DDoS Attack in a Lab Setting

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Disclaimer

This project is for educational purposes only and was done by trained professionals. It was performed on a local, private network, hosted by Virtual Machines, and within the bounds of a lab setting. We do not advise you to replicate this type of attack.

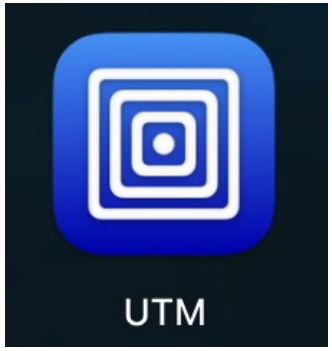
Table of Contents

Overview

Conduct a successful DDoS attack on a local network of VMs, hosted on multiple machines. The attack will target a website, hosted locally, to try and disrupt access to it by using the Low-Orbit Ion Cannon tool.

Project Background

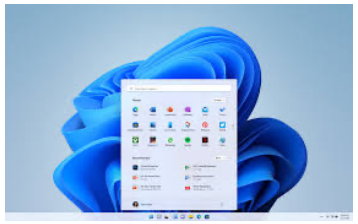
Environment Setup



For Mac, UTM (Universal Transverse Mercator), because it is supported by M2 chips.

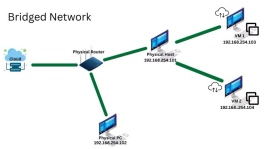
VirtualBox works for both Mac and PC. It is a popular choice, but Windows VMs are experimental on Mac.

VMs and Settings



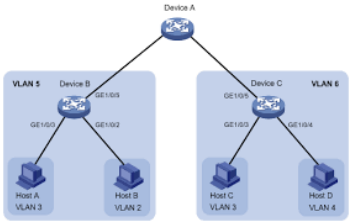
Windows 11 VM

For software, GUI and ease of usage



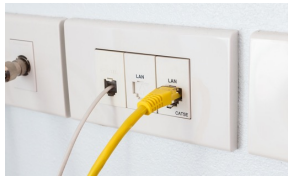
Bridged Adapter

For VM to appear as another device in the same network



Promiscuous

Allowed all so that we can receive all types of packets



Cable Connect

To all network (internet) into the VM

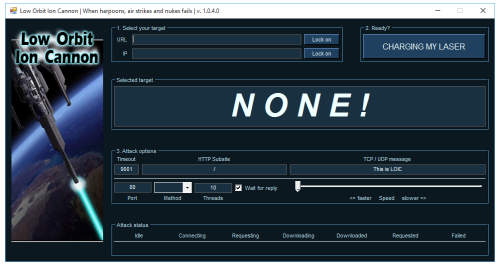
Tools Used

Wireshark

network packet analyzer - lets you capture and inspect all traffic flowing through a network interface

LOIC

Low Orbit Ion Cannon - Sends massive amounts of TCP, UDP, or HTTP requests to a target IP

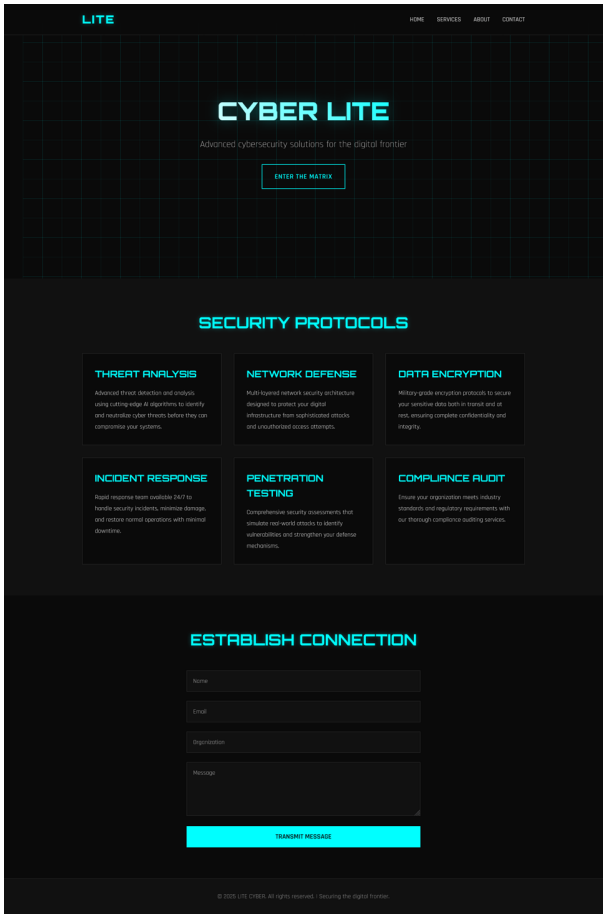


Website and Hosting

- Made a website using HTML and CSS
- Hosted locally using python

```
python -m http.server 8000
```

You need to be in the same directory

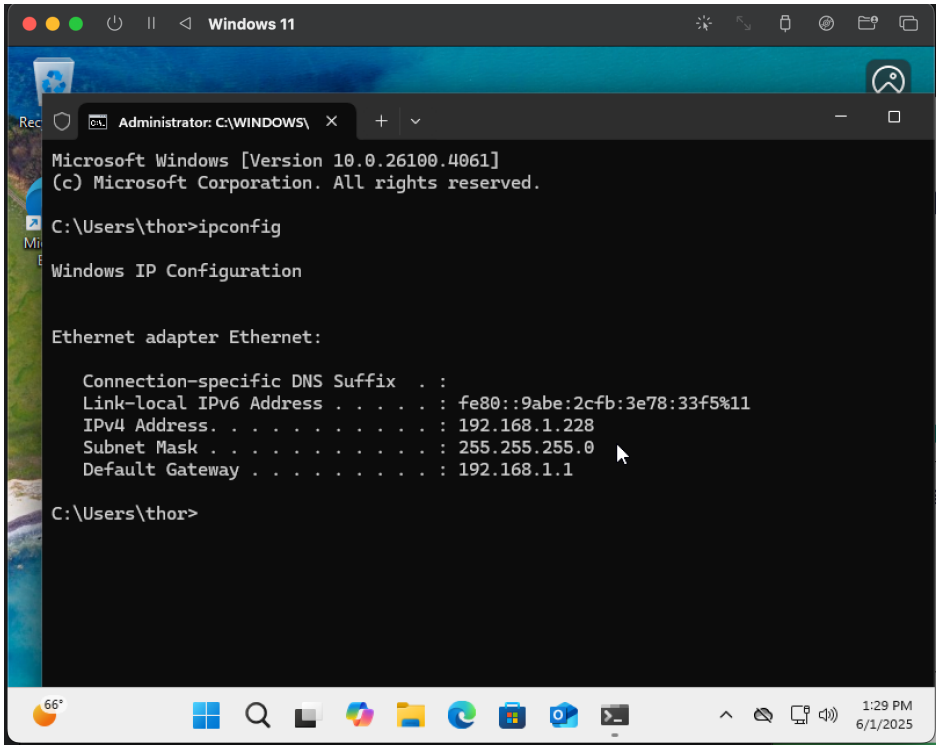


Troubleshooting

Problems and Troubleshooting

Valid IP Address

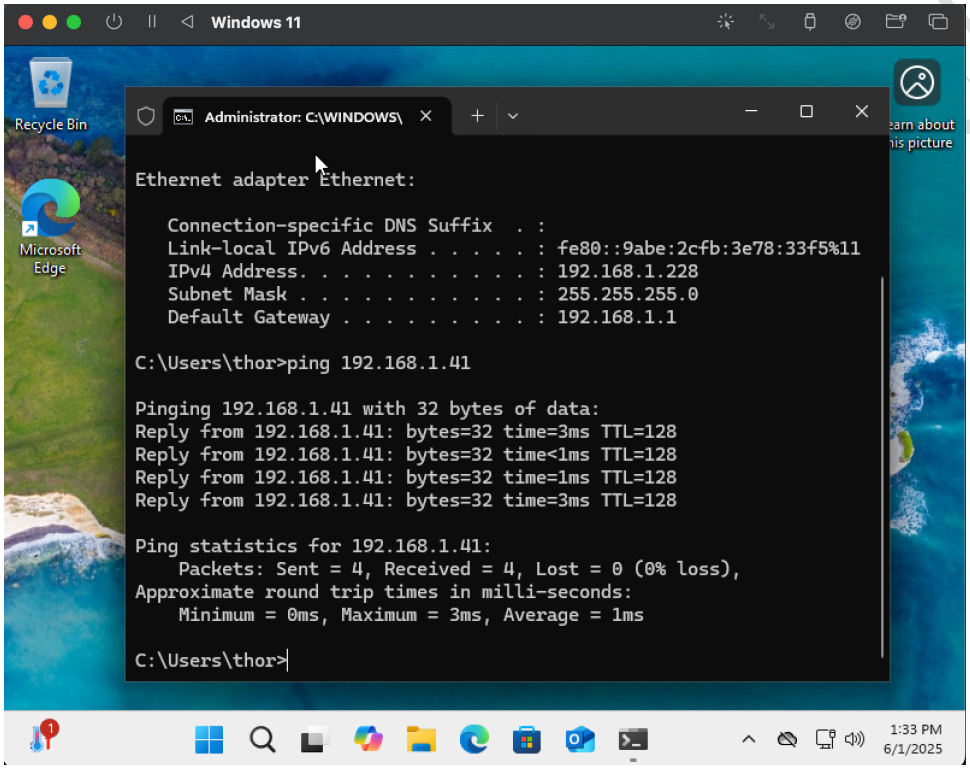
- 169.XXX... vs. 192.XXX...
- Restart the VM/Host Machine
- Restart the Wi-Fi router
- Resetting DHCP and IPv4 Protocols
- Setting a manual IP



Problems and Troubleshooting

Pinging another VM

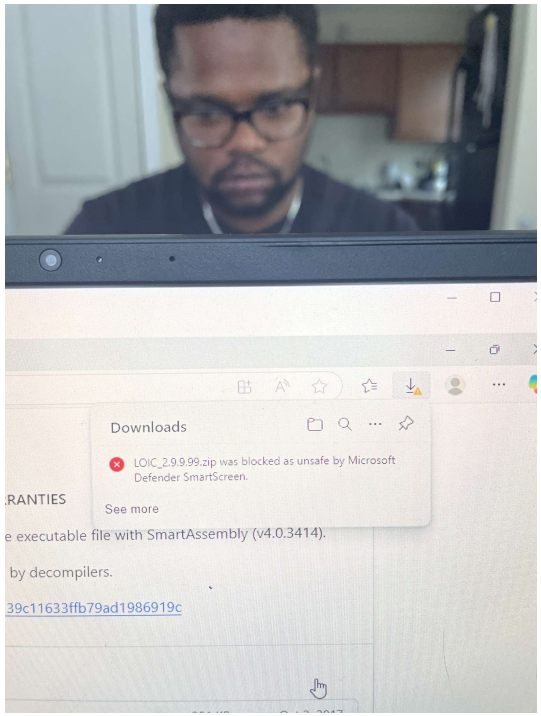
- NAT Network vs Bridged Adapter
- Unique MAC Addresses
- Disabling Windows Firewall

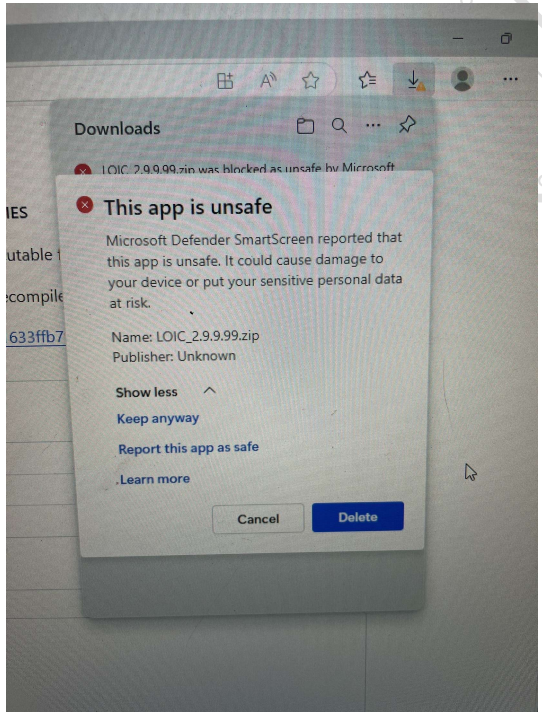


Problems and Troubleshooting

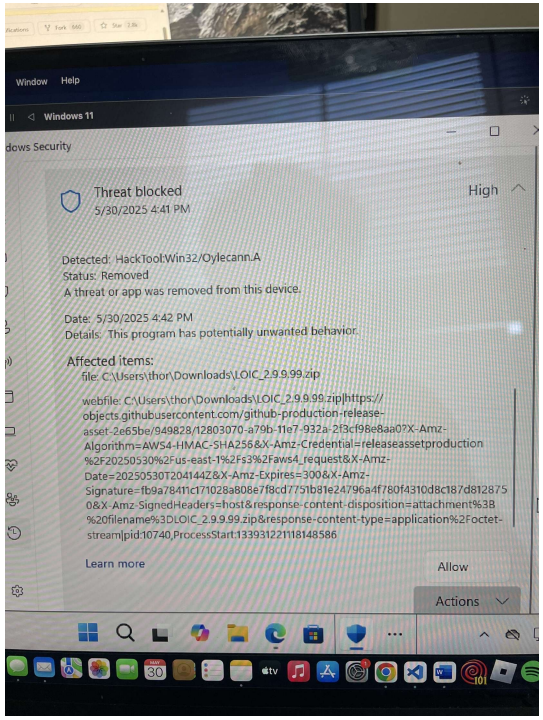
Downloading LOIC

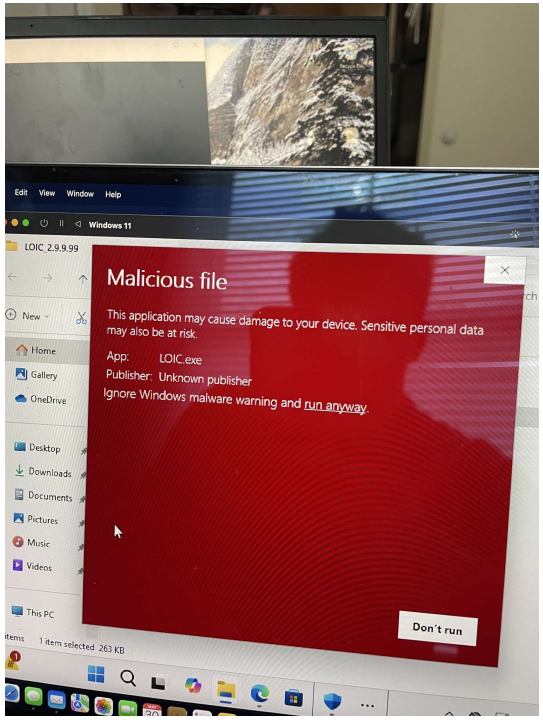
- GitHub download
- Circumventing Windows Firewall and Microsoft Detection Antivirus
- Machine/VM errors





Problems and Troubleshooting

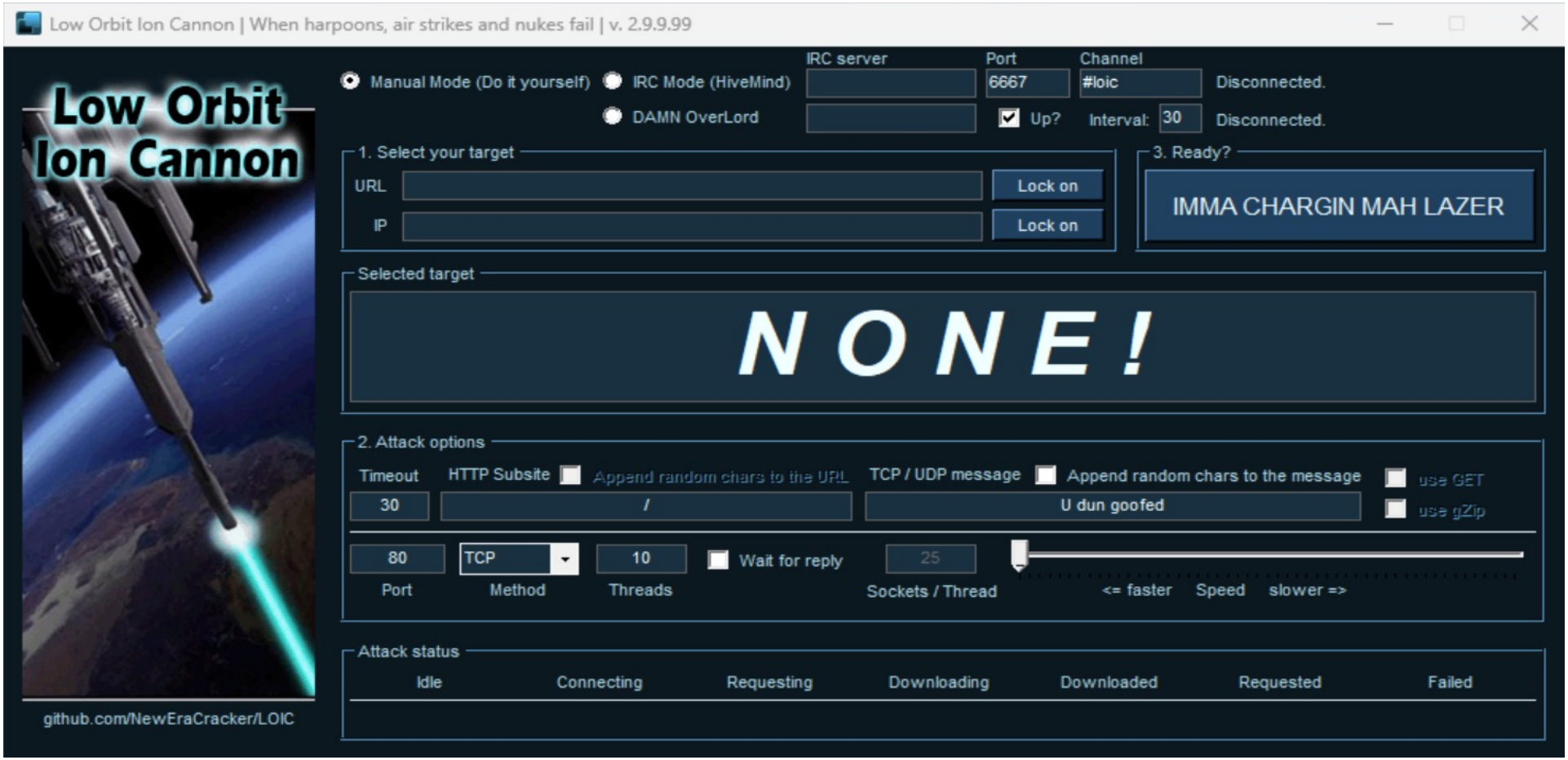




Execution

Low Orbit Ion Cannon

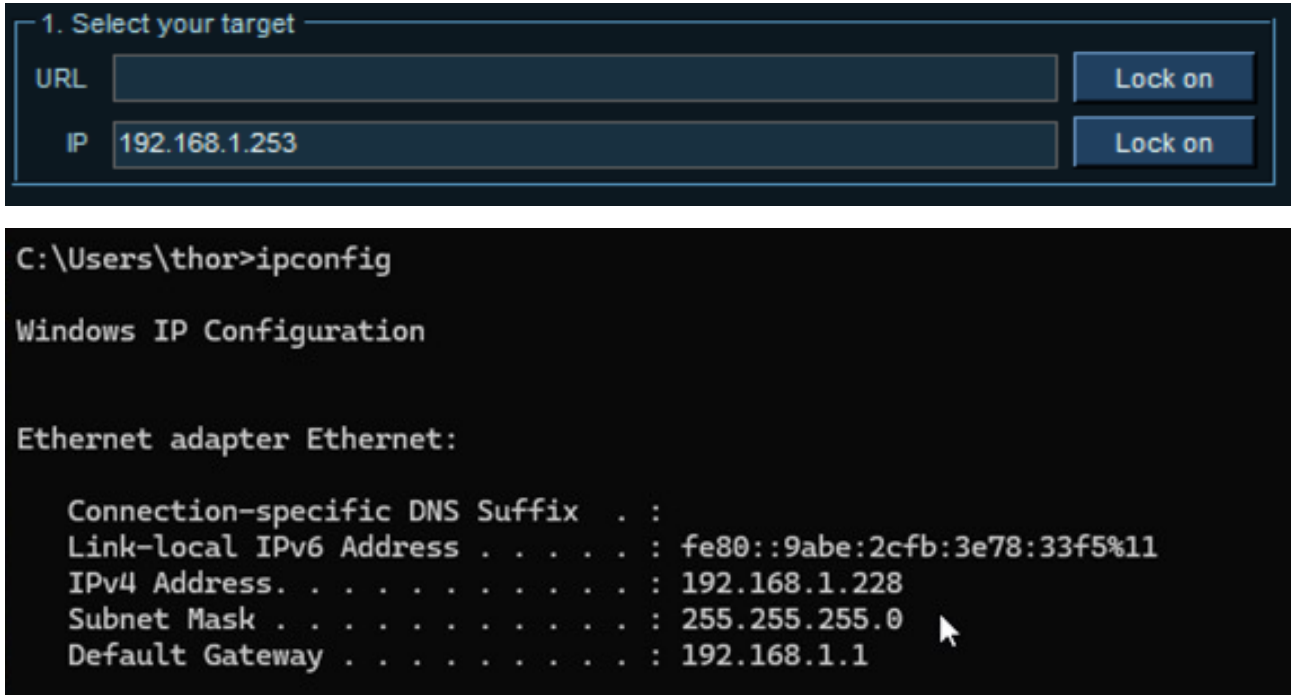
- Developed in 2010 by Praetox Technology
- Network Stress-Testing Application
- Written in C#
- Become open-source (around 2015/2016)
- Last release in October 2017
- Made popular by Anonymous
- Very easy to use


Low Orbit Ion Cannon | When harpoons, air strikes and nukes fail | v. 2.9.9.99
Low Orbit Ion Cannon
github.com/NewEraCracker/LOIC
Manual Mode (Do it yourself)
IRC Mode (HiveMind)
DAMN OverLord
IRC server
Port
6667
Channel
#loic
Disconnected.
Up?
Interval:
30
Disconnected.
1. Select your target
URL
Lock on
IP
Lock on
3. Ready?
IMMA CHARGIN MAH LAZER
Selected target
NONE!
2. Attack options
Timeout
30
HTTP Subsite
Append random chars to the URL
/
TCP / UDP message
Append random chars to the message
U dun goofed
use GET
use gZip
80
Port
TCP
Method
10
Threads
Wait for reply
25
Sockets / Thread
<= faster
Speed
slower =>
Attack status
Idle
Connecting
Requesting
Downloading
Downloaded
Requested
Failed

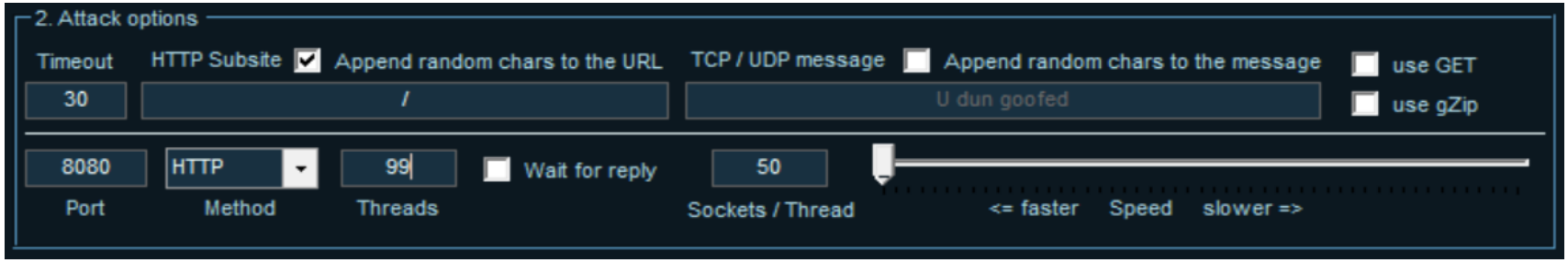
Attack Simulation Details

- 7 Total VMs (5 Attackers, 1 Target, 1 Observer)
- All attackers were identical
- Independently controlled
- Goal: Deny a legitimate user access to the site

Step 1: Identify Target Address



Step 2: Customize Attack



Options:

- Port: 8080
- Threads: 99 (Max)
- Sockets/Thread: 50
- Request Type: ?

METHOD

TCP - Transmission Control Protocol

Transport Layer Protocol

UDP - User Datagram Protocol

Internet Layer Protocol

HTTP - Hypertext Transfer Protocol

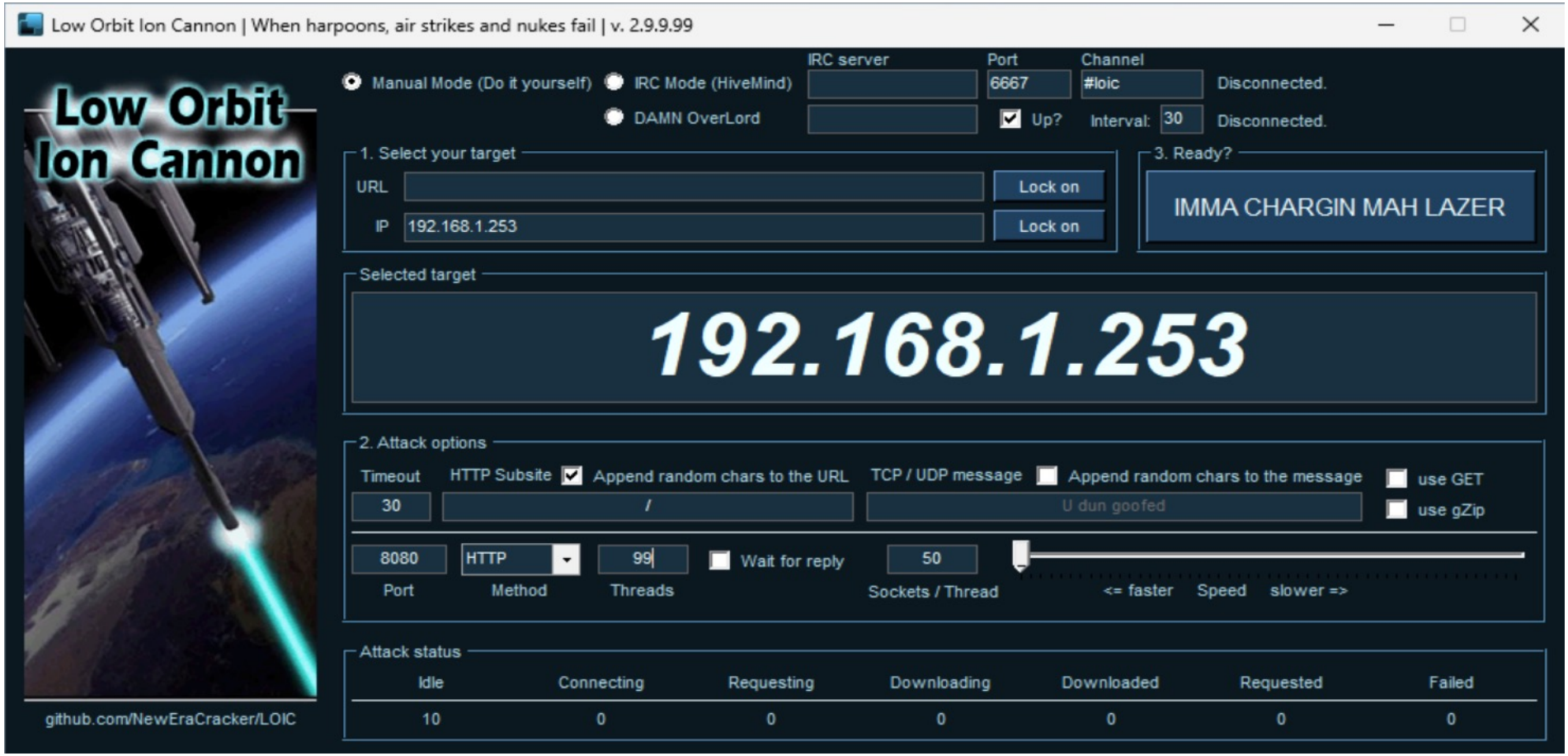
Application Layer Protocol

Step 3: CHARGE THE LASER

Options:

- **DO something illegal (in most scenarios)**
- **DON'T do something illegal**

We were very careful to not do anything illegal, we promise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Selected target
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2. Attack options
Timeout
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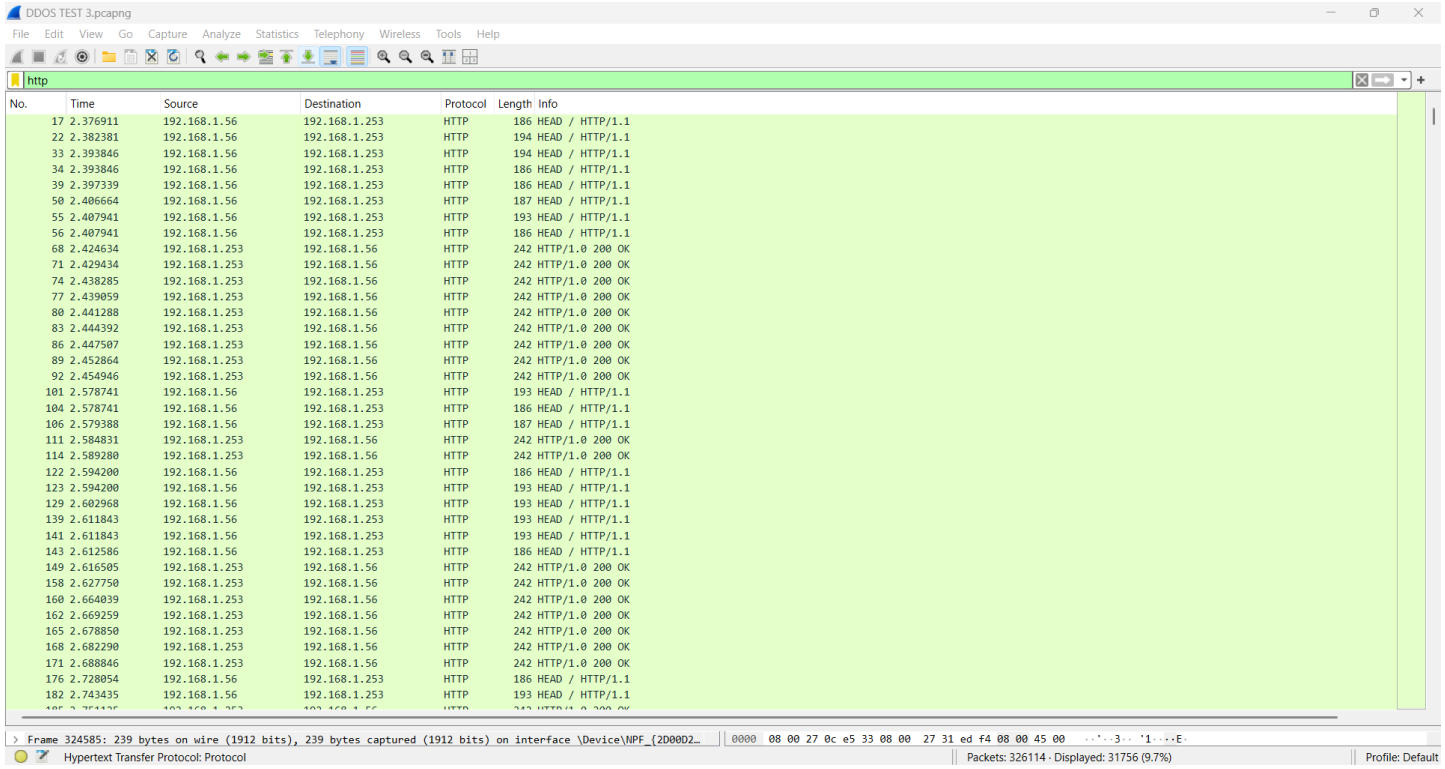
HTTP Subsite
Append random chars to the URL
/
TCP / UDP message
Append random chars to the message
U dun goofed
use GET
use gZip
8080
Port
HTTP
Method
99
Threads
Wait for reply
50
Sockets / Thread
<= faster
Speed
slower =>
Attack status
Idle
Connecting
Requesting
Downloading
Downloaded
Requested
Failed
10
0
0
0
0
0
0

RESULTS

Observer VM

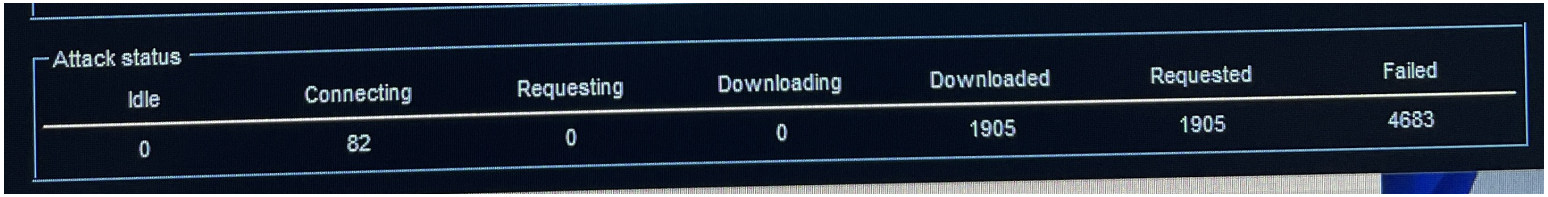

DDOS TEST 3.pcapng
File Edit View Go Capture Analyze Statistics Telephony Wireless Tools Help
http
No. Time Source Destination Protocol Length Info
17 2.376911 192.168.1.56 192.168.1.253 HTTP 186 HEAD / HTTP/1.1
22 2.382381 192.168.1.56 192.168.1.253 HTTP 194 HEAD / HTTP/1.1
33 2.393846 192.168.1.56 192.168.1.253 HTTP 194 HEAD / HTTP/1.1
34 2.393846 192.168.1.56 192.168.1.253 HTTP 186 HEAD / HTTP/1.1
39 2.397339 192.168.1.56 192.168.1.253 HTTP 186 HEAD / HTTP/1.1
50 2.406664 192.168.1.56 192.168.1.253 HTTP 187 HEAD / HTTP/1.1
55 2.407941 192.168.1.56 192.168.1.253 HTTP 193 HEAD / HTTP/1.1
56 2.407941 192.168.1.56 192.168.1.253 HTTP 186 HEAD / HTTP/1.1
68 2.424634 192.168.1.253 192.168.1.56 HTTP 242 HTTP/1.0 200 OK
71 2.429434 192.168.1.253 192.168.1.56 HTTP 242 HTTP/1.0 200 OK
74 2.438285 192.168.1.253 192.168.1.56 HTTP 242 HTTP/1.0 200 OK
77 2.439059 192.168.1.253 192.168.1.56 HTTP 242 HTTP/1.0 200 OK
80 2.441288 192.168.1.253 192.168.1.56 HTTP 242 HTTP/1.0 200 OK
83 2.444392 192.168.1.253 192.168.1.56 HTTP 242 HTTP/1.0 200 OK
86 2.447507 192.168.1.253 192.168.1.56 HTTP 242 HTTP/1.0 200 OK
89 2.452864 192.168.1.253 192.168.1.56 HTTP 242 HTTP/1.0 200 OK
92 2.454946 192.168.1.253 192.168.1.56 HTTP 242 HTTP/1.0 200 OK
101 2.578741 192.168.1.56 192.168.1.253 HTTP 193 HEAD / HTTP/1.1
104 2.578741 192.168.1.56 192.168.1.253 HTTP 186 HEAD / HTTP/1.1
106 2.579388 192.168.1.56 192.168.1.253 HTTP 187 HEAD / HTTP/1.1
111 2.584831 192.168.1.253 192.168.1.56 HTTP 242 HTTP/1.0 200 OK
114 2.589280 192.168.1.253 192.168.1.56 HTTP 242 HTTP/1.0 200 OK
122 2.594200 192.168.1.56 192.168.1.253 HTTP 186 HEAD / HTTP/1.1
123 2.594200 192.168.1.56 192.168.1.253 HTTP 193 HEAD / HTTP/1.1
129 2.602968 192.168.1.56 192.168.1.253 HTTP 193 HEAD / HTTP/1.1
139 2.611843 192.168.1.56 192.168.1.253 HTTP 193 HEAD / HTTP/1.1
141 2.611843 192.168.1.56 192.168.1.253 HTTP 193 HEAD / HTTP/1.1
143 2.612586 192.168.1.56 192.168.1.253 HTTP 186 HEAD / HTTP/1.1
149 2.616505 192.168.1.253 192.168.1.56 HTTP 242 HTTP/1.0 200 OK
158 2.627750 192.168.1.253 192.168.1.56 HTTP 242 HTTP/1.0 200 OK
160 2.664039 192.168.1.253 192.168.1.56 HTTP 242 HTTP/1.0 200 OK
162 2.669259 192.168.1.253 192.168.1.56 HTTP 242 HTTP/1.0 200 OK
165 2.678850 192.168.1.253 192.168.1.56 HTTP 242 HTTP/1.0 200 OK
168 2.682290 192.168.1.253 192.168.1.56 HTTP 242 HTTP/1.0 200 OK
171 2.688846 192.168.1.253 192.168.1.56 HTTP 242 HTTP/1.0 200 OK
176 2.728054 192.168.1.56 192.168.1.253 HTTP 186 HEAD / HTTP/1.1
182 2.743435 192.168.1.56 192.168.1.253 HTTP 193 HEAD / HTTP/1.1
Frame 324585: 239 bytes on wire (1912 bits), 239 bytes captured (1912 bits) on interface \Device\NPF_{2D00D2…
0000 08 00 27 0c e5 33 08 00 27 31 ed f4 08 00 45 00
Hypertext Transfer Protocol: Protocol
Packets: 326114 · Displayed: 31756 (9.7%)
Profile: Default

~16,000+

Requests sent in 2.5 minutes

Success Metrics

1. **Low Orbit Ion Cannon: Failed Requests**



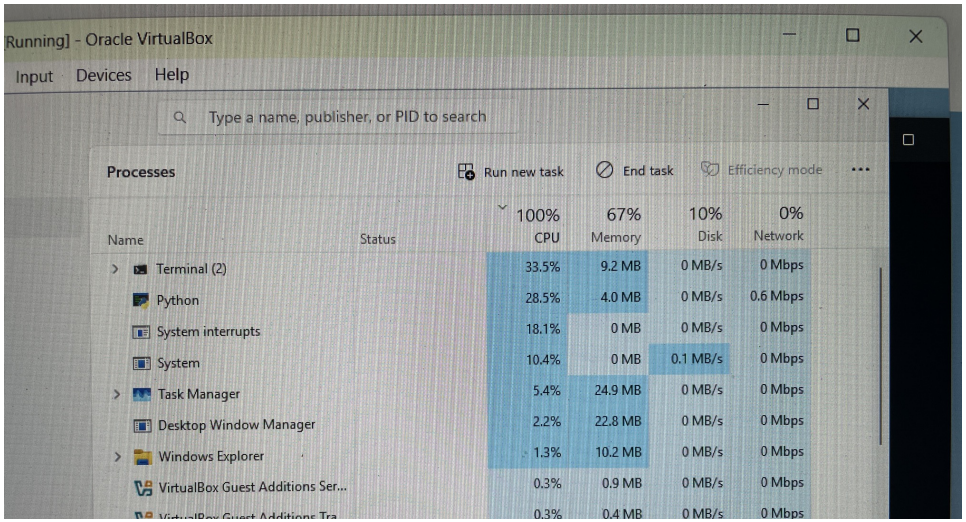
Success Metrics

2. Wireshark: Retransmission Requests

3251…	152.603287	192.168.1.56	192.168.1.253	TCP	66 [TCP Port numbers reused] 53458 → 8080 [SYN] Seq=0 Win=65535 Len=0 MSS=1460 WS=256 SACK_PERM
3251…	152.603287	192.168.1.56	192.168.1.253	TCP	66 [TCP Port numbers reused] 53408 → 8080 [SYN] Seq=0 Win=65535 Len=0 MSS=1460 WS=256 SACK_PERM
3251…	152.603287	192.168.1.56	192.168.1.253	TCP	66 [TCP Port numbers reused] 53401 → 8080 [SYN] Seq=0 Win=65535 Len=0 MSS=1460 WS=256 SACK_PERM
3251…	152.604467	192.168.1.56	192.168.1.253	TCP	66 [TCP Port numbers reused] 53387 → 8080 [SYN] Seq=0 Win=65535 Len=0 MSS=1460 WS=256 SACK_PERM
3251…	152.604467	192.168.1.56	192.168.1.253	TCP	66 [TCP Port numbers reused] 53367 → 8080 [SYN] Seq=0 Win=65535 Len=0 MSS=1460 WS=256 SACK_PERM
3251…	152.604467	192.168.1.56	192.168.1.253	TCP	66 [TCP Port numbers reused] 53406 → 8080 [SYN] Seq=0 Win=65535 Len=0 MSS=1460 WS=256 SACK_PERM
3251…	152.604467	192.168.1.56	192.168.1.253	TCP	66 [TCP Port numbers reused] 53388 → 8080 [SYN] Seq=0 Win=65535 Len=0 MSS=1460 WS=256 SACK_PERM
3251…	152.604467	192.168.1.56	192.168.1.253	TCP	66 [TCP Port numbers reused] 53383 → 8080 [SYN] Seq=0 Win=65535 Len=0 MSS=1460 WS=256 SACK_PERM
3251…	152.604467	192.168.1.56	192.168.1.253	TCP	66 [TCP Port numbers reused] 53386 → 8080 [SYN] Seq=0 Win=65535 Len=0 MSS=1460 WS=256 SACK_PERM
3251…	152.605016	192.168.1.56	192.168.1.253	TCP	66 [TCP Port numbers reused] 53385 → 8080 [SYN] Seq=0 Win=65535 Len=0 MSS=1460 WS=256 SACK_PERM
3251…	152.605016	192.168.1.56	192.168.1.253	TCP	66 [TCP Port numbers reused] 53400 → 8080 [SYN] Seq=0 Win=65535 Len=0 MSS=1460 WS=256 SACK_PERM
3251…	152.605016	192.168.1.56	192.168.1.253	TCP	66 [TCP Port numbers reused] 53390 → 8080 [SYN] Seq=0 Win=65535 Len=0 MSS=1460 WS=256 SACK_PERM
3251…	152.605016	192.168.1.56	192.168.1.253	TCP	66 [TCP Port numbers reused] 53405 → 8080 [SYN] Seq=0 Win=65535 Len=0 MSS=1460 WS=256 SACK_PERM
3251…	152.605572	192.168.1.56	192.168.1.253	TCP	66 [TCP Port numbers reused] 53395 → 8080 [SYN] Seq=0 Win=65535 Len=0 MSS=1460 WS=256 SACK_PERM
3251…	152.605572	192.168.1.56	192.168.1.253	TCP	66 [TCP Port numbers reused] 53403 → 8080 [SYN] Seq=0 Win=65535 Len=0 MSS=1460 WS=256 SACK_PERM

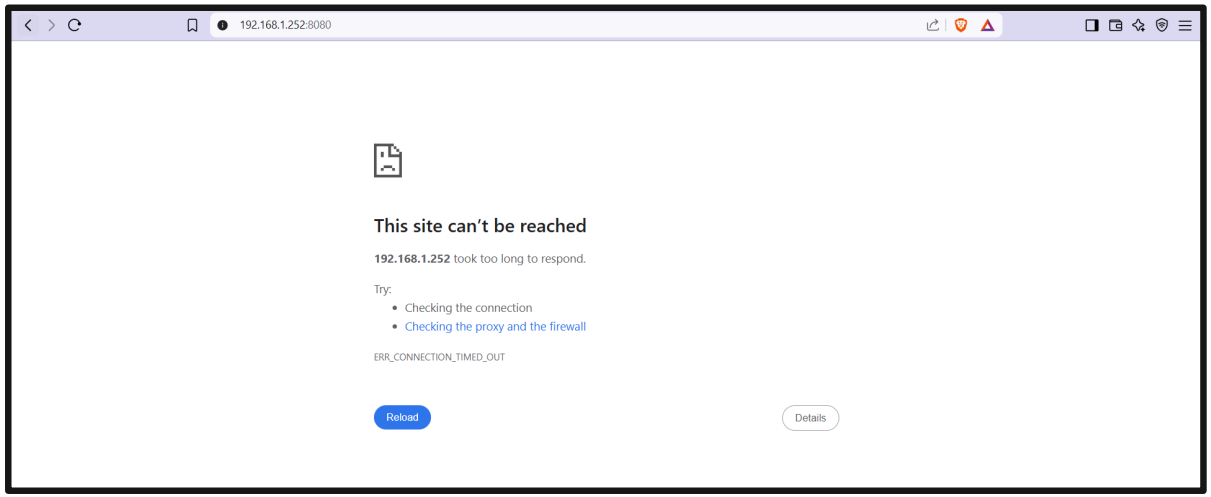
Success Metrics

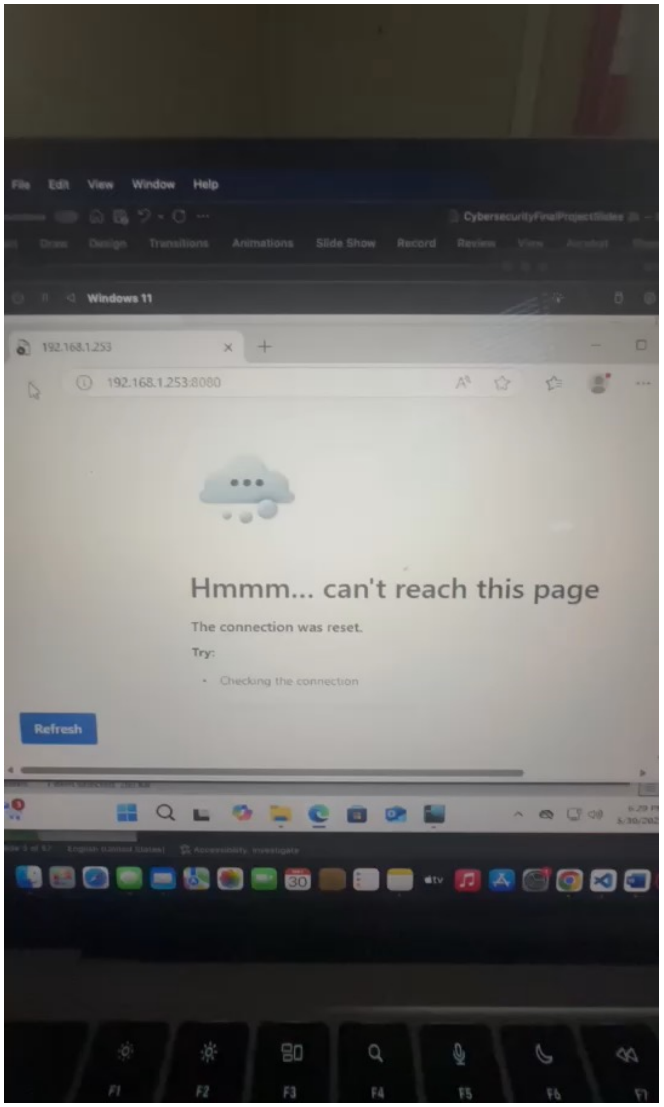
3. **Target VM Task Manager: Fully-utilizing host resources**



Success Metrics

4. **Website unavailable to Legitimate Users**





Discussion Questions

- If we had a Web Application Firewall or rate limiting in place, how many of you think the attack would still succeed? Why or why not?
- What do you think would've been different if we launched this attack at Layer 3 or 4 instead of the application layer (Layer 7)?
- Do you think using tools like LOIC makes these attacks too easy? If so, should they be more restricted or harder to access?

Future Improvements

- We could have attacked the network layer
    - We attacked layer 7, which is typical, we could have shown deeper understanding by attacking layer 3 or 4
- Our own attack scripts
    - Writing our own scripts could have shown understanding and mastery
- Secured the app, so that we can find loopholes around
    - Attacking a rate limited system and one with Web Application Firewall (WAF) could have improved the robustness of our attack.
- Tried on a full-stack app
    - Instead of packet overload, we could focus on cutting down services:
        - API hangs - servers takes long to respond
        - Database overloads - database receives more queries than it can handle
        - UI timeouts - database receives more queries than it can handle

Final Thoughts

Reassurances

- Environment and attack set-up: Complicated and time consuming
- One machine is not strong enough
- Some level of knowledge required to implement the attack

Concerns

- Simplicity of the attack: Easy to replicate
- The resources are open and obtainable
- Organizations with the resources will have the means to conduct large-scale attacks

Sources

- https://www.cloudflare.com/learning/ddos/ddos-attack-tools/low-orbit-ion-cannon-loic/
- https://openhub.net/p/LOIC
- https://github.com/NewEraCracker/LOIC/releases
- https://developer.mozilla.org/en-US/docs/Learn_web_development/Howto/Tools_and_setup/set_up_a_local_testing_server
- https://www.geeksforgeeks.org/differences-between-tcp-and-udp/
- https://www.akamai.com/glossary/what-is-a-layer-3-attack
- https://developers.cloudflare.com/waf/rate-limiting-rules/best-practices/
- https://www.catchpoint.com/api-monitoring-tools/api-gateway-timeout
- https://www.virtualbox.org/wiki/Downloads
- https://mac.getutm.app/
- https://www.microsoft.com/en-us/software-download/windows11
- https://www.wireshark.org/download.html

Questions?