

RSSAC0XX:

RSSAC Advisory on Rogue DNS Root Server Operators

A Report from the ICANN Root Server System Advisory Committee (RSSAC)

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Preface

RSSAC Advisory on Rogue DNS Root Server Operators

In this report, the ICANN Root Server System Advisory Committee (RSSAC) examines measurable and subjective root server operator (RSO) activities that could be considered rogue. The purpose of this document is to inform future Root Server System (RSS) governance bodies on types of RSO activity that might be considered rogue and the risks that these activities may pose to the Internet community. Future RSS governance bodies may use this document for developing a more complete definition of rogue RSO actions and will ultimately be the authority in determining subjective factors, such as intent, when judging the actions of an RSO. The audience of this report is the Board of Directors of the Internet Corporation for Assigned Names and Numbers (ICANN), the future root server system governance body, and more broadly, the Internet community.

The RSSAC advises the ICANN community and Board on matters relating to the operation, administration, security, and integrity of the Internet's Root Server System. It has the following responsibilities:

1. Communicate on matters relating to the operation of the Root Servers and their multiple instances with the Internet technical community and the ICANN community.
2. Communicate on matters relating to the administration of the Root Zone with those who have direct responsibility for that administration.
3. Engage in ongoing threat assessment and risk analysis of the Root Server System and recommend any necessary audit activity to assess the current status of root servers and the root zone.
4. Respond to requests for information or opinions from the ICANN Board of Directors.
5. Report periodically to the Board on its activities.
6. Make policy recommendations to the ICANN community and Board.

The RSSAC has no authority to regulate, enforce, or adjudicate. The advice offered in this report should be evaluated on its merit.

A list of the contributors to this report, references to RSSAC Caucus members' statements of interest, and RSSAC members' objections to the findings or recommendations in this report are at the end of this report.

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1 Introduction

The purpose of the Root Server System is to give authoritative answers to queries about the DNS root. Its intended users are caching recursive DNS resolvers who need to know the contents of the root zone. These resolvers trust that every query to any RSO will be answered correctly; that trust is based on many decades of positive experience.

A rogue operator has the potential to adversely affect this trust in a variety of ways. Some of these adverse effects include denying or delaying root zone resolution, violating the privacy of users, causing the user to interact with the wrong endpoint, and eroding user confidence in the global DNS. While protections within the DNS protocols and at other layers of the protocol stack can help mitigate the effect on the end-user, a rogue operator is a serious consideration.

In this document, we examine objective and subjective criteria for considering an RSO's activities as rogue. We provide a non-exhaustive list of rogue behaviors, with examples and supporting reasons.

Given the evolution of the root server system governance, this document aims to inform future Root Server System (RSS) governance bodies on types of RSO activity that might be considered rogue and the risks that these activities may pose to the Internet community. Future RSS governance bodies may use this document for developing a more complete definition of rogue RSO actions and will ultimately be the authority in determining subjective factors, such as intent, when judging the actions of an RSO.

In this document, an RSO is an operator of one of the nameservers listed in the authoritative root zone from IANA, as described in RSSAC030.¹ This document focuses only on the activity of an IANA-designated RSO.

Finally, throughout this document, unless otherwise indicated, “the root zone” always refers to the authoritative root zone from IANA.

2 Related Work

2.1 Guiding Principles of the Root Server System

In RSSAC037,² “A Proposed Governance Model for the DNS Root Server System,” the RSSAC articulated eleven principles that guided the development and operation of the RSS and RSOs. The RSSAC has since published these principles as a standalone document in RSSACXXX.³ These principles provide a high level framework for the working group in our discussion of rogue behaviors.

¹ See <https://www.icann.org/en/system/files/files/rssac-030-04nov17-en.pdf>

² See <https://www.icann.org/en/system/files/files/rssac-037-15jun18-en.pdf>

³ <editor note: add the URL in the new RSSAC publication on principles>

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2.2 RSSAC037 and the Term “Rogue”

Section 6 of RSSAC037 describes how a potential root server system governance model might work in a handful of different scenarios; Section 6.5 of that document describes scenarios in which an RSO “goes rogue”. Examples of rogue misbehavior in RSSAC037 are the RSO intentionally not serving the correct contents of the root zone file, the RSO not answering queries from selected entities, and the RSO misusing funds from the Financial Function (FF). That section describes how such behaviors might be reported and handled.

This document is informed by RSSAC037, and expands on the examples of section 6.5 of RSSAC037 by examining objective and subjective criteria for considering an RSO's activities as rogue, as well as providing an expanded list of rogue behaviors, with examples and supporting reasons. This document, however, does not go into intent, detection and mitigation of such behaviors because those are appropriate for the future governance body to determine.

3 Descriptions of a Rogue Operator

This section describes representative actions of an RSO that may be considered rogue in terms of the guiding principles outlined in RSSAC037. Actions of a root server operator that are deemed deliberate or in repeated violation of these core principles may qualify as rogue operations.

Accidental, mistaken, or temporary conditions that are reasonably remediated (such as testing new software) should not be considered rogue behavior. Any future governing body has the difficult task of determining the intent behind potentially rogue actions that would separate such temporary/accidental actions with true intent to deceive or negatively impact the query source. This report addresses “non-RSO” responses, meaning responses that do not actually come from the RSO, in a later section.

The following is a list of objective measurements or observations of how an operator can be considered "rogue", based on the guiding principles from RSSAC037. The examples listed here are illustrative, and are not meant to be exhaustive.

1. *Changed answers:* An RSO intentionally gives an answer to a query where any of the record sets in the Answer or Authority or Additional sections of the response differ from those contained in the root zone. Examples include responses with record sets that have fewer records than the corresponding record sets in the root zone and responses where any record in a record set has values different from the record set in the root zone.
2. *Incorrect additional answers:* An RSO intentionally gives an answer to a query where the Answer, Authority, or Additional sections contain correct data from the root zone, but also include additional data not found in the root zone.. Examples include responses with extra NS records that are not the root zone.
3. *Bad error codes:* An RSO intentionally gives a negative answer to a query for which there is any data in the root zone. Examples include responses with an RCODE of SERVFAIL at a time when the same server is giving NOERROR responses, responses

with an RCODE of NOTIMP for queries that other RSOs can answer, and responses with an RCODE of FORMERR for queries that other RSOs can answer.

4. *Omitting DNSSEC*: An RSO intentionally returns responses that omit DNSSEC-related records from the root zone for queries that have the DO bit set. Examples include not returning RRSIG records and not returning NSEC records.
5. *Bad DNS usage*: An RSO intentionally responds to queries in a manner that is not supported by standards-track RFCs. Examples include using undefined RCODEs, undefined OPCODEs, and improper values in EDNS0 fields.

The following is an illustrative, non-exhaustive list of subjective observations that could be considered "rogue", based on the guiding principles from RSSAC037. Note that this document is primarily discussing rogue operators in the form of rogue organizations. Because organizations hire many individuals to fulfill their root service obligations, it is possible that an individual of an organization may make statements or perform actions that are considered rogue by this document. An organization should generally not be considered rogue based on the behaviour of individuals unless those actions are left unresolved.

1. *Intentionally degraded service*: An RSO purposely degrades service to queries based on the source of the queries, except in the case where the RSO is under attack. Examples include sources based on country, likely ethnic or religious status, or service provider. For example, this could be done by dropping packets, delaying responses, or routing methods outside of normal traffic engineering.

2. *Reduction in trust*: Actions or statements of an RSO with the intent to cause a significant reduction in the trust of the RSS.

Commented [1]: This really needs clarification (or removal?). It should not stifle speech, but it should try to keep an RSO from nefariously undermining the RSS. Judging "intent" is difficult, but critical here.

4 Non-RSO Responses

An important consideration for determining whether an RSO is rogue is that responses to root zone queries may not actually come from a server operated by that RSO. There are scenarios where an observer may receive a response from someone or something other than the expected root server. A "non-RSO" response is anything other than the actual response from a system authorized to operate a root server IP address in the root zone. Non-RSO responses are not actions of an RSO, and therefore shall not be considered in an evaluation of an RSO. Identifying an observation as an RSO response versus a non-RSO response may be difficult.

5 Recommendations

Recommendation 1: The RSSAC recommends the future governance body for the root server system take the description of the rogue operator articulated in this document as a starting point to: (1) define a process for deciding how intent of rogue behaviors will be identified and adjudicated, define a complete list of rogueness behavior, (2) develop detection techniques for the rogueness, and (3) develop mitigation measure and options for these behaviors.

Commented [2]: Is this reasonably possible? Or do we want the future governance body to define a process for determining whether an observed action is rogue?

6 Acknowledgments, Disclosures of Interest, Dissents, and Withdrawals

In the interest of transparency, these sections provide the reader with information about four aspects of the RSSAC process. The Acknowledgements section lists the RSSAC caucus members, outside experts, and ICANN staff who contributed directly to this particular document. The Statement of Interest section points to the biographies of all RSSAC caucus members. The Dissents section provides a place for individual members to describe any disagreement that they may have with the content of this document or the process for preparing it. The Withdrawals section identifies individual members who have recused themselves from discussion of the topic with which this Advisory is concerned. Except for members listed in the Dissents and Withdrawals sections, this document has the consensus approval of the RSSAC.

6.1 Acknowledgments

The RSSAC thanks the following members of the Caucus and external experts for their time, contributions, and review in producing this Report.

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6.2 Statements of Interest

RSSAC caucus member biographical information and Statements of Interests are available at: <https://community.icann.org/display/RSI/RSSAC+Caucus+Statements+of+Interest>

6.3 Dissents

There were no dissents.

6.4 Withdrawals

There were no withdrawals.

Appendix A: Guiding Principles of the Root Server System and Root Server Operators

Eleven principles guide the development and operation of the RSS and RSOs. These are first articulated in RSSAC037, and copied verbatim to this document.

1. ~~**To remain a global network, the Internet requires a globally unique public namespace.**~~ The DNS namespace is a hierarchy derived from a single, globally unique root. This is the key tenet of RFC 2826.
2. ~~**IANA is the source of DNS root data. RSOs are committed to serving the IANA global root DNS namespace.**~~ Root servers provide DNS answers containing *complete* and *unmodified* DNS data, including DNS Security Extensions (DNSSEC) data. In addition, IANA maintains the necessary technical information identifying root servers.
3. ~~**The RSS must be a stable, reliable, and resilient platform for the DNS.**~~ The RSOs have a responsibility to provide a high-quality service to the Internet. For example, if an RSO should need to transition operational control to a successor operator, the RSO will provide the Internet community with advance notice and take reasonable measures to facilitate a smooth transition.
4. ~~**Diversity of the root server operations is a strength of the overall system.**~~ Diversity in RSOs' operational models and organizational structures increases the resiliency of the overall system.
5. ~~**Architectural changes should result from technical evolution and demonstrated technical need.**~~ RSOs should embrace emerging technologies affecting the RSS, as long as the Internet's globally unique public namespace is preserved.
6. ~~**The IETF defines technical operation of the DNS.**~~ The IETF and IAB define the protocols underlying DNS implementation in Requests for Comments (RFCs) and other documentation.
7. ~~**RSOs must operate with integrity and an ethos demonstrating a commitment to the common good of the Internet.**~~ RSOs should operate with high moral and ethical

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standards. They must be committed to sending and responding to traffic without filtering, to serving the IANA global root DNS namespace,¹¹ and to avoiding conflicts of interest and reciprocal agreements.

8. ~~**RSOs must be transparent.**~~ RSOs must be as transparent as is reasonable without compromising their operational security.
9. ~~**RSOs must collaborate and engage with their stakeholder community.**~~ An RSO must collaborate openly with other operators, participate in group meetings and activities, engage at the IETF in the technical standardization process, and respond to stakeholder questions in a timely manner.
10. ~~**RSOs must be autonomous and independent.**~~ An RSO should have autonomy and independence in architecting and operating their service, while also adhering to standards and service expectations.
11. ~~**RSOs must be neutral and impartial.**~~ An RSO is neutral to the politics of geographic regions and nation states when delivering the DNS root service. The RSO's focus is on provisioning a reliable technical service which knows no political boundaries and maintains an unbiased position to the politics of any nation state. RSOs must offer DNS service without bias, on the same terms, to users everywhere.