# Zombies

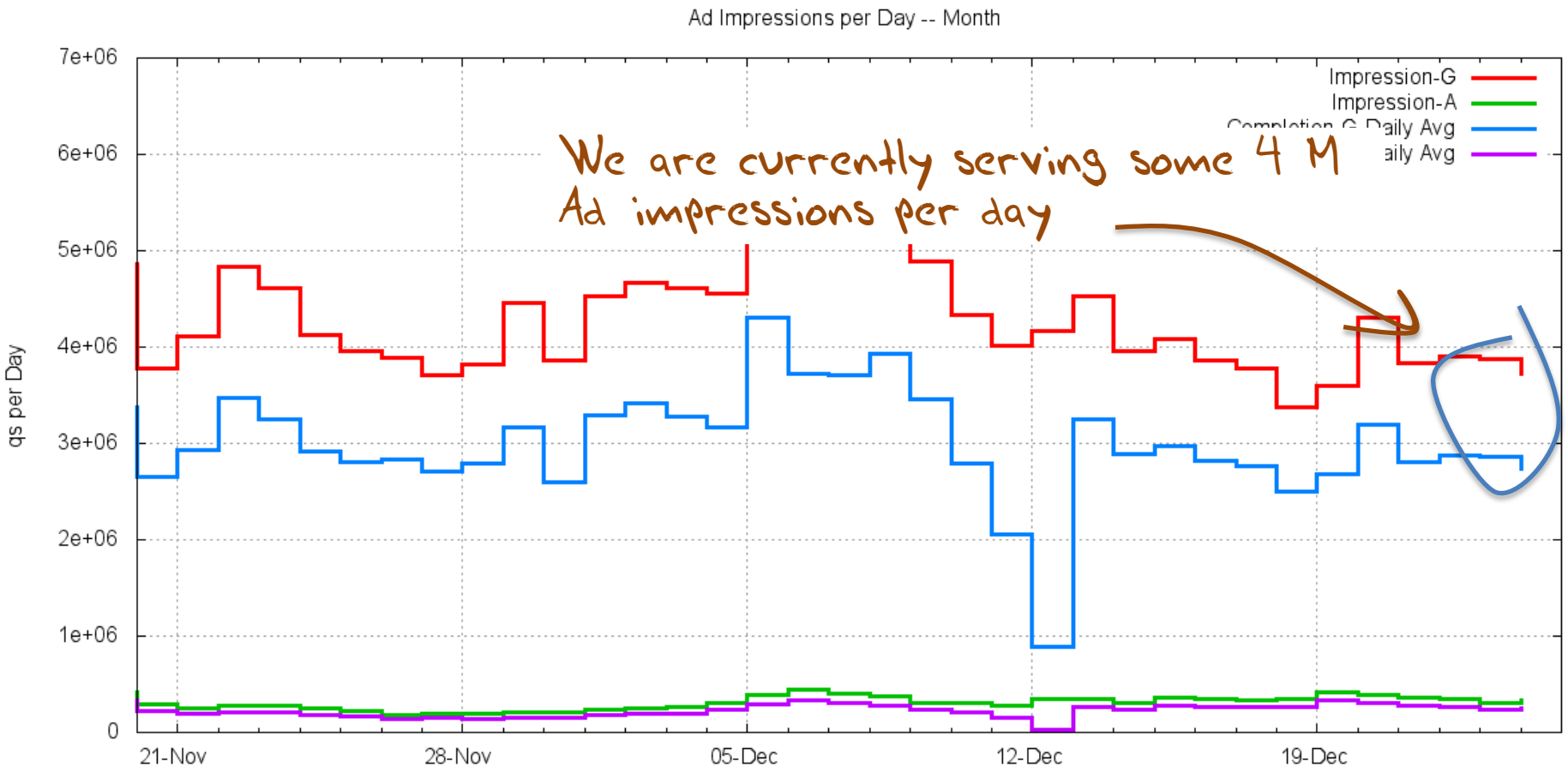
Geoff Huston
APNIC Labs

# What we did:

Run an online advertisement with an embedded measurement script

- The script caused the browser to fetch a number of 1x1 ‘blots’
- To ensure that we had a clear view of the actions of the user and the DNS resolvers they use, we used unique URL labels.

# Ad Impressions per Day



# URL Load

- We are generating some 12 million DNS queries for “unique” DNS names per day
- And similarly performing some 12 million HTTP blot fetches for “unique” URLs per day

# "Unique"?

What is meant by "**unique**"?

- The DNS name is queried by a single endpoint once and only once(*) – never again!
  (And the name includes a subfield of the time it was created)
- The TTL of the record is 1 second
- The URL fetch is performed by a single endpoint once and only once – and never again!
- Which means that we should see one query for the name at the authoritative name server

* Well not quite, 25% of the time its queried twice, and sometimes more, but its all triggered by a single resolution action initiated by the endpoint – all these queries are clustered together in time

# What do we see?

```
1450151673.887  [x] 15-Dec-2015  query: z.t10000.u953a6ea5.s1448087430.i5112.vxxxx.06ca0.z.dotnxdomain.net  A
1450151673.887  [x] 15-Dec-2015  query: z.t10000.uc86fd1d9.s1447672979.i5112.vxxxx.3b460.z.dotnxdomain.net  A
1450151673.887  [x] 15-Dec-2015  query: z.t10000.ub46e3821.s1447703026.i5112.vxxxx.0c914.z.dotnxdomain.net  A
1450151674.013  [x] 15-Dec-2015  query: z.t10000.u953a6ea5.s1448087430.i5112.vxxxx.06ca0.z.dotnxdomain.net  A
1450151674.015  [x] 15-Dec-2015  query: z.t10000.ub46e3821.s1447703026.i5112.vxxxx.0c914.z.dotnxdomain.net  A
1450151674.017  [x] 15-Dec-2015  query: z.t10000.uc86fd1d9.s1447672979.i5112.vxxxx.3b460.z.dotnxdomain.net  A
1450151674.753  [x] 15-Dec-2015  query: z.t10000.u953a6ea5.s1448087430.i5112.vxxxx.06ca0.z.dotnxdomain.net  A
1450151674.755  [x] 15-Dec-2015  query: z.t10000.uc86fd1d9.s1447672979.i5112.vxxxx.3b460.z.dotnxdomain.net  A
1450151674.756  [x] 15-Dec-2015  query: z.t10000.u953a6ea5.s1448087430.i5112.vxxxx.06ca0.z.dotnxdomain.net  A
1450151674.757  [x] 15-Dec-2015  query: z.t10000.ub46e3821.s1447703026.i5112.vxxxx.0c914.z.dotnxdomain.net  A
```

# What do we see?

2015-12-15 03:54:33

query time

```
1450151673.887  [x] 15-Dec-2015  query:  z.t10000.u953a6ea5.s1448087430.i5112.vxxxx.06ca0.z.dotnxdomain.net  A
1450151673.887  [x] 15-Dec-2015  query:  z.t10000.uc86fd1d9.s1447672979.i5112.vxxxx.3b460.z.dotnxdomain.net  A
1450151673.887  [x] 15-Dec-2015  query:  z.t10000.ub46e3821.s1447703026.i5112.vxxxx.0c914.z.dotnxdomain.net  A
1450151674.013  [x] 15-Dec-2015  query:  z.t10000.u953a6ea5.s1448087430.i5112.vxxxx.06ca0.z.dotnxdomain.net  A
1450151674.015  [x] 15-Dec-2015  query:  z.t10000.ub46e3821.s1447703026.i5112.vxxxx.0c914.z.dotnxdomain.net  A
1450151674.017  [x] 15-Dec-2015  query:  z.t10000.uc86fd1d9.s1447672979.i5112.vxxxx.3b460.z.dotnxdomain.net  A
1450151674.753  [x] 15-Dec-2015  query:  z.t10000.u953a6ea5.s1448087430.i5112.vxxxx.06ca0.z.dotnxdomain.net  A
1450151674.755  [x] 15-Dec-2015  query:  z.t10000.uc86fd1d9.s1447672979.i5112.vxxxx.3b460.z.dotnxdomain.net  A
1450151674.756  [x] 15-Dec-2015  query:  z.t10000.u953a6ea5.s1448087430.i5112.vxxxx.06ca0.z.dotnxdomain.net  A
1450151674.757  [x] 15-Dec-2015  query:  z.t10000.ub46e3821.s1447703026.i5112.vxxxx.0c914.z.dotnxdomain.net  A
```

2015-11-21 06:30:30
2015-11-16 11:22:59
2015-11-16 19:43:46
2015-11-21 06:30:30
2015-11-16 19:43:46
2015-11-16 11:22:59
2015-11-21 06:30:30
2015-11-16 11:22:59
2015-11-21 06:30:30
2015-11-16 19:43:46

The time that the ad was created!

# What do we see?

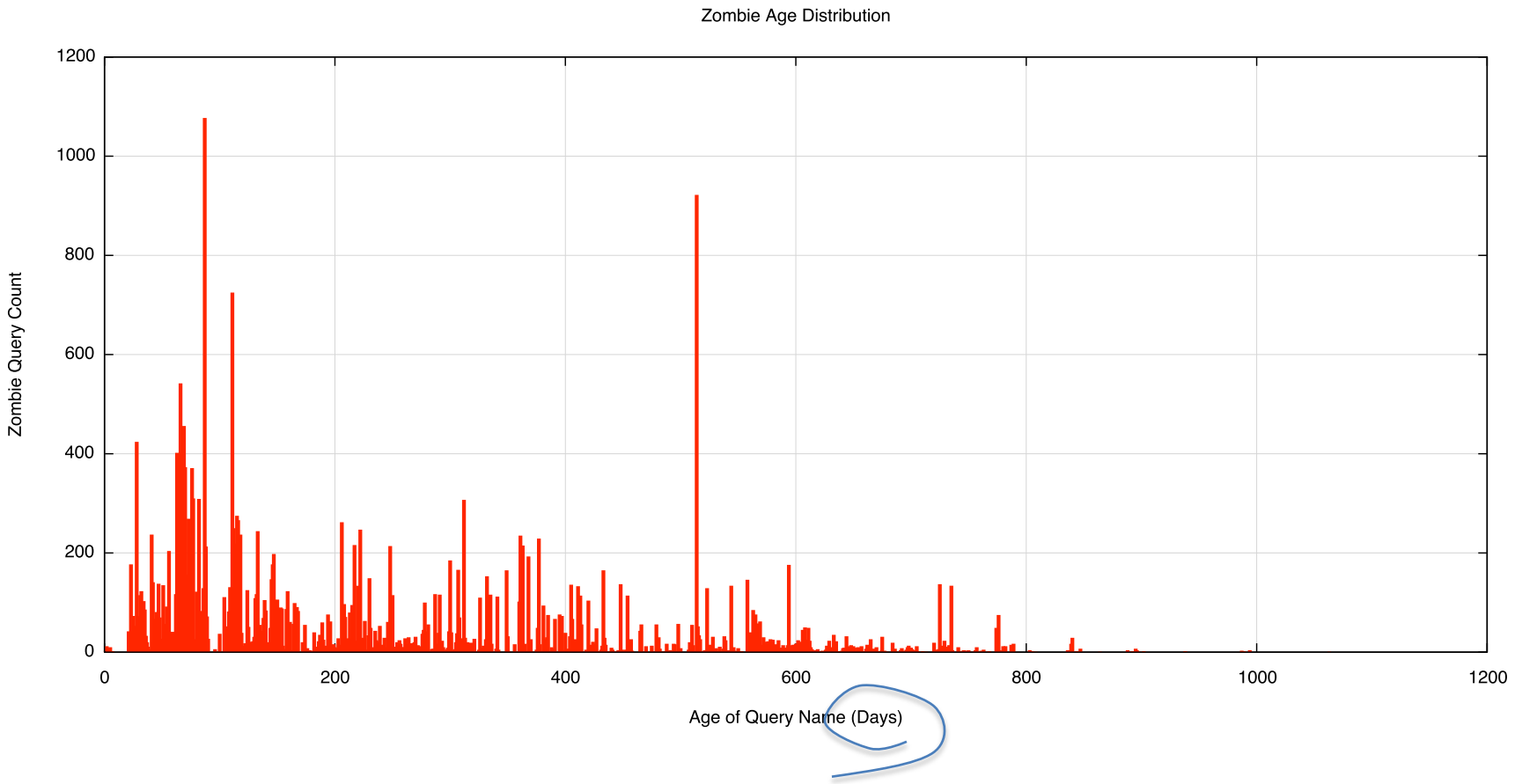
```
1450151673.887   [x] 15-Dec-2015  query:  z.t10000.u953a6ea5.s1448087430.i5112.vxxxx.06ca0.z.dotnxdomain.net  A
1450151673.887   [x] 15-Dec-2015  query:  z.t10000.uc86fd1d9.s1447672979.i5112.vxxxx.3b460.z.dotnxdomain.net  A
1450151673.887   [x] 15-Dec-2015  query:  z.t10000.ub46e3821.s1447703026.i5112.vxxxx.0c914.z.dotnxdomain.net  A
1450151674.013   [x] 15-Dec-2015  query:  z.t10000.u953a6ea5.s1448087430.i5112.vxxxx.06ca0.z.dotnxdomain.net  A
1450151674.015   [x] 15-Dec-2015  query:  z.t10000.ub46e3821.s1447703026.i5112.vxxxx.0c914.z.dotnxdomain.net  A
1450151674.017   [x] 15-Dec-2015  query:  z.t10000.uc86fd1d9.s1447672979.i5112.vxxxx.3b460.z.dotnxdomain.net  A
1450151674.753   [x] 15-Dec-2015  query:  z.t10000.u953a6ea5.s1448087430.i5112.vxxxx.06ca0.z.dotnxdomain.net  A
1450151674.755   [x] 15-Dec-2015  query:  z.t10000.uc86fd1d9.s1447672979.i5112.vxxxx.3b460.z.dotnxdomain.net  A
1450151674.756   [x] 15-Dec-2015  query:  z.t10000.u953a6ea5.s1448087430.i5112.vxxxx.06ca0.z.dotnxdomain.net  A
1450151674.757   [x] 15-Dec-2015  query:  z.t10000.ub46e3821.s1447703026.i5112.vxxxx.0c914.z.dotnxdomain.net  A
```

Query Time

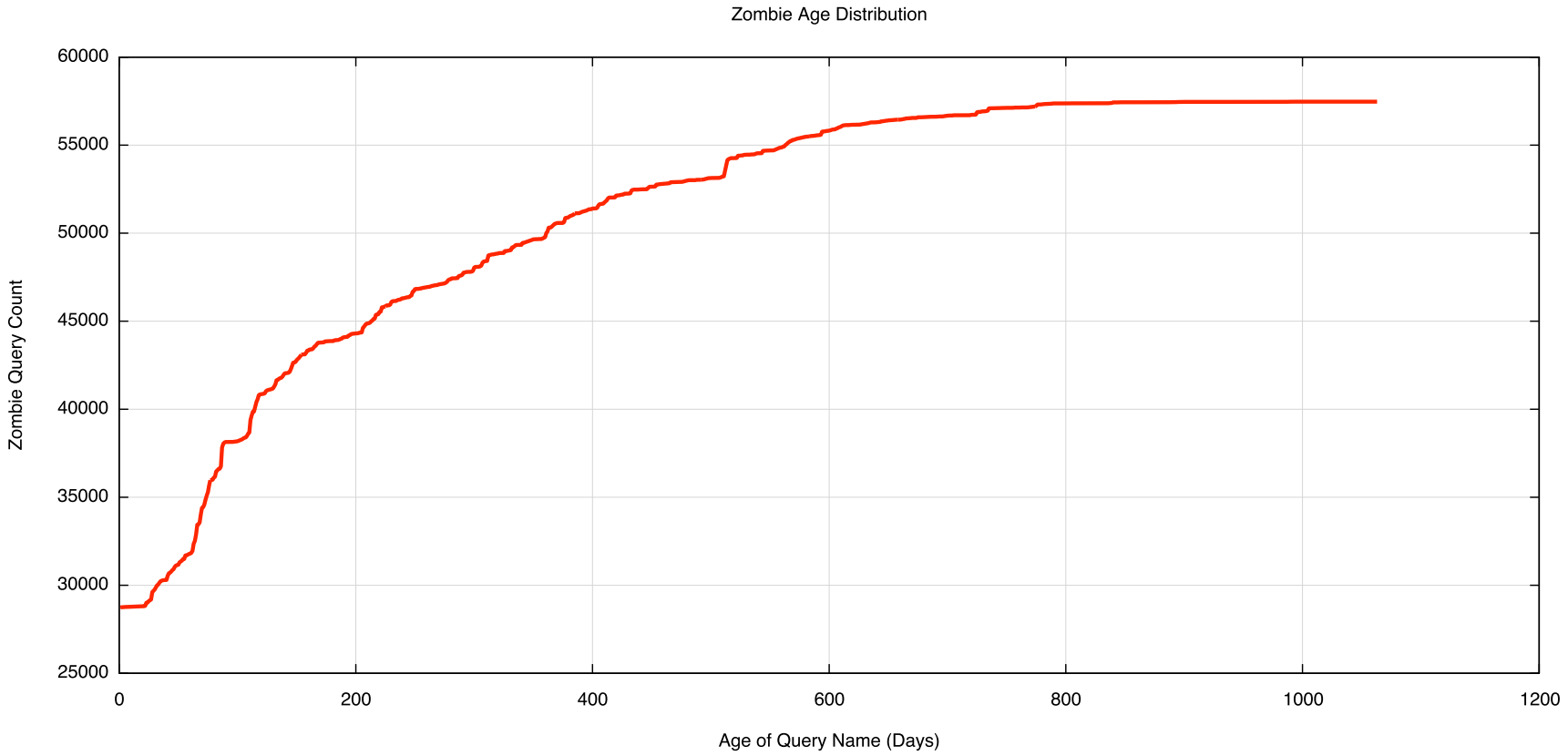
CreationTime

Diff == Zombie Time!

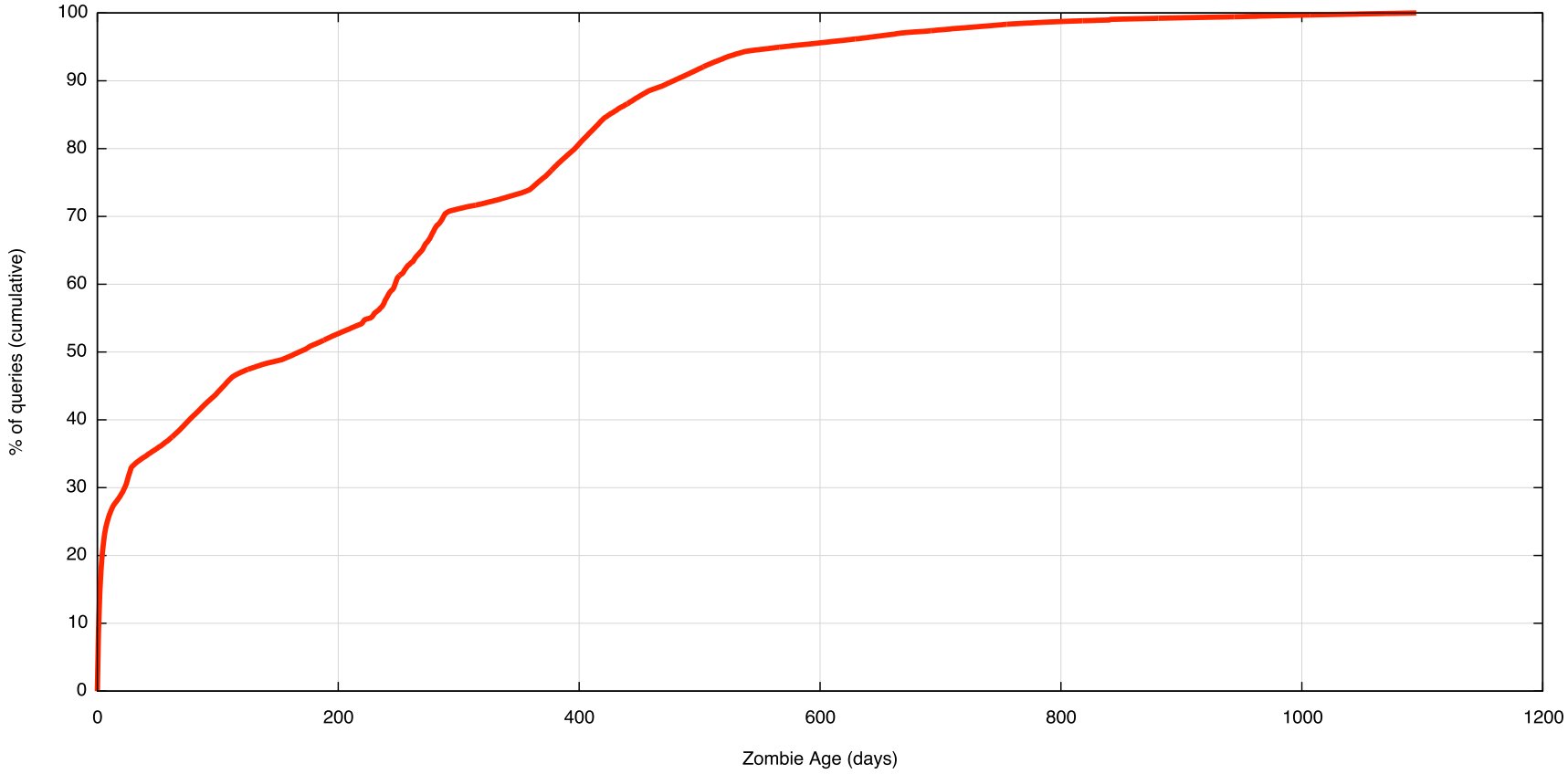
# One Day, One DNS Server



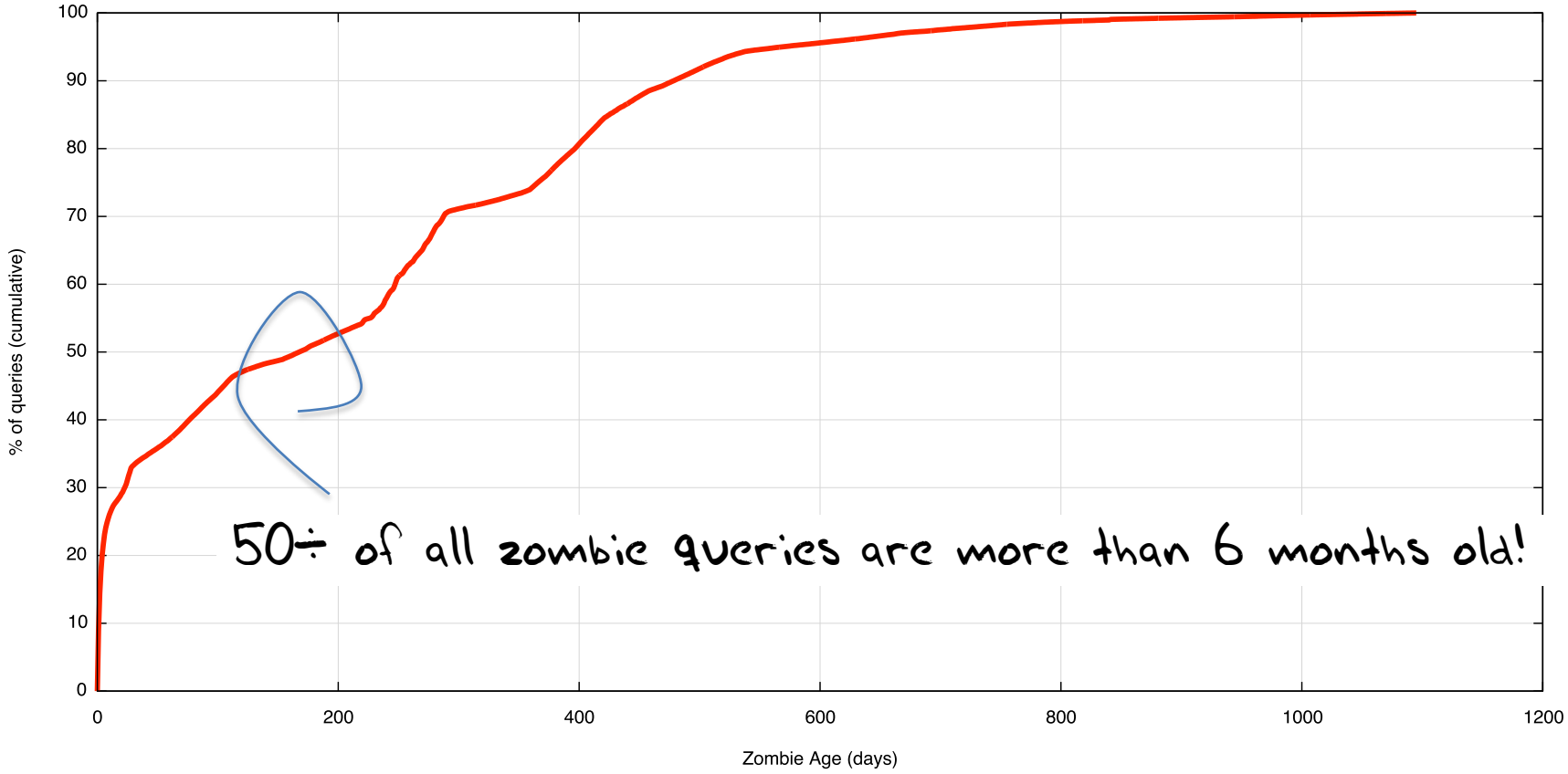
# One Day, One DNS Server



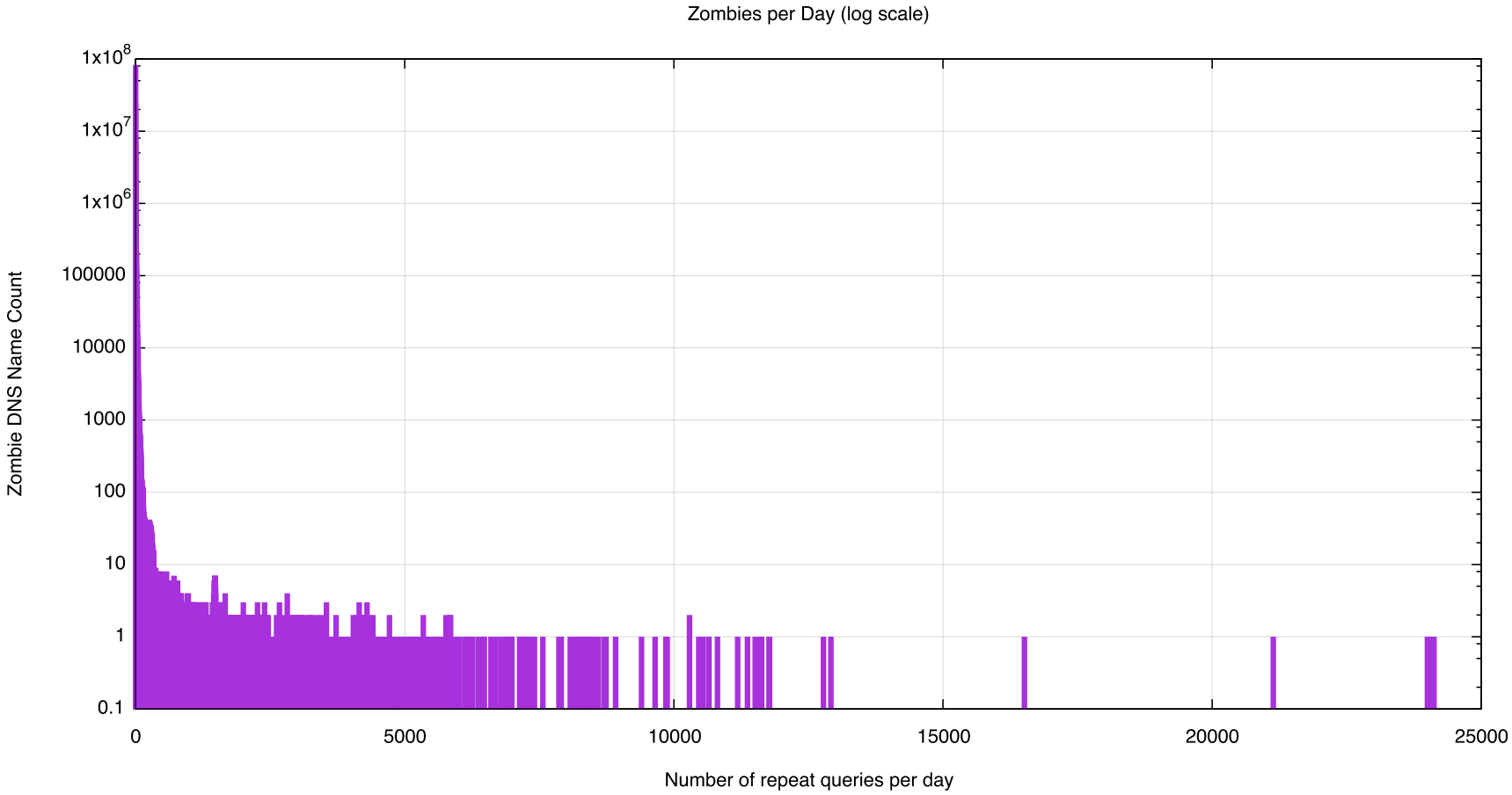
# 60 Days, All DNS Servers



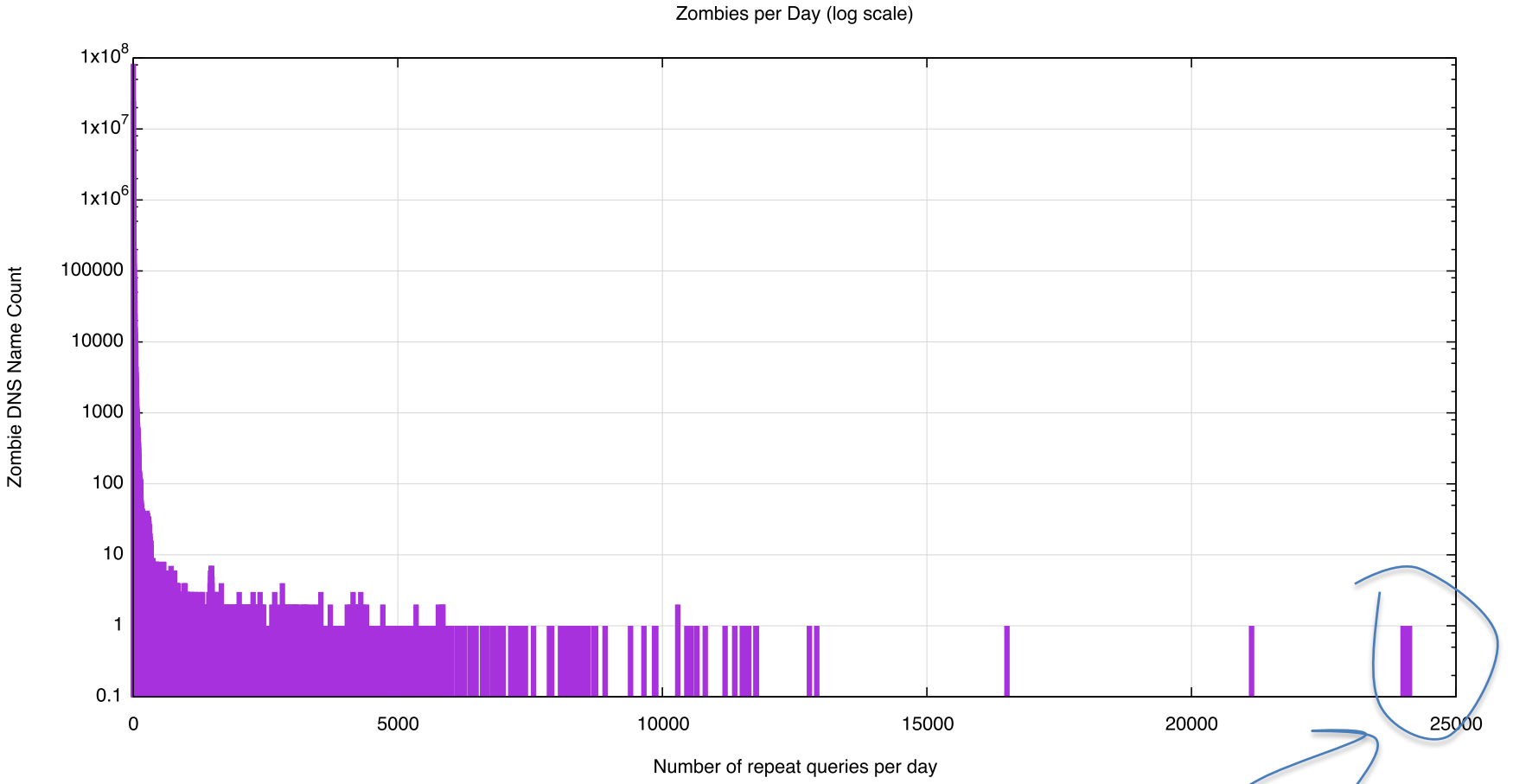
# 60 Days, All DNS Servers



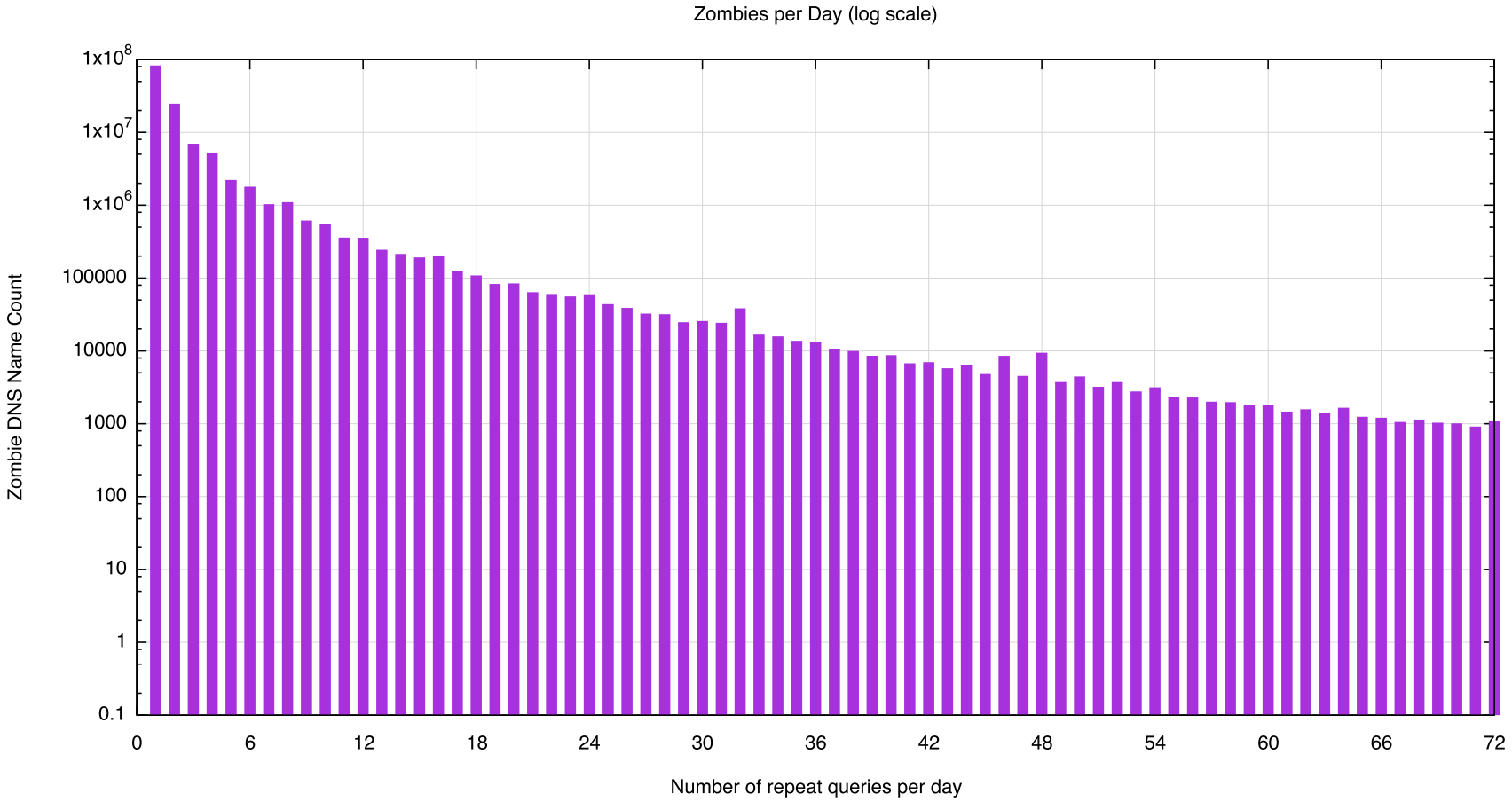
# Zombie Repeats per day



# Zombie Repeats per day

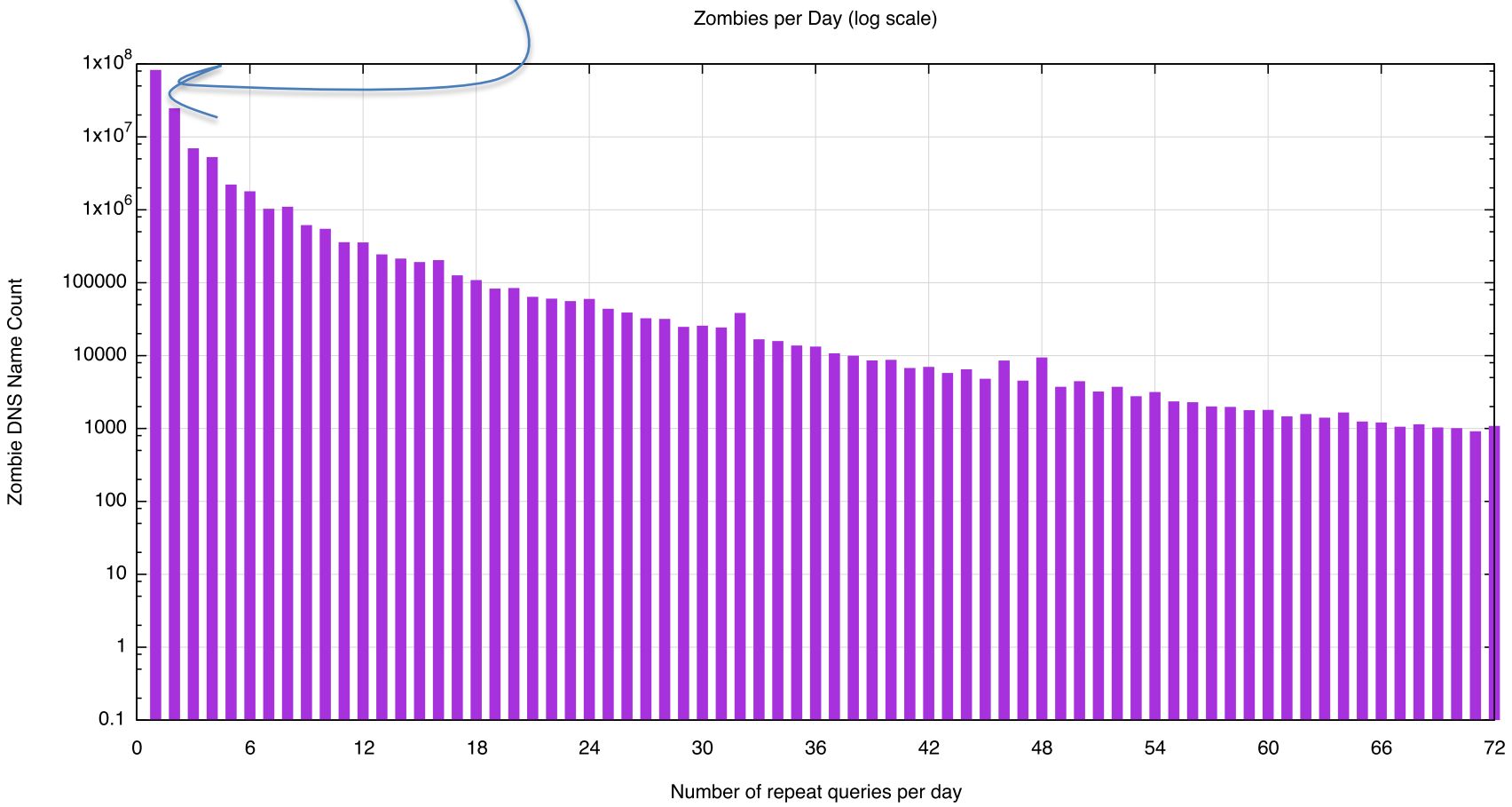


# Zombie Repeats per day



# Zombie Repeats per day

2/3 of all queries occur once per day



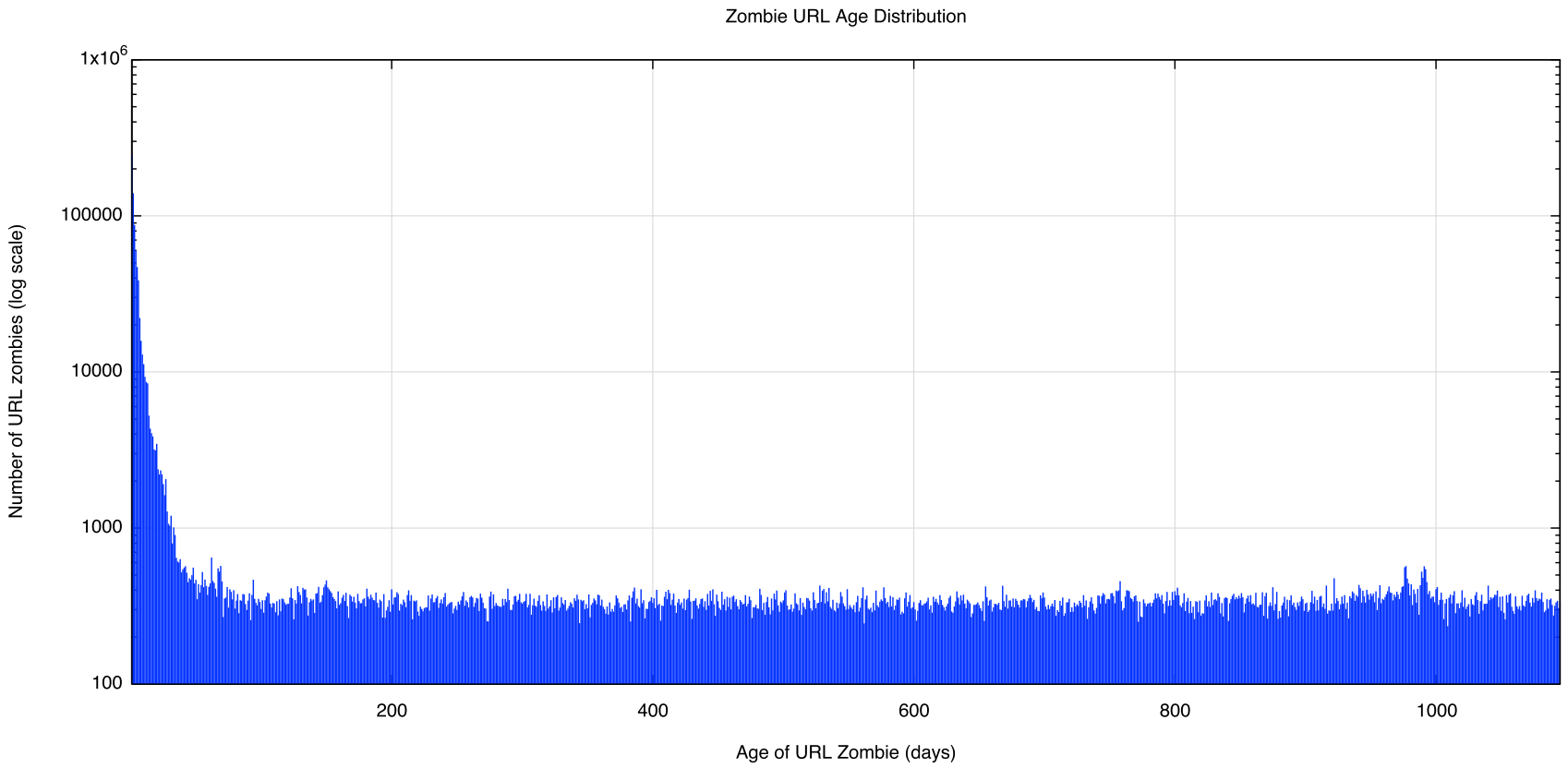
# What is causing this?

Is this the result of a collection of deranged DNS recursive resolvers with an obsession about never forgetting a thing?

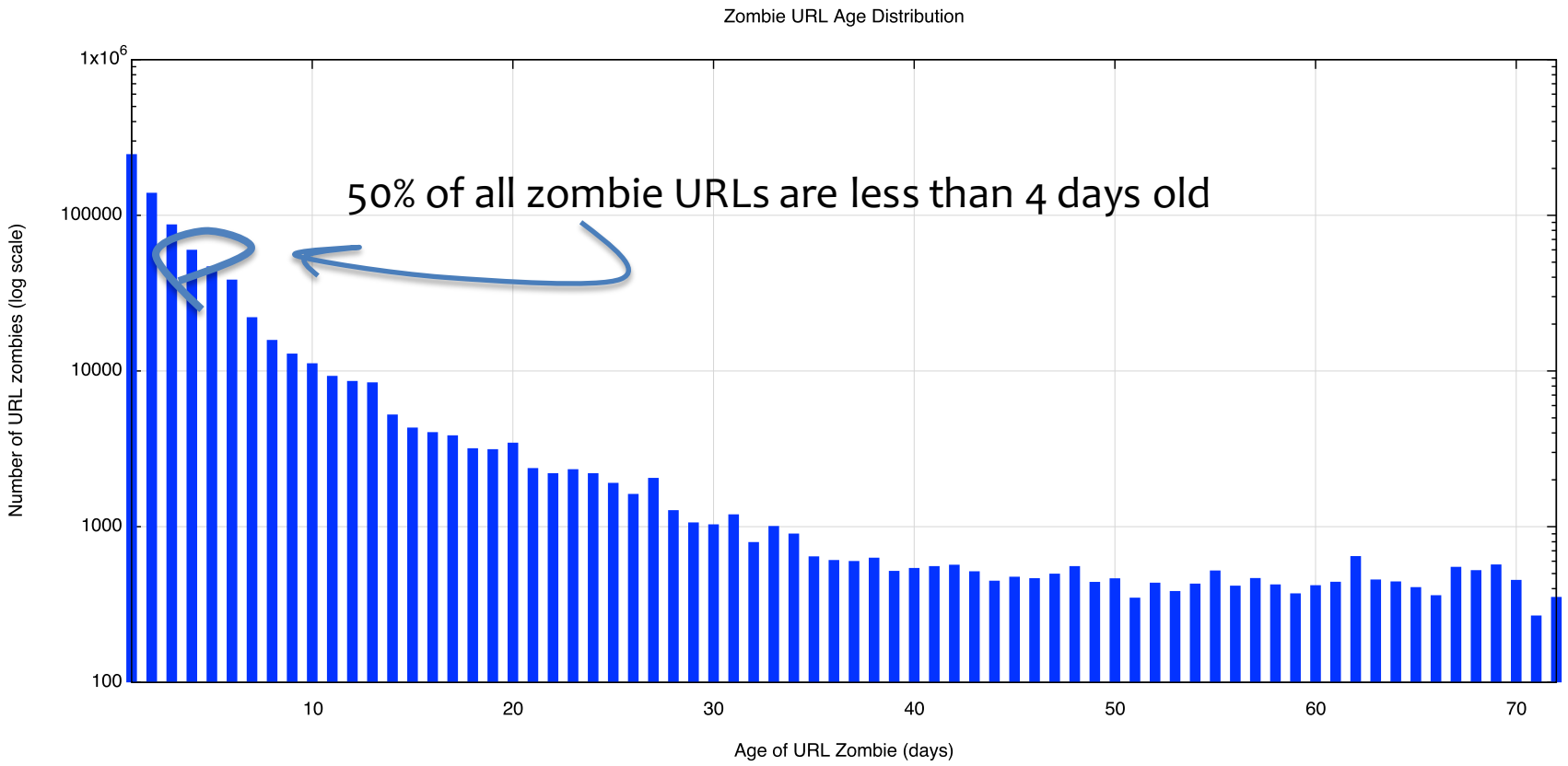
Or web proxies that just have too much time (and space) on their hands and want to fill that space with a vast collection of 1 pixel gifs?

Let's look at web zombies …

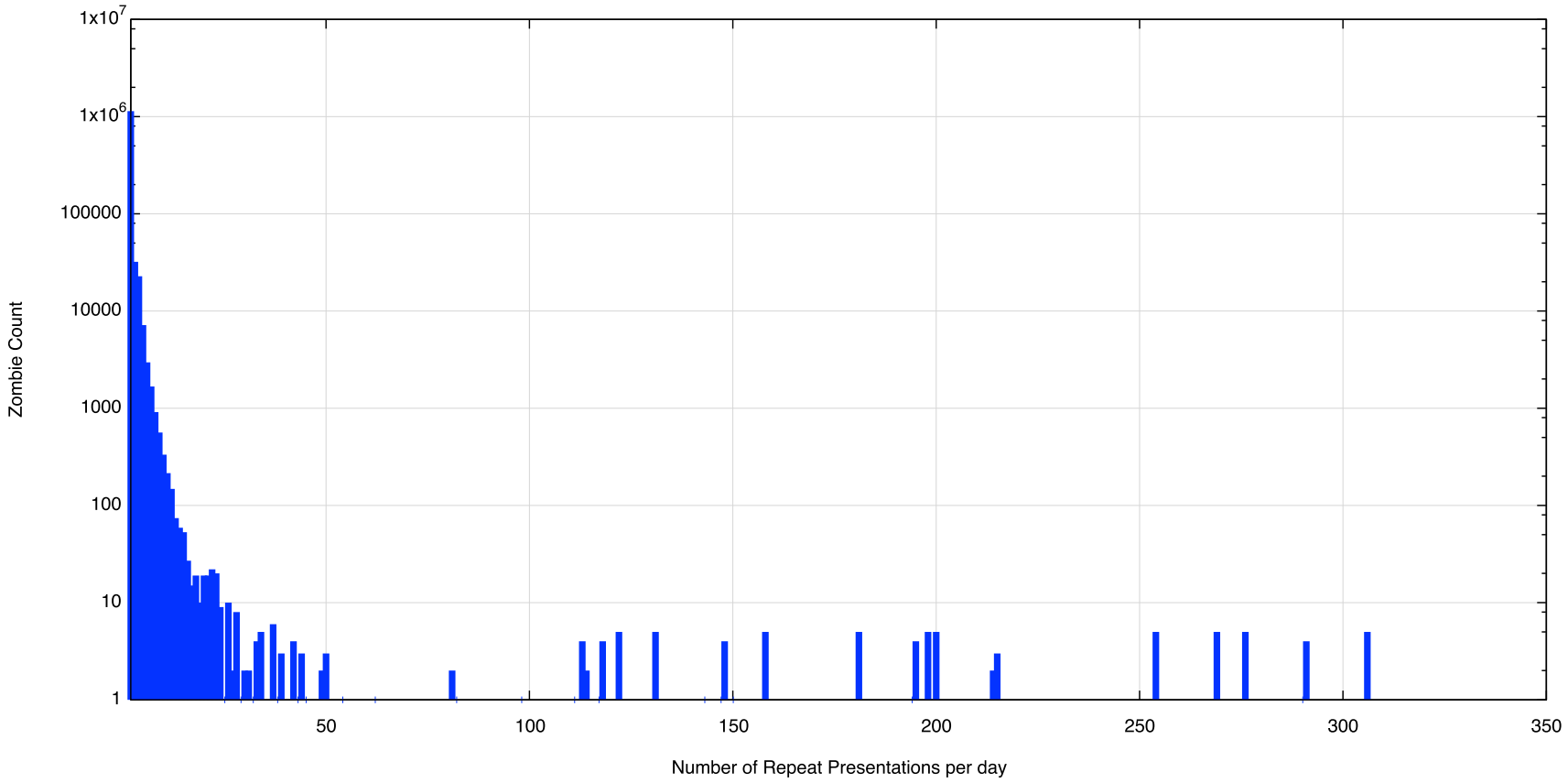
# Zombie URL Age Distribution



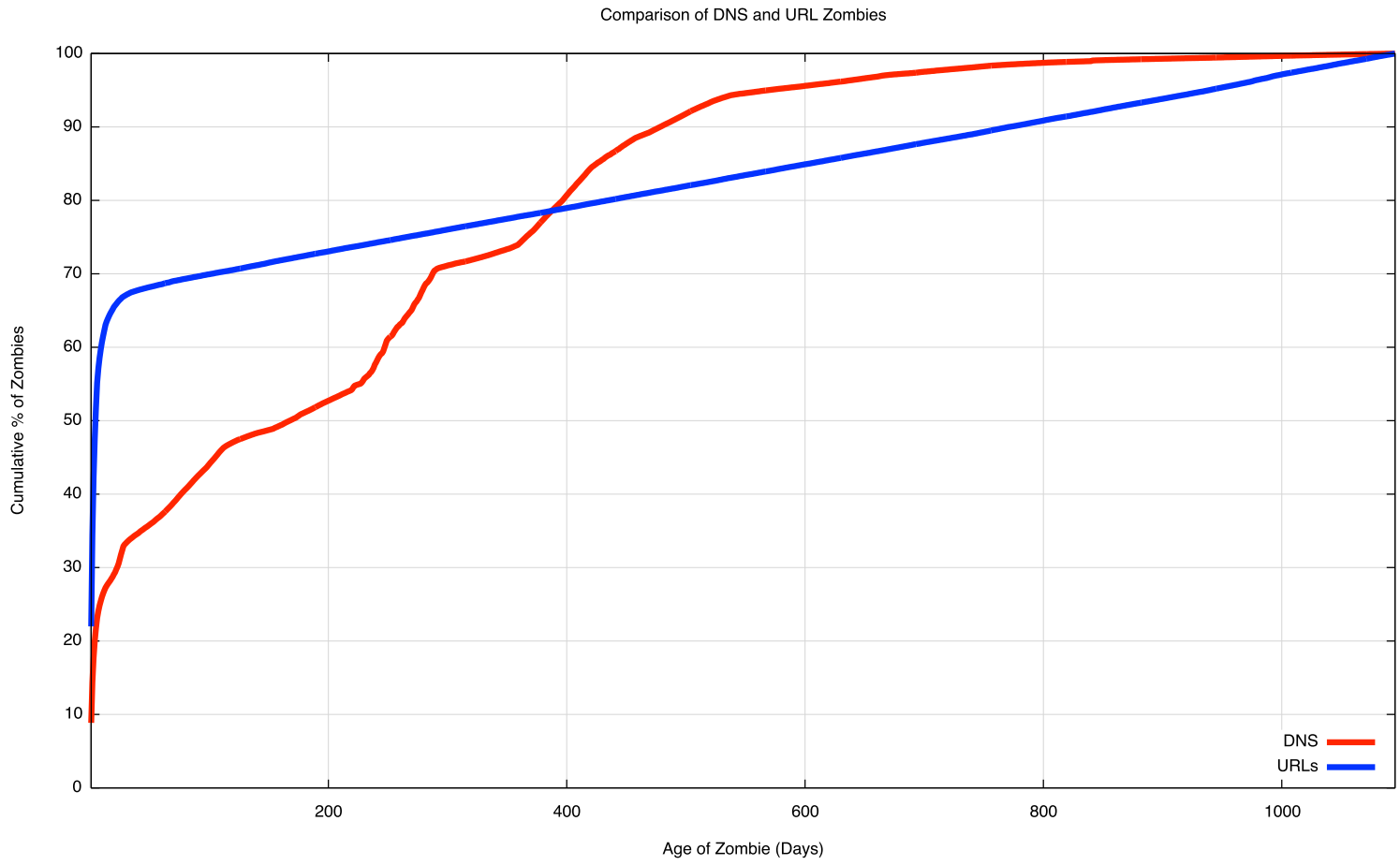
# Zombie URL Age Distribution



# Zombie URL Repeats



# DNS vs URLs


Comparison of DNS and URL Zombies
Cumulative % of Zombies
Age of Zombie (Days)
0
10
20
30
40
50
60
70
80
90
100
200
400
600
800
1000
DNS
URLs

# Zombies

- It seems that on the Internet very little is allowed to be forgotten
- Daily refresh cycles operate on both URL and DNS caches in many parts of the net

# DNS as storage

Write(index,data)

query = “data.index.storage”

foreach i (0..100) { dig IN A query; }

# DNS as storage

Write(index,data)

query = data.index.storage

foreach i (0..100) { dig IN A query; }

Read(index)

wait(query,'index.storage')

return data

# DNS as storage

Write(index,data)
   query = data.index.storage
   foreach i (0..100) { dig IN A query; }

Read(index)
   wait(query,'index.storage')
   return data

Delete(index)
   print("I'm sorry Dave, I can't do that")

Thanks!