PUT 2019 : “Fearless, 1000 days and still running...”

Camille Akmut

Abstract

A combination of our previous research on the Tor network for PUT 2019 (the ‘small conference’ before PETS). Including additions.

Fearless, 1000 days and still running...
Tor's most resilient exit nodes and oldest relays

Carroll Annals

Abstract

We make use of results to identify what is the most resilient network nodes as well as the "object" subject to the network, and so gain an insight into their characteristics to particular their design.

Topics: network resilience, network diversity

Most resilient exit nodes

- Criteria
 - The relay is on an exit node.
 - The host was involved for at least 1000 days.
 - The end node is running.
- Query
 - Repeat running from that, user_days 1000-2000

(and it could be "userless")
<https://irclog.greynix.net/channel/irc/2016-07-01>

2. Results

ID#	Number of exit nodes average	User involved	Total Sessions
London	2	1	113/10%
Paris	2	1	113/10%
Amsterdam	2	1	113/10%
Frankfurt	2	1	113/10%
London	2	1	113/10%

Notes: 1. Total number and nodes of the network, and consistent IP.

[illegible]

Oldest relays

1. Criteria

Here all relays were considered: virtual and real nodes, entry guards, C, DNS, Icmp, Tor, bridges, most of their old and new addresses. Our criteria were: 1) 100% of the 100% of the relay's exit capacity and present status (working).

2. Query

running from 9/11/2009 until 2/25/2010

IP	number of relay messages	status
194.10.10.1	7	OK (100%)
194.10.10.2	28	OK (100%)
194.10.10.3	28	OK (100%)
194.10.10.4	27	OK (100%)
194.10.10.5	27	OK (100%)

3. Software: The relay and exit nodes were Tor.

Hardware / group

Hardware / group	number of relays	status
Intel / America	graph	40 (100%)
Intel / Europe	graph	1 (100%)
Intel / Asia	graph	1 (100%)
Intel / Oceania	graph	1 (100%)
Intel / Africa	graph	1 (100%)
Intel / Middle East	graph	1 (100%)
Intel / South America	graph	1 (100%)
Intel / Europe	graph	1 (100%)
Intel / Asia	graph	1 (100%)
Intel / Oceania	graph	1 (100%)
Intel / Africa	graph	1 (100%)
Intel / Middle East	graph	1 (100%)
Intel / South America	graph	1 (100%)
Intel / Europe	graph	1 (100%)
Intel / Asia	graph	1 (100%)
Intel / Oceania	graph	1 (100%)
Intel / Africa	graph	1 (100%)
Intel / Middle East	graph	1 (100%)
Intel / South America	graph	1 (100%)
Intel / Europe	graph	1 (100%)
Intel / Asia	graph	1 (100%)
Intel / Oceania	graph	1 (100%)
Intel / Africa	graph	1 (100%)
Intel / Middle East	graph	1 (100%)
Intel / South America	graph	1 (100%)
Intel / Europe	graph	1 (100%)
Intel / Asia	graph	1 (100%)
Intel / Oceania	graph	1 (100%)
Intel / Africa	graph	1 (100%)
Intel / Middle East	graph	1 (100%)
Intel / South America	graph	1 (100%)
Intel / Europe	graph	1 (100%)
Intel / Asia	graph	1 (100%)
Intel / Oceania	graph	1 (100%)
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Intel / Middle East	graph	1 (100%)
Intel / South America	graph	1 (100%)
Intel / Europe	graph	1 (100%)
Intel / Asia	graph	1 (100%)
Intel / Oceania	graph	1 (100%)
Intel / Africa	graph	1 (100%)
Intel / Middle East	graph	1 (100%)
Intel / South America	graph	1 (100%)
Intel / Europe	graph	1 (100%)
Intel / Asia	graph	1 (100%)
Intel / Oceania	graph	1 (100%)
Intel / Africa	graph	1 (100%)
Intel / Middle East	graph	1 (100%)
Intel / South America	graph	1 (100%)
Intel / Europe	graph	1 (100%)
Intel / Asia	graph	1 (100%)
Intel / Oceania	graph	1 (100%)
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Intel / Middle East	graph	1 (100%)
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Intel / Oceania	graph	1 (100%)
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Intel / Europe	graph	1 (100%)
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Intel / Middle East	graph	1 (100%)
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Intel / Europe	graph	1 (100%)
Intel / Asia	graph	1 (100%)
Intel / Oceania	graph	1 (100%)
Intel / Africa	graph	1 (100%)
Intel / Middle East	graph	1 (100%)

Fearless, 1000 days and still running...
Tor's most resilient exit nodes and oldest relays

Abstract

We make use of metrics to identify what we call the most resilient end nodes as well as the "vulnerable" nodes of the network, and to gain an insight into their characteristics (in particular their ISP's).

Topics: network resilience, network diversity.

Most resilient end nodes

- Criteria
 - The relay is an end node.
 - The end node has been used for at least 1000 days.
 - The end node is running.
- Query

Find end running time first, then: 1000-100000
(that is not for yourself) <https://www.ripe.net/lookup/origin/asn>
- Results

ASN	Number of end nodes running time "most resilient"	Total bandwidth
AS161	20	133 Gbit/s
AS754	20	133 Gbit/s
AS13335	20	133 Gbit/s
AS15169	20	133 Gbit/s
AS15558	20	133 Gbit/s
AS15559	20	133 Gbit/s
AS15560	20	133 Gbit/s
AS15561	20	133 Gbit/s
AS15562	20	133 Gbit/s
AS15563	20	133 Gbit/s
AS15564	20	133 Gbit/s
AS15565	20	133 Gbit/s
AS15566	20	133 Gbit/s
AS15567	20	133 Gbit/s
AS15568	20	133 Gbit/s
AS15569	20	133 Gbit/s
AS15570	20	133 Gbit/s
AS15571	20	133 Gbit/s
AS15572	20	133 Gbit/s
AS15573	20	133 Gbit/s
AS15574	20	133 Gbit/s
AS15575	20	133 Gbit/s
AS15576	20	133 Gbit/s
AS15577	20	133 Gbit/s
AS15578	20	133 Gbit/s
AS15579	20	133 Gbit/s
AS15580	20	133 Gbit/s
AS15581	20	133 Gbit/s
AS15582	20	133 Gbit/s
AS15583	20	133 Gbit/s
AS15584	20	133 Gbit/s
AS15585	20	133 Gbit/s
AS15586	20	133 Gbit/s
AS15587	20	133 Gbit/s
AS15588	20	133 Gbit/s
AS15589	20	133 Gbit/s
AS15590	20	133 Gbit/s
AS15591	20	133 Gbit/s
AS15592	20	133 Gbit/s
AS15593	20	133 Gbit/s
AS15594	20	133 Gbit/s
AS15595	20	133 Gbit/s
AS15596	20	133 Gbit/s
AS15597	20	133 Gbit/s
AS15598	20	133 Gbit/s
AS15599	20	133 Gbit/s
AS15600	20	133 Gbit/s
AS15601	20	133 Gbit/s
AS15602	20	133 Gbit/s
AS15603	20	133 Gbit/s
AS15604	20	133 Gbit/s
AS15605	20	133 Gbit/s
AS15606	20	133 Gbit/s
AS15607	20	133 Gbit/s
AS15608	20	133 Gbit/s
AS15609	20	133 Gbit/s
AS15610	20	133 Gbit/s
AS15611	20	133 Gbit/s
AS15612	20	133 Gbit/s
AS15613	20	133 Gbit/s
AS15614	20	133 Gbit/s
AS15615	20	133 Gbit/s
AS15616	20	133 Gbit/s
AS15617	20	133 Gbit/s
AS15618	20	133 Gbit/s
AS15619	20	133 Gbit/s
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AS15621	20	133 Gbit/s
AS15622	20	133 Gbit/s
AS15623	20	133 Gbit/s
AS15624	20	133 Gbit/s
AS15625	20	133 Gbit/s
AS15626	20	133 Gbit/s
AS15627	20	133 Gbit/s
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AS15629	20	133 Gbit/s
AS15630	20	133 Gbit/s
AS15631	20	133 Gbit/s
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AS15640	20	133 Gbit/s
AS15641	20	133 Gbit/s
AS15642	20	133 Gbit/s
AS15643	20	133 Gbit/s
AS15644	20	133 Gbit/s
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AS15659	20	133 Gbit/s
AS15660	20	133 Gbit/s
AS15661	20	133 Gbit/s
AS15662	20	133 Gbit/s
AS15663	20	133 Gbit/s
AS15664	20	133 Gbit/s
AS15665	20	133 Gbit/s
AS15666	20	133 Gbit/s
AS15667	20	133 Gbit/s
AS15668	20	133 Gbit/s
AS15669	20	133 Gbit/s
AS15670	20	133 Gbit/s

[illegible]

Oldest relays

1. Criteria

Here is what relays were considered – whether end nodes, relay quality, or other, (except bidders, most of them close to me geographically)

Our criteria were: age (10 years, or 1025 days, of minimum existence) and present status (Working)

2. Query

```
running_top_first_seen_days:10000
```

id	number of relays	status	lastrelay
0x016a	3	OK	0x016a016a
0x016b	10	OK	0x016b016b
0x016c	1	OK	0x016c016c
0x016d	1	OK	0x016d016d

Note: 1 is "Relay not connected or no relay"

category / group	relays accepted	lastrelay
Relays > 100 relays	100	0x016a016a
Relays 10-100 relays	100	0x016b016b
Relays 1-10 relays	100	0x016c016c
Relays 0-1 relays	100	0x016d016d
Relays 0-1 relays	100	0x016e016e
Relays 0-1 relays	100	0x016f016f
Relays 0-1 relays	100	0x01700170
Relays 0-1 relays	100	0x01710171
Relays 0-1 relays	100	0x01720172
Relays 0-1 relays	100	0x01730173
Relays 0-1 relays	100	0x01740174
Relays 0-1 relays	100	0x01750175
Relays 0-1 relays	100	0x01760176
Relays 0-1 relays	100	0x01770177
Relays 0-1 relays	100	0x01780178
Relays 0-1 relays	100	0x01790179
Relays 0-1 relays	100	0x017a017a
Relays 0-1 relays	100	0x017b017b
Relays 0-1 relays	100	0x017c017c
Relays 0-1 relays	100	0x017d017d
Relays 0-1 relays	100	0x017e017e
Relays 0-1 relays	100	0x017f017f
Relays 0-1 relays	100	0x01800180
Relays 0-1 relays	100	0x01810181
Relays 0-1 relays	100	0x01820182
Relays 0-1 relays	100	0x01830183
Relays 0-1 relays	100	0x01840184
Relays 0-1 relays	100	0x01850185
Relays 0-1 relays	100	0x01860186
Relays 0-1 relays	100	0x01870187
Relays 0-1 relays	100	0x01880188
Relays 0-1 relays	100	0x01890189
Relays 0-1 relays	100	0x018a018a
Relays 0-1 relays	100	0x018b018b
Relays 0-1 relays	100	0x018c018c
Relays 0-1 relays	100	0x018d018d
Relays 0-1 relays	100	0x018e018e
Relays 0-1 relays	100	0x018f018f
Relays 0-1 relays	100	0x01900190
Relays 0-1 relays	100	0x01910191
Relays 0-1 relays	100	0x01920192
Relays 0-1 relays	100	0x01930193
Relays 0-1 relays	100	0x01940194
Relays 0-1 relays	100	0x01950195
Relays 0-1 relays	100	0x01960196
Relays 0-1 relays	100	0x01970197
Relays 0-1 relays	100	0x01980198
Relays 0-1 relays	100	0x01990199
Relays 0-1 relays	100	0x019a019a
Relays 0-1 relays	100	0x019b019b
Relays 0-1 relays	100	0x019c019c
Relays 0-1 relays	100	0x019d019d
Relays 0-1 relays	100	0x019e019e
Relays 0-1 relays	100	0x019f019f
Relays 0-1 relays	100	0x01a001a0
Relays 0-1 relays	100	0x01a101a1
Relays 0-1 relays	100	0x01a201a2
Relays 0-1 relays	100	0x01a301a3
Relays 0-1 relays	100	0x01a401a4
Relays 0-1 relays	100	0x01a501a5
Relays 0-1 relays	100	0x01a601a6
Relays 0-1 relays	100	0x01a701a7
Relays 0-1 relays	100	0x01a801a8
Relays 0-1 relays	100	0x01a901a9
Relays 0-1 relays	100	0x01aa01aa
Relays 0-1 relays	100	0x01ab01ab
Relays 0-1 relays	100	0x01ac01ac
Relays 0-1 relays	100	0x01ad01ad
Relays 0-1 relays	100	0x01ae01ae
Relays 0-1 relays	100	0x01af01af
Relays 0-1 relays	100	0x01b001b0
Relays 0-1 relays	100	0x01b101b1
Relays 0-1 relays	100	0x01b201b2
Relays 0-1 relays	100	0x01b301b3
Relays 0-1 relays	100	0x01b401b4
Relays 0-1 relays	100	0x01b501b5
Relays 0-1 relays	100	0x01b601b6
Relays 0-1 relays	100	0x01b701b7
Relays 0-1 relays	100	0x01b801b8
Relays 0-1 relays	100	0x01b901b9
Relays 0-1 relays	100	0x01ba01ba
Relays 0-1 relays	100	0x01bb01bb
Relays 0-1 relays	100	0x01bc01bc
Relays 0-1 relays	100	0x01bd01bd
Relays 0-1 relays	100	0x01be01be
Relays 0-1 relays	100	0x01bf01bf
Relays 0-1 relays	100	0x01c001c0
Relays 0-1 relays	100	0x01c101c1
Relays 0-1 relays	100	0x01c201c2
Relays 0-1 relays	100	0x01c301c3
Relays 0-1 relays	100	0x01c401c4
Relays 0-1 relays	100	0x01c501c5
Relays 0-1 relays	100	0x01c601c6
Relays 0-1 relays	100	0x01c701c7
Relays 0-1 relays	100	0x01c801c8
Relays 0-1 relays	100	0x01c901c9
Relays 0-1 relays	100	0x01ca01ca
Relays 0-1 relays	100	0x01cb01cb
Relays 0-1 relays	100	0x01cc01cc
Relays 0-1 relays	100	0x01cd01cd
Relays 0-1 relays	100	0x01ce01ce
Relays 0-1 relays	100	0x01cf01cf
Relays 0-1 relays	100	0x01d001d0
Relays 0-1 relays	100	0x01d101d1
Relays 0-1 relays	100	0x01d201d2
Relays 0-1 relays	100	0x01d301d3
Relays 0-1 relays	100	0x01d401d4
Relays 0-1 relays	100	0x01d501d5
Relays 0-1 relays	100	0x01d601d6
Relays 0-1 relays	100	0x01d701d7
Relays 0-1 relays	100	0x01d801d8
Relays 0-1 relays	100	0x01d901d9
Relays 0-1 relays	100	0x01da01da
Relays 0-1 relays	100	0x01db01db
Relays 0-1 relays	100	0x01dc01dc
Relays 0-1 relays	100	0x01dd01dd
Relays 0-1 relays	100	0x01de01de
Relays 0-1 relays	100	0x01df01df
Relays 0-1 relays	100	0x01e001e0
Relays 0-1 relays	100	0x01e101e1
Relays 0-1 relays	100	0x01e201e2
Relays 0-1 relays	100	0x01e301e3
Relays 0-1 relays	100	0x01e401e4
Relays 0-1 relays	100	0x01e501e5
Relays 0-1 relays	100	0x01e601e6
Relays 0-1 relays	100	0x01e701e7
Relays 0-1 relays	100	0x01e801e8
Relays 0-1 relays	100	0x01e901e9
Relays 0-1 relays	100	0x01ea01ea
Relays 0-1 relays	100	0x01eb01eb
Relays 0-1 relays	100	0x01ec01ec
Relays 0-1 relays	100	0x01ed01ed
Relays 0-1 relays	100	0x01ee01ee
Relays 0-1 relays	100	0x01ef01ef
Relays 0-1 relays	100	0x01f001f0
Relays 0-1 relays	100	0x01f101f1
Relays 0-1 relays	100	0x01f201f2
Relays 0-1 relays	100	0x01f301f3
Relays 0-1 relays	100	0x01f401f4
Relays 0-1 relays	100	0x01f501f5
Relays 0-1 relays	100	0x01f601f6
Relays 0-1 relays	100	0x01f701f7
Relays 0-1 relays	100	0x01f801f8
Relays 0-1 relays	100	0x01f901f9
Relays 0-1 relays	100	0x01fa01fa
Relays 0-1 relays	100	0x01fb01fb
Relays 0-1 relays	100	0x01fc01fc
Relays 0-1 relays	100	0x01fd01fd
Relays 0-1 relays	100	0x01fe01fe
Relays 0-1 relays	100	0x01ff01ff

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96.00 x 48.00 inch
3 approx. A0

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(accepted 06/26)
PUT and PETS 2019, July 15-20, Stockholm, KTH.

Fearless, Tor's most res

Camille Akmut

Abstract

We make use of metrics to identify what we call 'the most resilient' exit nodes as well as the 'oldest' relays of the Tor network, and so gain an insight into their characteristics (in particular their ISP's).

Topics : network resilience, network diversity.

Most resilient exit nodes

1. Criteria

- The relay is an exit node,
- The exit node has existed for at least 1000 days,
- The exit node is running.

2. Query

flag:exit running:true first_seen_days:1000-10000

(test it out for yourself : <https://metrics.torproject.org/rs.html>)

3. Results

ISP	Number of exit nodes amongst 'most resilient'	Total bandwidth
OVH	10	155 MiB/s
Leaseweb	3	118 MiB/s
NForce	3	89 MiB/s
Online	6	53 MiB/s
Bahnhof	1	38 MiB/s
Flokinet	6	22 MiB/s

Table 1: Most resilient exit nodes of the Tor network and commercial ISP's.

1000 days and still resilient exit nodes and

ISP / org.	Number of exit nodes amongst 'most resilient'	Total bandwidth
Zwiebelfreunde E.V.	12	490 MiB/s
Calyx Institute	13	163 MiB/s
Tetaneutral.net	2	107 MiB/s
DFRI	5	105 MiB/s

Table 2: Most resilient Tor exit nodes and non-commercial ISP's, organizations.

I forgot to include Frënn vun der Ënn (enn.lu)!

They run tollana, kree and ori -- 3 major, major 'most resilient' exits (c. 100 MiB/s).

4. Recommendations + bonus ('umbrella' relay config)

As the association *Nos oignons* – two of the largest 'most resilient' exit nodes – point out the Tor network suffers from what they call a problem of "diversity", understood in the following specific sense :

(...) a big majority of Tor relays are hosted at OVH, Online and Hetzner, three leaders in cheap, mainstream hosting.

With the algorithm currently used by Tor to determine routes or circuits between relays, it would unfortunately be enough to compromise these three companies to gain a considerable overview of the network, and make it easy to launch attacks on users with the goal of de-anonymization.

By choosing other ISP's, we contribute to improve the Tor network's quality : the more relays are hosted with other providers, the harder it gets to conduct a global surveillance of the network, the better its security.⁵

Dockerfile

```
FROM debian:9-slim
RUN apt-get update
RUN apt-get install -y tor
COPY torrc /etc/tor/
EXPOSE 443 #9001
RUN adduser user
USER user
CMD ["tor"]
```

torrc (example from the Tor Project)

```
ORPort 443
Exitpolicy reject *:~
BridgeRelay 1
```

running...

oldest relays

Oldest relays

1. Criteria

Here *all* relays were considered : whether exit nodes, entry guards, or else. (except bridges, most of their data is not public))
Our criteria were : age (5 years, or 1825 days, of minimum existence) and present status ('running').

2. Query

running:true first_seen_days:1825-10000

ISP	number of relays amongst 'oldest'	bandwith
Online	7	143 MiB/s
Hetzner	13	135 MiB/s
OVH	10	84 MiB/s
XS4ALL	2	40 MiB/s
Bahnhof	1	38 MiB/s
myLoc	2	26 MiB/s

Table 1: 'oldest' Tor relays and commercial ISP's.

University / group	relays amongst 'oldest'	bandwidth
University of Waterloo	gurgle	40 MiB/s
MIT (CSAIL)	csailmitnoexit	18 MiB/s
Stanford	everfailed	12 MiB/s
University of Washington	UWashingtonCSE	6 MiB/s
Boston University	BostonUCompSci	5 MiB/s
UNC	ibibUNCO	5 MiB/s
CMU	cmutornode	3 MiB/s

Table 2: universities and 'oldest' Tor relays.

Full research

<https://hcommons.org/members/cami/>

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