

ICANN | RSSAC

Root Server System Advisory Committee

29 January 2018

Subject: RSSAC031: Response to the GNSO Policy Development Process (PDP) Working Group on the new Generic Top Level Domains (gTLDs) Subsequent Procedures

To: Avri Doria and Jeff Neuman (Working Group Co-Chairs)

On 14 September 2017, the co-chairs of the GNSO Policy Development Process (PDP) Working Group on the new generic Top-Level Domains (gTLDs) Subsequent Procedures requested input from RSSAC, SSAC, the Office of the CTO and the Global Domains Division on root scaling. The RSSAC understands the questions to be:

1. whether the limitations on delegations per annum (1000 / year) could be revisited given the results of the Continuous Data-driven Analysis of Root Stability (CDAR)¹ study and if so, what guidance can RSSAC provide to maintain the security and stability of the root;
2. suggestions on ways that might mitigate potential issues in the event the working group recommends increasing the maximum annual delegation rate; and
3. inputs on the total number of TLDs that could be delegated without negative impact to root server performance.

The RSSAC's past advice on root scaling includes:

- RSSAC Comments on Root Scaling, 25 November 2010²
- RSSAC002: Advisory on Measurements of the Root Server System (v1,³ v2,⁴ v3⁵).
- RSSAC022: Response to the GNSO Policy Development Process (PDP) Working Group on the new Generic Top Level Domains (gTLDs) Subsequent Procedures.⁶

In particular, RSSAC002 measurements have been implemented by all root server operators, thus fulfilling the request by the ICANN Board resolution on root scaling⁷ (which in turn was largely a response to that previous advice regarding monitoring of the root server system). RSSAC002 has been revised several times in light of deployment experience, and the RSSAC expects to

¹ See <https://www.icann.org/en/system/files/files/cdar-root-stability-final-08mar17-en.pdf>

² See <https://www.icann.org/en/system/files/files/murai-to-board-25nov10-en.pdf>

³ See <https://www.icann.org/en/system/files/files/rssac-002-20nov14-en.pdf>

⁴ See <https://www.icann.org/en/system/files/files/rssac-002-measurements-root-07jan16-en.pdf>

⁵ See <https://www.icann.org/en/system/files/files/rssac-002-measurements-root-06jun16-en.pdf>

⁶ See <https://www.icann.org/en/system/files/files/rssac-022-response-newgtld-06oct16-en.pdf>

⁷ See <https://www.icann.org/resources/board-material/resolutions-2010-09-25-en#2.3>

continue to refine the type and precision of root server data. Furthermore, the RSSAC002 measurement data is publicly available and has been used by researchers^{8,9,10} to advance understanding of the functioning of the root servers; the RSSAC expects this to continue as well.

On the specific questions, the RSSAC offers the following advice. First, regarding the limitations on delegations per annum, the RSSAC advises that:

- Delegations “per annum” is the wrong way to think about the problem because it could lead to very sudden changes depending on its implementation. It would be better to think in terms of changes over smaller periods of time (e.g., monthly).
- The rate of change is more important than absolute magnitude. Based on historical trends since 2014 and our operational experiences, the RSSAC strongly recommends that the number of TLDs delegated in the root zone should not increase by more than about 5% per month, with the understanding that there may be minor variations from time-to-time. The Appendix provides some data and context for this recommendation.
- It is important to note that stability also depends on other factors which are not directly related to the size or growth rate of the root zone, especially the “churn” rate of the content within the root zone. It has been the case for many years that the root zone changes on a very infrequent basis compared to other zones. The root zone is different than other zones, and special to the stability of the Internet. This lower potential “churn” in the root zone has added to the security, stability and resiliency of the DNS by ensuring operational predictability.
- It is also the case that the root zone is stable in part because only a very restricted set of DNS record types are allowed and changes to that set are carefully considered. In the past, decisions to add IPv6 address records (AAAA) and DNSSEC types (e.g., DS, NSEC) were deliberated at length. This conservatism is appropriate, given that trouble-free access to the root zone is one of the very few things that is critical for all Internet users, and should be honored in future new gTLD rounds.
- The working group inquiry suggests the possibility of adding between 10,000 and 25,000 more TLDs to the root zone over some period of time, with “streamlined” review of applications. While there are many DNS zones larger than this, the root zone is uniquely a shared resource upon which all Internet users rely. For this reason, the RSSAC believes it will continue to be important to limit the rate of addition of new gTLDs as described above, and preserve the current restrictions on update rates for the root zone, unless the RSSAC has a chance to review specific proposed changes to these restrictions in advance.

Second, regarding ways to mitigate potential issues, the RSSAC advises that:

⁸ Moura, Giovane, et al. "Anycast vs. DDoS: evaluating the November 2015 root DNS event." Proceedings of the 2016 ACM on Internet Measurement Conference. ACM, 2016.

⁹ Moura, Giovane CM, et al. "Anycast vs. DDoS: Evaluating the November 2015 Root DNS Event (extended)

¹⁰ See <https://www.icann.org/en/system/files/files/cdar-root-stability-final-08mar17-en.pdf>

- Root zone management partners and root server operators can leverage existing relationships and communication channels to notify ICANN in the event of stress on the root name service.
- If significant and unexpected problems arise, it may be necessary to temporarily suspend the addition of new gTLDs in order to maintain the stability of the root name service.
- ICANN should structure its obligations to new gTLD registries so that it can delay their addition to the root zone in case of root name service instabilities or remove a recently delegated TLD that is shown to be the cause of problems.
- Work done to date by the RSSAC and the root server operators has greatly expanded the amount and consistency of publicly available data on the root servers (see above on RSSAC002). However, as the system evolves, there remains work to be done on defining, collecting, and interpreting data that would reflect the functioning of the Root Server System as a whole, in addition to data on individual servers or operators. The ICANN organization should, in consultation with the community, coordinate further efforts among the root zone management partners and the root server operators to develop an early warning system for the Root Server System as an aggregate, in order to ensure we have the ability to detect issues as early as possible.

Third, regarding the total number of TLDs that could be delegated without negative impact to root server performance, the RSSAC advises that:

- Creating a large number of new TLDs has the effect of flattening the namespace. Traffic could be pushed towards the root of the tree, which potentially creates a different shape of the database and traffic patterns. The impact on caching behavior in particular could potentially result in higher resource utilization for DNS servers at high levels of the tree. Whether such a trend impacts the stability of the whole system, the RSSAC does not know at this point, but this is an area worth studying.
- The referenced CDAR study showed that the impact of the past addition of new TLDs to the Root Server System was minimal, but also advised, "... the rate of new gTLD delegations should remain gradual." The RSSAC agrees with this conclusion.
- Furthermore, the CDAR study (understandably) could only look at past data available for queries to the Root Server System and showed that popularity of the new TLDs was still rather low, and thus the query rates to the Root Server System for those new TLDs are correspondingly low. However, popularity and increased use of new technologies typically lag behind deployment. Therefore, it is a significant challenge to define a "safe" total number of new TLDs without basing the results on a study that attempts to predict the load of associated TLDs. Put more simply, there is a vast difference between adding TLDs to the root zone that go mostly unused versus adding TLDs that become as popular as .com, .net or .org (the three most popular TLDs from Table 3 in the CDAR study).

Please do not hesitate to contact the RSSAC for clarification or further information.

Best Regards
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Co-Chairs, Root Server System Advisory Committee

Appendix

This appendix contains graphs based on historical data and future predictions of root zone growth. The data comes from the Domain Name System Operations Analysis and Research Center's (DNS-OARC) Root Zone Archive¹¹. The RSSAC would like to thank DNS-OARC for providing this data and giving permission to include it here.

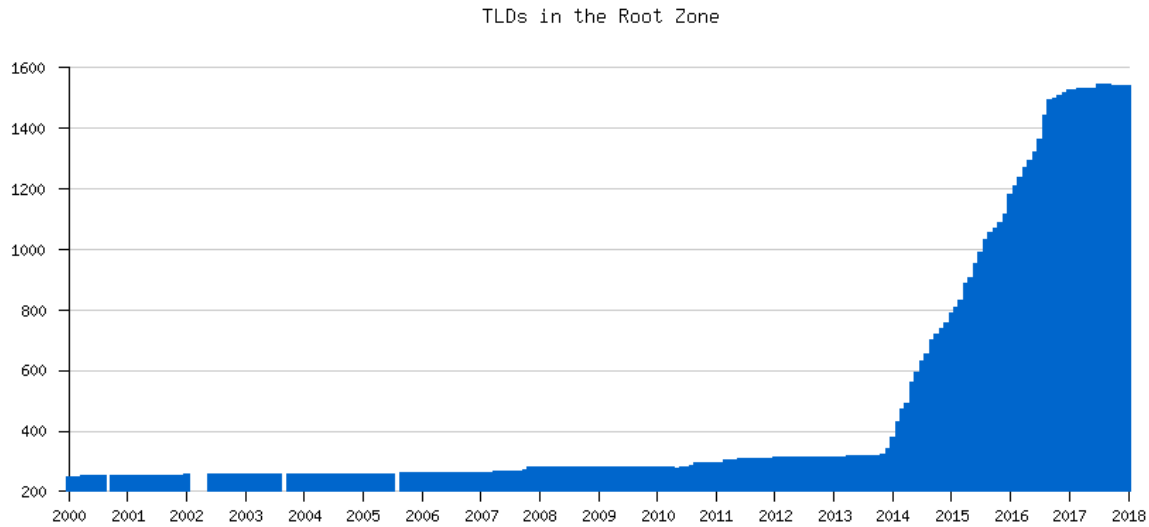


Figure 1: This shows the total number of TLDs in the root zone from 2000-2018.

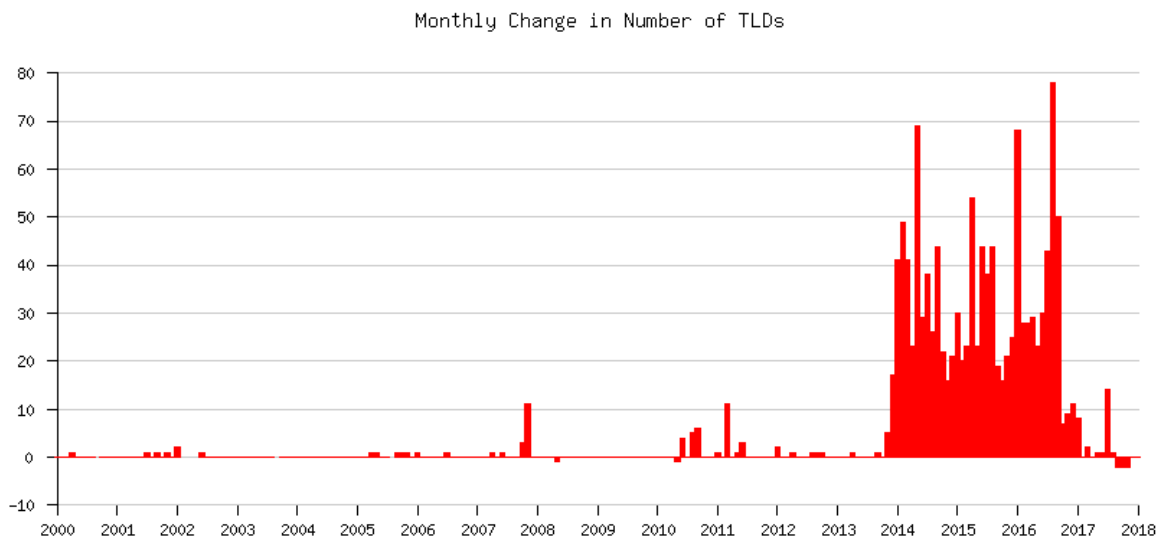


Figure 2: This shows the absolute change in TLD count. Between 2014 and 2017 the root zone added 20-70 TLDs per month.

¹¹ <https://www.dns-oarc.net/oarc/data/zfr/root>

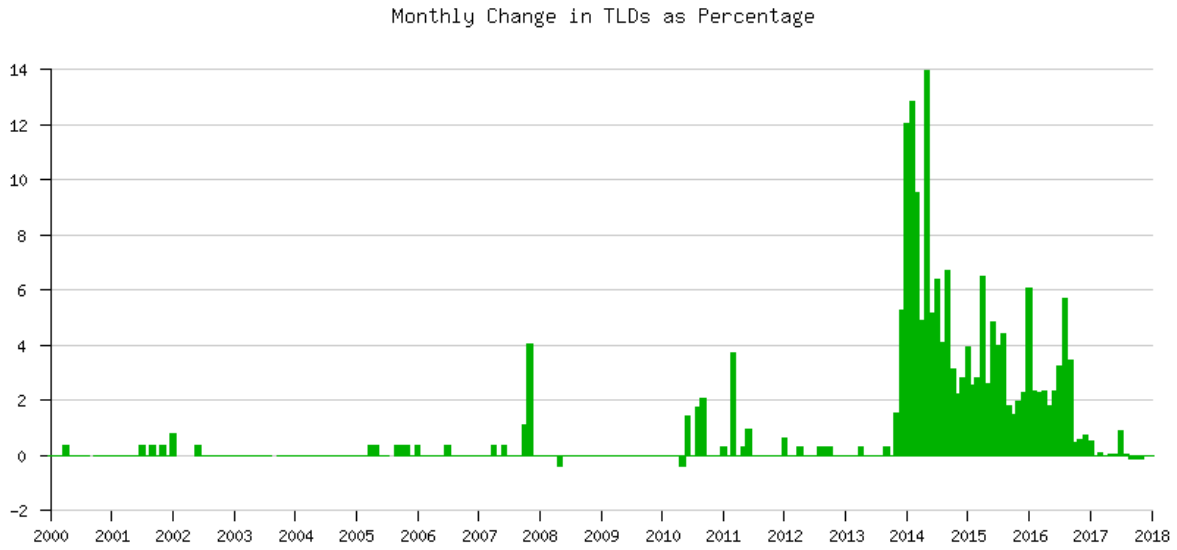


Figure 3: This shows changes in the number of TLDs as a percentage. After the initial wave in early 2014, monthly growth was typically around 2-3%.

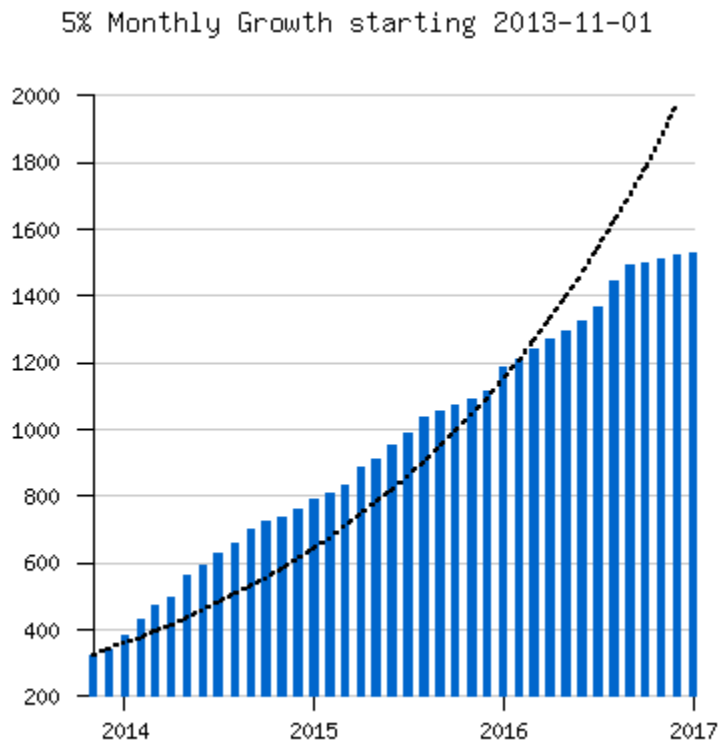


Figure 4: Here a theoretical growth curve of 5% per month is superimposed on the historical 2014-2017 data.

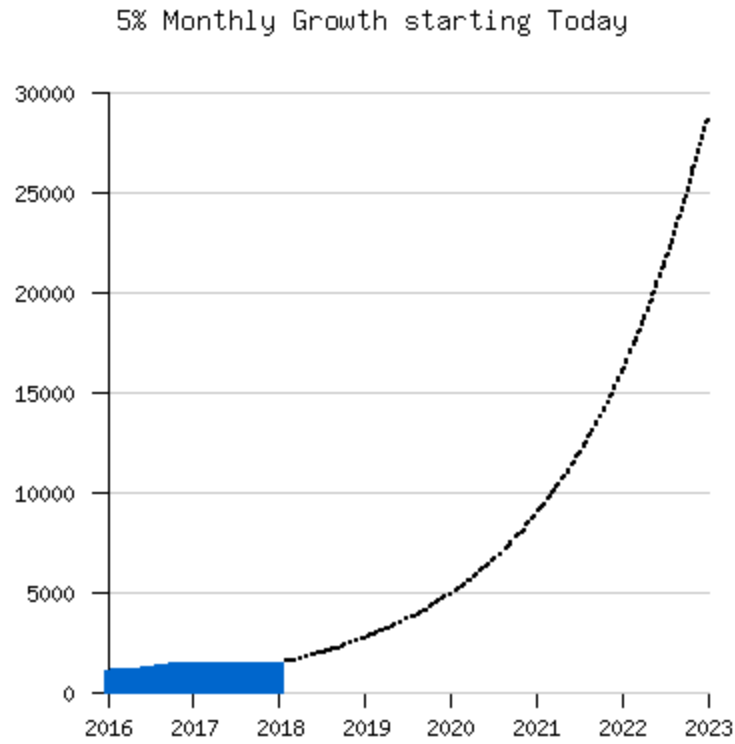


Figure 5: This shows what a steady rate of 5% monthly growth would look like over the next five years (2018-2023). If 5% monthly growth were steadily achieved over this period we would end up with a little under 30,000 TLDs.