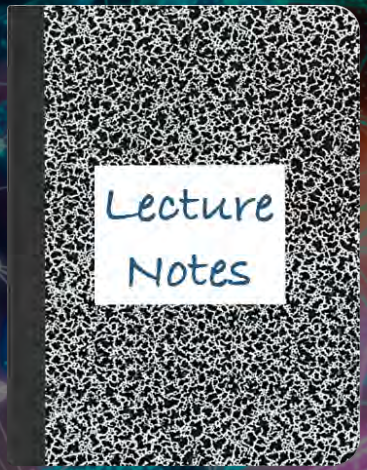


CS 419: Computer Security

Week 13: Part 2
DDoS: Amplification Attacks

Paul Krzyzanowski

Denial of Service

Denial of Service (DoS) Attacks

- **Find bugs**
  - Get the system to crash
- **Overwhelm a system so it will not be be responsive**

  Challenge: overwhelm targets that may be far bigger than you
  - **Find asymmetries**
    - Cases where handling requests is more expensive than issuing them
  - **Avoid getting responses**
    - Fake return addresses
  - **Send responses to the target**
    - Set the return address to the target ⇒ amplification
  - **Join forces**
    - Get many systems to participate ⇒ create a botnet for a **Distributed DoS (DDoS)** attack
    - Systems contact a **command & control server** for directions

Forms of overwhelming a system for DoS

- **Volumetric attack**
  - Generate more traffic than the target's network link(s) can handle
- **Packet-per-second focused attack**
  - Generate a higher packet rate than an application (or OS or routers) can process

Bugs & Asymmetric attacks

- **Challenge Collapser**
  - Attacker sends URLs that require time-consuming operations on the server
- **ICMP attacks**
  - Ping flood
    - Send ICMP Echo Request messages with responses that go to the target
  - Ping of Death
    - Send fragmented IP packets so that they will be >64KB when reassembled ⇒buffer overflow
  - Send spoofed source addresses to unreachable destinations
    - Routers will return *Destination Unreachable* to the target

Amplification Attacks

Reflection amplification attack

- Attacker spoofs target's IP address
- Sends request to a service — server responds to the target
- Need UDP so there's no connection state

Send a small request that produces a large response

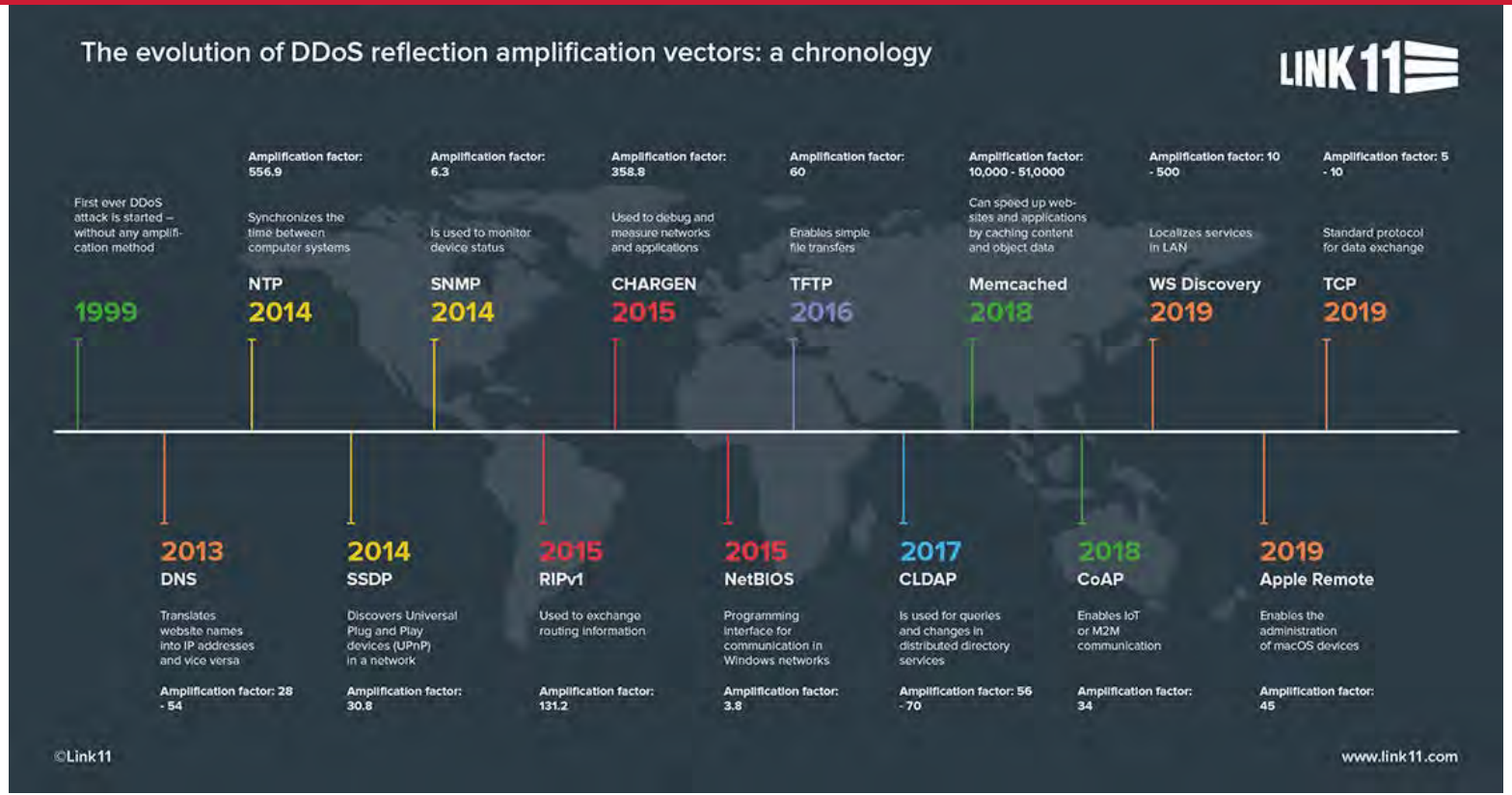
Amplification attacks generate a lot of traffic for targets

- Magnify the response size relative to the request
- Obscure the origin of the attack
- Exploit services that generate a lot of traffic to a small query

Some services vulnerable to amplification attacks

- **Memcached**
  - Attacker enters a large payload onto an exposed memcached server
  - Spoofs an HTTP GET request with IP address of target (often requesting web cache data)
  - Amplification factor: up to 51,200
- **Network Time Protocol (NTP)**
  - Monlist command causes NTP to respond with the last 600 source IP addresses of requests which have been made to the server
  - Amplification factor: 556
- **Domain Name System (DNS) Server**
  - Send a DNS lookup request for as much info as possible with a spoofed source address
  - Amplification factor: 50 - 179
- **Datagram TLS (D/TLS; TLS over UDP)**
  - Because it's UDP, protocol is spoofable
  - Affects misconfigured servers: attackers send small DTLS packets and get large responses sent to spoofed addresses
  - Amplification factor: 37

Amplification Vectors



https://www.zdnet.com/article/aws-said-it-mitigated-a-2-3-tbps-ddos-attack-the-largest-ever/

DDoS: Distributed Denial of Service

- **Vast quantities of compromised systems reduce need for amplification**
  - Create a botnet of millions of systems
- **Some targets are too huge to hurt with traffic**
  - Amazon, Google, sites using CDNs such as Akamai

AWS said it mitigated a 2.3 Tbps DDoS attack, the largest ever

2020

The previous record for the largest DDoS attack ever recorded was of 1.7 Tbps, recorded in March 2018.

Catalin Cimpanu • June 17, 2020

Amazon said its AWS Shield service mitigated the largest DDoS attack ever recorded, stopping a 2.3 Tbps attack in mid-February this year.

The incident was disclosed in the company's AWS Shield Threat Landscape [PDF], a report detailing web attacks mitigated by Amazon's AWS Shield protection service.

The report didn't identify the targeted AWS customer but said the attack was carried out using hijacked CLDAP web servers and caused three days of "elevated threat" for its AWS Shield staff.

CLDAP (Connection-less Lightweight Directory Access Protocol) is an alternative to the older LDAP protocol and is used to connect, search, and modify Internet-shared directories.

The protocol has been abused for DDoS attacks since late 2016, and CLDAP servers are known to amplify DDoS traffic by 56 to 70 times its initial size, making it a highly sought-after protocol and a common option provided by DDoS-for-hire services.

https://www.zdnet.com/article/aws-said-it-mitigated-a-2-3-tbps-ddos-attack-the-largest-ever/

Two record DDoSes disclosed this week underscore their growing menace

2020

More bots + better DDoS traps = ever-growing amounts of junk traffic.

Dan Goodin • June 25, 2020

The race upward is showing no signs of slowing. Last week, Amazon reported that its AWS Shield DDoS mitigation service went head-to-head with a 2.3 Tbps attack, a 35-percent increase over the 2018 record. Meanwhile, network provider Akamai said on Thursday that its Prolexic service repelled a DDoS that generated 809 million packets per second. That's a 35-percent increase over what's believed to be the previous high-water mark of the 600Mpps DDoS that Roland Dobbins, principal engineer at competing mitigation service Netscout Arbor, said his company handled.

"We anticipate continued innovation in the area of DDoS attack vectors due to the various financial, ideological, and social motivations of attackers," Dobbins told me. "DDoS attacks allow attackers to have a hugely disproportionate negative impact on both the intended targets of attacks, as well as uninvolved bystanders."

The attack, which Akamai said hit an unnamed European bank, was notable for how quickly it ramped up. As the image below illustrates, attackers needed less than three minutes to unleash its peak of 809 Mpps.

https://arstechnica.com/information-technology/2020/06/two-record-ddoses-disclosed-this-week-underscore-their-growing-menace/

Microsoft fends off record-breaking 3.47 Tbps DDoS attack

2022

While a crude brute-force attack, DDoSes are growing ever more potent.

Dan Goodin • January 28, 2022

The company's Azure DDoS Protection team said that in November, it fended off what industry experts say is likely the biggest distributed denial-of-service attack ever: a torrent of junk data with a throughput of 3.47 terabits per second. The record DDoS came from more than 10,000 sources located in at least 10 countries around the world.

The DDoS targeted an unidentified Azure customer in Asia and lasted for about two minutes. The following month, Microsoft said, Azure warded off two other monster DDoSes. Weighing in at 3.25Tbps, the first one came in four bursts and lasted about 15 minutes.
… The 3.7Tbps attack delivered roughly 340 million packets per second.
…
Sadly, the Internet is awash with millions of misconfigured servers that make reflection amplification attacks possible. These Internet nuisances played a big role in the 3.47Tbps attack Microsoft reported.
…
Most of those attacks came from Internet-of-Things devices infected with the open source Mirai botnet malware and lower-volume UDP protocol attacks. The vast majority were UDP spoof floods. A much smaller portion used UDP reflection and amplification, mostly SSDP, memcached, and NTP.

https://arstechnica.com/information-technology/2022/01/microsoft-fends-off-record-breaking-3-47-tbps-ddos-attack/

Dealing with DDoS

Really difficult in general

- **Disable unnecessary UDP services**
  - So you're not a participant in the attacks
- **Enable bandwidth management in routers**
  - Either in data center or ISP
  - Limit outbound or inbound traffic on a per-IP basis
- **Blackhole routing**
  - Set a **null route** route when DNS attack was detected
  - Traffic to attacked DNS goes nowhere
- **Egress filtering by ISPs**
  - Attempt to find malicious hosts participating in DDoS or sending spam
- **Identify incoming attackers & block traffic at firewall**
  - Difficult with a truly distributed DDoS attack

The End