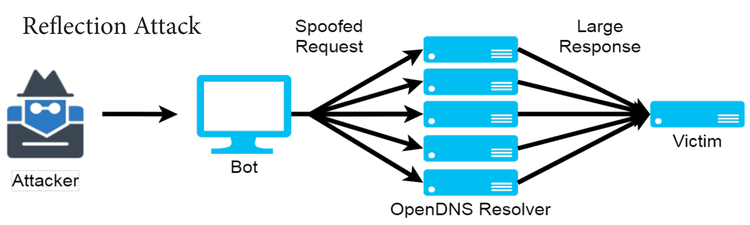
MADDVIPR: Mapping DNS DDoS Vulnerabilities to Improve Protection and Prevention

Raffaele Sommese, Anna Sperotto, Roland van Rijswijk-Deij
University of Twente

Alberto Dainotti, Kimberly Claffy
CAIDA, UCSD

Why? The Domain Name System is a fundamental pillar of the Internet's Core Infrastructure. DDoS Attacks against DNS infrastructure will have devastating effects.

DNS as Source of Attack



Potential Vectors of Amplification:

- EDNS Record
- ANY Record
- DNSKEY Record
- NSEC(3) Record
- TXT Record (Special Domain Crafted)

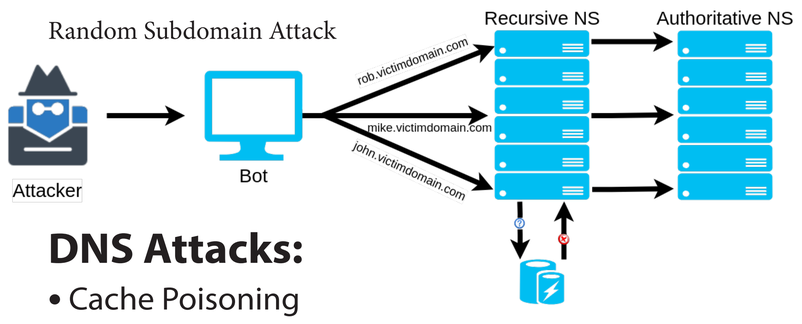
Open Resolvers:

Due to the connectionless architecture of DNS Protocol and its amplification factor, OpenDNS Resolvers pose a significant threat to the global network.

Is it really effective?

- The AmpPot project monitors reflection attacks through different HoneyPots, detecting DNS Amplification Attacks.
- DNS Reflection Attacks were monitored similarly through the CAIDA Network Telescope by discovering responses to spoofed queries in the Internet Background Radiation.

DNS as Destination of Attack



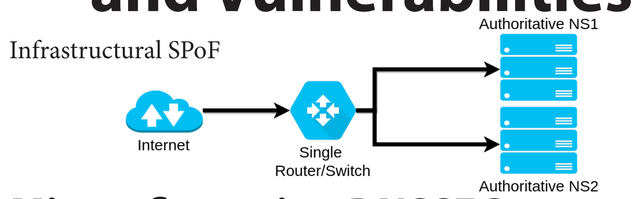
DNS Attacks:

- Cache Poisoning
- Domain hijacking
- Random subdomain attack
- NXDOMAIN attack
- Phantom domain attack
- NSEC White Lie DoS
- DDoS DNS flood attack
- Distributed Reflection Denial of Service (DRDoS)

Impact of an Attack: Dyn's Case

One of the biggest DDoS attacks on the DNS infrastructure was performed in 2016 against Dyn DNS.
This attack affected a number of large Internet services on the East Coast of the United States, including some big-name Internet brands such as Twitter, PayPal, and Spotify.

DNS Misconfiguration and Vulnerabilities



Misconfiguration DNSSEC

- Unreachability
- NSEC(3) Enumeration

Parent-Child Zone Data Mismatch

- TTL and NS Mismatch
- Ghost Glue Record
- Lame Delegation
- Cyclic Zone Dependency

Single Point of Failure (SPoF)

- Single and Duplicated NS Records
- Infrastructural Single Point of Failure

Dangling Pointer

- DARE Records
- Cloud IP Addresses and DNS names
- Expired Domain Hijacking

Proposed Solution in Literature

Spoofing Protection

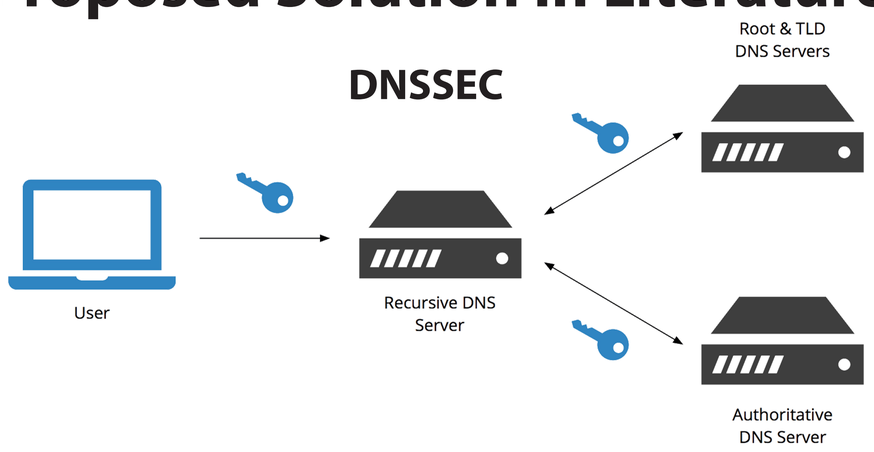
- BCP38
- Spoofer Project

Rate Limiting Feature and Record Disabling

- Still vulnerable to Crafted Domains

DNSSEC Key Shrinking

- Adoption of ECDSA



DDoS Protection Services

- Adoption and Effectiveness

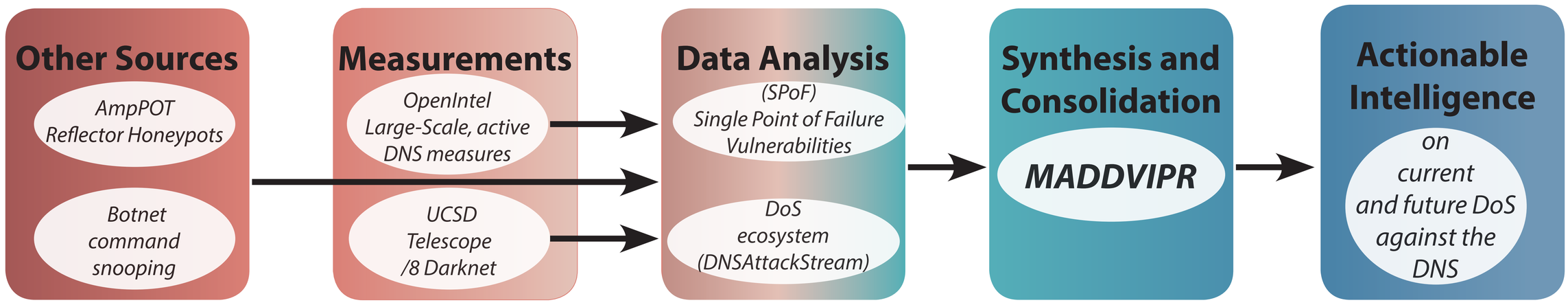
Serving Stale Data

- "Stale bread is better than no bread".
- Serving data with expired TTL if the Authoritative Nameservers become unreachable.

ANYCAST

- Increase resilience.
- Problem to manage situations of partial failures.

Our Approach



1) Identification of impact of possible attacks

2) Provide a view of future attacks

3) Prioritization of the risks

UNIVERSITY OF TWENTE.

Netherlands Organisation for Scientific Research