Root Zone scaling measurements at L-Root

L-Root Measurements

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Introduction

RSSAC have identified an initial set of parameters that they believe would be useful to monitor for the root zone scaling concern, as identified by SSAC and the ICANN Board, and where monitoring should be implementable without major changes within the root zone system.

- The latency in the distribution system
- The size of the overall root zone
- The number of queries
- The response size distribution
- The number of sources seen

Further, the document "Impact on Root Server Operations and Provisioning"[1] details a set of qualitative measures for the analysis of the root zone when considering the impact of additional delegations being added to the root.

The additional measures considered here are:

- The number of delegations
- The root zone size per delegation
- The number of resource records in the root zone

This document describes these measurements, the mechanism for how L-Root, the operator for the "L" root server, will collect the required data for these measurements and the frequency by which this data will be provided or published to the greater Internet community.

Goals

The goals of these measurements are:

- To identify long-term trends in the performance of L-Root related to root zone size.
- To provide the community with a set of consistent reports for L-Root published at a stable location.

Measurements

Root Zone System Measurements

These measurements are based on behaviors seen specifically by ICANN as a function of being a root server operator for "L-Root".

[1] http://www.icann.org/en/news/announcements/announcement-27jun12-en.htm

The latency in the distribution system

The latency in the distribution system can be defined as the time it takes from the initial DNS NOTIFY being sent from the distribution master servers (operated by Verisign) to the point in time at which all instances of root servers have updated with that specific zone file. This can be measured in seconds.

Due to the nature of operating anycast DNS clouds there may be multiple steps in the distribution dependent on the internal distribution processes at each root-server operator. ICANN will make distribution measurements once the zone is received from the Zone Maintainer.

The trend identified by this measurement provides a lens on the scale aspect asking the question of what distribution effects are seen when the zone size is increased.

The number of queries

The number of queries provides a useful base line insight to the effects of changes on the broader health of the root zone system.

The number of queries should be defined as follows:

dns-udp-queries-received-ipv4
: Number of DNS queries received over IPv4/UDP transport at each root server during the reporting period

dns-udp-queries-received-ipv6
: Number of DNS queries received over IPv6/UDP transport at each root server during the reporting period

dns-tcp-queries-received-ipv4
: Number of DNS queries received over IPv4/TCP transport at each root server during the reporting period

dns-tcp-queries-received-ipv6
: Number of DNS queries received over IPv6/TCP transport at each root server during the reporting period

The query and response size distribution

DNS query sizes are determined by the length of the QNAME and the presence and, where applicable, content of the EDNS OPT RR. The query size distribution is defined as a list of comma separated values for the number of queries received during the reporting period of a particular size range:

16-31, 32-47, 48-63, 64-79, ..., 256-271, 272-287, 288 and over

DNS response sizes are determined by the length of the QNAME, the use of EDNS (see above), the RCODE and the actual response data. The response size distribution is defined as a list of comma separated values for the number of responses sent during the reporting period of a particular size range.

DNS query and response size shows the insight to the effects of changes on the broader health of the root zone system.

The number of sources seen

The number of sources seen is the number of unique IP source addresses accumulated across all instances of a root server cluster during the reporting period.
The number of sources seen provides a general insight into the growth of the internet set against any observations related to changes root zone system or root zone.

There are three measures:

num-sources-ipv4
: The number of unique IPv4 addresses sending DNS queries during the reporting period

num-sources-ipv6
: The number of unique IPv6 addresses sending DNS queries during the reporting period

num-sources-ipv6-aggregate
: The number of unique IPv6 addresses sending DNS queries during the reporting period, aggregated at the /64 level.

Zone contents measurements

These measurements are specific to the content of the root zone and the trend lines associated to the changes or growth of the root zone provides insight when considered in parallel with the other measures of the root zone system.

The size of the overall root zone

The size of the root zone can be measure in bytes. It can be defined as the size of signed DNS root zone file that is placed on or collected from the master distribution servers.

This measurement may be useful to track over a longer period of time to detect any trends in the growth of the zone and correlate this to other measurements such as the latency in distribution.

The number of delegations

This is a count of the number of Top Level Domains (TLDs) in the root zone. The very basic measure, over time, of root zone growth.

The root zone size per delegation

Dividing the compiled size of the root zone by the number of delegations produces the per delegation size.

This measure of growth trend identifies the impacts of resource record types on the predictive size of delegations given IPv6 records and DNSSEC.

The number of resource records in the root zone

The remaining measurement that significantly aids in scale analysis is the number of resource records in the root zone.

Measurement Collection Process

Publication of data

All measures and data defined in this document will be published at http://dns.icann.org

Measurement Interval

For the following measurements ICANN will use a 24-hour interval period of UTC 0:00:00 to UTC 23:59:59.

- The number of queries
- The response size distribution
- The number of sources seen

Root Zone System Measurements

The latency in the distribution system

ICANN will provide the time it takes for each and every one of the ICANN anycast instances to collect a new version of the root zone from L-Root's internal distribution point(s), once L-Root has received the new zone from the Root Zone Maintainer. This will be a measure inclusive of the time it takes to send DNS Notify messages to the ICANN anycast instances.

ICANN will also produce and graph the mean and mode values for all of L-Root.

The number of queries

ICANN will provide the number of DNS queries for each of the defined categories; as seen at each and every one of the L-root operated anycast instances for the measurement interval. The L-Root wide aggregates of each query category will be provided, and published.

The query and response size distribution

ICANN will provide the query and response size distribution as seen at each and every one of the L-root operated anycast instances for the measurement interval. The L-Root wide aggregates of each size distribution will be provided, and published.

ICANN will use distribution ranges based on the following breakdown.

16-31, 32-47, 48-63, 64-79, ..., 256-271, 272-287, 288 and over

The number of sources seen

ICANN will provide the number of unique DNS sources for each of the three sources categories; as seen at each and every one of the L-root operated anycast instances for the measurement interval. The L-Root wide aggregates of each category will be provided, and published.

Zone content measurements

The zone size data is acquired through a larger process where each and every root zone version (serial) is collected and stored in a repository, while this is an internal ICANN repository; a publically available version of the data will be exported daily and published.

The size of the overall root zone

ICANN will provide the size of the compiled root zone as transferred from the Root Zone Maintainer. This will be graphed against time for known versions of the root zone and published.

The number of delegations

ICANN will provide the number of DNS delegations as seen in the root zone over time. This will be graphed against time for known versions of the root zone and published.

The root zone size per delegation

ICANN will provide the number of 'size per delegation' as seen in the root zone over time. This will be graphed against time for known versions of the root zone and published.

The number of resource records in the root zone

ICANN will provide the number of resource records in the root zone as seen in the root zone over time. This will be graphed against time for known versions of the root zone and published.

Reporting Process and Frequency

ICANN specific publication

All measures, and data, specifically in relation to L-Root will be published and updated at least weekly at http://dns.icann.org

Publication to a third party

RSSAC is in the process of identifying a third party, separate from all of the root-server operators, to host RSSAC defined measures data on behalf all the root-server operators. When that third party is identified, and the mechanisms for uploading that data, ICANN will also publish to that location in addition to maintaining the L-Root specific measurements.

Implementation Timeline

Table 1 – Implementation Timeline

Date	Deliverable
January 2013	Collection of data underway
January 2013	Publication of Zone content measurements and data
March 2013	Publication of Root Zone System measurements and data
May 2013	Initiate 2 week public consultation of measurements and data
June 2013	Implement action plan from consultation feedback