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CONTROL YOUR NETWORK

DNS:
Useful tool or just a hammer?

Paul Ebersman
pebersman@infoblox.com, @paul_ipv6

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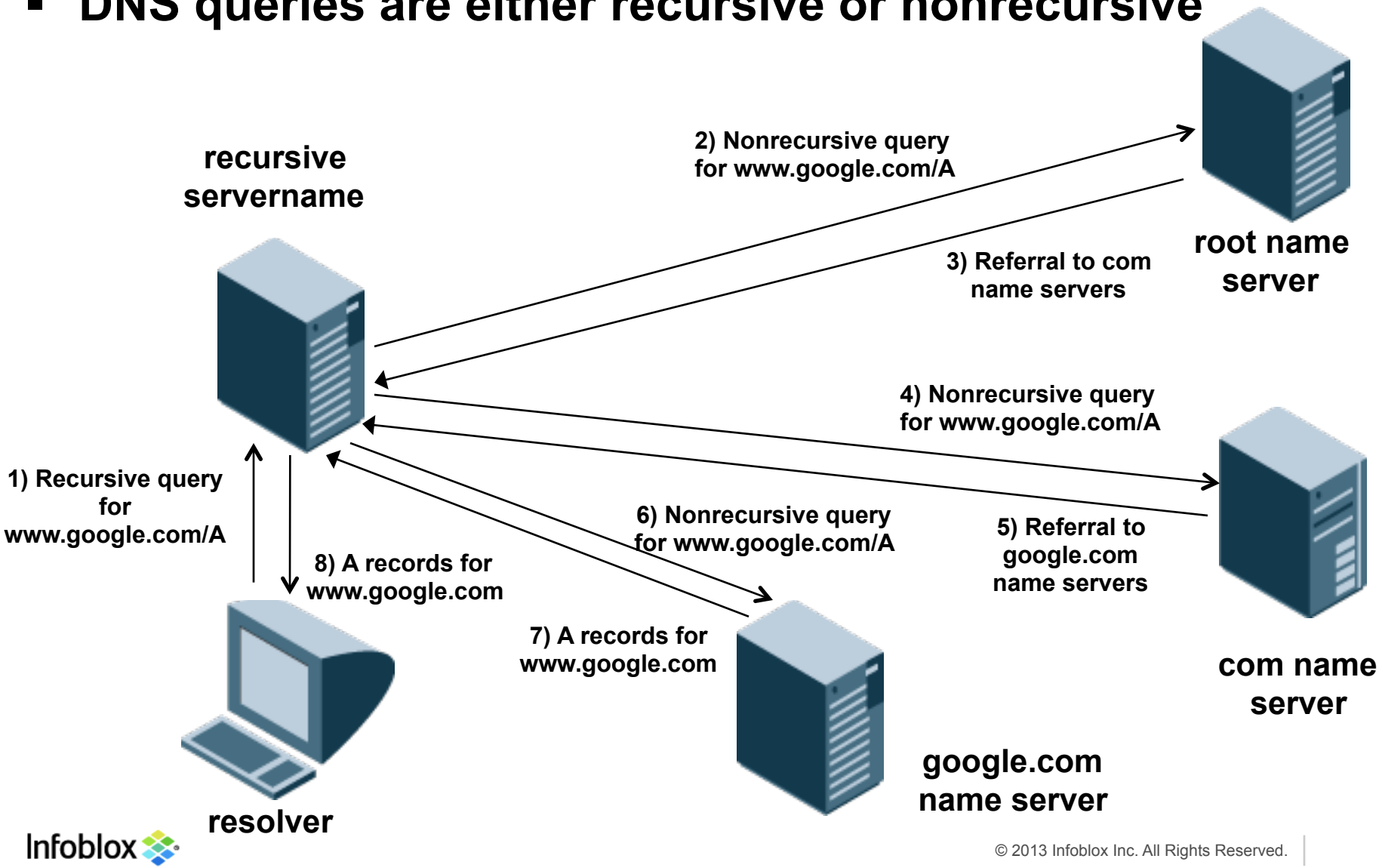
Attacking your cache

Recursion

- DNS queries are either recursive or nonrecursive



Cache Poisoning

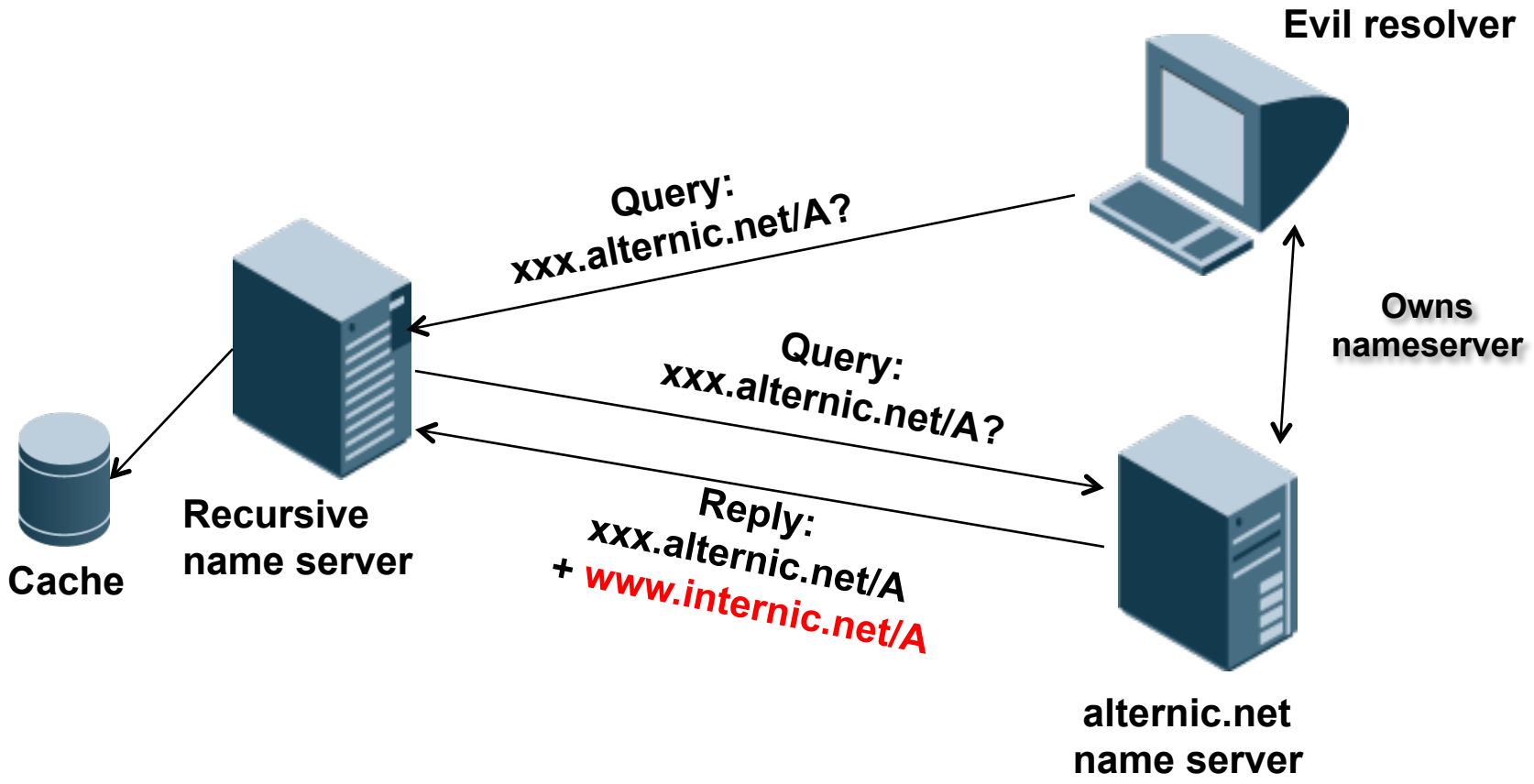
- **What is it?**
  - Inducing a name server to cache bogus records
- **Made possible by**
  - Flaws in name server implementations
  - Short DNS message IDs (only 16 bits, or 0-65535)
- **Made easier on**
  - Open recursive name servers

Cache Poisoning Consequences

- A hacker can fool your name server into caching bogus records
- Your users might connect to the wrong web site and reveal sensitive
- Your users email might go to the wrong destination
- Man in the middle attacks

The Kashpureff Attack

- **Eugene Kashpureff's cache poisoning attack used a flaw in BIND's additional data processing**



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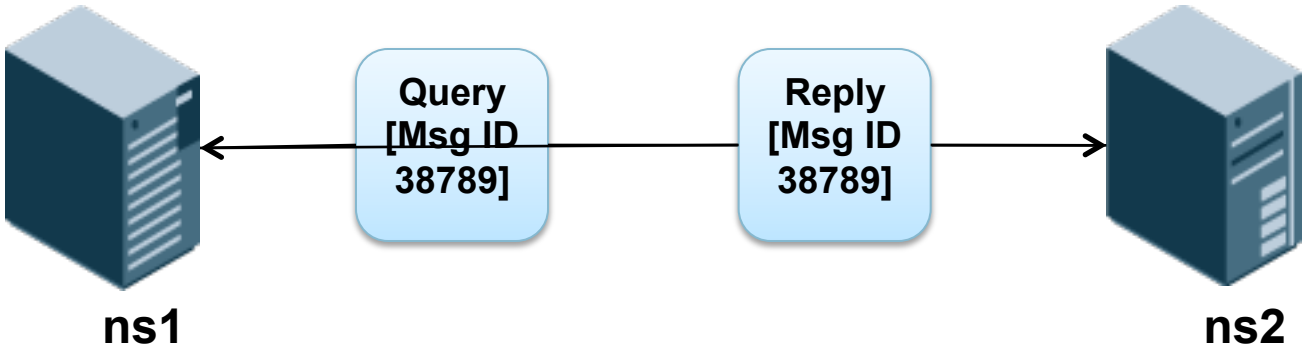
DNS Message IDs

- **Message ID in a reply must match the message ID in the query**
- **The message ID is a "random," 16-bit quantity**



How Random - Not!

- **Amit Klein of Trusteer found that flaws in most versions of BIND's message ID generator (PRNG) don't use sufficiently random message IDs**
  - If the current message ID is even, the next one is one of only 10 possible values
  - Also possible, with 13-15 queries, to reproduce the state of the PRNG entirely, and guess all successive message IDs

Birthday Attacks

- **Barring a man in the middle or a vulnerability, a hacker must guess the message ID in use**
  - Isn't that hard?
  - As it turns out, not that hard
- **Brute-force guessing is a birthday attack:**
  - 365 (or 366) possible birthdays, 65536 possible message IDs
  - Chances of two people chosen at random having different birthdays:

$$\frac{364}{365} \approx 99.7\%$$

  - Chances of n people (n > 1) chosen at random all having different birthdays:

$$\bar{p}(n) = \frac{364}{365} \times \frac{363}{365} \times \ldots \times \frac{366 - n}{365} \qquad p(n) = \left(1 - \bar{p}(n)\right)$$

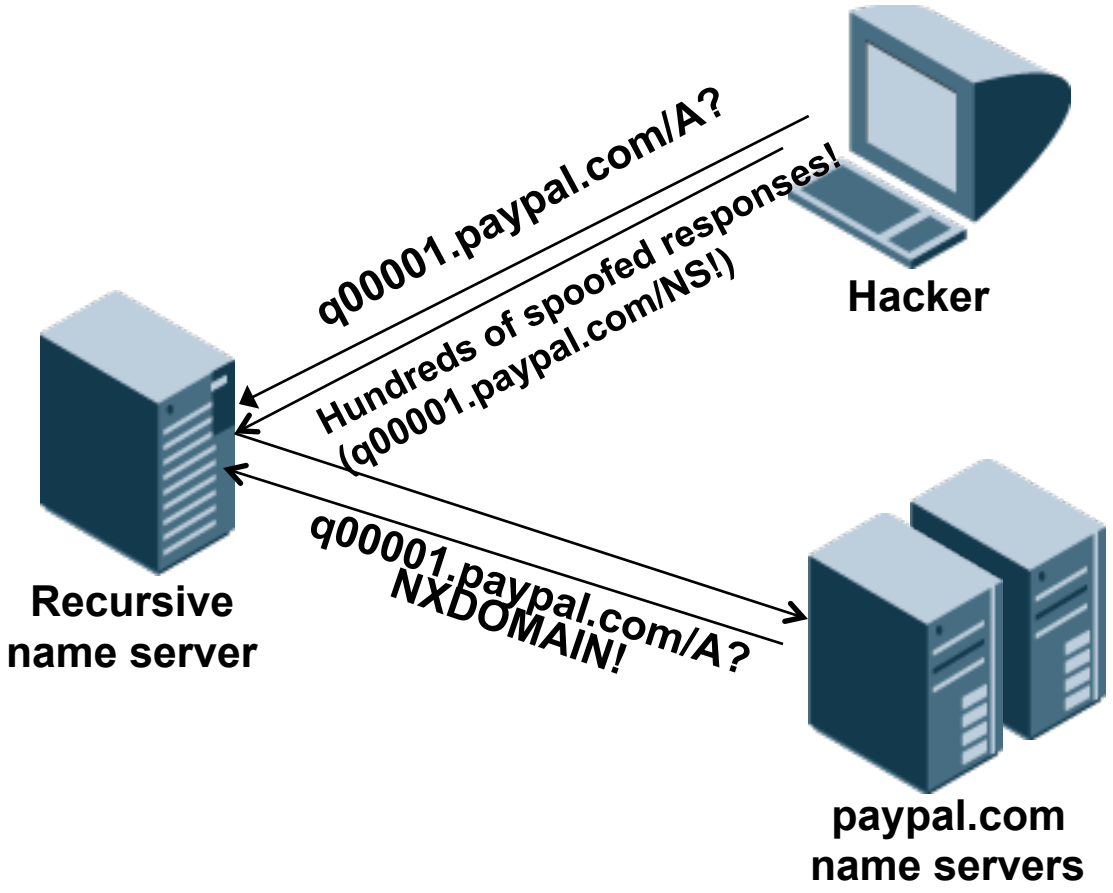
Birthday Attacks (continued)

People	Chances of two or more people having the same birthday
10	12%
20	41%
23	50.7%
30	70%
50	97%
100	99.99996%

Number of reply messages	Chances of guessing the right message ID
200	~20%
300	~40%
500	~80%
600	~90%

The Kaminsky Vulnerability

- **How do you get that many guesses at the right message ID?**



The Kaminsky Vulnerability (continued)

- **How does a response about q00001.paypal.com poison www.paypal.com's A record?**
- **Response:**

```
;; ->>HEADER<<- opcode: QUERY, status: NOERROR, id: 61718
;; flags: qr rd ra; QUERY: 1, ANSWER: 0, AUTHORITY: 1,
ADDITIONAL: 1

;;; QUESTION SECTION:
;q00001.paypal.com.          IN      A
;;; AUTHORITY SECTION
q00001.paypal.com.          86400   IN      NS      www.paypal.com.
;;; ADDITIONAL SECTION
www.paypal.com.             86400   IN      A       10.0.0.1
```

Initial Kaminsky fixes

- **To make it more difficult for a hacker to spoof a response, we use a random query port**
  - In addition to a random message ID
  - If we use 8K or 16K source ports, we increase entropy by 13 or 14 bits
  - This increases the average time it would take to spoof a response substantially
- **However, this is not a complete solution**
  - Spoofing is harder, but still possible
  - Evgeniy Polyakov demonstrated that he could successfully spoof a patched BIND name server over high-speed LAN in about 10 hours

Defending your cache

Defenses

- More randomness in DNS msg IDs, source ports, etc.
- Better checks on glue
- DNSSEC
- ACLs

Attacking your authoritative servers

Sheer volume and persistence

- **10s of thousands of bots**
- **10s of millions of open resolvers**
  - *(see http://openresolverproject.org/)*
- **Gbps of traffic generated**
- **45% of ISPs experience 1-10 DDoS/ month, 47% experience 10-500 DDoS/ month**

High Yield Results

- **Small queries, large responses (DNSSEC records)**
- **Using NSEC3 against you**

Make sure they're your servers…

- **Vet your registry/registrar**
- **Think about NS TTLs**

Defending your auth servers

Harden your server

- **Perimeter ACLs**
- **Higher capacity servers**
- **Clusters or load balanced servers**
- **Response Rate limiting (RRL)**
  - http://www.iana.org/about/presentations/20130512-knight-rrl.pdf
  - https://www.isc.org/blogs/cache-poisoning-gets-a-second-wind-from-rrl-probably-not/

Spread yourself out

- Fatter internet pipes (but makes you more dangerous to others)
- More authoritative servers (up to a point)
- Anycast
- HA

Being a good internet citizen

It’s not just you being attacked

- If you allow spoofed packets out from your network, you are part of the problem…
- Use BCP38/BCP84 Ingress filtering
- Implement RFC5358
- http://openresolverproject.org/

Revise DNS standards?

Changing RFCs?

- **Glaciers start to look speedy**
- **Source Address Validation**
- **TCP vs UDP**
- **DNS Cookies**
  - http://tools.ietf.org/html/draft-eastlake-dnsext-cookies-03

DNS use by the bad guys

DNS use by bad guys

- **Command and control**
- **DNS Amplification**
- **Fastflux**
  - single flux
  - double flux
- **Storm, Conficker, etc.**

Protecting your users

Dealing with malware

- **Prevent infections (antivirus)**
- **Block at the perimeter (NGFW, IDS)**
- **Block at the client (DNS)**

Antivirus

- **Useful but has issues:**
  - **Depends on client update cycles**
  - **Too many mutations**
  - **Not hard to disable**

Perimeter defenses

- **Necessary but not complete:**
  - **Limited usefulness after client is already infected**
  - **Detection of infected files only after download starts**
  - **Usually IP based reputation lists**
  - **Limited sources of data**

RPZ DNS

- Uses a reputation feed(s) (ala spam)
- Can be IP or DNS based ID
- Fast updates via AXFR/IXFR
- Protects infected clients, helps ID them
- Can isolate infected clients to walled garden

There is *not* only one

Use all methods you can!

Q&A

Thank you!