

DDoS attack: DNS Reflection and Amplification

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Abstract

[1] [2] [3] [4] [5] [6] [7] [8] [9] [10]

1 DNS based DDoS attacks

The DNS service is a critical part of the Internet infrastructure. Almost every communication exploits the DNS service, and attacking it could lead a significant number of networked applications to run out of service. The DNS service has been designed to provide fast responses and is less oriented towards security, which makes it vulnerable to different types of attacks. According to a recent Cloudflare's report^[6] the most used vector in DDoS is the DNS. The types of attacks involving DNS are of three main types: *DNS query flood*, *TCP flood*, *DNS reflection and amplification*, and *DNS water torture*.

DNS query flood

This is a direct attack aimed at consuming the server resources until run it out of service. The attacker sends a large number of DNS queries to the target recursive DNS server, leveraging a zombie devices army (botnet). The requests are structured in a way that the server has not the record cached and it is forced to perform recursive queries to provide the responses. It is easier to perform this type of attack on smaller DNS servers that may have limited resources to handle a large number of queries.

TCP flood

This is another type of attack aimed at consuming the server resources. These latter are consumed by the attacker sending lots of TCP connection requests without closing them. The server is forced to allocate resources to handle the TCP connections and, when the numbers get larger it may run out of resources.

DNS water torture

This is a type of indirect attack aimed at consuming the resources of a target authoritative DNS server. The attacker sends a huge number of queries about properly constructed hostnames. These are made up by two parts: the domain whose authoritative server is the target, and a random string such that the FQDN cannot exist. That way the recursive NS starts its search until it reaches the authoritative server. This latter notices the non-existence of the FQDN and sends NXDOMAIN response. All the queries travel until the authoritative server, which is forced to handle all of them until it is overwhelmed.

DNS reflection and amplification

This is an indirect attack aimed at consuming the target network bandwidth. It start with the spoofing of the target's IP address, then lots of queries are sent to the DNS server using as the source address the spoofed IP address. This latter will receives the responses from the DNS server (reflection). The queries are structured in a way that the responses are larger in size (amplification). That way the target's bandwidth is fulfilled, with the

attacker having used just a small quantity of its resources. The effectiveness of this attack is given by the amplification factor (AF), measured as the ratio between the size of the response and the size of the query. An easy but effective choice for the attacker is to perform a type ANY which provides a large AF.

Since according to the already cited report^[6] the most common type of attack is the DNS reflection and amplification, in this project we focus on this type of attack.

2 Methodologies and experimental setup

To ensure the success of the project, it is essential to establish a clear methodology and employ a well-defined set of tools. This section aims to provide a detailed explanation of the methodologies utilized to accomplish the project's objectives.

The selected methodologies encompass a systematic approach that allows for the accurate replication of a DDoS attack while maintaining ethical considerations and minimizing the potential impact on live networks. These methodologies were carefully chosen to ensure the reliability and validity of the experimental results. The methodological approach used is the following:

Why

The objective of this study is to assess the impact of a DoS attack, exploiting the DNS protocol and monitor the reachability of the targeted device and other network nodes. By simulating realistic attack scenarios, this study aims to understand the vulnerabilities within the DNS protocol, evaluate network resilience, and identify potential countermeasures.

Which/Who

The chosen target for the DDoS attack is a laptop (HP ENVY x360), which acts as a host for a DNS server running BIND9. Two laptops, specifically a MacBook Pro 14 and another device (to be specified)!!!!!!!!!!!!!!!, are utilized as vantage points to initiate the attack.

What

The chosen metrics include measuring the response time for each ICMP or DNS message sent, accounting for potential timeouts. Furthermore, the CPU and memory utilization of the DNS server were also monitored during the simulation.

Where

The vantage point is a MacBook Air inside the network and passive to the attack.

To ensure the security and stability of public networks and devices, the DDoS attack simulations were conducted within a local area network (LAN) environment.

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