Imperva's Hacker Intelligence Summary Report

The Anatomy of an Anonymous Attack

Executive Summary

During 2011, Imperva witnessed an assault by the hacktivist group 'Anonymous' that lasted 25 days. Our observations give insightful information on Anonymous, including a detailed analysis of hacking methods, as well as an examination of how social media provides a communications platform for recruitment and attack coordination. Hacktivism has grown dramatically in the past year and has become a priority for security organizations worldwide. Understanding Anonymous' attack methods will help organizations prepare if they are ever a target.

Our observation of an Anonymous campaign reveals:

- The process used by Anonymous to pick victims as well as recruit and use needed hacking talent.
- How Anonymous leverages social networks to recruit members and promotes hack campaigns.
- The specific cyber reconnaissance and attack methods used by Anonymous' hackers. We detail and sequence the steps Anonymous hackers deploy that cause data breaches and bring down websites.

Finally, we recommend key mitigation steps that organizations need to help protect against attacks.

Methodology

This report is based on an Anonymous attack observed by the Imperva Application Defense Center. The target organization of the attack had a Web application firewall deployed which recorded and repelled the attacks. By analyzing traffic logs, we analyzed the attacks on these applications and categorized them according to the attack method, as well as identified patterns and trends within these attacks. We also analyzed Anonymous social media communications in the days leading up to and after the attack. We believe this is the first end-to-end record of a full Anonymous attack.

The attack took place in 2011. However, to protect against another Anonymous attack of this organization, we want the organization that was attacked – sorry, pun unavoidable – to remain anonymous.

The Plot

In 2011, Anonymous made headlines worldwide as it grew globally. Anonymous attacked organizations in numerous countries worldwide. Attacks fell into two categories:

- **Reactive:** In this case, some incident inspired the members of Anonymous to attack a target. For example, when MasterCard, Visa and others stopped allowing payments to Wikileaks, Anonymous began Operation Payback intended to bring down websites with excessive traffic. When BART police blocked the use of cell phones in certain stations, Anonymous hacked into BART computers, exposing the data of dozens of employees.
- **Proactive:** In this case, Anonymous announces an intention to attack a target. Significantly less common, there have only been a few incidents. For example, threats against Facebook and Mexican drug lords were made, but attacks either fizzled or never even materialized. It is difficult to estimate how many proactive attacks have occurred since, like terrorist attacks; only successful campaigns become public.

The attack Imperva witnessed during 2011 was the proactive variety. In this case, Anonymous hoped to disrupt an event that would take place on a specific date. A website designed to support the event enabled e-commerce and information dissemination would become Anonymous' target. Though we cannot identify the target, it is a large, well-known organization.

The attack occurred over a period of 25 days in three phases. The first phase, recruiting and communications, a small group of instigators elicited support and recruit for an attack, as members of Anonymous created a website rationalizing an attack on their target. Twitter and Facebook promoted traffic to this site. Additionally, YouTube videos were produced to help rationalize attacks. Once a critical mass was achieved, the second phase, reconnaissance and application attack, could begin. During this phase, around 10 to 15 skilled hackers probed the website's applications in an effort to identify weaknesses that could lead to a data breach. The third and final phase was a distributed denial of service (DDoS). Having failed to expose data, hackers obtained help from Anonymous' nontechnical members. Several hundred to a few thousand people either downloaded attack software (such as was done in Operation Payback) or went to custom-built websites that perform DDoS attacks. When this failed, the attack ended.

Introduction: What have we learned about Anonymous?

Over the past 18 months, Anonymous began a new age of hacktivism. Although the results are well known – publicly exposed data and interrupted web services – the methods are much less clear. Our findings show:

- **Anonymous hackers are real people with real techniques – but they use conventional black hat methods and technologies.** In fact, Anonymous' hacking methods very much mirror what profiteering hackers do daily. For example, Anonymous hackers use many of the same tools for hacking, such as Havij, a SQL injection tool (probably invented in Iran[1]) designed to penetrate applications and steal data. In other words, they are able to take advantage of common application vulnerabilities found in many websites, the same thing that fuels today's black market, data-driven cyber crime economy. The main innovation seen from Anonymous is the creation of many websites that perform denial of service attacks.
- **Anonymous will try to steal data first and, if that fails, attempt a DDoS attack.** The first major attack by Anonymous in December 2010, Operation Payback, was a DDoS attack targeting PayPal, Visa, MasterCard and others. Though the attack attracted a lot of attention, it failed to disrupt these companies' operations. Other attacks, such as Sony (and whether that was the work of Anonymous is not clear), succeeded because data was exposed. The impact? Sony suffered a public relations debacle in the period following the data exposure. The lesson was not lost on Anonymous who continued with data-centric attacks on PBS, BART, and other organizations.
- **The Anonymous hackers are comprised of two types of volunteers:**
  - **Skilled hackers** – In this campaign, we witnessed a small group of skilled hackers. In total, this group numbered no more than 10 to 15 individuals. Given their display of hacking skills, one can surmise that they have genuine hacking experience and are quite savvy.
  - **Laypeople** – This group can be quite large, ranging from a few dozen to a few hundred volunteers. Directed by the skilled hackers, their role is primarily to conduct DDoS attacks by either downloading and using special software or visiting websites designed to flood victims with excessive traffic. The technical skills required range from very low to modest.

    In this incident, there was about a 10:1 ratio of laypeople to skilled hackers.
- **Anonymous hacking operation fell into three distinctive phases:**
  1. **Recruiting and communications phase (Day 1-18)** – In this phase, Anonymous leverages social media to recruit members and promotes messages and campaigns. In particular, they use Twitter, Facebook, and YouTube to suggest and justify an attack. If a sufficient number of volunteers are persuaded to participate, the skilled hackers begin initial reconnaissance.
  2. **Reconnaissance and application attack phase (Day 19-22)** – During this phase, the skilled hackers carefully hide their true identity and place of operation. They probe applications in an effort to identify weaknesses that could lead to a data breach. They use common vulnerability assessment tools, such as Acunetix, to identify potential holes that could lead to data theft.

     During this phase, skilled hackers raise the bar and use attack software specifically designed to take data. As mentioned previously, one tool, probably developed in Iran, conducts a high volume of SQL injection attacks. Havij picks up where traditional penetration testing tools stop, actually performing data extraction and harvesting instead of just pointing to potential vulnerabilities.
  3. **DDoS phase (Day 24-25)** – If data breach attempts fail, the skilled hackers elicit help from the laypeople. At this point, a large volume of individuals download attack software such as was done in Operation Payback or go to custom-built websites that perform DDoS attacks.

[1] Havij in Farsi means "carrot" and is used in Iran as slang for the male sexual organ.

- **They have developed some custom-attack software that can be used on computers as well as mobile devices.** In the past, they refined an open-source stress testing/DDoS tool to develop the so-called low-orbit ion canon (LOIC). In this case, they also developed a DDoS tool that allows users to attack sites with mobile browsers. However, their mobile tool, though innovative, is not complicated. In fact, it is probably just a few hundred lines of Javascript codek, which enables any device – PC, Apple, mobile device – to perform an attack by virtue of just having a web browser.

  In this attack, Anonymous created a web page that contains a Javascript. The script iterates endlessly (as long as the page is open in the browser) and generates a new image attribute. The source of the image is the victim's web page, and the script creates multiple requests to the victims' website as the page is rendered by the browser. In other words, all it takes for an attacker to participate in the attack is to browse to the specific web-page and leave the page open. No need to install or download any software. This is what makes this technique so simple to use, as opposed to other methods. Since the code is written in Javascript, it enables any device equipped with a standard browser to take part in the attack – and indeed we have seen mobile devices participating in the attack.

- **Attack velocity is critical.** Anonymous can't attack at will. Rather, Anonymous is subject to the dynamics of crowd-sourced hacking. This means someone must make a compelling case for attack, which requires persuasion and recruitment. This takes time – and if there's a specific event to disrupt – then a deadline looms. From a hacking perspective, this restricts the available hacking activity to taking targeted shots as opposed to setting cyber traps. This is in strong contrast to the hacking methods of government-sponsored hackers who can be more patient. For example these groups rely heavily on phishing, whereas Anonymous does not.

- **Anonymous uses inexpensive, off-the-shelf tools as opposed to inventing new techniques or developing complex attacks.** Advanced, hard-to-detect attacks are a hallmark of government-sponsored cyber attacks – but this is not the case with Anonymous. Their use of off-the-shelf-attack tools that are commonly used and cheap – in some cases free – to acquire. A typical Anonymous attack requires virtually no financial investment.

- **There are several key differences with profiteering hackers.** The crowd-sourced hacking model restricts the use of several commonly used hacking techniques, including:
  - **Sporadic use of bots** – Bots are typically rented, incurring a cost. Since Anonymous relies on volunteers, bots are not always available. In the campaign we observed, no bots were used. Analyses of chat discussions for other Anonymous campaigns, such as Operation Payback, shows that sometimes hackers have offered to use their bot armies to help conduct attacks, though no direct evidence exists that they were used.
  - **No reliance on malware** – There is no current evidence that Anonymous has ever deployed malware. In the event we observed, malware was not used.
  - **No phishing or spear phishing** – Developing alluring emails with malware attachments or malicious links typically takes time to execute. This does not fit into Anonymous' need to conduct rapid attacks.
  - **Public recruitment phase** – In private hacking, recruitment takes place on hacker forums, typically in private communications. By contrast, Anonymous recruits through social media outlets in broad, public view. For security teams, this gives time to anticipate attacks if diligence is devoted to monitoring social media.

How can companies prepare for an Anonymous attack?

If companies are prepared against application layer attacks and have put in place solid defenses to mitigate SQL injection, cross site scripting, local file inclusion and DDoS, then such enterprises will be well prepped against Anonymous.

What are the lessons?

- **Any high profile organization can be a target.** There is not a lot of consistency to Anonymous' campaigns, their targets include a wide range including religious organizations, pornography sites, consumer electronics firms, banks, Mexican drug lords, law enforcement, and government.

- **The threat is real if applications are vulnerable.** Using good app security standards, potential targets can reduce their risk.

Anonymous' Brazilian Flavor

Brazil is famous for many things: Ayrton Senna, jiu-jitsu and caipirinhas. In cyber security, however, Brazil may add hacktivism to the list. Though unrelated to the incident, which is the subject of this report, Brazil's experience with hacktivism sheds light on how it is born and then thrives.

In the past twelve months, we have seen an increase in high-profile hacktivism in Brazil. Note the recent, high volume of Anonymous attacks on several government and private enterprises. Starting in May 2011, TIM Mobile Operator suffered a DDoS attack linked to Anonymous.[2] Next month, inspired by the World Wide #AntiSec Operation, LulzSecBrasil was formed. Wasting little time, they attacked websites belonging to Brazil's President, Brazil's biggest gas and oil firm Petrobras, Brazil's tax agency (Receita Federal), the Ministry of Sports, and Brazil's biggest newspaper, *Rede Globo*. The group also disclosed the personal information of Brazilian president, Dilma Rousseff and Mayor of São Paulo, Gilberto Kassab.[3]

A month later, Brazilian LulzSec ceased operating. This opened the door for Anonymous Brazil. They quickly hacked a Brazilian Federal Police Agent and some of her e-mails were leaked and exposed online. Credentials from Petrobras employees and Municipal Chambers of Uberlandia were leaked and exposed. Several Brazilian political parties now were targeted and had their websites hacked.[4] In January 2012, a total of nine major bank or government agencies were attacked, including Ciello (Visa in Brazil), Citibank Brazil,[5] Banco Central, Caixa Economica Federal, HSBC, Bank Itau and Bradesco.[6]

Why is hacktivism hitting Brazil with such intensity? Short answer: Twitter. Today, Brazil ranks second after the US in Twitter usage. Ironically, the widespread use of Twitter has given hacktivism an elevated communications platform for recruitment.

First, a note on some socioeconomic history in Brazil as it pertains to internet use. A *Time* magazine article from 2010 observed:

> *Much of Brazil's transformation can be seen through the spread of telecommunications and the growth of social media. With telephone landlines once the preserve of wealthy elites, millions have turned over the years to mobile phones as their primary connection. That shift worked well with Twitter, which entered the Brazilian market first as an SMS service. To confront the gap between rich and poor, both the government and private NGOs sought to introduce computer technology to the poorest classes as early as the beginning of the 1990s. "Brazil was a pioneer in creating democratic access to computers and Internet for the poor, well ahead of the United States," says Green. And while many favelas are still excluded from the electric grid, the country's "Popular PC Project" of installing cheap computers in poorer areas has become a model the world over.*

How has this translated into hacktivism? When hacktivism first started, hacktivists attracted the attention of many Brazilians. More importantly, many of the hacktivist targets, Brazilians perceived, deserved attack. In the minds of many Brazilians, the cyber mayhem was no crime.

Anonymous Brazil touched a populist nerve. The main innovation? They made DDoS accessible to the masses. Anyone with a browser – even a mobile browser – could participate in an attack. You could see the fruits of your labor as target sites went down with a populist cyber riot. No pitchfork required.

Are there any lessons for countries to learn? While no two countries are identical culturally or economically, there are some factors to consider. Clearly, having strong government or corporate resentment in a population is a key factor – it's hard to see the same dynamic ever occurring in Norway. Second, monitoring Twitter will be a critical corporate and law enforcement activity. Recently, the FBI issued an request for information for social media monitoring.[7] It's a safe bet that Brazilian enterprises will be doing the same – if they aren't already.

[2] https://twitter.com/#!/Anony_Ops/status/65303916757266432
[3] http://g1.globo.com/tecnologia/noticia/2011/06/hackers-divulgam-supostos-dados-de-politicos-na-internet.html
[4] http://www1.folha.uol.com.br/poder/934535-policia-federal-investiga-ataques-de-hackers.shtml
[5] http://online.wsj.com/article/SB10001424052970203889904577200964142208498.html?mod=WSJ_Tech_LEFTTopNews
[6] http://topstories.foxnews.mobi/quickPage.html?page=17224&external=1313500.proteus.fma&pageNum=-1
[7] https://www.fbo.gov/index?s=opportunity&mode=form&id=c65777356334dab8685984fa74bfd636&tab=core&_cview=1

Attack Timeline

In 2011, a branch of Anonymous launched a hacktivism campaign. Imperva's ADC team was able to obtain and analyze the attack traffic from start to end.

Our research concludes that the attack consisted of three phases:

› **Recruiting and communications phase (Day 1-18)** – This is really the essence of all hacktivism campaigns. The raison d'être of hacktivism is to attract attention to a cause, so this phase is critical. Messages were spread via social media applications, in particular, Facebook, Twitter and YouTube.

The content during this phase:

- Explained their political agenda for the campaign. In this case, a website was created that rationalized the attack. Twitter and Facebook were used to bring attention to the website and its arguments. Further, YouTube videos further rationalized the attack by denigrating the target and exposing perceived transgressions.
- Declared the dates and targets of protest to recruit protesters and hackers.

› **Reconnaissance phase and application attack phase (day 19-22)** – A few days before the attack's "D-Day", a group of savvy hackers conducted a survey on the security of the target website. This phase lasted three days.

The reconnaissance group members:

- Had knowledge of hacking tools.
- Used anonymity services to disguise their identity.
- Used just a few attack sources (compared to the attack phase).
- Kept a low profile. Their attack traffic levels during this phase were relatively low, especially when compared to the attack phase. However, the reconnaissance traffic was relatively high compared to ordinary days.

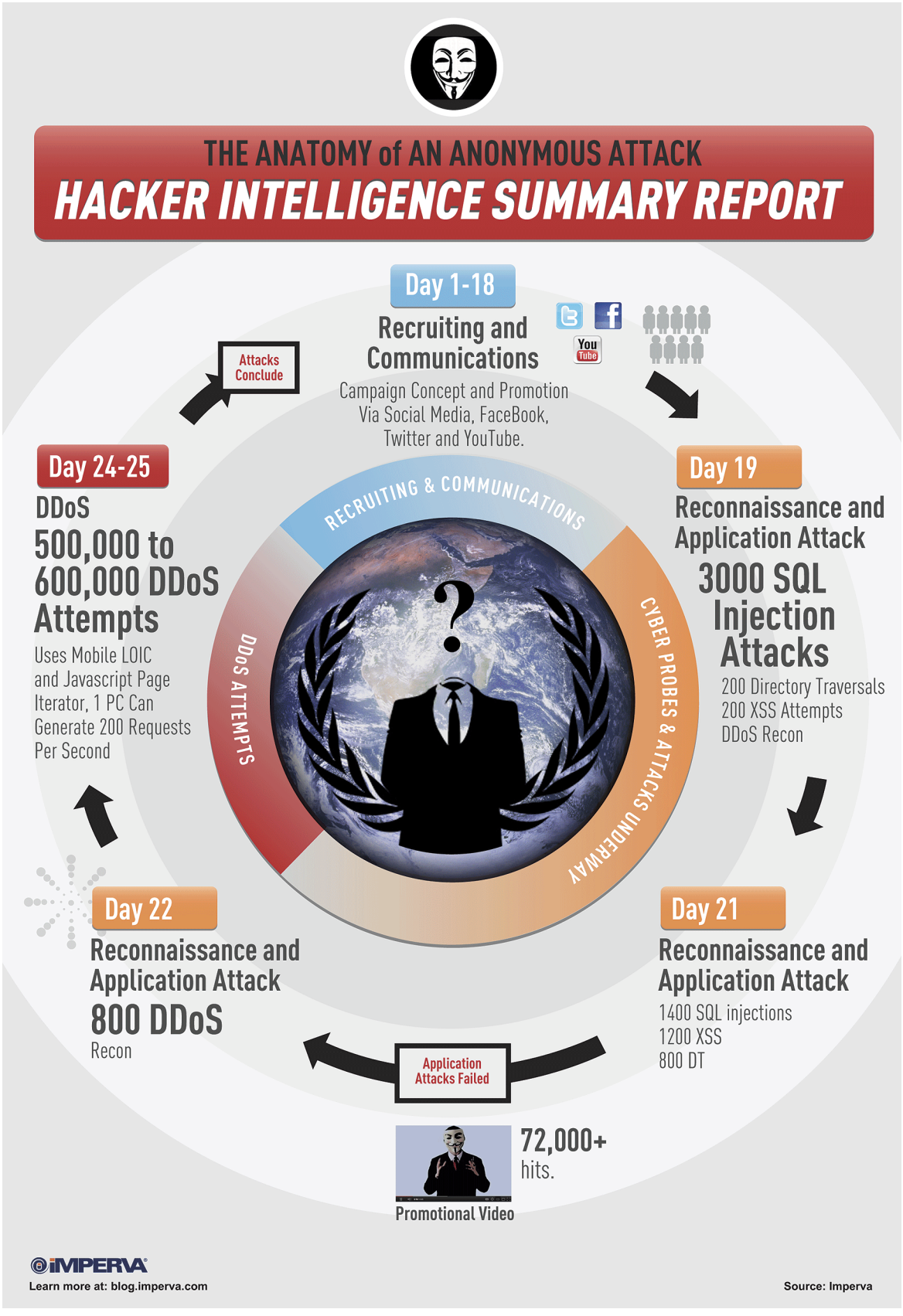
Eventually, the attackers tried to penetrate web applications with "off-the-shelf" attack tools. After failing to find such vulnerabilities, they had fallen back to the option of launching a DDoS attack against the website. The application attack phase lasted about three days.

› **DDoS Attack phase (day 24-25)** – Following the findings of the reconnaissance group, a DDoS attack was launched against the targeted website.

The attack tool used for the DDoS attack was coded in the Javascript language and hosted on a website. This type of attack is commonly referred to as "Mobile LOIC." In this campaign, some portion of the attacks was conducted from mobile devices.

The ADC was able to obtain the attack tool, analyze its source code, and test its performance in a captive environment.

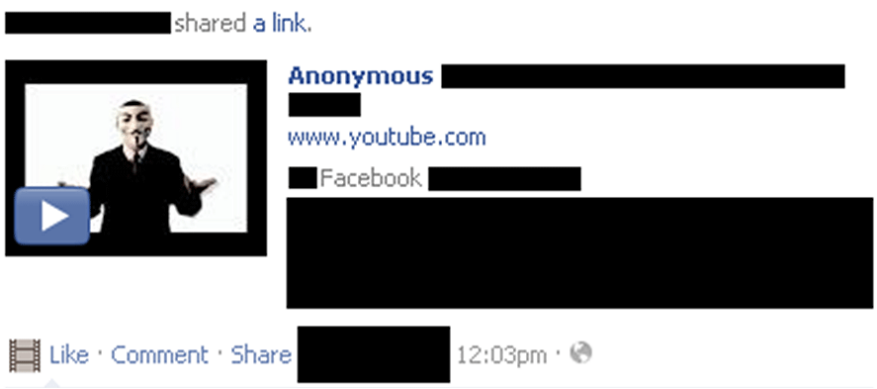
The attack traffic was considerably higher than on the reconnaissance phase and conducted by many more attackers, but it was done with less security awareness as most of the attackers didn't use the protection of anonymity services.


THE ANATOMY of AN ANONYMOUS ATTACK
HACKER INTELLIGENCE SUMMARY REPORT
Day 1-18
Recruiting and Communications
Campaign Concept and Promotion Via Social Media, FaceBook, Twitter and YouTube.
Day 19
Reconnaissance and Application Attack
3000 SQL Injection Attacks
200 Directory Traversals
200 XSS Attempts
DDoS Recon
Day 21
Reconnaissance and Application Attack
1400 SQL injections
1200 XSS
800 DT
Application Attacks Failed
Day 22
Reconnaissance and Application Attack
800 DDoS
Recon
Day 24-25
DDoS
500,000 to 600,000 DDoS Attempts
Uses Mobile LOIC and Javascript Page Iterator, 1 PC Can Generate 200 Requests Per Second
Attacks Conclude
RECRUITING & COMMUNICATIONS
CYBER PROBES & ATTACKS UNDERWAY
DDoS ATTEMPTS
72,000+ hits.
Promotional Video
Learn more at: blog.imperva.com
Source: Imperva

Recruiting and Communications Phase (Day 1-18)

The hacktivist campaign targeted the disruption of a specific event. Anonymous recruits and communicates through web 2.0. The hacktivists used many channels – some prominent examples include:

› Facebook was used to feature a promotional video:



› Twitter

› YouTube

The promotional video resulted in thousands of views in just a few days from initial posting.

Reconnaissance and Application Attack Phase (Day 19-22)

The reconnaissance phase took place for four days and consisted of:

- Scanning for general web application vulnerabilities
- Scanning for DDoS relevant pages.

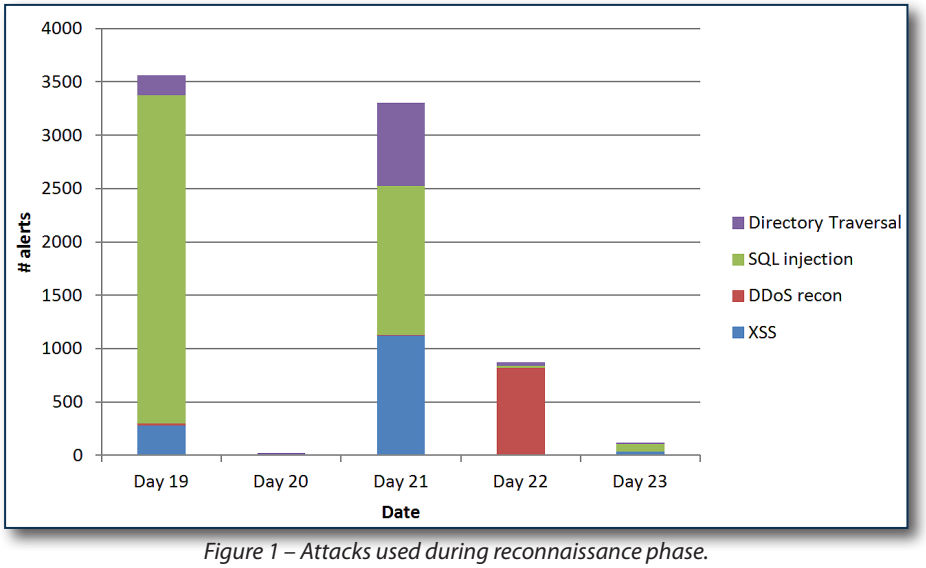


Figure 1 – Attacks used during reconnaissance phase.

Figure 1 shows the number of different types of attacks during the reconnaissance phase. The attackers first tried to check for general web-application vulnerabilities, such as XSS, SQL injection, and Directory Traversal. Notice the high volume of attack traffic (thousands) on these days.

Only when failing to find such vulnerabilities, the attackers resorted to searching a resource suitable for DDoS. Such resources involve actions which are time and resource consuming and might lead to exhaustion of the server resources. Eventually, attackers spotted a specific URL that was later used in the attack itself.

Attack Tools

There was an extensive usage of various automated tools for web application vulnerability scanning. These scanners are general "off-the-shelf" products and weren't coded specifically for this attack. All attacks on the application were blocked and logged by a Web application firewall.

A few prominent examples include:

Havij Scanner

Havij is an automated SQL Injection tool that helps penetration testers to find and exploit SQL Injection vulnerabilities on a web page. By using this software, a user can perform back-end database fingerprint, retrieve DBMS users and password hashes, dump tables and columns, fetch data from the database, running SQL statements and even access the underlying file system and executing commands on the operating system.[8] We believe Havij was probably developed in April 2010 in Iran. Today, Havij earns kudos for its accuracy and ease of use.[9]

Note the User-Agent Havij keyword:

```
GET [redacted].php ? id=106147073' and ascii(substring((SELECT distinct table_name FROM information_sche
ma.tables Where table_schema=0x202020 limit 0,1),2,1))=56 and 'x'='x   HTTP/1.1
Host: [redacted]
Accept: */*
User-Agent: Mozilla/4.0 (compatible; MSIE 7.0; Windows NT 5.1; SV1; .NET CLR 2.0.50727) Havij
Connection: Close
```

[8] http://www.vulnerabilitydatabase.com/2011/06/havij-v1-15-advanced-sql-injection-released
[9] http://itsecteam.com/en/projects/project1.htm

In the following example, the "Havij magic number" was used in order to find the number of columns:

```
GET [redacted].php ? id=999999.9 union all select 0x31303235343830303536 0x31303235343830303536,0x3
1303235343830303536,0x31303235343830303536,0x31303235343830303536,0x313032353438303035
36,0x31303235343830303536,0x31303235343830303536,0x31303235343830303536,0x313032353438 3
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03235343830303536,0x31303235343830303536,0x31303235343830303536,0x31303235343830303536,
0x31303235343830303536,0x31303235343830303536--   HTTP/1.1
Host: [redacted]
Accept: */*
User-Agent: Mozilla/4.0 (compatible; MSIE 7.0; Windows NT 5.1; SV1; .NET CLR 2.0.50727) Havij
Connection: Close
```

Acunetix Scanner

The Acunetix Web Vulnerability Scanner is an automated black box scanner that checks websites and Web applications for vulnerabilities such as SQL injection, Cross Site scripting, and other vulnerabilities.[10]

The scanner was used mostly to look for Remote File Inclusion (RFI) vulnerabilities:

```
GET [redacted].php ? [redacted]path=http://test.acuneti
x.com/acunetix_not_execute[[#0]] HTTP/1.1
Referer: [redacted]
User-Agent: Mozilla/5.0 (Windows; U; Windows NT 5.2; en-US; rv:1.9.0.3) Gecko/2008092417 Firefox/3.0.
  3
X-Akamai-CONFIG-LOG-DETAIL: true
TE: chunked;q=1.0
Connection: TE
Accept-Encoding: gzip
```

Nikto Scanner

Nikto Web Scanner is a Web server scanner that tests Web servers for dangerous files/CGIs, outdated server software and other problems. It performs generic and server type specific checks. It also captures and prints any cookies received. The Nikto code itself is Open Source (GPL).[11]

```
GET [redacted].php ? root=</script><script>alert('Vulnerable')/<script> HTTP/1.1
User-Agent: Mozilla/5.00 (Nikto/2.1.4) (Evasions:None) (Test:000831)
X-Akamai-CONFIG-LOG-DETAIL: true
TE: chunked;q=1.0
Connection: TE
Accept-Encoding: gzip
```

[10] http://www.acunetix.com/vulnerability-scanner/
[11] http://www.cirt.net/nikto2

Web Application Vulnerabilities Reconnaissance Traffic Analysis:

The ADC had analyzed the attack sources of the Web Application Vulnerabilities Reconnaissance phase.

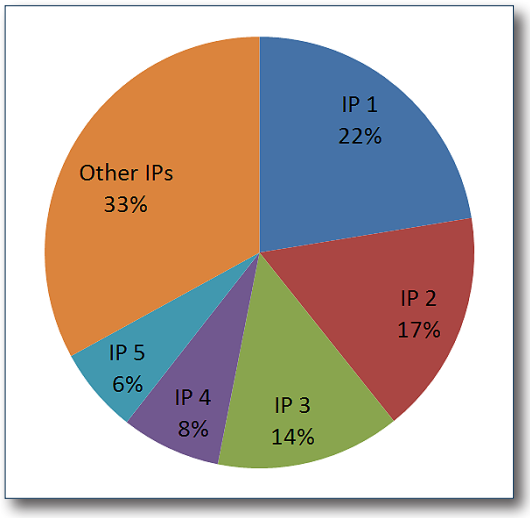


Figure 2 – Source IPs distribution for the XSS, SQL injection., and Directory Traversal attack traffic across 1860 IP addresses.

Figure 2 shows the distribution of IPs that produced the XSS, SQL injection and Directory Traversal traffic on the reconnaissance phase. The Figure shows only the percentage of traffic done by different IPs as the actual IPs are not listed for anonymity.

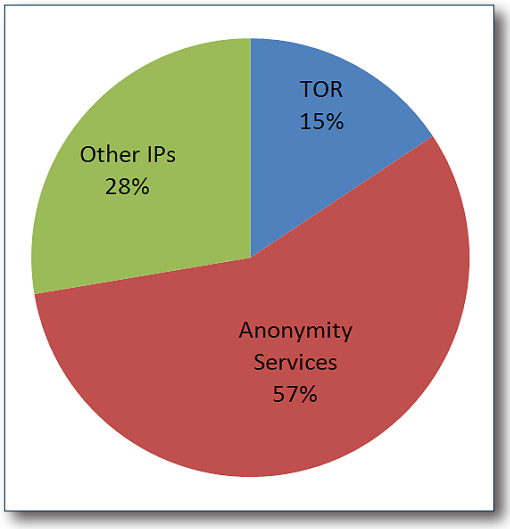


Figure 3 – Source IPs anonymity analysis that produced XSS, SQL injection and DT attack traffic

Figure 3 shows the identity of the IPs mentioned in Figure 2. Our analysis showed that the vast majority (at least 75%) of the attack traffic was produced by users who used means of anonymity. This specific group of attackers is obviously more familiar with security and privacy issues.

DDoS reconnaissance (Day 22)

The DDoS reconnaissance was on the 22nd day of the attack. Most reconnaissance traffic was related through that TOR, identify obfuscation network.

Below is an example:

```
POST [redacted]search/ ? searchword=test HTTP/1.1
User-Agent: Mozilla/5.0 (Windows; U; Windows NT 6.0; en-US; rv:1.9.2.4) Gecko/20100523 Firefox/3.6.4 (
   .NET CLR 3.5.30729)
Accept: */*
Content-Length: 1
Content-Type: application/x-www-form-urlencoded
```

- We suspect that the hackers had profiled the site in order to find resources that will require the server to work harder than others – expressed by slower time to respond. However, we didn't find evidence for such activity. Another option is that they had selected the search URL with no previous profiling, as a target as it is known to involve fetching data from database which is a relatively resource intensive action. Repeatedly searching the site may lead to the exhaustion of server resources and create denial of service. The DDoS reconnaissance phase contained a large volume of requests to the search functionality; all of them contain the 'test' word. As this URL was later used to the DDoS attack itself, it can be deduced that those requests were used in order to test the system resources.
- The search reconnaissance sources were two TOR IPs.

DDoS Attack (Day 24-25)

Following the reconnaissance phase, the real DDoS attack lasted two days.

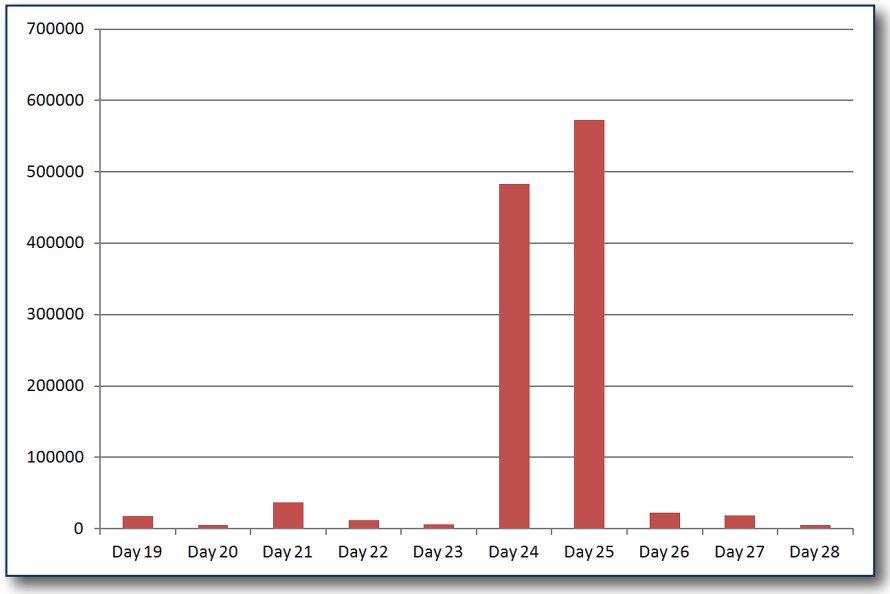
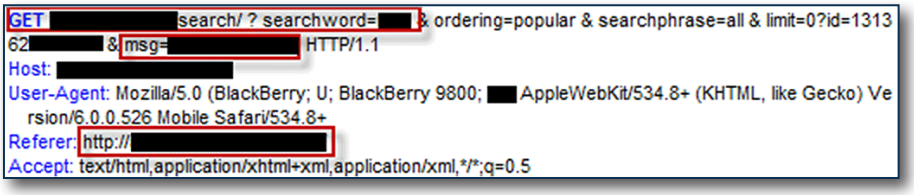


Figure 4 – Number attacks per day

Figure 4 shows the volume of attack traffic in each day. The actual attack can be seen clearly with a significantly higher number of attacks in the hundreds of thousands.

Attack Traffic Characteristics

All of the attack's requests were of the following type:



When examining this example, a few details should be noted:

- It is a request to the search URL – the same one as was tested on the Reconnaissance phase.
- The value to search (searchword parameter in the request) was carefully chosen in order to massively overload the server and exceed the server's resources faster than an un-related keyword.
- Again, the hacktivists are loud, and they mark their attack with a distinctive message that was redacted in the picture above.
- The Referrer[12] header is constant throughout the attack and reveals interesting information on the attack source, a specific URL that was also redacted.
- The id parameter was incremented in every request to create a different request each time, so the response wouldn't be delivered from cache (such as Akamai's CDN cache, or the attacker browser cache).

Attack Tool Analysis

By analyzing the format of attack messages and comparing it to code we found on the Web, we believe that we were able to identify the tool used for generating attack traffic.

In previous Anonymous attacks, the attacker used the LOIC tool. The LOIC tool was coded in the C# language and required installation of the tool on the attacker machine. Since installation is required, not all platforms could run the LOIC application.

In this attack, other method and tool were used. Anonymous created a web-page that contains a Javascript. The script iterates endlessly (as long as the page is open in the browser) and generates a new image attribute. The source of the image is the victim's web page. By thus, creating multiple requests to the victims' website as the page is rendered by the browser.

All it takes for an attacker to participate in the attack is to browse to the specific web page and leave the page open. No need to install or download any software. This is what makes this technique so simple to use, as opposed to other methods.

Since the code is written in Javascript, it enables any device equipped with a standard browser to take part in the attack – and indeed we have seen mobile devices participating in the attack.

This is the reason why such tools are often being referred to as "Mobile LOIC."

It contains links to information from the DDos attack:

- The source code refers to a specific site (which has since been removed). This site is the source of the attack as established by the Referrer header as noted in the picture above.
- Same URL characteristics for the attack:
  1. Fixed part
  2. Parameter named "id" that contains current time in mSec units
  3. Parameter named "msg" that contains an Anonymous slogan

To conclude, the tool generates the same attack we had seen on the wire.

[12] Although headers (Referrer included) can be forged by the attackers, we had found evidence that the attack was indeed originated from that host.

Javascript Code Structure

The tool javascript code creates requests by continuously changing the source of an HTML image with JavaScript code.

Each time the image source is changed the browser need to create a request in order to fetch it.

```
img.setAttribute("src", targetURL + "?id=" + rID + "&msg=" + messageNode.value)
```

Where rID is the date:

```
rID =Number(new Date())
```

This is consistent with the traffic we have seen.

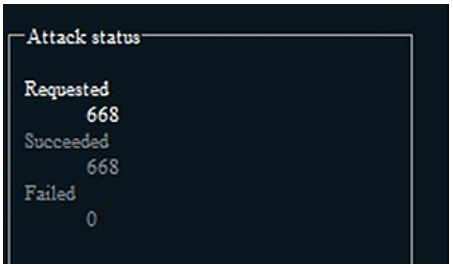
As stated before, the purpose of the dynamic changing parameter (date granularity is in mSec) is to avoid a state where the response will be in the server from some cache and to make sure that the attack will be actually received on the attacked server.

Finally, we note that the DDoS tool itself doesn't provide anonymity; one will have anonymity only if his browser will use specific tools for it – such as working with TOR or Proxy.

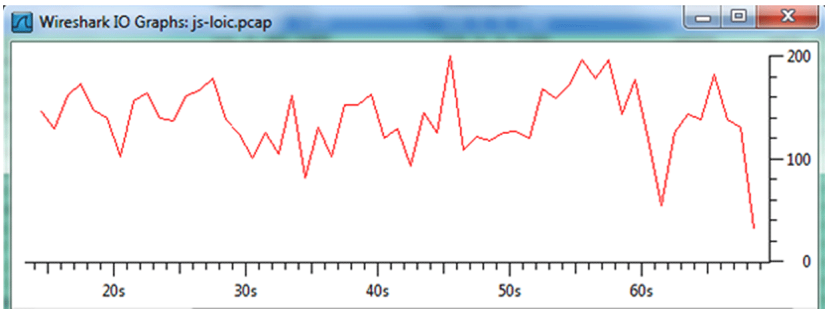
Testing the Tool in "Captive" Environment

In order to assess the attack tool capabilities we had set it to attack a server in our lab. The tool user interface is depicted below (NOTE: This is a screenshot of a generic tool used in another Anonymous attack and is not the tool used in the particular incident we recorded):

During the attack, the attack counters are incremented:



On a regular PC, the attack tool was able to create up to 200 requests per second.



Sources Analysis

Following are two graphs of the distribution over time for DDoS alerts, each one for each day of the attack. One bar represents a time frame of half an hour.

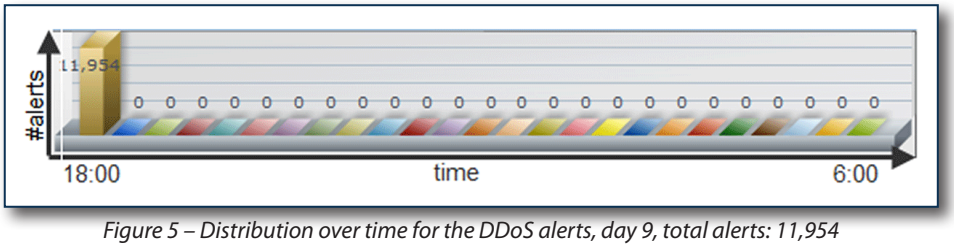


Figure 5 – Distribution over time for the DDoS alerts, day 9, total alerts: 11,954

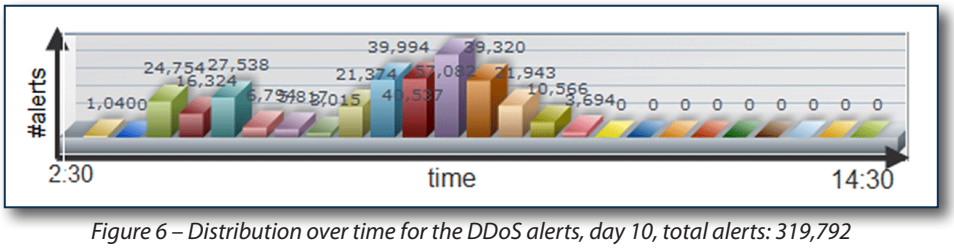


Figure 6 – Distribution over time for the DDoS alerts, day 10, total alerts: 319,792

As can be seen in the graph, there were two peaks to the attack – the first one was between 3:30 am to 4:30 am and the second one was between 6:30 am to 9:30 am, local time.

So, even while being under attack, there's an opportunity for security team to assess the attack details and, if needed, fine tune the rules in order to detect and block the entire attack more precisely.

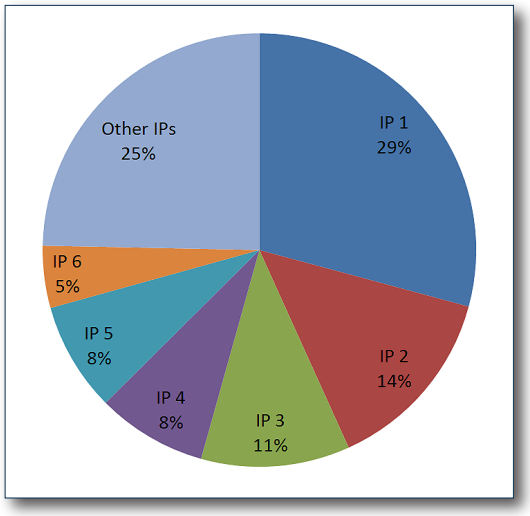


Figure 7 – Number of DDoS alerts per IP

Figure 6 shows the distribution of the DDoS alerts produced by different IPs. Once more – the actual IPs are not listed for anonymity. As can be seen – the DDoS attack had originated mainly from a subset of six different IPs that produced most of the traffic. Note that the maximum DDoS alerts were 22 transactions/sec with a bandwidth of 124.5 kilo bits/sec.

Following is a table that shows the geographic origin for each IP that is represented as a percentile in Figure 6. The table focuses on the IPs that produced most of the traffic:

Percentile	Geo-Location/Proxy
29%	Country 1
14%	Anonymous Proxy
11%	Country 2
8%	Country 3
8%	Country 4
5%	Country 3

Table 1 - Percentile of traffic produced by a single IP and its Geo-location

As can be seen in the table above, most of the traffic originated from four different countries. That suggests that these IPs indeed represent individual attackers that don't bother with disguising their identity. Only a small portion of the traffic was delivered through an anonymous proxy.

It's important to note few thousands of attack requests originated from mobile sources, as established by their user agent's header.

Conclusions/ Detection and Mitigation

- **Monitor social media** – Hacktivism is loud by definition. Hacktivists use all of the channels the Web offers – Twitter, Facebook, YouTube, blogspot, pastebin etc. One should proactively scan the Web for hints of coming attacks (Google alerts, for example). The data obtained should be used to accommodate the attack as the data disclosed specifies attack date, means, etc.
- **Protect applications** – Exposing data transacted by applications can have a damaging impact. A strong application security program consisting of Web application firewalls, vulnerability assessments and code reviews can help mitigate the risk of a breach.
- **DDoS is the hacker's last resort** – Attackers prefer small scale, effective campaigns that do not require massive recruitment of willing participants. Therefore, possible attack victims should make it their priority to mitigate application vulnerabilities, even before mitigating DDoS attacks.
- **Analyze the alert messages generated by your security devices** – the DDoS attack was preceded by a few-days-long phase of reconnaissance. By examining these alerts, one can strengthen the security policy and be better prepared for the attack. Daily analysis of alert information may help better prepare for tomorrow's attack.
- **IP reputation is very valuable** – IP reputation is a very powerful tool, especially in high-volume attacks. Using IP reputation, most of the reconnaissance traffic could have been blocked. However, like any PoW they should be interrogated – scrutinizing the content may yield important insights on the purpose of the attackers.

Hacker Intelligence Initiative Overview

The Imperva Hacker Intelligence Initiative will be going inside the cyber-underground and providing analysis of the trending hacking techniques and interesting attack campaigns from the past month. A part of Imperva's Application Defense Center research arm, the Hacker Intelligence Initiative (HII), is focused on tracking the latest trends in attacks, Web application security and cyber-crime business models with the goal of improving security controls and risk management processes.

Imperva
Headquarters
3400 Bridge Parkway, Suite 200
Redwood Shores, CA 94065
Tel: +1-650-345-9000
Fax: +1-650-345-9004

Toll Free (U.S. only): +1-866-926-4678
www.imperva.com