Recommendations for Early Warning for Root Zone Scaling

ICANN Office of the Chief Technology Officer

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This revision contains updates from many people who reviewed OCTO-015v1 as part of the Public Comment period.[1] ICANN greatly appreciates these reviews.

This document supports ICANN's strategic goal to improve the shared responsibility for upholding the security and stability of the DNS by strengthening DNS coordination in partnership with relevant stakeholders. It is part of ICANN's strategic objective to strengthen the security of the DNS and the DNS root server system.

[1] See https://www.icann.org/public-comments/recommendations-early-warning-root-scaling-2020-10-05-en

1 Introduction

A decade ago, it became clear to the community that the root zone might grow significantly larger due to the addition of many more generic top-level domains (gTLDs). Discussions in the community led to various concerns, including:

- A risk that the root server operators (RSOs) might not be able to handle the anticipated zone growth
- The Internet Assigned Numbers Authority (IANA) might become overwhelmed with requests for additions and changes to the root zone
- Recursive resolvers could run out of cache space
- Anti-abuse communities and law enforcement agencies could have trouble dealing with a greatly-increased number of new gTLDs
- ICANN processes could be severely impacted by the increased number of gTLDs

To mitigate these risks, ICANN stakeholders, including the Security and Stability Advisory Committee (SSAC), At-Large Advisory Committee (ALAC), and Governmental Advisory Committee (GAC), proposed an early warning system to alert the community that the growth of the root zone was proceeding too quickly. Discussions on what such a system would entail did not lead to the deployment of such a system due to a lack of agreement on what should be measured, and how those measurements could be made.

It is important to note that the topic of this document is the *rate of scaling* the root zone, not determining a *maximum size* for that zone. The RSOs as a group have not expressed any concern about a particular root zone size. However, the speed of additions and changes to the root zone might be an issue for RSOs that are not prepared.

This document describes the initial desire for an early warning system, outlines proposals that were ultimately abandoned, and details a new proposal for a non-technical means for providing an early warning that the root zone is growing too rapidly. The document assumes a medium amount of understanding of the root server system (RSS) and the various parties who manage it.

2 Background

In 2009, the ICANN Board asked for SSAC and the Root Server System Advisory Committee (RSSAC) to study the stability of the root zone as it scales up in size and increases in volatility.[2] The resulting report, “Delegation Rate Scenarios For New gTLDs”, was published in October 2010.[3] Many aspects of root zone operations were considered.[4] The report proposed that a system be established to alert the community if there were problems associated with root zone scaling.

Before the first large set of new top-level domain (TLD) additions to the root zone, SSAC issued SAC046, “Report of the Security and Stability Advisory Committee on Root Scaling”.[5] Part of

[2] See https://www.icann.org/resources/board-material/minutes-2009-02-03-en

[3] See https://www.icann.org/en/topics/new-gtlds/delegation-rate-scenarios-new-gtlds-06oct10-en.pdf

[4] See https://www.icann.org/resources/pages/root-scaling-study-tor-2009-05-05-en

[5] See https://www.icann.org/en/system/files/files/sac-046-en.pdf

that document recommends that ICANN collect "...actual measurement, monitoring, and data-sharing capability of root zone performance, in cooperation with RSSAC and other root zone management participants...". As described in the rest of this document, there were many attempts at fulfilling this recommendation.

In 2014, RSSAC responded to the desire for an early warning system with RSSAC002, "RSSAC Advisory on Measurements of the Root Server System".[6] The introduction states:

> "In response to a desire voiced by the ICANN Board, the RSSAC made a commitment to prepare for an implementation of an early warning system that shall assist in detecting and mitigating any effects (or the absence of such effects) which might challenge the scaling and/or normal performance of the Internet's DNS root server system caused by growth of the DNS root zone itself or the Internet's use of a larger root zone file - in any dimension."

RSSAC002 specified data that each RSO should collect, although there was no indication in the document how that data could be used to indicate that the root zone was scaling too quickly.

In 2017, after the new gTLD program that started in 2012 was well underway and the ICANN community was considering another round of additions, SSAC issued SAC100, "SSAC Response to the New gTLD Subsequent Procedures Policy Development Process Working Group Request Regarding Root Scaling".[7] One of the report's recommendations was that "ICANN should continue developing the monitoring and early warning capability with respect to root zone scaling".

Despite these recommendations, the DNS technical and security communities did not identify any such measurements that could be used in an early warning system. At ICANN66 in 2019 in Montréal, the ICANN organization solicited proposals from the technical community for such measurements, but the session did not yield any viable suggestions.[8]

3 Problems Associating Measurements with Scaling Issues

After a review by the technical community, none of the proposed measurements could be directly associated with scaling issues for the root zone (although there have been no formal reports on such reviews). This is true of both the internally visible measurements taken by the RSOs and the externally visible measurements that were proposed. Further, internal measurements, such as name server memory and router bandwidth consumption, could be perceived as highly invasive and might expose sensitive information.

Though not specifically designed to provide data that could be used to assess root zone scaling, RSSAC002 specifies five measurements that the RSOs report daily:

- The latency in publishing new zones after they come from IANA
- The number of queries the RSO receives

[6] See https://www.icann.org/en/system/files/files/rssac-002-20nov14-en.pdf

[7] See https://www.icann.org/en/system/files/files/sac-100-en.pdf

[8] See https://66.schedule.icann.org/meetings/1116870

- The distribution of the size of the queries
- The distribution of the types of the queries
- The number of addresses making the queries

Since RSSAC002's publication in 2014, it is generally agreed that the root zone has not scaled too quickly for the RSOs to handle. No one has suggested how to obtain a reliable signal from this data to indicate if the root zone is scaling too quickly. This seems particularly challenging given that the data shows a wide variability between RSOs and even within the anycast clouds of individual RSOs.

4 Getting Early Warning of Problems with Rate of Scaling the Root Zone

The rate of scaling of the root zone could impact many parts of the DNS ecosystem. This section describes how ICANN org can get alerts if the root zone is scaling too quickly. Proposals are based on the problems described in Section 3, particularly avoiding attempts to use imprecise technical measurements to get early warning of root zone scaling.

For all the proposals shown below, data that is collected for the early warning system must be collected, used, stored, and destroyed in accordance with the Internet users' right of privacy.

4.1 Root Server Operators

There are apparently no measurements, whether made externally or reported by the RSOs themselves, that would reliably indicate issues with root scaling that a third party could detect. Instead, the RSOs can periodically report if they perceive any scaling issues. ICANN org can ask each individual RSO annually whether that RSO has experienced any issues related to root zone scaling, or if they anticipate any such issues based on their individual testing. Each RSO is in the best position to understand its own infrastructure and processes in order to report on scaling issues. In addition, the RSOs know that they can report at any time between requests, which should be sufficient for providing an early warning about effects on the RSS.

Note that this focuses on problems seen in individual RSOs as potential early warnings of scaling issues for the entire RSS. If one waits for the RSOs as a whole to report scaling for the entire RSS, it would likely significantly delay significantly the warning being seen by the Internet community. RSSAC has discussed scaling the root zone in RSSAC022, and in greater detail, in RSSAC031. [9,10]

4.2 IANA Naming Function

One early concern with root zone scaling was that with many more TLDs, the IANA team would not be able to keep up with the day-to-day changes to the root zone (such as Name Server (NS) and Delegation Signer (DS) resource record changes). The IANA team can report each year to its Customer Standing Committee (CSC) whether they see any root zone scaling issues for the

[9] See https://www.icann.org/en/system/files/files/rssac-022-response-newgtld-06oct16-en.pdf
[10] See https://www.icann.org/en/system/files/files/rssac-031-02feb18-en.pdf

IANA team's processes. There is no expectation that the size of IANA's team would scale with the size of the root zone; the scaling of the size of the IANA team is not considered an early warning by itself. Having the IANA team report any scaling concerns at any time between requests will be sufficient for having an early warning about effects on the RSS.

4.3 Recursive Resolvers

Entries for TLDs occupy only a tiny portion of the caches in recursive resolvers. The rate of scaling of the root zone is likely unnoticeable to any production resolver operators. ICANN org can periodically ask a sample of resolver operators, both those active in ICANN and others (such as those in network operations communities), if they perceive any scaling issues.

4.4 Anti-Abuse Communities and Law Enforcement Agencies

ICANN org has extensive relationships with the many anti-abuse groups that relate to the DNS; it also has decades-long associations with law enforcement agencies. ICANN org can periodically ask those groups and agencies if they perceive any scaling issues.

4.5 ICANN Processes

The ICANN community tracks its own work levels fairly well. If the rate of scaling the root zone affects the ability for the ICANN community to do its work, the community itself will regulate the scaling of the root zone using normal policy processes.

5 Summary

Concerns about scaling the root zone led to efforts to create an early warning system based on technical measurements. Those efforts did not find any reliable measurements that could be used for such a system. Instead, it is recommended that the most reliable path forward is for periodic direct discussions with the groups that could be affected by root zone scaling issues, as described in Section 4.