DDOS ATTACKS:
PREPARATION-DETECTION-MITIGATION

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AGENDA

1. Overview of (D)DoS
2. How to (D)DoS
3. Motivation
4. Attack Type
5. Detection
6. Preparation
7. Mitigation
   - Layer 4 DDoS
   - Layer 7 DDoS
   - Link-Local DoS: IPv6 RA Attack

(D)DOS: A REAL WORLD EXAMPLE

Imagine a Restaurant

1. People come & order

2. The waiter takes their order

3. Served as the waiter becomes free

(D)DOS: A REAL WORLD EXAMPLE

Suddenly, hundreds or thousands of customers come in and order a glass of water.

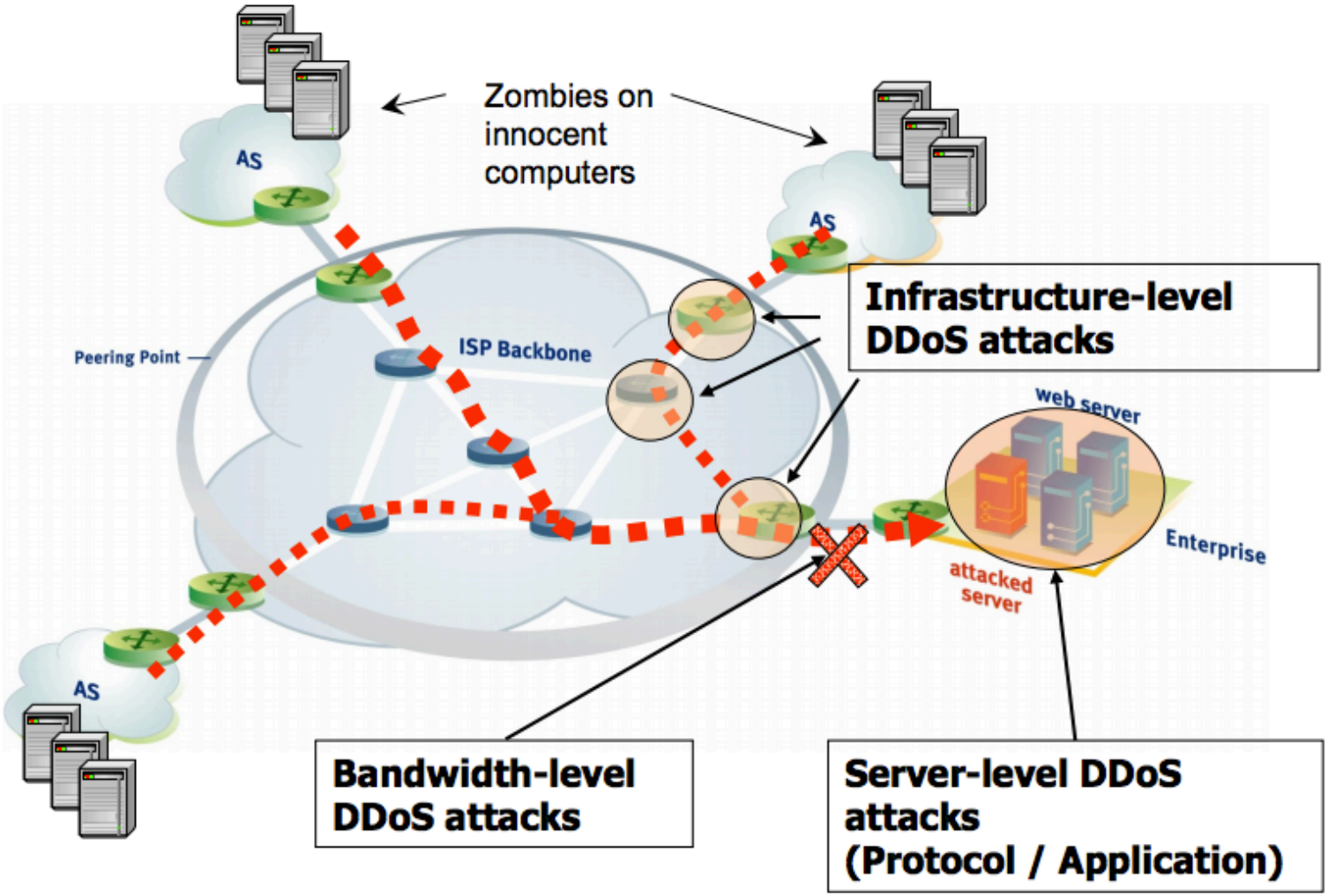
The waiter becomes overwhelmed with the quantity of requests. As more customers enter the restaurant the waiter is unable to attend to them because they are so overwhelmed.

That is a (D)DoS:
making a resource unavailable by overloading.

(D)DOS: IN THE COMPUTING WORLD

- In computing, a denial-of-service attack (DoS attack) or distributed denial-of-service attack (DDoS attack) is an attempt to make a machine or network resource unavailable to its intended users.
- It is a "Denial of Service". The server is never compromised, the databases never viewed, and the data never deleted. Throughout and after the attack, the server remains intact.
- Compromise “A” of CIA.

(D)DOS: IN THE COMPUTING WORLD



DO I HAVE TO CARE

"To **expect** the world to treat you fairly, because you're a **good person**, is somewhat like asking a bull not to **attack** you, because you're a **vegetarian**!"

- Quote from the Reader's Digest

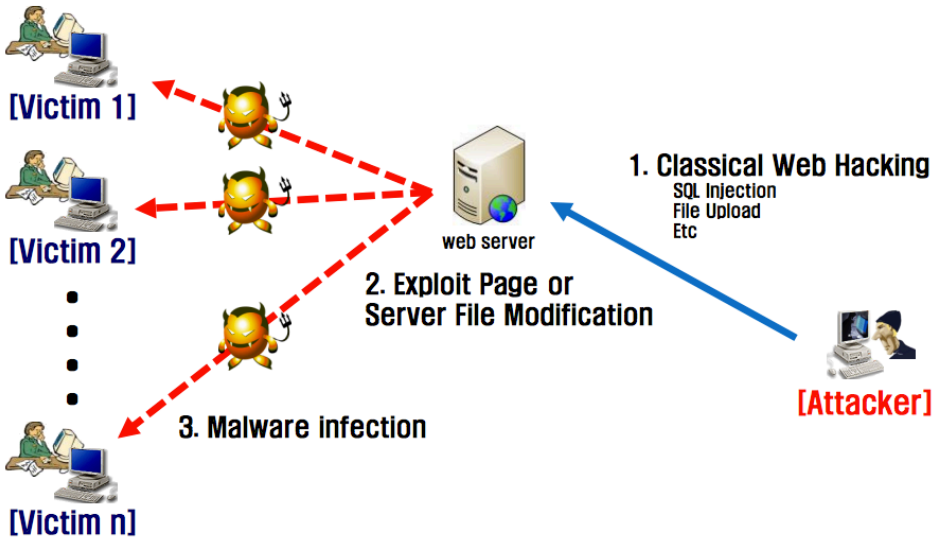
HOW TO (D)DOS

Click really, really fast the “retry/reload” button

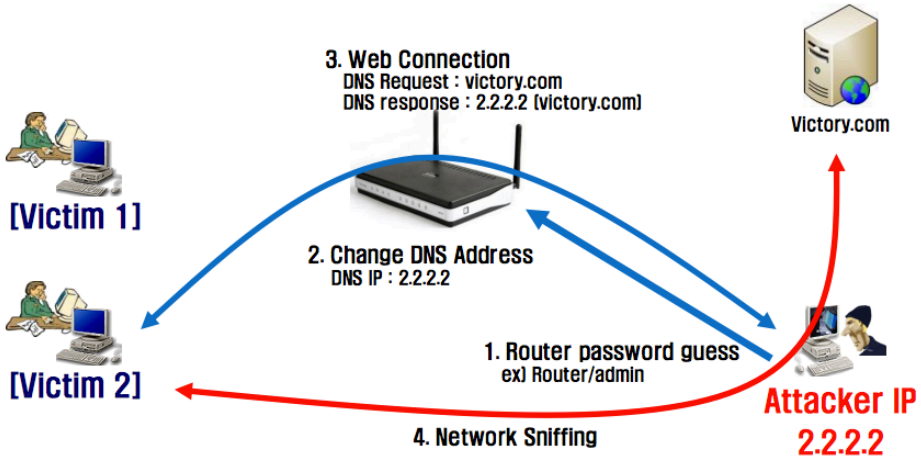
Scale vertically-> Recruit your friends/kids to do so

Scale horizontally -> Get a BOT

HOW TO (D)DOS: BOT

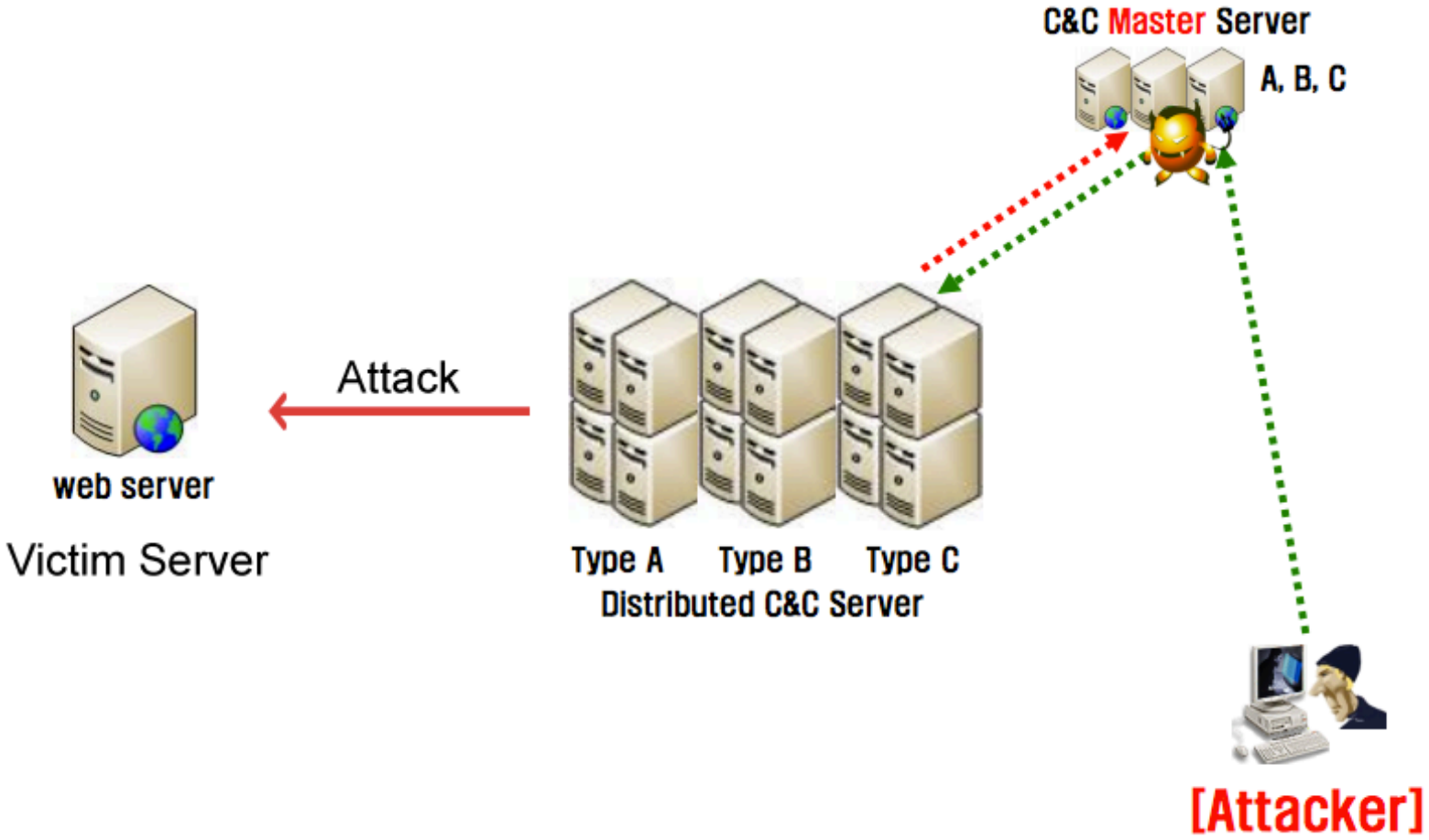


Conventional way of creating BOT.



New technique, Rouge AP

HOW TO (D)DOS: C&C



MOTIVATION

Financial

- Competition
- Extortion
- Divert attention
- Proof of Power

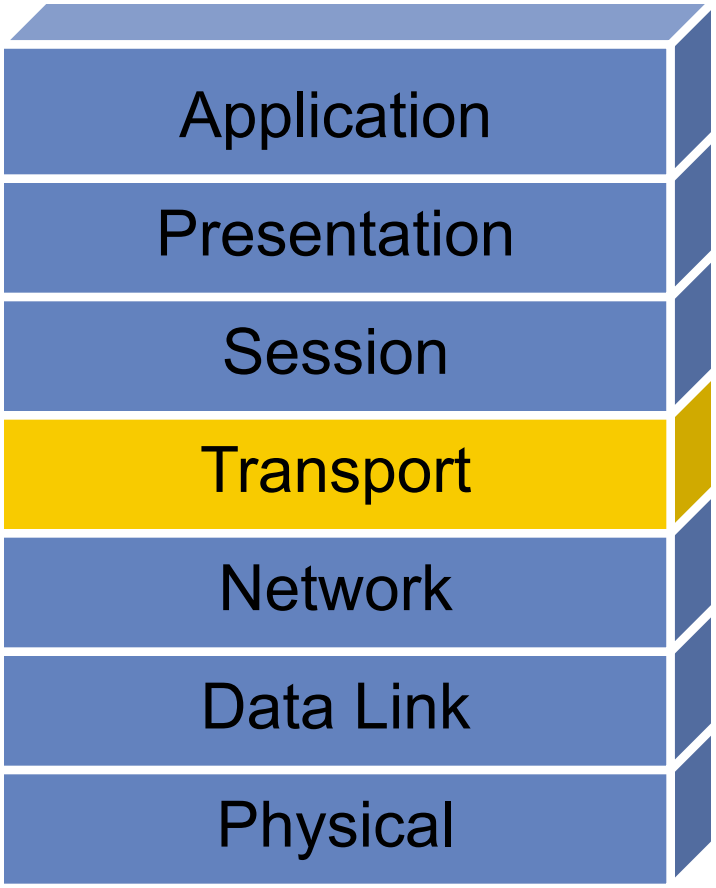
Political

- Hacktivism
- “I’m a cooler kid than you”

ATTACK TYPE

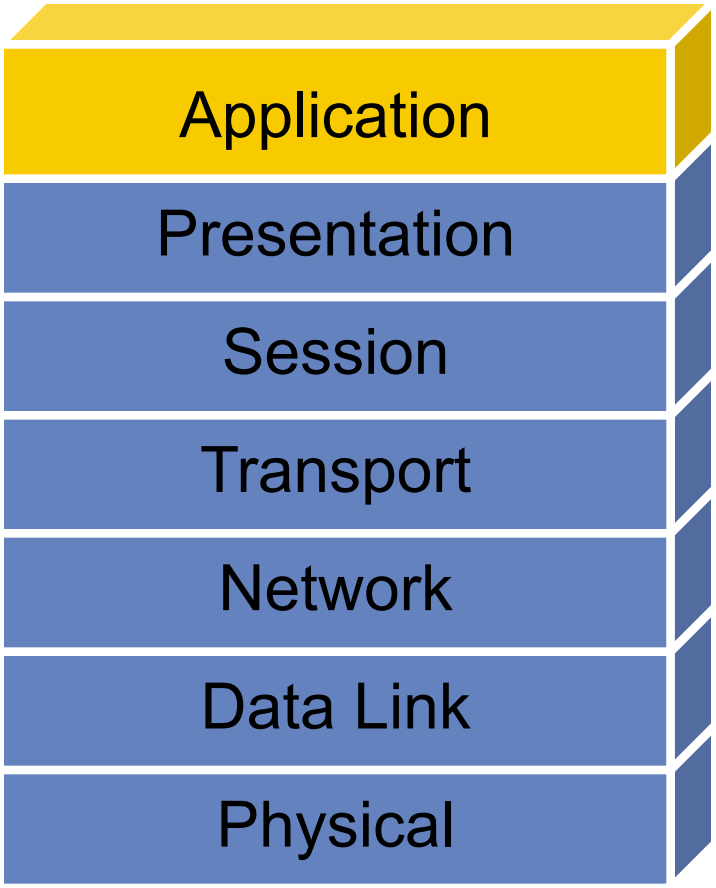
- Asymmetric
  - DNS queries
  - SYN flood
- Symmetric
  - GET flood
- Reflected
  - Smurf/DNS (spoofed source)
- Brute force or logic state attacks
- Distributed
  - Any of the above (and many more)

LAYER 4 ATTACK



- SYN Flood
- RST Flood
- FIN Flood

LAYER 7 ATTACK



- SPAM
- DNS Queries
- HTTP GET Flood

DETECTION: GAME OF RESOURCE EXHAUSTION

- Bandwidth
- PPS
- Storage
- CPU
- Application specific

SIMPLIFIED TCP STATE MACHINE

- LISTEN – waiting for a connection request
- SYN_RECV – received request still negotiating
- ESTABLISHED – connection working OK
- FIN-WAIT1/2 – one side closed the connection
- TIME-WAIT – waiting for a while

LIFE OF A SOCKET

- Socket = TCP/UDP port + IP address
- Normal connection

```
root@access:/home/fakrul# netstat -nap | grep 8080
tcp        0      0 :::8080                 :::*                    LISTEN      1426/apache2

root@access:/home/fakrul# netstat -nap | grep 8080
tcp        0      0 192.168.1.250:8080      192.168.1.35:49560      ESTABLISHED
3918/apache2

root@access:/home/fakrul# netstat -nap | grep 8080
tcp        0      0 192.168.1.250:8080      192.168.1.35:49557      TIME_WAIT
-
```

DETECTION ON THE HOST

- Your best friend: netstat

```
netstat –nap
```

- Your next best friend: tcpdump

```
tcpdump –n –i <interface> –s 0 –w <target_file.pcap>
–c <packet_count>
```

- Dedicated IDS (snort/suricata)

PREPARATION & MITIGATION

Key Points to Note:

1. You can only stop DDoS attacks after your own perimeter.
2. You can't stop DDoS attacks before your perimeter – unless others are ready to help you.

IN PEACE TIME

- You should have your monitoring ahead of time.
- Have a Incident response plan.
- When do you need to escalate?
- Your security gear (if at all present).

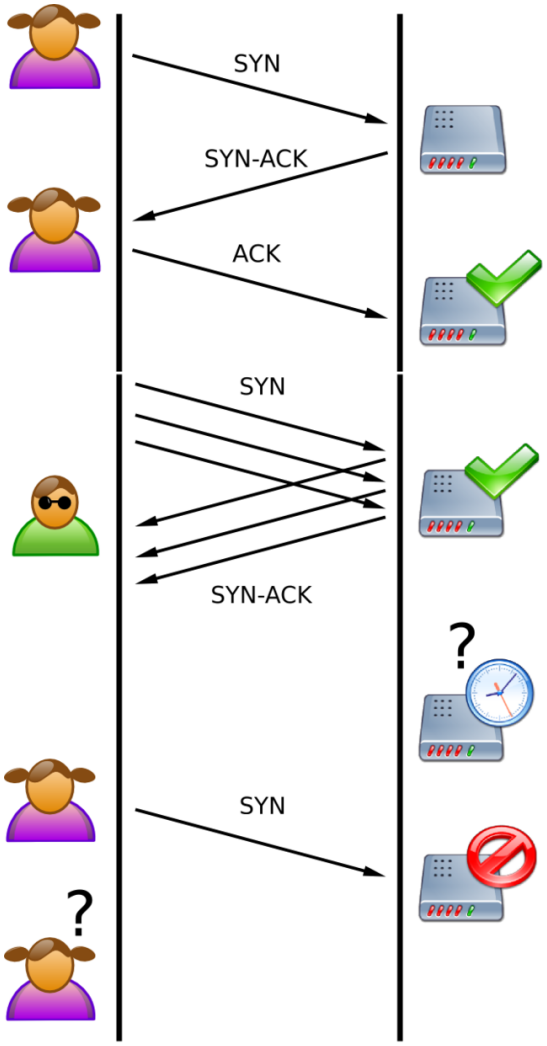
MONITORING IMPACT

- The most neglected resource.
- No matter how much traffic they throw at you, there is no problem until your users start seeing it.
- Use internal monitoring.
- Use external monitoring services.

IN THE HEAT OF THE MOMENT

- What is actually happening? Focus on the facts.
- Collect data (from Systems, Network Graphs, Capture Traffic).
- Create a response plan.
- Execute.
- Observe.

SYN FLOOD



What does it take:

- Think 3-way handshake.
- Server has a number of slots for incoming connections.
- When slots are full no more connections are accepted.

HOW TO RECOGNIZE SYN FLOOD

```
Active Internet connections (servers and established)
Proto Recv-Q Send-Q Local Address Foreign Address State PID/
Program
name
tcp 0 0 0.0.0.0:111 0.0.0.0:* LISTEN 1339/rpcbind
tcp 0 0 0.0.0.0:33586 0.0.0.0:* LISTEN 1395/rpc.statd
tcp 0 0 192.168.122.1:53 0.0.0.0:* LISTEN 1962/dnsmasq
tcp 0 0 192.168.1.250:631 0.0.0.0:* LISTEN 1586/cupsd
tcp 0 0 192.168.1.250:25 0.0.0.0:* LISTEN 2703/sendmail: acce
tcp 0 0 192.168.1.250:25 192.168.1.35:49718 SYN_RECV -
tcp 0 0 192.168.1.250:25 192.168.1.35:49717 SYN_RECV -
tcp 0 0 192.168.1.250:25 192.168.1.35:49722 SYN_RECV -
tcp 0 0 192.168.1.250:25 192.168.1.35:49720 SYN_RECV -
tcp 0 0 192.168.1.250:25 192.168.1.35:49719 SYN_RECV -
tcp 0 0 192.168.1.250:25 192.168.1.35:49721 SYN_RECV -
tcp 0 0 192.168.1.250:25 192.168.1.35:49716 SYN_RECV -
```

SYN MITIGATION

SYN Cookies

- Special hash
- Enable by:
  - `echo 1 > /proc/sys/net/ipv4/tcp_syncookies`
- Other timeouts to tweak (in /proc/sys/net/ipv4/):
  - `tcp_max_syn_backlog`
  - `tcp_synack_retries`
  - `tcp_syn_retries`

HOW TO RECOGNIZE SOCKET EXHAUSTION

```
Active Internet connections (servers and established)
Proto Recv-Q Send-Q Local Address Foreign Address State PID/
Program
Name
tcp 0 0 192.168.1.250:631 0.0.0.0:* LISTEN 1586/cupsd
tcp 0 0 192.168.1.250:25 0.0.0.0:* LISTEN 2703/sendmail: acce
tcp 0 0 192.168.1.250:25 192.168.1.35:49718 TIME_WAIT -
tcp 0 0 192.168.1.250:25 192.168.1.35:49717 TIME_WAIT -
tcp 0 0 192.168.1.250:25 192.168.1.35:49722 TIME_WAIT -
tcp 0 0 192.168.1.250:25 192.168.1.35:49720 TIME_WAIT -
tcp 0 0 192.168.1.250:25 192.168.1.35:49719 TIME_WAIT -
tcp 0 0 192.168.1.250:25 192.168.1.35:49721 TIME_WAIT -
tcp 0 0 192.168.1.250:25 192.168.1.35:49716 TIME_WAIT -
```

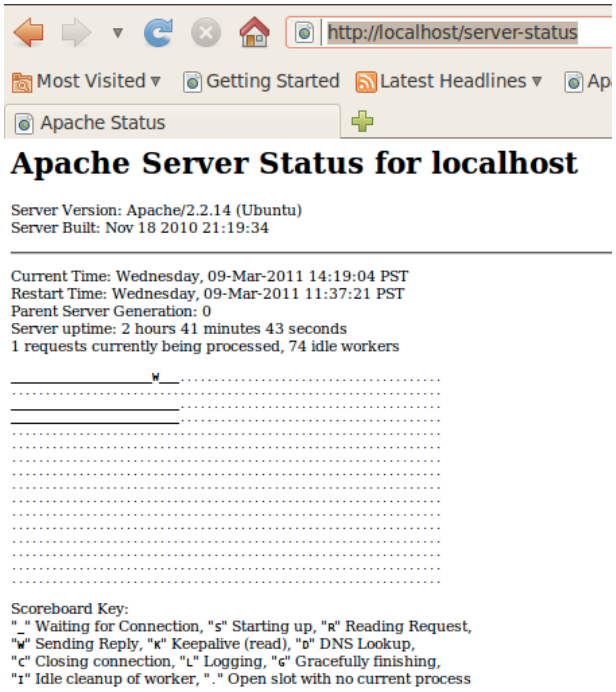
SOCKET EXHAUSTION/CONNECT MITIGATION

- Enable socket reuse
  - `echo 1 > /proc/sys/net/ipv4/tcp_tw_recycle`
  - `echo 1 > /proc/sys/net/ipv4/tcp_tw_reuse`
- Increase local port range
  - `echo 1024 65535 > /proc/sys/net/ipv4/ip_local_port_range`
- Check learn about the value in
  - `/proc/sys/net/ipv4/tcp_*`

UPPER LAYER (D)DOS ATTACK

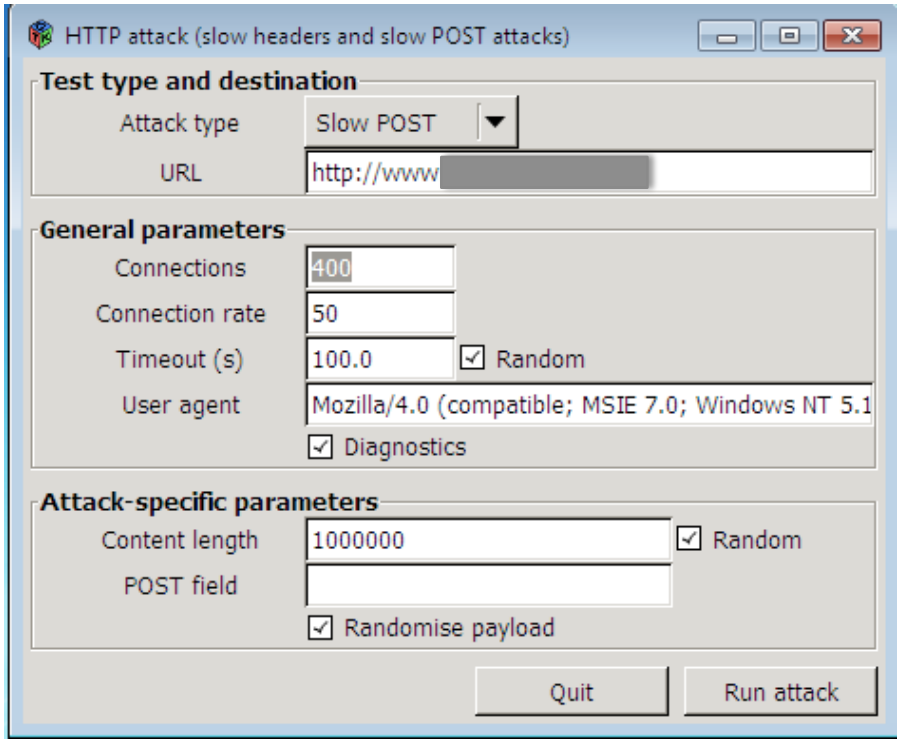
- **SlowLoris**
  - **Send incomplete GET request.**
  - **Freeze apache with one packet per second.**
  - **It's specific to Apache only, other webserver will not be effected.**

```
$ ./slowloris.pl -dns
[www.example.com] –options
```



UPPER LAYER (D)DOS ATTACK

- **OWASP HTTP POST Tool & R-U-Dead-Yet**
  - **Incomplete HTTP POSTs.**
  - **Stops IIS, but requires thousand of packet per seconds.**




```
$ ./r-u-dead-yet.py
http://localhost/
upload.html
```

MITIGATION UPPER LAYER

- **Architecture of applications**
  - Apache – process based – In Linux kernel level threads
  - Nginx – event based
- **Mitigation through challenges**
  - Nginx plugin – Roboo (ECL-LABS.ORG)
  - Apache - ModSecurity
- **Load Balancer**
- **Split DNS!!**

MITIGATION UPPER LAYER

- Nginx plugin – Roboo Configuration

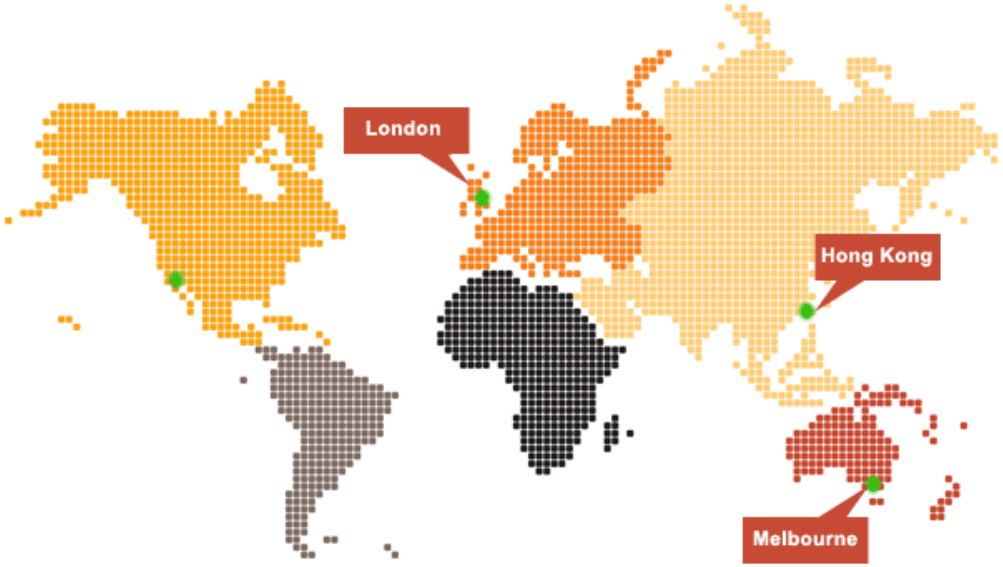
```
perl Roboo::handler;
set $Roboo_challenge_modes      "SWF,gzip";
set $Roboo_cookie_name "Anti-Robot”;
set $Roboo_validity_window 600;
set $Roboo_whitelist "IP(),UA(''),URI('')”;
set $Roboo_charset "UTF-8”;
set $Roboo_challenge_hash_input $remote_addr;
```

Sample challenged.log

192.168.1.250 - - [08/Nov/2012:13:03:47 +0600] "**GET /Anti-Robot-GET-f9e5de6f1f226fbb7472.swf** HTTP/1.1" 200 1023 "http://192.168.1.1/" "Mozilla/5.0 (Macintosh; Intel Mac OS X 10_7_5) AppleWebKit/537.4 (KHTML, like Gecko) Chrome/22.0.1229.94 Safari/537.4”

MITIGATION UPPER LAYER

- **Split DNS!!**

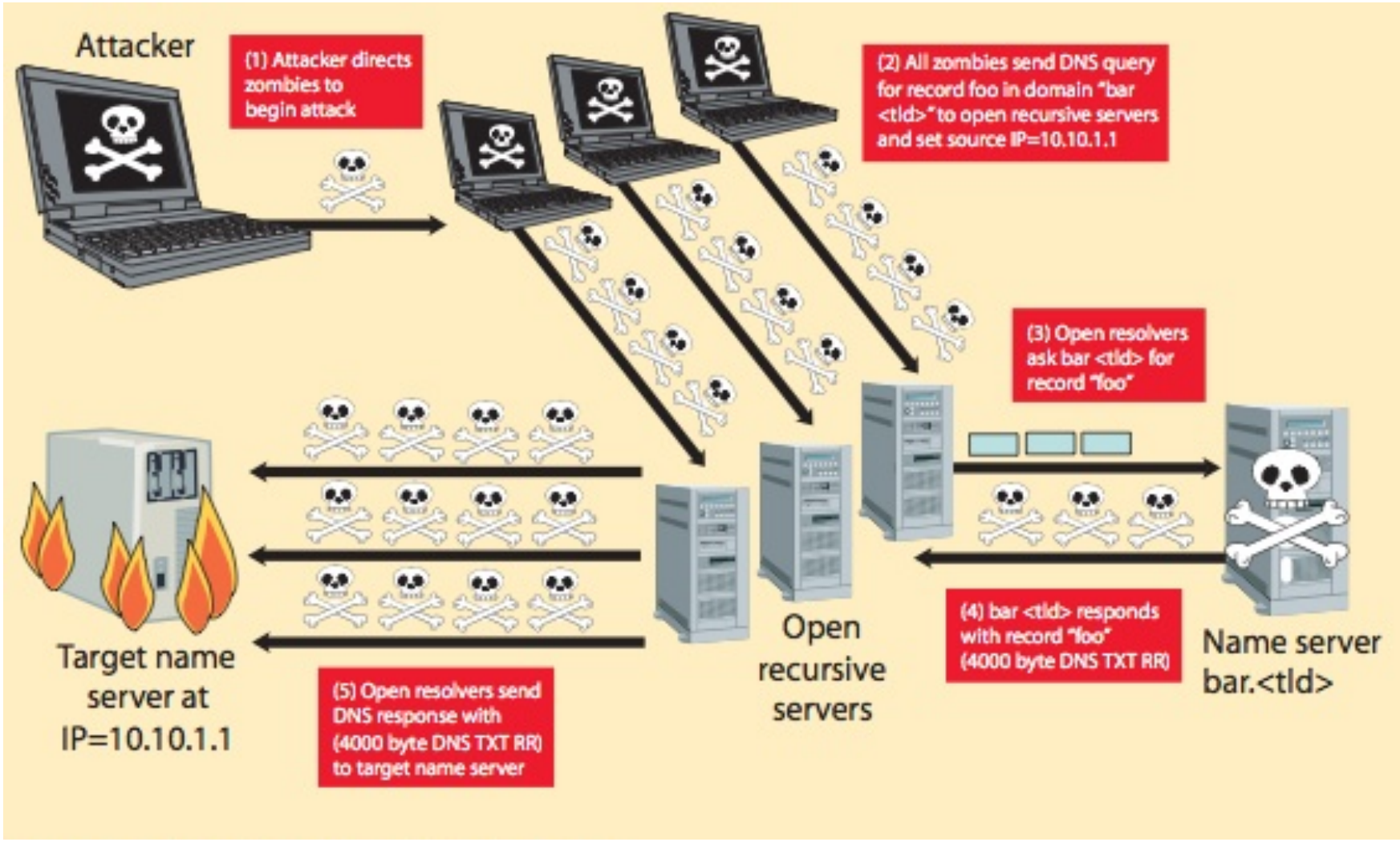


- DNS resolve based on the users source.
- Possible to distribute the (D)DoS load.
- BIND ACL with IP.
- GeoDNS BIND patch.

DNS AMPLIFICATION DDOS ATTACK

- Attacks using IP spoofed DNS query
  - Generating a traffic overload
  - Bandwidth attack
  - Similar to ‘smurf attacks’
- Components are:
  - IP spoofing
  - DNS amplification

DNS AMPLIFICATION DDOS ATTACK



DNS AMPLIFICATION DDOS ATTACK

- dig ANY isc.org @x.x.x.x +edns=0

```
-->output truncated<--
;; AUTHORITY SECTION:
isc.org.            3569    IN      NS      ams.sns-pb.isc.org.
isc.org.            3569    IN      NS      sfba.sns-pb.isc.org.
isc.org.            3569    IN      NS      ord.sns-pb.isc.org.
isc.org.            3569    IN      NS      ns.isc.afilias-nst.info.

;; ADDITIONAL SECTION:
ns.isc.afilias-nst.info. 82769          IN
ns.isc.afilias-nst.info. 82769          IN

;; Query time: 79 msec
;; SERVER: 103.xxx.xxx.12#53(103.xxx.xxx.12)
;; WHEN: Mon Nov 26 16:50:09 2012
;; MSG SIZE  rcvd: 3191
```

That's a 64 byte query that resulted in a 3,191 byte response. In other words, an attacker is able to achieve a 50x amplification over whatever traffic they can initiate to an open DNS resolver.

MITIGATION DNS AMPLIFICATION

- Disable Open Recursive DNS
  - For BIND 9.x authoritative servers, apply the following global options:

```
options {
    recursion no;
    additional-from-cache no;
};
```

  - For BIND 9.x caching servers

```
acl "trusted" {
      192.0.2.0/24;
  };
  options {
      recursion no;
      additional-from-cache
no;
      allow-query { none; };
  };
```

```
 view "trusted" in {
      match-clients
{ trusted; };
      allow-query { trusted; };
      recursion yes;
      additional-from-cache yes;
  };
```

LINK LOCAL DOS: IPV6 RA ATTACK

1. A single device can instantly stop all the Windows machines on a Local Area Network.
2. Effected OS:
   - Windows XP, Vista, Windows 7, Server 2008
   - It is also reported that X-Box & PS3 is also effected.
   - FreeBSD
3. CVE-2010-4669
   - CVSS Severity: High

LINK LOCAL DOS: IPV6 RA ATTACK

Live Demonstration

MITIGATION LINK LOCAL DOS

- Disable IPv6.
- Turn of Router Discovery.
- Use a firewall to block rogue Router Advertisements.
- Microsoft's "IPv6 Readiness Update" provides some protection.
  - Released November 13, 2012
  - KB 2750841

FEW RECOMMENDATION

1. Stop spoofed TCP attacks at your perimeter.
2. Don’t let dark address packets pass your perimeter.
3. Block unused protocols and ports.
4. Limit number of access per second per source IP.
5. Limit number of concurrent connections per source IP.
6. Monitor self similarity in traffic.

QUESTIONS?