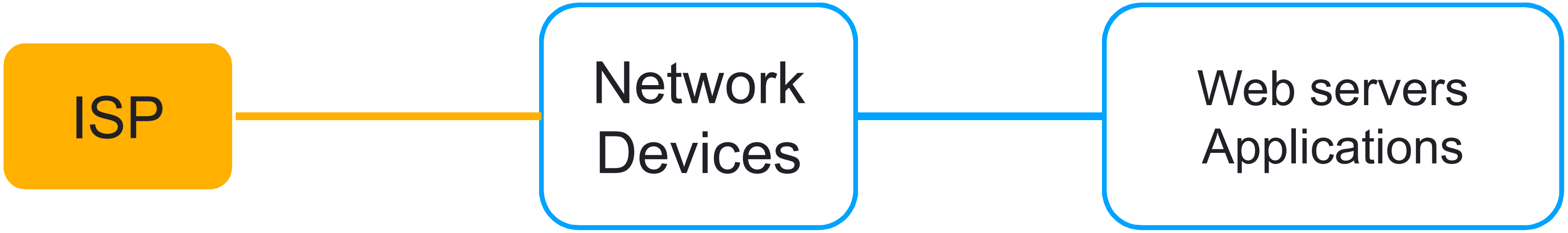
DDos Protection

Load Balancing & Failover

DDoS 101

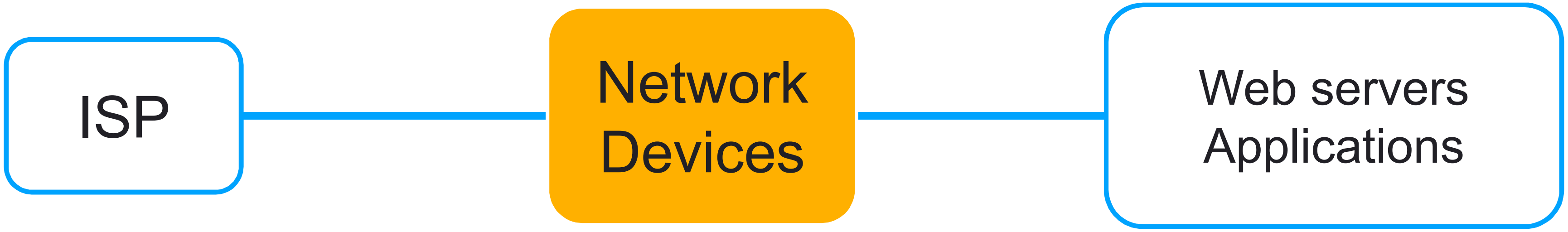


DDoS 101



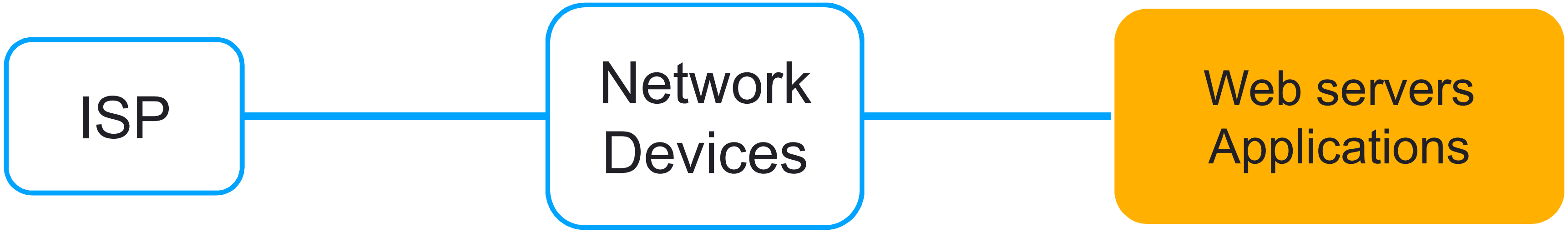
- **Volume Based Attacks**
  - **Method:** Include UDP floods, ICMP floods, and other spoofed packet floods.
  - **Objective:** Saturate the bandwidth of the attacked site.
  - **Magnitude**: Typically measured in Bits per second.

DDoS 101



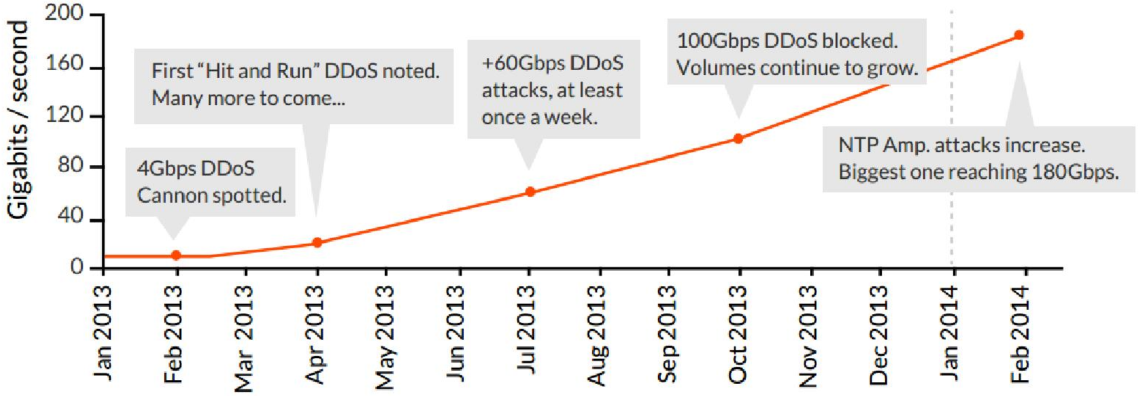
- **Protocol Attacks**:
  - > **Method:** Primarily SYN floods, but also fragmented packet attacks.
  - > **Objective:** Consume web server resources or intermediate communication equipment, such as firewalls and load balancers.
  - > **Magnitude :**These are usually measured in Packets per second.

DDoS 101



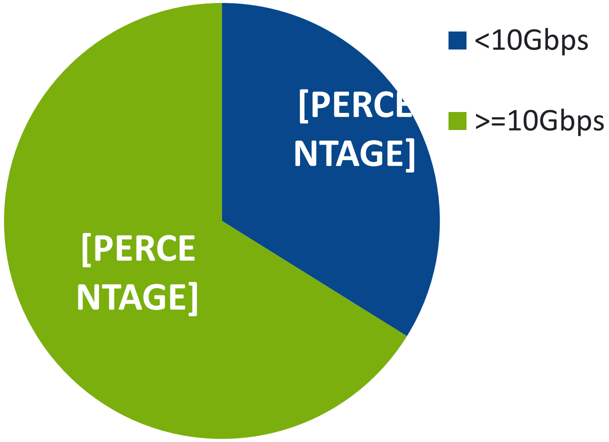
- **Application Layer Attacks**
  - **Method:** Unlike protocol attacks, these are comprised of legitimate and seemingly innocent requests.
  - **Objective:** Bring the application servers down.
  - **Magnitude:** Requests per second.

Where do we stand today?

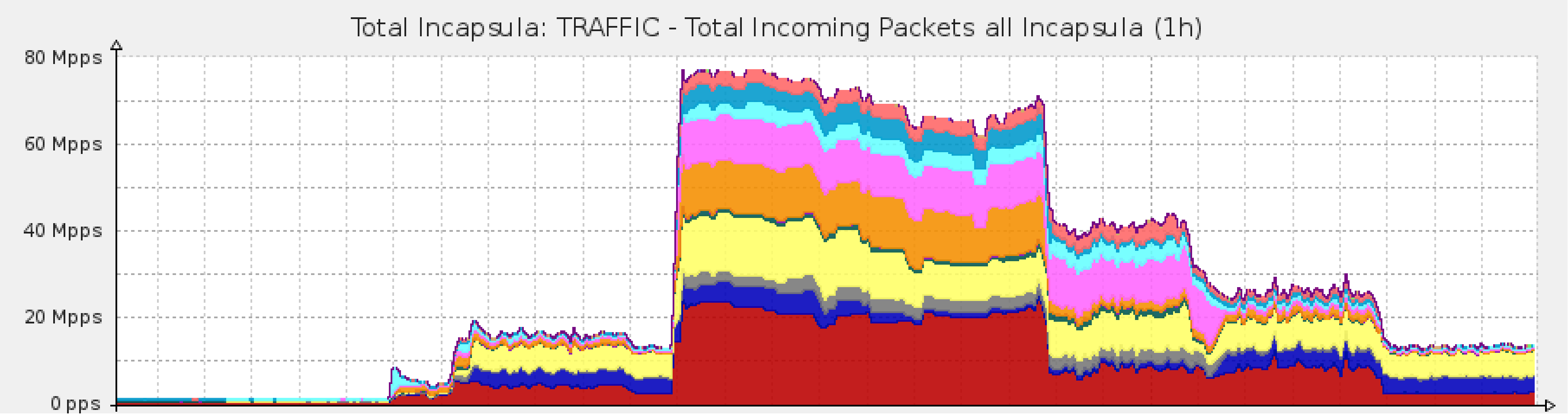


Attacks bandwidth is showing exponential growth

Two thirds of attacks exceed 10Gbps
More than 13% exceed 40Gbps

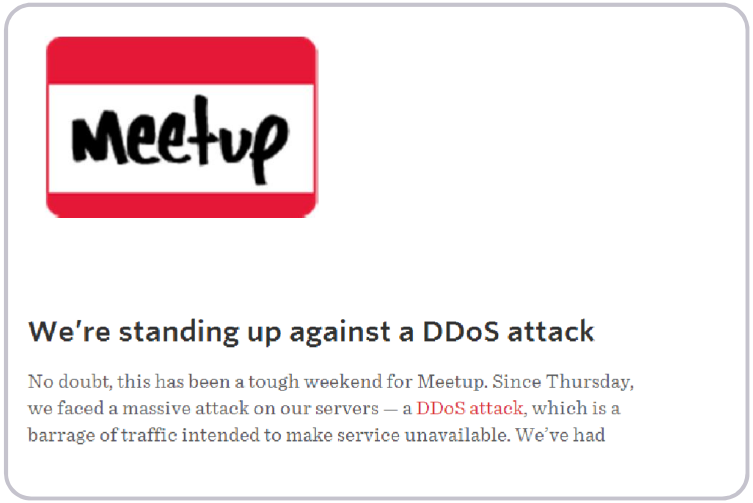


It’s not all bandwidth



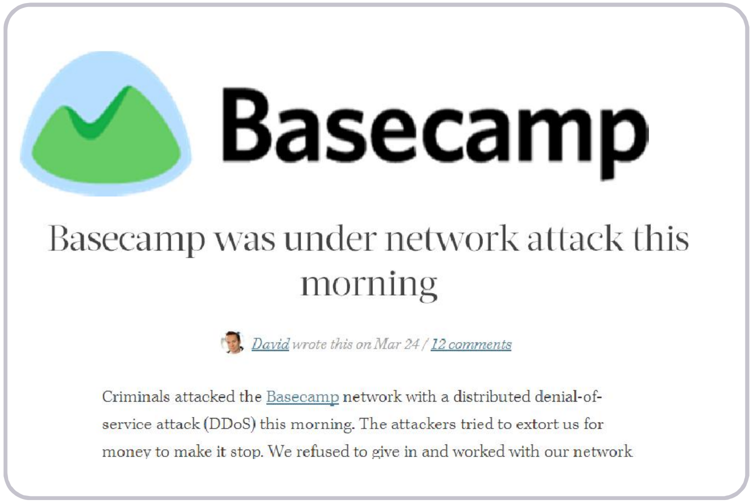
More than 25% of attacks exceed 10Mpps
Most IPS/IDS will crash at 5Mpps

Recent campaigns / SaaS applications



We're standing up against a DDoS attack

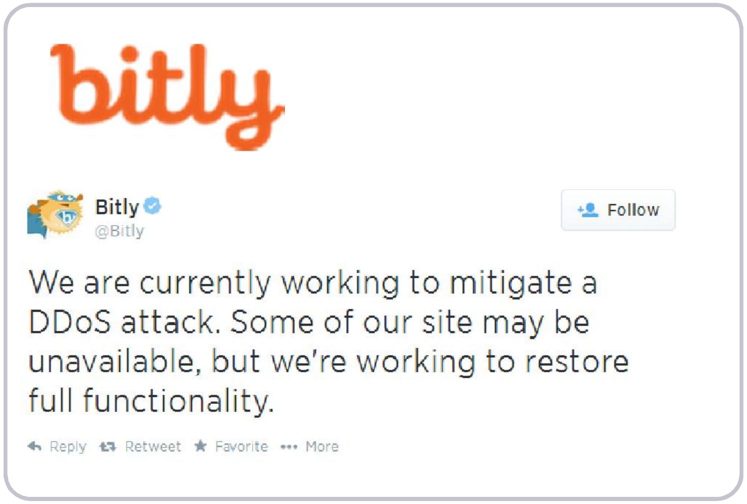
No doubt, this has been a tough weekend for Meetup. Since Thursday, we faced a massive attack on our servers — a DDoS attack, which is a barrage of traffic intended to make service unavailable. We've had



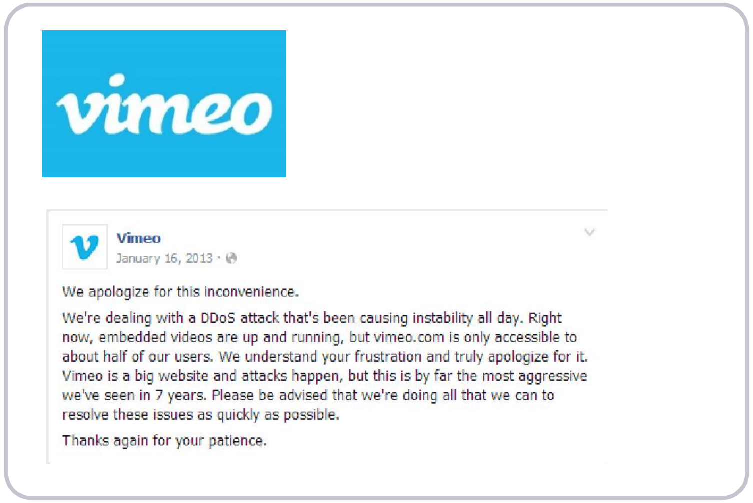
Basecamp was under network attack this morning

David wrote this on Mar 24 / 12 comments

Criminals attacked the Basecamp network with a distributed denial-of-service attack (DDoS) this morning. The attackers tried to extort us for money to make it stop. We refused to give in and worked with our network



We are currently working to mitigate a DDoS attack. Some of our site may be unavailable, but we're working to restore full functionality.



We apologize for this inconvenience.

We're dealing with a DDoS attack that's been causing instability all day. Right now, embedded videos are up and running, but vimeo.com is only accessible to about half of our users. We understand your frustration and truly apologize for it. Vimeo is a big website and attacks happen, but this is by far the most aggressive we've seen in 7 years. Please be advised that we're doing all that we can to resolve these issues as quickly as possible.

Thanks again for your patience.

How are attackers reaching these numbers?

- Are botnets becoming bigger?
  - No, according to www.shadowserver.org

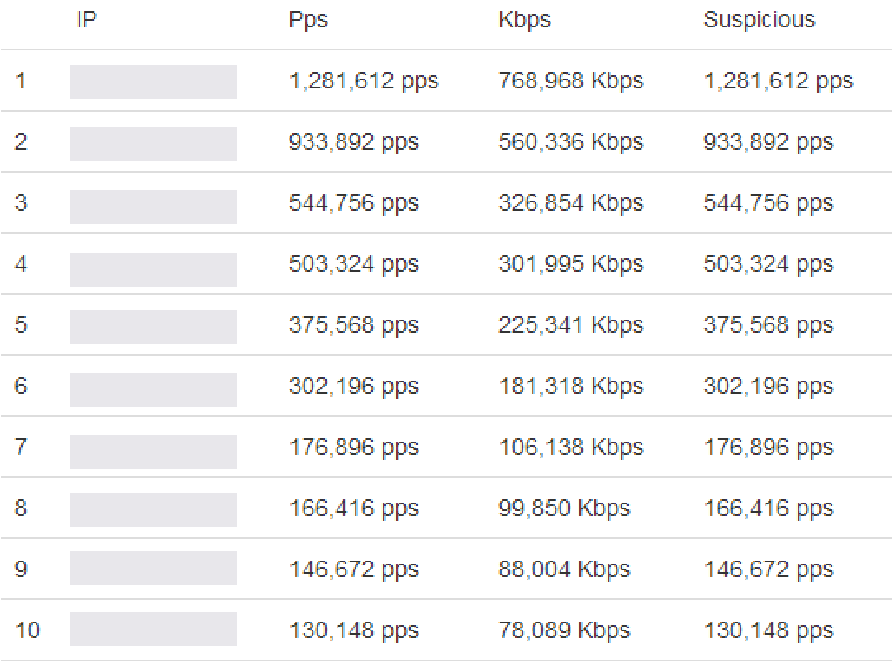
- Are there more open DNS resolvers?
  - No, the number is actually declining according to www.openresolverproject.org

- Are there more open NTP servers?
  - Probably not, www.openntpproject.org

- So what is it then?

How are attackers reaching these numbers?

- They are using bigger guns



	IP	Pps	Kbps	Suspicious
1	[redacted]	1,281,612 pps	768,968 Kbps	1,281,612 pps
2	[redacted]	933,892 pps	560,336 Kbps	933,892 pps
3	[redacted]	544,756 pps	326,854 Kbps	544,756 pps
4	[redacted]	503,324 pps	301,995 Kbps	503,324 pps
5	[redacted]	375,568 pps	225,341 Kbps	375,568 pps
6	[redacted]	302,196 pps	181,318 Kbps	302,196 pps
7	[redacted]	176,896 pps	106,138 Kbps	176,896 pps
8	[redacted]	166,416 pps	99,850 Kbps	166,416 pps
9	[redacted]	146,672 pps	88,004 Kbps	146,672 pps
10	[redacted]	130,148 pps	78,089 Kbps	130,148 pps

Example of a 4Mpps attack

Less than 30 IPs are generating more than 99% of the traffic

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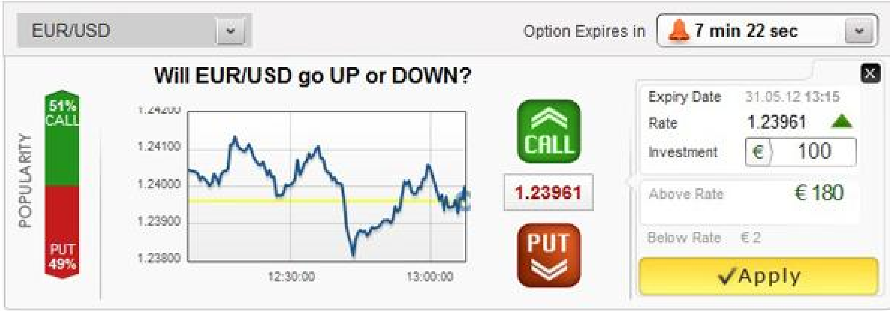
Peeling the Onion on One of the Most Sophisticated Attacks Ever Seen

The players

VS



Expiry Date 31.05.12 13:15

Rate 1.23961

Investment € 100

Above Rate € 180

Below Rate € 2

- Polish hackers

- Successful SaaS Platform
- Very competitive online trading industry

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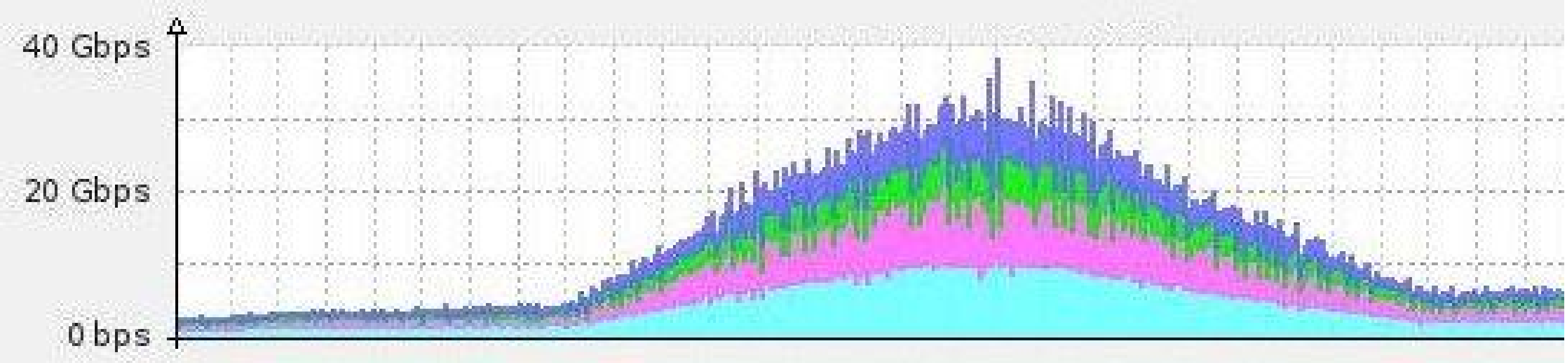
Round 1

FIRST BLOOD

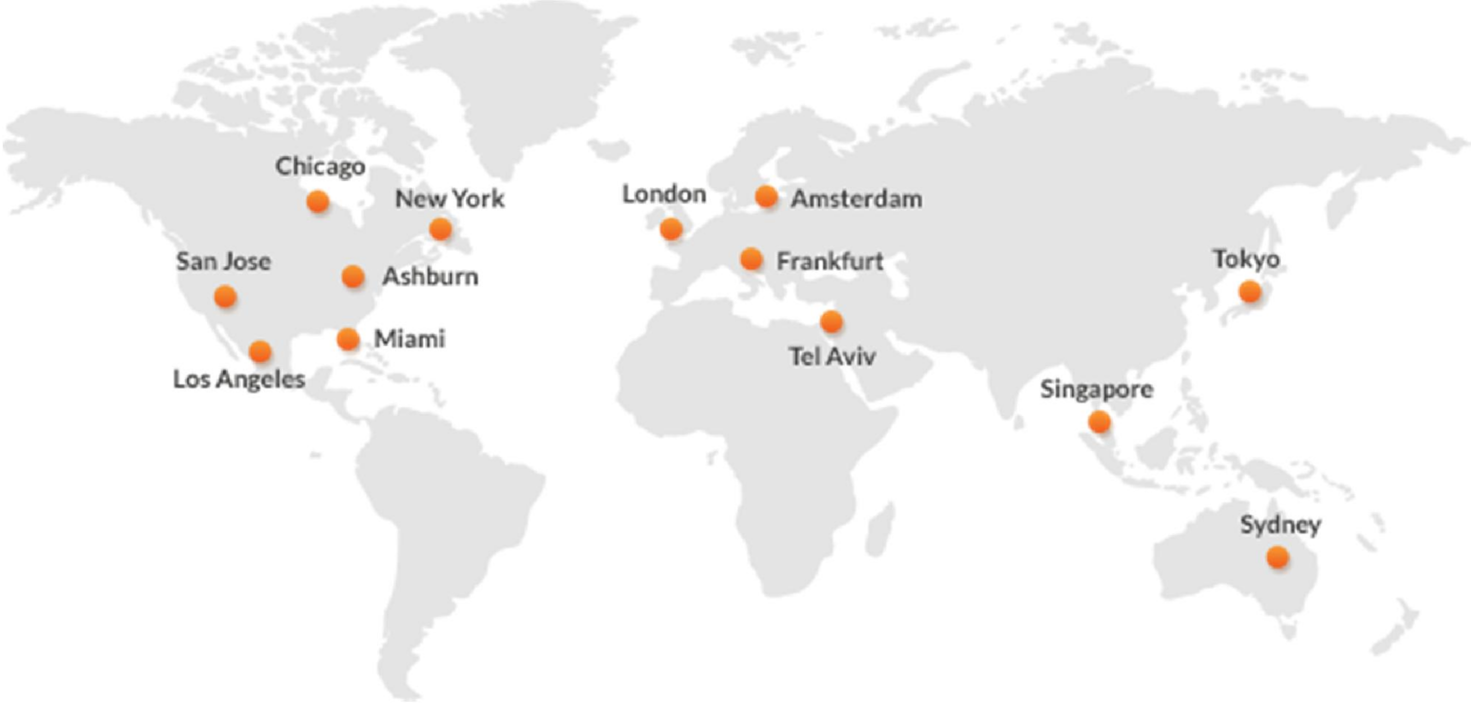
Round 1 - Volumetric Attack

- 30Gbps SYN Flood
- Typical of any DDoS attack
  - > Easy to perform (Given the resources)
- No amplification was used



Round 1 – Win, Geo distribution

- Geo Distribution of attack traffic (sharing the load)
- Dedicated networking capabilities to deal with volumetric attacks
- Aggressive blacklisting of offending IP addresses



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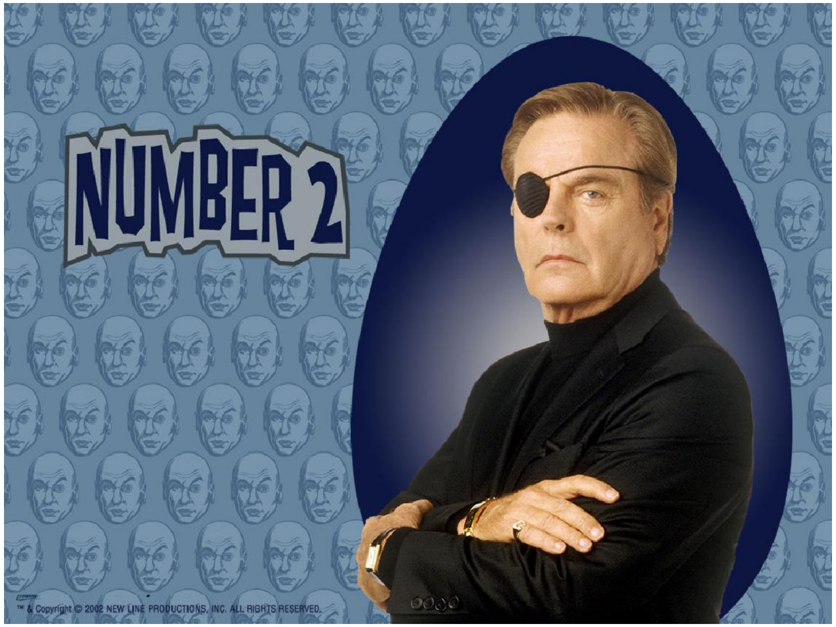
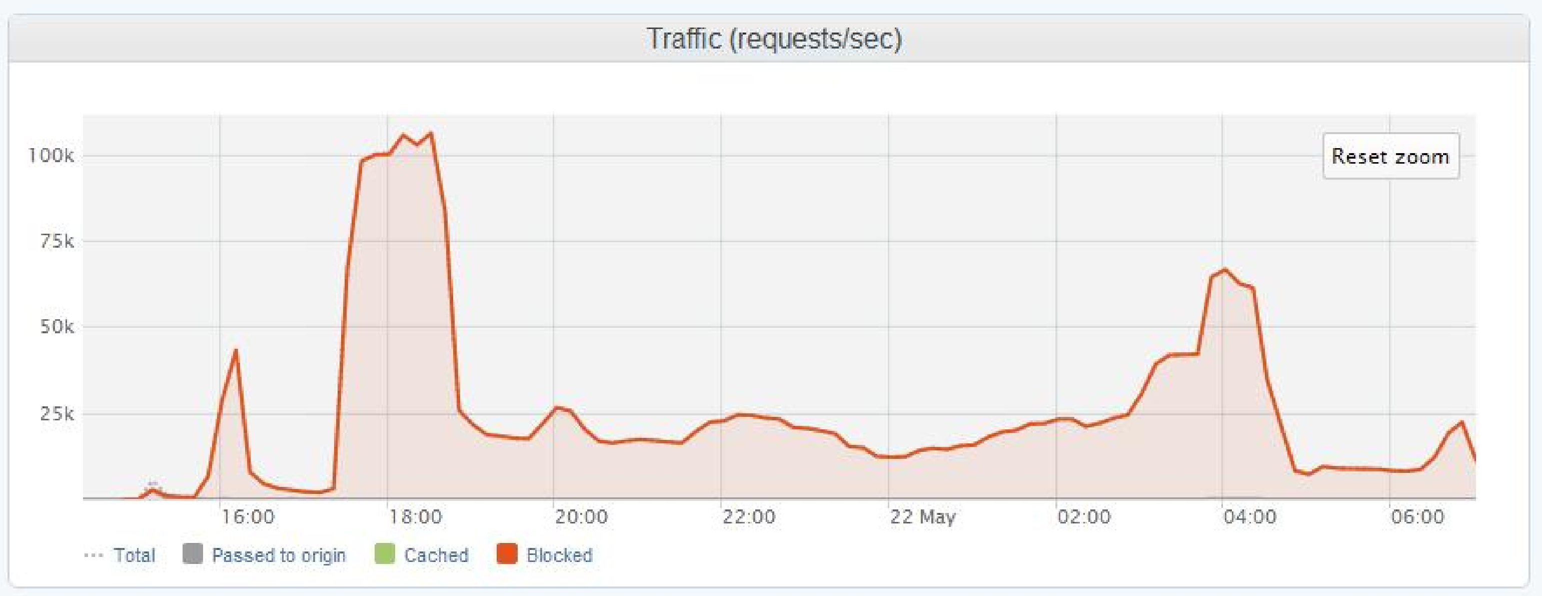
Round 2


NUMBER 2
™ & Copyright © 2002 NEW LINE PRODUCTIONS, INC. ALL RIGHTS RESERVED.

Round 2 – HTTP Flood

- Layer 7 - 100K Req/Sec
- Targeting "resource intensive" pages
- "The smoke screen"
  - > This type & level of attack persisted for weeks



Round 2 – Win, spot the bot

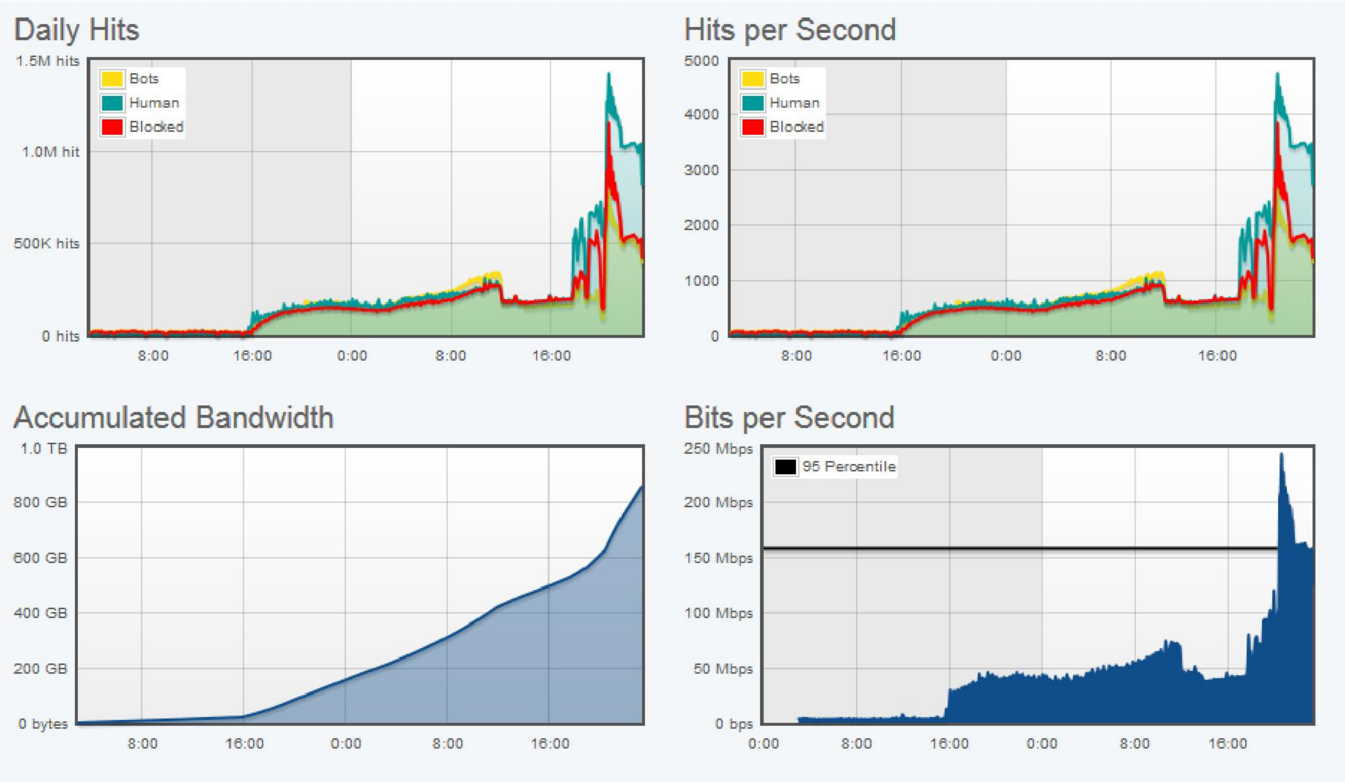
- Anti bot technology
- Non intrusive differentiation between legitimate browsers and bots
- Good bots vs. Bad bots
  - Google / Bing / Yandex / Baido = Good
  - DDoS agents = Bad

```
*********************

                ORG   $4000
A1              =     $3C
A2              =     $3E
A4              =     $42
AUXMOVE         =     $C311

******************************
* SETUP - move data for VTOC
* and catalog to auxmem at
* B000-B3FF (pseudo trk 11
* 0-3)
******************************
SETUP           LDA   #<VTOC
                STA   A1
                LDA   #>VTOC
                STA   A1+1
                LDA   #<END
                STA   A2
                LDA   #>END
                STA   A2+1
                LDA   #$00
                STA   A4
                LDA   #$B0
                STA   A4+1
                SEC
                JMP   AUXMOVE

                DS    4
***************
```

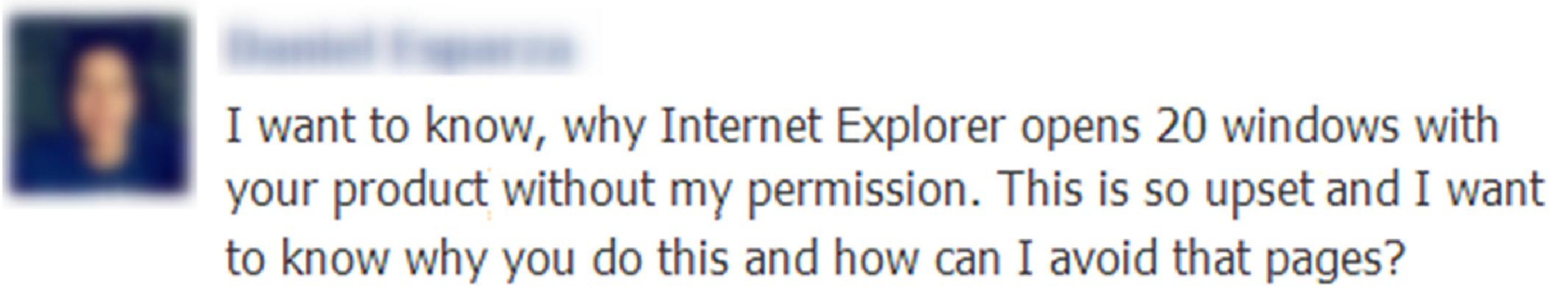
Round 3

Round 3 – Real browsers on call

- **Legit traffic?**



Round 3 – Real browsers on call

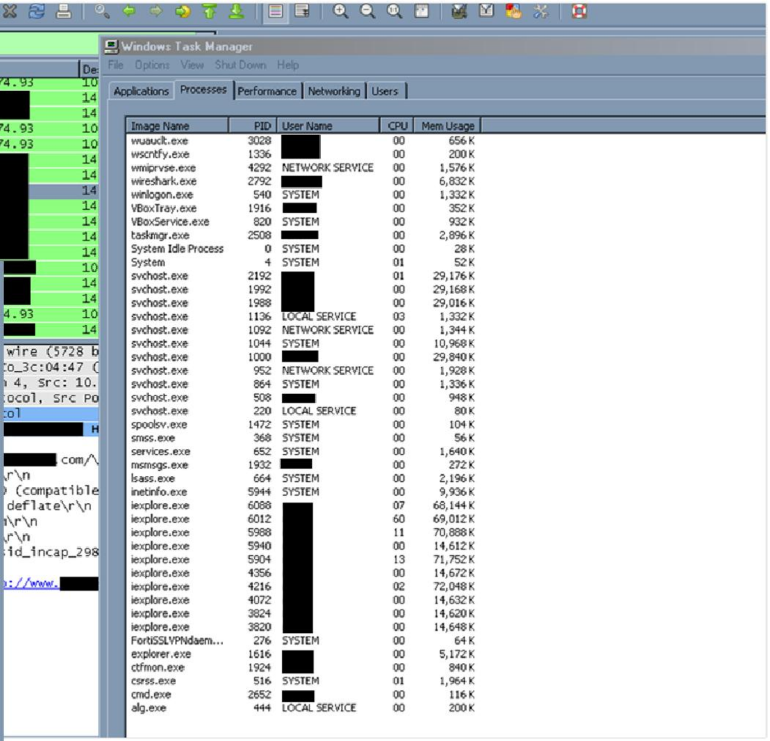


[redacted]

I want to know, why Internet Explorer opens 20 windows with your product without my permission. This is so upset and I want to know why you do this and how can I avoid that pages?

Round 3 – Win, Pushdo CAPTCHA

We got one! It's Pushdo

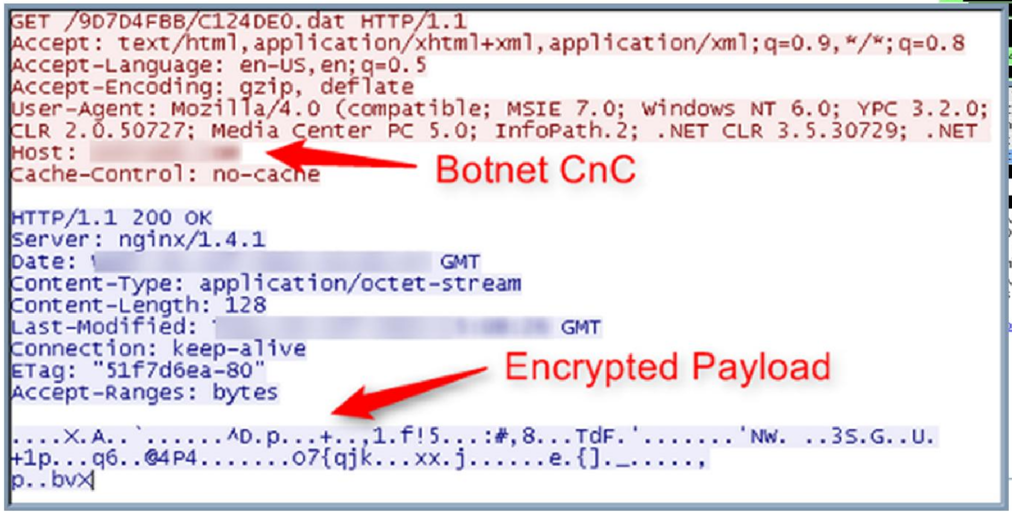


Windows Task Manager
File Options View Shut Down Help
Applications Processes Performance Networking Users

```
Source          De
149.126.74.93   10
10.[redacted]   14
10.             14
149.126.74.93   10
149.126.74.93   10
10.[redacted]   14
10.             14
10.             14
10.             14
10.             14
10.             14
10.             14
[redacted]      10
[redacted]      14
                14
4.93            10
[redacted]      14

wire (5728 b
to_3c:04:47 (
n 4, Src: 10.
tocol, Src Po
col
[redacted] H

[redacted].com/\
\r\n
) (compatible
 deflate\r\n
n\r\n
\r\n
id_incap_298

p://www.[redacted]
```

Image Name	PID	User Name	CPU	Mem Usage
wuauclt.exe	3028	[redacted]	00	656 K
wscntfy.exe	1336	[redacted]	00	200 K
wmiprvse.exe	4292	NETWORK SERVICE	00	1,576 K
wireshark.exe	2792	[redacted]	00	6,832 K
winlogon.exe	540	SYSTEM	00	1,332 K
VBoxTray.exe	1916	[redacted]	00	352 K
VBoxService.exe	820	SYSTEM	00	932 K
taskmgr.exe	2508	[redacted]	00	2,896 K
System Idle Process	0	SYSTEM	00	28 K
System	4	SYSTEM	01	52 K
svchost.exe	2192	[redacted]	01	29,176 K
svchost.exe	1992	[redacted]	00	29,168 K
svchost.exe	1988	[redacted]	00	29,016 K
svchost.exe	1136	LOCAL SERVICE	03	1,332 K
svchost.exe	1092	NETWORK SERVICE	00	1,344 K
svchost.exe	1044	SYSTEM	00	10,968 K
svchost.exe	1000	[redacted]	00	29,840 K
svchost.exe	952	NETWORK SERVICE	00	1,928 K
svchost.exe	864	SYSTEM	00	1,336 K
svchost.exe	508	[redacted]	00	948 K
svchost.exe	220	LOCAL SERVICE	00	80 K
spoolsv.exe	1472	SYSTEM	00	104 K
smss.exe	368	SYSTEM	00	56 K
services.exe	652	SYSTEM	00	1,640 K
msmsgs.exe	1932	[redacted]	00	272 K
lsass.exe	664	SYSTEM	00	2,196 K
inetinfo.exe	5944	SYSTEM	00	9,936 K
iexplore.exe	6088	[redacted]	07	68,144 K
iexplore.exe	6012	[redacted]	60	69,012 K
iexplore.exe	5988	[redacted]	11	70,888 K
iexplore.exe	5940	[redacted]	00	14,612 K
iexplore.exe	5904	[redacted]	13	71,752 K
iexplore.exe	4356	[redacted]	00	14,672 K
iexplore.exe	4216	[redacted]	02	72,048 K
iexplore.exe	4072	[redacted]	00	14,632 K
iexplore.exe	3824	[redacted]	00	14,620 K
iexplore.exe	3820	[redacted]	00	14,648 K
FortiSSLVPNdaem...	276	SYSTEM	00	64 K
explorer.exe	1616	[redacted]	00	5,172 K
ctfmon.exe	1924	[redacted]	00	840 K
csrss.exe	516	SYSTEM	01	1,964 K
cmd.exe	2652	[redacted]	00	116 K
alg.exe	444	LOCAL SERVICE	00	200 K

O look, it's calling home



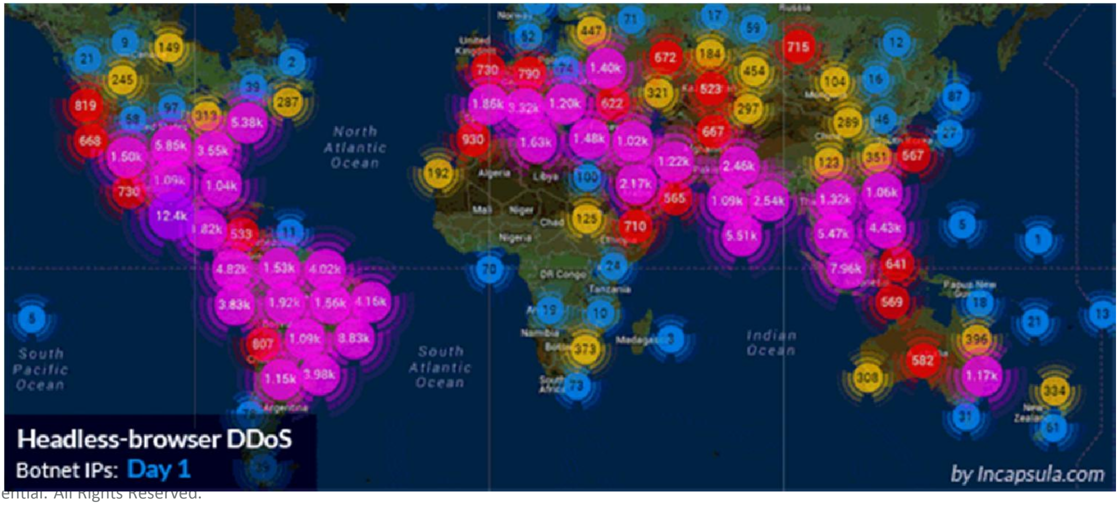
```
GET /9D7D4FBB/C124DE0.dat HTTP/1.1
Accept: text/html,application/xhtml+xml,application/xml;q=0.9,*/*;q=0.8
Accept-Language: en-US,en;q=0.5
Accept-Encoding: gzip, deflate
User-Agent: Mozilla/4.0 (compatible; MSIE 7.0; Windows NT 6.0; YPC 3.2.0;
CLR 2.0.50727; Media Center PC 5.0; InfoPath.2; .NET CLR 3.5.30729; .NET
Host: [redacted]
Cache-Control: no-cache

HTTP/1.1 200 OK
Server: nginx/1.4.1
Date: [redacted] GMT
Content-Type: application/octet-stream
Content-Length: 128
Last-Modified: [redacted] GMT
Connection: keep-alive
ETag: "51f7d6ea-80"
Accept-Ranges: bytes

....X.A..`.......^D.p...+...1.f!5...:#,8...TdF.'.......'NW. ..3S.G..U.
+1p...q6..@4P4.......07{qjk...xx.j......e.{]._.....,
p..bvX
```

Round 4

Round 4 – Headless Browsers

PhantomJS

- **Headless browsers leveraging Phantom JS were being used to emulate real users**
  - > **Generating 700 Million requests / Day**

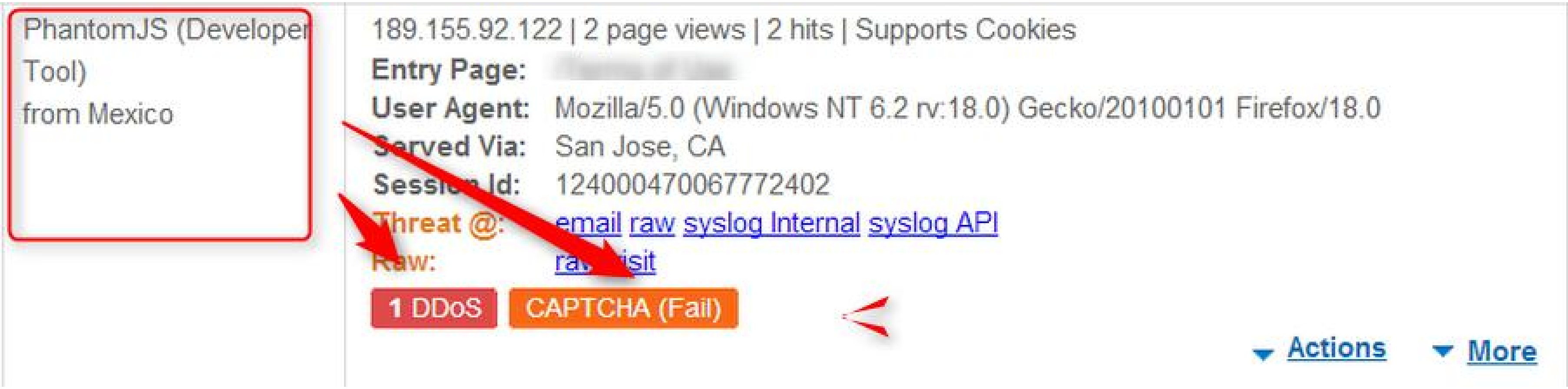


Headless-browser DDoS
Botnet IPs: Day 1

by Incapsula.com

Round 4 – Win, Phantom JS fingerprinting

- Reverse engineering Phantom JS Kit
- Crafting a signature to identify all bots using the kit



PhantomJS (Developer Tool)
from Mexico

189.155.92.122 | 2 page views | 2 hits | Supports Cookies

Entry Page: [redacted]

User Agent: Mozilla/5.0 (Windows NT 6.2 rv:18.0) Gecko/20100101 Firefox/18.0

Served Via: San Jose, CA

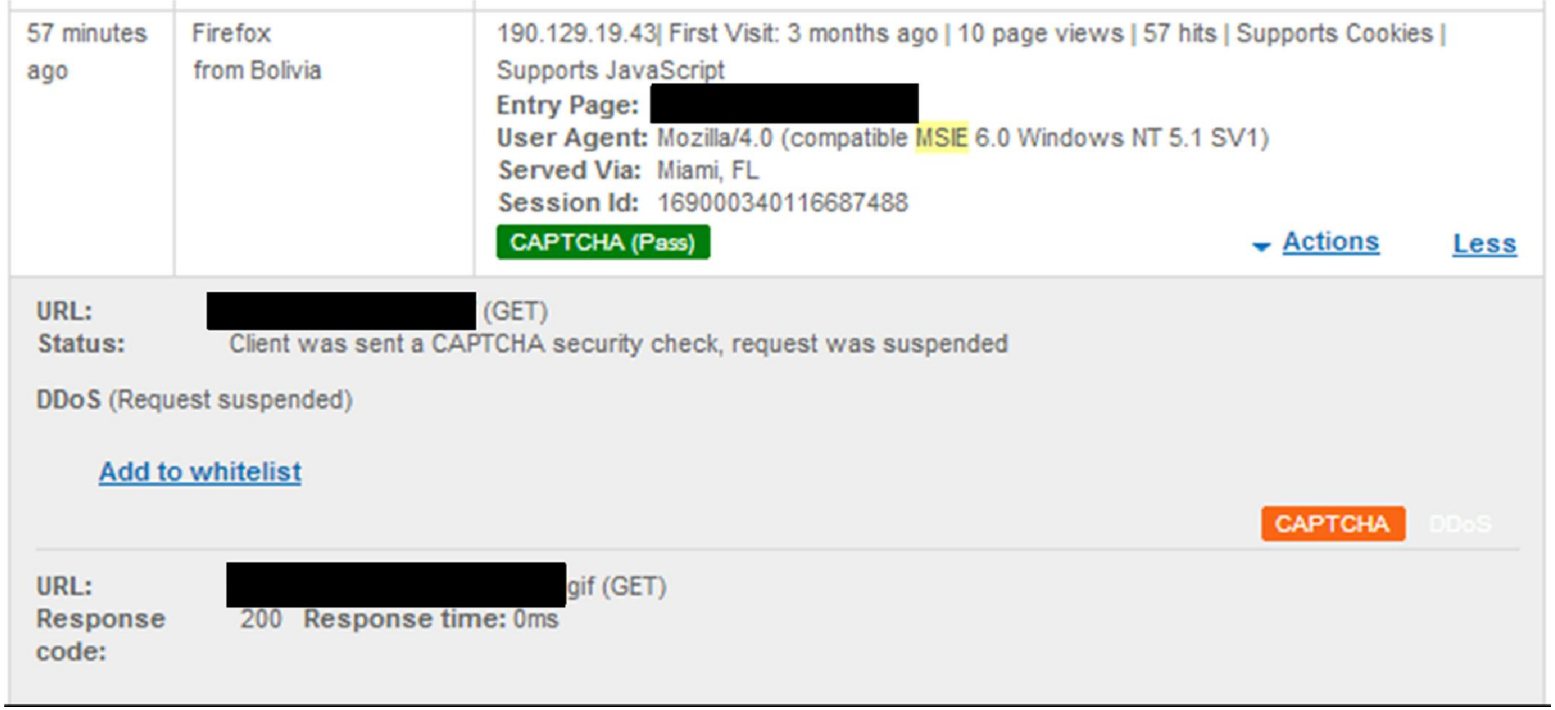
Session Id: 124000470067772402

Threat @: email raw syslog Internal syslog API

Raw: raw visit

Round 5

Round 5 – CAPTCHA solving Firefox???



57 minutes ago

Firefox from Bolivia

190.129.19.43| First Visit: 3 months ago | 10 page views | 57 hits | Supports Cookies | Supports JavaScript

Entry Page: [redacted]

User Agent: Mozilla/4.0 (compatible MSIE 6.0 Windows NT 5.1 SV1)

Served Via: Miami, FL

Session Id: 169000340116687488

URL: [redacted] (GET)

Status: Client was sent a CAPTCHA security check, request was suspended

DDoS (Request suspended)

Add to whitelist

URL: [redacted] gif (GET)

Response code: 200 **Response time:** 0ms

- **Yes, CAPTCHA solving Firefox!**

Round 5 – Win, Javascript injection to the rescue

- Added some JavaScript to the CAPTCHA page template
- The JavaScript logs the user typing the CAPTCHA challenge
- A-Ha! The attackers are not typing the CAPTCHA

Round 5 – Adaptation

- A week later, attackers are typing CAPTCHA☹

Round 5 – Win, Javascript injection to the rescue

- HEHE! Typing Slow ☺

- Seems it takes them more than a minute to start typing the CAPTCHA

- Added a JS that puts a time limit on the CAPTCHA

Round 5 – Adaptation

- The clients that manage to be quick still cause damage
- Randomizing URLs

Round 5 – How we won

- Tracking DDoS botnets – Same botnet is used to launch the Firefox attacks
- ~200K unique IP per day

The aftermath

- DDoS can resemble APTs
- Visibility is crucial
- Analyzing different levels of the interaction is crucial
- Reacting fast is crucial

Thank you

Please send follow up questions to eldad@incapsula.com