Internet Security

CS 249i

~this week in security~

a cybersecurity newsletter by @zackwhittaker

volume 4, issue 41

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Tue 16 Jan 2024 / 15:00 UTC


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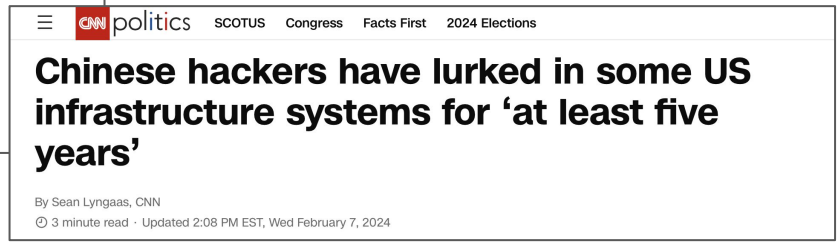
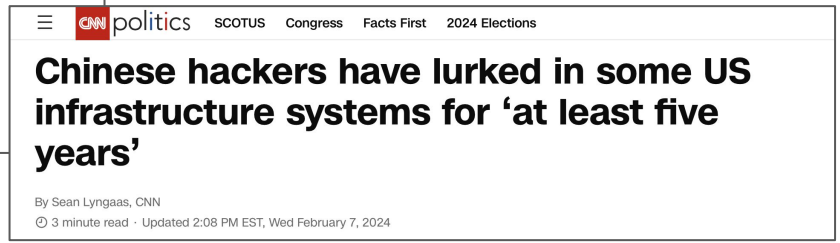

CNN politics
SCOTUS Congress Facts First 2024 Elections
Chinese hackers have lurked in some US infrastructure systems for ‘at least five years’
By Sean Lyngaas, CNN
3 minute read · Updated 2:08 PM EST, Wed February 7, 2024

How do these attacks happen over the Internet?



What Internet security problems plague us *today*?

(1) Vulnerable/Exposed Services on the Internet
   (a) Sensitive data leakage
   (b) Ransomware
   (c) Botnets → Distributed Denial of Service

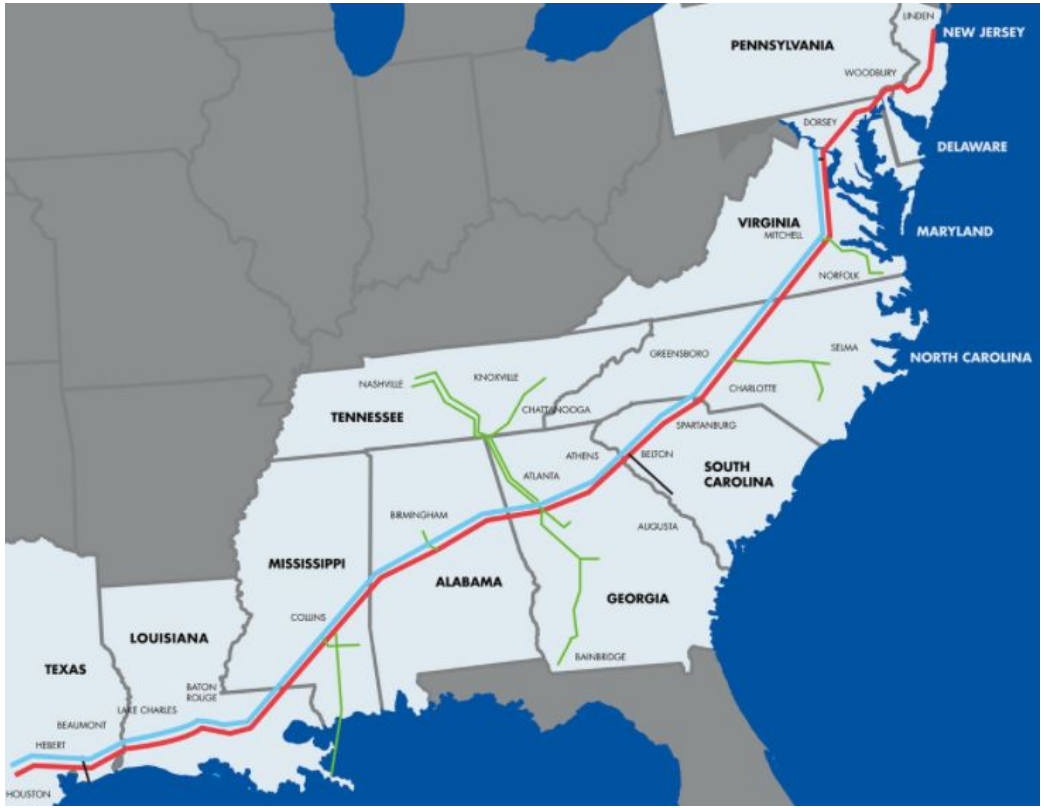
(2) “Bulletproof”/ “Neutral” Hosting
   (a) Network attacks
   (b) Misinformation

Real world consequences

(attacks on natural resources, hospitals, information sources, vaccination rates)

How are network intrusion attacks orchestrated on the Internet?

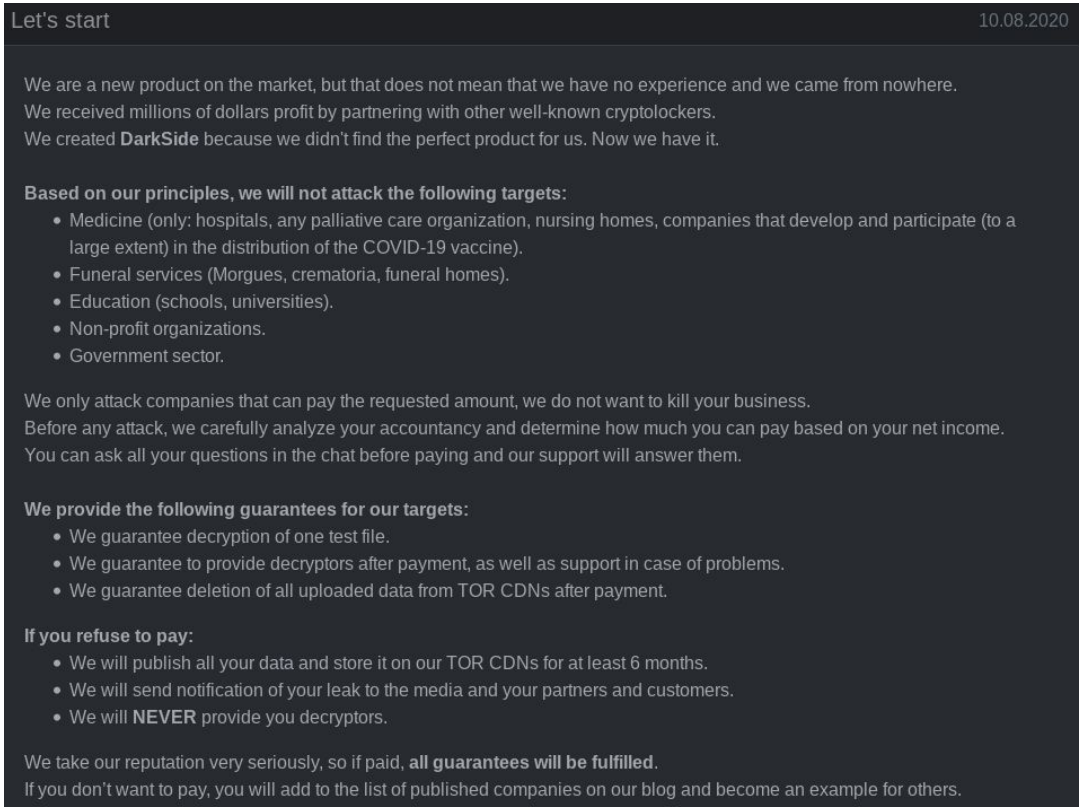
Colonial Pipeline ransomware attack - May 2021



- May 7: Attackers penetrate, encrypt, and hold internal systems for ransom
- May 7 -- May 12: colonial pipeline operations are shut down
- Fuel shortages across the entire east coast (affected drivers, airlines, etc)

DarkSide (“Ransomware-as-a-Service”)

- Responsible for Colonial Pipeline Hack
- Operates from Russia



Let's start 10.08.2020

We are a new product on the market, but that does not mean that we have no experience and we came from nowhere.
We received millions of dollars profit by partnering with other well-known cryptolockers.
We created **DarkSide** because we didn't find the perfect product for us. Now we have it.

Based on our principles, we will not attack the following targets:

- Medicine (only: hospitals, any palliative care organization, nursing homes, companies that develop and participate (to a large extent) in the distribution of the COVID-19 vaccine).
- Funeral services (Morgues, crematoria, funeral homes).
- Education (schools, universities).
- Non-profit organizations.
- Government sector.

We only attack companies that can pay the requested amount, we do not want to kill your business.
Before any attack, we carefully analyze your accountancy and determine how much you can pay based on your net income.
You can ask all your questions in the chat before paying and our support will answer them.

We provide the following guarantees for our targets:

- We guarantee decryption of one test file.
- We guarantee to provide decryptors after payment, as well as support in case of problems.
- We guarantee deletion of all uploaded data from TOR CDNs after payment.

If you refuse to pay:

- We will publish all your data and store it on our TOR CDNs for at least 6 months.
- We will send notification of your leak to the media and your partners and customers.
- We will **NEVER** provide you decryptors.

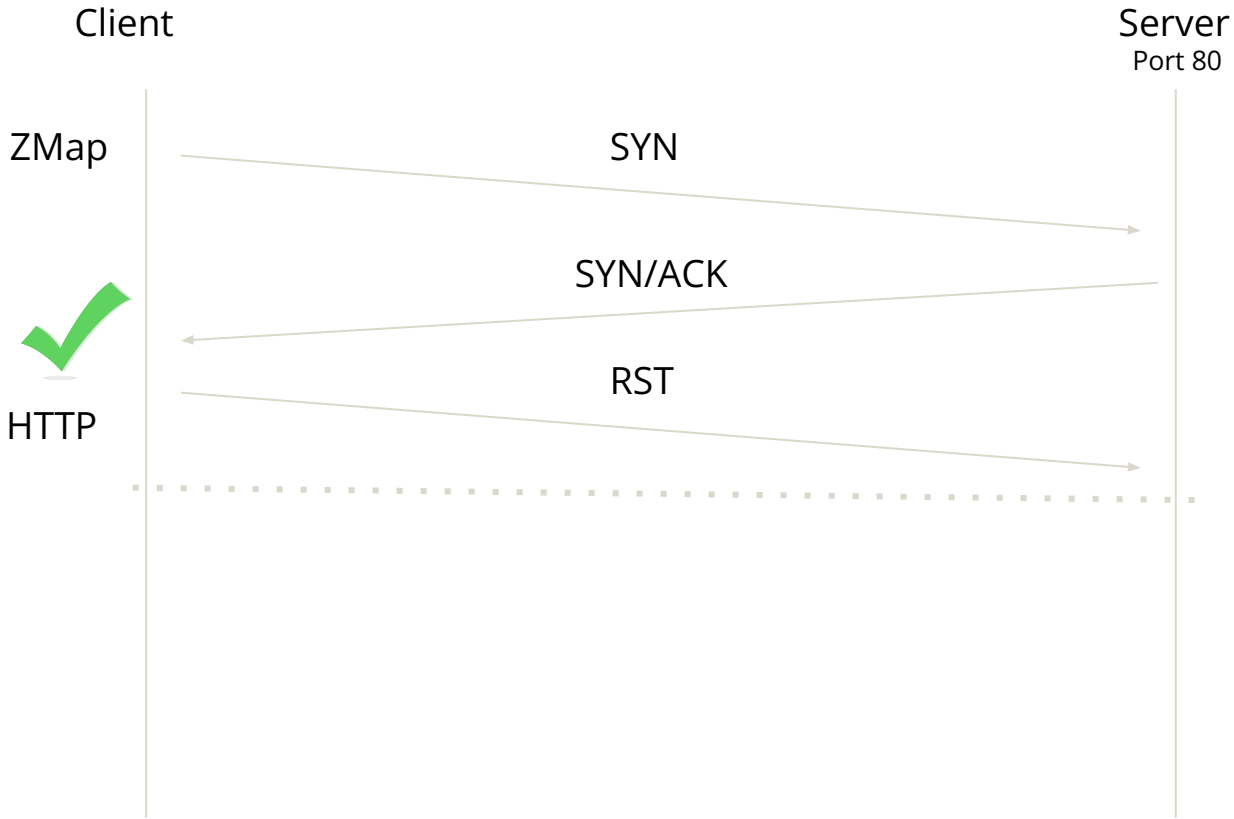
We take our reputation very seriously, so if paid, **all guarantees will be fulfilled**.
If you don’t want to pay, you will add to the list of published companies on our blog and become an example for others.

How do attackers (and researchers) find Internet services to gain control of (study) ?

Finding services using Internet scanning

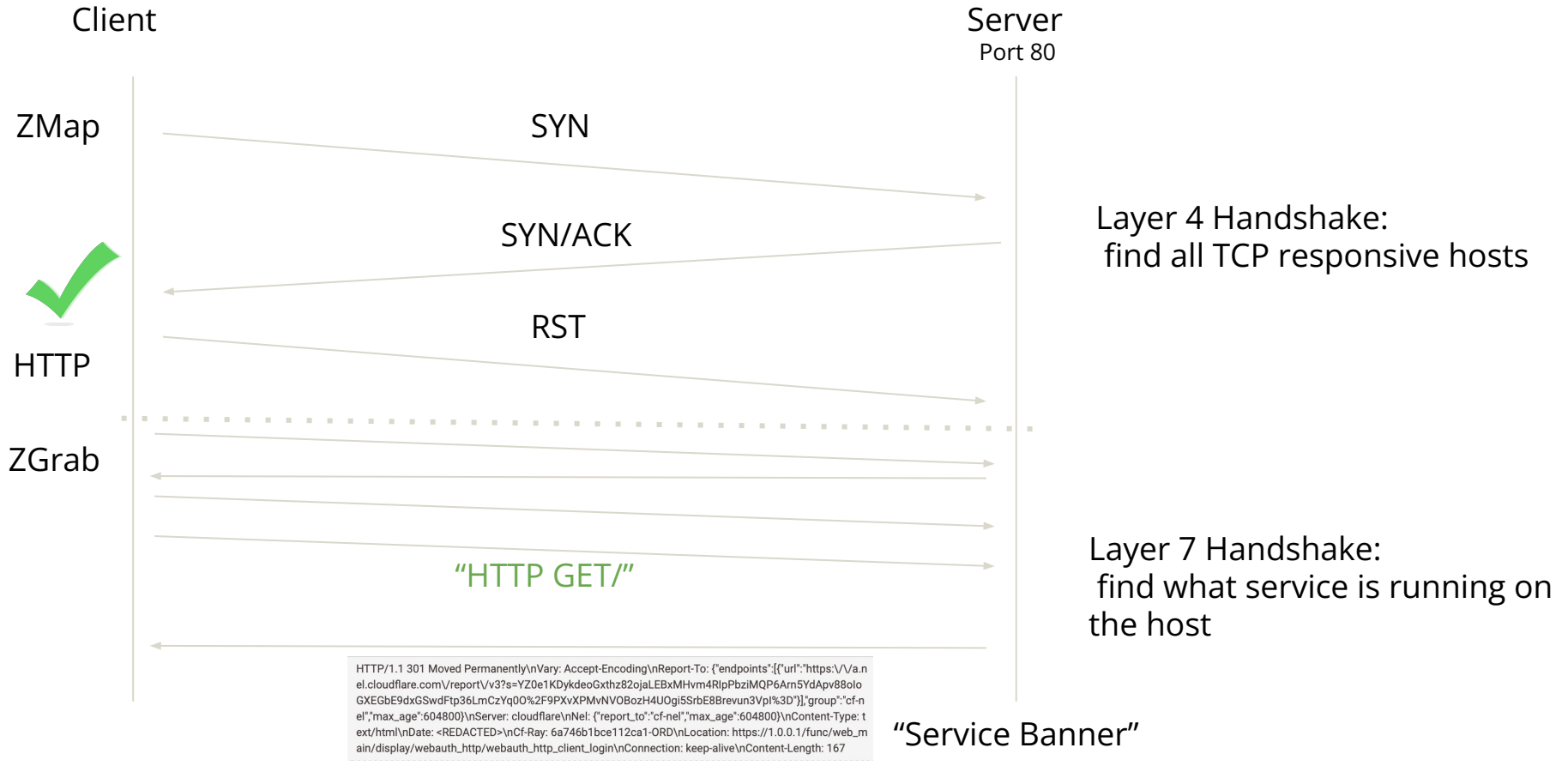
- Internet Scanning: The process of connecting to IP addresses on chosen ports in order to detect active services

Most commonly used* TCP Internet scanning methodology



Layer 4 Handshake:
find all TCP responsive hosts

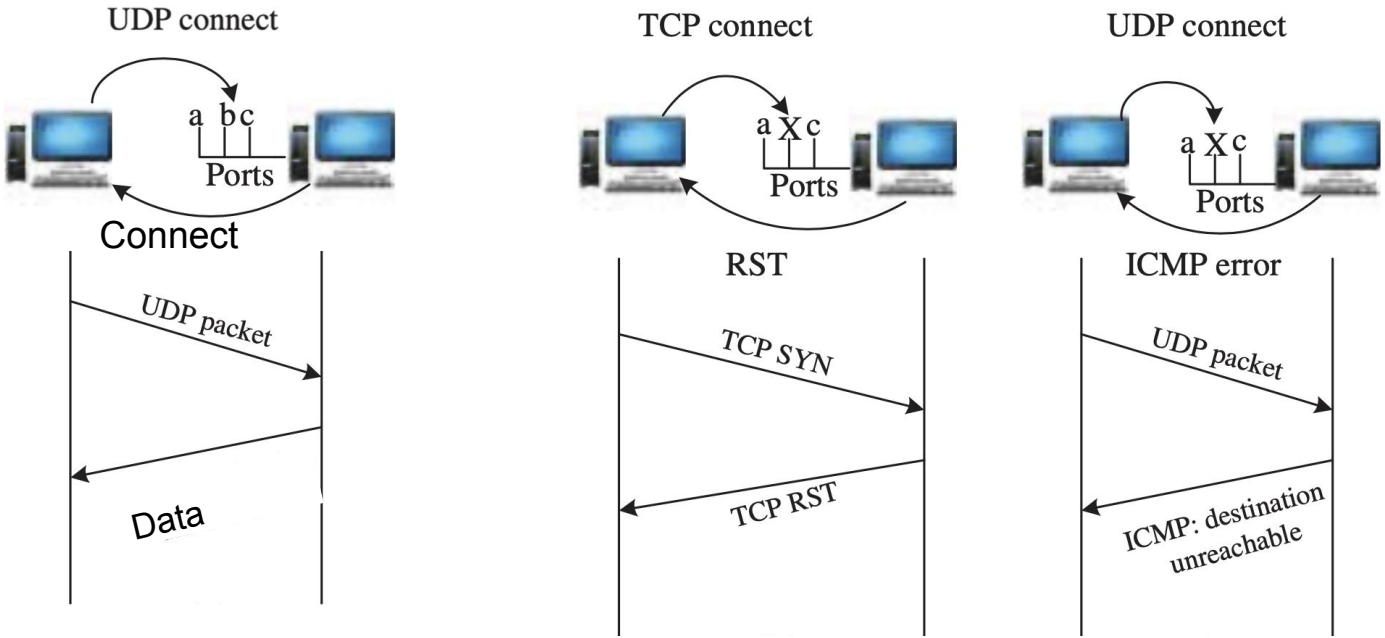
Most commonly used* TCP Internet scanning methodology



Layer 4 Handshake:
find all TCP responsive hosts

Layer 7 Handshake:
find what service is running on the host

Layer 4 Internet scanning (continued)



Finding services using Internet scanning

IPv4: connect to all ~2^32 IP addresses on a subset of “interesting” ports and protocols
(e.g., HTTP/80, TLS/443, TELNET/23)

- ~1 hour to scan 100% of IPv4 on 1 port at 1Gb/s bandwidth

Finding services using Internet scanning

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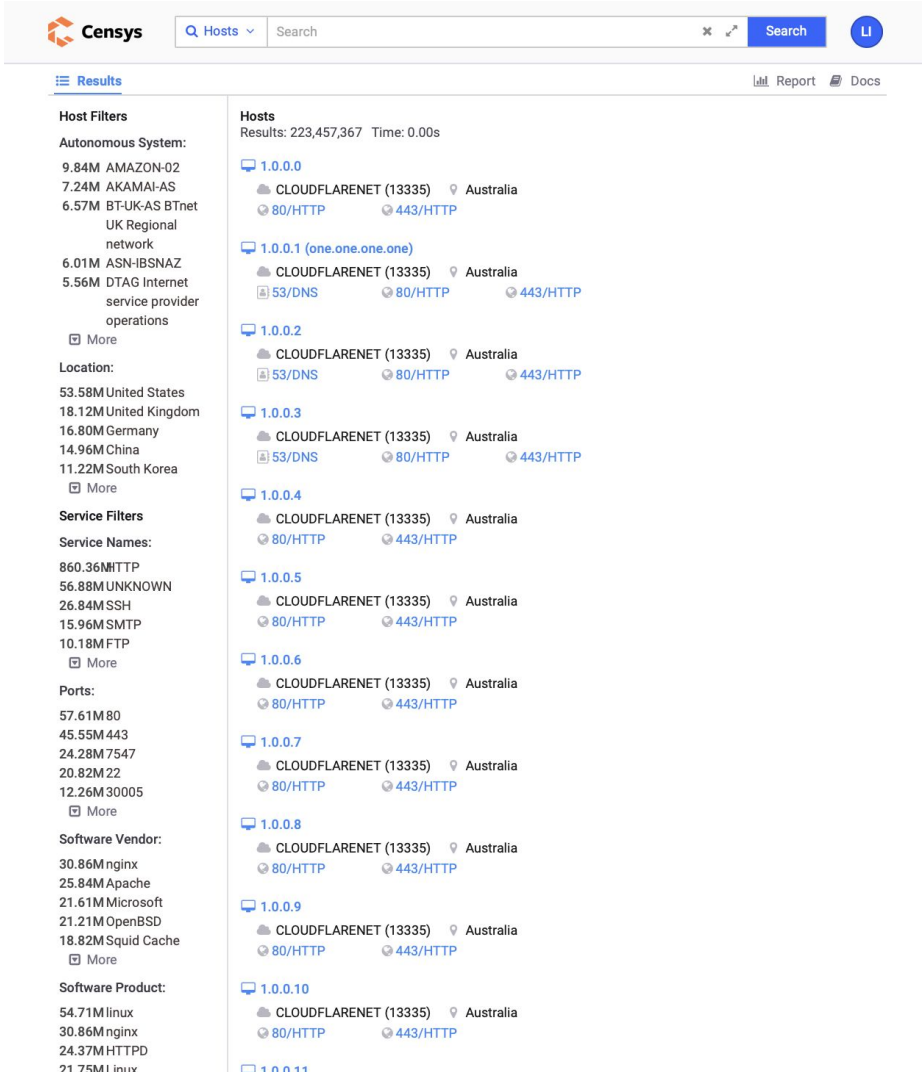
- ~1 hour to scan 100% of IPv4 on 1 port at 1Gb/s bandwidth

IPv6: not possible to connect to all ~2^128 IP addresses...need a smart way of predicting which IP addresses will most likely respond

- IPv6 scanning is an open research problem!



- “Internet search engines” exist to help map and track all services on the Internet
- Companies operating Internet search engines scan the Internet for you

SHODAN | Explore | Pricing | camera

TOTAL RESULTS

5,886,146

TOP COUNTRIES

United States	987,894
Viet Nam	373,306
United Kingdom	294,580
Germany	268,283
China	235,469

More...

TOP PORTS

80	1,949,772
81	414,584
443	242,032
8080	160,375
82	148,393

More...

TOP ORGANIZATIONS

Amazon Technologies Inc.	279,565
Viettel Group	164,143
Amazon.com, Inc.	158,481
Vietnam Posts and Telecommunications Group	140,441
Korea Telecom	104,785

More...

TOP PRODUCTS

Hikvision IP Camera	3,351,931
Apache httpd	80,231
Apache Advanced Extranet Server httpd	76,057
nginx	68,431
TruVision NVR/DVR/IP Camera	29,147

View Report | Browse Images | View on Map

New Service: Keep track of what you have connected to the Internet. Check out Shodan Monitor

Security check

104.16.51.111
Cloudflare, Inc.
United States, San Francisco

cdn

2021-10-

SSL Certificate
Issued By:
|- Common Name:
Cloudflare Inc ECC CA-3

|- Organization:
Cloudflare, Inc.

Issued To:
|- Common Name:
endgameinc.zendesk.com

|- Organization:
Cloudflare, Inc.

Supported SSL Versions:
TLSv1.2

```
HTTP/1.1 403 Forbidden
Date: Fri, 29 Oct 2021 17:38:19 GMT
Content-Type: text/html; charset=UTF-8
Transfer-Encoding: chunked
Connection: close
CF-Chl-Bypass: 1
Permissions-Policy: accelerometer=(),autoplay=(),camera=(),clipboard-read=(),clipboard-write=(),fullscreen=(),geolocation=(),gyrosc
```

301 Moved Permanently

141.90.14.228
finanzamt-marburg-biedenkopf.hessen.de
Wiesbaden
Germany, Wiesbaden

2021-10-

SSL Certificate
Issued By:
|- Common Name:
SwissSign Server Gold CA 2014 - G22

|- Organization:
SwissSign AG

Issued To:
|- Common Name:
p2.hessen.de

|- Organization:
Land Hessen

Supported SSL Versions:
TLSv1.2, TLSv1.3

```
HTTP/1.1 301 Moved Permanently
Strict-Transport-Security: max-age=15768000
Date: Fri, 29 Oct 2021 17:36:14 GMT
Server: Apache
Referrer-Policy: no-referrer-when-downgrade
X-Xss-Protection: 1; mode=block
X-Frame-Options: SAMEORIGIN
Content-Security-Policy: default-src https: data: 'unsafe-in...
```

52.55.45.182

ec2-52-55-45-182.compute-1.amazonaws.com
Amazon Technologies Inc.
United States, Ashburn

cloud

2021-10-

SSL Certificate
Issued By:
|- Common Name:
Amazon

|- Organization:
Amazon

Issued To:
|- Common Name:
pursuitdealerstore.com

```
HTTP/1.1 302 302
Date: Fri, 29 Oct 2021 17:34:53 GMT
Content-Length: 0
Connection: keep-alive
Set-Cookie: JSESSIONID=BCE4BF7379EEB7DA72D4E51B154814DE; Path=/; secure; HttpOnly; SameSite=None; Secure; HttpOnly
Set-Cookie: navigation=20201211483=-1437935980163552893733; Path=/./; secure; Http...
```

Internet Scanning

- Researchers use Internet scanning to:
  - Uncover new attacks (e.g., DDoS amplification techniques, email delivery security)
  - Understand botnets (Mirai)
  - Find cryptographic weaknesses (TLS, SSH, Web PKI)
  - Examine industrial control system/ IoT deployment
  - Study censorship
  - Measure operator behavior

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- Attackers use Internet scanning to:
  - Find and exploit services

Common practices for good Internet scanning citizenship

- Slow down scanning speeds to not overwhelm end networks (major bottleneck in Internet scanning)
  - You might have a 40Gb/s link--but you should not be scanning at 40Gb/s, or you might denial of service a small end-network

Common practices for good Internet scanning citizenship

- Slow down scanning speeds to not overwhelm end networks (major bottleneck in Internet scanning)
  - You might have a 40Gb/s link--but you should not be scanning at 40Gb/s, or you might denial of service a small end-network
- Configure source scanning address to
  - (1) point to a DNS record that indicates the scanning is a part of a research study (e.g., research.esrg.stanford.edu)
  - (2) host a webpage that explains the nature of scans
  - (3) provide an email address that can be contacted to request exclusion from future scans

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Stanford University

Why am I receiving connection attempts from this host?

These connections are part of a long-term computer science research project at Stanford University. This research involves making a small number of harmless connection attempts to every publicly accessible computer worldwide each day. This allows scientists to measure the global Internet and analyze trends in technology deployment and security.

As part of this research, every public IP address receives a handful of packets on common ports. These consist of standard connection attempts followed by RFC-compliant protocol handshakes with responsive hosts. We never attempt to exploit security problems, guess passwords, or change device configurations. We only receive data that is publicly visible to anyone who connects to a particular address and port.

Why are you collecting this data?

How did DarkSide infiltrate Colonial Pipeline?

How did DarkSide infiltrate Colonial Pipeline?

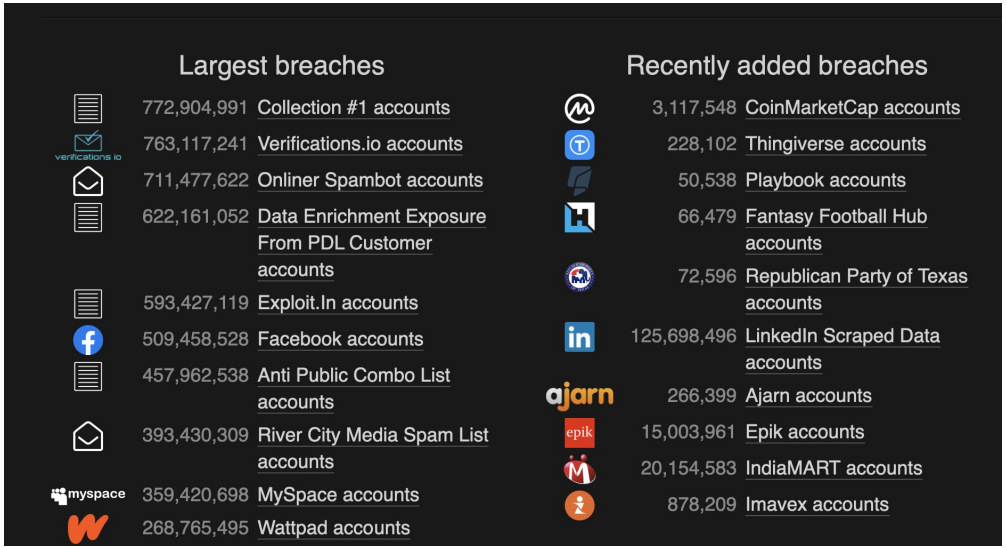
- “RockYou2021” password leak (~8.2 billion credentials) on the dark web
  - Contained an outdated, but still used, credential to a Colonial Pipeline Virtual Private Network (VPN)
    - Businesses typically use a VPN **to give remote employees access to internal applications and data**, or to create a single shared network between multiple office locations.

> "It was a complicated password, I want to be clear on that. It was not a Colonial123-type password." - Colonial Pipeline CEO in Senate Hearing

';--have i been pwned?

Check if your email or phone is in a data breach

email or phone (international format) | pwned?



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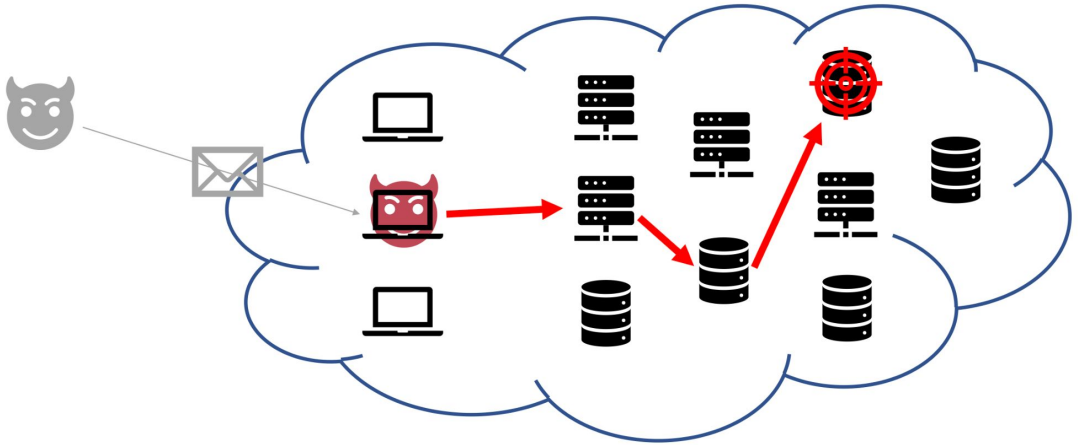
- Scanned to find all VPNs (e.g., port 427 if using VMware ESXi, port 3389 if searching for applications that use the Remote Desk Protocol)
- Try the Colonial Pipeline/leaked credentials
- Attempted the credential---no two-factor authentication (legacy VPN)---so it just worked!
- Direct access to internal network/systems/files.

Once inside a network, attackers “laterally move”

Lateral Movement:
Attacker movement *between* internal machines



5

Hopper: Modeling and Detecting Lateral Movement

Grant Ho, *UC San Diego, UC Berkeley, and Dropbox;* Mayank Dhiman, *Dropbox;* Devdatta Akhawe, *Figma, Inc.;* Vern Paxson, *UC Berkeley and International Computer Science Institute;* Stefan Savage and Geoffrey M. Voelker, *UC San Diego;* David Wagner, *UC Berkeley*

https://www.usenix.org/conference/usenixsecurity21/presentation/ho

Lateral Movement

(1) Reconnaissance: explore and map the network (e.g., netstat, ifconfig, arp cache, ip tables…)
(2) Privilege Escalation: gain access to the credentials needed to log into the next server (e.g., social engineering, exploit)
(3) Movement

DarkSide succeeds in lateral movement...and begins encrypting ~100GB of their files

Aftermath of Colonial Pipeline Hack

- Colonial Pipeline shuts down to stop lateral movement / ransomware spread
- FBI, CISA, DoE, DHS all notified
- Colonial Pipeline pays ransom
  - It is illegal for companies to pay ransom to terrorist organizations, but it is not illegal (only “advised against”) to pay ransoms in general

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- Colonial ends up using its own back-ups to restore data
- DarkSide regrets going high-profile
- FBI recovers some of the ransom money (blockchain analysis + secrets)

DarkSide has used more sophisticated ways to gain access to networks…

- Critical VPN/ Remote Access tools CVEs (Common Vulnerabilities and Exposures)
  - CVE-2021-20016 : “A SQL-Injection vulnerability in the SonicWall SSLVPN SMA100 product allows a remote unauthenticated attacker to perform SQL query to achieve remote control execution”
  - CVE-2019-554/ CVE-2020-3992: Targets a use-after-free bug in VMware ESXi that allows an attacker to achieve remote control execution

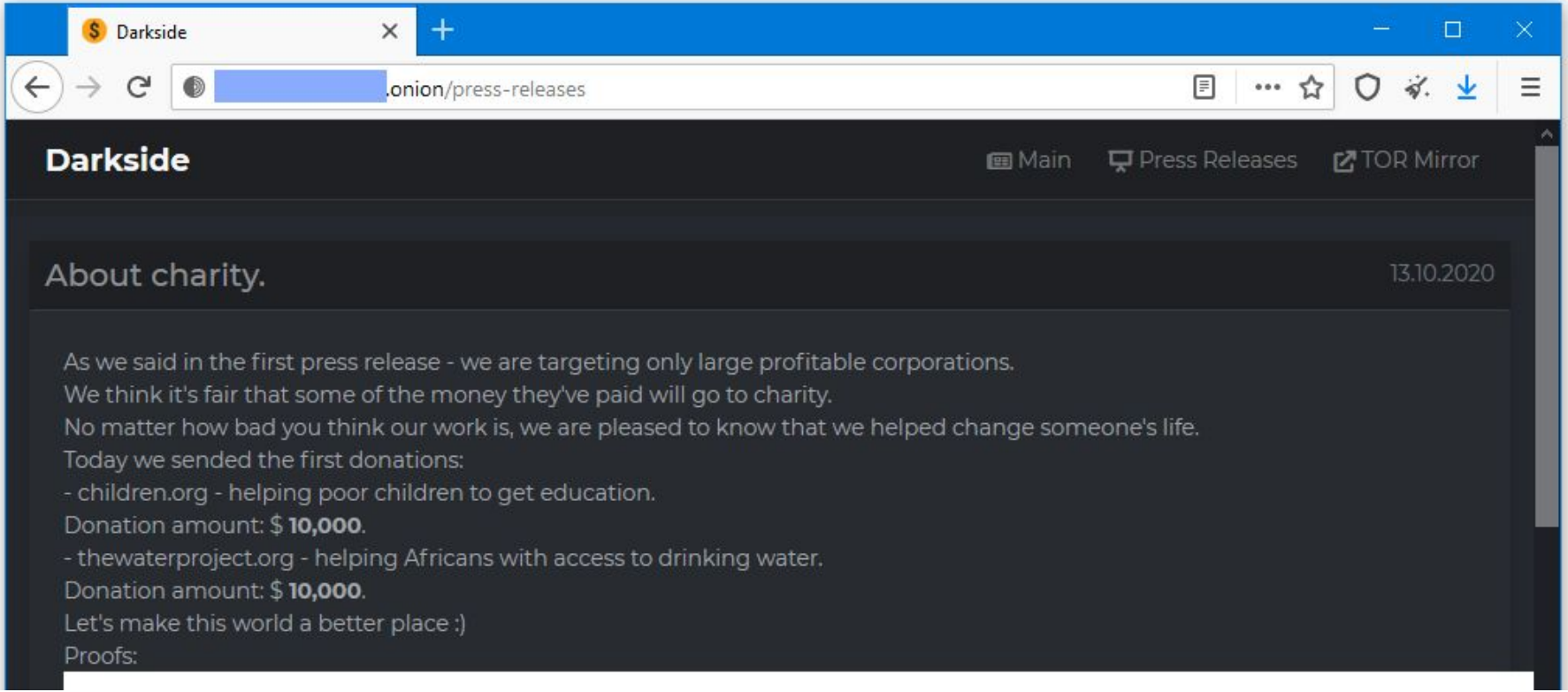
VMware ESXi 6.7.0

VMware ESXi 6.5.0

May 2021 (Shodan)

https://cybersecurityworks.com/blog/ransomware/darkside-the-ransomware-that-brought-a-us-pipeline-to-a-halt.html

The BrightSide of DarkSide



An increasingly common variation: software supply chain attacks

MOVEit ransomware attacks - 2023

- Zero-day SQL injection vulnerability in MOVEit file transfer software
  - New CVE, old OWASP vulnerability class
- Cl0p ransomware gang seem to have developed attack for ~2 years before mass-exploiting organizations using MOVEit

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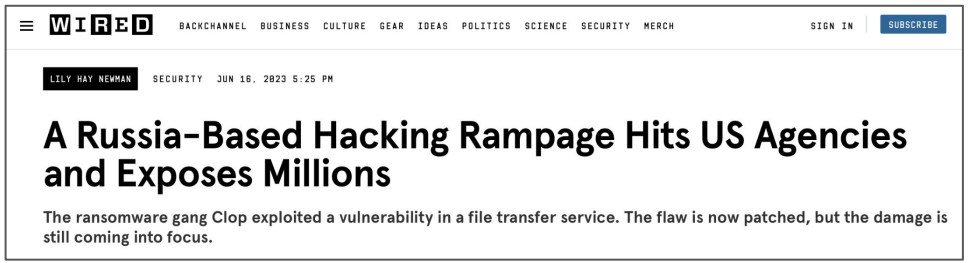
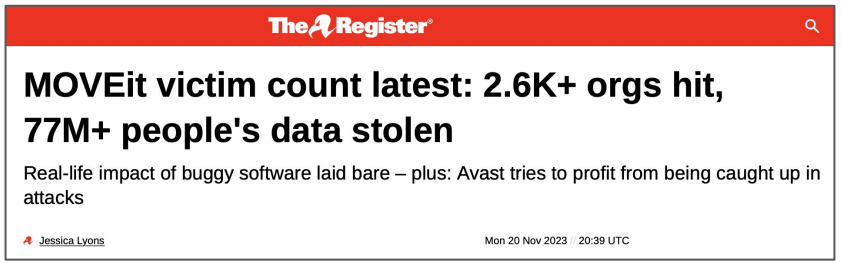
- Hundreds of organizations affected, including British Airways, the BBC, Shell, Ernst & Young, US Medicare/Medicaid Services, US Department of Energy… and Stanford Healthcare and LPCH





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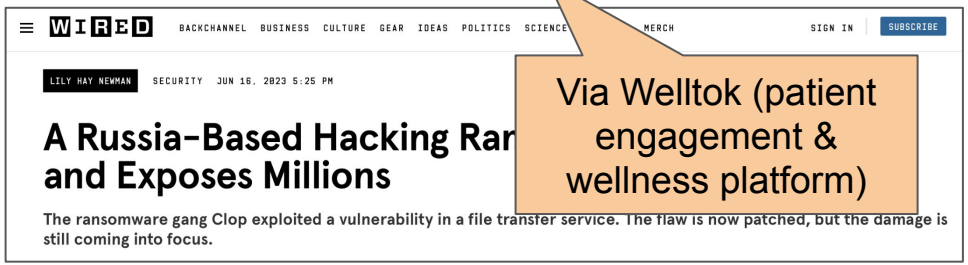
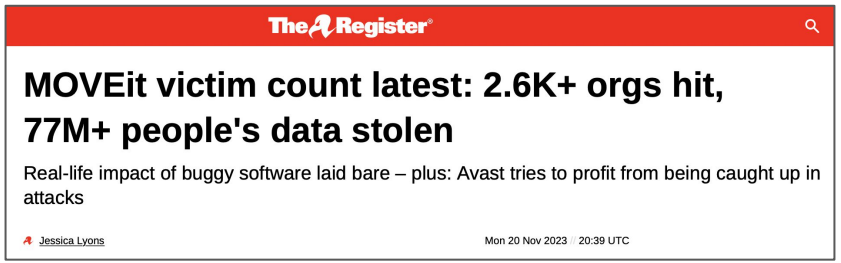
Via Maximus (govt health tech services contractor)

Via Zellis (payroll services provider)

Via Welltok (patient engagement & wellness platform)





MOVEit ransomware attacks - 2023

- MOVEit issued a patch quickly and organizations scrambled to apply it, but attackers were faster
- Cl0p has demanded money from organizations in exchange for not leaking all their data
- Many leaks have already happened and will likely continue to

How should one protect an Internet service from Internet Scans?

Defenses against Internet Scanning

- Don’t expose unnecessary services to the public internet
- Constantly upgrade (CVEs get patched all the time)

Defenses against Internet Scanning

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Not “good-practice” defenses (i.e., obscuring a service):

- Use IPv6 address
  - May show up in passive data sources (e.g., DNS, network taps)
- Use an unassigned/unexpected port
  - New scanners/techniques have been developed to find such hosts

How to detect unassigned port usage

How to detect port 80 is actually hosting SSH?

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Use LZR (a system for identifying unexpected Internet services)

- sends specially crafted network packets to fingerprint the running service
- can detect up to 18 unique popular protocols (HTTP, SSH, TLS, etc) with 1 packet

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How to detect that an IoT manufacturer configured a group of devices to use port 12345 to host Telnet?

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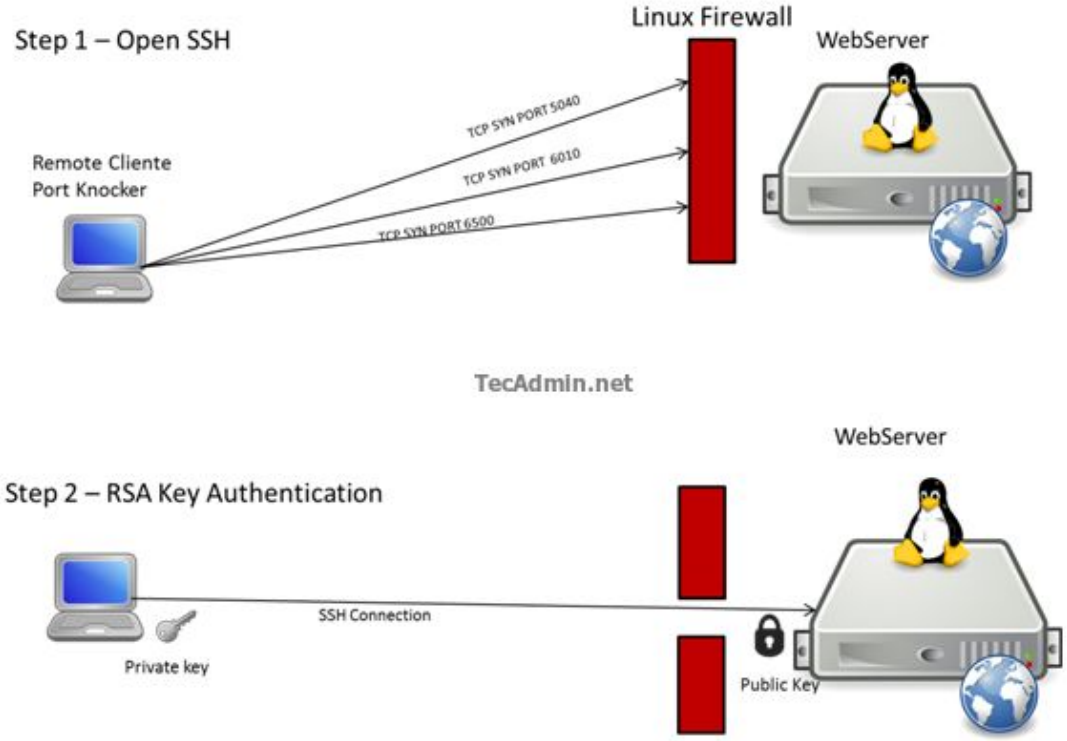
Use GPS (a system for discovering IPv4 services across all ports)

- Using a small “seed scan”, detects patterns of port usage (by computing massive conditional probabilities) for groups of devices

How to detect unassigned port usage

- How to detect an individual operator decision to assign a single service to a random port?
  - Passive data source
  - Brute force scanning
  - ??

Security Through Obscurity: Port Knocking



"Knock" on a sequence of ports before being allowed into the port that is hosting the service

- Unsolved: how to detect and bypass port knocking

Where do other attackers originate?
What do they target?

Bureau 121

- A group within the North Korean General Bureau of Reconnaissance that is in charge of cyber warfare
- UN 2019 reported that North Korea raised > $2 billion from hacking (and spends the $ on nuclear missile development)
- North Korea generally denies involvement
- Affiliated with Lazarus group (also from North Korea)
- U.S Justice Department indicted 3 men from this group for:
  - 2014 hack of Sony Pictures
  - the global “WannaCry ransomware contagion” of 2017
  - the theft of roughly $200 million and attempted theft of more than $1.2 billion from banks and other victims worldwide.

WannaCry / WannaCrypt Attack

- The NSA developed an exploit (“EternalBlue”) and a backdoor tool (“DoublePulsar”) that both target Microsoft SMB (port 445)
  - SMB “Server Message Block” protocol allows users to access files on remote servers
  - Exploit/backdoor sends specially crafted packets using SMB to allow for remote code execution on server

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  - Exploit/backdoor sends specially crafted packets using SMB to allow for remote code execution on server

- Exploit/Backdoor leaked by “The Shadow Brokers” hacker group
  - Microsoft releases patches (Microsoft was unaware that vulnerabilities had even existed before..)...but not all organizations update in time

WannaCry / WannaCrypt Attack

- The NSA developed an exploit (“EternalBlue”) and a backdoor tool (“DoublePulsar”) that both target Microsoft SMB (port 445)
  - SMB “Server Message Block” protocol allows users to access files on remote servers
  - Exploit/backdoor sends specially crafted packets using SMB to allow for remote code execution on server

- Exploit/Backdoor leaked by “The Shadow Brokers” hacker group
  - Microsoft releases patches (Microsoft was unaware that vulnerabilities had even existed before..)...but not all organizations update in time

- Bureau 121 uses EternalBlue and DoublePulsar to build a ransomware attack (WannaCry)

WannaCry / WannaCrypt Attack

- Upon Infection, WannaCry will:
  - (1) Encrypt all the content + demands a ransom
  - (2) Scan for other vulnerable targets (within internal network and external network) to replicate infection

WannaCry / WannaCrypt Attack

- Upon Infection, WannaCry will:
  - (1) Encrypt all the content + demands a ransom
  - (2) Scan for other vulnerable targets (within internal network and external network) to replicate infection
    - If target already has DoublePulsar (creates a back door and allows for root execution of code):
      - Infect machine with WannaCry.
    - If target is vulnerable to EternalBlue:
      - use EternalBlue to deliver DoublePulsar
      - Use DoublePulsar to infects the machine with WannaCry

WannaCry / WannaCrypt Attack

- Within a day the code was reported to have infected more than 230,000 computers in over 150 countries
- ~70K devices (computers, MRI scanners, blood-storage refrigerators) in England's National Health Service were estimated to be affected and some non-critical emergencies and ambulances were diverted

HSR Health Services Research

RESEARCH ARTICLE

Data breach remediation efforts and their implications for hospital quality

Sung J. Choi PhD, M. Eric Johnson PhD, Christoph U. Lehmann MD,

First published: 10 September 2019 | https://doi.org/10.1111/1475-6773.13203 | Citations: 7

Principal Findings

Hospital time-to-electrocardiogram increased as much as 2.7 minutes and 30-day acute myocardial infarction mortality increased as much as 0.36 percentage points during the 3-year window following a breach.

How to Accidentally Stop a Global Cyber Attacks

By : MalwareTech May 13, 2017 Category : Personal Stories Tags: ms17-010, ransowmare, stories, WannaCry

- WannaCry gets “accidentally” stopped because Marcus Hutchins---a free-lance(ish) security geek---began reverse-engineering the code and noticed a domain
- Domain was unregistered and it turned out to be a baked in “kill-switch” with the following logic
    - If: domain is unregistered, continue with infection
    - Else: stop the encryption/infection
- Marcus quickly registered the domain name and the infection stopped (and for the most part doesn’t reach the US)

```
qmemcpy(&szUrl, sinkholeddomain, 0x39u);      // previously unregistered domain, now sinkholed
v8 = 0;
v9 = 0;
v10 = 0;
v11 = 0;
v12 = 0;
v13 = 0;
v14 = 0;
v4 = InternetOpenA(0, 1u, 0, 0, 0);
v5 = InternetOpenUrlA(v4, &szUrl, 0, 0, 0x84000000, 0);// do HTTP request to previously unregistered domain
if ( v5 )                                     // if request successful quit
{
  InternetCloseHandle(v4);
  InternetCloseHandle(v5);
  result = 0;
}
else                                          // if request fails, execute payload
{
  InternetCloseHandle(v4);
  InternetCloseHandle(0);
  detonate();
  result = 0;
}
return result;
}
```

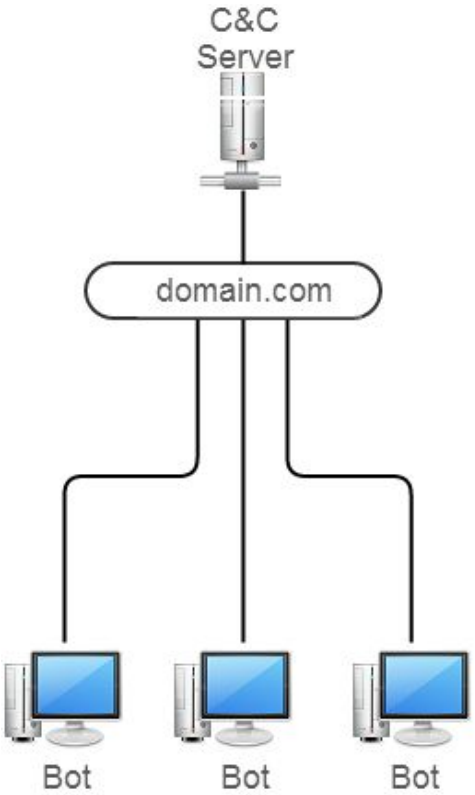
Why do hacker groups generally operate out of Russia, North Korea, China?

- “Anti-western” philosophies
- Good STEM education
- Russia in particular: Russian law only applies to crime against Russia
  - No pushback from government; sometimes, even encouragement
- North Korea in particular: Goal is to fund nuclear weapons program despite international sanctions

Installing a Russian keyboard deters Russian attackers from compromising the device

How are botnets/``contagions” designed from a systems perspective?

C&C Botnet Anatomy



- Centralized “command and control” (C&C) server that instructs the bots what to do
- C&C server will likely have multiple domains that the bots can reach it over
  - Complicates the process of shutting down botnet: need to take down all domains, can’t just take down the actual server
- C&C server will likely be hosted on a “bulletproof” server

Mirai Botnet

- Command and Control botnet
- At its peak, infected over 600K IoT devices (routers, cameras, printers, etc)
- In 2016, orchestrated one of the largest DDoS attacks at 623 Gbps on https://krebsonsecurity.com/ and against DYN (DNS provider) that GitHub, HBO, Twitter, Reddit, PayPal, Netflix, and Airbnb all rely on
- Code leaked online -> TONS of new variants

Understanding the Mirai Botnet

Manos Antonakakis[◇] Tim April[‡] Michael Bailey[†] Matthew Bernhard[◁] Elie Bursztein[○]
Jaime Cochran[▷] Zakir Durumeric[◁] J. Alex Halderman[◁] Luca Invernizzi[○]
Michalis Kallitsis[§] Deepak Kumar[†] Chaz Lever[◇] Zane Ma[†*] Joshua Mason[†]
Damian Menscher[○] Chad Seaman[‡] Nick Sullivan[▷] Kurt Thomas[○] Yi Zhou[†]

[‡]*Akamai Technologies* [▷]*Cloudflare* [◇]*Georgia Institute of Technology* [○]*Google*
[§]*Merit Network* [†]*University of Illinois Urbana-Champaign* [◁]*University of Michigan*

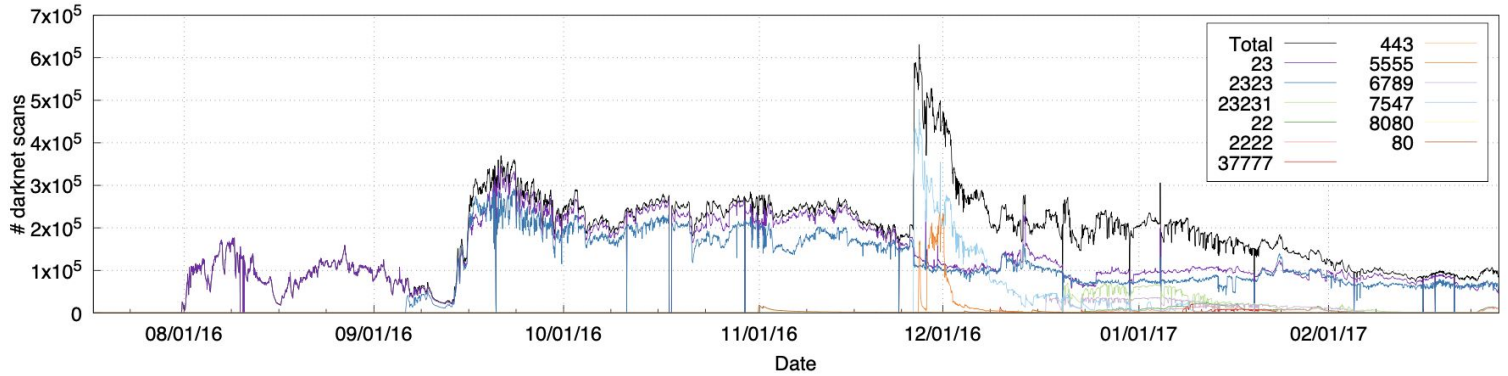
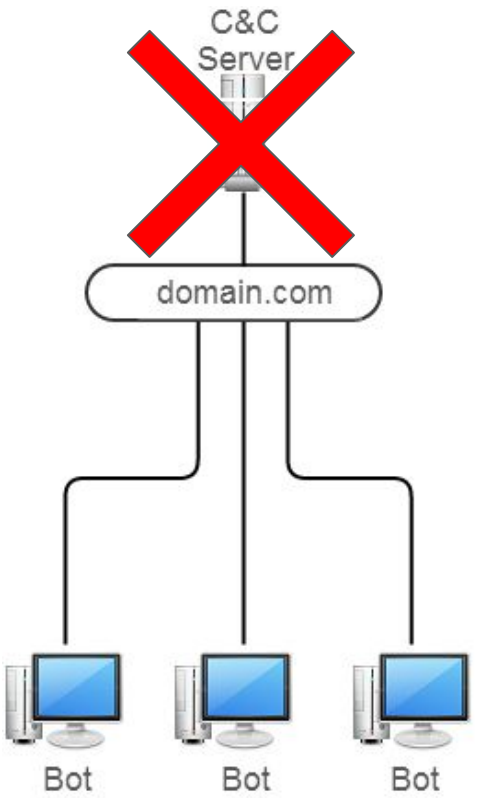


Figure 3: **Temporal Mirai Infections** — We estimate of the number of Mirai-infected devices over time by tracking the number of hosts actively scanning with Mirai fingerprint at the start of every hour. Mirai started by scanning Telnet, and variants evolved to target 11 additional protocols. The total population initially fluctuated between 200,000–300,000 devices before receding to 100,000 devices, with a brief peak of 600,000 devices.

Taking down C&C botnets

- Take control of C&C server
- Issue remediation commands to compromised devices as if C&C had issued them
- Bots think they’re taking orders from C&C and clear out the malware



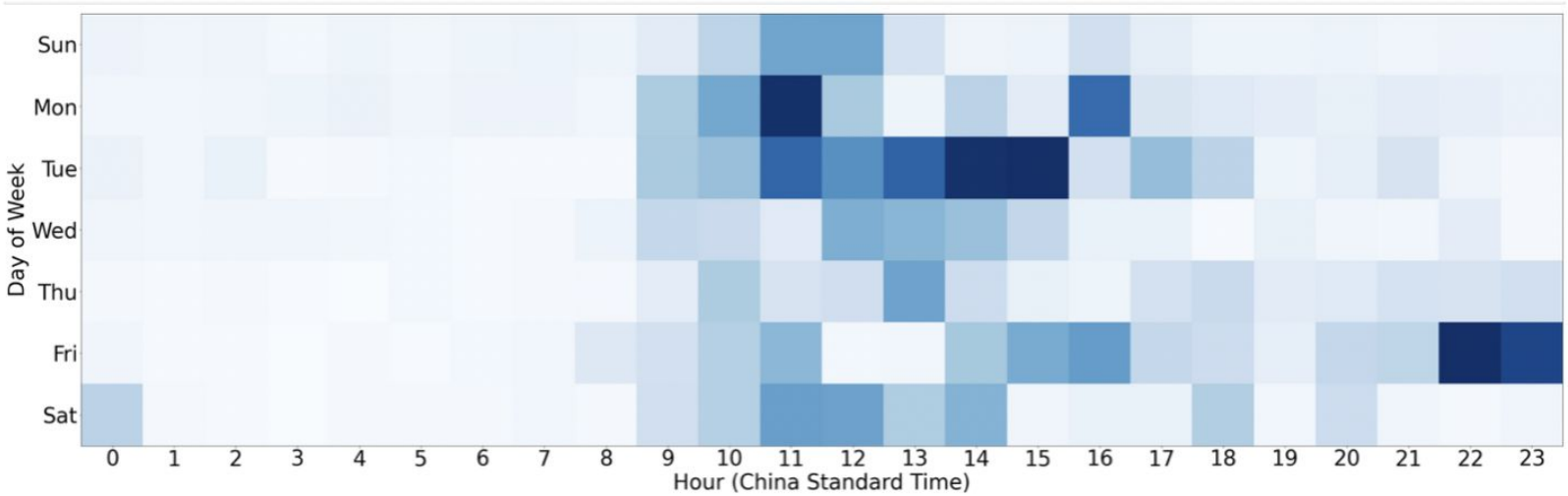
Taking down C&C botnets

- Botnet run by Russian military hacking group Fancy Bear
- Commodity malware “Moobot” repurposed to log in to routers with default admin passwords
  - Moobot is a Mirai variant… it haunts us still
- February 2024 (last week!): FBI takedown

Taking down C&C botnets

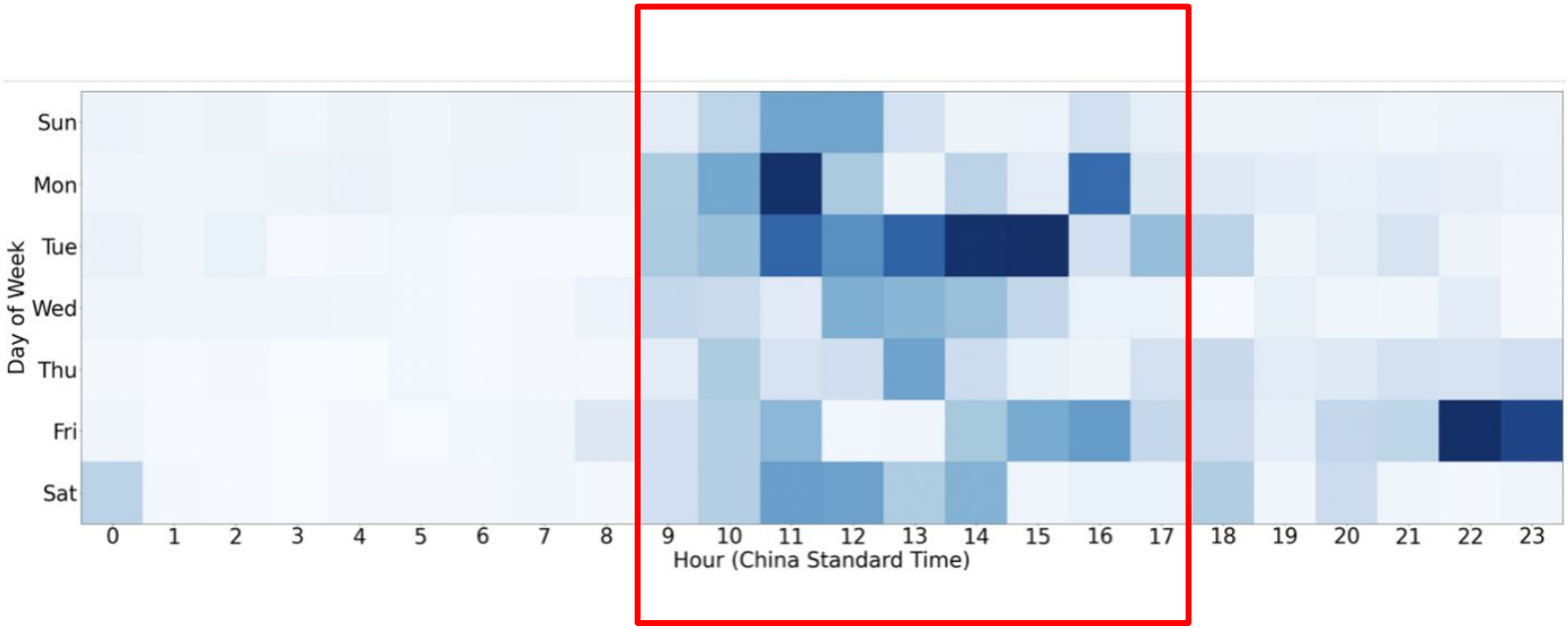
- “KV Botnet” run by Chinese state-sponsored hacking group Volt Typhoon
- Provided cover for group working to infiltrate US critical infrastructure
- Botnet targeted vulnerable end-of-life routers
- January 2024: FBI takedown

Sidenote: State-sponsored hacker working hours



Source:
https://blog.lumen.com/routers-roasting-on-an-open-firewall-the-kv-botnet-investigation/

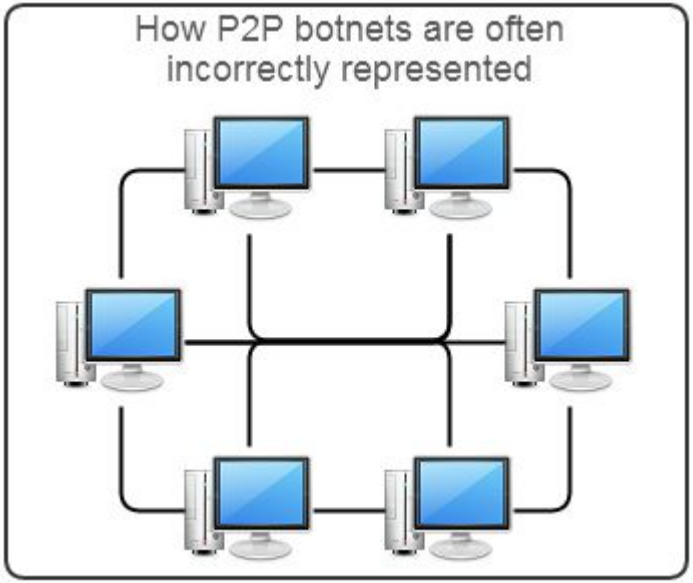
Sidenote: State-sponsored hacker working hours



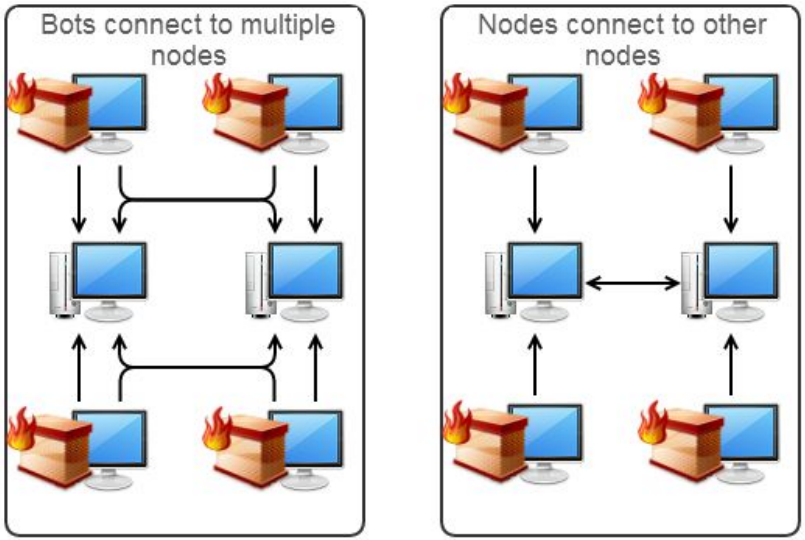
They’re working a 9-5 job!

Source: https://blog.lumen.com/routers-roasting-on-an-open-firewall-the-kv-botnet-investigation/

Peer2Peer Botnet Anatomy



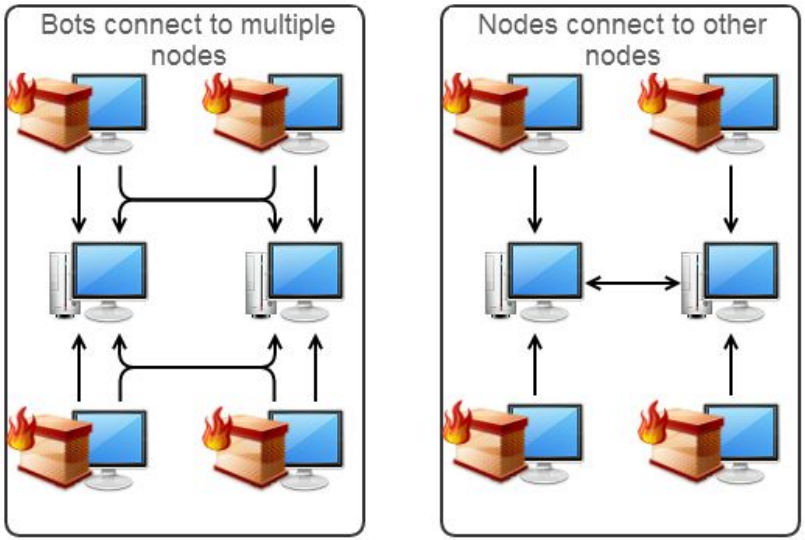
Peer2Peer Botnet Anatomy



- "**Nodes/Peers**": Servers that are able to receive incoming connections (i.e., not behind a NAT/Firewall)
- "**Workers**": Servers that cannot receive incoming connections

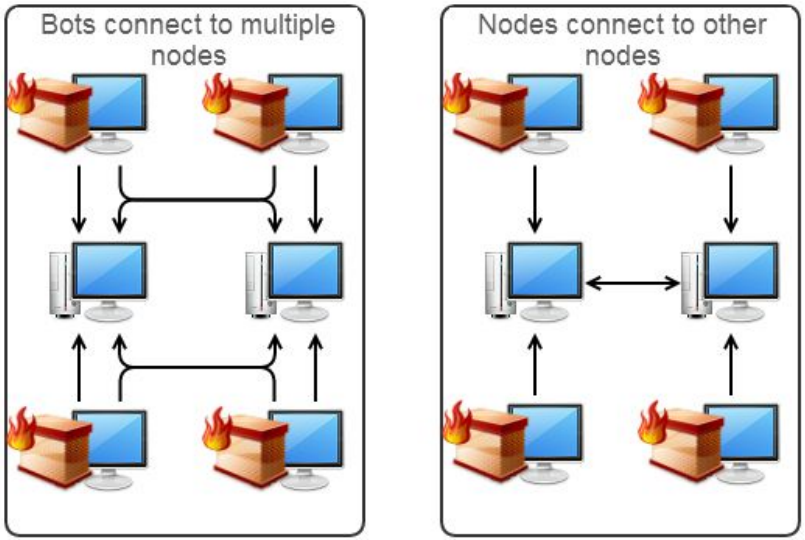
- Commands circulate the P2P network by passing commands between peers
  - Commands get passed to a worker once it reaches out

Peer2Peer Botnet Anatomy



- When a worker joins the botnet it is given a list of IP addresses (peers) to connect to.
  - Long list of candidates ensures that all peers need to be taken down for new bots to join
- If all peers get taken down...existing bots may continue to carry out existing attack

Dismantling P2P Botnets



- Need to introduce many “deceptive” peers into the network
  - Introduce by advertise the peer as a new “infected” peer
  - “deceptive” : peers with the intention of taking down the botnet)
- Have the peers provide workers with peer IP addresses that only belong to “deceptive” peers
- “Deceptive” peers/workers will soon become a majority of the network
- At some point, use “deceptive” network to tell workers to stop

Mozi Botnet

- Peer-to-Peer botnet
- Discovered in 2019 and supposedly has > 1.5 million peers (majority in China)
- Uses the Distributed Hash Table (DHT) protocol (i.e., Bittorrent protocol)
- Mostly infects Netgear, D-Link and Huawei routers -> Microsoft shared that botnet can perform MitM and spoofing attacks
- July 2021: Mozi botnet authors arrested by Chinese law enforcement
- August-September 2023: Sudden drop in botnet activity and activation of botnet “kill switch”
- Nobody claimed credit for takedown

Bulletproof Hosting

Bulletproof Hosting

- Operators allow/assist in hosting abusive content
- “Basic building block” of malicious activity (proxy, command & control)

Platforms in Everything: Analyzing Ground-Truth Data on the Anatomy and Economics of Bullet-Proof Hosting

Arman Noroozian, *TU Delft;* Jan Koenders and Eelco van Veldhuizen, *Dutch National High-Tech Crime Unit;* Carlos H. Ganan, *TU Delft;* Sumayah Alrwais, *King Saud University and International Computer Science Institute;* Damon McCoy, *New York University;* Michel van Eeten, *TU Delft*

https://www.usenix.org/conference/usenixsecurity19/presentation/noroozian

This paper is included in the Proceedings of the 28th USENIX Security Symposium.

August 14–16, 2019 • Santa Clara, CA, USA

Bulletproof Hosting

“Static” hosting: organization owns and operates infrastructure/networks/ASes

(+) Independent, “stable”

Bulletproof Hosting

“Static” hosting: organization owns and operates infrastructure/networks/ASes

(+) Independent, “stable”

(-) Easily blocked at the AS-level (other ASes would de-peer with them)

(-) Servers at risk of getting seized

Bullet-Proof Hosting

“Agile” hosting: rent/resell infrastructure from legitimate (cheap, often under-invest in security) ISPs

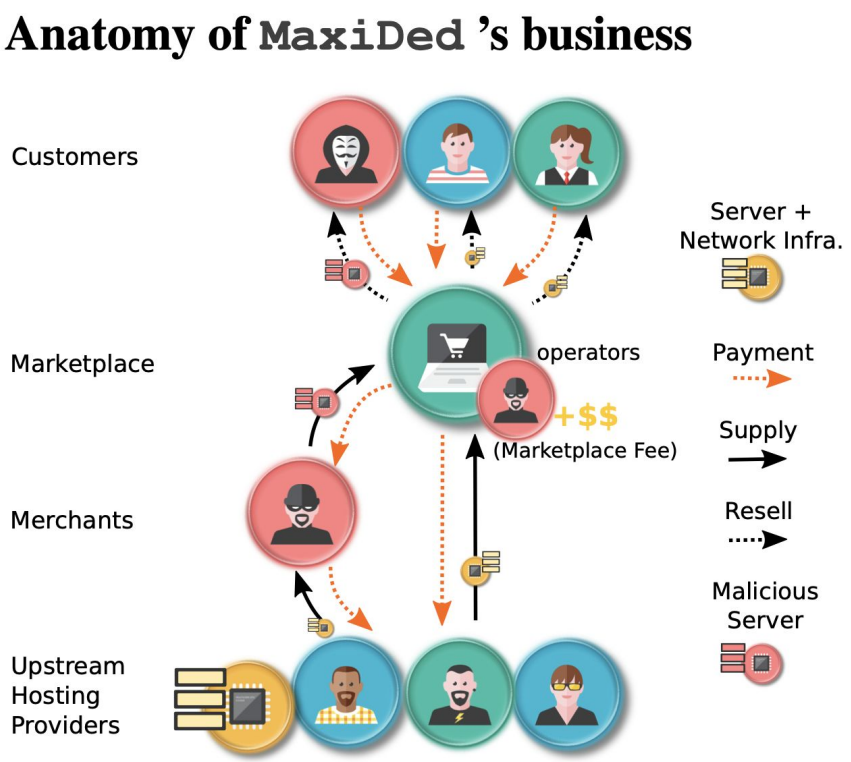
(+) Malicious traffic mixed with benign traffic -> hard to block

Bullet-Proof Hosting

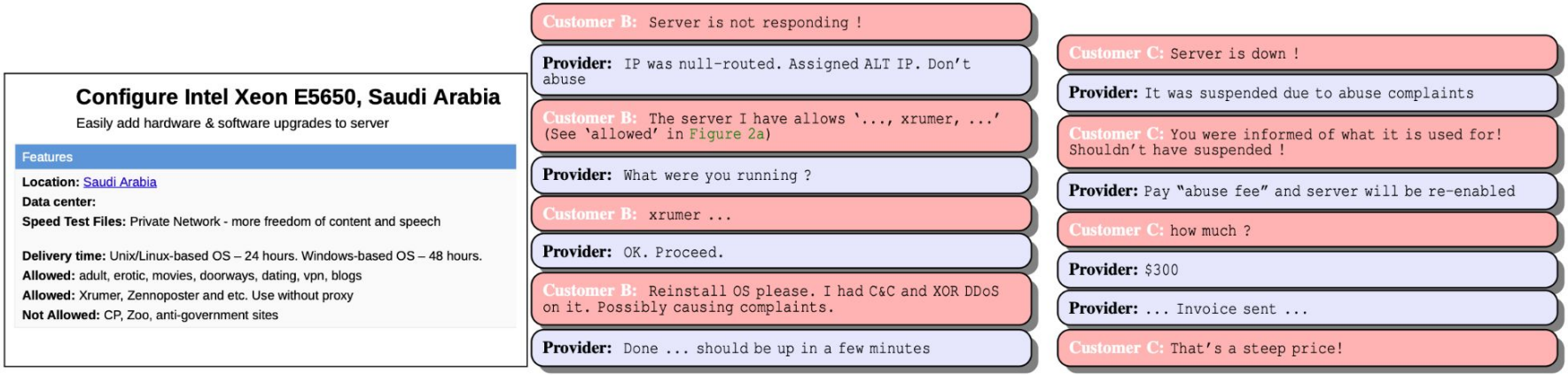
“Agile” hosting: rent/resell infrastructure from legitimate (cheap, often under-invest in security) ISPs

- (+) Malicious traffic mixed with benign traffic -> hard to block
- (-) Upstream providers can get angry, infrastructure can get shut-down

MaxiDed bulletproof hosting



- Maxided uses 395 unique upstream ASes
- $ 3.3M revenue



(a) **(b)** **(c)**

Figure 2: Examples of MaxiDed's bullet-proof behavior. (a) screenshot of server publicly advertised to customers. (b) and (c) are excerpts of a conversation between customer and administrator (edited for readability).

“Neutral Hosting”

What terms of services/ acceptable use policies should benign hosting providers have?

Specifically prohibit harassing or abusive content, including racially or ethnically offensive content

- e.g., OVH, Digital Ocean

Disavow sites that incite violence, but do not extend to hate speech or misinformation

- e.g., GoDaddy, Amazon, Unified Layer, WordPress, Fastly

Content-neutral: “cannot remove material from the Internet that is hosted by others”

- e.g., Cloudflare

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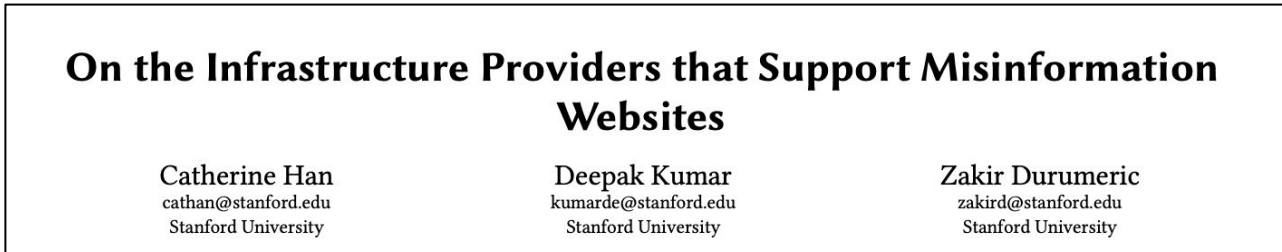

On the Infrastructure Providers that Support Misinformation Websites

Catherine Han
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Deepak Kumar
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Stanford University

Zakir Durumeric
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Stanford University

Misinformation

- extreme bias
  - (breitbart.com)
- peddle conspiracy theories or bigoted propaganda
  - (infowars.com, barenakedislam.com)
- promote junk science
  - (naturalnews.com).

Misinformation has real-world consequences and costs lives

For example, study shows that believing misinformation is correlated with avoiding vaccines

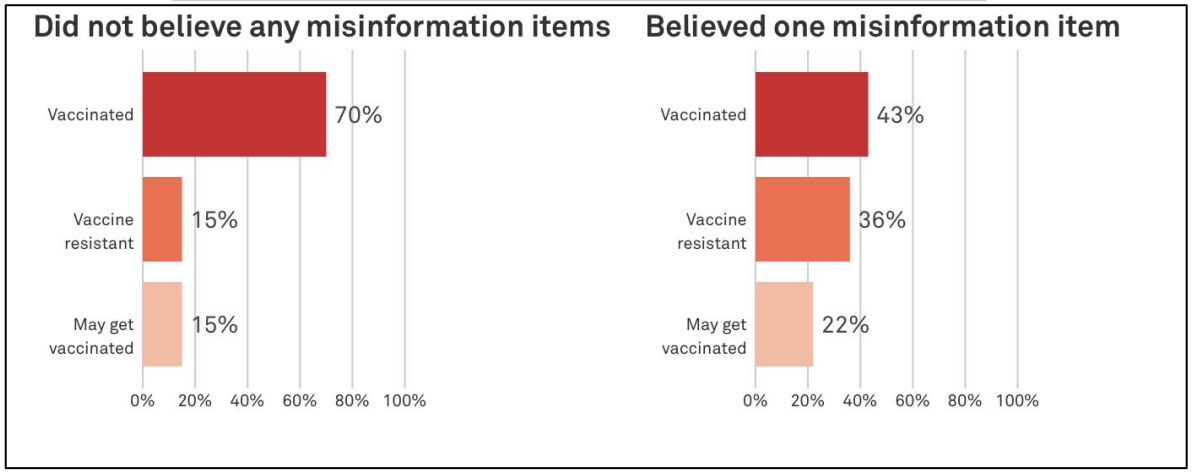
REPORT #60: VACCINE MISINFORMATION, FROM UNCERTAINTY TO RESISTANCE

USA, August 2021

Katherine Ognyanova, Rutgers University
David Lazer, Northeastern University
Matthew A. Baum, Harvard University
James Druckman, Northwestern University
Jon Green, Northeastern University
Roy H. Perlis, Harvard Medical School
Mauricio Santillana, Harvard Medical School
Jennifer Lin, Northwestern University
Matthew Simonson, Northeastern University
Ata Uslu, Northeastern University

Which of the following vaccine beliefs that routinely circulate on social media are true?

- COVID-19 vaccines will alter people's DNA;
- COVID-19 vaccines contain microchips that could track people;
- COVID-19 vaccines contain the lung tissue of aborted fetuses;
- And COVID-19 vaccines can cause infertility, making it more difficult to get pregnant.



Misinformation websites often migrate to Cloudflare to seek protection from vigilante DDoS attacks

Cloudflare Sites	Attack	Cloudflare Migration	
		Date	Post-Attack
barenakedislam.com	2/4/15	8/31/17	✓
drudgereport.com	12/30/16	1/4/17	✓
frontpagemag.com	3/23/15	3/24/15	✓
godlikeproductions.com	4/13/16	8/9/17	✓
naturalnews.com	8/8/17	8/8/17	✓
off-guardian.org	9/26/19	5/6/19	✗
returnofkings.com	9/2/15	10/23/14	✗
russia-insider.com	4/11/18	4/13/18	✓
thegatewaypundit.com	4/15/18	6/12/15	✓
weaselzuppers.us	1/5/15	1/1/14	✗
infostormer.com	12/7/19	8/15/17	✗

Table 5: DDoS Attacks Against Cloudflare Misinformation Sites—Misinformation sites with known DDoS attack history and when they were first observed using Cloudflare hosting in our dataset.

- Misinformation websites are 1.7x more likely to be hosted on Cloudflare compared to a mainstream site (due to free DDoS protections)

A handful of advertisers disproportionately support misinformation

Ad Provider	Misinformation with Ads	Mainstream with Ads	Effect Size
RevContent	22.8%	0.2%	0.91
DoubleClick	34.4%	14.1%	0.48
Outbrain	8.0%	1.5%	0.32
AppNexus	2.2%	0.0%	0.39
Google Syndication	14.5%	6.1%	0.28

- A mis-information website is 114x more likely to use RevContent than a mainstream website

What terms of services/ acceptable use policies should benign hosting providers have?

Do misinformation and DoS attacks have similar consequences? Should they be treated the same?

The End.

But take CS 155 and CS 356 if you want more!