Recent Authoritative Exhaustion Attacks

Chris Baker

DNS OARC 2016 Dallas

INTERNET
PERFORMANCE.
DELIVERED.

dyn.com @dyn

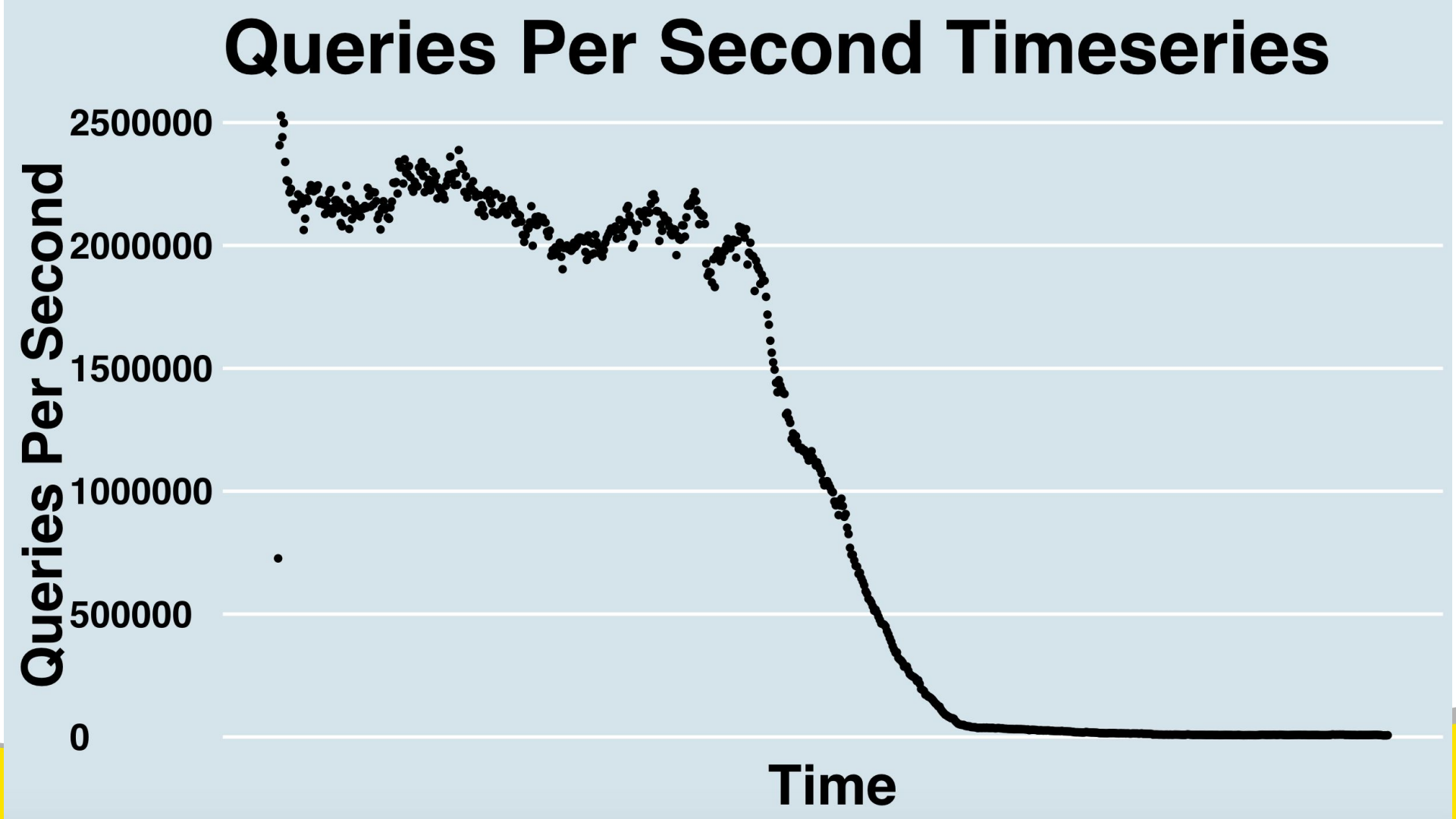
https://github.com/jgamblin/Mirai-Source-Code/blob/master/mirai/prompt.txt

Introduction

- In early August we started to see an uptick in DDoS attacks
  - Both targeting our customers and observed in recursive traffic
- These were out of the norm when contrasted with traditional booter / stresser attack payloads
  - Not DNS amplification using cpsc.gov, SSDP, NTP, Chargen … etc
- The attacks fit the profile of authoritative DNS exhaustion
  - A large volume of properly formed in protocol queries
  - Targeting domains that were delegated to Dyn's nameservers
  - Recursive cache busting set of pseudo-random characters
    - Example: lq18v2V3N2lQ.<sub domain>.<domain>.<tld>
    - The 12 character pseudorandom string attached to the valid domain was a consistent attribute
    - "Random" seems to exclude certain values 'z' and '9' for example

How scary does this look?

- Recent trends in attack patterns have lead operators to assume that the packets sources are spoofed until proven authentic
- One thing that stood out when looking was the traffic was the distribution of qnames with 0x20 bit character randomization.
- Not only did it stand out but, it matched known patterns
  - Traffic from resolvers known to have implemented 0x20 bit randomization were consistently randomized
  - At that point it became reasonable to assume that this traffic was being generated by clients and passing through the recursive layer


Queries Per Second Timeseries
2500000
2000000
1500000
1000000
500000
0
Queries Per Second
Time

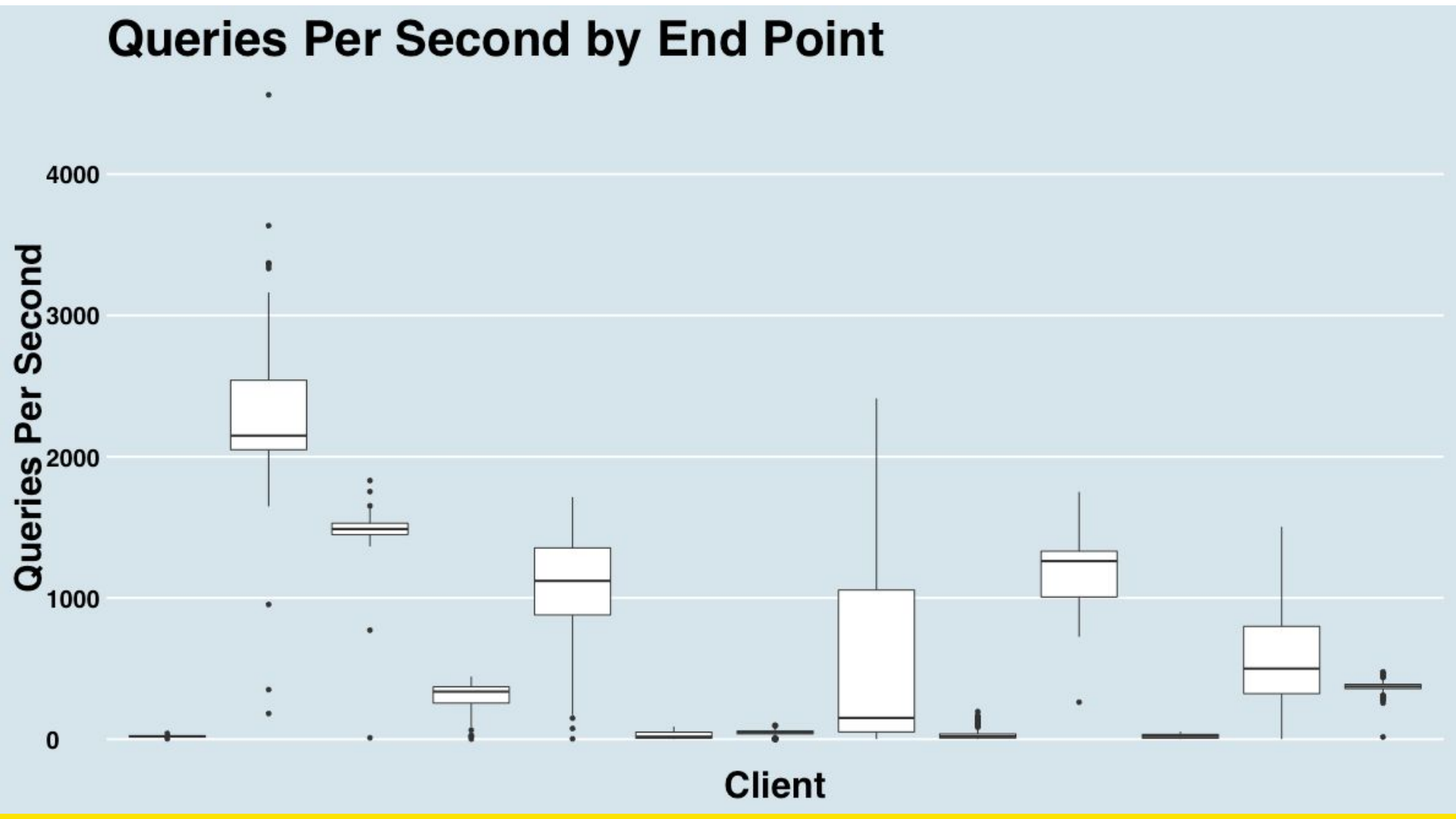
Into the Recursive Layer!

Dyn operates a recursive resolver platform

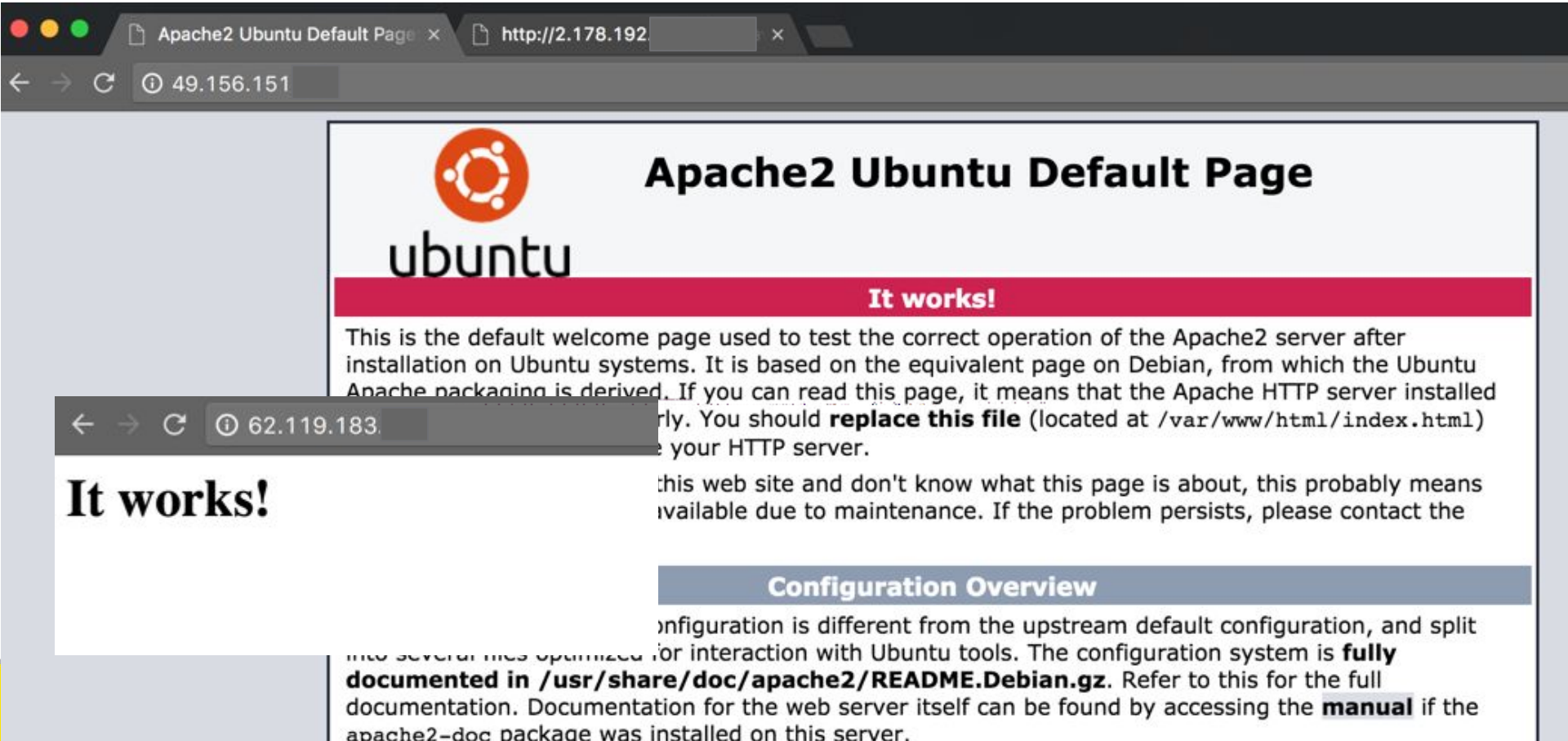
A handful of infected devices were configured to use Dyn's recursive resolvers from an array of different autonomous systems

This provides us with some data around the number of queries per second individual client IPs were issuing

The variability in the rate of queries per second and the IPs which were involved in one attack and not other was also of interest


Queries Per Second by End Point
Queries Per Second
4000
3000
2000
1000
0
Client

What are they?



Country Code	Number of Prefixes	Count of ASNs	% of Traffic
US	226	99	31.54
CN	269	42	15.12
BR	580	264	8.33
RU	522	373	5.58
TW	22	12	3.88
UA	181	139	3.03
KR	26	14	2.95
BG	128	86	2.71
CL	18	9	1.95
ID	35	21	1.94

Attack Source Code Leaked on HackForums

```
void attack_udp_dns(uint8_t targs_len, struct attack_target *targs, uint8_t opts_len, struct attack_option *opts)
{
    int i, fd;
    char **pkts = calloc(targs_len, sizeof (char *));
    uint8_t ip_tos = attack_get_opt_int(opts_len, opts, ATK_OPT_IP_TOS, 0);
    uint16_t ip_ident = attack_get_opt_int(opts_len, opts, ATK_OPT_IP_IDENT, 0xffff);
    uint8_t ip_ttl = attack_get_opt_int(opts_len, opts, ATK_OPT_IP_TTL, 64);
    BOOL dont_frag = attack_get_opt_int(opts_len, opts, ATK_OPT_IP_DF, FALSE);
    port_t sport = attack_get_opt_int(opts_len, opts, ATK_OPT_SPORT, 0xffff);
    port_t dport = attack_get_opt_int(opts_len, opts, ATK_OPT_DPORT, 53);
    uint16_t dns_hdr_id = attack_get_opt_int(opts_len, opts, ATK_OPT_DNS_HDR_ID, 0xffff);
    uint8_t data_len = attack_get_opt_int(opts_len, opts, ATK_OPT_PAYLOAD_SIZE, 12);
    char *domain = attack_get_opt_str(opts_len, opts, ATK_OPT_DOMAIN, NULL);
    int domain_len;
    ipv4_t dns_resolver = get_dns_resolver();

    if (domain == NULL)
    {
#ifdef DEBUG
        printf("Cannot send DNS flood without a domain\n");
```

If Local Resolver Not Found ...

```
switch (rand_next() % 4)
{
case 0:
    return INET_ADDR(8,8,8,8);
case 1:
    return INET_ADDR(74,82,42,42);
case 2:
    return INET_ADDR(64,6,64,6);
case 3:
    return INET_ADDR(4,2,2,2);
}
```

This explains why 34% of the traffic is being attributed to the US

Google
Hurricane Electric
Verisign
Level 3

The defaults make up 24% of aggregate traffic.

Duration

The DNS attacks from Mirai targeting our customers lasted for about 10 mins.

Some researchers have attributed this to the limitations of the command and control infrastructure relative to the size of the infrastructure being managed

Other researchers attribute this to issues with the stability of the devices the attack is being launched from.

Anna-Senpai, the handle which dumped the source code, mentioned the botnet was ~380K devices however post Krebs DDoS the number was down to 300K and dropping due to ISP reactions

Other Patterns Emerging

We have observed another / other bot(s) with authoritative exhaustion functionality

- The character set being used is different
  - Only lowercase letters - abcdefghijklmnopquestuvxyz
- The length of the cachebuster varies from 4 - 16
- This bot is able to keep long running attacks

From samples obtained, this can’t be tied back to any known qbot / lizkebab variants


Thank You!