

Zombies

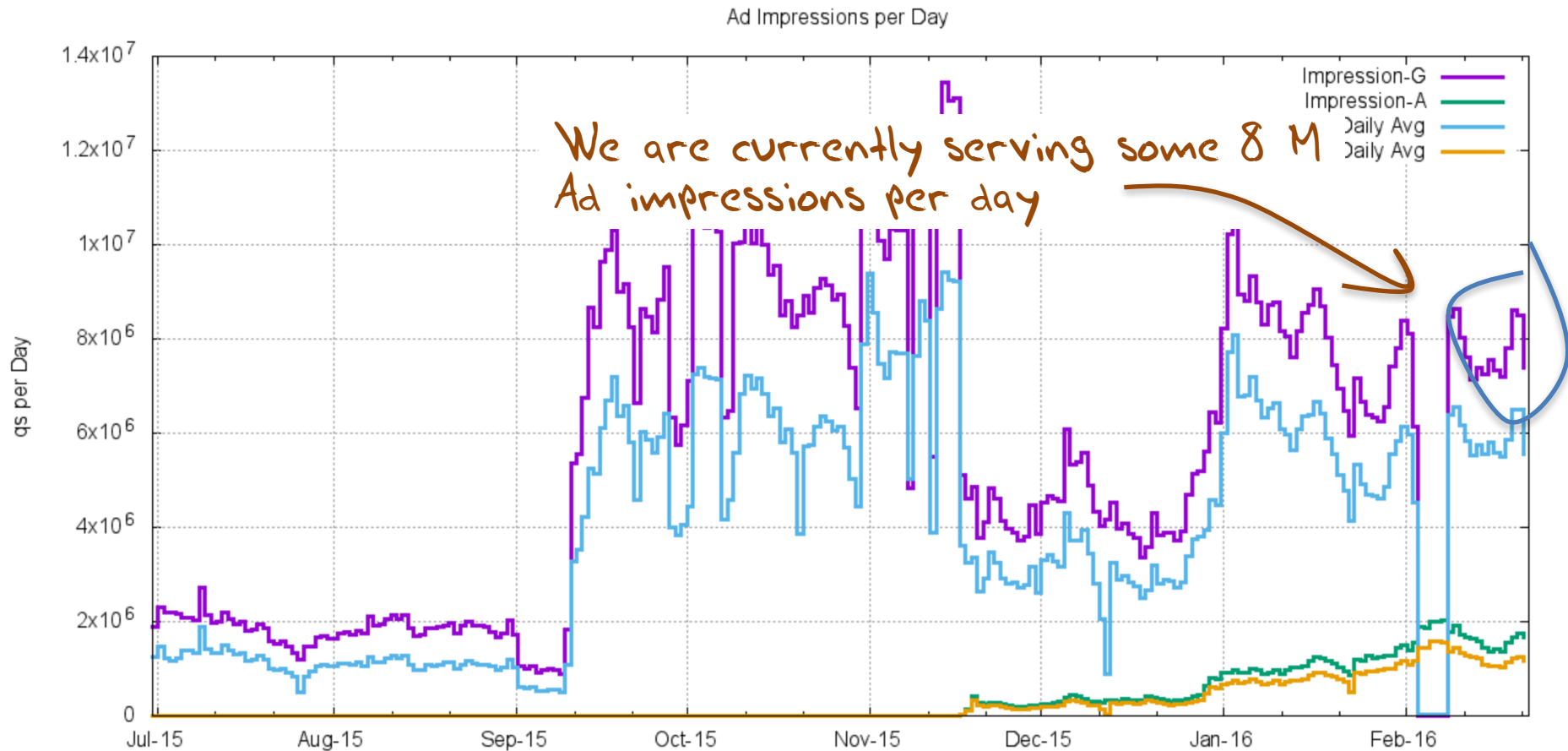
Geoff Huston
APNIC Labs

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 24 million DNS queries for “unique” DNS names per day
- And similarly performing some 24 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

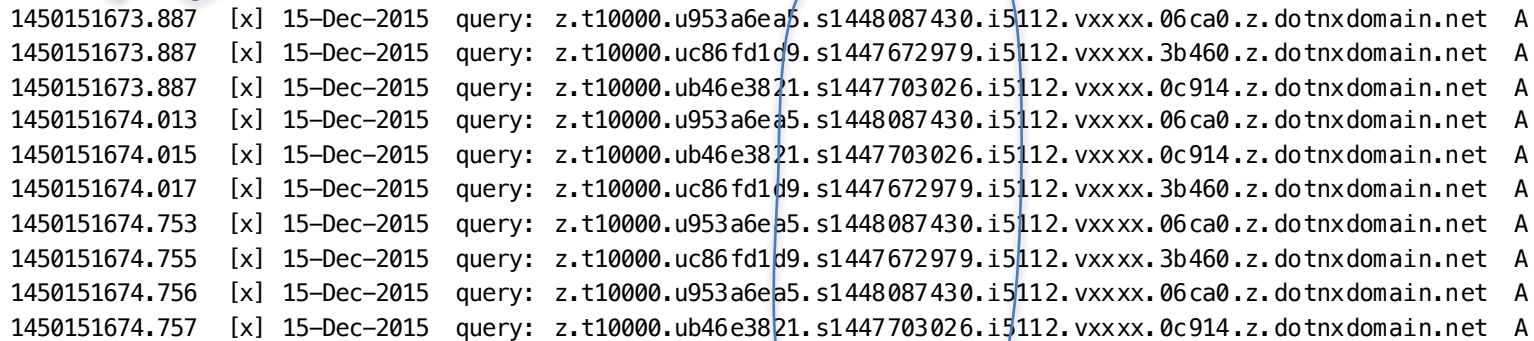
What do we see?

```
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
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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
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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

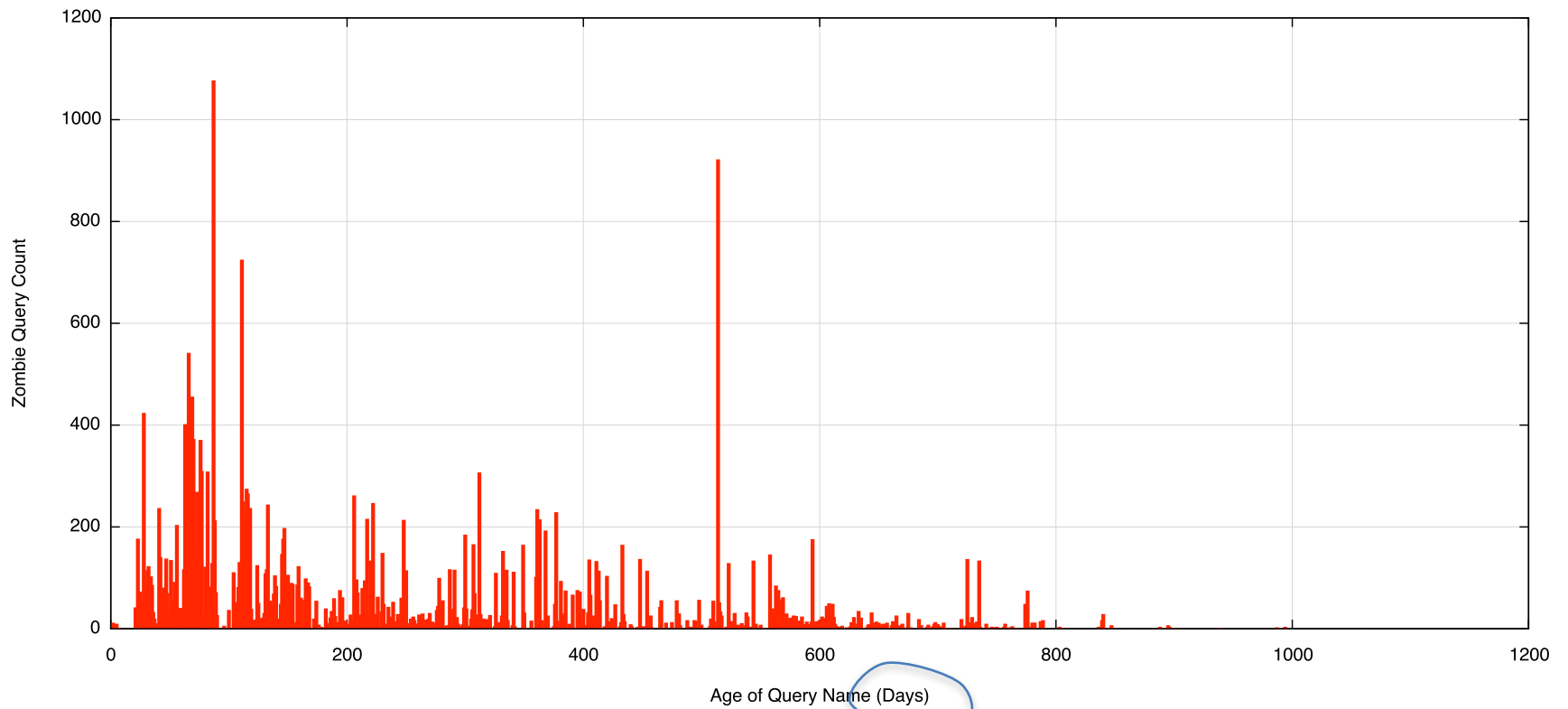
Query Time

CreationTime

Diff == Zombie Time!

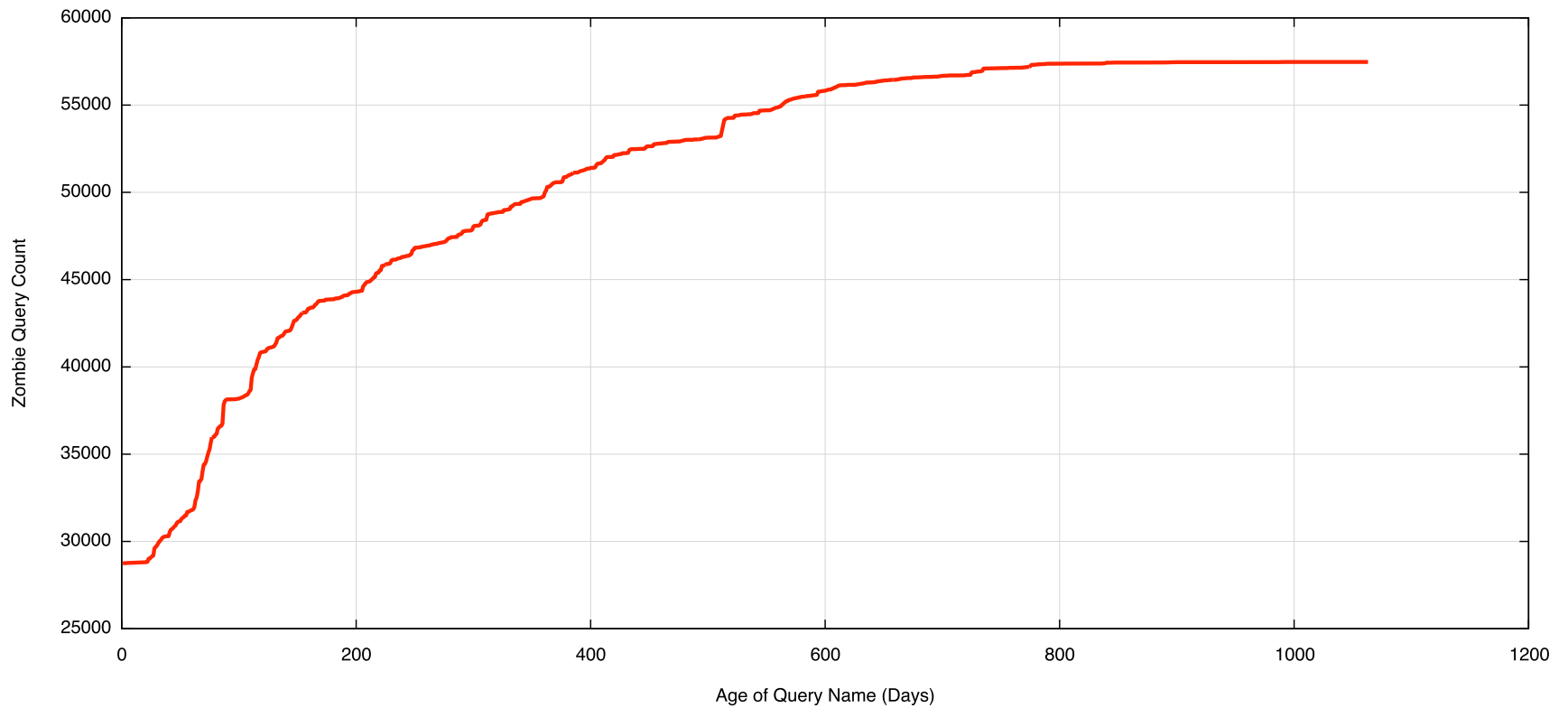
One Day, One DNS Server

Zombie Age Distribution

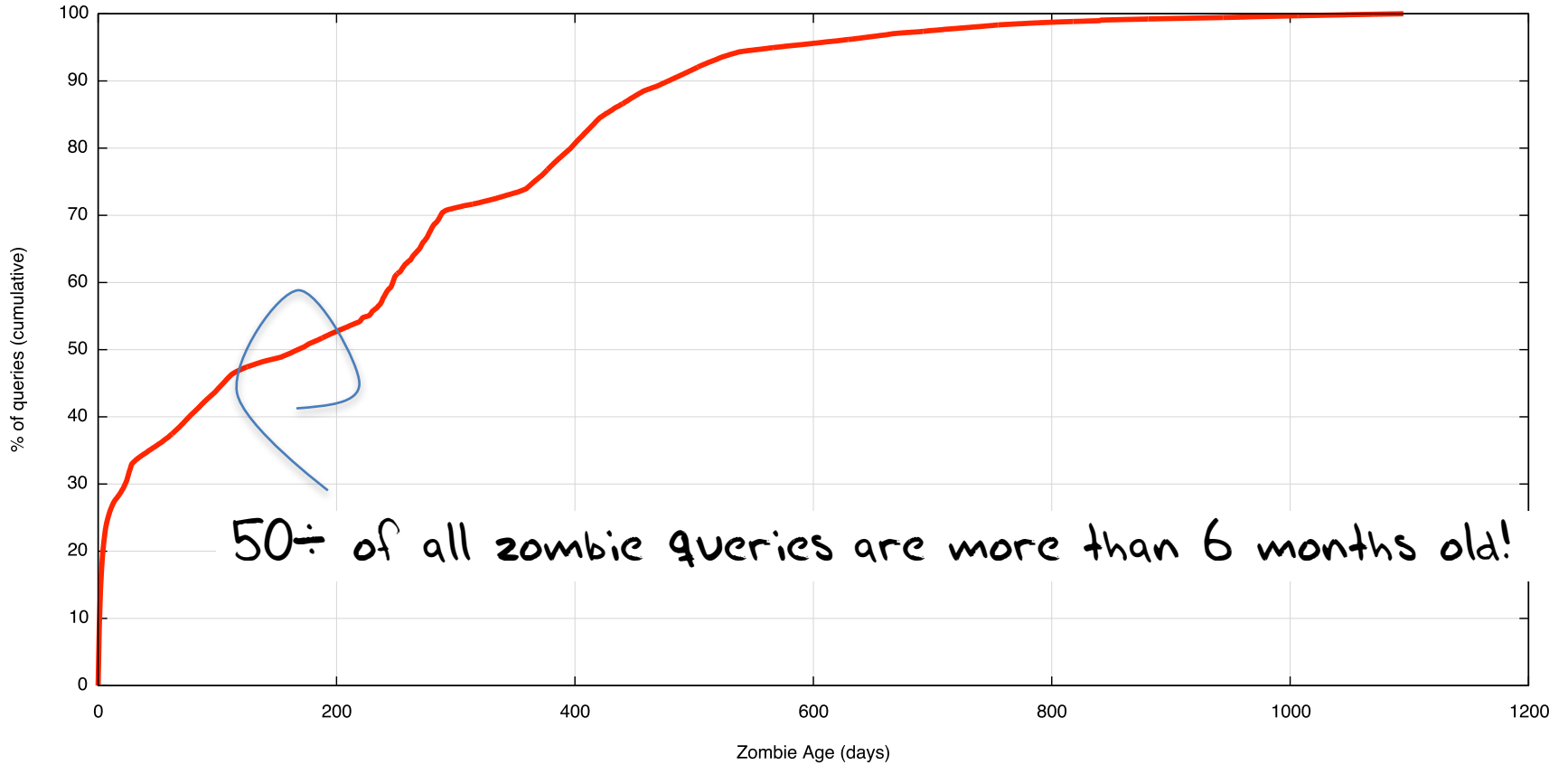


One Day, One DNS Server

Zombie Age Distribution



60 Days, All DNS Servers



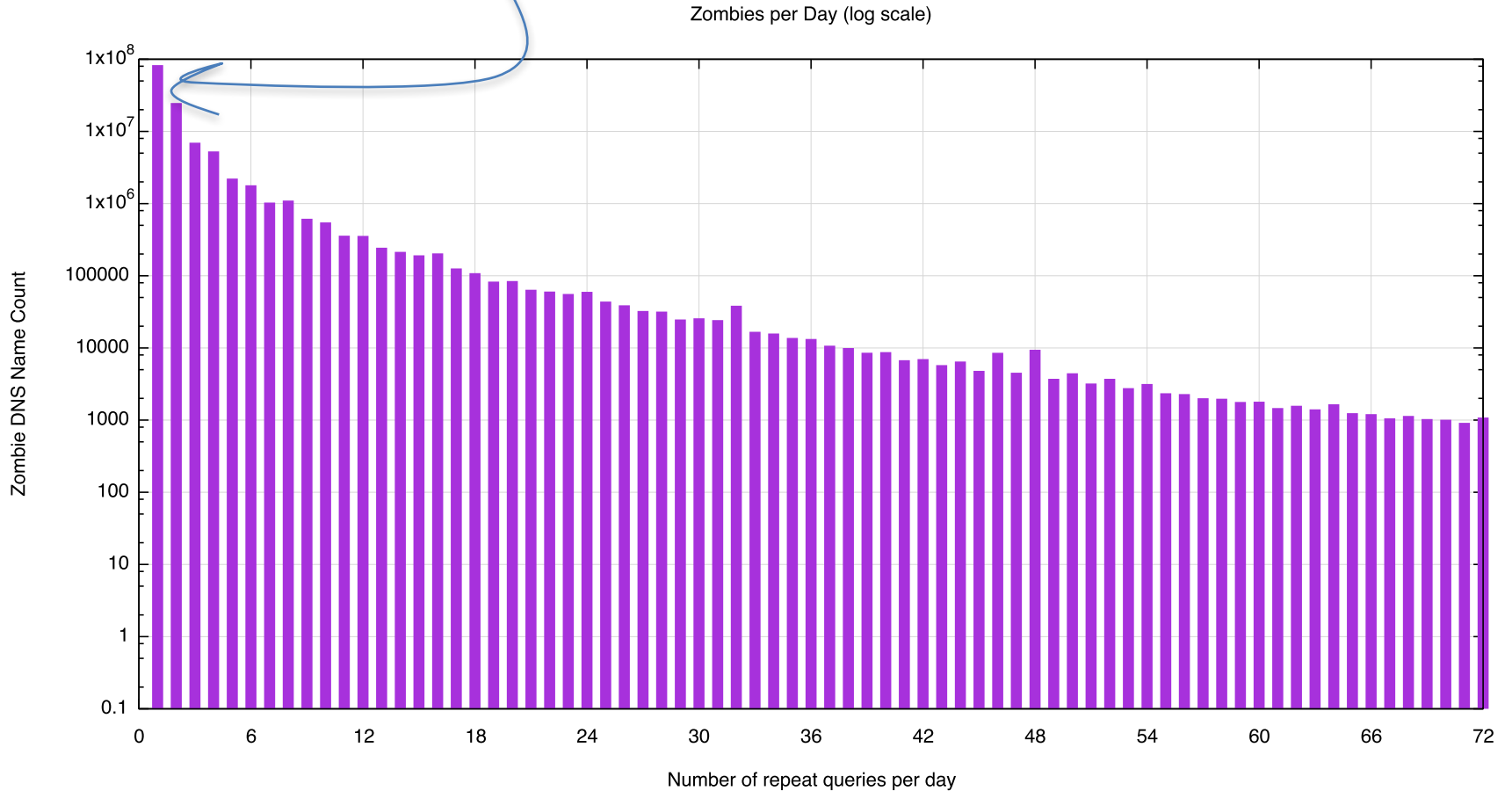
180 Days, All DNS Servers



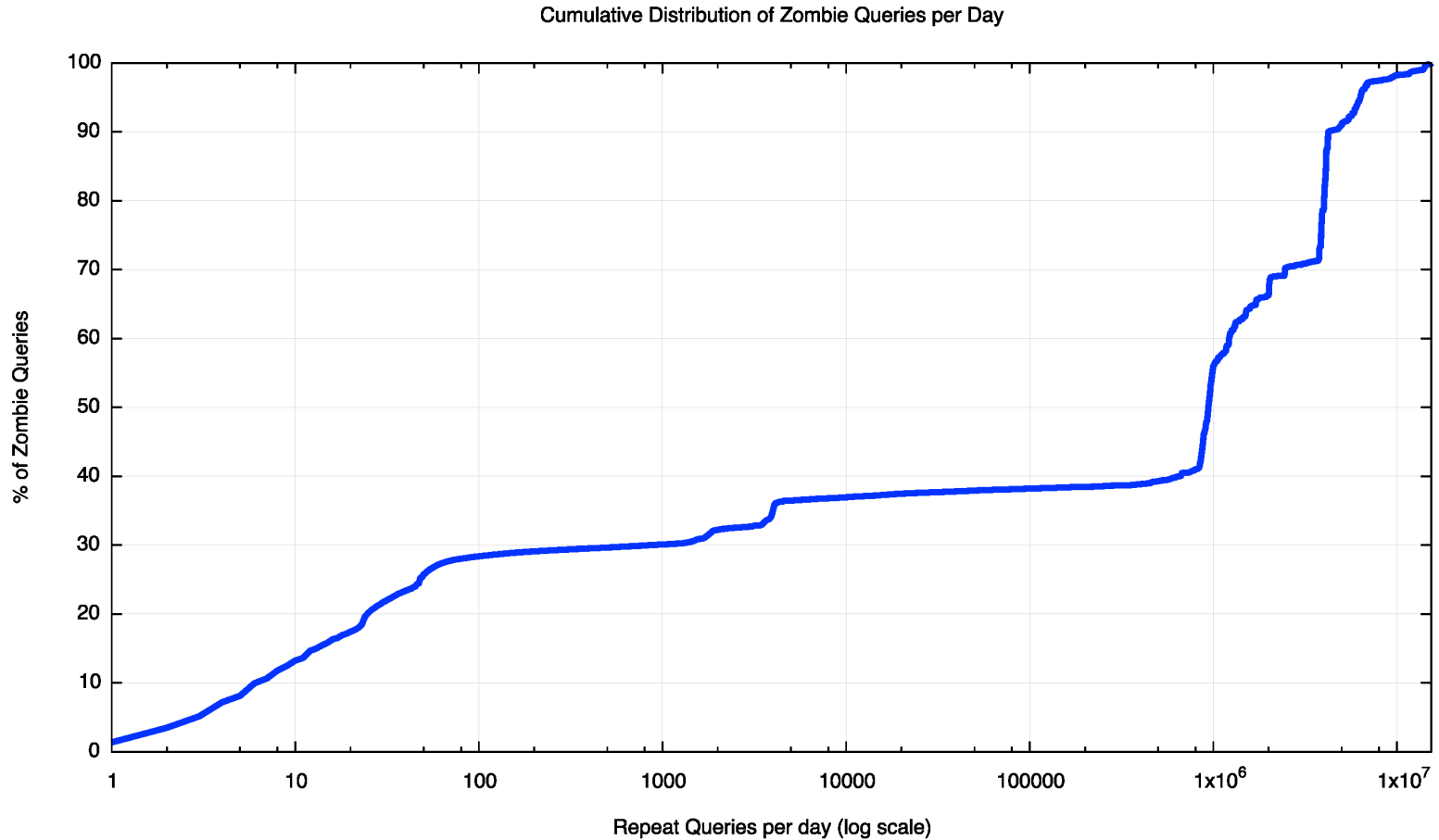
44,733,946,408 DNS queries, of which 11,274,142,797 are zombies – a 25% zombie rating!

Zombie Queries per day

2/3 of all queries occur once per day



Zombie Repeats per day



What is causing this?

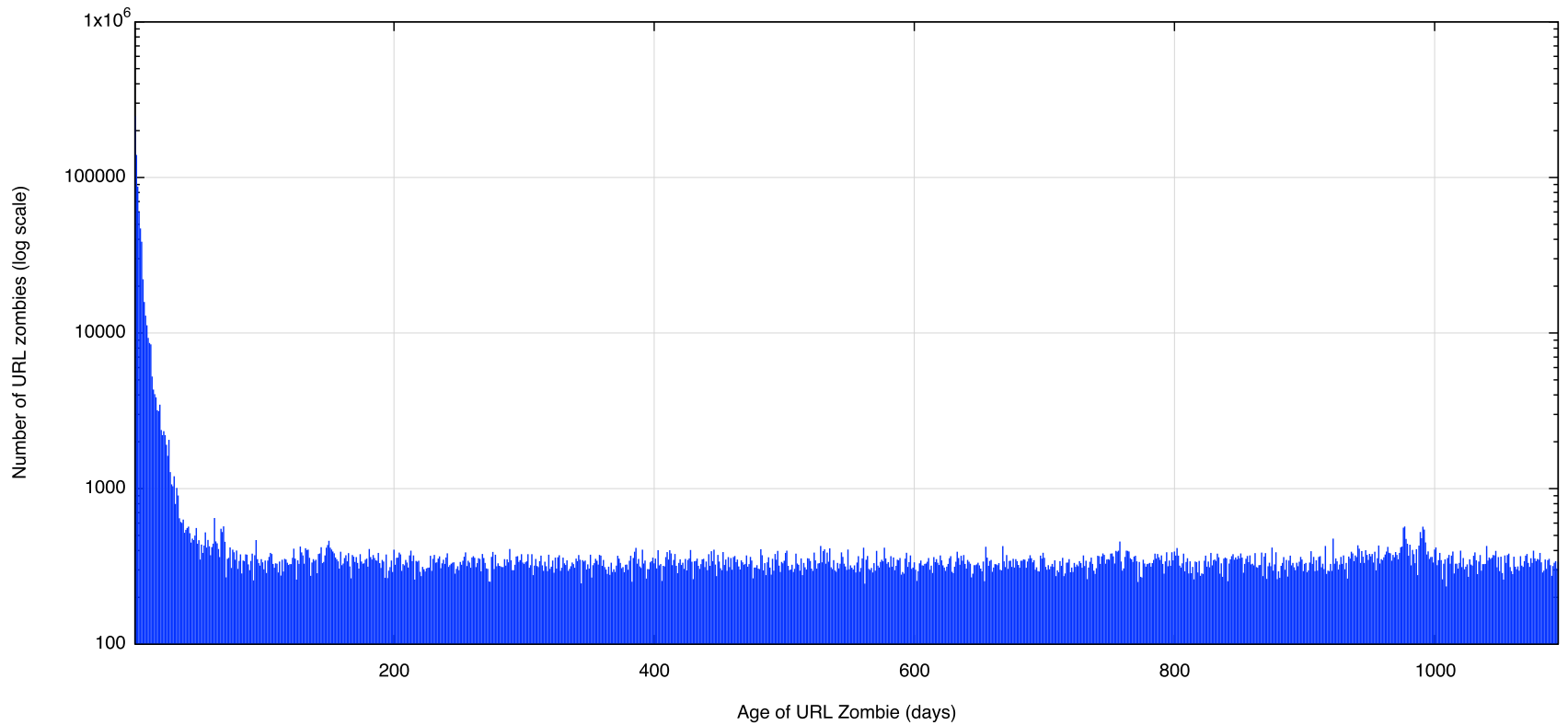
Is this the result of a collection of deranged DNS recursive resolvers with an obsession about never forgetting a thing?

Or web proxies that just have too much time (and space) on their hands and want to fill all that space with a vast collection of identical 1x1 pixel gifs?

Let's look at web zombies ...

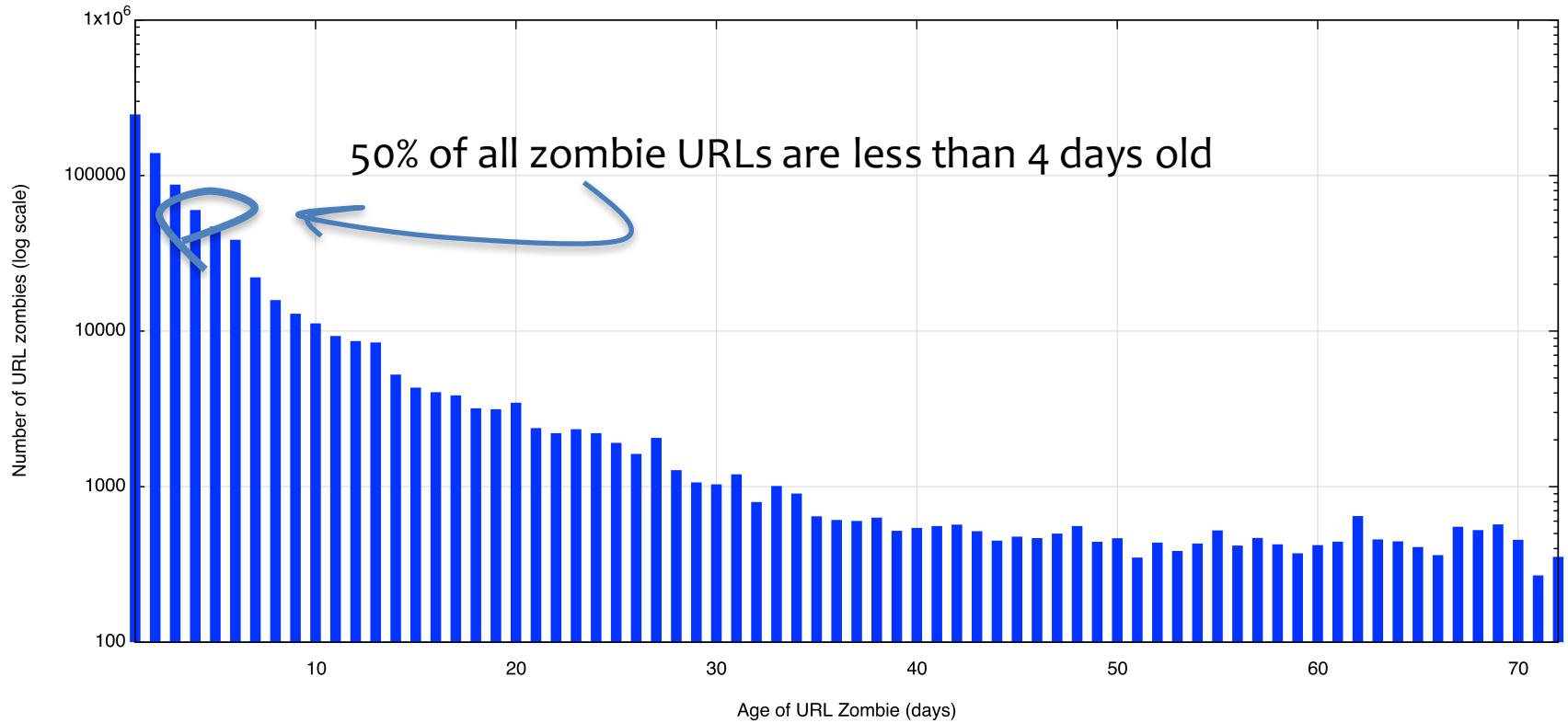
Zombie URL Age Distribution

Zombie URL Age Distribution

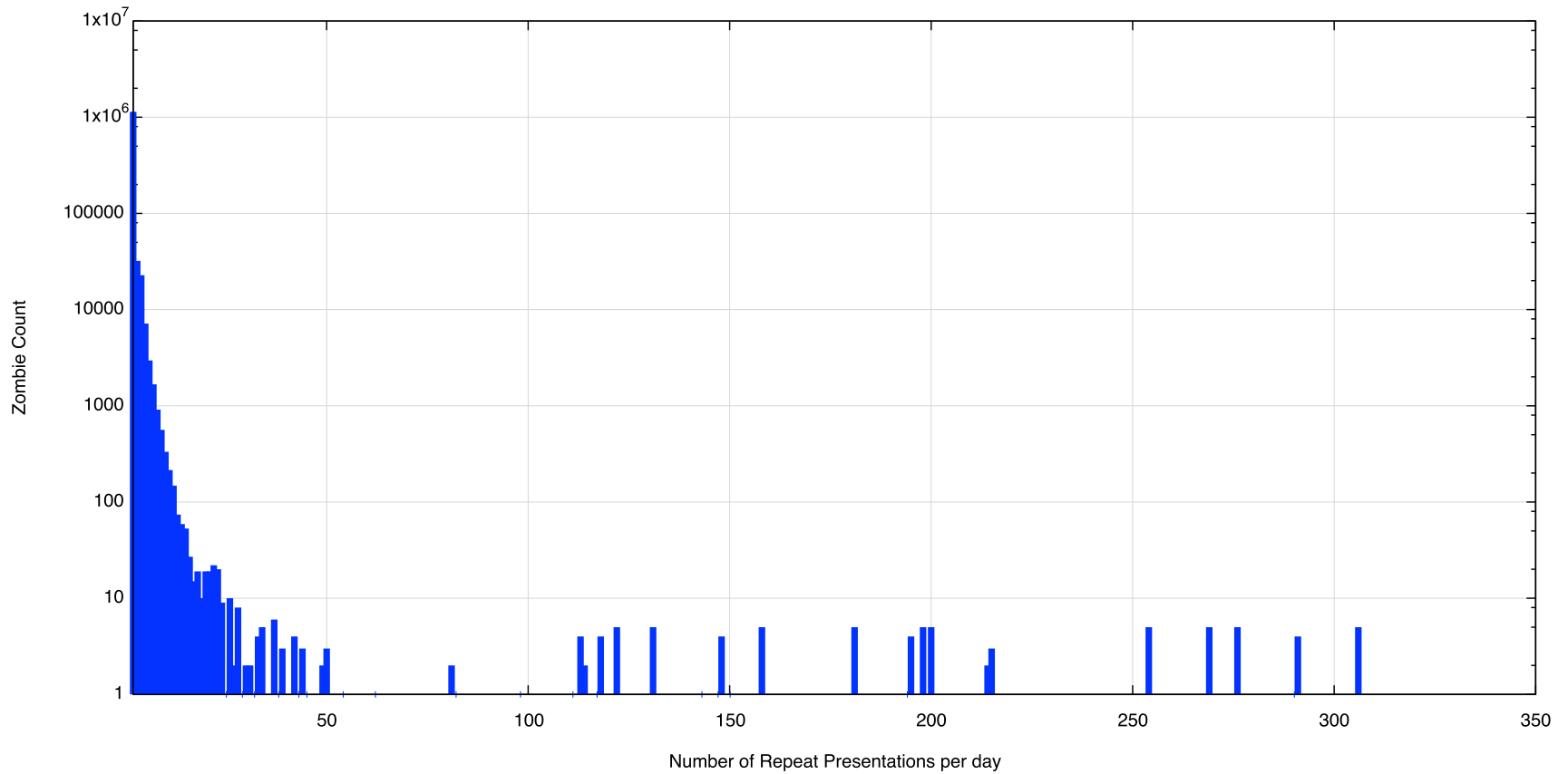


Zombie URL Age Distribution

Zombie URL Age Distribution

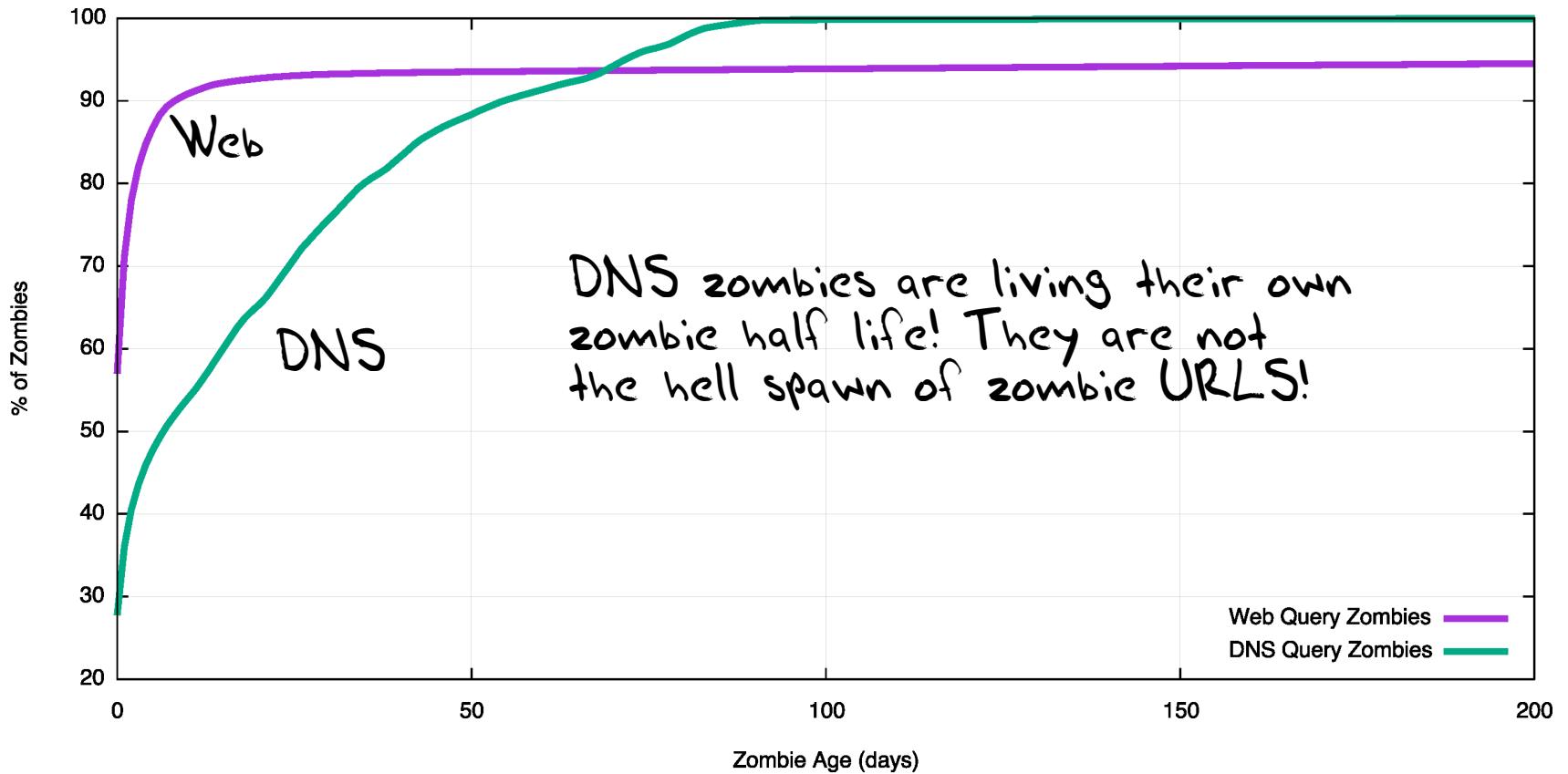


Zombie URL Repeats



DNS vs URLs

Zombie Cumulative Age Distribution: Web vs DNS



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 all that space with a vast collection of identical 1x1 pixel gifs?

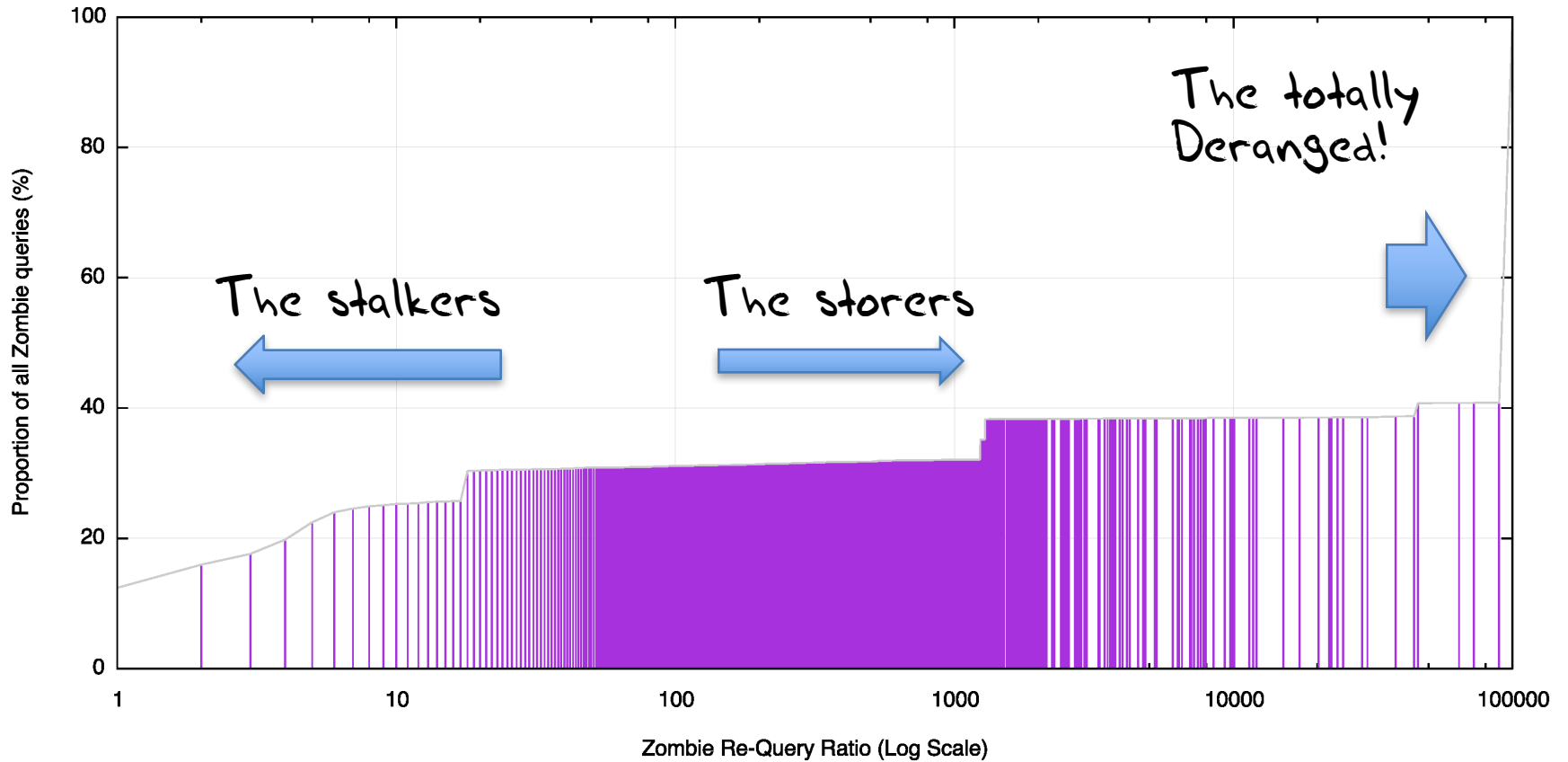
Let's look at web zombies ...

Who Are These Deranged Resolvers?

Resolver	Current	Zombie	Ratio	ASN	CC	AS Name
186.151.28.130	3,978,931	4,610,444	1,158	14754	GT	Telgua, Guatemala
87.236.233.178	14,124,423	1,006,797	71	35656	JO	JUNET Jordanian Universities, Jordan
74.205.176.249	9,868,204	870,945	88	53618	CA	ADITY-OSH - Aditya Birla Minacs, Canada
204.184.141.253	35,034,545	594,314	16	2572	US	Missouri Research and Edu., United States
38.229.33.65	7	573,038	81,862,630	23028	US	Team Cymru Inc. United States
80.246.0.3	1,486,712	379,724	255	21391	DZ	TDA-AS,DZ Algeria
80.246.0.2	2,041,670	373,155	182	21391	DZ	TDA-AS,DZ Algeria
87.236.232.5	5,697,987	255,364	44	35656	JO	JUNET Jordanian Universities, Jordan
74.205.162.254	1,975,978	200,821	101	14214	CA	MINACS - Minacs Inc, Canada
38.229.33.67	11	128,929	11,720,898	23028	US	Team Cymru Inc, United States
38.229.33.68	2	109,905	54,952,514	23028	US	Team Cymru Inc, United States
38.229.33.100	3	90,637	30,212,596	23028	US	Team Cymru Inc, United States
38.229.33.99	3	67,436	22,478,752	23028	US	Team Cymru Inc, United States
200.195.185.205	93,986	39,623	421	14868	BR	COPEL Telecom S.A. Brazil
167.102.229.10	1,632,910	17,868	10	27026	US	Network Maryland, US United States
54.183.221.9	13	17,637	1,356,735	16509	US	AMAZON-02 - Amazon.com, United States
54.183.144.165	59	17,331	293,758	16509	US	AMAZON-02 - Amazon.com, United States
192.235.48.69	3,259,591	12,759	4	14813	BB	Columbus Telecommunications, Barbados

Three Zombie Factories

Zombie Re-Query Distribution



The Stalkers

Resolver	Current	Zombie	Ratio	ASN	CC	AS Name
38.229.33.65	7	573,038,416	81,862,630	23028	US	Team Cymru Inc, United States
38.229.33.68	2	109,905,028	54,952,514	23028	US	Team Cymru Inc, United States
38.229.33.100	3	90,637,788	30,212,596	23028	US	Team Cymru Inc, United States
38.229.33.99	3	67,436,258	22,478,752	23028	US	Team Cymru Inc, United States
38.229.33.67	11	128,929,881	11,720,898	23028	US	Team Cymru Inc, United States
199.91.135.162	0	5,519,461	5,519,461	27471	US	Blue Coat Systems, Inc, United States
212.142.63.183	0	2,472,109	2,472,109	6830	NL	LGI-UPC Liberty Global Operations, Netherlands
212.142.48.75	0	2,401,930	2,401,930	6830	NL	LGI-UPC Liberty Global Operations, Netherlands
54.193.90.244	1	1,480,634	1,480,634	16509	US	AMAZON-02 - Amazon.com, Inc, United States
54.193.58.86	0	1,479,066	1,479,066	16509	US	AMAZON-02 - Amazon.com, Inc, United States
54.193.65.165	0	1,423,147	1,423,147	16509	US	AMAZON-02 - Amazon.com, Inc, United States
54.183.221.9	13	17,637,567	1,356,735	16509	US	AMAZON-02 - Amazon.com, Inc, United States
54.193.7.134	0	842,849	842,849	16509	US	AMAZON-02 - Amazon.com, Inc, United States
218.241.99.50	0	713,779	713,779	24151	CN	China Internet Network Information Center, China
54.215.202.77	0	372,889	372,889	16509	US	AMAZON-02 - Amazon.com, Inc, United States
54.215.190.109	0	365,598	365,598	16509	US	AMAZON-02 - Amazon.com, Inc, United States
54.215.215.191	0	361,804	361,804	16509	US	AMAZON-02 - Amazon.com, Inc, United States
54.193.83.224	0	361,474	361,474	16509	US	AMAZON-02 - Amazon.com, Inc, United States
54.219.130.114	0	345,080	345,080	16509	US	AMAZON-02 - Amazon.com, Inc, United States
54.183.145.224	0	338,949	338,949	16509	US	AMAZON-02 - Amazon.com, Inc, United States
54.193.11.144	0	334,725	334,725	16509	US	AMAZON-02 - Amazon.com, Inc, United States
220.128.227.81	0	326,208	326,208	3462	TW	HINET Data Communication Business Group, Taiwan
59.120.57.250	0	323,403	323,403	3462	TW	HINET Data Communication Business Group, Taiwan
86.82.68.237	0	321,396	321,396	1136	NL	KPN, Netherlands
64.89.232.86	0	317,115	317,115	17204	US	Nominum, Inc, United States

The Storers (and the totally deranged!)

Resolver	Current		Zombie		Zombie	ASN	CC	AS Name
	Uniques	Repeats	Uniques	Repeats	Repeat Ratio			
74.205.176.249	3,238	10,501,108	724	876,780,601	1,211,023	53618	CA	Aditya Birla Minacs Worldwide, Canada
204.184.141.253	2,495	35,034,545	572	600,739,995	1,050,244	2572	US	MOREnet, United States
186.151.28.130	926	3,978,931	6,462	4,704,634,886	728,046	14754	GT	Telgua, Guatemala
74.205.162.254	345	2,167,441	411	202,079,128	491,676	14214	CA	MINACS - Minacs, Canada
87.236.233.178	8,201	14,435,262	3,094	1,019,572,525	329,532	35656	JO	JUNET Jordanian Universities, Jordan
209.173.47.77	136	495,700	11	3,338,108	303,464	18474	US	Aeneas Internet Services, United States
115.249.45.34	37	265,058	12	3,154,574	262,881	18101	IN	Reliance Communications, India
200.195.185.205	74	93,986	218	40,534,251	185,936	14868	BR	COPEL Telecom, Brazil
195.53.128.4	215	70,442	1	138,326	138,326	31418	ES	SOGECABLE, Spain
50.203.18.22	223	1,946,242	6	668,671	111,445	7922	US	Comcast, United States
197.215.152.195	13,830	37,012,512	1,408	142,438,304	101,163	37558	LY	LITC, Libya
201.94.158.33	98	347,644	17	1,522,810	89,577	28625	BR	Terremark do Brasil, Brazil
38.95.167.66	75	242,166	6	436,269	72,711	174	US	Cogent Communications, United States
46.174.164.4	93	785,915	6	435,973	72,662	39742	UA	ITM IT-MARK, Ukraine
167.102.229.7	612	99,122	58	3,729,929	64,309	27026	US	NETWORKMARYLAND, United States
87.236.232.5	54,998	5,819,430	5,634	258,275,972	45,842	35656	JO	JUNET Jordanian Universities, Jordan
217.108.239.47	12	55,886	39	1,731,390	44,394	3215	FR	AS3215 Orange, France
217.108.239.58	68	57,215	39	1,727,063	44,283	3215	FR	AS3215 Orange, France
167.102.229.10	6,823	1,634,688	505	19,286,366	38,190	27026	US	NETWORKMARYLAND, United States
67.51.123.126	57	239,777	5	150,976	30,195	7385	US	Integra Telecom, United States
89.207.162.2	670	16,443	1	28,921	28,921	41383	GB	WOLASN Wolseley, United Kingdom
187.7.128.5	0	0	18	444,244	24,680	8167	BR	Brasil Telecom, Brazil
41.63.166.180	14	4,696	4	94,524	23,631	36907	AO	TVCaboAngola, Angola
216.195.101.101	189	358,403	9	201,797	22,421	33481	US	BELWAVE COMMUNICATIONS, United States
212.118.102.114	94	223,292	3	66,067	22,022	34397	SA	Cyberia Riyadh, Saudi Arabia
200.111.157.10	41	53,333	183	3,690,776	20,168	6471	CL	ENTEL, Chile
12.13.190.116	14	1,890	8	137,972	17,246	7018	US	ATT-INTERNET4, United States
98.142.39.194	19	484,707	2	30,221	15,110	25899	US	LS Networks, United States of America
200.3.214.69	5	3,536	16	193,635	12,102	17126	CL	E-money, Chile
84.17.5.235	42	195,941	13	152,705	11,746	8359	RU	MTS MTS PJSC, Russian Federation

We can use this...

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!