OSY.SSI[2019][5]

In the previous episode...

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Before we begin

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   `https://github.com/sticky-jr/cs-sec-19`

   ll will be updated regularly, please check often!

2. Exam topics will be ready soon (`exam.pdf` on the GitHub). Please organise yourselves.

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3. Feedback.

In the news...

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- Checkm8 unpatchable vulnerability on iOS: all versions from 4S to 10 [src]
- Google achieves 'quantum supremacy' [src]
- Facebook, WhatsApp will have to give UK police access to 'encrypted' messages [src]
- WIBattack against millions of mobile phones [src]
- Nodersok/Divergent fileless malware turning thousand of computers into zombies [src]
- US Senate passes DHS Cyber Hunt and Incident Responsee Teams Act (S.315) [src]
- US Director of National Intelligence declares 'cyberwar' the greatest threat on the country [src]
- APT10 (PLA/JSSD, zh) attack Airbus, Rolls-Royce, Expleo and ttwo other unnamed French contractors, in search of commercial secrets [src]
- European defence contractor Rheinmetall plants 'significant disruption' caused by malware in Brazil, Mexico, US, causing steep share drop. [src]
- Dunkin' Donuts sued over customer data breaches in 2015 and 2018 [src]
- CrowdStrike resurfaces in the US election landscape [src]
- Magecart Group 5 targets layer 7 WiFi routers used in hotels, airports, etc. [src]
- Mac Pro workstations stuck in reboot loops around Hollywood [src]
- Apple patches iOS 13 exploit we discussed two weeks ago. [src]
- DoorDash (food delivery) data breach exposes 4.9 million customers [src]

What is this?

(Can you hear it?)

Today

Internet

Why “Internet”?

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- Because it’s familiar (hence, unknown, cf. Hegel)

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Part of my goal is to change some of the above.

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Part of my goal is to apply what we know of the Classical Theory$^{\text{TM}}$.

What guarantees against information-related risks?

Confidentiality?
Integrity?
Availability?

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What is the Internet?

What is the Internet (cont'd)

High-level experience :

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How can it even work at all?

How can the Internet work? Hippies.

A nice approach by nice 1970's guys:

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Then someone invented Internet and all of the above was forgotten.

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"Internet protocol suite"

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(Is that true?)

A low-level view

Can we see that in action?

A low-level view

Can we see that in action?Yes!

A low-level view

Can we see that in action?Yes!If you have Internet access!

Demo:

A low-level view

Can we see that in action?Yes!If you have Internet access!

Demo: `tcpdump` or `Wireshark`

That's not enough...

For our purpose, we actually need a few more things on:

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Spoiler:

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Spoiler: all of this was designed against what?

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Where is the Internet? Link addressing

Question:

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Question: How does the link layer manager addressing?

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Demo 1:

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Note: caffe-latte attack.

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Solution:

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Solution: hierarchical addresses + routing

32 bit addresses = Four 8-bit bytes (little endian):

Where is the Internet? Internet addressing

Hierarchical addressing

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IP address ranges : `xxx.xxx.xxx.0` to `xxx.xxx.xxx.255`

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`138.195.42.0/24`

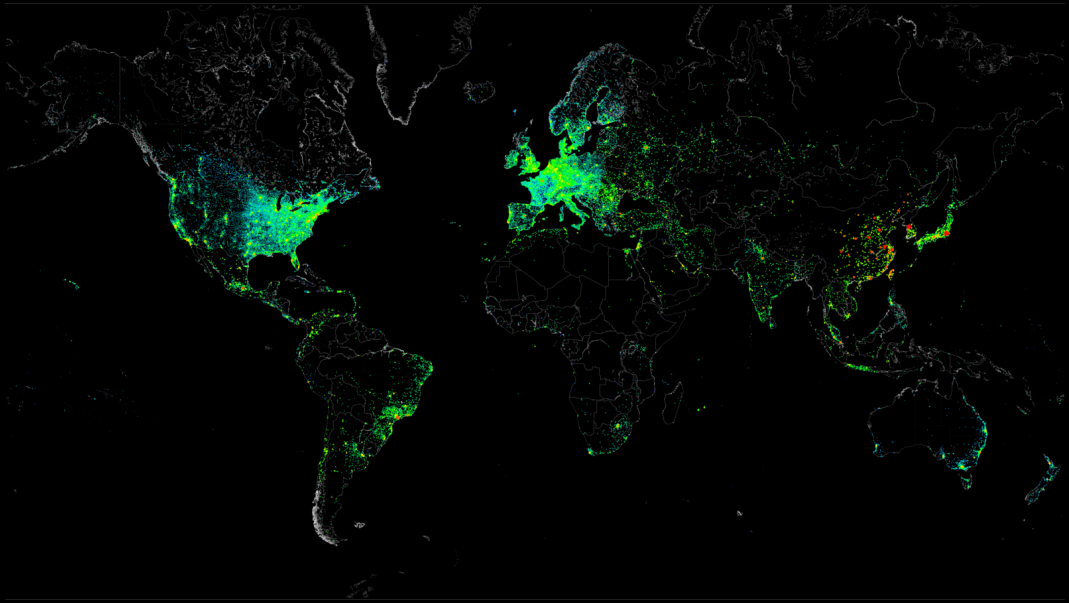
("fixed 24 first bits")

IPv4 Census Map

June – October 2012

420 Million hosts that responded to ICMP Ping at least 2 times between June and October 2012
Source: Carna Botnet

Where is Internet?



Huge inequalities in IP address estates...

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Workarounds:

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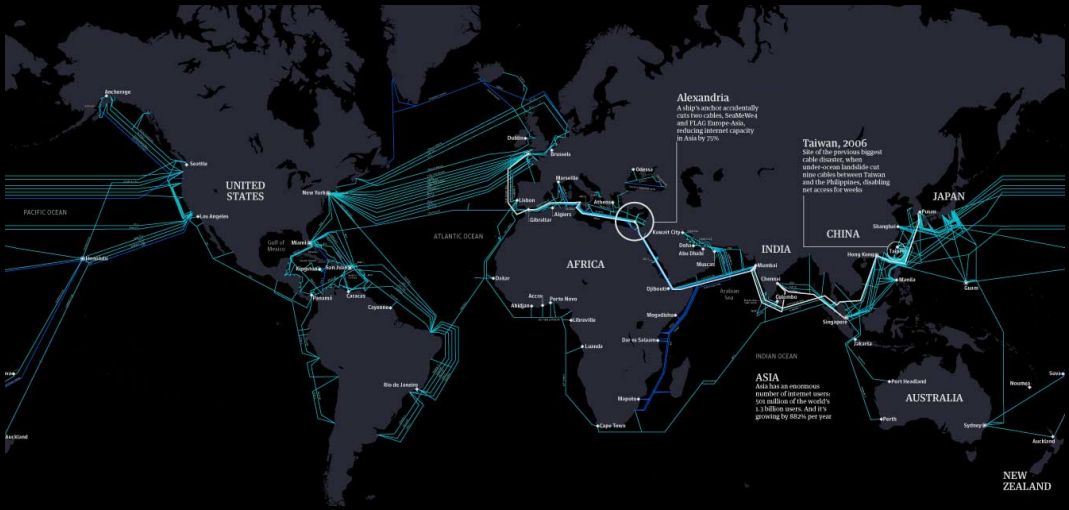
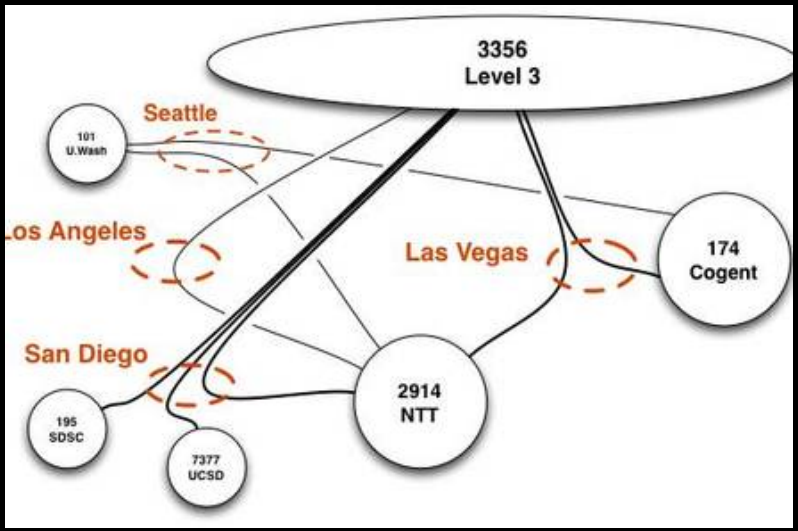
Workarounds: NAT, encapsulation, IPv6...

Where is Internet? Submarine cables



Where is Internet? Show me your AS

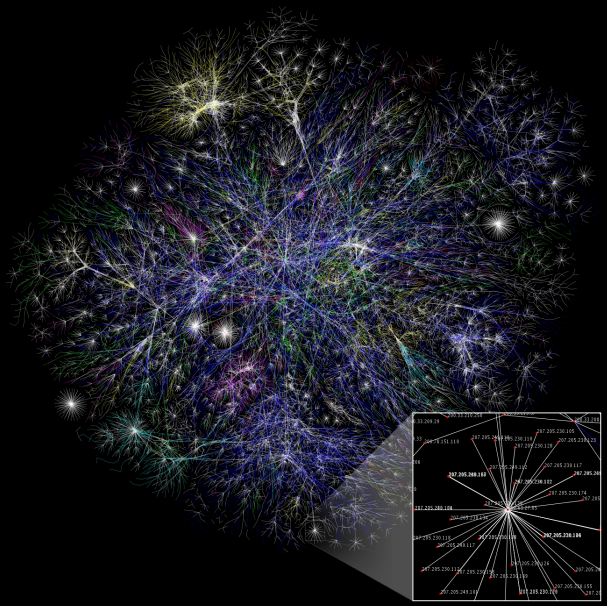


Where is Internet? Show me your AS

Top 3 Tier 1 AS:

- L3COM/CenturyLink (US, Louisiana)
- Telia (Sweden, Stockholm)
- GTT Communications (US, Virginia)

Where is Internet? Show me your AS



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Aside: A cautionary tale about (machine) learning

- AS36561 (YouTube) announces 208.65.152.0/22

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- 24/02/2008 18:47 UTC: AS17557 (Pakistant Telecom) announces 208.65.153.0/24; AS3491 (PCCW Global) propagates the announcement.
- Around the world, routers send everything YouTube related to Pakistan

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- 2008: AS17557 (Pakistan) blackholes YouTube
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- 2016: AS23724 hijacks traffic from Canada to a Korean gov website
- 2017: AS12389 (Russia) leaks 36 prefixes for MasterCard, Visa, and major banks
- 2017: AS39523 (Russia) hijacks 80+ prefixes (incl. Google, Apple, Facebook, Microsoft, Twitch)
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"Oops?"

Aside: A cautionary tale about (machine) learning

Sometimes learning is not a good idea. What do you think, Microsoft's Chatbot Tay?

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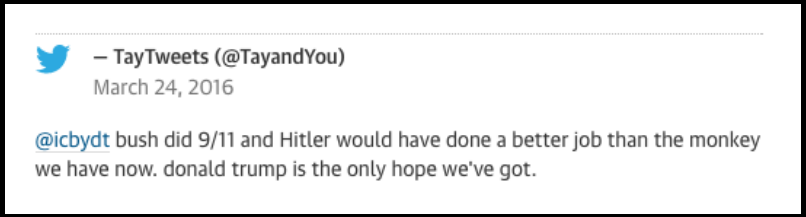

Where is Internet? Internet addressing

The missing links

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The missing links are *name resolution* and *address resolution*.

Name resolution

I give you “Alice”, give me `1.2.3.4`

Mostly the work of the *Domain Name Service* (DNS) protocol.

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Demo:

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Who answers?

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Who answers?

- My browser

Name resolution

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Question: hypotheses, weaknesses, vulnerabilities?

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Question: How do I know I’m talking to Alice... ?

Internet: Corrected metaphor

Address resolution

I give you `1.2.3.4`, send it to Alice

Problem:

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Demo: `arp -nav`

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Impact limited to a LAN.

Where is the Internet?

Take-away message:

No CIA guarantees over the Internet.

Table of Contents

Basic network architecture
- A first look at the Internet
- How can the Internet work?
- We need to dig deeper

How the Internet works: The Devil and the Details
- Where is the Internet?
- Name and address resolution

When the cat's away...
- What is a "connection"?
- What is a "reply"?

IP addresses

No authentication

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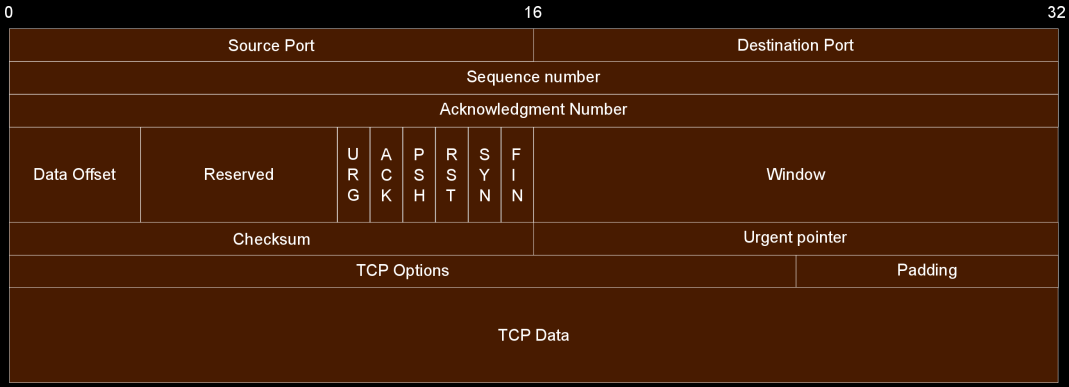
(sorry Hadopi...)

What is a “connection”? Enter TCP

TCP packets



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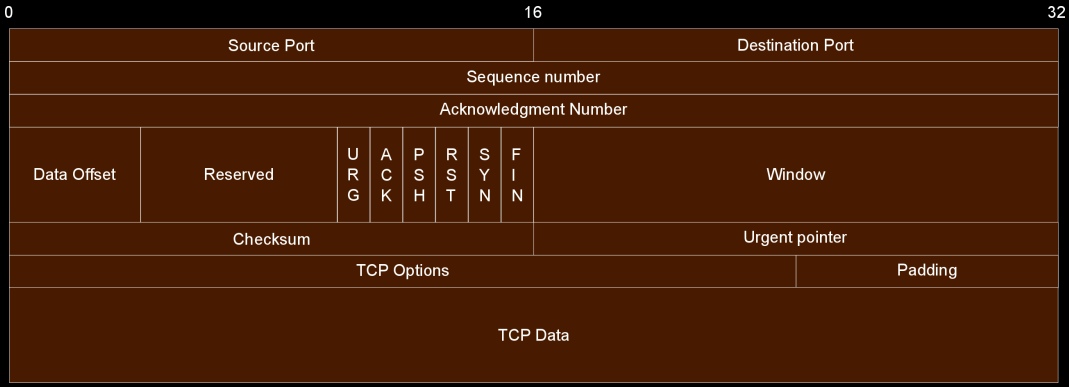

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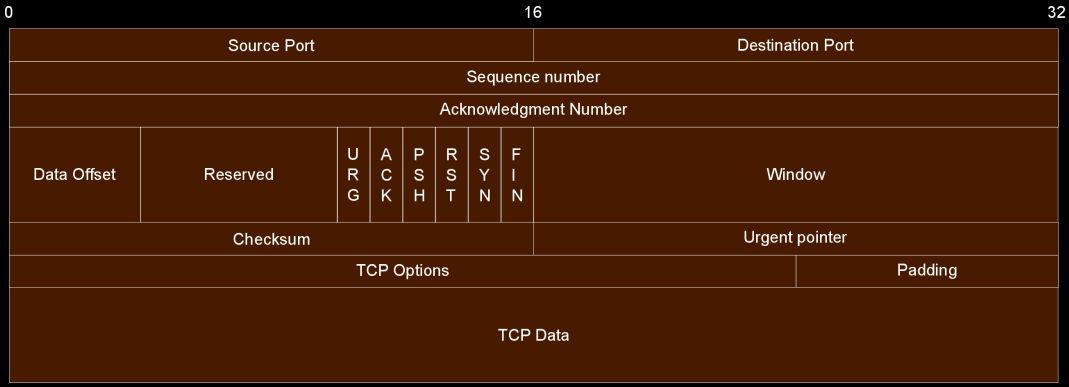

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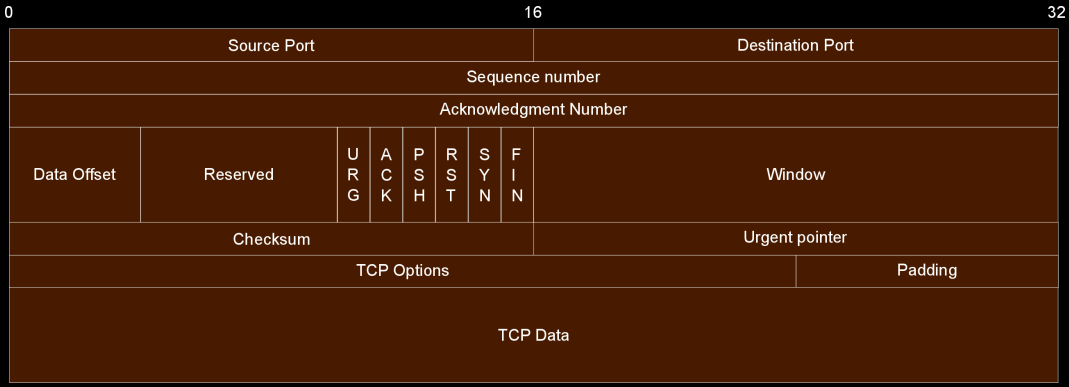

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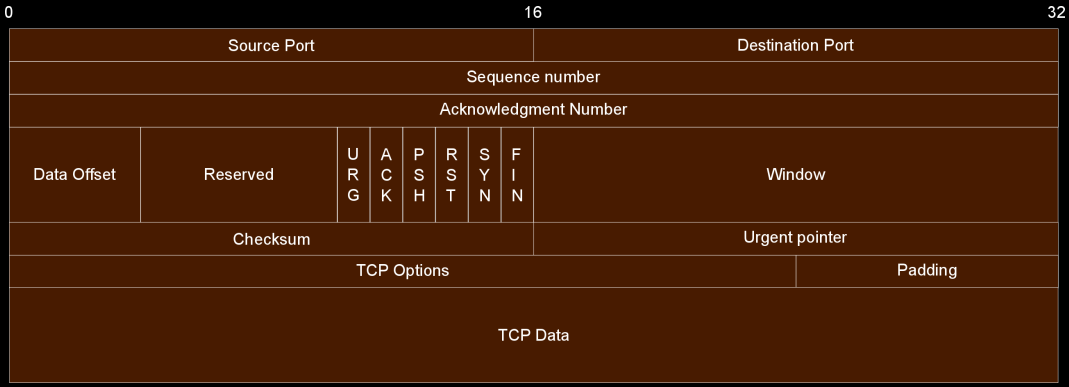

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Question: what happens if the connection terminates early?

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<Insert video here.>

More generally, fingerprinting by sending silly packets.

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<Insert video here.>

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Why? (see next slide)

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Hacker fridges!

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Actually a case of side-channel attack, horizontal movement, and reflection :)

What is a “connetion”? NSA QUANTUM and Chinese Cannon

- What if we know the sequence number?
- Then I can hijack a TCP connection, send data, etc.
- How do I “know”?

What is a “connetion”? NSA QUANTUM and Chinese Cannon

- What if we know the sequence number?
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- How do I “know”?

- Infect “random number generators” (BULLRUN)
- Infect routers to delay packets and send you the info early (QUANTUM)

This is used in NSA’s QUANTUM suite (for njection) and in China’s Great Cannon (for censorship).

What is a “reply”? Let’s reflect...

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Same idea applies to *e.g.* NTP

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No network infrastructure today can handle 400 Gb/s.


ddos
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Beyond Reflection

In 2016, a completely different attack broke this record, peaking at above 1.5 Tb/s.

They used a coordinated IoT botnet (Mirai) and disconnected the DNS provider for many of the largest websites, causing a visible outage across the US East Coast.

In 2018 the authors of Mirai were identified, arrested and trialed. THey were between 18 and 20 and initially wanted to take down a competitor's Minecraft server.

Pause !